Infrastructure Delivery, Management and Staging Plan – Flooding & Stormwater

RPAH Redevelopment Stage 1

Health Infrastructure

18 January 2023

201957

Taylor Thomson Whitting (NSW) Pty Ltd (ACN 649 974 112)
Consulting Engineers I Level 6, 73 Miller Street, North Sydney NSW 2060

Your Partner in Engineering

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Rev	Date	Prepared By	Approved By	Status
1	26 September 2022	TM	TM	Draft
2	04 October 2022	DM	TM	Draft
3	06 October 2022	DM	TM	For Approval
4	01 November 2022	DM	TM	For Approval
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1. Introduction

TTW has been engaged by Health Infrastructure to provided flooding and stormwater consultancy services for the proposed Royal Prince Alfred Hospital (RPAH) redevelopment. This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARS) issued on 29 August 2022 for the State Significant Development submission (SSD-47662959).

The Industry Specific – Hospitals SEARs relevant to the flooding and stormwater design are listed below:

13. Ground and Water Conditions • Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils. • Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on: o surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses. o groundwater resources in accordance with the *Groundwater Guidelines*.	• Geotechnical Assessment • Surface and Groundwater Impact Assessment • Salinity Management Plan and/or Acid Sulfate Soils Management Plan

14. Water Management • Provide an Integrated Water Management Plan for the development that: o is prepared in consultation with the local council and any other relevant drainage or water authority. o outlines the water-related servicing infrastructure required by the development (informed by the anticipated annual and ultimate increase in servicing demand) and evaluates opportunities to reduce water demand (such as recycled water provision). o details the proposed drainage design (stormwater and wastewater) for the site including any on-site treatment, reuse and detention facilities, water quality management measures, and nominated discharge points. o demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse downstream impacts. • Where water and drainage infrastructure works are required that would be handed over to the local council, or other drainage or water authority, provide full hydraulic details and detailed plans and specification of proposed works that have been prepared in consultation with, and comply with the relevant standards of, the local council or other drainage or water authority.	• Water Management Plan

15. Flooding Risk • Identify any flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the *NSW Floodplain Development Manual*. • Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions and operational procedures to mitigate flood risk where required.	• Flood Risk Assessment

Additional site-specific SEARs related to flooding were included in the Department of Planning and Environments cover letter. These are included below:

<u>*Flooding*</u> • Provide a flood impact and risk assessment prepared in accordance with the NSW Floodplain Development Manual, and existing councils and government studies and guidance. • Identify flood behaviour, flood constraints and risks on the site and its surrounding, including the potential impacts of climate change for the full range of events, i.e. up to and including theprobable maximum event (PMF). • Assess the impacts of the development, including any changes to flood behaviour and risk, impacts of flooding on the development and its future community and on the existing community for the full range of events. • Propose management measures required to minimise the impacts of flooding on the development and minimise flood risks to the community, including an Emergency ManagementPlan considering access to and from the site, and evacuation issues during significant flood events including the PMF, from both local catchments and/or regional catchments. *If the site is in a flood catchment, or flood affected, you must undertake consultation with the NSW State Emergency Service (as a relevant agency) prior to lodgement of the EIS.*

1.1 Reference Materials

The following documents were reviewed and informed the flooding and stormwater design of RPAH:

- NSW Floodplain Development Manual - 2005
- Onsite Stormwater Detention Policy – Sydney Water – 04/02/2021
- Onsite Stormwater Detention Guidelines – Sydney Water – 16/06/2021
- Development Control Plan – Section 3: General Provisions – City of Sydney – Dec. 2012
- Interim Floodplain Management Policy – City of Sydney – May 2014
- *JohnstonsCreek Catchment – Floodplain Risk Management Plan* -WMA Water–Sep. 2015

2. The Site

2.1 Site Description

The Royal Prince Alfred (RPA) Hospital campus is located in Sydney's inner west suburb of Camperdown, within the City of Sydney Local Government Area. The campus is situated between the University of Sydney to the east and the residential area of Camperdown to the west. A north-south arterial road (Missenden Road) divides the campus into two distinct portions, known as the East and West Campuses. The northern boundary of the campus is defined by the Queen Elizabeth II Rehabilitation Centre and the southern extent of the campus is defined by Carillon Avenue.

The works are proposed to both the East and West Campuses, as well as some off-site works occurring within the University of Sydney.

The site comprises the following land titles:

East campus:

- Lot 1000 DP 1159799 (12 Missenden Road, Camperdown, 2050).

West campus:

- Lot 11 DP 809663 (114 Church Street, Camperdown, 2050); and
- Lot 101 DP 1179349 (68-81 Missenden Road, Camperdown 2050).

Off-site works are proposed on University of Sydney land, known as Lot 1 DP 1171804 (3 Parramatta Road, Camperdown, 2050) and Lot 1001 DP 1159799 (12A Missenden Road, Camperdown, 2050).

2.2 Project Background

In March 2019, the NSW Government announced a significant $750 million investment for the redevelopment and refurbishment of the RPA Hospital campus. The Project will include the development of clinical and non-clinical services infrastructure to expand, integrate, transform and optimise current capacity within the hospital to provide contemporary patient centred care, including expanded and enhanced facilities.

The last major redevelopment of RPA Hospital was undertaken from 1998 to 2004 projected to 2006 service needs. Since then, significant growth has been experienced in the volume and complexity of patients, requiring significant investment to address projected shortfalls in capacity and to update existing services to align with leading models of care.

The redevelopment of RPA Hospital has been the top priority for the Sydney Local Health District since 2017 through the Asset Strategic Planning process, to achieve NSW Health strategic direction to develop a future focused, adaptive, resilient and sustainable health system.

2.3 Description of Development

Alterations and additions to the RPA Hospital East Campus, comprising:

- Eastern wing: A new fifteen (15) storey building with clinical space for Inpatient Units (IPU's), Medical Imaging, Delivery, Neonatal and Women's Health Services, connecting to the existing hospital building and a rooftop helicopter landing site (HLS);
- Eastern extension: A three (3) storey extension to the east the existing clinical services building to accommodate new operating theatres and associated plant areas;
- Northern expansion: A two (2) storey vertical expansion over RPA Building 89 accommodating a new Intensive Care Unit and connected with the Eastern Wing;
- Internal refurbishment: Major internal refurbishment to existing services including Emergency Department and Imaging, circulation and support spaces;
- Enhanced Northern Entry/ Arrival including improved pedestrian access and public amenity;
- Demolition of affected buildings, structures and trees;
- Changes to internal road alignments and paving treatments; and
- Landscaping works, including tree removal, tree pruning, and compensatory tree planting including off-site on University of Sydney land.

Ancillary works to the RPA Hospital West Campus, comprising:

- Temporary helicopter landing site above existing multi storey carpark;
- Re-routing of existing services; and
- Associated tree removal along Grose Street.

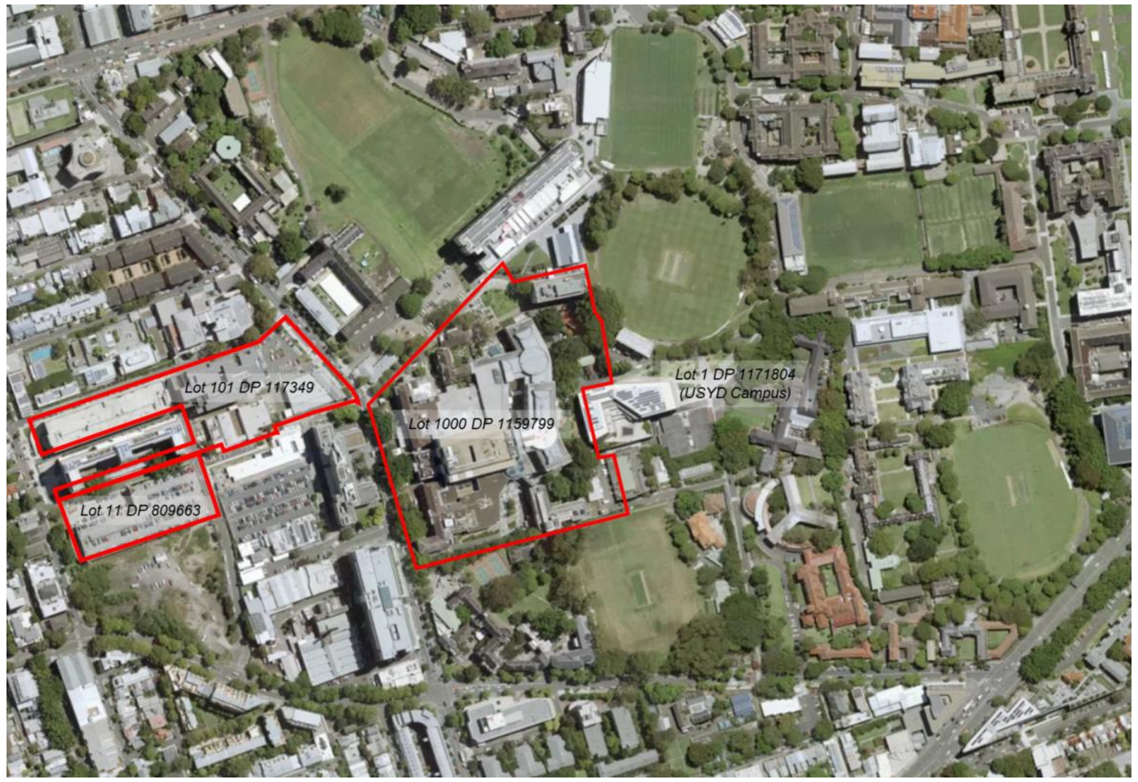

Figure 1 – Site boundary

3. Flooding

3.1 SEARs

This section of the report directly addresses the below flooding SEARs received from the Department of Planning and Environment.

15. Flooding Risk • Identify any flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the *NSW Floodplain Development Manual*. • Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions and operational procedures to mitigate flood risk where required.	• Flood Risk Assessment

Flooding

- Provide a flood impact and risk assessment prepared in accordance with the NSW Floodplain Development Manual, and existing councils and government studies and guidance.
- Identify flood behaviour, flood constraints and risks on the site and its surrounding, including the potential impacts of climate change for the full range of events, i.e. up to and including theprobable maximum event (PMF).
- Assess the impacts of the development, including any changes to flood behaviour and risk, impacts of flooding on the development and its future community and on the existing community for the full range of events.
- Propose management measures required to minimise the impacts of flooding on the development and minimise flood risks to the community, including an Emergency ManagementPlan considering access to and from the site, and evacuation issues during significant flood events including the PMF, from both local catchments and/or regional catchments.

