Flooding SSD Report

Children's Medical Research Institute (CMRI) – Gene Technologies Building (GTB)

Prepared for Children's Medical Research Institute (CMRI) / 6 May 2026

212012

TTW (NSW) Pty Ltd (ACN 113 578 377)
as trustee for the Taylor Thomson Whitting NSW Trust
(ABN 59 514 956 558) I Consulting Engineers
Level 6, 73 Miller Street, North Sydney NSW 2050

Contents

Rev	Date	Prepared by	Approved by	Remarks
A	17/05/2024	RC/MK	JM	Draft SSDA Submission
B	20/06/2024	RC/MK	JM	Final SSDA Submission
C	12/12/2024	RC/JM	JM	Updated SSDA Submission
D	14/01/2025	RC/JM	JM	Updated SSDA Submission
E	02/09/2025	RC/MK	TM	Updated SSDA Submission - SIP
F	14/04/2026	RC/MK	MK	Draft for Client Comment
G	06/05/2026	RC/MK	TM	Updated to include assessment using Parramatta River Flood Study model

1.0 Introduction

This report addresses the SEARS flooding requirements in relation to the proposed Children's Medical Research Institute (CMRI) - Gene Technologies Building (GTB) development. The relevant requirements of City of Parramatta's Development Control Plan (DCP) and engineering specifications are also referenced.

CPHR Response to Submission

This Revision G report has been updated (i.e. from the previous Revision E report) to address the request from Conservation Programs, Heritage and Regulation (CPHR) Group raised during the Public Exhibition period – in particular, additional flood modelling and assessment has been carried out for the GTB development using the Parramatta River Flood Study TUFLOW model currently adopted by Council.

The State Significant Development Application (SSD-45576956) was lodged on 28th March 2025 and was placed on Public Exhibition for 28 days between 7th May 2025 and 3rd June 2025.

At the conclusion of this exhibition period, DPHI issued a letter that requested response to the issues raised during the Public Exhibition. In their submission, the Conservation Programs, Heritage and Regulation (CPHR) Group in the NSW Department of Climate Change, Energy, the Environment and Water has stated that 'the flood information provided is superseded by the Parramatta River Flood Study (PRFS)' and 'the PRFS and flood modelling from this study must be included in a revised Flood Report" (refer Figure 1).

> CPHR has reviewed the EIS and relevant supporting technical reports and provides its comments and recommendations at Attachment A. In summary:
>
> - the flood information provided is superseded by the Parramatta River Flood Study (PRFS) (Stantec, 2024)
> - the PRFS and flood modelling from this study must be included in a revised Flood Report
> - the proponent must confirm whether the proposed development would be categorised as a sensitive land use and require additional flood mitigation
> - if a sensitive land use is confirmed, consultation with the NSW State Emergency Service is required
> - the project description provided in the EIS is consistent with the Biodiversity Development Assessment Report waiver for this SSD that was granted on 23 September 2024.

Figure 1 - Comments provided within the CPHR Response to Submission (dated 17th June 2025)

The TUFLOW model and associated data produced for the Children's Hospital Westmead (CHW) Kids Park Flood Impact Assessment (Arup, 2023) were provided to TTW as part of the GTB assessment and adopted as the baseline model. The 2023 model was the most up-to-date and accurate depiction of the surrounding area at the time of assessment.

The model was originally developed for the 2021 assessment of the CHW Paediatric Services Building and contained information on works completed for the adjacent Central Acute Services Building (CASB), alongside incorporating the latest information on the Paramatta Light Rail (PLR). The input information for the 2023 model, as described in Section 4.1 of the Arup report, is presented in Figure 2. The use of fine-resolution survey data surrounding the site ensures the assessment reflects actual flood behaviour.

4.1 Input Information for Model

The 1D/2D TUFLOW flood model was built using information collated from various sources including works previously undertaken in the Westmead Health Precinct, adjacent works (by others) and recent information. Having collated and assessed all of the information available, where multiple sources exist, the information which was considered to be of the highest level of accuracy / reliability was used in constructing the model. The input information for the model is as follows:

- City of Parramatta Council flood map (dated 11/05/2016) and Parramatta River MIKE11 model;
- CASB flood report and model (by Arup; ref: CASB-ARP-CV-RT-0004; dated 22 June 2016);
- PLR Hawkesbury Road works flood model, survey, as-built and other relevant design documentation (dated 2019);
- PLR North Parramatta TUFLOW model
- LTS survey of CHW (ref: 32572 088DT; rev: L; Dated 26/05/2021); and
- Online Pipe CCTV of existing stormwater assets at CHW and Redbank Road (Dated January 2021).

In January 2023, the model was updated with the following information:

1. Updated survey within the Kids Park/Forecourt area (Crux survey reference “123589-SU-DT” dated 15/12/2022), including additional mark-ups received 11/01/2023.
2. Recently reconstructed Hawkesbury Road pedestrian crossing (Crux survey reference “123589-SU-DT” dated 15/12/2022).
3. Recently constructed Set down area road works at the Children’s Hospital entryway (works as executed survey by Ford Civil reference “221017_2” dated 17/10/2022).
4. Recently constructed Set down area stormwater works at the Children’s Hospital entryway (design stormwater management plan by Enspire reference “190078-08-C05.01” revision 5 dated 31/01/2022).

Figure 2 - Input information for the Arup 2023 TUFLOW model, used as the baseline model in TTW's assessment

TTW prepared a letter providing justification of the baseline CHW TUFLOW model used in TTW’s initial flood assessment (dated 2 October 2025). CPHR issued a response (dated 8 December 2025) confirming that additional flood modelling works should be carried out as part of the submission that are based on the new 2024 Parramatta River Flood Study.

Section 5.0 and Section 6.0 of this FIRA details the additional flood modelling works that have been completed as part of this assessment and the subsequent flood behaviour at the site when using the PRFS 2024 model as a baseline.

1.1 Existing Site

The site (known as Lot 101 DP 1119583) is located on the corner of Hawkesbury Road and Research Lane, Westmead, which is within the Parramatta Local Government Area (LGA). The site is currently developed with the eastern corner of the site comprising of the Ainsworth Tower which was constructed as Stage 1 of the CMRI upgrade works. This structure will be retained alongside the proposed Stage 2 works described in this report. The site is bounded by Hawkesbury Road to the south-east, the Westmead Institute for Medical Research (WIMR) building to the south-west, the Kids Research Building to the north-west and Kids Park to the north-east. Figure 3 shows the site location and its surrounding areas.

Figure 3 - CMRI GTB Site Locality

1.2 Proposed Works

The proposed design includes the staged construction of a multi-storey medical research building including car park, landscaping and associated infrastructure, Children's Medical Research Institute, located at Lot 101 DP 1119583, Hawkesbury Road, Westmead.

The proposed Civil Works as part of this SSDA (State Significant Development application) comprise:

- Site preparation works including demolition, bulk excavation and removal of existing structures on the site, tree and vegetation clearing and bulk earthworks;
- New stormwater collection and treatment;
- New pavements;
- Landscaping;
- Coordination with existing services; and
- Compliance with Development Control Plan (DCP) requirements.

The architectural departmental plan for the GTB site, prepared by Hassell Architectural Consultants for this project are attached in Appendix A. Refer to TTW's SSDA Civil Engineering Report Revision B (Appendix B) for TTW's civil design drawings that this flood assessment has been based upon.

1.3 SEARS Requirements

The development falls under a State Significant Development (SSD) application. The flooding related requirements for hospitals, medical centres and health research facilities specified as part of the Industry Specific Planning Secretary's Environmental Assessment Requirements (SEARS) are included in Table 1 below. These are addressed in the subsequent sections of this report to support the SSD submission.

Table 1 - Industry Specific (Hospitals) SEARS

SEARS Item	Requirements	Section Reference (this report)
14 - 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.	Previous flood studies discussed in Section 2.2. Current assessment discussed in Section 4.2-4.4. Potential effects of climate change discussed in Section 4.5.
	Where the development could alter flood behaviour, affect flood risk to the existing community or expose its users to flood risk, provide a flood impact and risk assessment (FIRA) prepared in accordance with the Flood Impact and Risk Assessment – Flood Risk Management Guide LU01.	Impacts of the development discussed in Section 4.5.
	Detail design solutions and operational procedures to mitigate flood risk where required.	Current assessment discussed in Section 4.2-4.4. Potential effects of climate change discussed in Section 4.5. Flood planning and development controls discussed in Section 5.3.

This report provides an assessment of flood conditions at the site in accordance with the requirements of the Secretary's Environmental Assessment Requirements (SEARs) and summarises the flood modelling results for both the existing and proposed site conditions in the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events. A flood impact assessment has also been undertaken to investigate the potential flood impacts of the proposed development, on neighbouring properties.

1.4 Guidance Documents

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

- City of Parramatta (CoP) Development Control Plan (DCP) 2023;
- Parramatta Local Environmental Plan (LEP) 2023;
- Upper Parramatta River Catchment Floodplain Risk Management Study and Plan (Bewsher, 2003);
- Parramatta Light Rail Flooding Technical Paper (Arup, 2017);
- Parramatta Light Rail Stage 1 Infrastructure – Flood Assessment Report (WSPAJV, 2019);
- Children's Hospital Westmead (CHW) Paediatric Services Building (PSB) Flood Impact Assessment (Arup, Rev 01, February 2021);
- Children's Hospital Westmead (CHW) Kids Park Flood Impact Assessment (Arup, Rev 02, March 2023);
- Shelter-in-place guideline for flash flooding, NSW Department of Planning and Environment, January 2025;
- Flood Risk Management Manual, NSW Department of Planning and Environment, 2023; and
- Australian Rainfall and Runoff 2019.

1.5 Objectives and Methodology

The objective of this report is to assess the site's local flooding conditions in accordance with the *Flood Risk Management Manual (2023)* and address the flooding requirements of the SEARs with regards to the proposed redevelopment. This assessment involved the following methodology:

- Obtain available flood information relative to the site from the City of Parramatta Council.
- Obtain the hydraulic model (TUFLOW) previously established by Arup as part of the Kids Park flood impact assessment and determine the site existing flood characteristics for the 1% AEP and PMF events.
- Incorporate the proposed design into the base case TUFLOW model and assess the site flood characteristics in the proposed site conditions for the 1% AEP and PMF events.
- Prepare relevant flood maps including flood extents, depths, levels, velocities, hazards and impacts.
- Comment on flood characteristics and model outcomes for the existing and proposed site conditions in accordance with the flooding requirements of the SEARs.

2.0 Existing Flood Information

TTW note that there are two identified flood mechanisms relevant to the CMRI Stage 2 redevelopment as follows:

- Mainstream flooding from Toongabbie Creek/Parramatta River.
- Localised overland flow.

2.1 Council Flood Enquiry

A Flood Enquiry application was submitted in April 2022 to acquire flood drainage investigation information from the City of Parramatta Council (Refer to Appendix AB). It was found that the site does not fall within the flood inundation area, based on the Upper Parramatta River Flood Study, as shown in Figure 4 and is not affected by the Parramatta River or Toongabbie Creek flood extents during all flood events up to and including the PMF.

It should, however, be noted that the Upper Parramatta River Flood Study was published in 2003 and is therefore outdated and does not conform to current flood study guidelines, particularly in terms of hydraulic modelling. Additionally, the investigation noted that the site is subject to detailed investigation to determine if the property is likely to be affected by overland stormwater run-off from the local catchment. Therefore, a site-specific flood assessment was undertaken to determine the site flood conditions with relation to the local catchment.

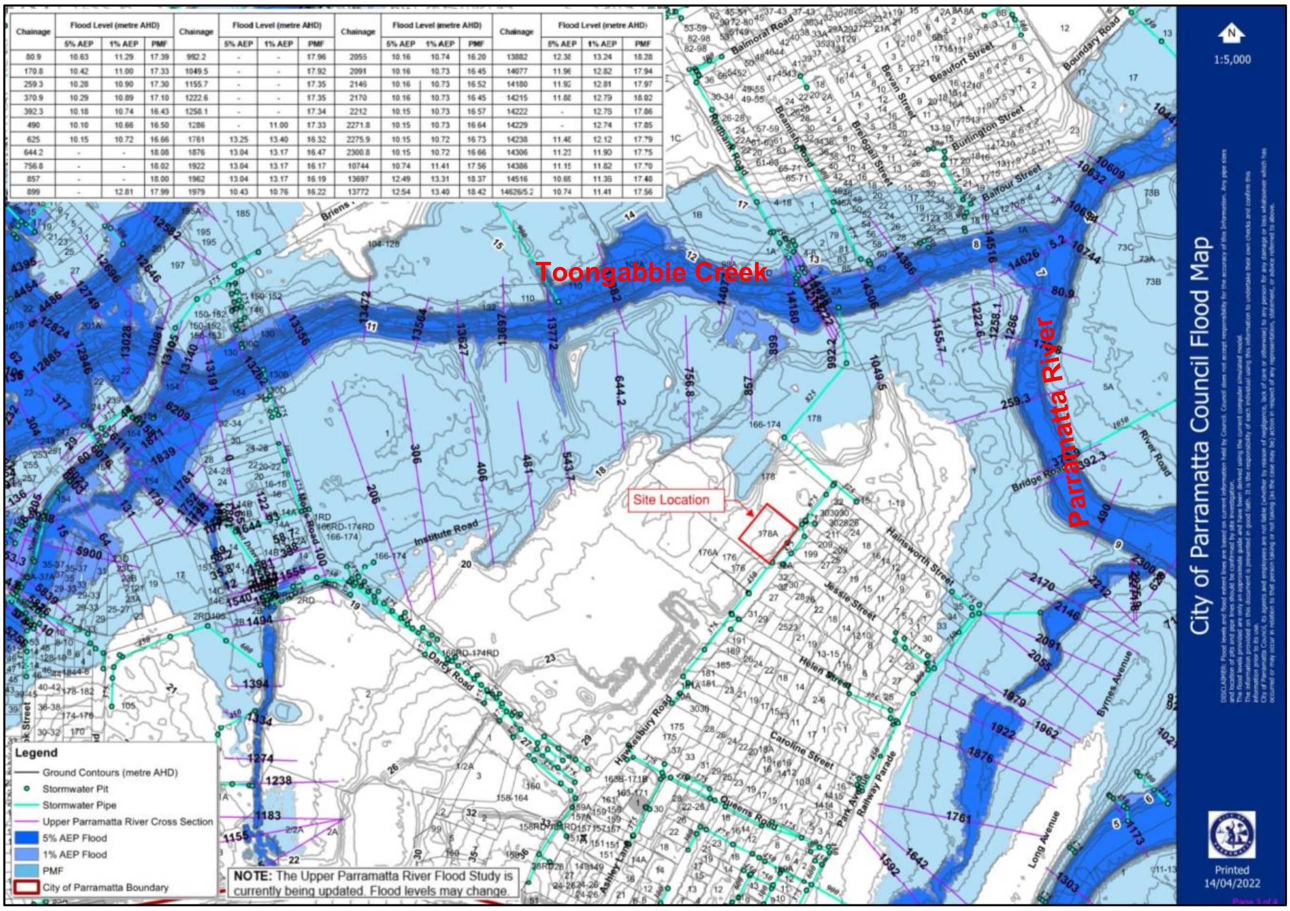

Figure 4 - Flood map provided by Council (based on Upper Parramatta River Catchment Floodplain Risk Management Study and Plan, Bewsher, 2003)

2.2 Previous Flood Studies

Parramatta is a low-lying catchment area fed by 39 tributary creeks, any of which can cause flooding. Flood information in the City of Parramatta LGA has primarily been developed through a number of flood studies throughout the 2000s.

2.2.1 Parramatta Flood Study Reports

As aforementioned, the *Upper Parramatta River Catchment Floodplain Risk Management Study and Plan* is the original Flood Study (Bewsher, 2003) adopted by the City of Parramatta Council relative to the site. It was completed using River MIKE 11 software which is a one-dimensional model.

Due to changes in the catchment and advances in modelling software, Council commissioned Stantec to produce a Flood Study in 2023 to assist in floodplain management, development control and emergency management. The study models mainstream flooding from rivers and creeks and includes overland flooding from stormwater drains and the local overland catchment. This was the most significant update to the City's flood data in 20 years. Updated flood maps from this draft study were released on 18th September 2023. A comparison of the currently adopted 1% AEP event flood extent (derived from the 2003 Flood Study) and the draft 2023 flood extent is presented in Figure 5 and Figure 6 respectively. PMF extents for the current and draft study are presented in Figure 7 and Figure 8, respectively. It should be noted that these flood maps are taken from Council's interactive flood mapping service and that the 2023 results were still in draft form at the time of preparation of this report. Therefore, this information is consequently subject to change without notice.

