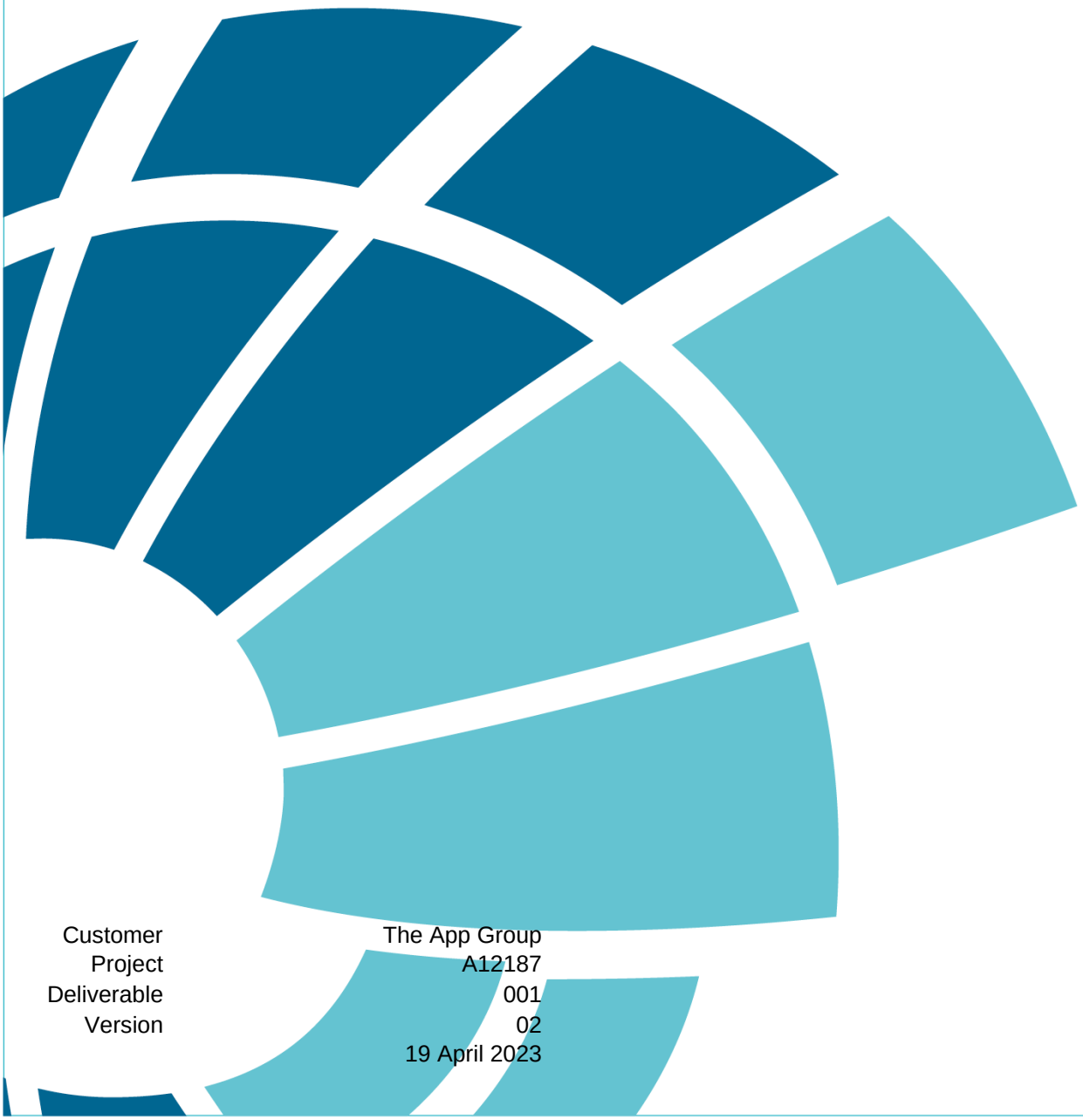
Hunter River High School

Flood Emergency Response Plan



Customer	The App Group
Project	A12187
Deliverable	001
Version	02
	19 April 2023

Document Control

Document Identification

Title	Hunter River High School
Project No	A12187
Deliverable No	001
Version No	02
Version Date	19 April 2023
Customer	The App Group
Classification	BMT (OFFICIAL)
Synopsis	Flood Emergency Response Plan to inform the development of the Hunter River High School

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Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
01	02 December 2022	The App Group	Report
02	19 April 2023	The App Group	Report Version 2

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1 Introduction

This Flood Emergency Response Plan (FERP) has been prepared for the proposed redevelopment and upgrade works within Hunter River High School at 36-40 Elkin Avenue, Heatherbrae, NSW 2324. The Site is located about 600 m east of the Hunter River and 500 m south-west of the junction of Grahams Town Drain and Windeyers Creek and is bounded by Adelaide Street and the Pacific Highway to the south-east, residential properties to the north-east and south-west, and open grassed land to the north-west.

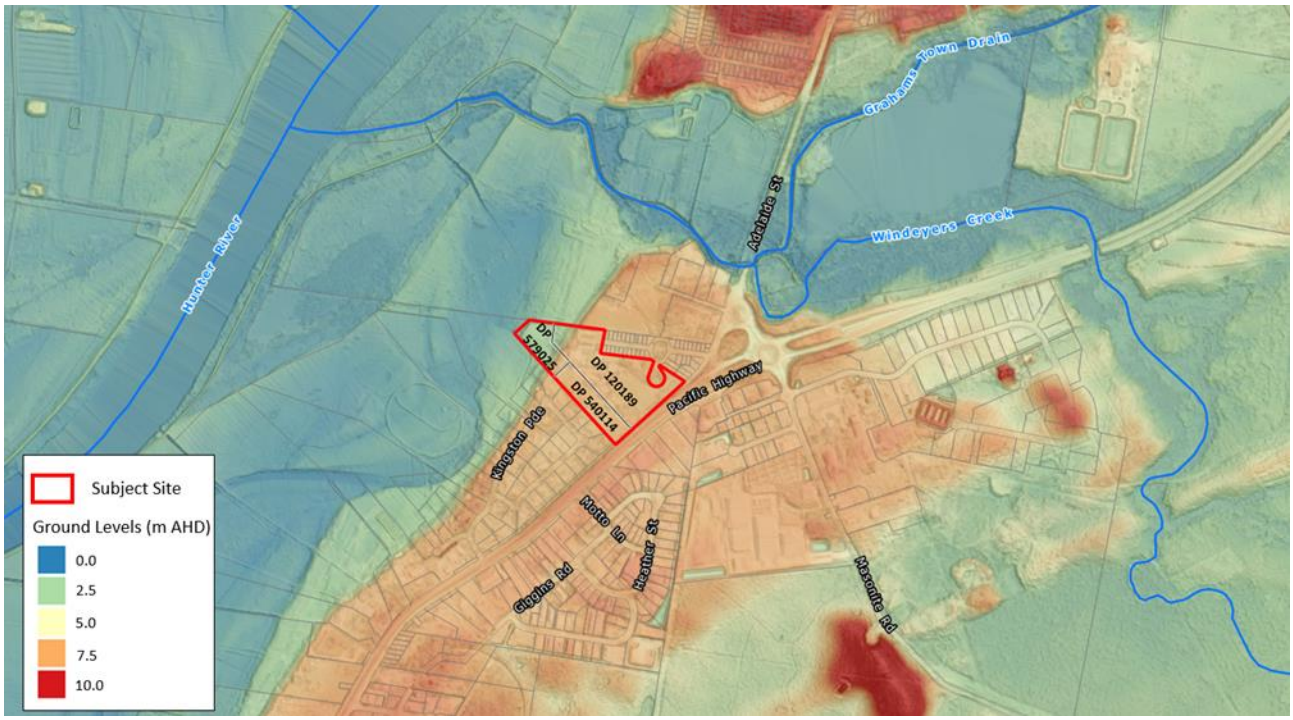


Figure 1.1 Hunter River High School Locality and Existing Terrain

An assessment of the flood risks for events up to the PMF has been undertaken based on information documented in the *Hunter River High School Flood Impact Assessment* (BMT, 2022) herein referred to as the "Flood Impact Assessment (FIA)".

The Site is subject to mainstream Hunter River flooding in rarer and extreme flood events, with flood depths and extent of inundation increasing in magnitude up to the Probable Maximum Flood (PMF). Other possible sources of flooding have been investigated in the FIA but have not been considered relevant (reference: FIA - Section 3)

This report outlines the proposed strategy for flood emergency management for the Site, taking into consideration the nature of flooding from the Hunter River, proposed development and relevant local and state government policies and guidelines, including the *NSW Floodplain Development Manual* (NSW Government, 2005). The report describes the requirements for the proposed buildings, such as required finished floor levels, 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 is to be read in conjunction with the FIA for the development (Reference:R.A12187.001.02_HRHS_FIA.docx).

2 Description of Proposed Development and Site Flood Behaviour

2.1 Proposed Development Summary

Proposed development works will be aimed at upgrading the existing Hunter River High School and will comprise the construction of a new staff administration building, a new double height gymnasium and a new support learning hub. Development works are completed by the construction of a new 62-space carpark, minor demolition works to existing walkways, shed and trees, refurbishment of some buildings, landscaping and roadworks.

Existing road access to the Site is via Elkin Avenue (to the north) , with additional access points on Adelaide Street (at south-east) and at the south-western lot boundary road proposed as part of the development. The proposed masterplan Site layout is shown in Figure 2.1.

2.2 Proposed Access Arrangement

Information regarding the main proposed accesses has been sourced from the Site plan provided by The App Group. The main access arrangement is described below.

2.2.1 Adelaide Street (southern arrangement):

The main access to the Site will be via Adelaide Street. Vehicular and a dedicated pedestrian accesses are provided at this location. The road will also be connected to the existing vehicle turnaround bay in Elkin Avenue.

2.2.2 South-West Lot boundary road (south-west arrangement):

It is understood that a controlled vehicular entry gate is proposed at the south-western Lot boundary road.

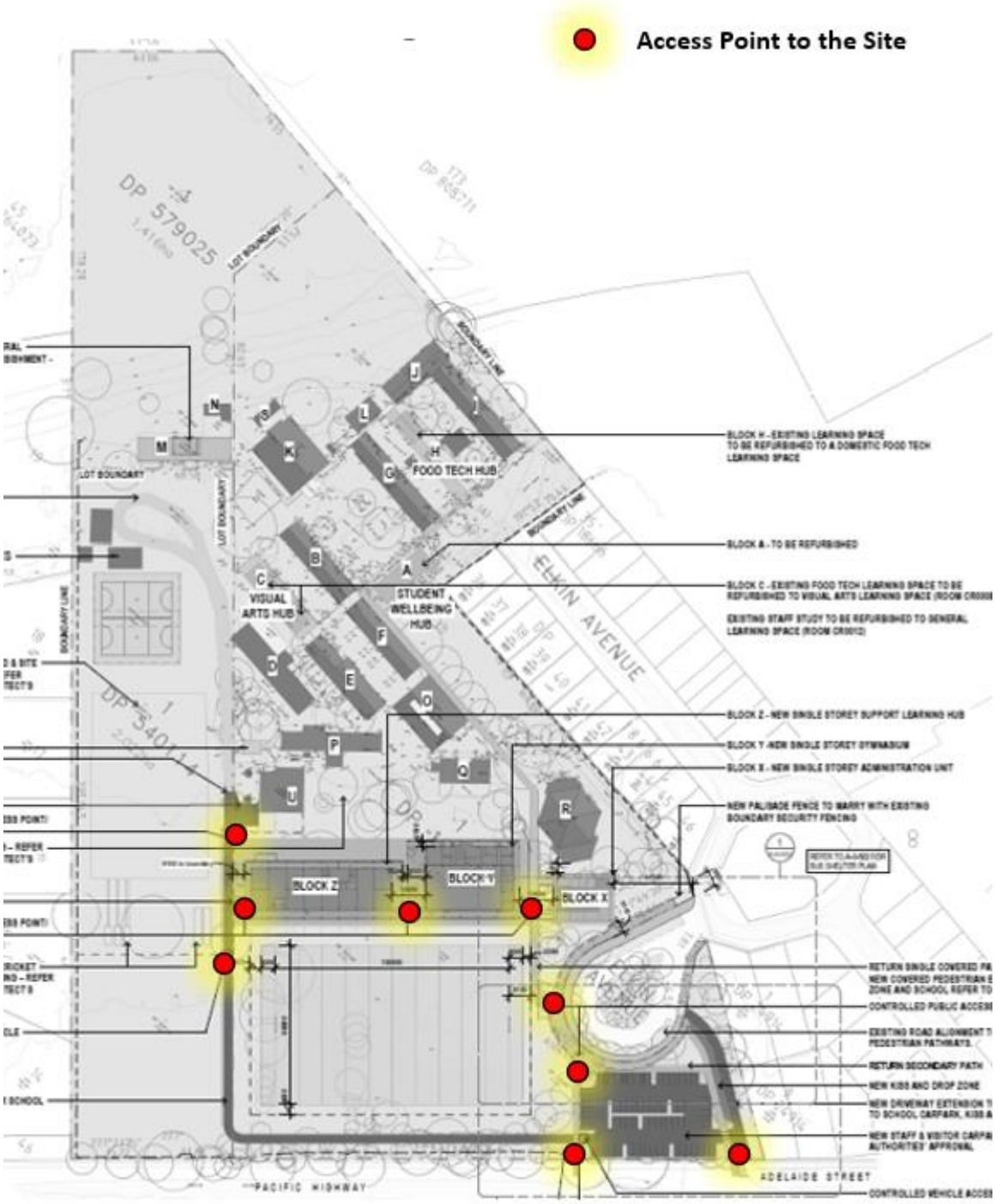


Figure 2.1 Masterplan Layout and Main Access Points

2.3 Flood Behaviour

Figure 2.2 identifies points of interest for the purpose of flooding timeline assessment. Flood levels due to Hunter River flood events at these locations are provided in Table 2.1.