If the site is in a flood catchment, or flood affected, you must undertake consultation with the NSW State Emergency Service (as a relevant agency) prior to lodgement of the EIS.

3.1 Catchment

The site is located within the Johnstons Creek Catchment, west of the Sydney Central Business District (CBD) and has been identified as being flood affected. The catchment is fully urbanised, with the upper area to the south and the lower area to the north. The catchment discharges to Rozelle Bay via a large open channel. The catchment is drained by a combination of Council stormwater pits and pipes which connect to Sydney Water's major trunk stormwater drainage system (SWC55). A flood study of the catchment has been completed by WMA Water for Council (*Johnstons Creek Catchment Flood Study, September 2015).*

RPAH is located towards the upper area of the catchment. Missenden Road is a natural ridge in the catchment with flows conveyed along the lower areas to the east and west. The topography of the West Campus splits stormwater flows into sub-catchments, with flows directed to existing stormwater infrastructure draining to Rozelle Bay.

For an overview of the catchment's topography, refer to **Figure 2**.

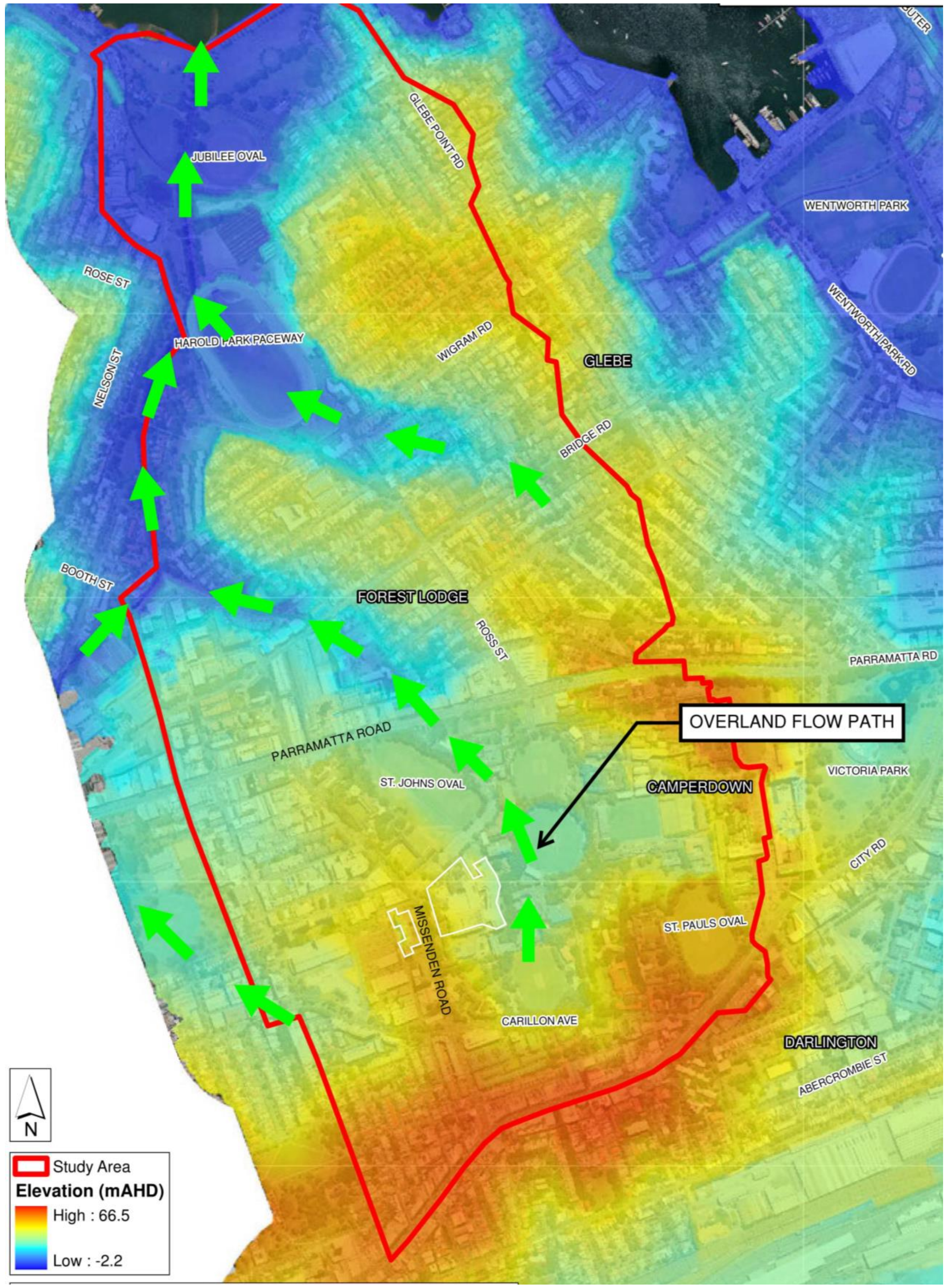

Figure 2 - Catchment Topography (Source: *Johnstons Creek Catchment Flood Study* – WMA Water)

3.2 Existing Council Flood Model

The *Johnstons Creek Catchment Flood Study* was completed in 2015. This flood study identifies an overland flow path to the east of RPAH and within the University of Sydney's Camperdown campus. The study also confirms that the ovals and sporting grounds within the campus provide informal detention for flood events from the 20% AEP (5-year ARI) up to the 1% AEP (100-year ARI) and PMF. The West Campus is shown to be only affected by overland flow and localised ponding in the 1% AEP event.

An extract from the 1% AEP flood result map is shown below as **Figure 3**:

Figure 3 - Council's 2015 Flood Study - 1% AEP (Source: *Johnstons Creek Catchment Flood Study* – WMA Water)

Since the completion of the flood study in 2015 there have been several developments completed within the local area of RPAH that have the potential to impact flood behaviour. These include:

- Susan Wakil Health Building, University of Sydney
- Charles Perkins Building, University of Sydney
- Centenary Institute, University of Sydney
- Oval 2 and Grandstand, University of Sydney
- 84-86 Parramatta Road

3.3 Updated Council Flood Model

The existing Council flood model was updated to include the new developments listed in **Section 3.2** while the latest lidar data available was used to represent changes in the digital elevation model. The 1% AEP and PMF results of the updated flood model, along with the location of recent developments, are presented below and overleaf as **Figures 4** & **5** respectively.

Further updates to the flood model may be required to incorporate any stormwater upgrades or amendments that may have been associated with the completed developments, together with a detailed review and analysis of the existing RPAH stormwater system.