Results indicate that Bewsher's 2003 flood study found that the site was unaffected by mainstream flooding but did not capture the vulnerability of the site to overland flooding. By contrast, the draft 2023 study found that the site is affected by overland flooding in both the 1% AEP and PMF events.

Figure 5 - Location of site (outlined in red) in relation to the current 1% AEP flood extents for the City of Parramatta LGA (Adapted from City of Parramatta Council, 2024).

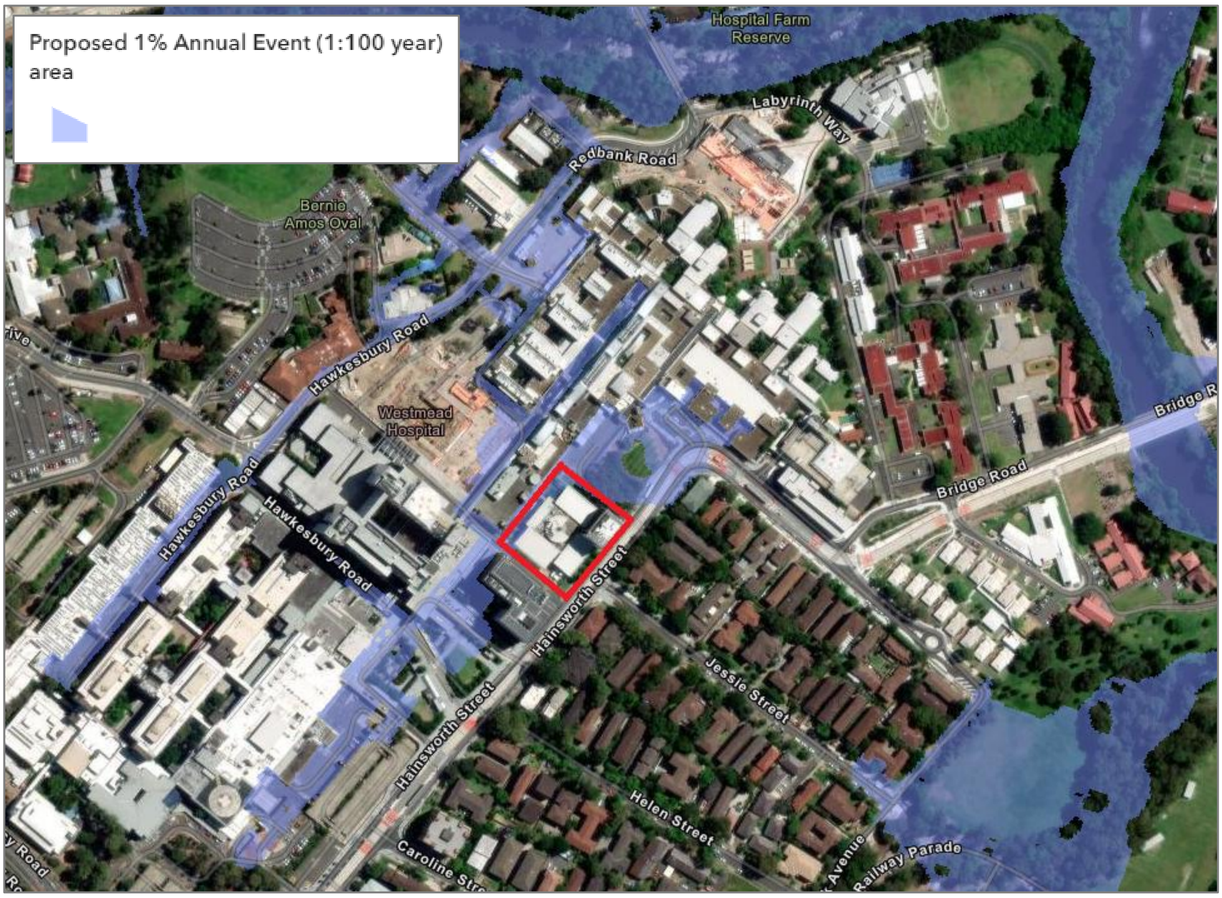

Figure 6 - Location of site (outlined in red) in relation to the proposed (draft) 1% AEP flood extents for the City of Parramatta LGA (Adapted from City of Parramatta Council, 2024).

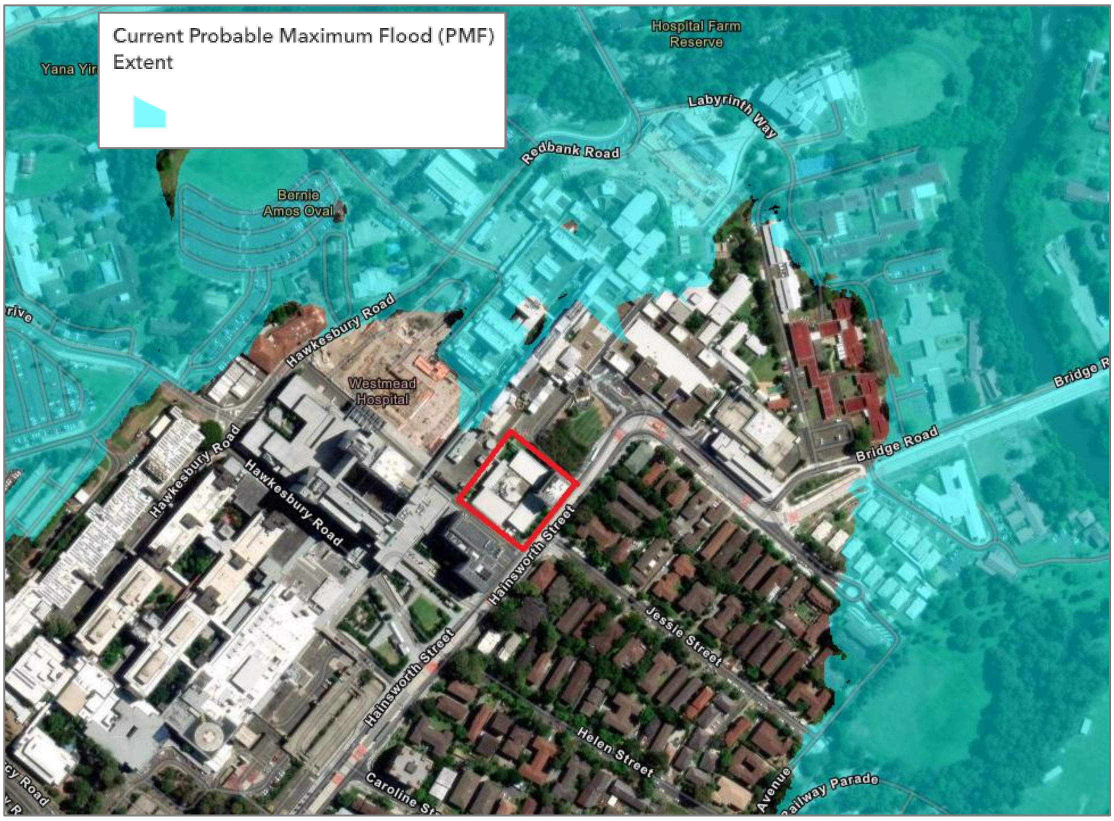

Figure 7 - Location of site (outlined in red) in relation to the current PMF extents for the City of Parramatta LGA (Adapted from City of Parramatta Council, 2024).

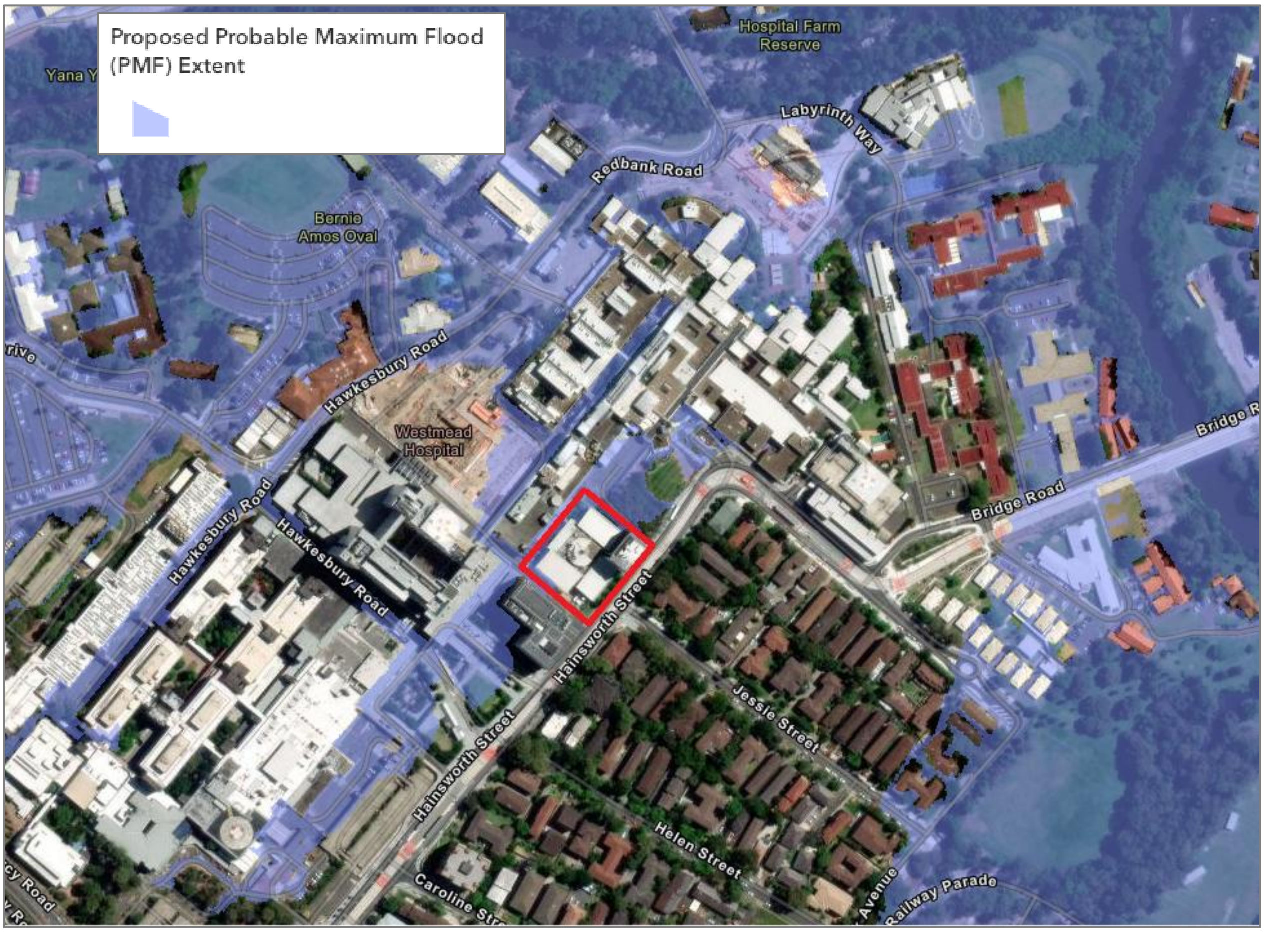

Figure 8 - Location of site (outlined in red) in relation to the proposed (draft) PMF extents for the City of Parramatta LGA (Adapted from City of Parramatta Council, 2024).

2.2.2 Parramatta Light Rail - Flooding Technical Paper (Arup, 2017)

Arup prepared a flooding study for Parramatta Light Rail – Stage 1 project (PLR) as part of the Environmental Impact Statement (EIS) for the light rail project. The study was carried out in response to the Secretary's Environmental Assessment Requirements (SEARs) to identify and assess the hydrology and flooding impacts of the project during both construction and operation.

Arup established five 1D/2D TUFLOW GPU models to identify overland flow behaviour within the catchment. The model was based on the Upper Parramatta River Catchment flood study previously completed by Bewsher (2003). The five models are identified as detailed below and shown in Figure 9:

- Westmead – Westmead terminus to Bridge Street bridge over Parramatta River, Cumberland Hospital
- North Parramatta Bridge Street bridge over Parramatta River, Cumberland Hospital to Lennox Bridge
- Parramatta CBD – Lennox Bridge to Parramatta River under bridge, Camellia
- Camellia - Parramatta River under bridge to Silver Water Road over Parramatta River
- Carlingford – Carlingford terminus to Rydalmere Street (Vineyard Creek outlet) Parramatta River

The temporal patterns adopted for the PLR project for events up to the 1% AEP are as per the Zone 1 patterns outlined in AR&R87. The design temporal distribution specified in the Generalised Short Duration Method (GSDM) procedure was utilised for determining PMP temporal rainfall distribution.

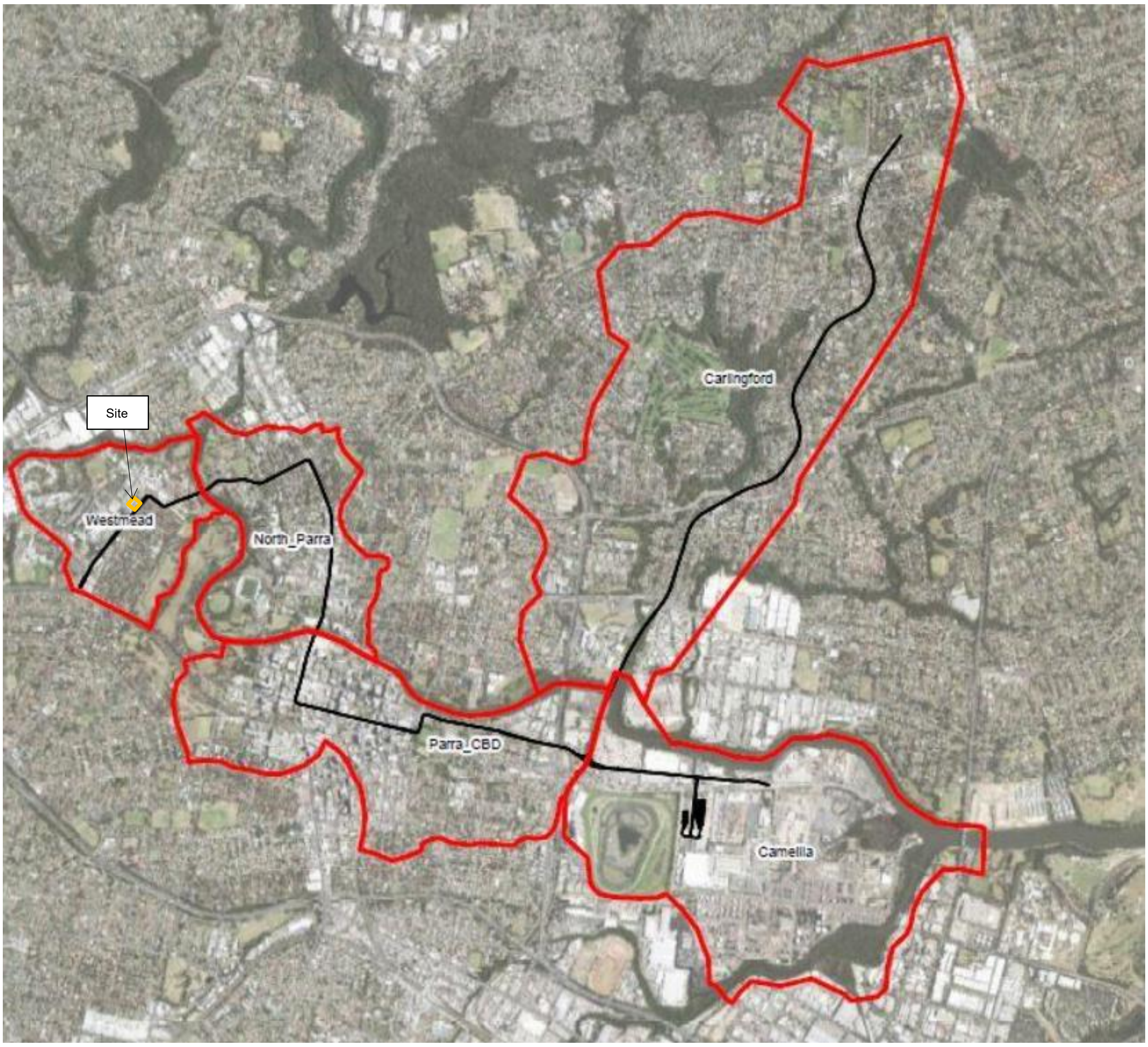

Figure 9 - Catchment Boundaries (Source: Flooding Technical Paper – Parramatta Light Rail, Arup 2017)

2.2.3 PLR Stage 1 Infrastructure – Flood Assessment Report (WSPAJV, 2019)

The WSP, Aurecon, Parramatta Light Rail (PLR) Joint Venture (WSPAJV) completed a flood assessment for the Parramatta Light Rail – Stage 1 to assess the impacts of flooding on the project. The hydraulic 1D/2D TUFLOW model originally prepared by Arup (2017), during the EIS assessment, was used as the basis of this study. Figure 10 shows the catchment boundaries adopted in the modelling carried out as part of this study.