Figure 2.2 Points of Interest

Table 2.1 Peak Flood Levels at Points of Interest

Points of Interest		Peak Flood Level (mAHD)*			
ID	Description	5% AEP	1% AEP	1% AEP+CC**	PMF
A	Subject Site - Low Point	3.05	4.67	5.21	8.52
B	Subject Site - Elkin Avenue Entrance	N/A	N/A	N/A	8.48
C	Subject Site – Adelaide Street Entrance	N/A	N/A	N/A	8.44
D	Adelaide Street @ Windeyers Creek Bridge	N/A	4.66	5.21	8.36
E	Pacific Highway @ Windeyers Creek Bridge	N/A	4.63	5.20	8.32
F	Masonite Road @ Low point	N/A	4.59	5.20	8.27
G	Pacific Highway @ Hunter Region Botanic Gardens	N/A	4.53	5.08	8.35

** = Peak flood levels extracted from the "Williamtown Salt Ash Floodplain Risk Management and Plan" (BMT WBM,2017) TUFLOW model. Flood levels relate to Hunter River flooding.*
*** = "1%AEP+CC" is the 1%AEP event calculated for the year 2100 to account for possible future and more severe climate conditions*

The FIA prepared as part of the development submission indicates that the Site is subject to flooding from the Hunter River in the 1%AEP, with this event inundating the low-lying areas only at the north-western corner of the Site with depths up to 3.5m. In the PMF event, the entire Site is flooded with depths of water up to 1.4m in the south-eastern area and up to 7.0m in the north-western low-lying areas.

2.3.2 Flood Hazard

Following the same hazard categorisation adopted in Port Stephens Council 2022 DCP, flood hazard maps were produced based on a combination of flood depths, velocity and depth-velocity product thresholds as show in Figure 2.3.

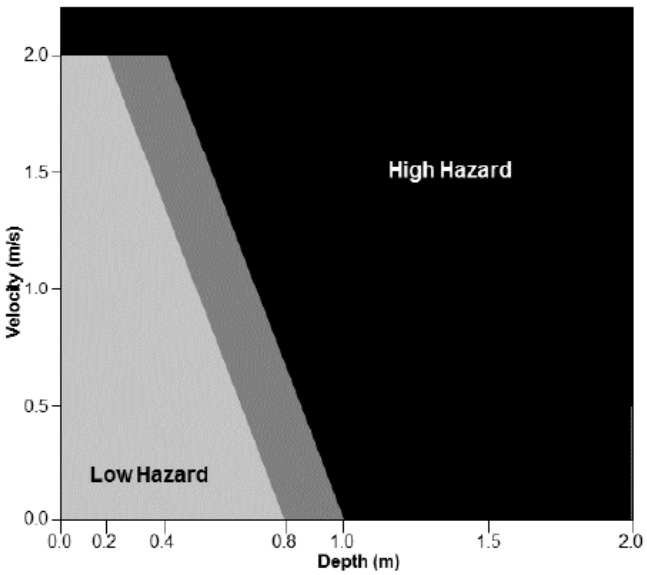


Figure 2.3 Flood Hazard Curves (NSWG,2005 Flood Hazard Categorization)

For all events up to and including the 1% AEP+CC (1% AEP event plus Climate Change), floodwaters are not expected to inundate the existing nor proposed buildings. However, as shown in Figure 2.4, the modelling results indicate that, while the area around the buildings would generally remain flood free in the 1% AEP+CC event and the school is still connected to parts of the town to the south and east, all evacuation routes from the Site towards flood-free areas are cut by floodwater at several points.

The northern evacuation route via Adelaide Street is first cut off by floodwater at Windeyers Creek (point of interest “D”). The Pacific Highway is interrupted in both driving directions, to the north at Windeyers Creek Bridge (point of interest “E”) and to the south at the Hunter Region Botanic Gardens (point of interest “G”). Travelling in a southerly direction via Masonite Road is also not possible since High Hazard is calculated along the road (point of interest “F”).

Should floodwater rise significantly above the 1%AEP level (water level in the Hunter River would need to be approximately 2 metres higher than the 1%AEP level in order to completely inundate the Site), the entire Site would be flooded, leaving no opportunity for its occupants to evacuate. In the PMF event, High Hazard is calculated across the entire Site indicating that all areas would be considered unsafe for all people and vehicles and that buildings would require special engineering design and construction.

From a Flood Emergency Planning perspective, the Site is classified as “Low Flood Island (LFI)”.

Figure 2.4 Peak 1% AEP + CC (year 2100 conditions) Flood Hazard

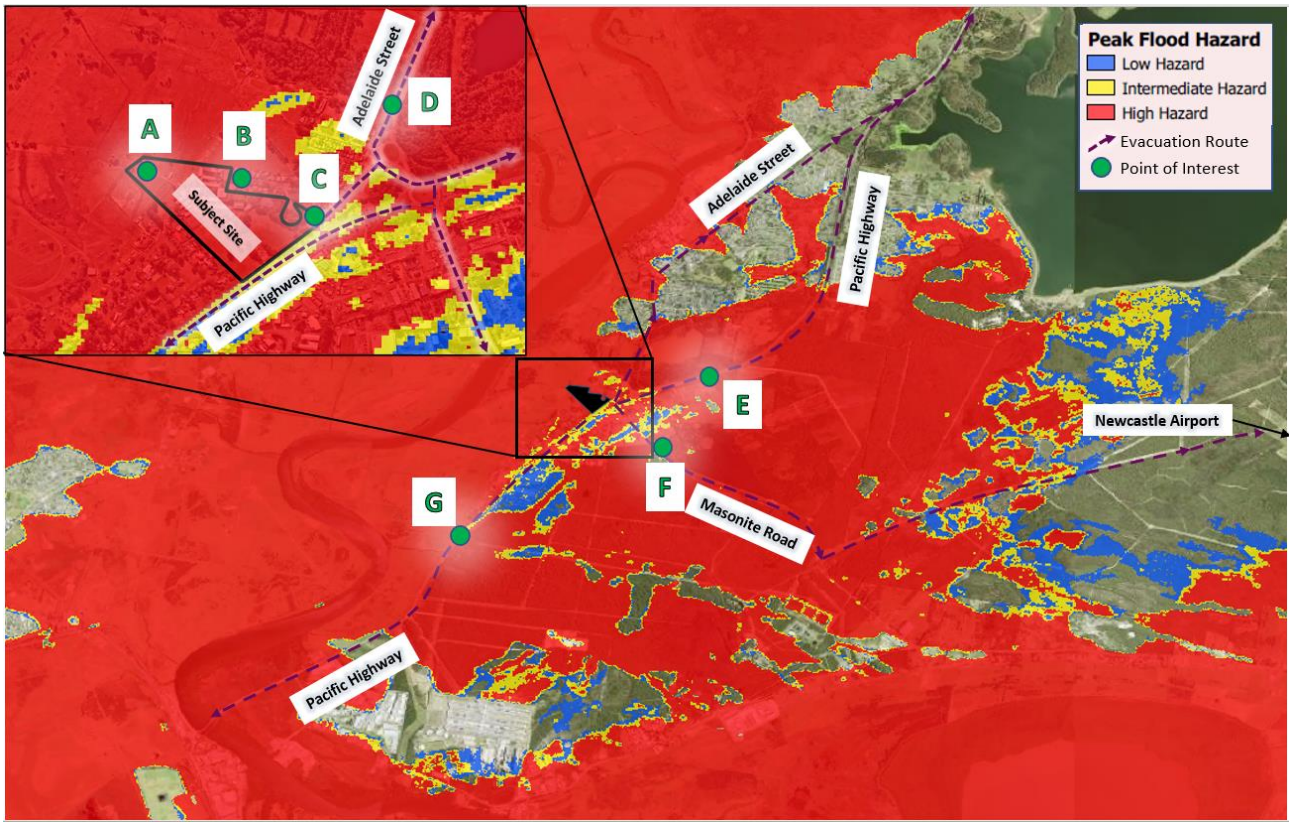


Figure 2.5 Peak PMF Flood Hazard

2.4 Available Flood Warning Time and Rate of Rise

The Bureau of Meteorology (BoM) provides flood forecasting and warning services based on a number of rainfall and stream level gauges scattered throughout the catchment. An automated information and alerting system based on rainfall and river threshold levels is provided to the New South Wales State Emergency Services using the BoM Enviromon system. The Bureau will issue flood watches when the combination of forecast rainfall and catchment conditions indicates flooding is possible and flood warnings when the river level of at least one forecast location will exceed or has exceeded the minor flood level. A list of available flood forecasting locations is available on the BoM web portal (http://www.bom.gov.au/nsw/NSW_SLS_Current.pdf). The nearest flood forecasting location to the Site is Raymond Terrace (Bureau ID number 561037), located near Seham Road bridge at the junction between Hunter River and Williams River, approximately 3.5km upstream of the Site. The flood level threshold values for flood level classification are shown in Table 2.2.

Times from the start of rainfall event to Minor, Moderate and Major flood level at the Raymond Terrace gauge were extracted from the “Williamtown Salt Ash Floodplain Risk Management and Plan" (BMT WBM,2017) TUFLOW simulation results and correlated to peak flood level hydrographs extracted at the points of interest (POI) to determine available flood warning times. Rate of flood rise and the duration of flooding are also obtained from the flood level hydrographs based on design floods.

Flooding at the POI begins when the measured water level raises above the Ground level: therefore, the horizontal trend in the hydrographs of Figure 2.6 to Figure 2.19 indicates time spans in which flooding at the POI has not yet occurred. Although it is acknowledged that actual flood events can have different rates of rise and durations, use of design flood events can provide an acceptable representation of flood behaviour across the Site and therefore have been used to identify a flood emergency management strategy, discussed in Section 3.

Table 2.2 SES Flood Classification Level at Raymond Terrace gauge (Bureau ID number 561037)

Gauge Location	SES Flood Classification Level (m AHD)		
	Minor	Moderate	Major
Raymond Terrace	2.5	3.1	3.5

2.4.2 Location A – Low point in Subject Site

The water level hydrograph at the point of Interest “A” for the 1%AEP+CC and PMF events are shown in Figure 2.6 and Figure 2.7 respectively. These figures also provide the time at which Minor, Moderate and Major flood levels are reached at the gauge station of Raymond Terrace.

In the 1%AEP+CC event, the Low point at the Subject Site gets starts to get inundated approximately 0.5 hours after the beginning of the rain event.

From the onset of flooding of the POI (water level ~1.21m AHD), water level rises with an average rate of rise of 0.10 m/hr in the 1%AEP+CC event and of 0.25 m/hr in the PMF event.

In the 1%AEP+CC event, the Minor, Moderate and Major flood levels at the Raymond Terrace gauge are related respectively to flood levels of 1.95m AHD, 2.53m AHD and 3.21m AHD at point of interest “A”. In the critical duration event, point of interest A would be flooded for a long period of time (i.e. longer than 48 hours).