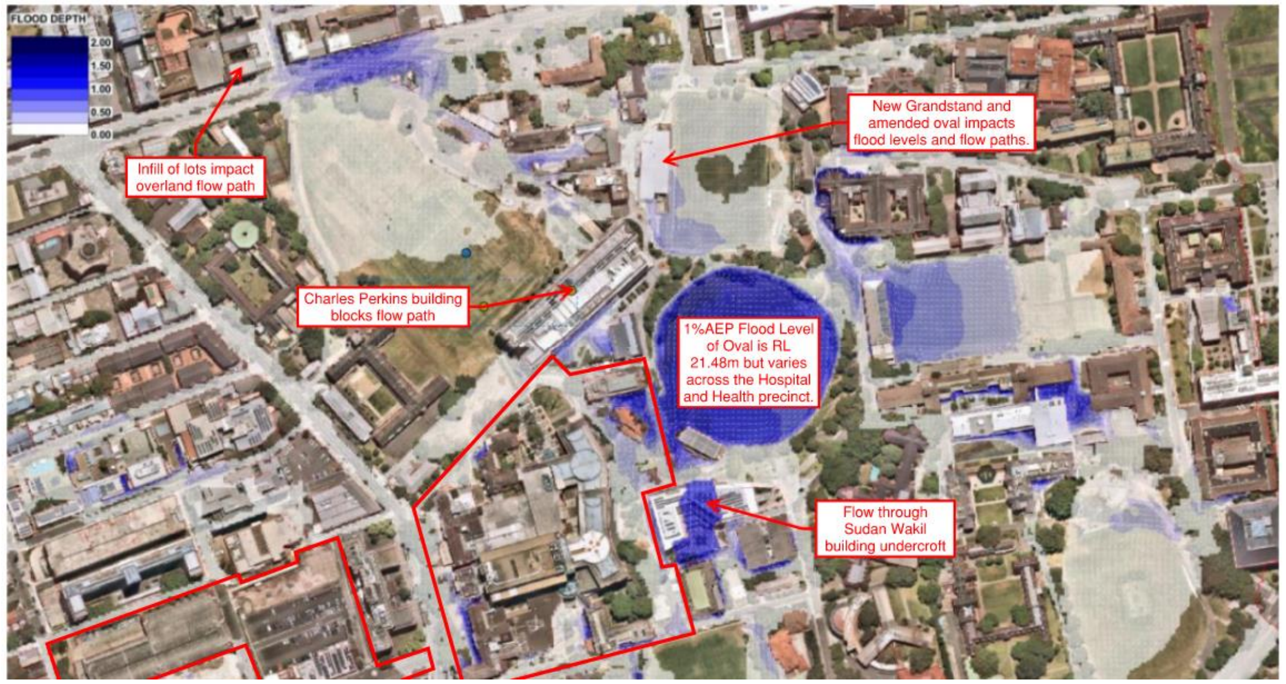

Figure 4 – Updated 1% AEP flood extents & depths

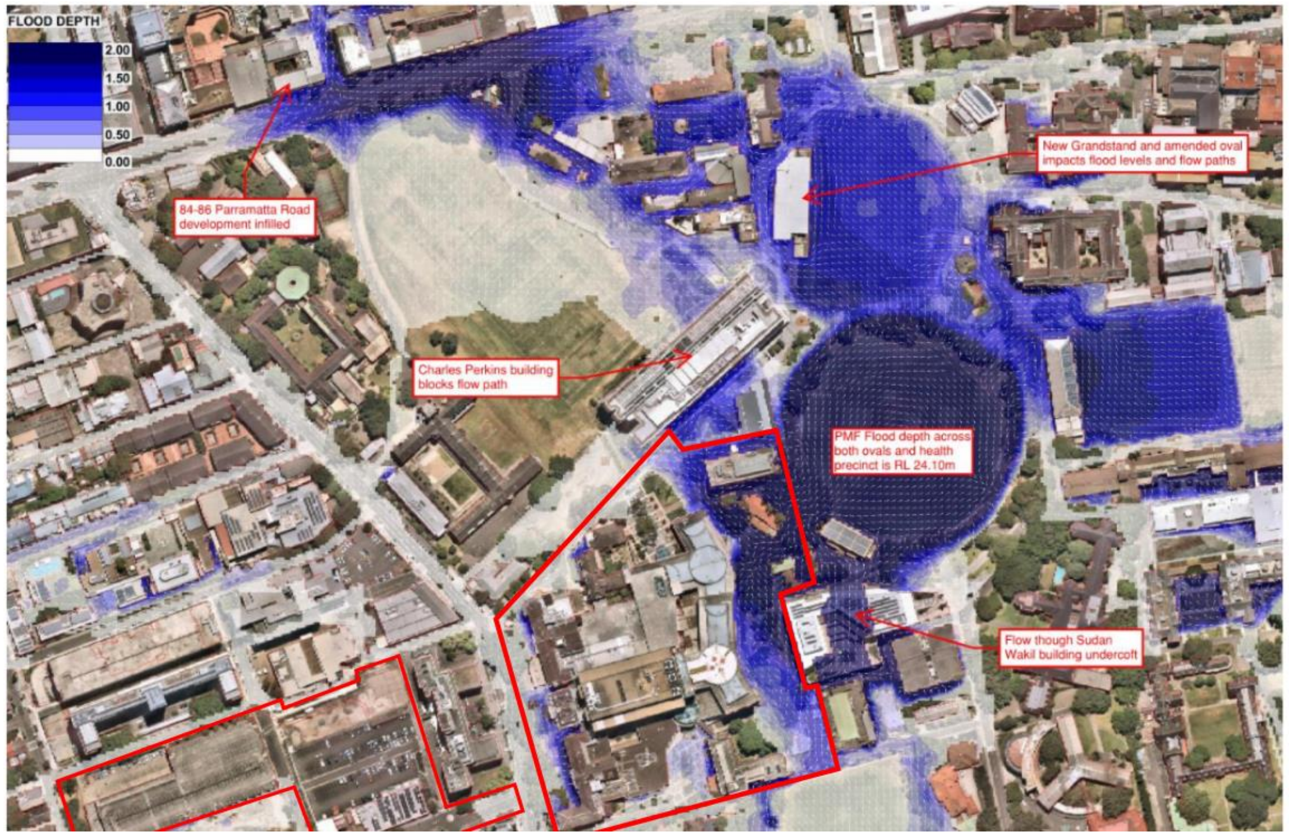

Figure 5 - Updated PMF extents & depths

The updated flood model results show that the PMF flood level has increased at the Sydney University Oval from RL 23.75m to RL 24.10m. Discussions are ongoing with the University of Sydney SBA design team to calibrate the baseline scenario of the flood model.

3.4 Flood Planning Requirements

The City of Sydney's *Interim Floodplain Management Policy 2014* sets the Flood Planning Requirements for all new development within the Local Government Area (LGA). As defined in the policy, the RPAH development will be classed as critical infrastructure:

Critical Facilities	Includes hospitals and ancillary services, communication centres, police, fire SES, major transport facilities, sewerage and electricity plants; any installations containing critical infrastructure control equipment and any operational centres for use in a flood.

Figure 6 - Critical infrastructure definition (Source: *Interim Floodplain Management Policy 2014)*

The Flood Planning Level requirements for the development are as follows:

5 Flood Planning Levels

A Flood Planning Level refers to the permissible minimum building floor levels. For below-ground parking or other forms of below-ground development, the Flood Planning Level refers to the minimum level at each access point. Where more than one flood planning level is applicable the higher of the applicable Flood Planning Levels shall prevail.

Development		Type of flooding	Flood Planning Level
	All other below-ground car parks	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m or the PMF (whichever is the higher) See Note 1
	Below-ground car park outside floodplain	Outside floodplain	0.3 m above the surrounding surface
Above ground car park	Enclosed car parks	Mainstream or local drainage flooding	1% AEP flood level
	Open car parks	Mainstream or local drainage	5% AEP flood level
Critical Facilities	Floor level	Mainstream or local drainage flooding	1% AEP flood level + 0.5m or the PMF (whichever is higher)
	Access to and from critical facility within	Mainstream or local drainage flooding	1% AEP flood level

Figure 7 - Flood planning levels (Source: *Interim Floodplain Management Policy 2014*)

The proposed RPAH East Campus development includes new facilities at Level 2 and above with some on-grade parking at ground level. All access points into the proposed East campus building will occur on Level 2 which has a proposed FFL of 24.28m. For the proposed development site the PMF level exceeds the 1% AEP plus 500mm freeboard level, as such, the proposed FFL of Level 2 is set above the PMF level of 24.10m to comply with Council's flood policy. Any open on-grade car parking proposed as part of the design development is to be above the 5% AEP Flood Level or above the 1% AEP if enclosed. Existing 1% AEP and PMF flood extents for the East Campus are shown in **Figure 8** and **Figure 9**.