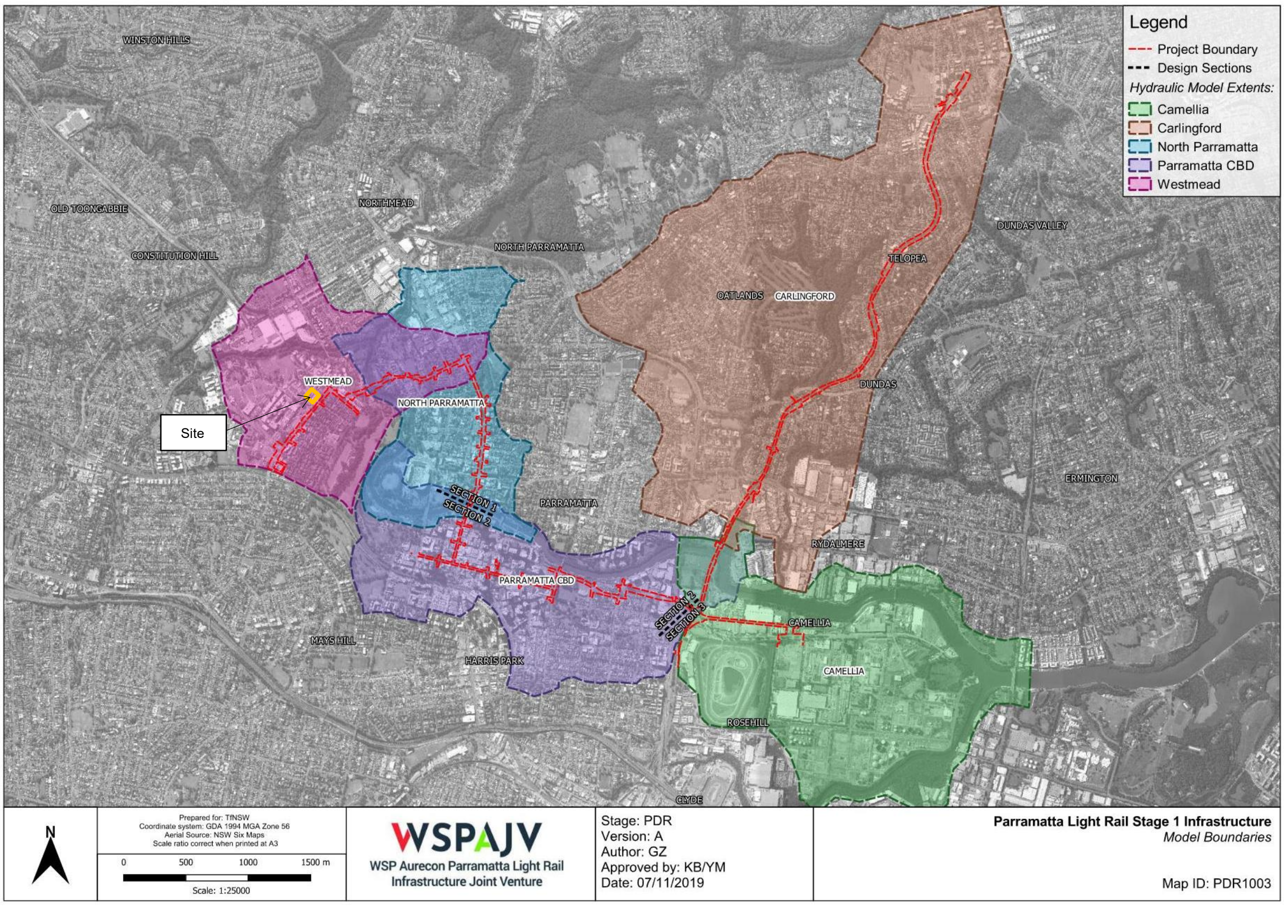

Figure 10 - Catchment Boundaries (Source: Parramatta Light Rail Stage 1– Parramatta Light Rail Stage 1 Flood Assessment Report WSPAJV, 2019)

As with the draft 2023 Flood Study, the PLR Stage 1 Infrastructure – Flood Assessment Report (WSPAJV, 2019) found that the CMRI site is affected by localised overland flooding.

The PLR Stage 1 Infrastructure – Flood Assessment Report shows peak flood depths across the CMRI Stage 2 site. The estimated peak flood depth for the 5% AEP, 1% AEP and PMF are shown in Figure 11, Figure 12 and Figure 13 respectively.

These maps show localised flooding to a maximum depth of 500mm in the 1% AEP and more extensive flooding to depths greater than 500mm in the PMF. The depth bands used make it difficult to determine exact flood levels, but these are estimated to be a maximum of about 21.5m in the 1% AEP and 21.8m in the PMF. These are generally consistent with the previous Arup study (2017) which is to be expected.

The PLR works are shown to have minimal impact on flood levels in the 1% AEP and PMF events. Figure 14 shows the peak flood afflux for the 1% AEP event which indicates developed flood levels will be within +/- 10mm of existing levels. Figure 15 shows the peak flood afflux for the PMF event which indicates flood levels will decrease between 30-100mm within the area north of the GTB site (i.e. area west of Kids Park) and increase up to 30mm in the forecourt area.

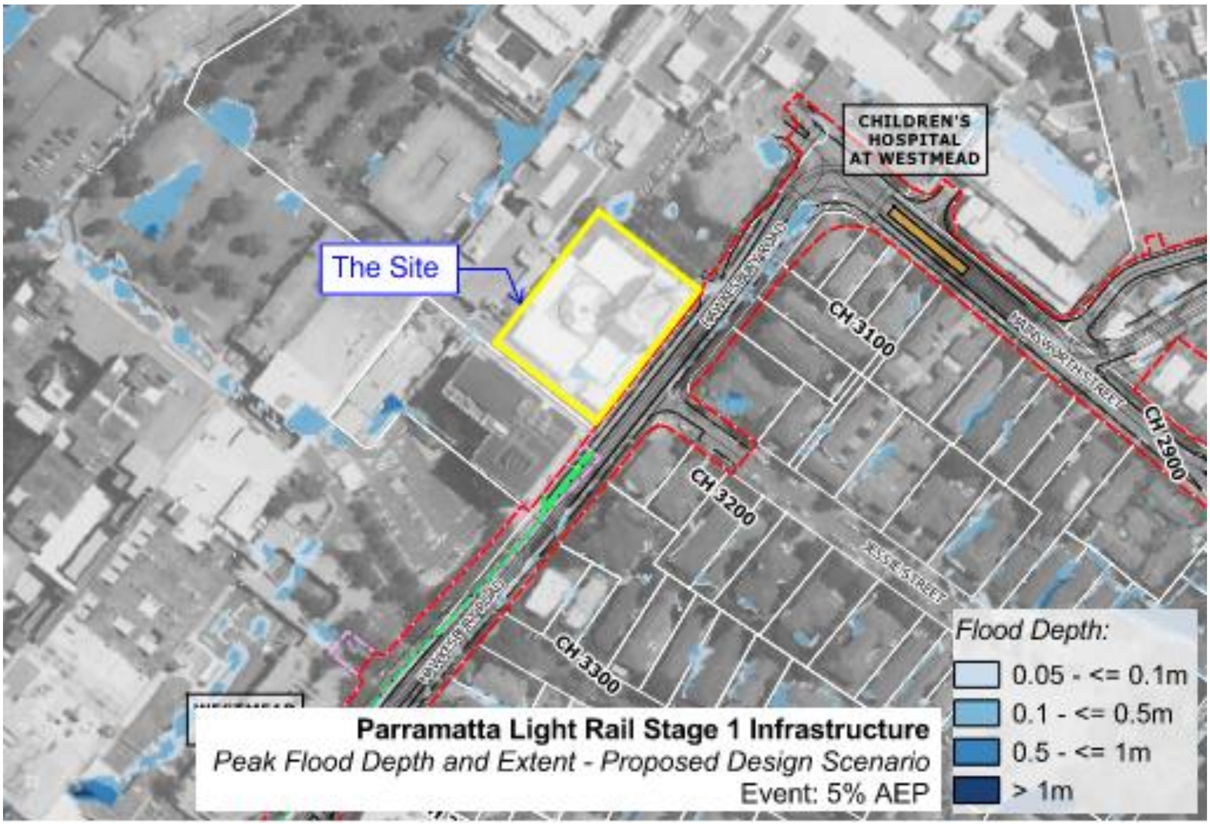

Figure 11 - PLR Stage 1 Infrastructure – 5% AEP Proposed Peak Flood Depth (Source: PLR Flood Assessment Report (PLR1INF-WSPA-ALL-SD-RPT-090001) Rev B 25/10/19, WSPAJV)

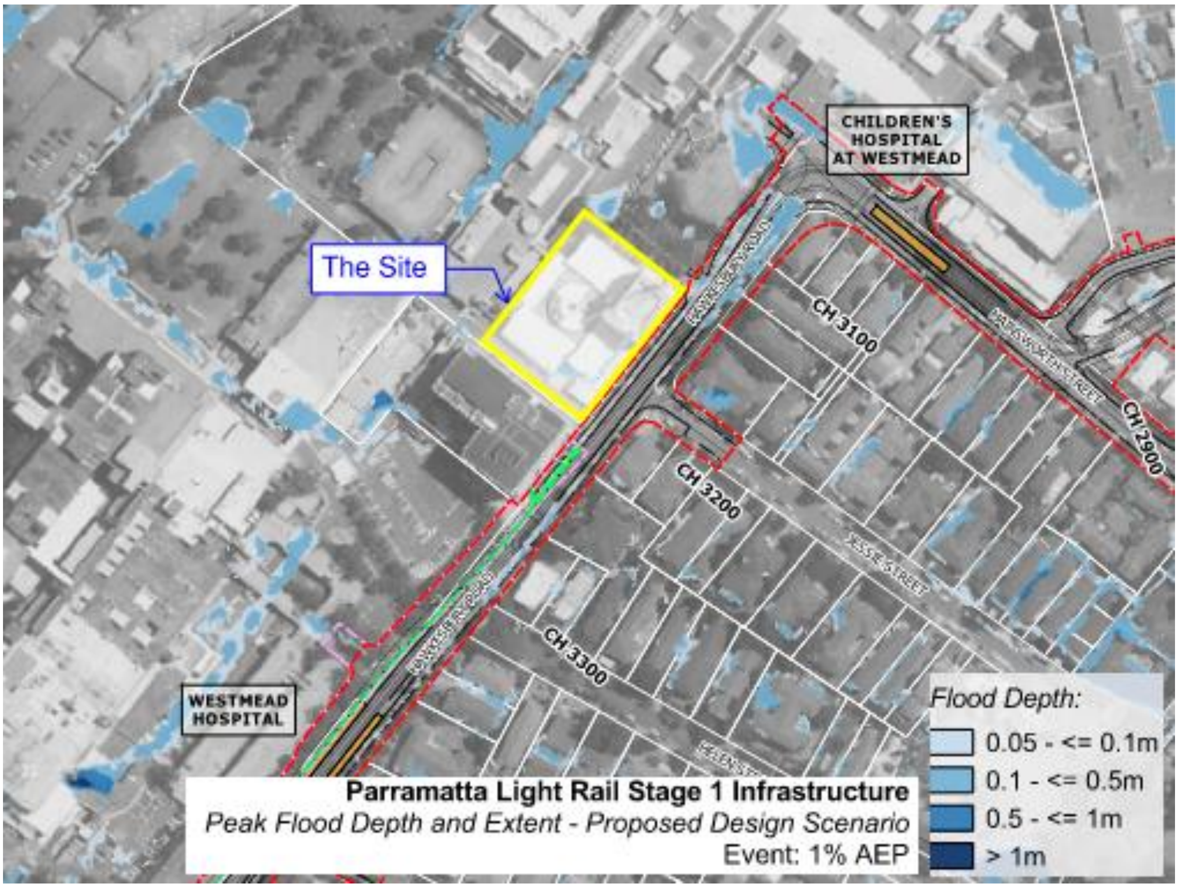

Figure 12 - PLR Stage 1 Infrastructure – 1% AEP Proposed Peak Flood Depth (Source: PLR Flood Assessment Report (PLR1INF-WSPA-ALL-SD-RPT-090001) Rev B 25/10/19, WSPAJV)

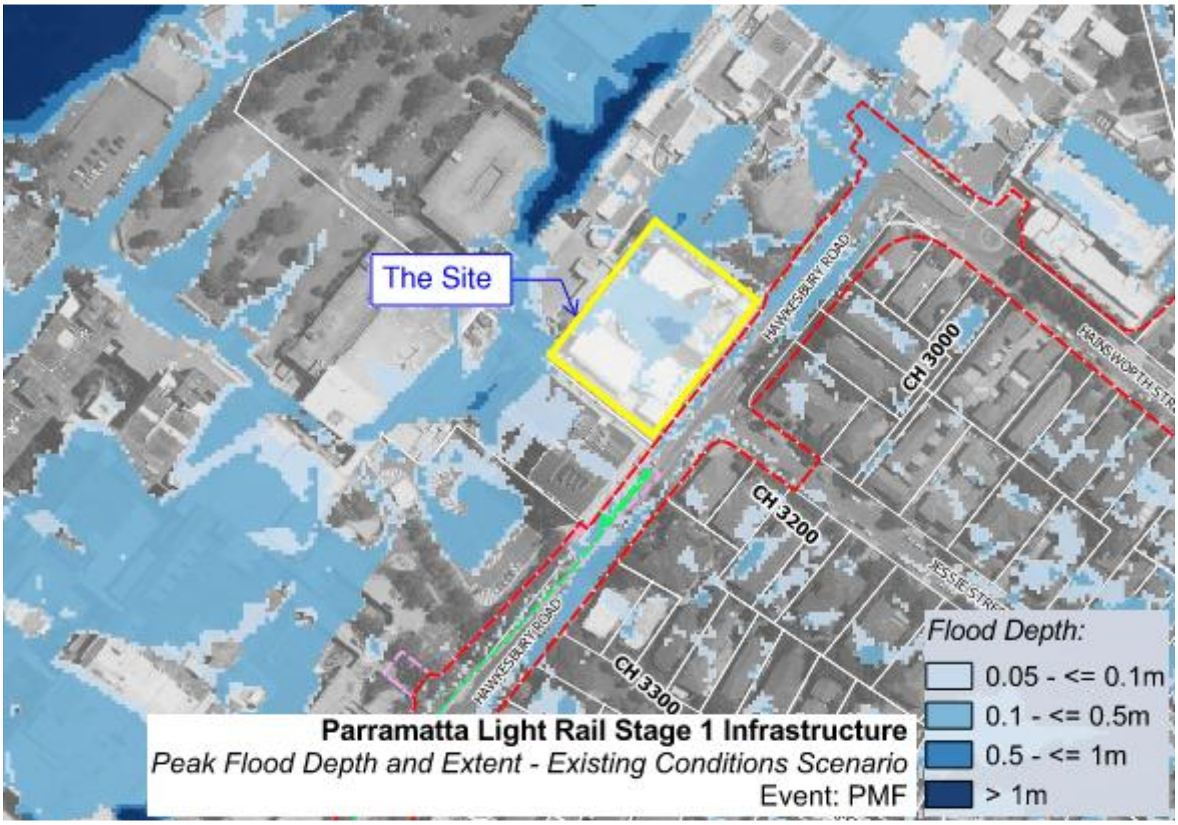

Figure 13 - PLR Stage 1 Infrastructure - PMF Proposed Peak Flood Depth (Source: PLR Flood Assessment Report (PLR1INF-WSPA-ALL-SD-RPT-090001) Rev B 25/10/19, WSPAJV)