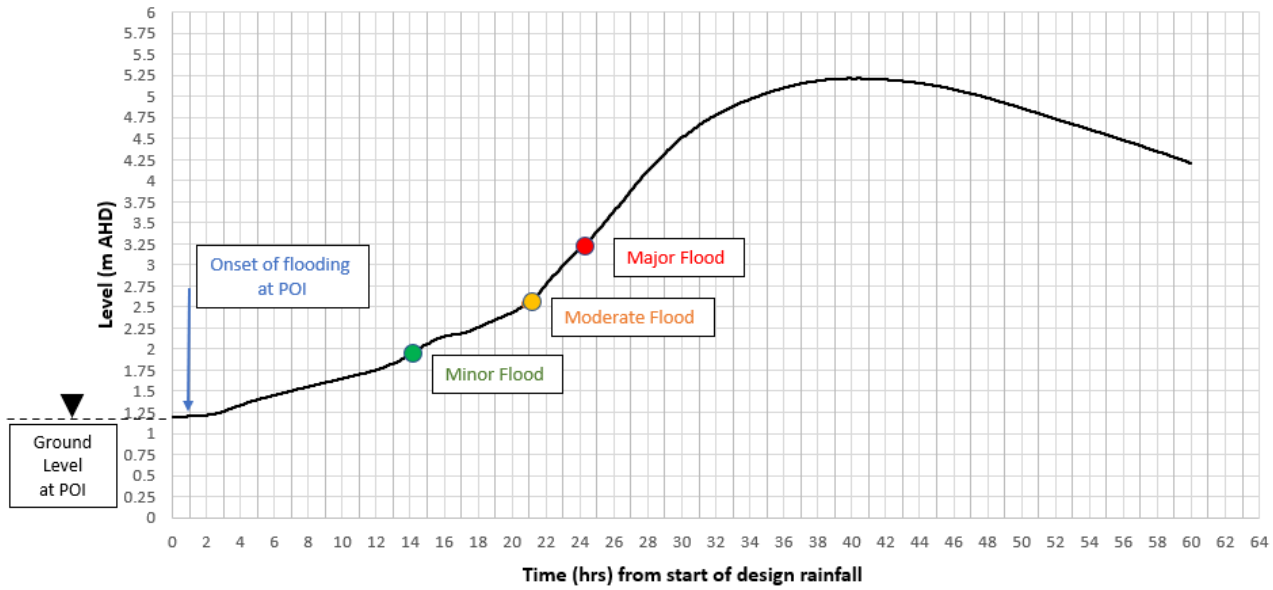


Figure 2.6 1%AEP+CC water level hydrograph at Point of Interest “A” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

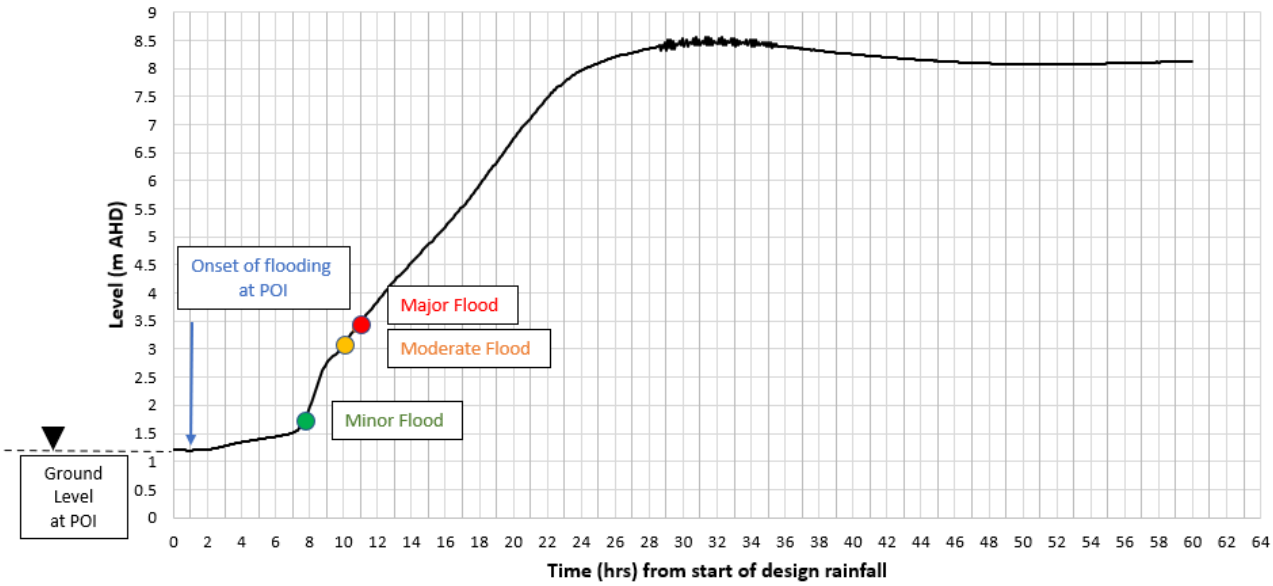


Figure 2.7 PMF water level hydrograph at Point of Interest “A” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.3 Location B – Elkin Avenue Site entrance

The water level hydrograph at the point of interest “B” for the 1%AEP+CC event and PMF are shown in Figure 2.8 and Figure 2.9Figure 2.8. On the hydrographs it is also indicated the time at which Minor, Moderate and Major flood levels are reached at the gauge station of Raymond Terrace. Figure 2.8 shows that the Elkin Avenue access has a high level of flood immunity (i.e. the POI is not flooded in the 1%AEP+CC event). However, in the PMF event flooding at this location occurs approximatively 21 hours after the beginning of rainfall with a maximum flood depth of almost 2m and an average rate of rise of 0.2m/hr. In the critical duration PMF event, the location would be flooded for a long period of time.

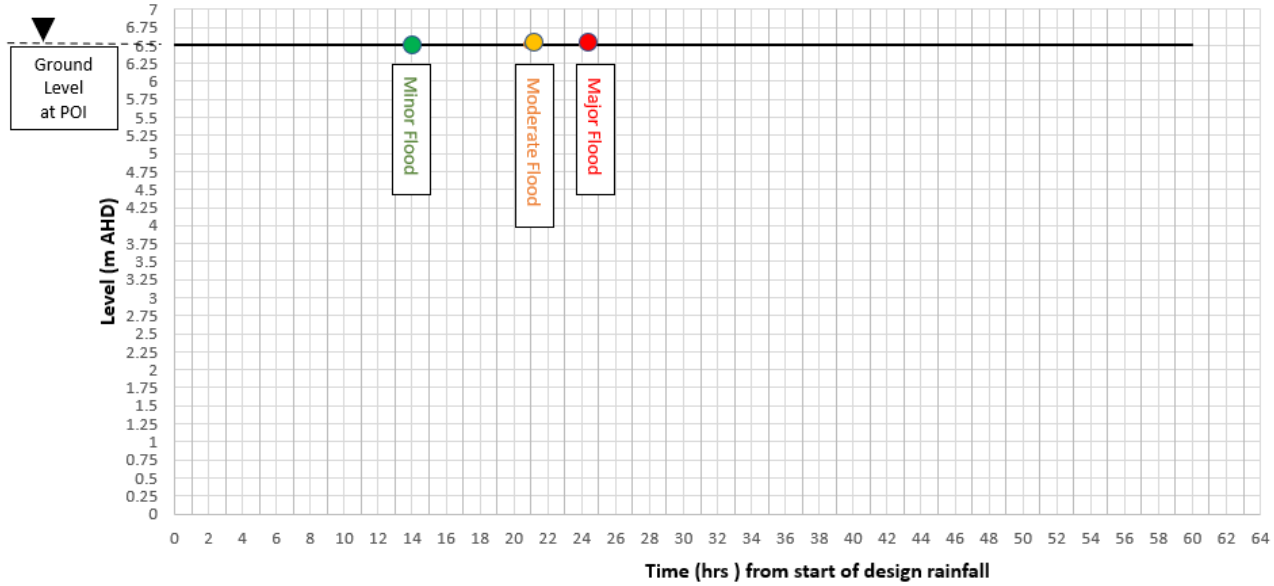


Figure 2.8 1%AEP+CC water level hydrograph at Point of Interest “B” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

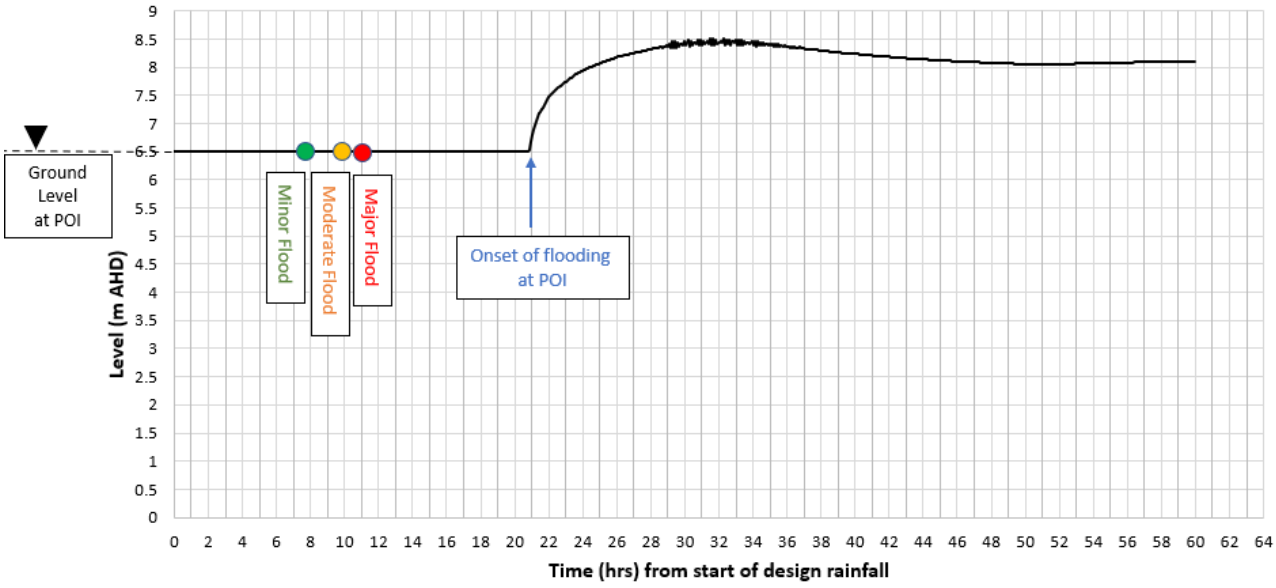


Figure 2.9 PMF water level hydrograph at Point of Interest “B” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.4 Location C – Adelaide Street site entrance

The main proposed access to the Site is via Adelaide Street. Water level hydrographs of Figure 2.10 and Figure 2.11 show that in the 1%AEP+CC event, the entrance is not flooded while depths of water up to 1.4 are calculated in the PMF event. An average rate of flood rise of 0.2m/hr is calculated in the PMF and long durations of flooding are expected. The Adelaide Street access has a high level of flood immunity (> 1%AEP+CC).