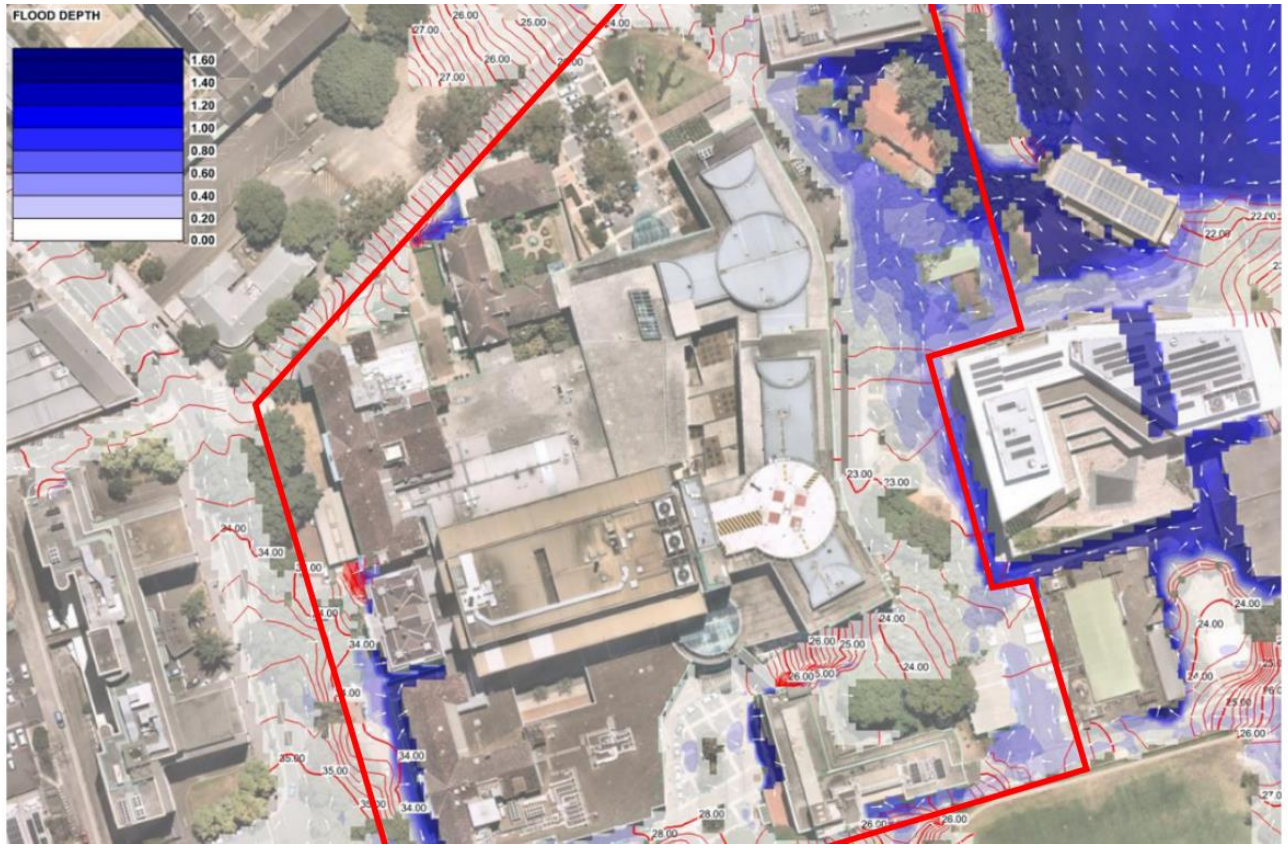

Figure 8 – East Campus Pre-development 1% AEP Flood Extents

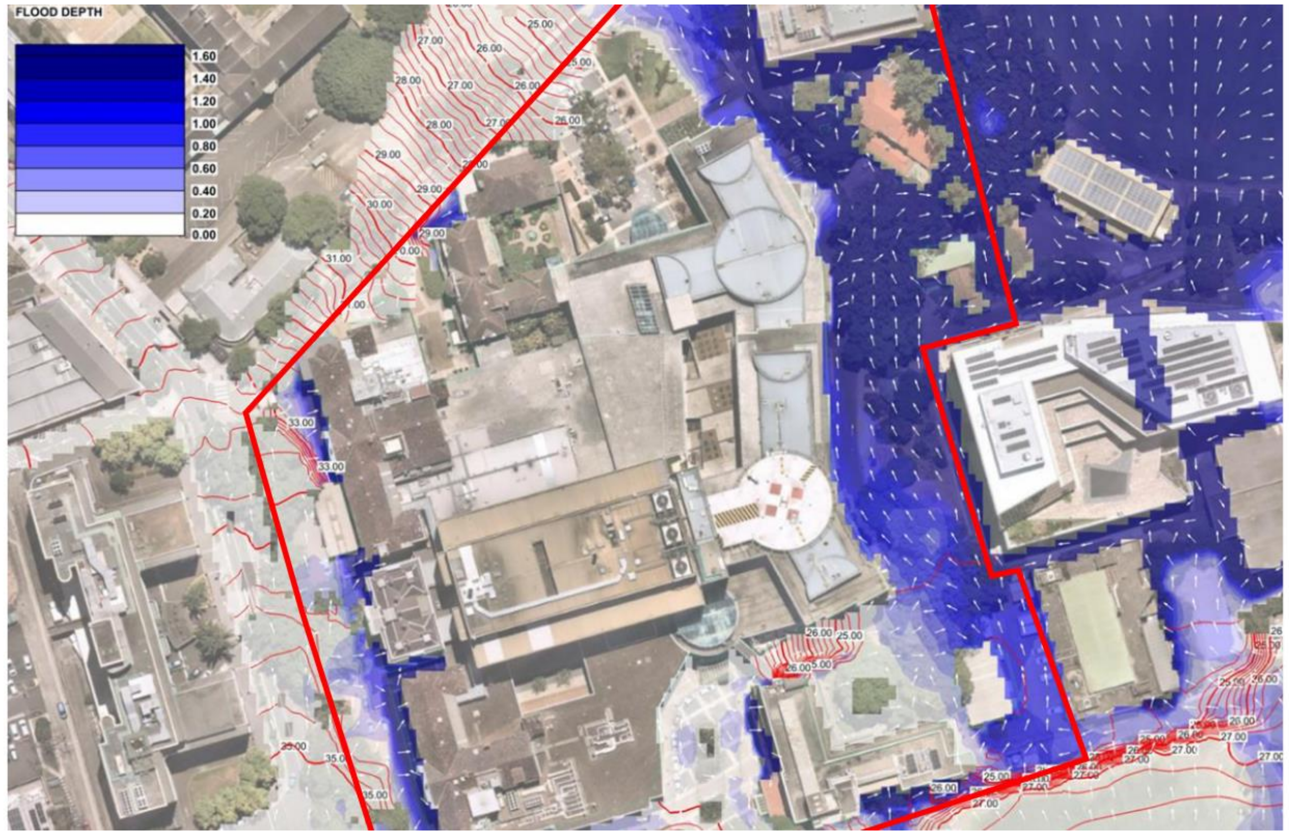

Figure 9 – East Campus Pre-development PMF Flood Extents

3.5 Post-development Flood Modelling

The updated Council flood model provides a pre-development baseline scenario taking account of developments such as the Charles Perkins Building and Susan Wakil Building which were not included in the original Council flood study. The post-development scenario has been modelled with the proposed buildings and site grading to determine the impact of the development on flood level. The post development 1% AEP and PMF scenarios as shown in Figure 10 and Figure 12 respectively. Figure 11 shows the 1% AEP afflux which is the change in flood level. In general water levels reduce beneath the East Extension and increase beneath the East Building. The increase is contained within the site boundary and so the flood impacts are deemed acceptable without the need for further flood mitigation controls. Further refinement of the flood model will be required as the design developments including calibration of the baseline scenario with the proposed University of Sydney's Sydney Biomedical Accelerator (SBA) design team.

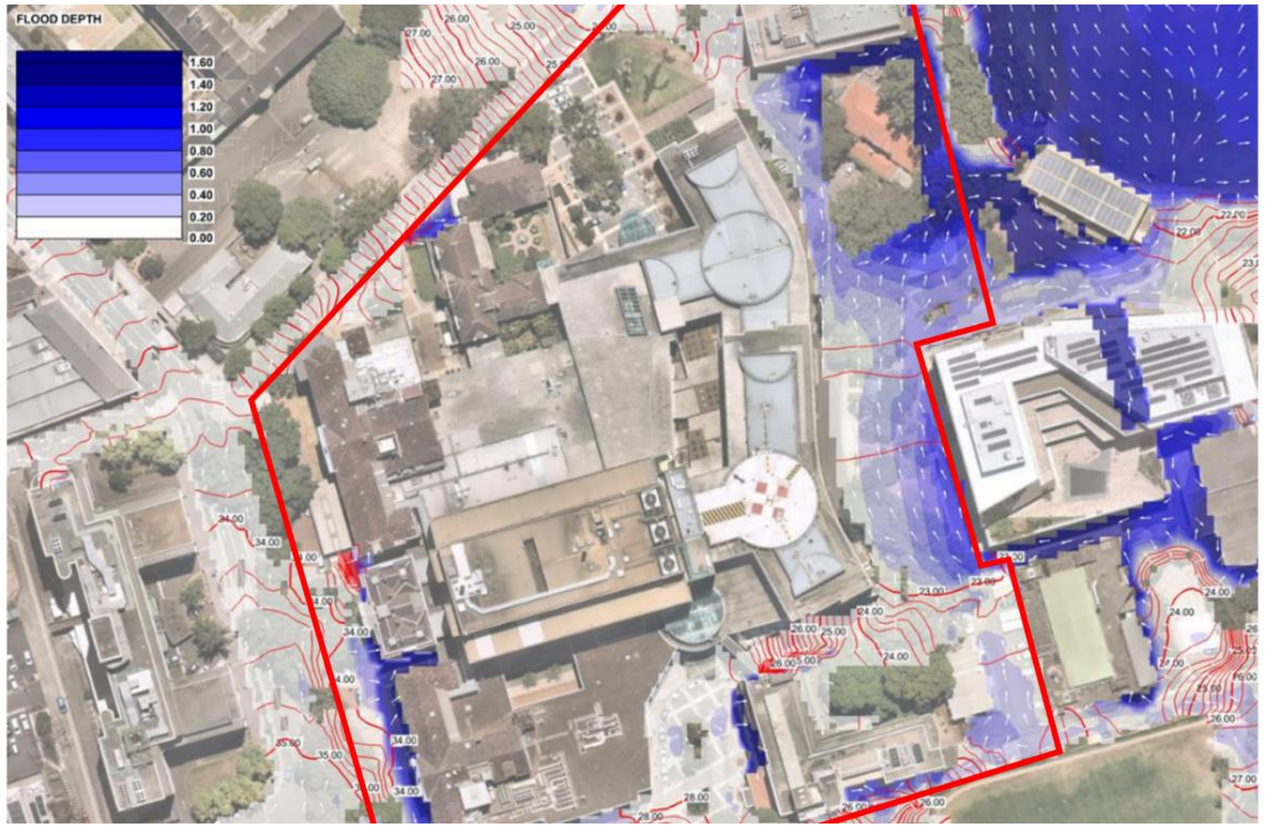

Figure 10 – East Campus post-development 1% AEP Flood Extents

Figure 11 – East Campus post-development 1% AEP Afflux

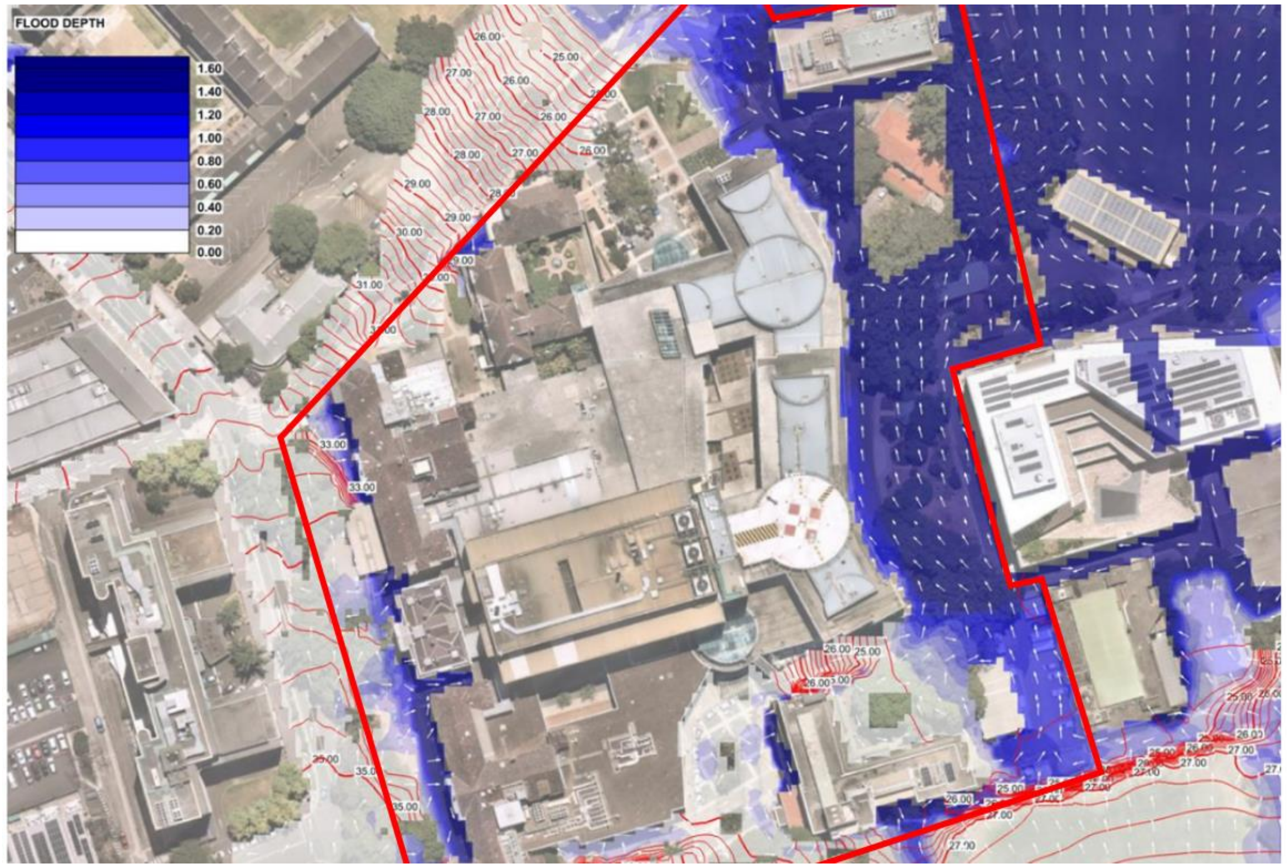

Figure 12 – East Campus post-development PMF Flood Extents

3.6 Climate Change

The impacts of Climate Change were analysed as part of the Johnstons Creek Flood Study. Climate change is expected to have an adverse impact on sea levels and rainfall intensities, both of which have the potential to have significant impact on flood behaviour at specific locations. Climate change projections in NSW are generated from the NSW and ACT Regional Climate Modelling (NARCliM) project.

The NARCliM projections for total rainfall for the Sydney Metropolitan Region will decrease in spring and winter, and increase in autumn and summer. The NARCliM projections for extreme rainfall are that both rainfall intensities and the frequency of extreme events will increase.