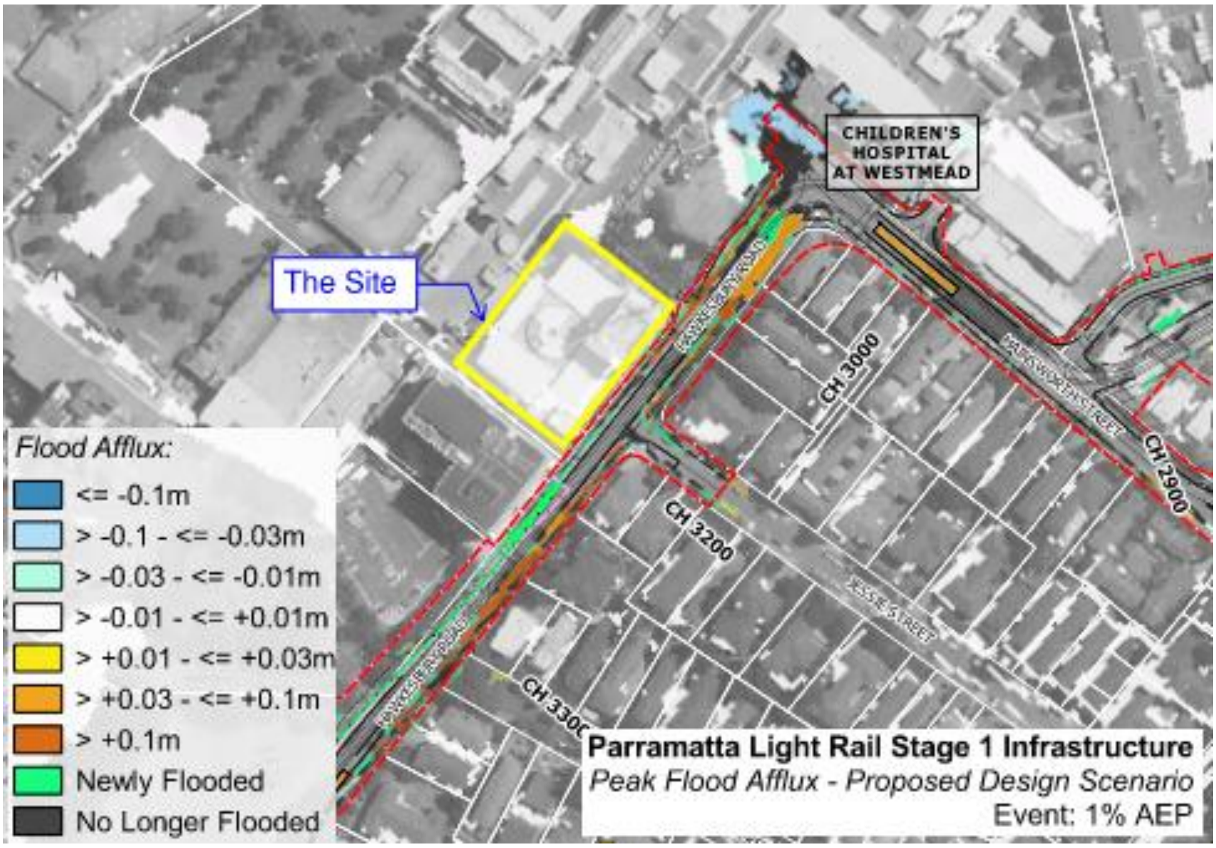

Figure 14 - PLR Stage 1 Infrastructure - 1% AEP Peak Flood Afflux (Source: PLR Flood Assessment Report (PLR1INF-WSPA-ALL-SD-RPT-090001) Rev B 25/10/19, WSPAJV)

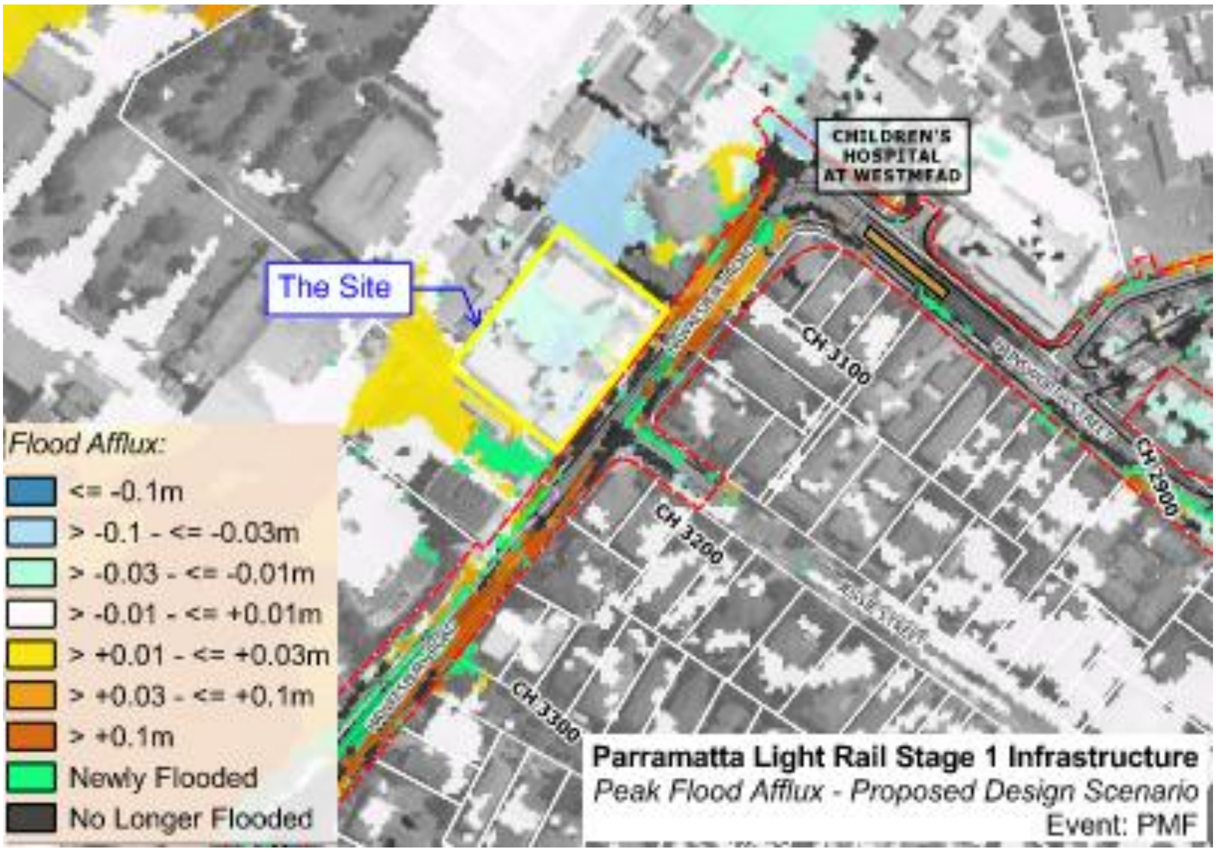

Figure 15 - PLR Stage 1 Infrastructure - PMF Peak Flood Afflux (Source: PLR Flood Assessment Report (PLR1INF-WSPA-ALL-SD-RPT-090001) Rev B 25/10/19, WSPAJV)

2.2.4 CHW PSB Building Flood Impact Assessment (Arup, 2021)

Arup were commissioned by NSW Health Infrastructure (HI) to undertake a Flood Impact Assessment for the proposed Paediatric Services Building (PSB) as part of the Children's Hospital Westmead (CHW) Stage 2 works.

The main purpose of this flood assessment was to provide an assessment of flood risk to the Paediatric Services Building development in compliance with, and adherence to, applicable planning controls including the Secretary's Environmental Assessment Requirements (SEARS)

As part of the flood assessment, Arup developed a site-specific flood model in TUFLOW using work previously completed for Central Acute Services Building (CASB) and for Parramatta Light Rail (PLR) and combined the above information with additional site survey to create a combined river and overland model. The final model extent and combined data are shown in Figure 16.

Figure 16 - Model Extent and Combined Data, CHW Stage 2 (Arup, 2021)

This assessment investigated the potential flood affection of the site from both riverine flooding (i.e., from Toongabbie Creek and Upper Parramatta River) and overland flow flooding mechanisms. This assessment confirms that the site is not affected by floodwaters from Toongabbie Creek nor Parramatta River mainstream bank overflows during flood events up to and including the PMF.

Flood maps of the 1D/2D TUFLOW model for the 1% AEP and PMF relative to the site are presented in Figure 17 and Figure 18 respectively.

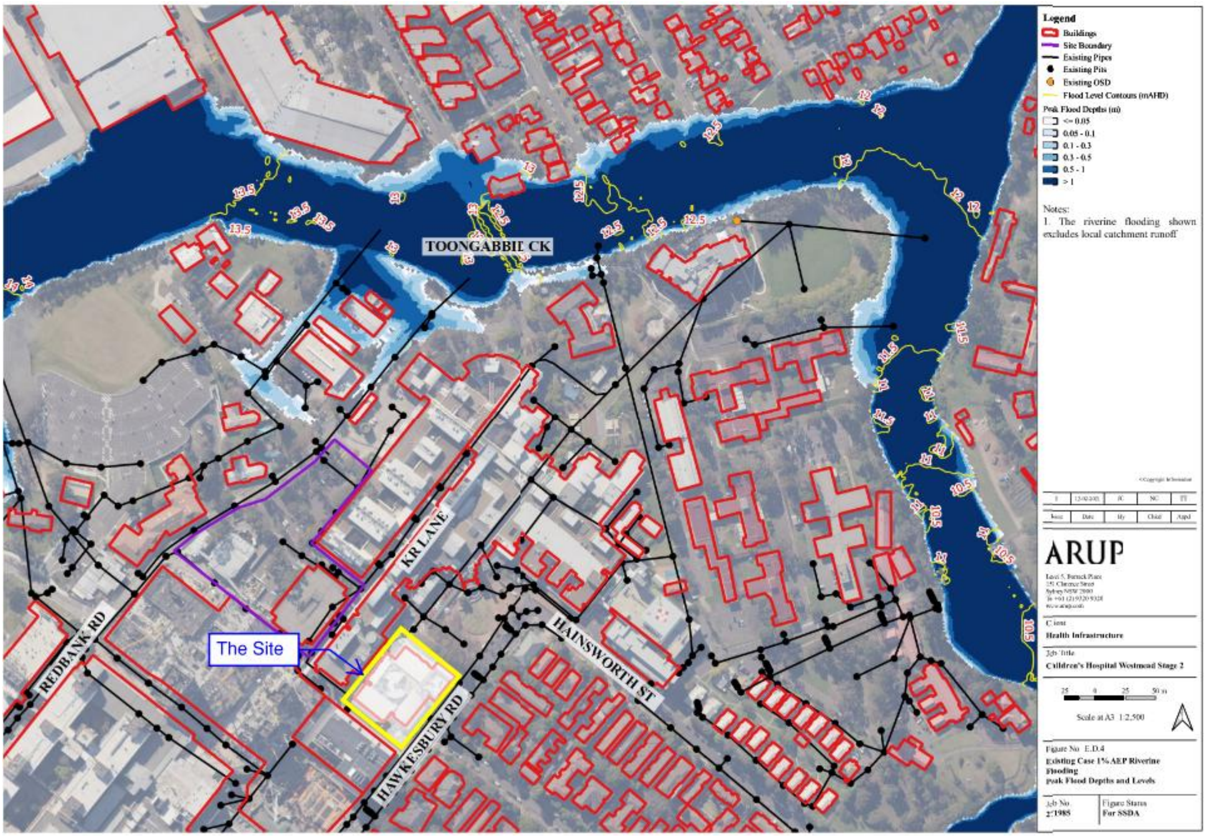

Figure 17 - 1% AEP Riverine Flood Map (Source: Children's Hospital Westmead Stage 2 Flood modelling and assessment, Arup, 2021)

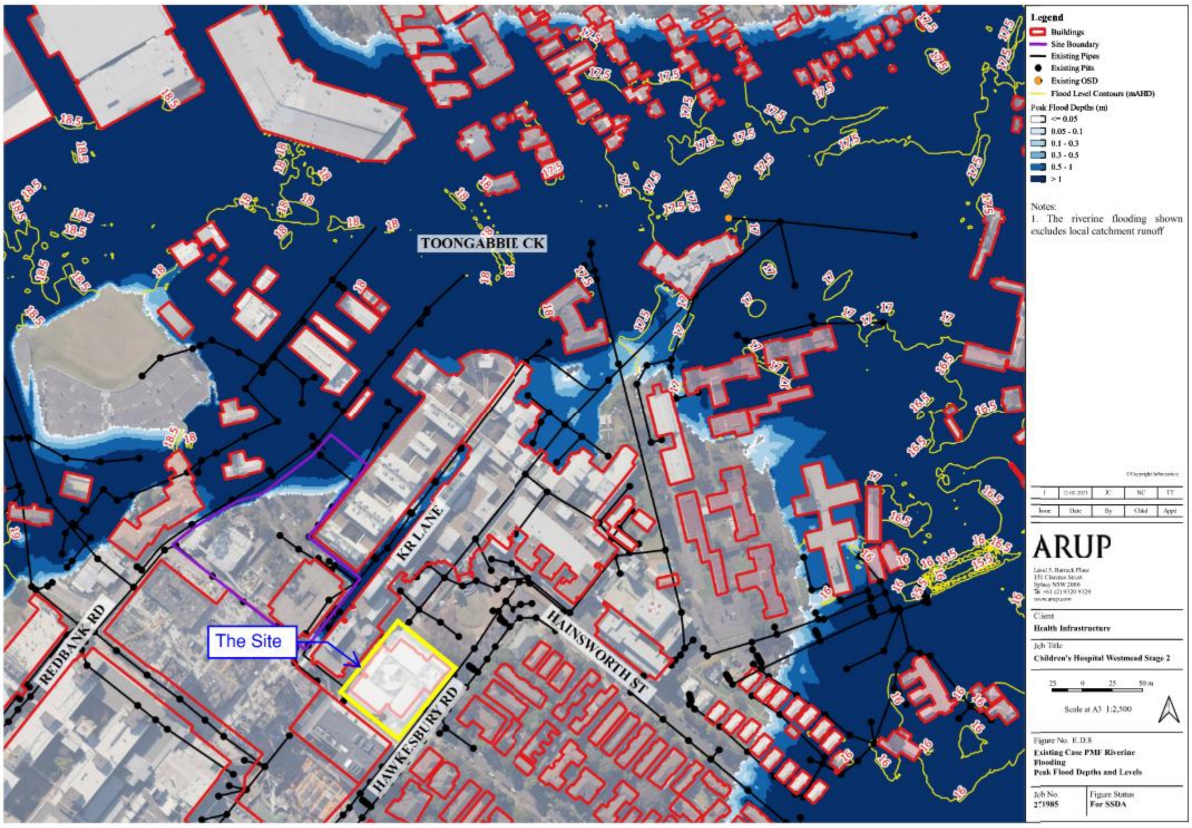

Figure 18 - PMF Riverine Flood Map (Source: Children's Hospital Westmead Stage 2 Flood modelling and assessment, Arup, 2021)

Further, the flood modelling results for CHW Stage 2 (Arup, 2021) confirms that:

- The flood modelling results are not significantly different from those of PLR model.
- The peak flood levels around the PSB site do not significantly increase from the 1% AEP to the 0.5% AEP and 0.2% AEP events.
- The proposed Gene Technologies Building (the subject site of this study) immediate surrounding areas are generally affected by overland flows in the 1% AEP and PMF events.

2.2.5 CHW Kids Park Flood Impact Assessment (Arup, 2023)

Arup were commissioned by NSW Health Infrastructure (HI) to undertake a Flood Impact Assessment for the proposed Kids Park as part of the Children's Hospital Westmead (CHW) Stage 2 works.

The main purpose of this flood assessment was to provide an assessment of flood risk to the Kids Park development in compliance with, and adherence to, applicable planning controls including the Secretary's Environmental Assessment Requirements (SEARS).

It is understood that Arup adopted the TUFLOW flood model developed as part of the Children's Hospital Westmead Paediatric Services Building Flood Impact Assessment (Arup, 2021) as the basis for the Kids Park assessment. The base model adopted for the Kids Park assessment has been updated with the following:

- Updated survey information for the Kids Park/Forecourt area;
- The constructed Hawkesbury Road pedestrian crossing surveyed data;
- The constructed set down area road works at the Children's Hospital entryway;
- The constructed set down area stormwater works at the Children's Hospital entryway; and
- Refinements of the model 1d stormwater network to improve model stability.

Similar to the Children's Hospital Westmead Paediatric Services Building Flood Impact Assessment (Arup, 2021), the 2023 Arup assessment has demonstrated that the subject site is surrounded by overland flow flood inundation in the 1% AEP and PMF events. Flood maps of the developed case model for the 1% AEP and PMF relative to the site are presented in Figure 19 and Figure 20 respectively.