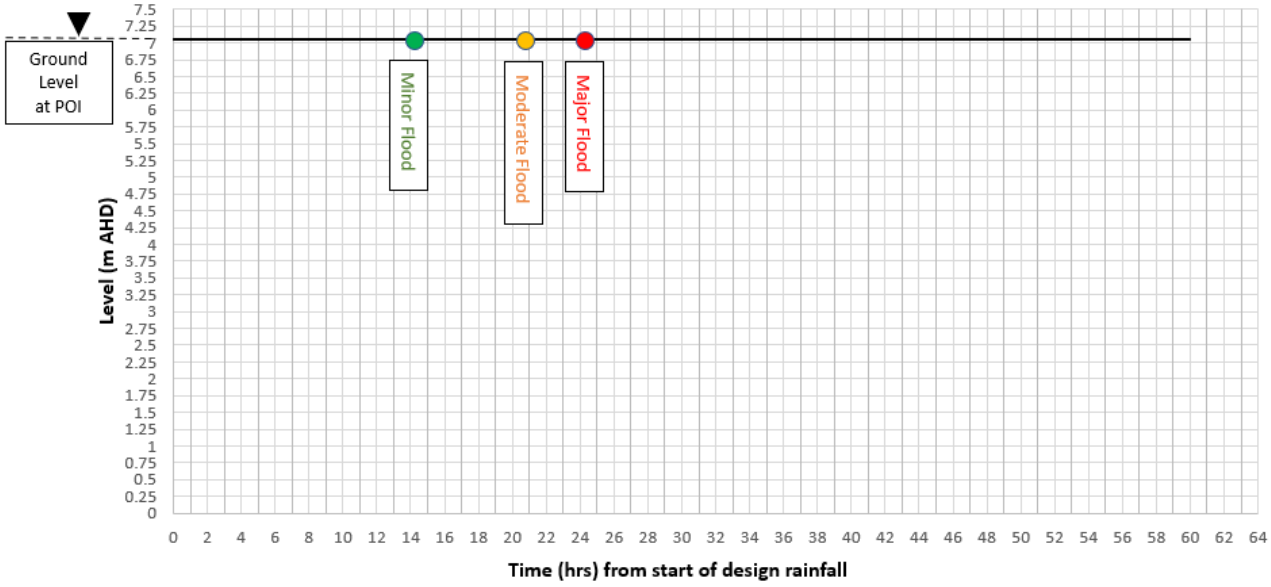


Figure 2.10 1%AEP+CC water level hydrograph at Point of Interest “C” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

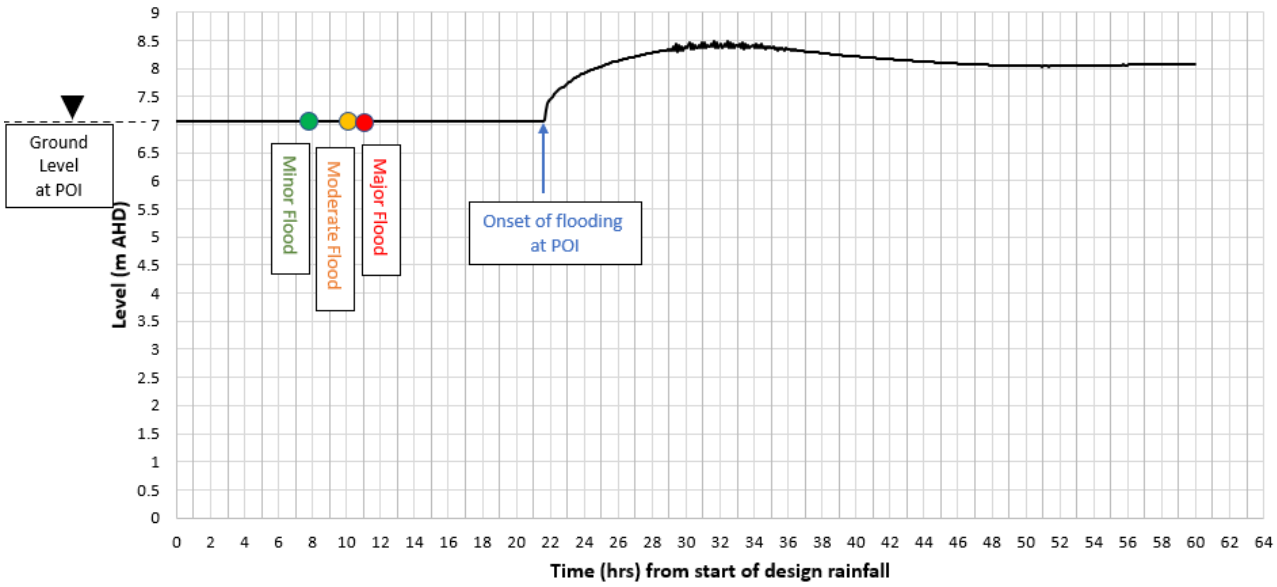


Figure 2.11 PMF water level hydrograph at Point of Interest “C” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.5 Location D – Adelaide Street @ Windeyers Creek Bridge

Evacuation route towards the north along Adelaide Street is subjected to flooding during the 1%AEP and rarer events. The water level hydrograph at the point of Interest “D” for the 1%AEP+CC event and PMF are shown in Figure 2.12 and Figure 2.13. Figure 2.12 shows that the road is not cut for a major flood level at the Raymond Terrace gauge. However, if the water level at the Raymond Terrace gauge rises above the Major flood threshold level, incipient flooding is expected at the road, making it inaccessible for evacuation purposes. In the 1%AEP+CC event, there are around 10 hours of available evacuation time form the moment when Minor Flood warning is issued at Raymond Terrace gauge to the moment when Location “D” starts to get flooded. This time reduces to 3 hours in the PMF event. Adelaide Street is also flooded in proximity of Port Stephens Council and other locations travelling north.

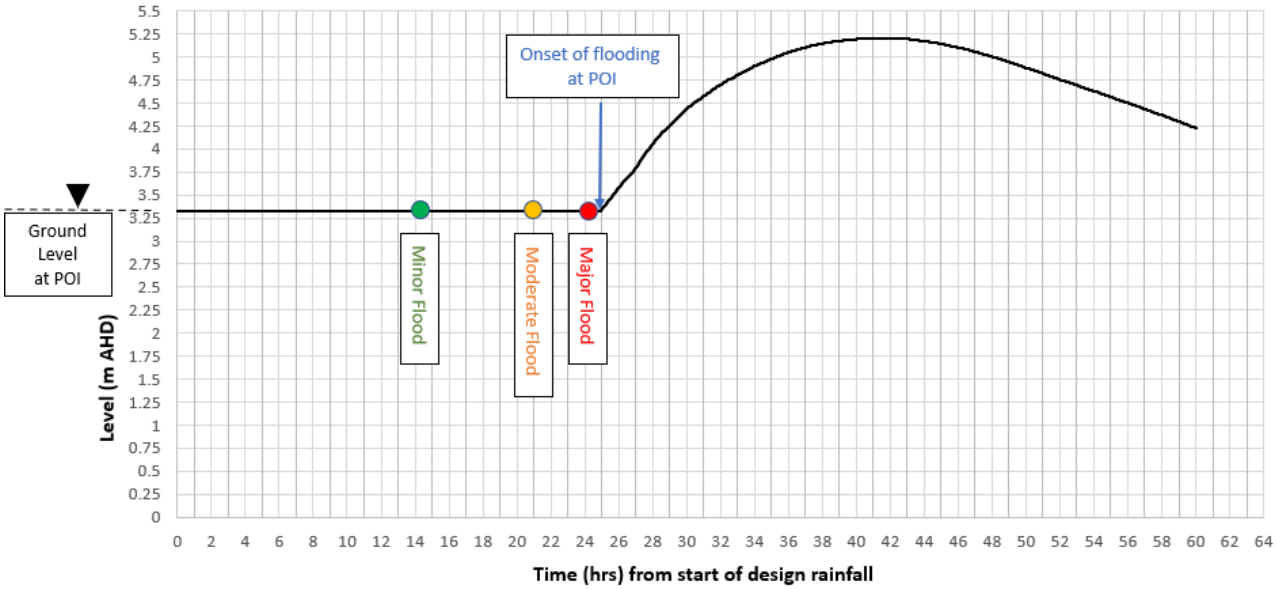


Figure 2.12 1%AEP+CC water level hydrograph at Point of Interest "D" with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

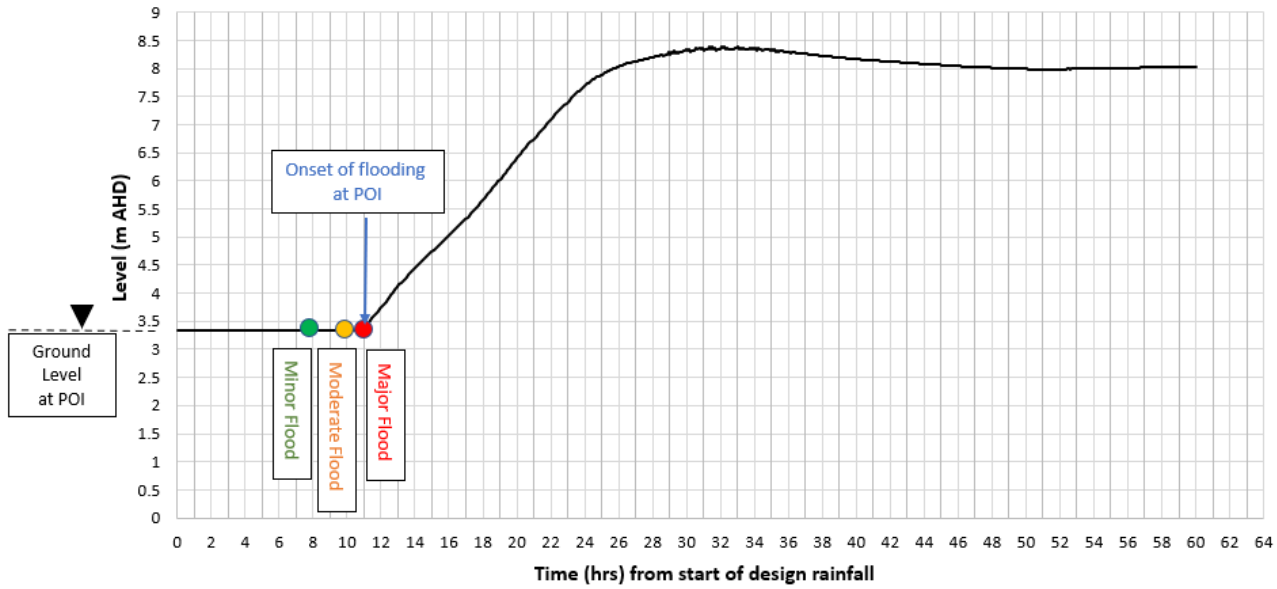


Figure 2.13 PMF water level hydrograph at Point of Interest "D" with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.6 Location E – Pacific Highway @ Windeyers Creek Bridge

The evacuation route in the northern direction via the Pacific Highway is cut by floodwater in the 1%AEP and rarer events. Figure 2.14 shows that, in the 1%AEP+CC event, there are around 13 hours from the time that the Minor Flood level is reached at Raymond Terrace gauge location to the moment that road flooding begins. This time reduces to around 5 hours in the PMF event.

In the 1%AEP event, the Pacific Highway gets flooded for around 2km in the northern direction.

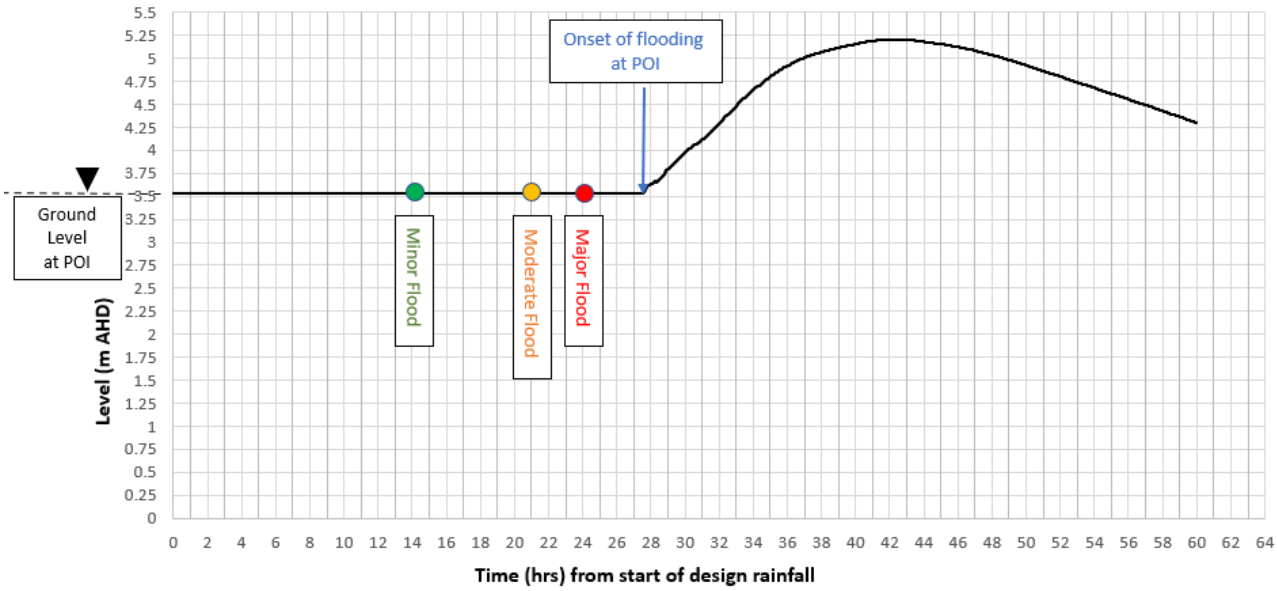


Figure 2.14 1%AEP+CC water level hydrograph at Point of Interest "E" with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