The current flood policy adopted by City of Sydney, and used in the Johnstons Creek Flood Study, allows for a 90cm increase in sea level rise by 2100 from the 2009 Mean Sea Level. This is also in accordance with the projections of the ‘very high greenhouse gas scenario’ (RCP8.5)

Current predictions for extreme rainfall are that peak rainfall intensity is likely to increase by up to 10%, however sensitivity analysis using an increase in peak rainfall of up to 30% has been adopted in accordance with Council’s Darling Harbour Flood Study.

Flood modelling was completed as part of Council’s catchment wide study and the results show that the increase in rainfall will have localised increased in flood depth for the 1% AEP, with an increase of up to 600mm at the oval with a 30% increase in rainfall. This increase is significantly below the PMF flood level which is approximately 2.5m higher than the 1% AEP flood level.

The increase in sea level rises only have impact in the immediate areas around the low-lying areas adjacent to Johnstons Creek, such as Rozelle Bay, with no affect at the hospital site. A summary of the climate change impacts are shown in the table below

Climate Change Scenario	Increase in flood level at Syd Uni Oval
10% Increase in rainfall	0.22m
20% Increase in rainfall	0.42m
30% Increase in rainfall	0.6m
Increase in sea levels by 90cm	0.00m

3.7 Hydraulic Hazard

The hydraulic hazard associated with flooding has been mapped for the post development scenario in accordance with the NSW Floodplain Development Manual 2005, refer to figure 12 and 13 for the 1% AEP hazard and PMF hazard, and figures 14 and 15 for the 1% AEP hazard and PMF volcities

The flood model results show that in the 1% AEP flood, typically low hydraulic Hazard and flood velocity is expected in and around the development site, with isolated areas of medium to high hydraulic hazard and higher velocities experienced adjacent to buildings including the existing Susan Wakil Health Building, and the area approaching the Oval to the northeast. In the PMF the area to the east of the hospital building will experience high hydraulic hazard and higher flood velocities, however the proposed building floor level will be located above the PMF level and will provide a safe refuge during a PMF event.

Figure 13 – East Campus post-development 1% AEP Hydraulic Hazard

Figure 14 – East Campus post-development PMF Hydraulic Hazard

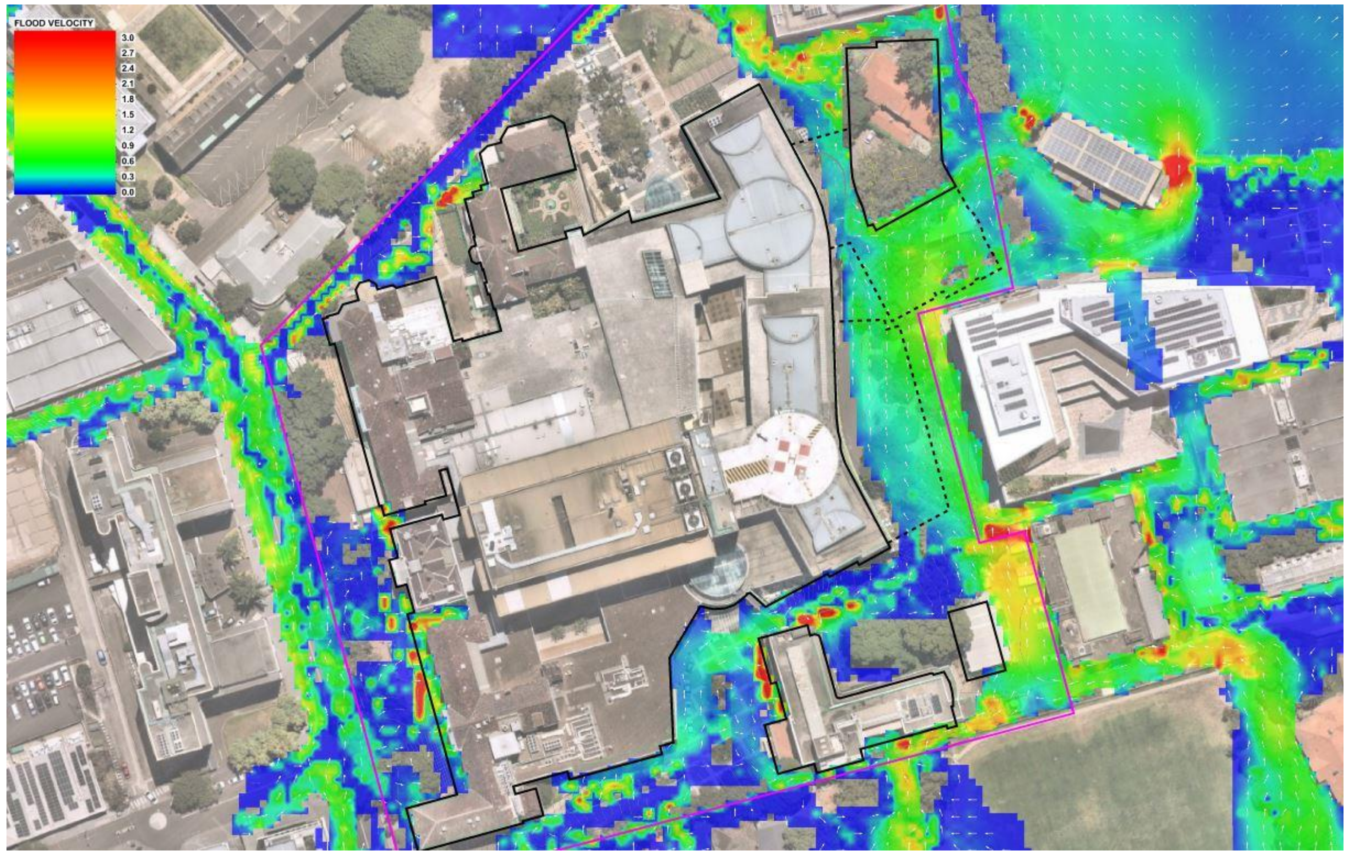

Figure 15 – East Campus post-development 1% AEP Flood Velocity

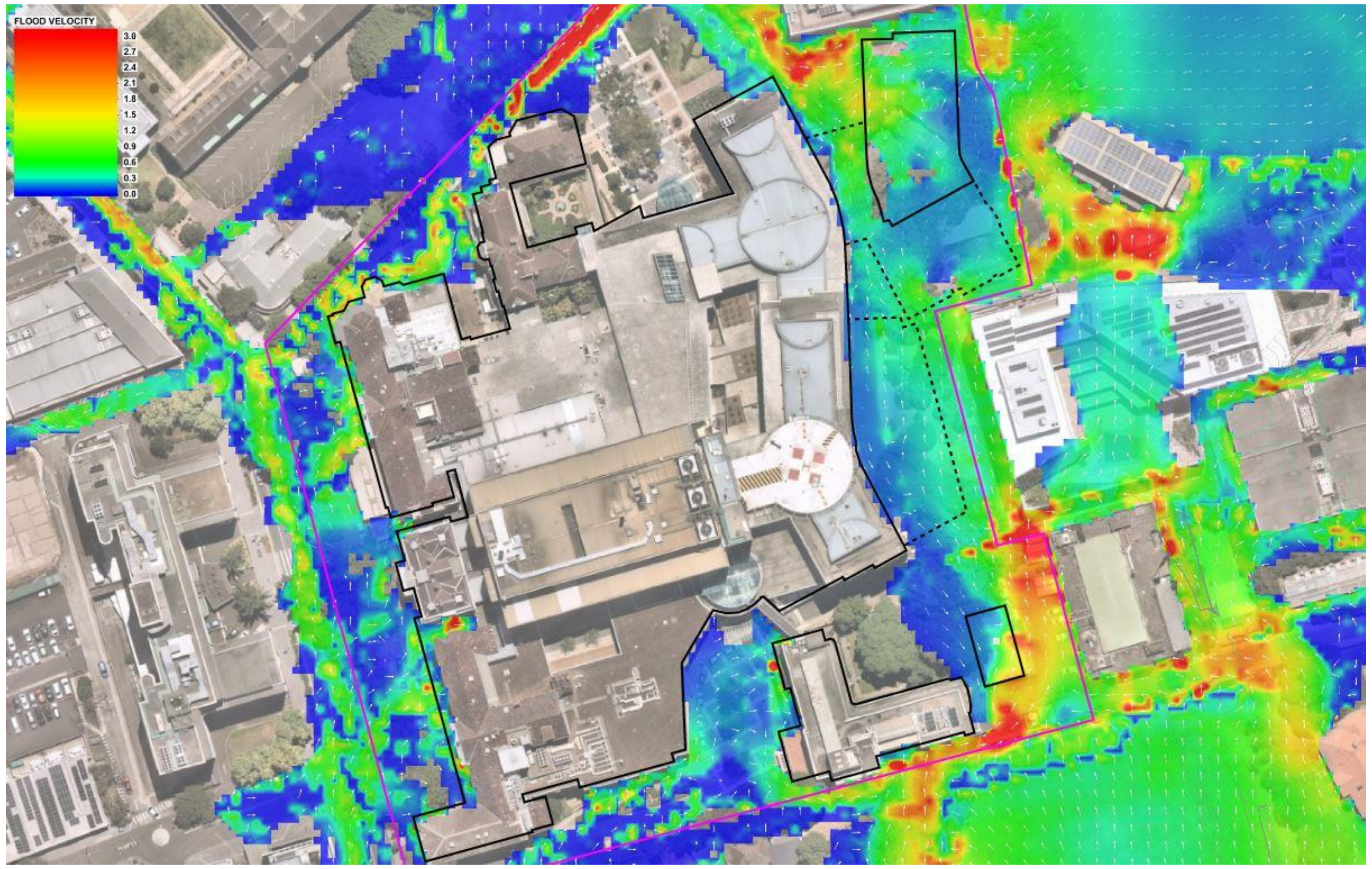

Figure 16 – East Campus post-development PMF Velocity

3.8 Emergency Management Plan

The below section is a preliminary flood emergency response plan to be incorporated into an overall Emergency Management Plan for the hospital.

Education

The awareness of flooding is a significant issue due to the infrequency of severe floods and the anticipated depths of flooding at the site location. During the occupation phase, as part of the preparation for a flood event, all staff and visitors on site will be made aware of the flood risk and the flood protocols & procedures (including their responsibilities) via briefing and signage. This will form part of the mandatory site inductions that all staff must undertake prior to gaining access to the site. A copy of a Flood Emergency Response Plan will be made available to all new staff, contractors, and site visitors. Completion of site induction and safety training is the responsibility of the Safety Manager.