The 2023 Arup assessment also indicated that increases in flood level of more than 10mm are anticipated as a result of the Kids Park development. These impacted areas include the north-eastern, northern and north-western boundary areas of the GTB site. Figure 21 and Figure 22 show the estimated flood level affluxes for the 1% AEP and PMF events respectively.

Figure 19 - 1% AEP Flood Map (Source: Children's Hospital Westmead Kids Park Flood Impact Assessment, Arup, 2023)

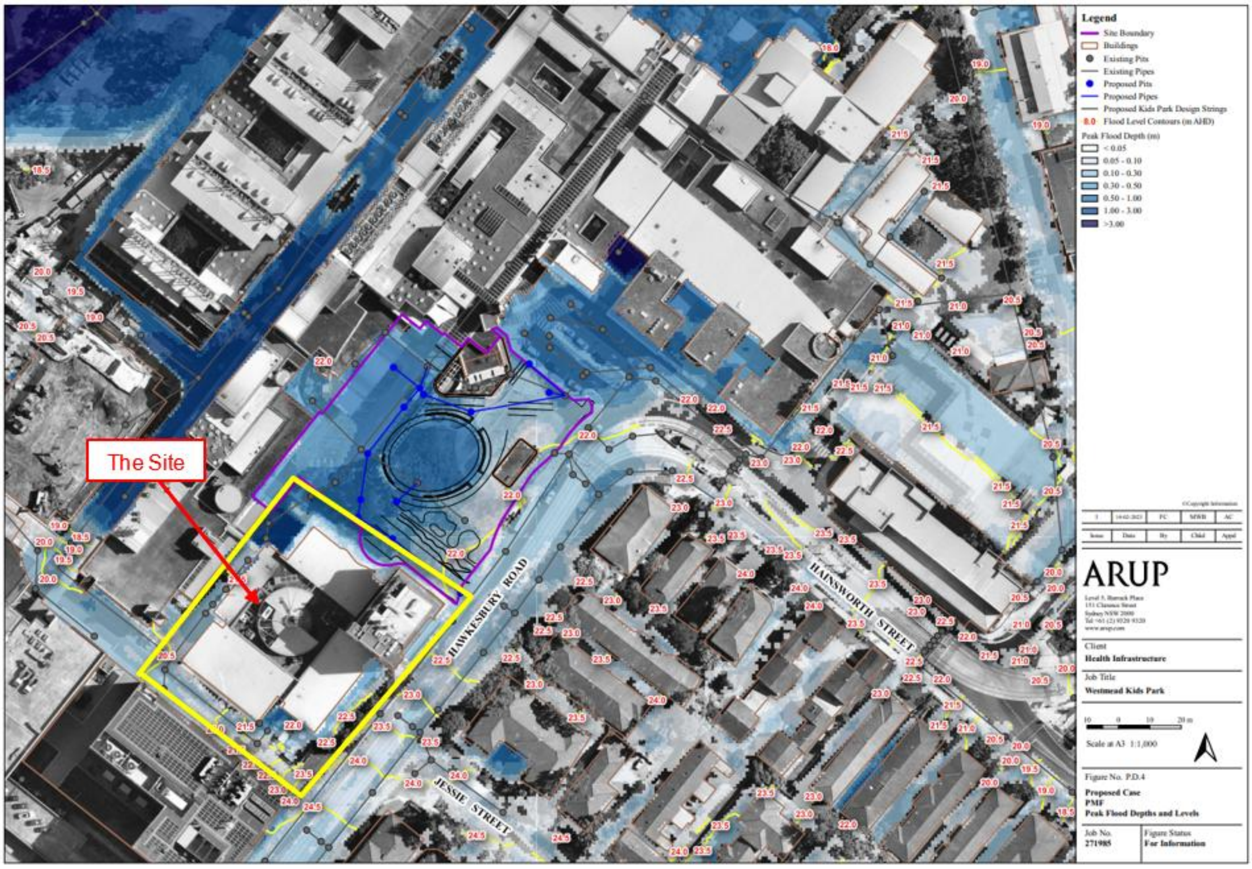

Figure 20 - PMF Flood Map (Source: Children's Hospital Westmead Kids Park Flood Impact Assessment, Arup, 2023)

Figure 21 - 1% AEP Flood Level Afflux Map (Source: Children's Hospital Westmead Kids Park Flood Impact Assessment, Arup, 2023)

Figure 22 - PMF Flood Level Afflux Map (Source: Children's Hospital Westmead Kids Park Flood Impact Assessment, Arup, 2023)

3.0 CHW Hydraulic Model

The TUFLOW model and associated data adopted for the CHW Kids Park Flood Impact Assessment (Arup, 2023) were provided to TTW as part of the GTB assessment. TTW has used the developed case model of the 2023 Arup assessment as the basis to assess the site flood conditions. This model was used as the developed case model of the 2023 Arup assessment included the survey data and design of the Kids Park development area, which is located adjacent (north-east) of the GTB site. This has provided an up-to-date and more accurate representation of the surface elevations of the area surrounding the GTB site.

The GTB modelling has been carried out using the TUFLOW version 2020-10-AA single precision in HPC (Heavy Parallelised Computing) scheme with SGS (Sub-Grid Sampling) at 1m distance. These remained similar to that adopted for the Children's Hospital Westmead Kids Park Flood Impact Assessment (Arup, 2023). The Arup report provides a more detailed description of model development and assumptions adopted for the original TUFLOW model supplied to TTW.

3.1 2D Model Domain

The model domain as received from Arup covers an area of circa 2.25km^2 straddled upstream of the confluence point of Toongabbie River and Parramatta River as shown in Figure 23.

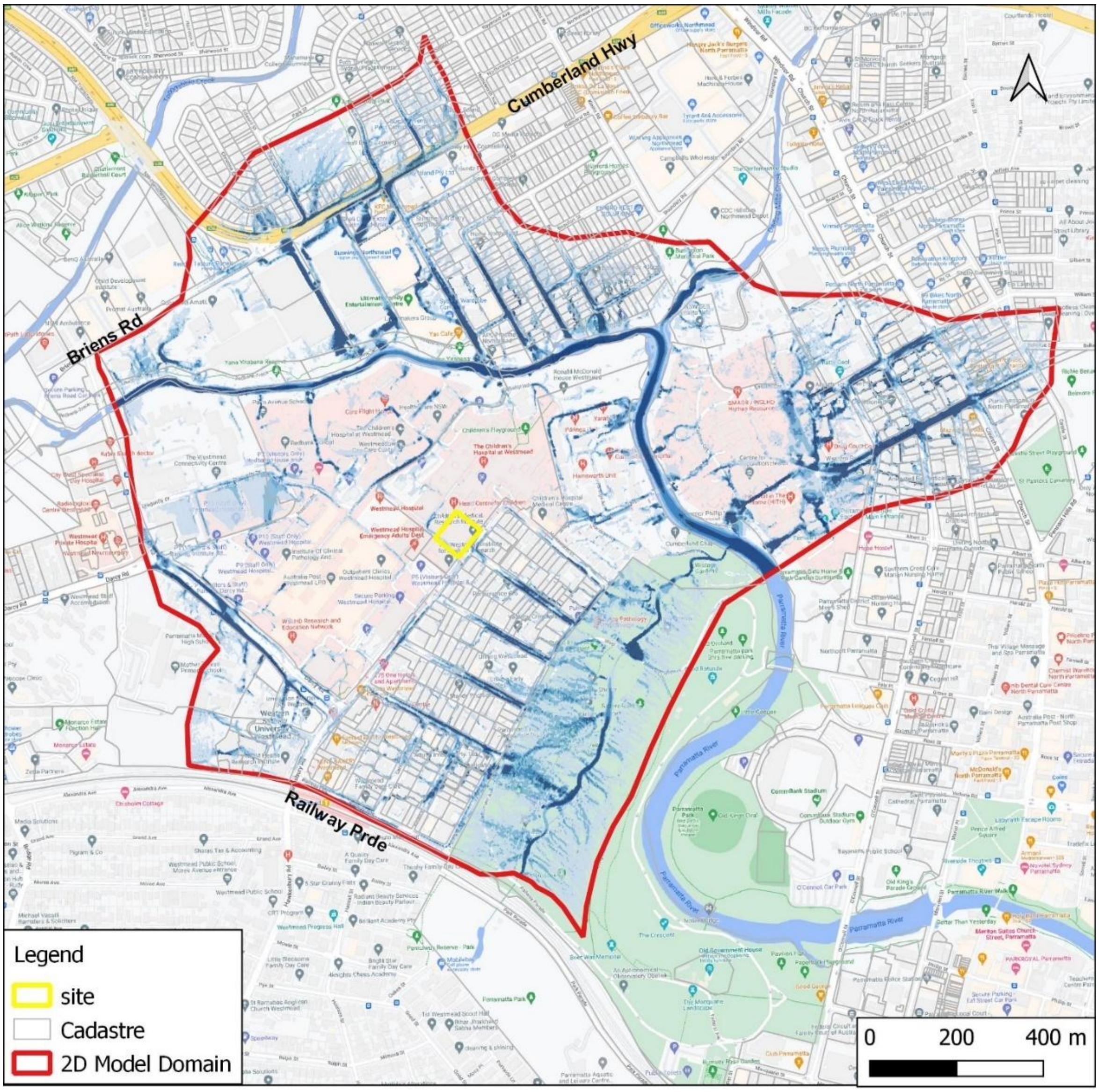

Figure 23 - 2D Model Domain Boundary

The model uses a 2m grid cell size. The grid cell size of 2m is considered to be sufficiently fine to appropriately represent the variations in topography and land use within the study area.

3.2 TUFLOW 1D Model Domain

The existing 1D network was retained inside the model, consistent with the original Children's Hospital Westmead Kids Park Flood Impact Assessment (Arup, 2023) model which includes the following data.

- Information received from Parramatta Light Rail;
- Information from CASB Flood Model;
- Information provided by LTS Lockley Survey;
- Pipe blockages based on the Council DCP requirements as applied in the CHW flood assessment; and
- Stormwater system proposed as part of the Kids Park development.

3.3 Topography

The surface elevation data adopted in the original Children's Hospital Westmead Kids Park Flood Impact Assessment (Arup, 2023) developed case model was used to form the existing surface in TUFLOW model for this GTB assessment, which included the design data of the Kids Park development.

3.4 Building Footprints

The footprints of buildings within the model domain were defined with nulled cells to act as blockage and prevent floodwater to flow through. Building outlines within the model remained similar to that of the original model provided.

3.5 Hydraulic Roughness and Rainfall Losses

The hydraulic roughness of a material is an estimate of the resistance to flow and energy loss due to friction between a surface and the flowing water. A higher hydraulic roughness indicates more resistance to the flow. Roughness in TUFLOW is modelled using the Manning's (n) roughness co-efficient. Manning's roughness materials adopted for this GTB assessment remained similar to the original 2023 Arup's model. Manning's values and rainfall losses adopted are detailed in Table 2.

Table 2 - Adopted Manning's Values

Land use category	Manning's (n)	IL (mm)	CL (mm)
Grass	0.030	10	2.5
Low Density Residential	1.000	6	1.5
Medium Density vegetation	0.045	10	2.5
Roof and Paved Ground	0.020	1	0
Road Pavement	0.020	1	0
Creek/Riverbed	0.035	0	0
Heavy Density vegetation	0.070	10	2.5
Creek/Riverbed between confluence of Toongabbie Creek	0.030	0	0

3.6 Boundary Conditions

Arup's TUFLOW model (2023) defines the model inflows generally through 'rainfall-on-grid' methodology and further applied inflow hydrographs extracted from a DRAINS hydrologic model to simulate the discharge flows of the building roof catchments directly into the stormwater pipes.

The Toongabbie Creek and Parramatta River inflow/tailwater boundary conditions have been derived from the City of Parramatta Council's Parramatta River MIKE11 model and the PLR North Parramatta TUFLOW model. Arup's TUFLOW model assumes a coincidental riverine and overland flow flooding at Toongabbie Creek and Parramatta River which is a conservative approach. Therefore, model boundaries were retained as received.

3.7 Flood Modelling Events

The 1% AEP and PMF events have been modelled and assessed as part of this GTB assessment to determine the flood characteristics as well as flood impacts as a result of the GTB redevelopment. All five design storms and four design storms adopted in the 2023 Arup's assessment model for the 1% AEP and PMF events, respectively have been simulated for this GTB assessment. Table 3 below summarises the design storms modelled and assessed as part of this GTB assessment.

Table 3 – Design Storm Events Adopted

AEP Event	Design Duration
1%	15 min
	25 min
	90 min
	120 min
	540 min
PMF	15 min
	30 min
	60 min
	180 min

3.8 Flood Modelling Scenarios

A total of two modelling scenarios were assessed as part of this GTB assessment, which include:

- Pre-Development Scenario – this is the scenario where the GTB site has been represented as it exists now and, as discussed in Section 3.0, the developed case model of the 2023 Arup assessment has been used.
- Post-Development Scenario – this is the scenario where the works proposed as part of the GTB redevelopment have been considered and incorporated into the pre-development model. Design levels for the areas surrounding the proposed building footprint of GTB were incorporated into the pre-development model.

Figure *24* shows the design levels adopted for the post-development model in the GTB assessment. Some slight changes to the stormwater pit surface elevation were made by TUFLOW automatically based on the incorporated GTB project area design levels (only surface elevation of stormwater pits located within the GTB project area with new design levels are adjusted). All other model parameters remained similar to the pre-development model for the assessment. Figure *25* shows the changes in surface elevation between the post-development and pre-development models adopted for this GTB assessment.

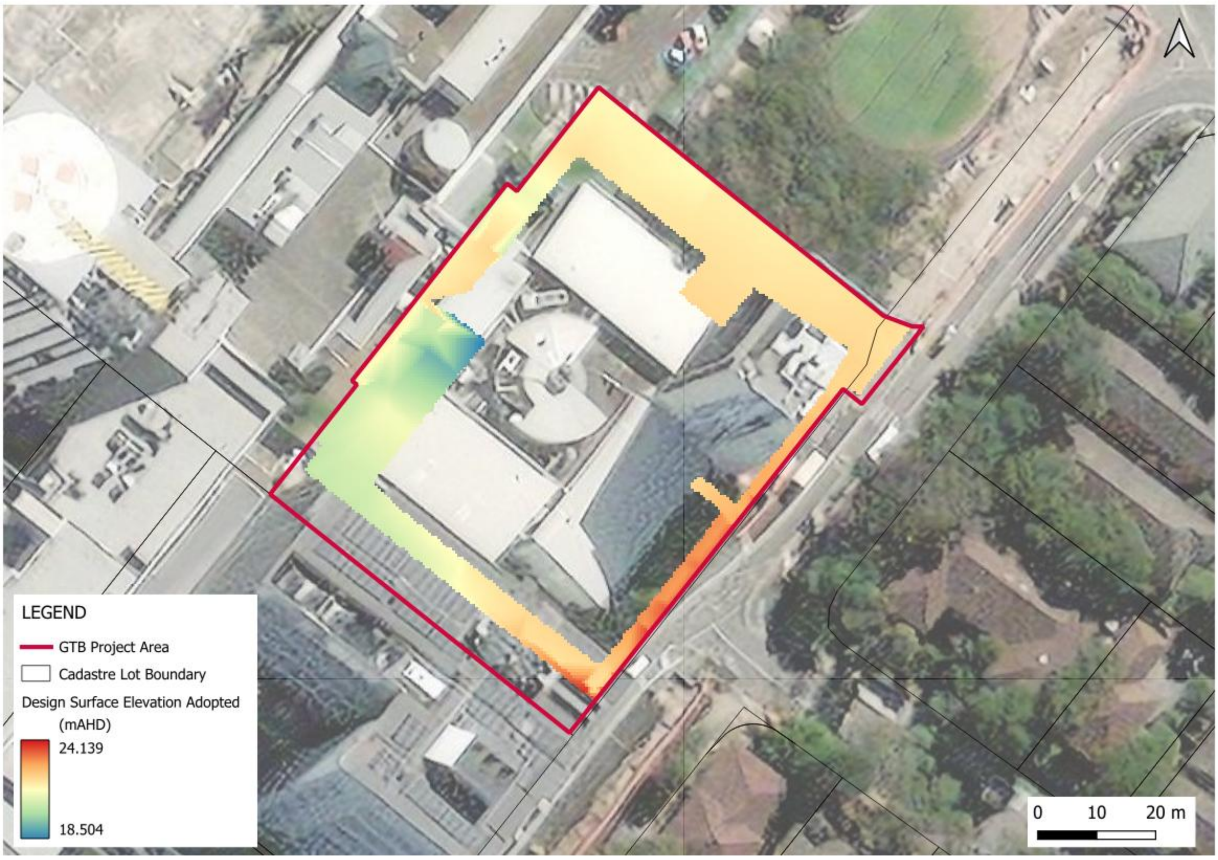

Figure 24 - Surface Elevation Adopted for GTB Project Area in Post-Development Model