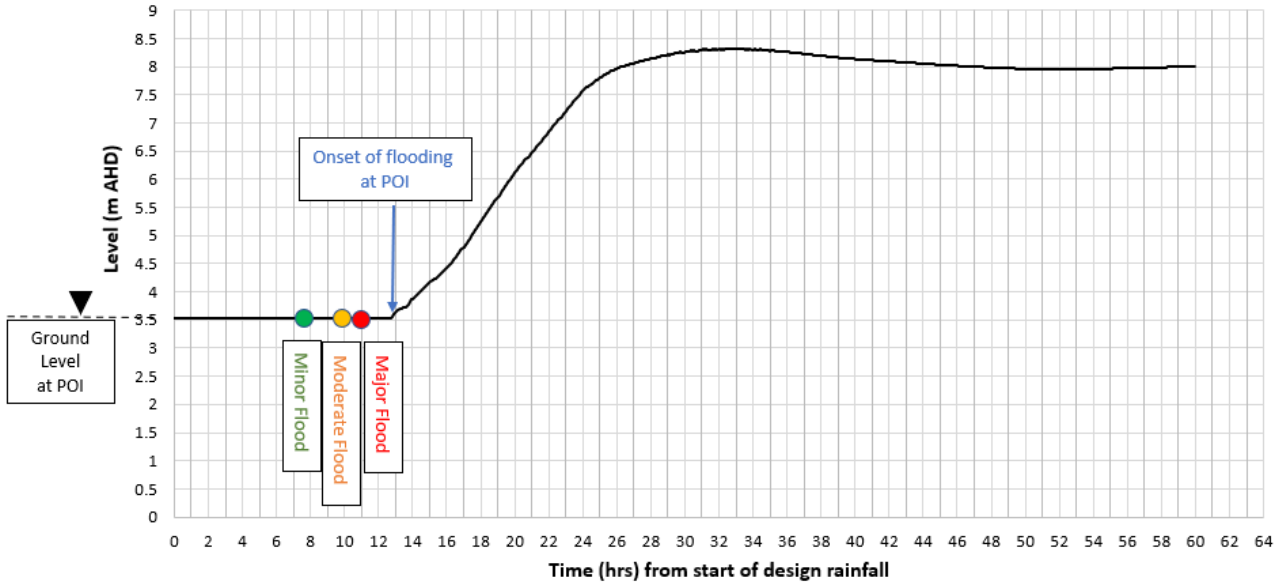


Figure 2.15 PMF water level hydrograph at Point of Interest "E" with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.7 Location F – Masonite Road @ Low point

The evacuation route in the southern direction via Masonite Road is cut by floodwater in the 1%AEP and rarer events. Figure 2.16 shows that, in the 1%AEP event, there are around 18 hours from the moment that the Minor Flood level is reached at Raymond Terrace gauge location to the moment that road flooding begins. Such time reduces to around 9 hours in the PMF event.

In the 1%AEP event, Masonite Road gets flooded for around 2.8 km till the junction to Main Trail (Trl) road, which is flood free in the north-western direction (towards Newcastle Airport).

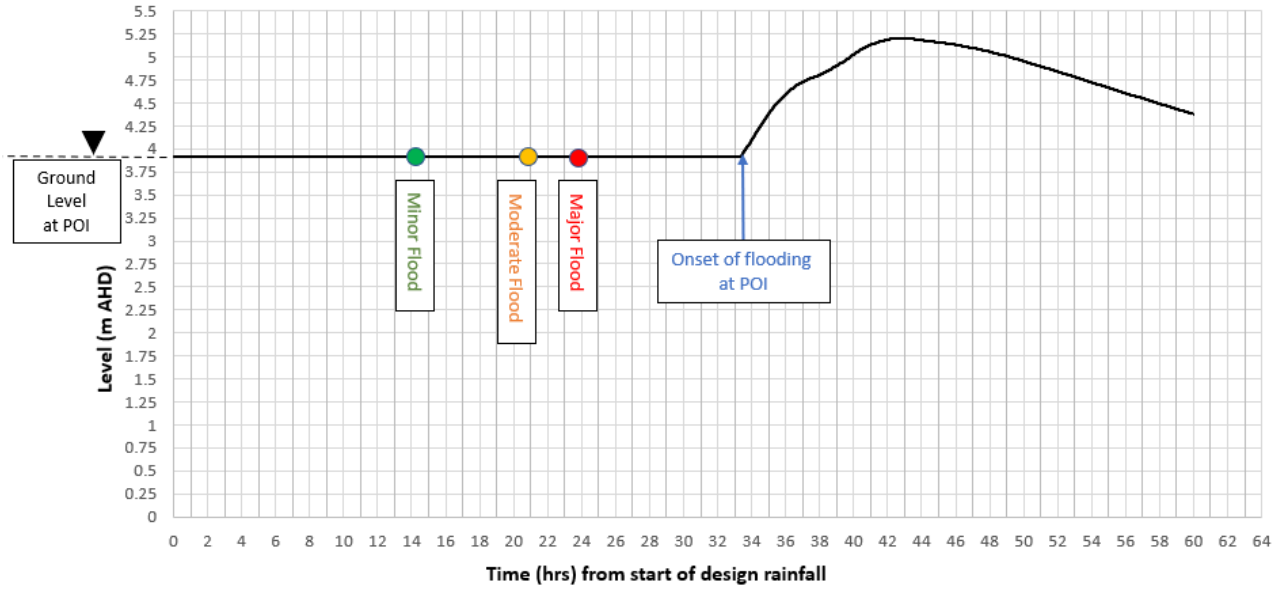


Figure 2.16 1%AEP+CC water level hydrograph at Point of Interest “F” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

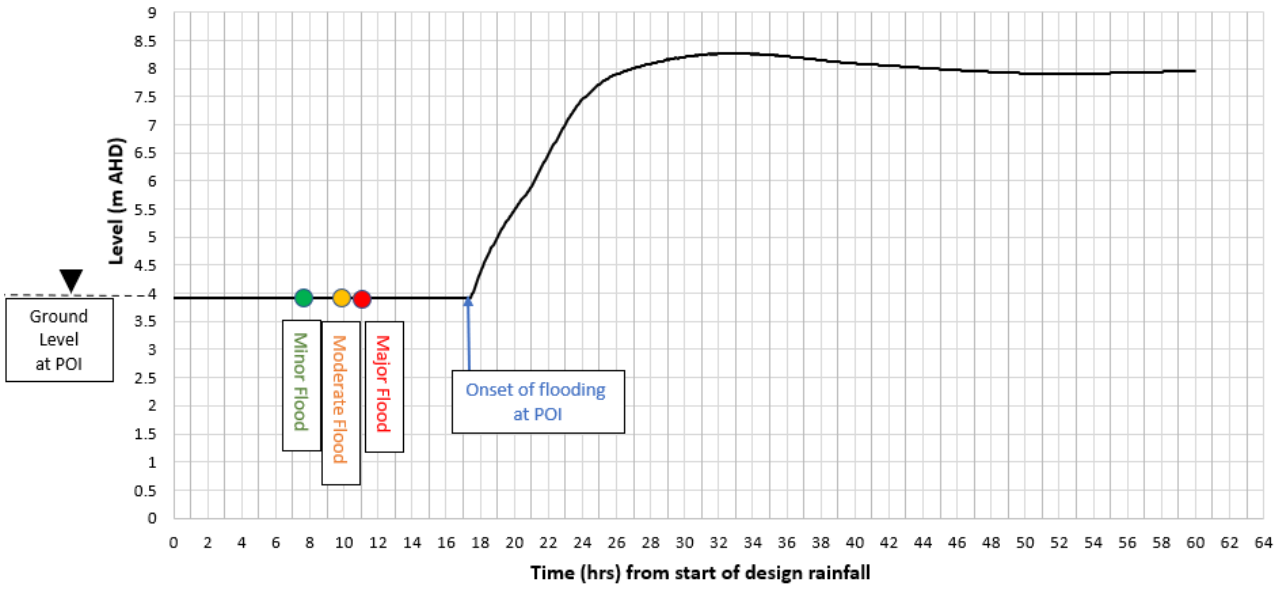


Figure 2.17 PMF water level hydrograph at Point of Interest “F” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.4.8 Location G – Pacific Highway @ Hunter Region Botanic Gardens

The evacuation route in the southern direction via the Pacific Highway is cut by floodwater at the Hunter River Botanic Garden first, and for extended road sections further south. It is not advisable to evacuate in the southern direction due to the scarcity of flood-free areas.

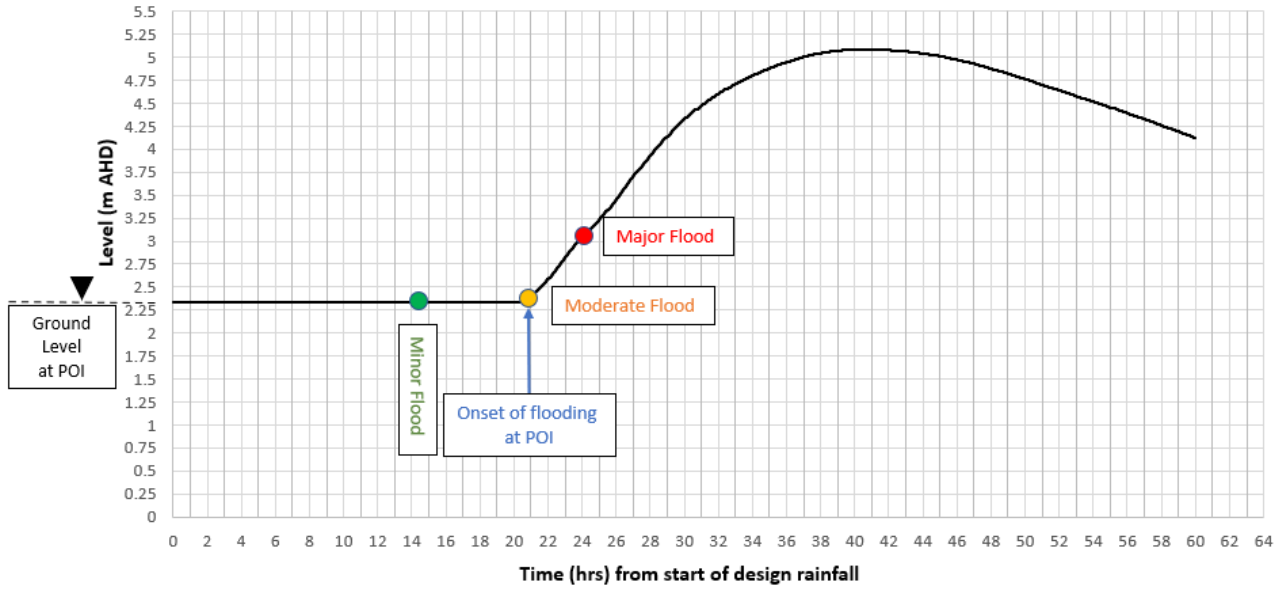


Figure 2.18 1AEP+CC water level hydrograph at Point of Interest “G” with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

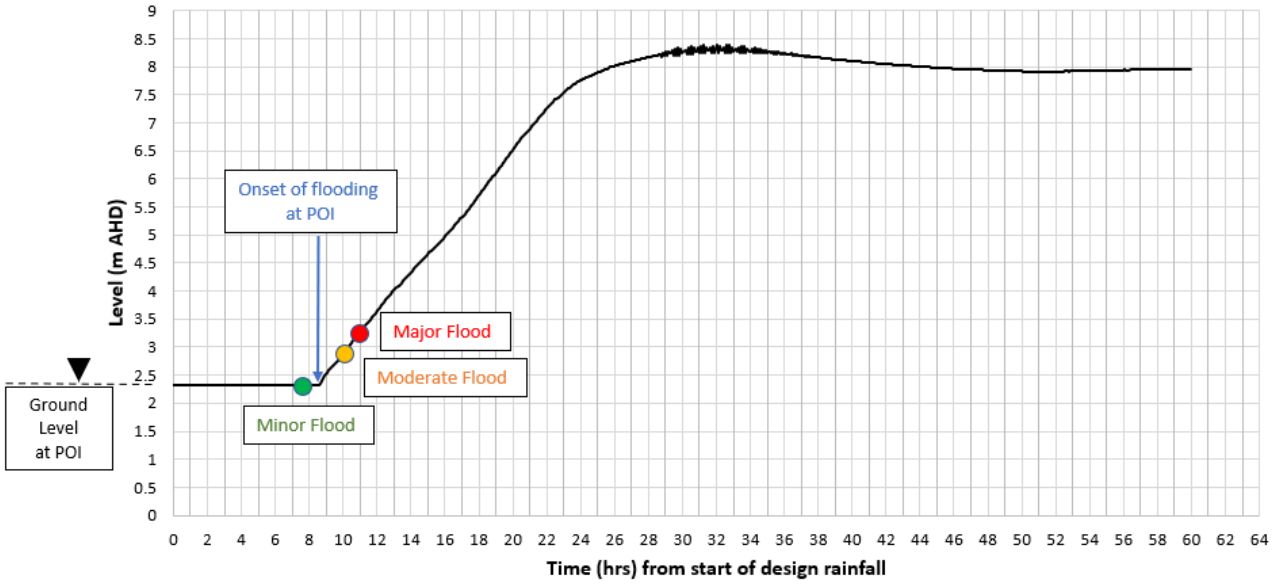


Figure 2.19 PMF water level hydrograph at Point of Interest "G" with indicated timeframe when flood levels thresholds are reached at Raymond Terrace gauge station

2.5 Summary of Flood Behaviour and Available Flood Warning Time

A summary of potential flood depths and flood timing across the locations of interest is included below in Table 2.3.