Staff Responsibilities

In the event of a severe flood, various staff members will be responsible for specific tasks as detailed in the below table.

Table 1 – Staff flood responsibilities

Role	Location	Responsibilities
Sydney Local Health District (SLHD)	**N/A**	▪ Liaise with SES for temporary closure of hospital departments impacted by flooding. ▪ Assist with evacuation coordination for any personal on site.
Chief Warden	**Within Hospital**	▪ Inform Staff of flood risk ▪ Notify the NSW Ambulance Service of the temporary inability of the facility to receive or transfer patients ▪ Coordinate the cancellation of all non-essential operations/procedures should occur, with non-essential staff and visitors recommended to return home (if safe to do so). ▪ Coordinate flood evacuation drills as a backup. ▪ Decide if evacuation is required prior to warnings from SES. ▪ Liaise with SES.
Safety Manager / First Aid Officer	**Within Hospital**	▪ If on site coordinate assistance for any less able person during evacuation. ▪ Prepare a Flood Emergency Kit that includes a portable radio, torch, spare batteries, first aid materials, emergency contact numbers, candles, waterproof matches, waterproof bags and required medications. ▪ Ensure evacuation pack is taken to the assembly area.
Floor / Building Wardens	**Within Hospital**	▪ Coordinate evacuation of their designated floor/building and assist in evacuation of any personal who are on site.
Staff	**Within Hospital**	▪ If on site assist Floor/Building Wardens in evacuation of any personal on site.

Evacuation Drills

It is recommended that evacuation drills be held at a minimum of every 12 months to ensure all staff are aware of and familiar with their flood response actions, the sound of the alert and occupancy warning system, and the location of the assembly point.

Flood Emergency Kit

A Flood Emergency Kit must be available prior to a flood event taking place and regularly checked to ensure that supplies within the kit are sufficient and in working condition. This check should occur during each evacuation, and the kit should include as a minimum:

- Two-way radio with spare batteries
- Torch with spare batteries
- First aid kit and other medicines
- Waterproof bags
- A copy of the Emergency Management Plan
- Emergency contact numbers.

This Emergency Kit should be stored in a waterproof container and is the responsibility of the Hospital's Safety Manager/First Aid Officer during the occupation phase.

Flood Watches and Warnings

Severe weather and thunderstorm warnings are issued by the Bureau of Meteorology (BOM) www.bom.gov.au. These warnings are continually updated with a description of the likely conditions (including predicted extreme rainfall depth).

BOM issues flood alerts, advice, and watches for the Johnston Creek catchment through coordination with the SES, water agencies and local councils.

SES will use a Standard Emergency Warning Signal (SEWS) to precede all Top Priority Flood Warnings and all Evacuation Warnings. Once activated, Evacuation Orders are broadcast over the radio stations and through the SES.

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.

SES Evacuation Warning is a warning message from SES advising the community to prepare for likely evacuation. The warning advises people on what to do and what to prepare to take with them.

A Flood Evacuation Order is a notification to the community authorised by the SES when the intent of an Incident Controller is to instruct a community to immediately evacuate in response to an imminent threat. It also advises where people should go and may advise which evacuation route to take.

Coordination of Flood Evacuation Warnings and Orders

The overall coordination of the road evacuation routes will be conducted from the Evacuation Coordination Desk at the NSW SES. The NSW SES Controller will decide when to issue Evacuation Warnings and Evacuation Orders for specific Sectors.

The Incident Controller ("Evacuation Coordination Desk") will distribute these warnings to other NSW SES control centres; metropolitan media outlets for immediate broadcast; and the Joint Media Information Centre. The Incident Controller will also advise Police and the NSW Transport Management Centre to begin traffic management procedures on road evacuation routes.

The Incident Controller will distribute an evacuation warning through the following systems (when available) internet, fax, email, text message, and automatic telephone dialling with pre-recorded messages.

NSW Local Controllers will distribute Evacuation Warnings through Warden systems. Emergency service personnel uses public announcement systems in vehicles, and door knocking.

If there is sufficient notice of a potential evacuation, the SES Controller will discuss temporary closure of appropriate facilities with the Regional Director of the NSW Department of Health. Due to long lead time required for SES to mobilise the required resources, the SES Incident Controller will provide early notice to the hospital should the hospital need to be evacuated.

Public Address System

The hospital will have a Public Address (PA) system including a continuous bell that can alert any personal on site in the event of an emergency. The hospital will have an internal Evacuation Procedure, as part of the Hospital's Emergency Management Plan, that addresses the process for evacuation within the hospital grounds.

In the event of this emergency tone, personal will assemble at a designated assembly point. Regular emergency drills will be undertaken to ensure all personal are aware of the emergency procedures.

Emergency Contact Details

In the event of a severe flood, key contact details are included in the table below.

Table 2 – Flood emergency contact details

Internal Contacts	
Emergency Coordinator	**Phone Contact**
Head of Administration of SLHD	TBA
Chief Warden	TBA
Safety Manager / First Aid Officer	TBA
On Duty Floor / Building Wardens	TBA
External Contacts	
Service	**Phone Contact**
Police / Ambulance / Fire	000
State Emergency Services (SES)	132 500
Police – Glebe Station	(02) 9552 8099
Police – Newtown Station	(02) 9550 8199
Police – Redfern Station	(02) 8303 5199
External Hospital – St Vincent's Hospital	(02) 8382 1111
NSW Ministry of Health	(02) 9391 9000
Department of Health Freecall	1800 020 103

On-Site Refuge

Ground floor levels have been set in accordance with Council's Flood Planning Requirements as outlined in Section 3.4 of this report. Due to the quantity and vulnerability of the building occupants, a shelter in place strategy is considered appropriate during major flooding events. It is also noted that the site contains a commercial kitchen which can provide food and water during the evacuation to upper floors of the building.

Emergency Assembly Point

As the project is still in planning proposal phase, exact on-site refuge locations are yet to be determined. Preliminary architectural designs indicate that East Building Levels 2 and above will be suitable location for on site refuge as they will be situated above the PMF flood levels.

Coordination of Flood Warnings and Orders

During the occupation phase, the Administration Office will be responsible for monitoring information from the SES regarding flood events. Under the direction of the Incident Controller, the Head of Administration will decide when to issue Flood Response Warnings and Orders for the site. Incident Controllers are appointed by the NSW SES State Controller, who will also establish Incident Control Centres.

Flood Response Actions

WHEN A FLOOD WATCH IS ISSUED the following actions should be undertaken:

1. Ensure the emergency kit is ready to use.
2. Listen to the local radio station for updates on forecasted flood heights and timings.
3. Call SES for an update and possible evacuation advice.
4. Notify all staff and visitors of the flood watch and assist availability of staff to assist with emergency actions if required.
5. Non-essential staff and visitors recommended to return home (if safe to do so).
6. Ensure staff are familiar with the safe flood evacuation route

WHEN A FLOOD WARNING IS ISSUED the following actions should be undertaken:

1. Undertake the actions nominated under the "flood watch".
2. Liaise flood response procedures with SES ON 132500. For life-threatening emergencies phone 000 immediately
3. Notify the NSW Ambulance Service of the temporary inability of the facility to receive or transfer patients
4. Coordinate the cancellation of all non-essential operations/procedures
5. Direct All staff and visitors to the Assembly point within the hospital before the property is flooded.
6. Evacuate Staff and visitors (if safe to do so).

NOTE: Should there be staff or visitors isolated on site during a flood event, it is recommended that they move to Level 2 or above of the East Building which should be free of flood waters and contact emergency services.

NOTE: Avoid driving or walking through floodwaters. These are the main causes of death during flooding. Although the hospital ground may not be flooded, the safe travel arrangements for staff and visitors to go home is likely to be disrupted by flooding and/or road closures.

Limitations and Revision of the Flood Emergency Response Plan

Section 3.7 of this report only addresses the evacuation strategies during extreme flooding events for staff and visitors within the site and is considered a guide only. It does not cover individual safe travel arrangements to and from the site should travel arrangement be disrupted by flooding and/or road closures.

It is RPAH's responsibility to ensure the Emergency Management Plan is current and updated as necessary to be in line with relevant standards, directorate, legislation and the Regional's State Emergency Management Plan to ensure the health, safety and welfare of all staff and visitors.

3.9 Consultation with NSW State Emergency Services (SES)

Consultation with NSW SES was undertaken via a meeting held on the 30th of August 2022 which involved the SES along with key members of Health Infrastructure, Sydney Local Health District (SLHD) and TTW. Minutes and action items from the meeting have been provided in Appendix A of this report. Action items have been address in this report and provided to SES as requested to assist in their assessment of emergency response for the hospital.

4. Stormwater

4.1 SEARs

This section of the report directly addresses the below stormwater SEARs received from the Department of Planning and Environment. This reports only addresses the below in part (i.e. civil stormwater elements) and must be read in conjunction with the accompanying geotechnical, geo-environment and hydraulic submissions to address their respective elements.

13. Ground and Water Conditions • Assess potential impacts on soil resources and related infrastructure and riparian lands on and near the site, including soil erosion, salinity and acid sulfate soils. • Provide a Surface and Groundwater Impact Assessment that assesses potential impacts on: o surface water resources (quality and quantity) including related infrastructure, hydrology, dependent ecosystems, drainage lines, downstream assets and watercourses. o groundwater resources in accordance with the *Groundwater Guidelines*.	• Geotechnical Assessment • Surface and Groundwater Impact Assessment • Salinity Management Plan and/or Acid Sulfate Soils Management Plan

14. Water Management • Provide an Integrated Water Management Plan for the development that: o is prepared in consultation with the local council and any other relevant drainage or water authority. o outlines the water-related servicing infrastructure required by the development (informed by the anticipated annual and ultimate increase in servicing demand) and evaluates opportunities to reduce water demand (such as recycled water provision). o details the proposed drainage design (stormwater and wastewater) for the site including any on-site treatment, reuse and detention facilities, water quality management measures, and nominated discharge points. o demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse downstream impacts. • Where water and drainage infrastructure works are required that would be handed over to the local council, or other drainage or water authority, provide full hydraulic details and detailed plans and specification of proposed works that have been prepared in consultation with, and comply with the relevant standards of, the local council or other drainage or water authority.	• Water Management Plan

4.1 Sydney Water Infrastructure

Existing

The footprint of the East Extension clashes with existing Sydney Water stormwater assets:

- A DN900 and DN1050 pipe running along the eastern boundary of the RPAH constructed in the 1940s. Existing access chambers for this pipe appear to be positioned just over the site boundary which is located just outside the existing site boundary fence line; and
- A DN1200 and DN1050 pipe which passes beneath the proposed building. This pipe was constructed in the 1960s as an upgraded diversion pipe for the aforementioned DN900 pipe.