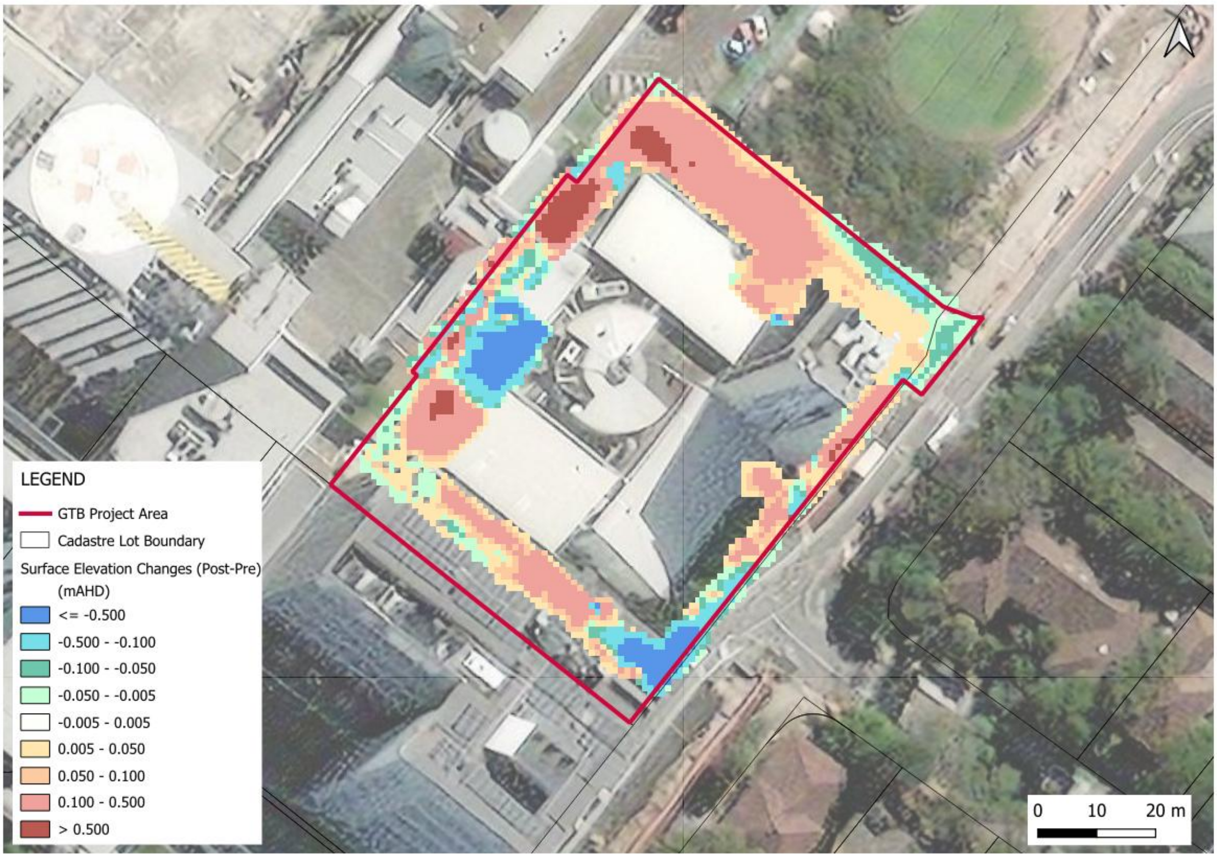

Figure 25 - Surface Elevation Changes in Post-Development Model When Compared to Pre-Development Model

4.0 CHW Hydraulic Modelling Results

4.1 Model Results Post Processing

It should be noted that the adopted TUFLOW model for this GTB assessment (i.e. based on original model by Arup for the 2023 assessment) uses the 'Rainfall-on-grid' approach, the SGS functionality within TUFLOW (to provide a better grid conveyance calculation) and design storms for each AEP event (as discussed in Section 3.7). Post-processing of the modelling results has been carried out as part of the GTB assessment as discussed below.

For each AEP event assessed, the maximum grids for all design storms modelled have been post-processed to create the maxmax (i.e. maximum of the individual maximum grids for individual AEP event) grids of that AEP event. Remapping was then carried out for all the maxmax grids created using the TUFLOW asc_to_asc remapping code (i.e. -wl), based on a 1m model elevation grid. This remapping process was required to ensure that the flood extent of the flood depth grid and other result grids were comparable.

4.2 Pre-Development Conditions

1% AEP Event

Flood results for existing conditions show that Hawkesbury roads and Research Lane, as well as the area along the adjacent to the Kids Park (i.e. within GTB project area), are generally affected by shallow overland flows with typical depths of less than 100mm in the 1% AEP flood event.

Model results also confirm that the flood depths are deeper than 100mm at some locations adjacent to the Ainsworth Tower entrance.

A few small trapped-low lying areas around the existing building such as the entrance ramp to the existing loading dock and rear courtyard are noticeable where the overland flows build up to greater than 100mm in depth.

The site, in existing conditions, incorporates a footpath and a garden along the eastern boundary with RLs of approximately 1m lower than the adjacent road. The overland flows across that low-lying area reach up to 180mm in depth during the 1% AEP event.

The 1% AEP flow velocities for the GTB project area and its immediate surrounding areas are generally estimated to be less than 0.5m/s with some small areas estimated to be as high as 0.9m/s.

The 1% AEP flood hazards are generally low (i.e. estimated at H1) over Hawkesbury Road and Research Lane as well as across the site, with some small pockets of areas estimated to be at H2 flood hazard category.

1% AEP flood depths, flood levels, flow velocities and flood hazards for the pre-development conditions are represented in Figure 26, Figure *27*, Figure *28* and Figure *29* respectively.