Table 2.3 Peak Flood Depths and flood timings at Points of Interests

Points of Interest		1% AEP Event (year 2100)			PMF Event		
ID	Description	Peak Flood Depth (m)	Onset of flooding after start of design rain (hours)	Onset of flooding after Minor Flood level is reached at Raymond Terrace gauge (hours)	Peak Flood Depth (m)	Onset of flooding after start of design rain (hours)	Onset of flooding after Minor Flood level is reached at Raymond Terrace gauge (hours)
A	Low point in Subject Site	3.3	<0.75	Already flooded when minor flood level is reached at Raymond Terrace gauge	6.6	<0.5	Already flooded when minor flood level is reached at Raymond Terrace gauge
B	Elkin Avenue Site Entrance	0	N/A	N/A	2.05	21	13
C	Adelaide Street Site Entrance	0	N/A	N/A	1.43	21	13
D	Adelaide Street @ Windeyers Creek Bridge	1.91	25	10	5.09	10	3
E	Pacific Highway @ Windeyers Creek Bridge	1.67	27	13	4.79	13	5
F	Masonite Road @ Low point	1.28	33	18	4.36	17	9
G	Pacific Highway @ Hunter Region Botanic Gardens	2.28	21	7	5.58	8	<1

As noted in the Flood Impact Assessment[1] for the Site, the Site will be largely flood free for all events up to and including the 1% AEP event calculated at the year 2100 design conditions ("1%AEP+CC"

[1] *Flood Impact Assessment - Hunter River High School*, BMT (2022), R.A12187.001.02_HRHS_FIA

event). The notable exception is the north-west corner of the Site where depths up to 3.5m are calculated in the 1%AEP+CC event.

While all Site access points are flood-free in the 1%AEP+CC event, evacuation to flood free areas cannot be achieved via a flood free route.

As the Site is classified as a Low Flood Island which is at risk of a long isolation time (>48h) during rare events, an emergency evacuation plan is required. There are no flood-free evacuation routes in the 1% AEP event, hence on-Site refuge must also be provided as a fallback (refer to Section 4.3)

Flood levels at the nearest BoM gauge of Raymond Terrace (around 3.5km upstream the Site) have been related to flood levels at the Site and at the main evacuation routes to determine available flood warning times. Table 2.4 shows the water levels at Raymond Terrace gauge and the corresponding levels at the Points of Interest for the 1%AEP+CC event. It is found that the Minor flood level at Raymond Terrace can be related to a flood level of 1.95m AHD at the north-west corner of the Subject Site (point of interest "A") and that, if an evacuation order is promptly issued, there would be not less than 10 hours available to evacuate in case of the 1%AEP event and around 5 hours in the unlikely case of PMF event. Such time is deemed to be sufficient to evacuate the Site. However, confirmation about the adequacy of such time must be obtained from SES or form a qualified traffic engineer.

Table 2.4 Correlation of water level measured at Raymond Terrace Gauge and at Point of Interests (POI)

	Minor Flood Level (mAHD)	Moderate Flood Level (mAHD)	Major Flood Level (mAHD)
Raymond Terrace Gauge	2.50	3.10	3.50
POI - A	1.95	2.53	3.21
POI - B	6.51	6.51	6.51
POI - C	7.05	7.05	7.05
POI - D	3.33	3.33	3.33
POI - E	3.53	3.53	3.53
POI - F	3.91	3.91	3.91
POI - G	2.32	2.38	3.05

Note: the above table is the time-based correlation of water levels measured at Raymond Terrace gauge and at the POI. The correlation is based on the 1%AEP+CC event. Slightly different water levels at POI are correlated to the flood levels at Raymond Terrace during PMF event due to the different water surface gradient.

3 Existing Flood Emergency Response

The existing HRHS is subject to flooding as discussed in Section 2.

The HRHS management is aware of potential for flood affectation at the Site. The existing arrangement adopted by the HRHS management during flood events is to visually monitor encroachment of water from the Hunter River in combination with the use Local ABC radio, Live Traffic NSW app, BOM Flood Warnings and BOM Rain and River Data for water levels, evacuation alerts and road closures.

In the event of a flood, the preliminary response strategy is to evacuate the Site. Once the Chief Warden has issued the evacuation order, the Existing FERP nominates the emergency numbers and calls that need to be made to alert the relevant authorities and coordinate evacuation.

The evacuation order must be issued via sound alarm and communication via Facebook, School Bytes and SMS messages.

All students must be gathered in their designated classrooms ready for evacuation and then accompanied by their teacher to the buses.

A copy of the existing FERP is enclosed to this report in Annex A

4 Consideration of Evacuation Requirements

4.1 Overview

Physical protection of buildings of a site through considered design to exclude floodwaters for all events up to and including the PMF is generally not practical and/or cost effective. It also does not consider the risks arising from isolation of occupants nor the risk to emergency services personnel who may be required to assist isolated occupants to evacuate in emergencies. As such, an emergency management plan is required to assist in mitigation of the residual flood risk to people during relevant flood events with consideration of the factors listed below:

- The likely Site occupants ;
- The number of potential occupants;
- Potential isolation periods and conditions (including but not limited to a lack of electricity power, water and food);
- The lack of access to emergency care or provisions; and
- The potential placement of emergency service personnel or other community members at risk if assistance is required.

The principal flood emergency management strategy proposed herein is evacuation prior to inundation of both evacuation routes and buildings, with a preference towards non-attendance of the Site if there is potential for a flood event to occur based on rainfall or flood forecast by the Bureau of Meteorology (BoM).

It is noted that the SES have indicated that:

- Development strategies relying on sheltering in buildings surrounded by floodwater are not equivalent, in risk management terms, to evacuation,
- Sheltering in a building within the flood extent is not safe, and
- Development strategies relying on an assumption that mass rescue may be possible where evacuation fails or is not implemented are not acceptable to the NSW SES.

Therefore, a shelter-in-place strategy is not considered suitable for the Site for any scenario except where it cannot be avoided due to unexpected changes in conditions which either made evacuation impossible or provided inadequate warning time (such as in the PMF event). In such an event, temporary shelter-in-place on the upper floor levels of the proposed new buildings would situate occupants well above the PMF level. In line with the above considerations, it is noted that this should not be the primary plan, but rather a fallback emergency option should evacuation not be possible.

4.2 Adopted Evacuation Option

The following evacuation routes were considered in the analysis:

- Pacific Highway in the southerly direction (through Location G in Figure 2.2 and Figure 2.4).
- Adelaide Street in the northerly direction toward the junction with Swan Street (through Location D in Figure 2.2). Then continue on Adelaide Street in the easterly direction to join the Pacific Highway;
- Pacific Highway in the northerly direction (through Location E in Figure 2.2);

- Masonite Road in the south-easterly direction (through Location F in Figure 2.2), then travel west along the Main Trail in the direction of the Newcastle Airport.

It is noted that, while all nominated evacuation routes are flooded in the 1%AEP event, evacuation is possible from the Site due to sufficient evacuation time. From the analysis of flood behaviour and available warning time (reference Section 2.4), it is noted that:

- The Pacific Highway in the southerly direction is the least preferrable option since it does not lead towards flood-free areas in the 1%AEP event. For this reason, this option has been discarded.
- Adelaide Street in the northerly direction is not recommended as it requires travelling for around 2 km in the direction of the Hunter River. Furthermore, it requires travelling towards densely inhabited (and potentially highly trafficked) areas;
- The Masonite Road route is an acceptable option as it allows for around 18 hours of evacuation time, from the time that Minor Flood level is reached at the Raymond Terrace gauge to the onset of flooding of the road. It leads towards flood-free areas in both the 1%AEP and PMF events;
- The Pacific Highway in the northerly direction is also an acceptable option as it allows for around 13 hours of evacuation time, from the time that Minor Flood level is reached at Raymond Terrace gauge to the onset of flooding of the road. It leads towards flood-free areas in both the 1%AEP and PMF events;

Between the two acceptable evacuation routing options (The Pacific Highway in the northerly direction and the Masonite Road route towards the Newcastle Airport), the Pacific Highway northerly option is preferred because:

- It allows for evacuation time similar to the Masonite Road route.
- Although potentially more trafficked, it is a main route and, as such, it is more likely that it will be patrolled by helicopter and other emergency services during the evacuation.
- The condition of the Masonite Road following a significant rainfall event might not be optimal.
- The Masonite Road route might be interrupted at some points by private gates and fences.
- The Pacific Highway northerly route requires travelling for a shorter stretch along high hazard areas.

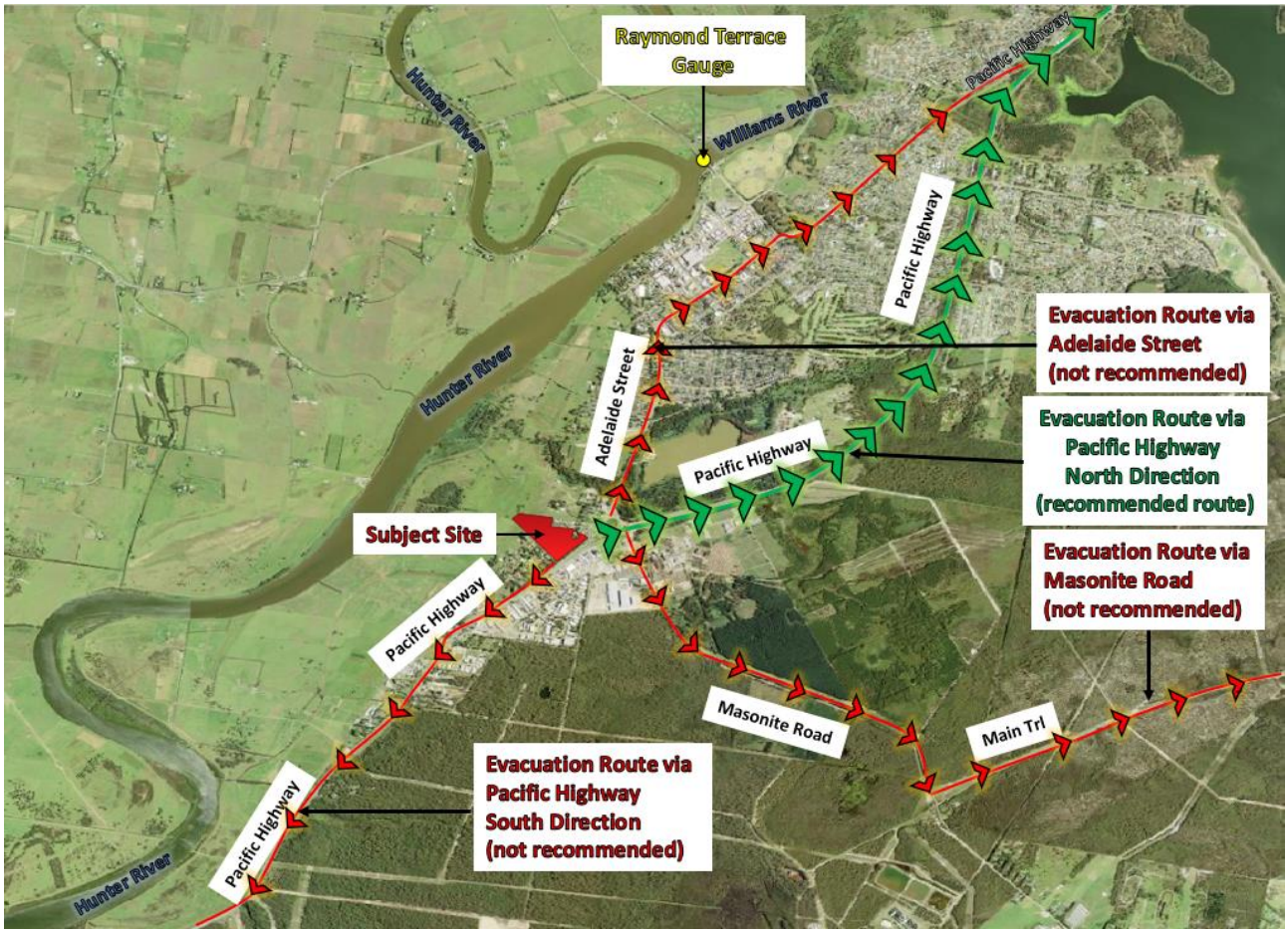


Figure 4.1 Off-Site evacuation routes options

4.3 Sheltering in place

In the case of an extreme flood (rarer than the 1%AEP+CC), floodwaters may inundate parts of the ground floor level and potentially enter into stairways, lift shafts and storage units.