Proposed

An options assessment was undertaken in consultation with Sydney Water. The preferred solution is as outlined below. This option has been chosen as it separates the diversion works from the main building and allows for it to be constructed as part of the enabling works. It clears the existing and proposed building footprints of stormwater lines and eliminates the need for maintenance or replacement works for pipes under structures.

Preliminary consultation with Sydney Water has confirmed the existing stormwater will need to be diverted to meet the following criteria:

- Provide a minimum 1.0m clearance from existing and proposed building structures to reduce of risk of damage caused by construction activity or bearing pressures.
- Provide access to the stormwater assets for maintenance; and
- Ensure there is no loss of hydraulic performance in the system for all storm events up to the 1% AEP (ARR2019).

It is proposed to divert the stormwater around the proposed building location as shown **Figure 17**. A description of the diversion proposal is outlined as follows:

- Existing DN1200 and DN1050 that pass beneath the proposed building would be removed or made redundant as required
- A new DN1200 pipe diversion pipe would be constructed which runs along the southern and eastern envelope of the proposed building. A minimum of 1.0m horizontal clearance is to be provided between the outside face of pipe and outside face of pile
- Existing DN900 and DN 1050 pipe that run along the eastern site boundary will be removed for the extent shown and upgraded to the DN1200 pipe. Existing pipe connections will be modified to suit the larger pipe. A reducer will be placed at the downstream end of the DN1200 pipe to match into the existing DN1050 pipe
- The diversion pipe will be sized to DN1200 with 6m internal radius curved bends installed to reduce hydraulic pressure losses caused by the 90-degree changes in directions. A preliminary DRAINS model has been developed to show the diversion will not adversely impact the capacity of the existing network

A Feasibility Report was submitted to Sydney Water for the proposed diversion. This was submitted by the Water Services Coordinator as a single combined application with sewer and potable water. A Feasibility Letter was received from Sydney Water dated 23 August 2021 which confirmed 'no objection' to the proposed stormwater diversion. Considerations will need to be made for the extent of excavation and trenching to ensure it does not impact any existing structures, trees or underground utilities. Works will also be required outside hospital land and thus would be subject to consultation and approval from the University of Sydney. Preliminary consultation has been undertaken the University, and they are generally supportive of the proposed diversion works. Note that for all Sydney Water stormwater assets, a comprehensive survey and CCTV condition survey would be completed to verify the proposed design and the underwriting assumptions.

Refer to the following figures for further details.

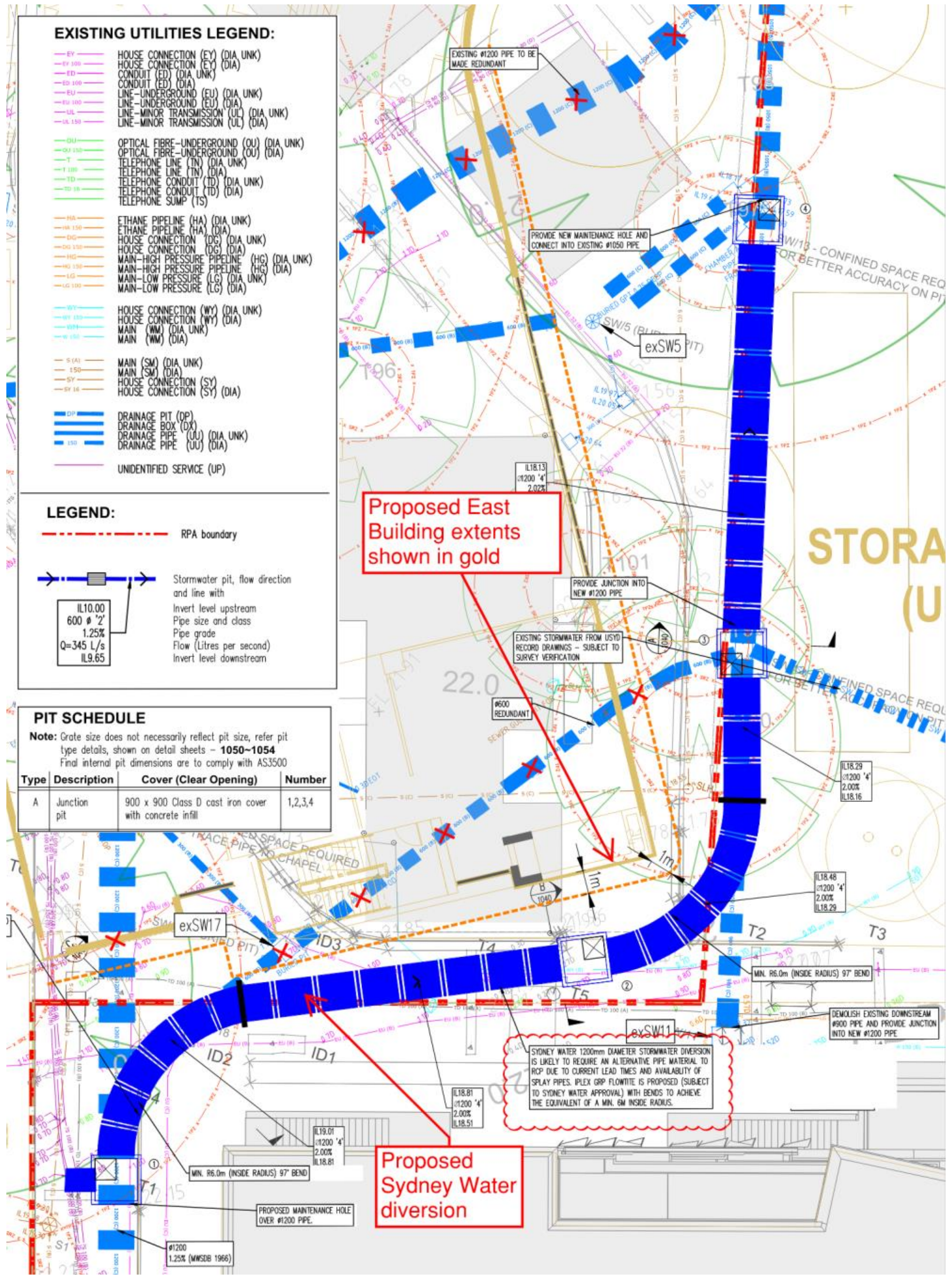

Figure 17 - Sydney Water stormwater asset diversion

4.2 Stormwater Quantity

The stormwater drainage management plan will satisfy the requirements of Councils DCP as well as to meet reduced drainage discharge requirements as outlined in the ESD strategy report. This includes a minor and major system. The minor system conveys flows up to the 5% AEP event below ground through a pit and pipe system. The major system conveys flows exceeding the 5% AEP event above ground through overland flow.

3.7.2 Drainage and stormwater management

(5) Drainage systems are to be designed so that:

(b) on a site with an area greater than 1,000sqm:

(i) stormwater flows up to the 5% annual exceedance probability event are conveyed by a minor drainage system; and

(ii) stormwater flows above the 5% annual exceedance probability event are conveyed by a major drainage system.

Figure 18 - Minor/Major event design criteria (Source: 3.7 Water and Flood Management – Council's DCP)

As the site is located within the City of Sydney LGA, OSD requirements are dictated by Sydney Water, as runoff drains to their assets. In correspondence dated to the 05/08/22, Sydney Water stated that OSD will be required for the East Campus and provided Site Storage Requirements (SSR) and Permissible Site Discharges (PSD).

To facilitate staging of the development, these OSD & Permissible Site Discharge (PSD) requirements have been determined separately for the East Building and East Extension. These requirements are as follows:

- East Building
  - PSD = 80 L/s
  - OSD = 48m^3
- East Extension
  - PSD = 41 L/s
  - OSD = 31m^3

Separate OSD tanks conforming to these requirements will be provided as part of each development. These will need to be positioned with a top water level and overflow above the 1% AEP flood levels identified in the updated flood modelling to ensure adequate head for them to function effectively.

There is also an additional DCP requirement for areas specially identified on Council's *Stormwater management map,* which includes RPAH:

3.7.2 Drainage and stormwater management

(4) Development on sites identified in the *Stormwater management map*, are to provide on-site stormwater detention within open space areas.

(12) Post-development stormwater volumes during an average rainfall year are to be:

(a) 70% of the volume if no measures were applied to reduce stormwater volume; or

(b) the equivalent volume generated if the site were 50% pervious, whichever results in the greater volume of detention required.

Figure 19 - OSD and stormwater runoff volumes (3.7 Water and Flood Management – Council's DCP)

Based on a high-level review of the catchment, it appears that the 50% pervious case (i.e. 12b) will govern. This presents a risk as primary options for reducing runoff volume are infiltration and reuse, both of which are unlikely to be acceptable on the hospital site. The inclusion of green roofs will deliver reductions, however additional re-use options and/or planning solutions will need to be reviewed as the stormwater design develops.

4.3 Stormwater Quality

A stormwater quality assessment is required in accordance with Council's DCP. To that end, a conceptual stormwater treatment train has been formulated and be modelled in MUSIC, using Council's MUSIC-LINK. This includes specific Water Sensitive Urban Design (WSUD) measures to meet the specified pollutant reduction targets:

3.7.3 Stormwater quality

(1) Development of a site greater than 1,000sqm must undertake a stormwater quality assessment to demonstrate that the development will achieve the post-development pollutant load standards indicated below:

(a) reduce the baseline annual pollutant load for litter and vegetation larger than 5mm by 90%;

(b) reduce the baseline annual pollutant load for total suspended solids by 85%;

(c) reduce the baseline annual pollutant load for total phosphorous by 65%; and

(d) reduce the baseline annual pollutant load for total nitrogen by 45%.

Figure 20 - Stormwater quality targets (3.6 Ecologically Sustainable Development – Council's DCP)

The above exceed reduction target B from Greenstar Emissions Credit 26.2. Greenstar requirements for this and Credit 26.1 (stormwater peak discharge), which is a pre-requisite for 26.2, are included within the HI ESD Framework.