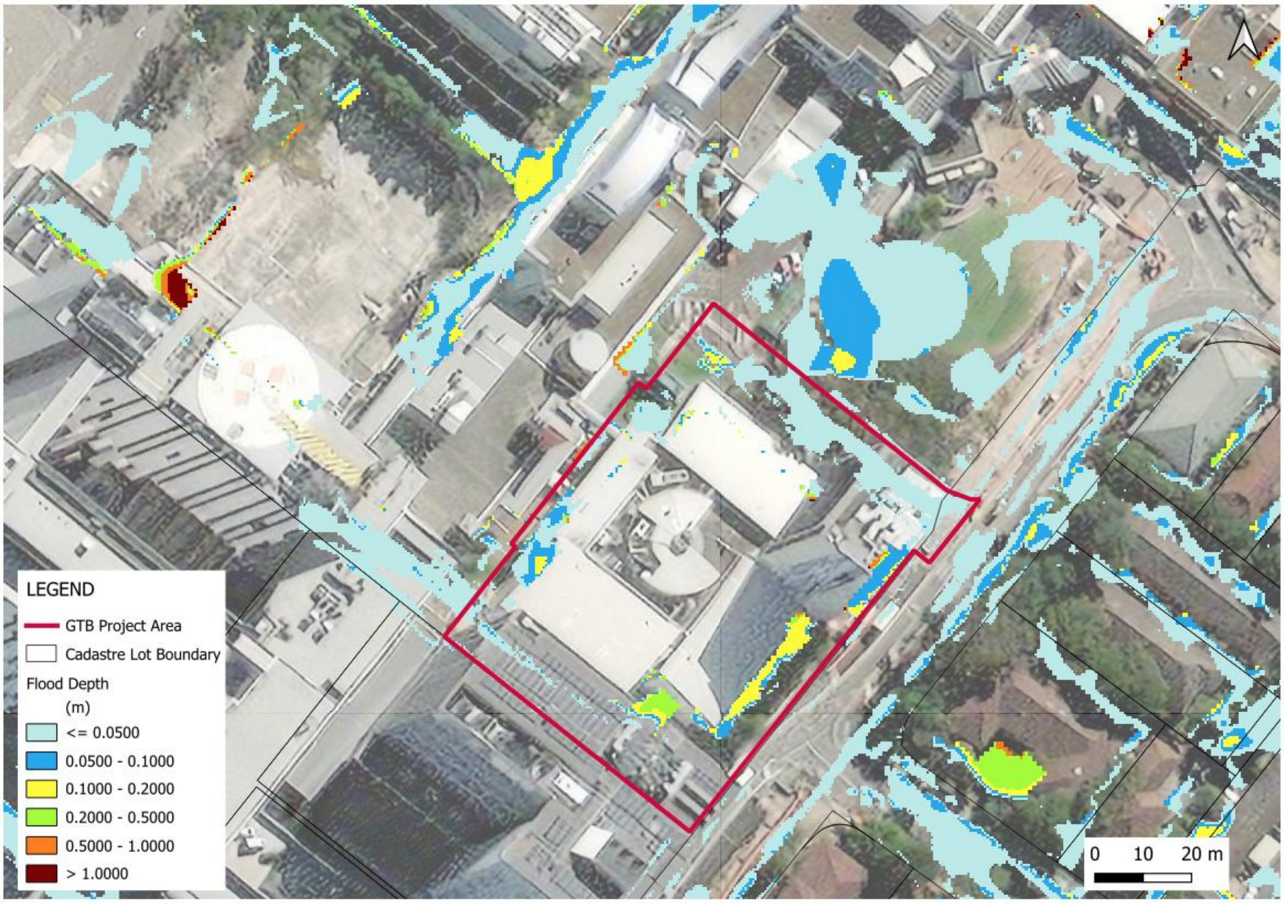

Figure 26 - 1% AEP Flood Depths – Pre-Development Conditions

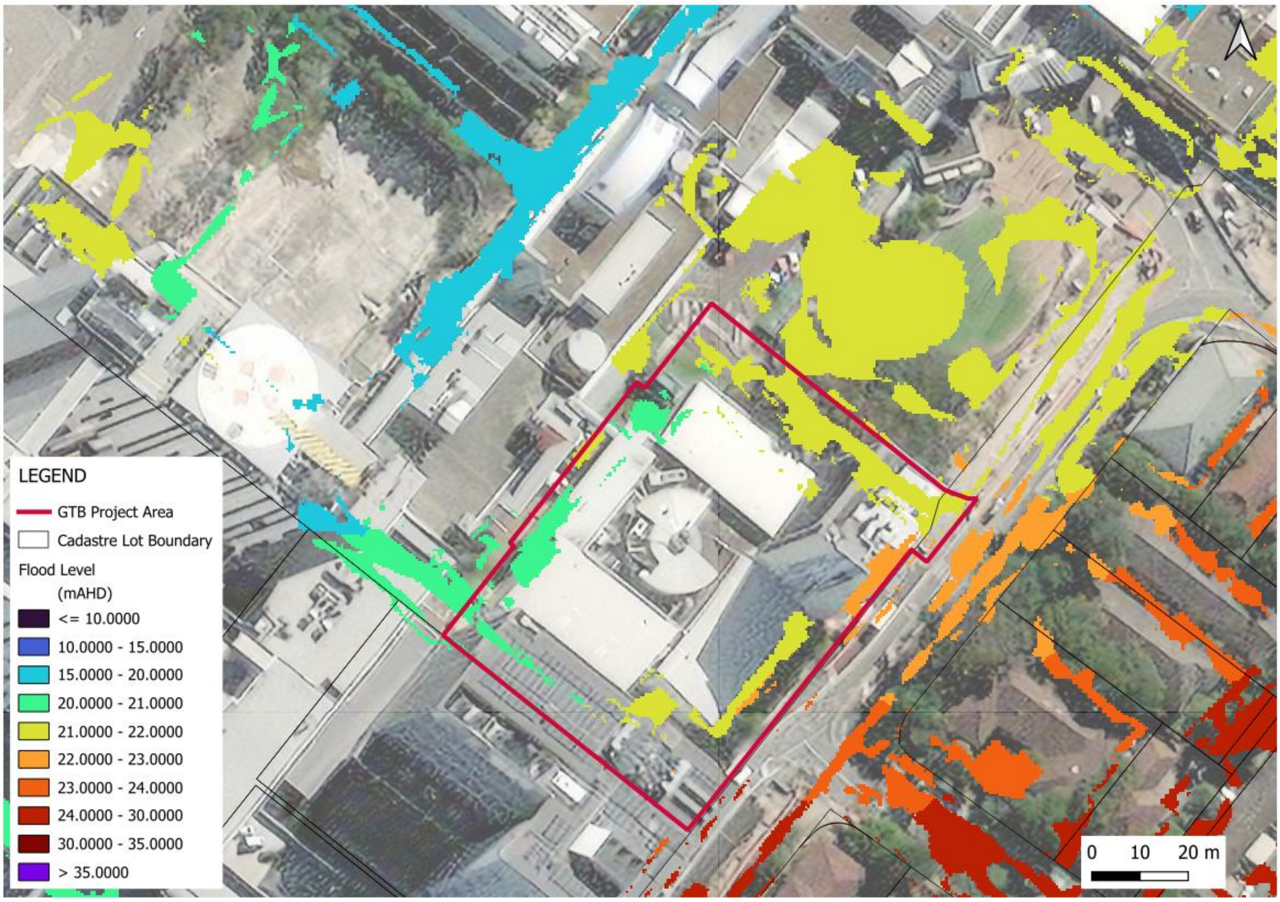

Figure 27 - 1% AEP Flood Levels – Pre-Development Conditions

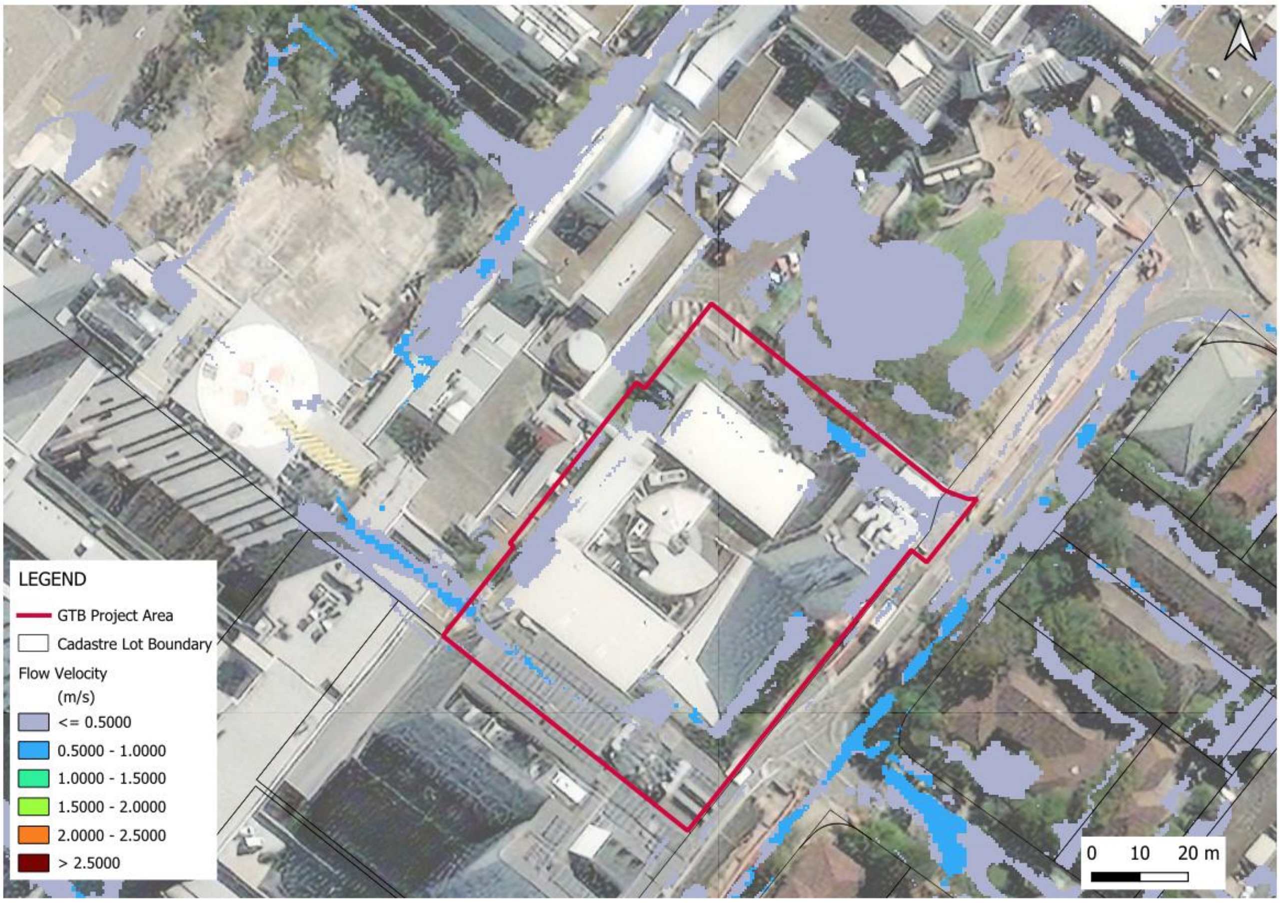

Figure 28 - 1% AEP Flow Velocities – Pre-Development Conditions

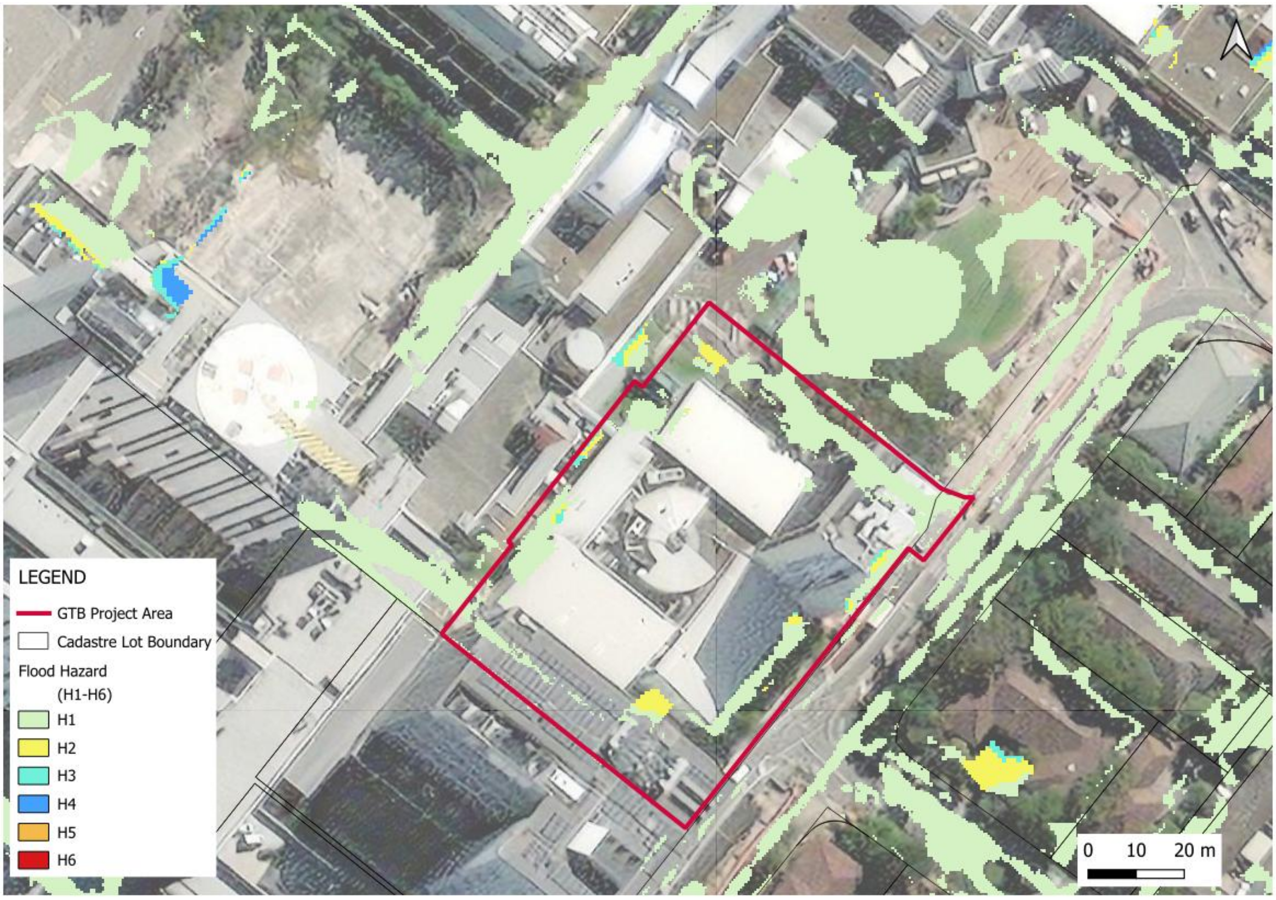

Figure 29 - 1% AEP Flood Hazards – Pre-Development Conditions

PMF Event

Flood modelling results suggest that the site is affected mainly by overland flows upon Hawkesbury Road during the PMF event. Overland flows from the residential areas south of Hawkesbury Road drain to Hawkesbury Road and flow northeast towards the site. Overland flows then partially flow through Research Lane along the southern site boundary while the rest of the flows continue running north along Hawkesbury Road along the eastern site boundary. Overland flows then flow west over the existing driveway north of the site running towards the Kids Park area located at the northern GTB project boundary.

Overland Flow depths over Hawkesbury Road and Research Lane are generally up to 200mm and 220mm respectively.

- The overland flows at the low-lying area along the eastern boundary reach up to 450mm in depth during the PMF and overflow onto Research Lane. The existing carpark to the north and the Kids Park area experience flow depths of up to 1.1m. These areas near the northern site boundary act as local flood storages during large flood events.
- Floodwaters build up to 650mm in depth over the existing loading dock area in the PMF event.

Flood hazards onsite as well as over the Hawkesbury Road and Research Lane range from H1 to H5 during the PMF, based on the Australian Emergency Management Institute hazard categories.

Estimated flood depths, flood levels, flow velocities and flood hazards in the PMF event are shown in Figure 30, Figure *31*, Figure *32* and Figure *33* for existing site conditions respectively.