While the preferrable flood emergency strategy is evacuation via the Pacific Highway (in the northerly direction), in the unlikely event of PMF flooding, the available evacuation time might be not sufficient to safely drive along the designated route. In this situation, a shelter-in-place strategy would be preferred.

Sheltering in place is possible in the existing upper levels of buildings Blocks G, H, I, J and K, whose upper floor levels sit above the PMF flood level. Location of the existing two-storey buildings is shown in Figure 4.2.

With respect to the number of people on Site, the actual number (considering students, teachers and staff) is 931: this is based on a current number of enrolled students equal to 842. School Infrastructure NSW is expecting an increase in the number of students in the next couple of years, and then a number drop thereafter. Table 4.1 is a projection of the students number till year 2025.

Table 4.1 Hunter River High School students number projection (source: SINSW)

YEAR	Projected Number of Students
2023	973
2024	954
2025	938

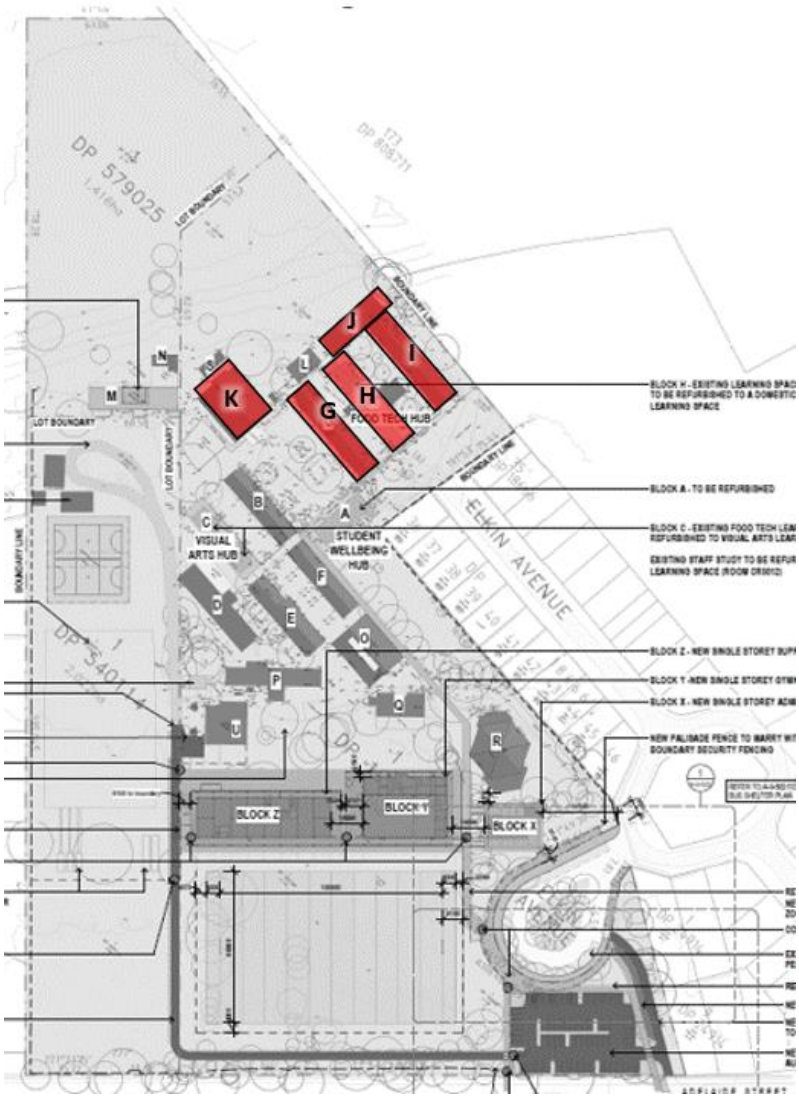


Figure 4.2 Existing two-storey buildings on Site (red marked)

In the email dated 30 November 2022, School Infrastructure NSW sent planimetries of the two-storey buildings on Site with indication of the surface areas suitable for sheltering. It is noted that are considered suitable for sheltering-in-place the areas that meet the following criteria:

- Are located above PMF level (8.52m AHD);
- Are intrinsically accessible to all people on the site, plainly evident and self-directing;
- Are accessible in sufficient time for all occupants with fail safe access and no reliance on elevators;
- Have unobstructed external access for emergency boats during flooding;
- Provide adequate shelter from the storm and have natural lighting and ventilation;
- Contain sufficient clean water, a first aid kit, portable radio with spare batteries and a torch with spare batteries.

It was calculated that the total available space for sheltering in place (sum of available space for all buildings) is equal to 1,543m² and is distributed as follows:

- Block G = 265m²
- Block H = 243m²
- Block I = 264m²
- Block J = 183m²
- Block K = 588m²

Furthermore, it is noted that:

- All buildings at the upper floor level are connected by an external covered walkway.
- All areas (except the external walkways) have climate control/fans (if electricity available) and windows for good ventilation if required;
- The total calculated area of 1543m² does not account for toilets, cubicles and walkway areas. With the addition of the external walkways, the total area available for sheltering in place is 1,885m².

Based on a total number of people that could reasonably be expected on-site at any one time equal to 1,062[2] people and an available total area for sheltering-in-place equal to 1,544m², the calculated per-capita available space for sheltering-in-place is approximately 1.5m²/pp.

[2] Calculated adding the projected number of students for year 2023 (973) to the current number of teaching (66) and non-teaching (23) staff members. The calculation assumes that the number of staff members will not change over time.

It is proposed that the available space for sheltering-in-place is adequate for the total number of people on Site considering that:

- The estimation of the total number expected on Site is conservative, due to the fact that it is based on maximum projected number of enrolled students;
- It is likely that most of the students would have already evacuated the Site and/or not attended the school due to severe (and easily predictable) weather circumstances;
- The PMF event is an extremely rare event that has been estimated having an annual probability of exceedance of 1 in 1,000,000.

5 Flood Emergency Response Plan

While the preferred emergency strategy for the school is early closure prior to the commencement of flooding and before the start of the school day, there is the possibility that a severe rainfall event may not be foreseen sufficiently in advance: therefore, people using the site must be informed about flood risk and behaviours to adopt during a flood.

A Flood Emergency Response Plan (FERP) is to be prepared by the school operator that will formalise flood evacuation planning and strategy with respect to flood intelligence, the flood behaviour presented in this report, and relevant procedures. The FERP will be expected to build on the strategy and intent presented in this report.

The SES recommends that all flood prone properties prepare their own emergency management plans as SES resources are scarce during emergencies and it is often the case that they cannot service all affected parties in case of flood, particularly given mobilisation time. The FERP shall be used as a guide for building wardens and other responsible parties nominated in the evacuation strategy. The aim of the FERP is to inform the existing and future operators of the building of the appropriate response measures required in the event of an extreme flood. In addition, the FERP will include a summary of the actions required in the form of warning systems and signage that are to be displayed at common muster points such as the ground floor entry, stairways, carpark and visible points along the ground floor. Maintenance activities must also be nominated in the FERP to ensure that all emergency management systems are in full working order at all times.

Key elements to be included in the FERP are outlined in the following sections.

5.1 Flood Response Personnel

Positions and responsibilities will need to be assigned to on-Site personnel for managing flood response. A chief flood warden or head 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 to manage evacuation.

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 the FERP to facilitate contact with the SES.

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 FERP 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 FERP. Further coordination of the proposed FERP will need to be undertaken with the SES. Regular drills will be required of the wardens to ensure the flood/emergency awareness and preparedness of the wardens and employees.

Table 5.1 Hunter River High School Flood Response Personnel

Position	Responsibilities
Director of the Campus	Coordinate preparation of specific Emergency Management Plan implementing the recommendations of this report. Order school closure should severe rainfall is predicted.
Chief Flood Warden	Coordinate flood evacuation drills - 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 Decide when shelter in place is required 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.

5.2 Emergency Warning Systems

Warning in case of a flood event is required to alert wardens and other people on-Site that a rare flood event may be imminent. As rare events are infrequent, a warning system in the form of an audible alarm is considered appropriate to communicate the urgency of the situation. An emergency siren and building Public Address (PA) system that is installed for other emergencies or day-to-day facility use is likely suitable for communicating with building occupants. These emergency warning systems are to be located above the PMF level.

Flood levels can rise rapidly, and it is necessary to ensure that sufficient warning time is given so that personnel may evacuate to safety. Triggers and notification are required to alert the head warden or others about the need to trigger the building emergency system. Triggers and notifications could include:

- On-Site Flood Warning System, outlined in Section 5.2.1;
- Existing Flood Warning System, outlined in Section 5.2.2;

- Rainfall intensity notifications from the BoM or a subscription to the BoM to send updates to flood wardens on anticipated heavy rainfall events ahead of time and to enable timely preparation.

These triggers could be communicated to the head warden and other key personnel using an automated SMS system. Back-up triggers, such as manually read flood markers, may be required to ensure redundancy in the warning system.

It is noted that the alert and trigger levels are to be based on regional flooding from the Hunter River. It is therefore advised to stay tuned to local media outlets or the local SES Centre to get an understanding of flooding and flood emergency situations across the broader area to verify that regional flooding is taking place. This will assist in minimising the potential for false triggers.

5.2.1 On-Site Flood Warning System

To maximise the available warning time and facilitate an orderly response, it is recommended that a flood warning system be installed. This system is to consist of the following components:

- Water level sensors;
- Monitoring control unit;
- Communications; and
- Power supply.

The system should be designed by an experienced supplier. Redundancy should be incorporated into the design such that failure of a single item does not result in failure of the overall warning system. The system supplier should also provide appropriate documentation to enable ongoing maintenance and calibration. .

Water Level Sensors

Water level sensors are to be installed at the location nominated in Figure 5.1. Placement of the water level sensor at the low point of the Site is aimed at informing Site occupants of rising floodwaters and (once a nominated level is reached) indicating that evacuation should commence. It is suggested that a trigger level of 1.95m AHD is set for issuing the warning: this level approximately corresponds to the Minor Flood level at Raymond Terrace BoM station.

There are a variety of sensors that can be used for this purpose and specific advice should be sought from the suppliers to indicate and confirm the most appropriate hardware. The sensors that are selected should be:

- Reliable – for example, the supplier should be able to demonstrate that the selected sensor has been used in similar installations.
- Stable – the calibration of the sensor should not unduly drift over time or be affected by external factors (such as changes in temperature).

There are a number of ultrasonic, pressure and capacitive sensors available that are able to meet these requirements. However, it is likely that periodic calibration and maintenance of the sensors will still be required. Facilities should be provided to calibrate the sensor (for example, by allowing adjustment to survey levels).

Typically, the sensor housing will be integrated into the surrounds in a discrete manner and protected the sensor from vandalism or other interference. However, easy access for maintenance and calibration should be provided.

Figure 5.1 Water Level Sensor Location

Control Unit
To accompany the sensors, a control or measuring unit will be required. This unit will undertake the following functions:

- Making the measurements from the sensors;
- Issuing alerts once the defined thresholds are exceeded;
- Monitoring the power supply;
- Cross-checking the data from the multiple sensors to ensure consistency (and provide warning of a potential malfunction); and
- Periodically polling the communication channels so that key users can be alerted of a system failure.

There are a range of commercially available data loggers that can provide these functions (e.g. Campbell Scientific).

The control unit can be co-located with the sensor or installed in a separate housing . In either case the unit should be immune to inundation by floodwater (e.g. by locating the unit above the PMF).

Communications
To communicate the warning to the occupants, the system will need to include a communications facility. Systems or processes will be required to identify and communicate the following events:

- Floodwater exceeding the identified thresholds;
- Sensor disagreements (indicating potential need for recalibration or failure);
- Power supply issues (including loss of primary power supply and low battery levels); and
- Failure of the loggers or communications systems.

This can be integrated into the on-Site emergency warning system. It may also be necessary to provide building wardens with more specific detail (for example, by SMS) so that they can co-ordinate an appropriate response. Some aspects, such as the failure of the loggers and communications systems, may require some degree of routine monitoring including confirmation that the system is active when a storm warning is issued.