To achieve the targets outlined in **Figure** 20, the following measures are proposed:

- OceanProtect OceanGuard pit inserts, or approved equivalents, are to be provided within the new kerb inlet pits proposed as part of the reconfigured Lambie Dew Drive
- OceanProtect Vortsentry, or approved equivalent, located prior to discharge to Sydney Water stormwater
- 16x OceanProtect Psorb cartridges, or approved equivalents, are to be provided as part of a dedicated water treatment chamber. This will treat flows from the proposed East Building, East Extension, and North Extension

The effectiveness of these measures is summarised in **Table 3** below:

Table 3 - MUSIC modelling results compared against Council's requirements

	GP	TSS	TP	TN
Target Reduction	90	85	65	45
Modelled Reduction	100	95	74.9	45.5

An excerpt from the MUSIC model is presented below as **Figure 21**:

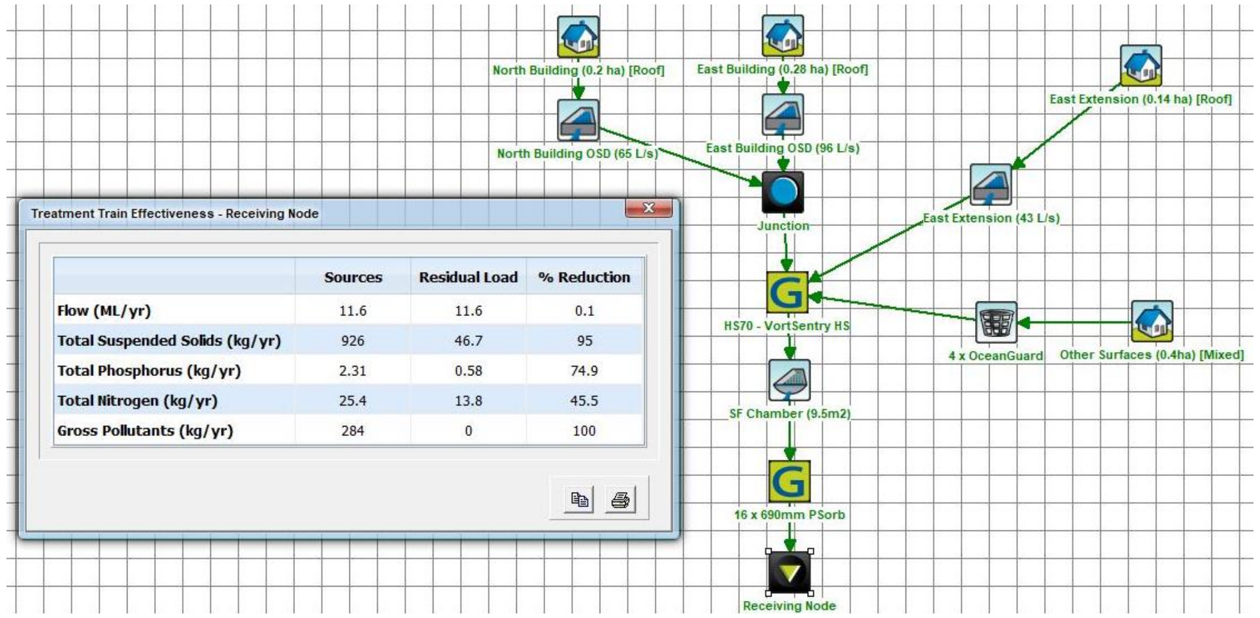

Figure 21 - Preliminary MUSIC model excerpt

4.4 Stormwater Reuse

Council's DCP generally requires all non-residential development to include rainwater collection and re-use. On previous HI hospital projects, the risk of cross-contamination has been raised and prevented the inclusion of rainwater re-use for the internal purposes such as toilet flushing. Where feasible, rainwater harvesting and reuse would be limited to landscape irrigation. Further opportunities for rainwater harvesting, conditioning and reuse to meet objectives outlined in the ESD strategy report will be reviewed as part of the design development.

3.6.2 Water efficiency in non-residential development

(2) Generally, rainwater tanks are to be installed for all non-residential developments, including major alterations and additions that have access to a roof form from which rainwater can be feasibly collected and plumbed to appropriate end uses.

(3) Where a non-residential building, the public domain, a public or private open space or a community facility is serviced by a dual reticulation system for permitted non-potable uses such as toilet flushing, irrigation, car washing, fire fighting and certain industrial purposes, the development is to be connected to the system.

(4) Generally, water used for irrigation of public and private open space is to be drawn from reclaimed water or harvested rainwater sources. Possible sources include harvested stormwater, treated greywater and wastewater and water from a decentralised local network.

3.7.5 Water re-use, recycling and harvesting

(1) Development proposals that seek to re-use water runoff from paved surfaces for irrigation and wash down purposes are to incorporate measures into the design of the development that will treat the water to ensure that it is fit for this purpose. These measures are to clean the water to exclude contaminants such as litter, sediment and oil.

Figure 22 - Stormwater Reuse extracts (3.6 Ecologically Sustainable Development and 3.7 Water and Flood Management – Council's DCP)

4.5 Stormwater Quality During Construction

During the construction stage of the project, an erosion and sediment control plan will be implemented to prevent sediment laden stormwater from flowing into adjoining properties, bushland, roadways or receiving water bodies. Stormwater controls onsite are detailed in an Erosion and Sediment Control Plan which is in accordance with relevant regulatory authority guidelines including Northern Beaches Council's Development Control Plan and Landcom NSW's Managing Urban Stormwater, Soils and Construction ("Blue Book"). Refer to the Civil Engineering drawings in Appendix A.

Prepared by	Authorised By
TAYLOR THOMSON WHITTING (NSW) PTY LTD	**TAYLOR THOMSON WHITTING (NSW) PTY LTD**
DUNCAN MARSHALL	**TIM MOORE**
Associate	Associate Director

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Appendix A

Meeting Minutes from SES Consultation, dated 30 August 2022

RPA Hospital Redevelopment
Minutes & Action List

Meeting:	**SES Consultation**	**Meeting No.:**	**1**
Date/Time:	30 August 2022	**Time:**	**9:00am – 9:45am**
Virtual	Microsoft Teams		

Member	Role	Organisation	Attendance
Elspeth O'Shannessy	Planning Coordinator – Emergency Risk Management	SES	Present
Peter Cinque	Senior Manager – Emergency Risk Management	SES	Present
Sharon Ladeira	Program Support Officer - Emergency Risk Management	SES	Present
Claire Muir	Town Planning	HI	Present
Michael Smytheman	Project Director	HI	Present
Prue Tarmizi	Communications & Engagement	HI	Present
Kristina Zarkos	Redevelopment Manager, SLHD Project Lead	SLHD	Present
Jon Gowdy	Executive Director Capital Infrastructure Engineering	SLHD	Present
Tim Moore	Associate Director (Civil)	TTW	
Greg Barlow	Project Lead	TSA	Present
Danielle Gardner	Senior Project Manager	TSA	Present
Paige Webley	Assistant Project Manager	TSA	Present
Imogen Ruberg	Graduate	TSA	Present

AGENDA ITEMS

Item	Topic	Responsibility
1	**Introductions**	**GB**
2	**Project Overview**	**GB**
2.2	GB presented overview of the RPHA redevelopment	
3	**Project Overview**	**TM**
3.1	TM presented flood modelling and mitigation strategy, focusing on the East Tower and Lambie Dew Drive realignment	
4	**Comments and Discussion**	
4.1	Flood durations • SES – Question on what sort of flood durations are considered in the model? • TM – Mostly shorter duration of around 90 minutes • **Action – TM to provide further detail on flood durations**	
4.2	Critical storm durations and warning times • SES – Question on what the critical storm durations and warning times used in models? • TM – Minutes to hours • **Action – TM to provide further detail from report of critical storm durations and warning times**	
4.3	Flow path velocities • SES – Question on what are the velocities are of flow paths particularly alongside buildings? • TM – Can provide further detail, but notes the area is relatively flat so doesn’t expect flow path velocities to be significant or worse than the existing. • **Action – TM to provide further detail on flow path velocities**	

Item	Topic	Responsibility
4.4	Pedestrian access through building to none flood areas • SES – asked for confirmation on the pedestrian access paths through the building and through bridges to none flood areas • TM – Level 2 is above the PMF with the L03 bridge another level above. Pedestrian access to the East Tower is through the existing hospital building with access to Missenden Rd, which is above the flood area. • SM – There isn't direct pedestrian access to the East Tower from ground level, rather access will be through connections to the existing building from Level 3 and up and existing entrances which will get upgraded	
4.5	Car parking • SES – Question on car parking in the redevelopment? • TM – no significant hospital car parking on the East Campus • SM – there is significant car parking on the west campus as will as privately operated car parking	
4.6	SBA and Gloucester House impacts • SES – Question of any impacts around SBA and Gloucester House • TM – Notes the existing SBA building will be demolished and redeveloped but it isn't part of the RPAH redevelopment • SM – Gloucester House will have ground level access and a bridge connecting to main hospital. Notes that it will be maintained during RPAH redevelopment and then potentially taken on by the SBA project • GB – Noted that the Gloucester House bridge will be raised during early works, which will allow larger vehicles access along Lambie Dew Drive	
4.7	Further information to help assess risk • JG – If possible, it would be useful to have a 3D model that shows the rising water levels between buildings. • JG – Asked if there is a 1 in 500 event flood model? • TM – question about consultation levels expected with SES and any key SES approvals? Noted that the key focus of the strategy will be to meet the CoS ECP requirements for the new redevelopment. Noted that the existing hospital is more susceptible to flood impacts. • **Action – TM to look into a 3D model showing rising water levels between buildings** • **Action – TM to look into a 1 in 500 yr flood model**	

Item	Topic	Responsibility
5	**Meeting Close**	**GB**
	• Minutes of meeting and presentation to be distributed • Further information to be provided in relation to key SES queries including flood durations, critical storm duration and warning times, flow path velocities, and 1 in 500 yr model and 3D view if possible	

ACTION LIST

	Action	Owner	Due Date	Status	Comments
1.	Provide further detail on flood durations	TM			
2.	Provide further detail from report of critical storm durations and warning times	TM			
3.	Provide further detail on flow path velocities	TM			
4.	Look into option of a 3D model showing rising water levels between buildings	TM			
5.	Look into option of a 1 in 500 yr flood model	TM			