Power Supply
The flood warning system will require a redundant power supply. Typically, the primary power would be drawn from the electricity grid. However, an independent back-up should be provided to enable the system to continue functioning in the event that power is cut.

Documentation
Accompanying the system design, appropriate documentation of the system should be provided by the system supplier. This documentation should cover:

- System components (including their location within the building);
- Use of the user interfaces;
- Software interfaces (including the use network connections and protocols);
- Wiring diagrams;
- Calibration procedures; and
- System maintenance requirements.

The documentation should be able to be understood by a suitably qualified professional and without requiring reference to additional documents that are not otherwise readily available. Diagrams and other graphics should be provided where appropriate.

5.2.2 Existing Flood Warning System

Warning in case of a flood event is required to alert Site occupants that a flood event may be imminent. Flood levels can rise rapidly (particularly during the PMF) and it is necessary to ensure that sufficient warning time is given so that Site occupants may evacuate to safety. Triggers and notification are required to alert occupants to evacuate and should include flood warning, flood watch and weather warnings including rainfall intensity notifications from the BoM, Council and the SES.

Observation of the Raymond Terrace gauge (561037), operated by BoM, is the most appropriate means by which to inform potential flooding events at the school. The gauge is located approximately 3.5 km upstream the Site along the Hunter River. Water Level forecasts and storm conditions at the gauge should be used to prepare for the possibility of flooding or to make the decision to close the school prior to opening.

The BoM has a target warning lead time of 6 hours for minor flood classifications at the gauge.

5.3 Evacuation Routes and Timings

5.3.1 Evacuation Off-Site

Evacuation in a safe manner is dependent on warning time and availability of easily identifiable routes. Proposed evacuation off-site is proposed via private vehicles and buses along the Pacific Highway in the northerly direction, with access via Adelaide Street roundabout.

The evacuation routes are indicated in Figure 4.1.

Total flood warning time – consisting of the time from when the Minor Flood level is reached at the Raymond Terrace gauge and at the on-site warning system to the time when the Pacific Highway will become inaccessible due to floodwaters – will vary with event rarity. The 1%AEP event has been nominated for evacuation assessment. Effective evacuation of the Site must utilise the total flood warning time available to ensure that evacuation of the Site will occur prior to inundation of evacuation routes.

Flood modelling undertaken as part of the FIA indicates that in a 1% AEP event (at year 2100 design horizon), there would be around 13 hours of safe evacuation time (calculated from the time that minor flood level at Raymond Terrace gauge is reached).

5.3.2 Structural Soundness

Although the proposed new buildings are not affected by flooding until an event rarer than the 1% AEP+CC, given the need for emergency shelter-in-place facilities the buildings will need to be designed to ensure the structural integrity will not be compromised for all flood events up to and including the PMF event. This will require confirmation by a suitably qualified structural engineer as part of the detailed design process.

5.4 Signage

To accompany the flood warning system, the building should include appropriate signage indicating what actions are to be undertaken in the event of flooding. This should consist of instructions (including direction arrows) that can be interpreted if the flood wardens are not available.

The following signs are recommended:

1. Flood depth indicators at visible locations such as the entry to the building;
2. Entry/exit points to stairwells; and
3. Evacuation routes (refer drawings in Section 5.3.1).

An example of the typical signage that might be displayed at key points is given in Figure 5.2.

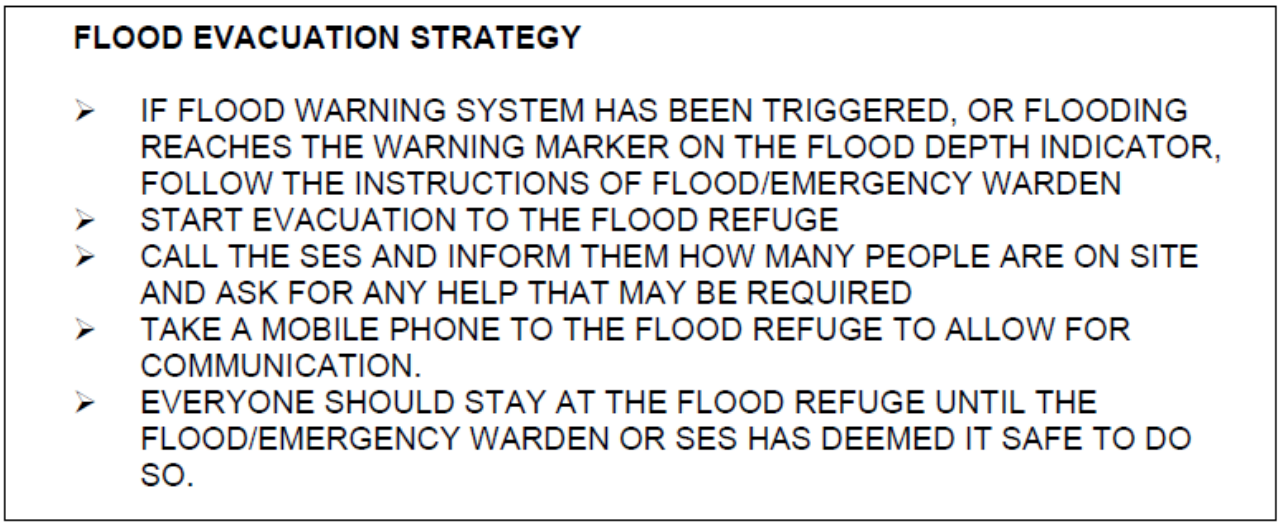


Figure 5.2 Typical Flood Evacuation Signage

6 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.

6.1 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. Consider School closure should severe rainfall be forecasted by the BoM.
- Review and be familiar with the applicable *SES Emergency Business Continuity Plan*.
- Ensure that the plan 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.

6.2 During a Flood

Outlined below are key flood safety measures to be followed by occupants during a flood or a severe weather event that may lead to flooding.

- Follow the procedures outlined in the applicable *SES Emergency Business Continuity Plan.*
- Locate the Emergency Flood Kit.
- Listen and respond to directions from emergency services or others with a special responsibility.

- Monitor the BoM website, ABC radio broadcasts, local emergency services social media pages, and local news outlets for severe thunderstorm warnings.
- Follow all advice and instructions given by emergency services.
- Ensure all occupants on-Site are informed and in agreeance on the evacuation approach.
- Only if safe to do so, turn off all utilities possible and relocate belongings to higher ground above the predicted flood level if possible.
- Monitor local rainfall , BoM Severe Thunderstorm Warnings and the Raymond Terrace water gauge. If the Minor Flood level at Raymond Terrace gauge is reached and/or if the on-site warning system gives the alarm, commence evacuation proceedings. This should ideally commence prior to the onset of heavy rainfall. If the Raymond Terrace water gauge is approaching the Minor Flood level prior to school commencement and heavy rain is predicted, consider cancelling school.
- Begin contacting students' parents/guardians to request they attend to pick-up students. Contact bus company to arrange evacuation transport to nominated evacuation refuge[3].
- Evacuate all students, staff and visitors on Site to the carparks for marshalling. All students, staff and visitors are to then be evacuated from this location via private vehicles or emergency evacuation buses. Avoid driving directly through floodwaters wherever possible. Remain at the evacuation refuge until advised safe to do so by the SES.
- In the event that evacuation does not occur in time, or there are floodwaters present along the evacuation route, immediately commence shelter-in-place proceedings on the upper floors of the buildings. Note that this is not the recommended option as it presents isolation risks both for occupants and SES personnel, but it is a safer option than attempting to evacuate through potentially hazardous floodwater. If the situation arises where the option is unavoidable, shelter in place until floodwaters have subsided off-Site and are no longer overtopping the Pacific Highway, or until advised safe to do so by the SES.

6.3 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.

[3] School management shall confirm which is the preferred evacuation method (bus, private cars etc…). Since SES continuously updates the list of evacuation centres, the evacuation refuge nominated by SES has to be checked at the time of the flooding on SES website (www.ses.nsw.gov.au)

7 Conclusion and Recommendations

This report outlines a flood emergency management strategy for the Hunter River High School that has been developed with consideration of the nature of flooding and flood hazard at the Site for mainstream Hunter River events up to the PMF, the proposed building designs and use of the Site, and relevant information contained in applicable floodplain risk management plans.

Flood emergency evacuation measures and requirements have been established for implementation with the redevelopment of the Site.

The differing nature of flooding at the Site in rare and extreme events means that multiple emergency management strategies must be considered. In rare events, the potential for both long warning times and potential long isolation periods means school evacuation is the best emergency management procedure.

The principal flood emergency management strategy is school evacuation prior to evacuation routes and buildings becoming flooded. It is proposed to install an automatic flood level sensor at the low-lying areas at the north-west corner of the Site to monitor flooding conditions that will be utilised to set trigger levels for the evacuation. In particular, it is proposed to set a warning alarm at the flood water trigger level of 1.95m AHD. Such level corresponds to the Minor Flood level of 2.5m AHD at the BoM gauge of Raymond Terrace. This will allow flood warning redundancy if either trigger fails to warn.

In the unlikely event of an extreme flood (PMF), the potentially rapid rise in floodwater and extremely hazardous conditions along potential evacuation routes means the opportunity for off-site evacuation are limited. It is proposed to utilise the school buildings of blocks G, H, I, J & K (that have upper floor levels above the PMF level) as a shelter-in-place refuge.

The following are further considerations to be made beyond this flood emergency strategy report:

- Confirmation with traffic engineer and/or SES that the available warning time (ref Section 2.5) is sufficient for safe Site evacuation and which is the preferrable evacuation modality (private cars, emergency buses, parent's pick-up etc…)
- Update of the existing Site FERP incorporating information available in this report. It is recommended that the school's management considers how they wish evacuation to take place.
- The existing school FERP nominates the Bunnings Heatherbrae at No. 8 Griffin Street as primary evacuation refuge. However, it is noted that the Bunnings itself is located in a Flood Island in the 1%AEP+CC event and gets inundated (although with lower depths as compared to the HRHS) in the PMF event. Therefore, long isolation times might follow the sheltering in the Bunnings Heatherbrae.
- SES Port-Stephens Flood Emergency Sub Plan (https://www.ses.nsw.gov.au/media/1719/plan-port-stephens-flood-emergency-sub-plan-2012-endorsed.pdf) nominates the HRHS itself as location suitable for sheltering in place. Since the HRHS is a Low Flood Island which could be isolated by floodwaters for long time, BMT does not recommend the HRHS as a suitable evacuation centre. Furthermore, given that the Site's occupants are mostly young people, it is deemed that they should seek refuge in they own houses (providing that they are flood-free) rather than in a communal evacuation centre. It is recommended that HRHS management liaise with SES to confirm the suitability of the school as evacuation centre and consider the circumstance where a large number

of people (significantly higher than the usual number of Site occupants) seek refuge at the Site's premises.

- This report highlights that the Pacific Highway in the north direction is the safest evacuation route towards flood free areas. However, the final evacuation destination is not confirmed at this stage. It is therefore recommended to regularly check the list of evacuation centres on SES website (www.ses.nsw.gov.au) and liaise with SES to define the most suitable evacuation centre.
- Periodic review and revision of FERP shall be scheduled after it is finalised and implemented.

8 References

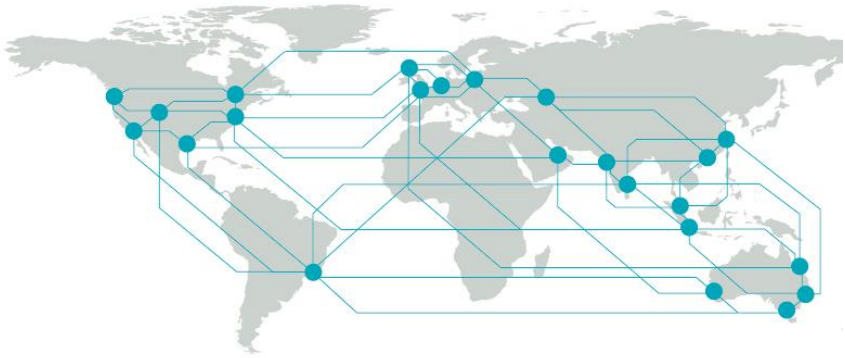
Australian Institute for Disaster Resilience (2017) *Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*.

BMT (2022) *Hunter River High School - Flood Impact Assessment*.

NSW Government (2022) *NSW Floodplain Development Manual*.

SES Port Stephens Flood Emergency Sub Plan (2013)

Annex A Existing Flood Emergency Response Plan



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