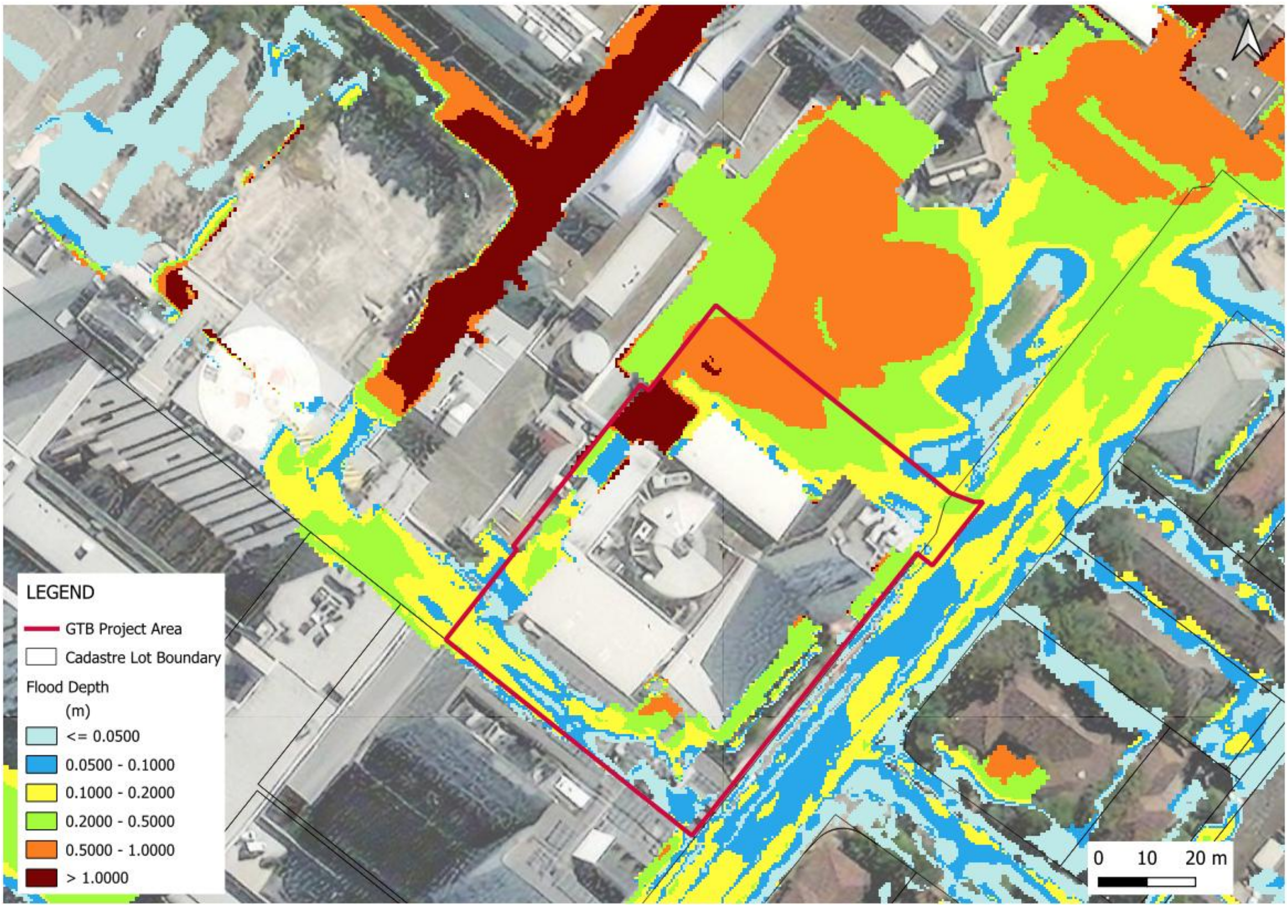

Figure 30 - PMF Flood Depths – Pre-Development Conditions

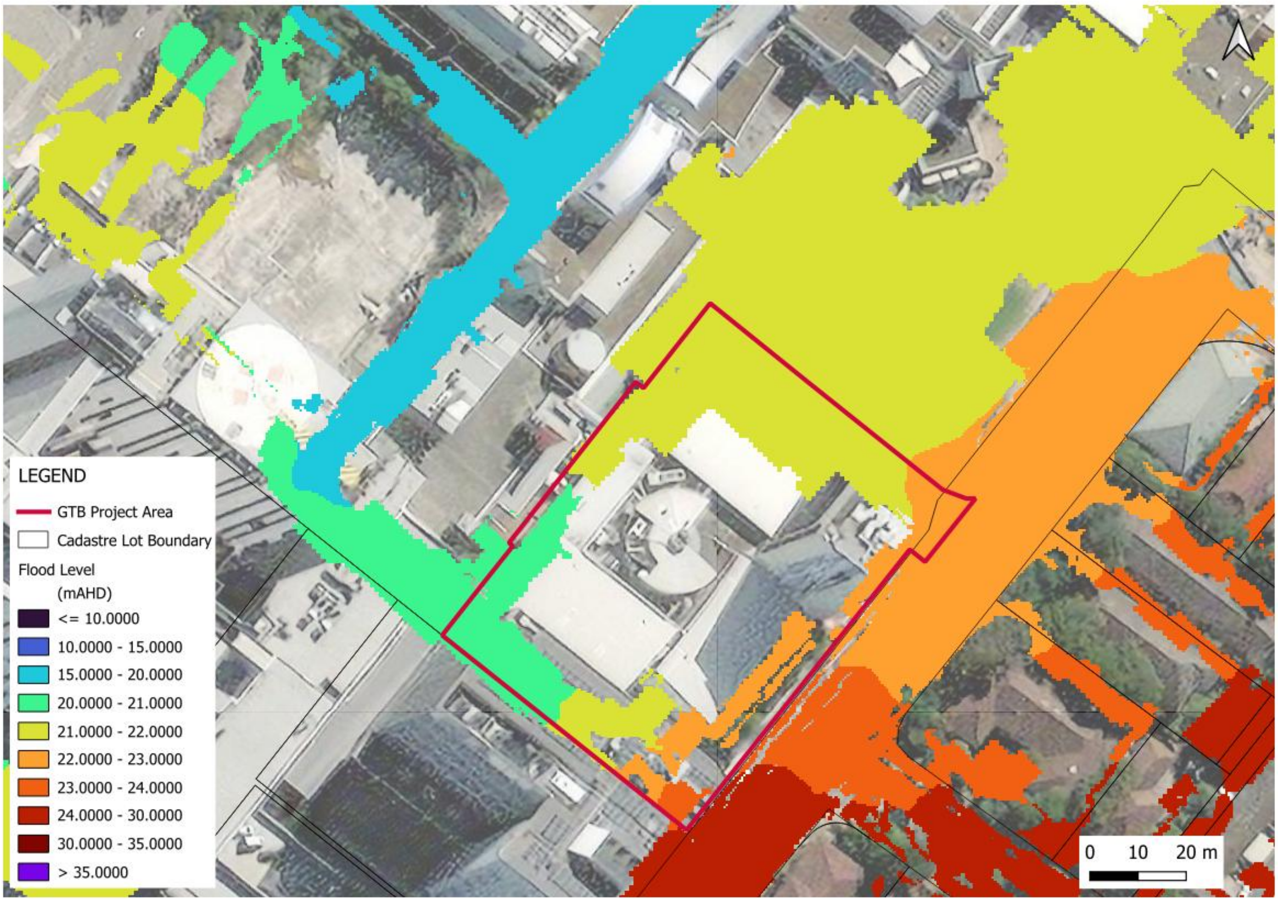

Figure 31 - PMF Flood Levels – Pre-Development Conditions

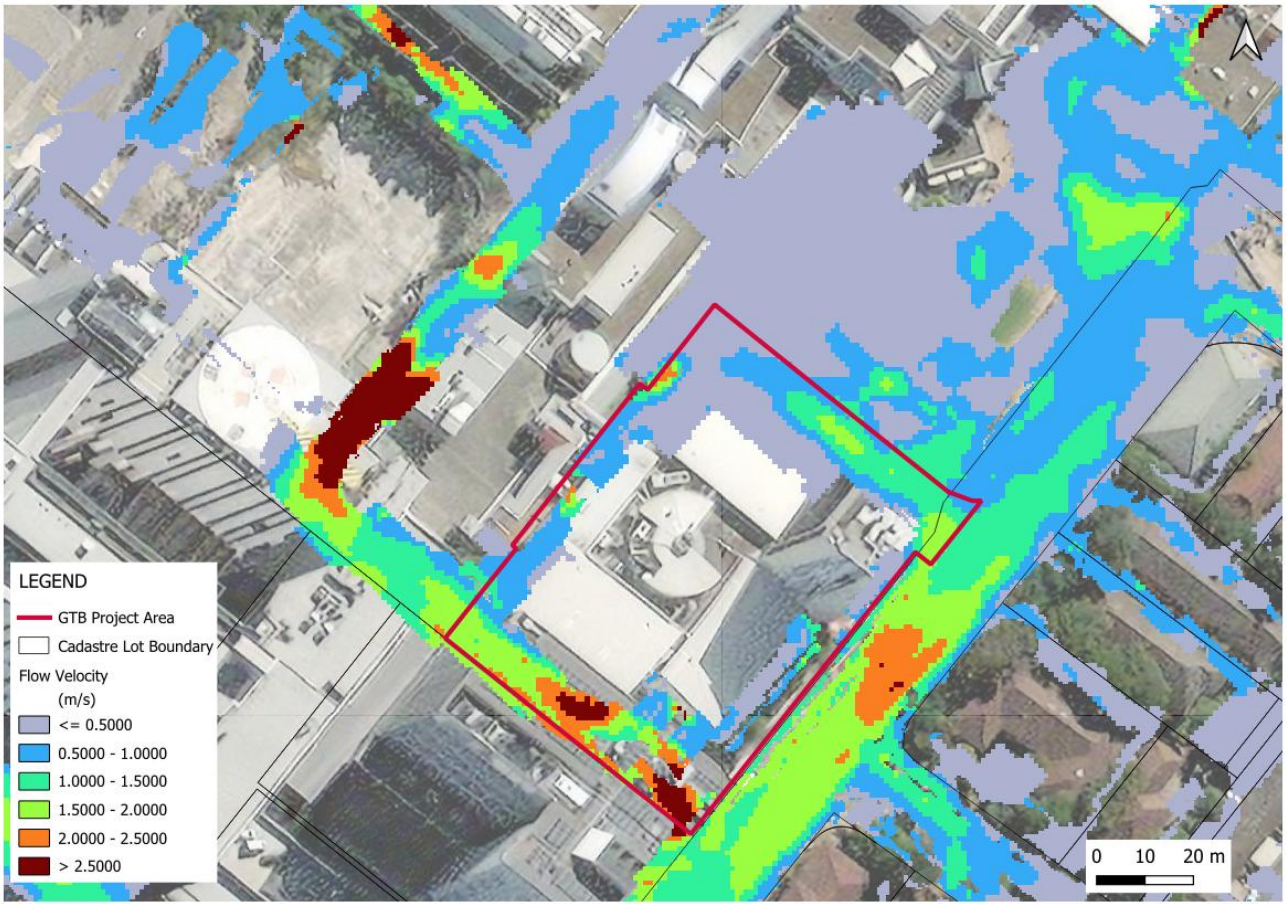

Figure 32 - PMF Flow Velocities – Pre-Development Conditions

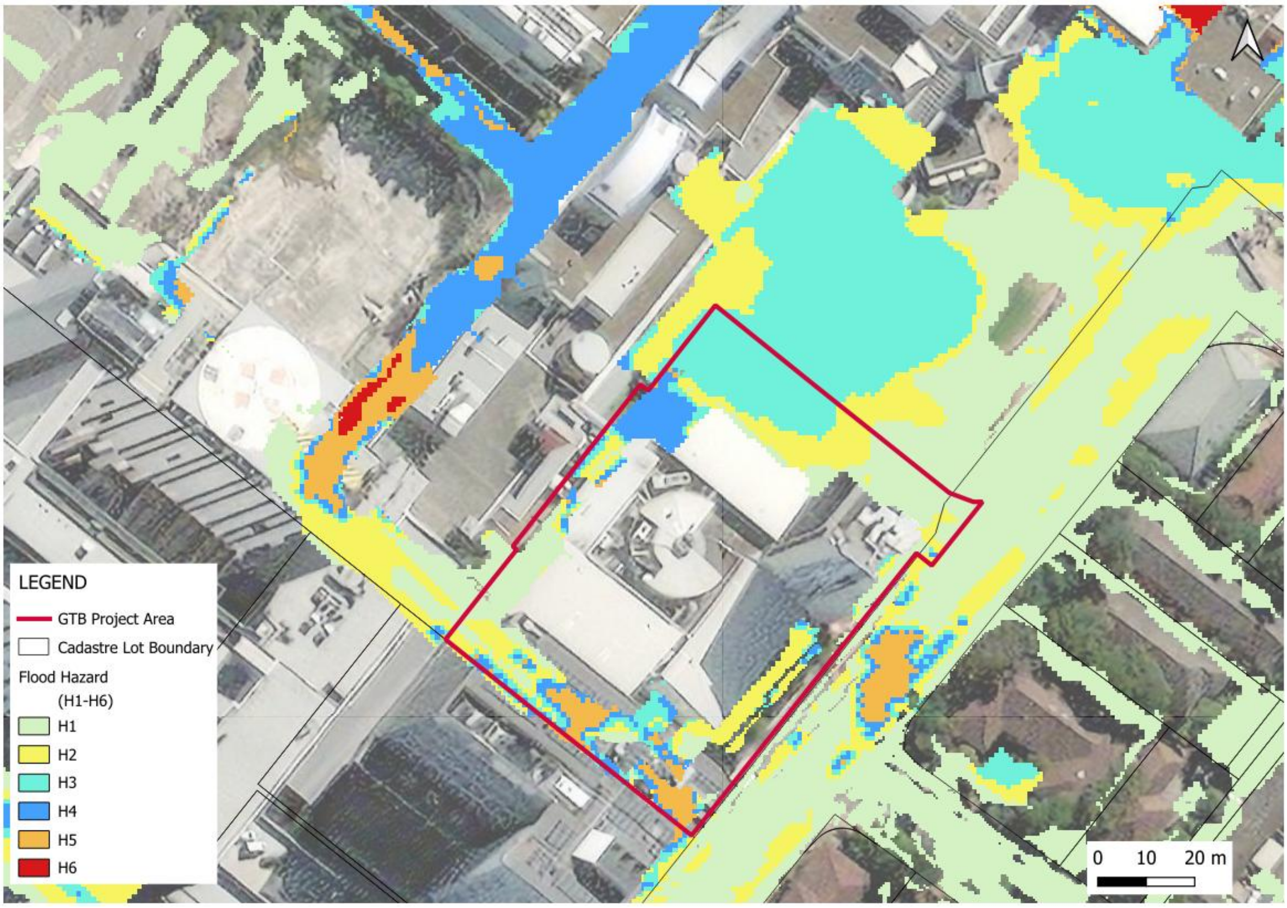

Figure 33 - PMF Flood Hazards – Pre-Development Conditions

4.3 Post-Development Conditions

<u>1% AEP Event</u>

Simulated 1% AEP flood depths, flood levels, flow velocities and flood hazards for the post-development site conditions are shown in Figure 34, Figure *35*, Figure *36* and Figure *37* respectively.

Flood results confirm that:

- The local flood behaviour in the post-development conditions is generally similar to pre-development conditions during the 1% AEP event.
- The site and the area in close proximity are generally affected by shallow (typical depth of less than 100mm), low hazard overland flows in the post-development conditions during the 1% AEP event.
- Overland flows over a small area near the north-western site boundary are as deep as 0.65m during the 1% AEP event.
- The existing carpark to the north experiences the flow depths of up to 150mm in the 1% AEP.
- The crest of the ramp to the proposed basement carparking area of the Gene Technologies Building (i.e. near south-west corner of GTB site) has been set (i.e. at 21.13mAHD) to provide more than 500mm of freeboard to the estimated 1% AEP flood level (i.e. at approximately 20.56mAHD) in this area, to prevent floodwater from entering the basement carparking area.
- While there is some residual flooding at the substation, this is to be addressed with the implementation of a retaining wall, which is still in the design process.

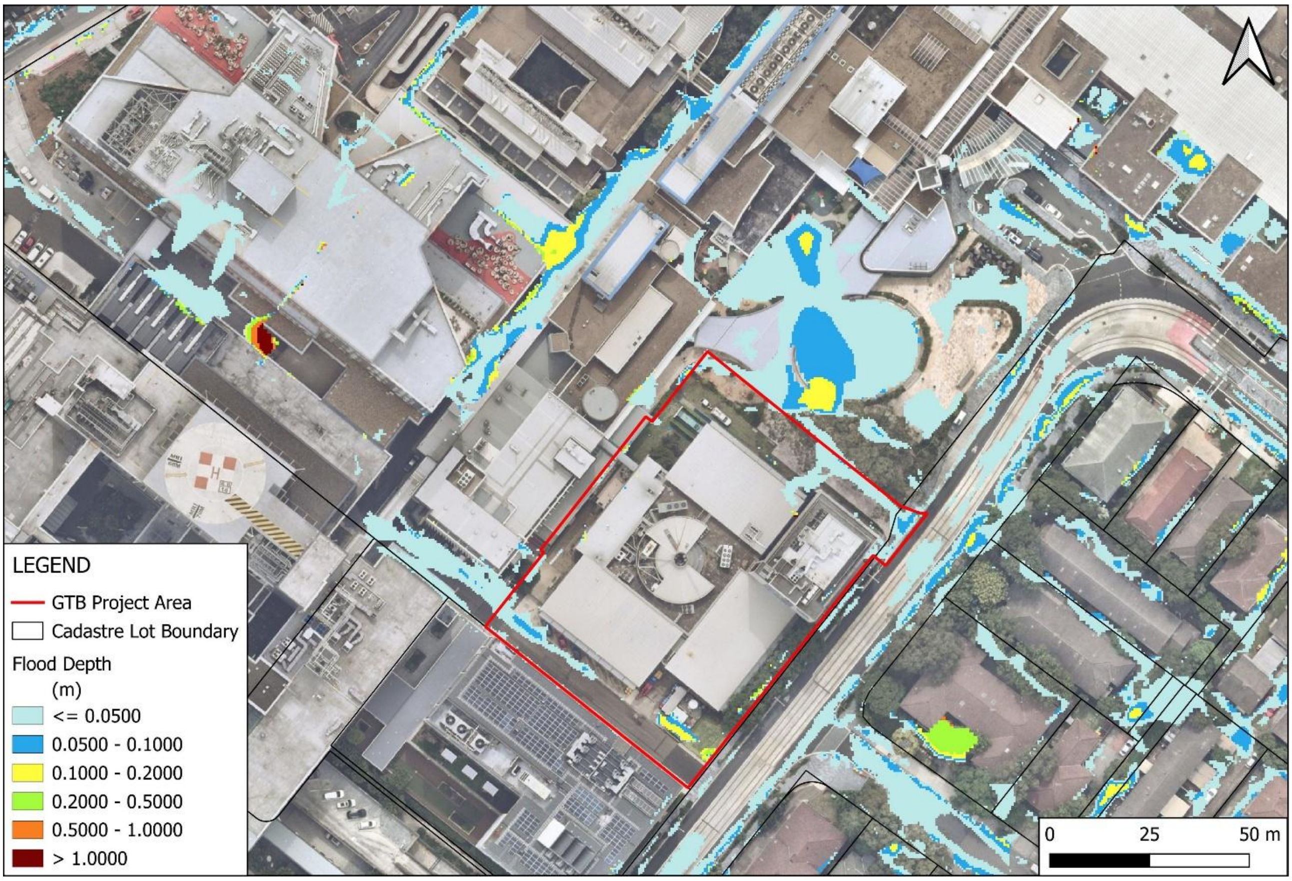

Figure 34 - 1% AEP Flood Depths – Post-Development Conditions

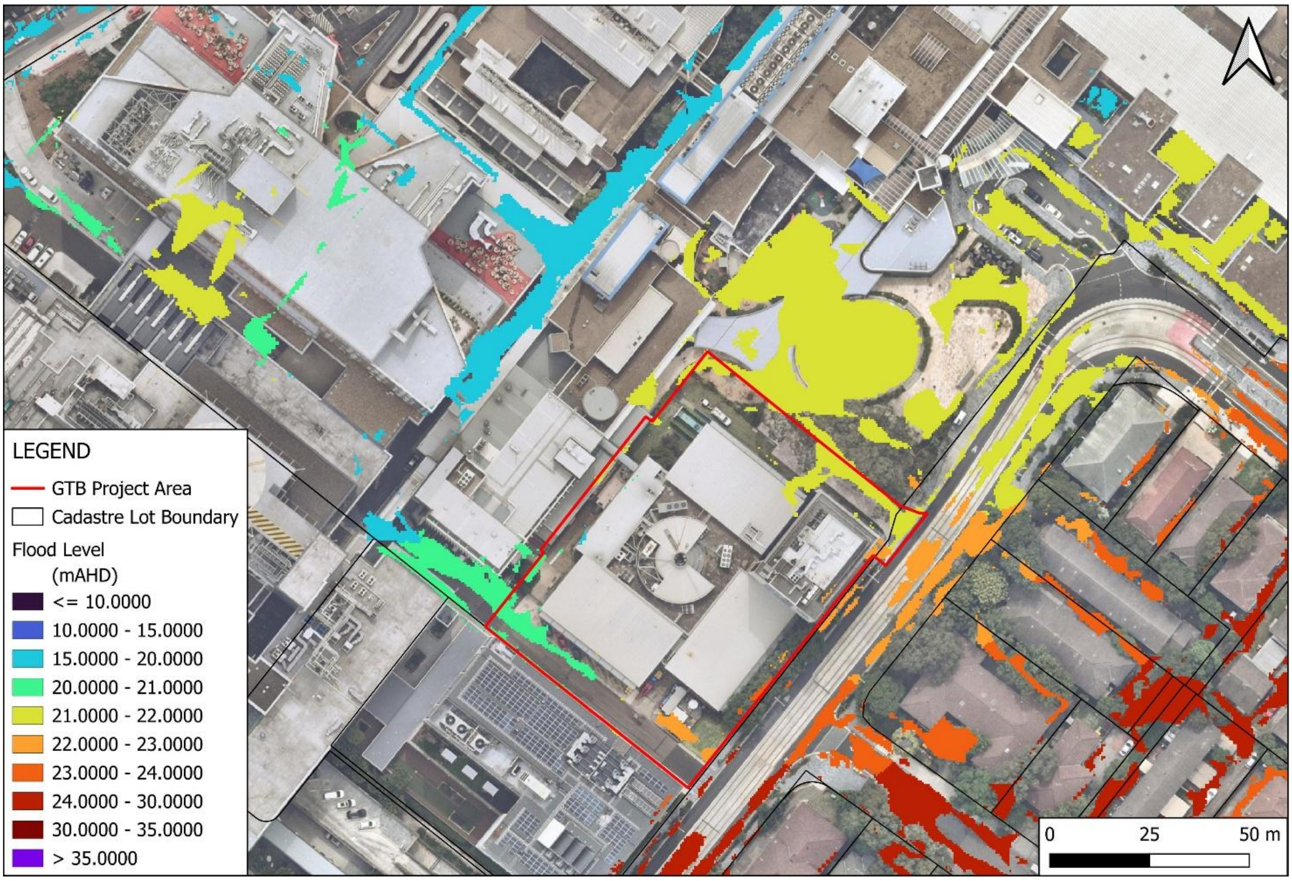

Figure 35 - 1% AEP Flood Levels – Post-Development Conditions

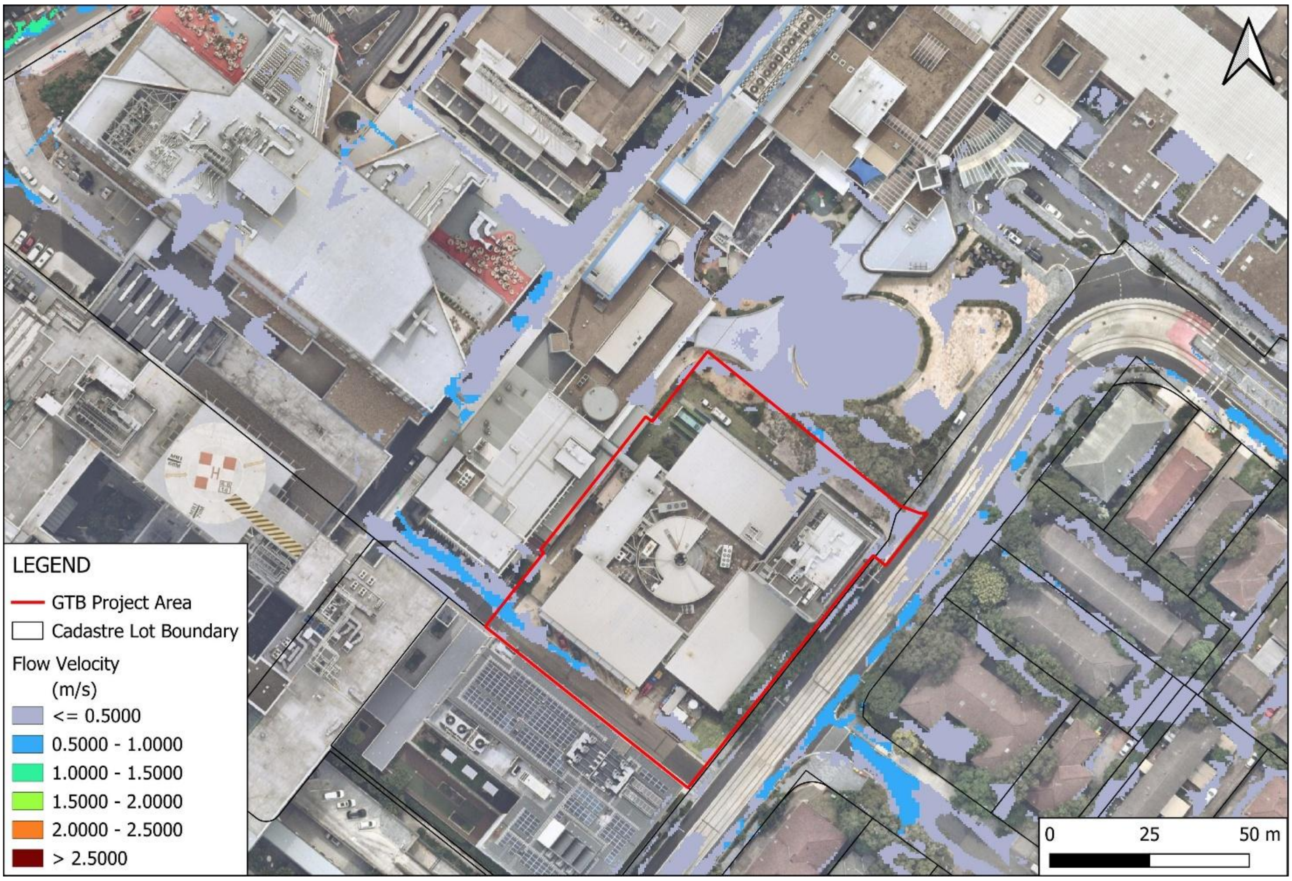

Figure 36 - 1% AEP Flow Velocities – Post-Development Conditions

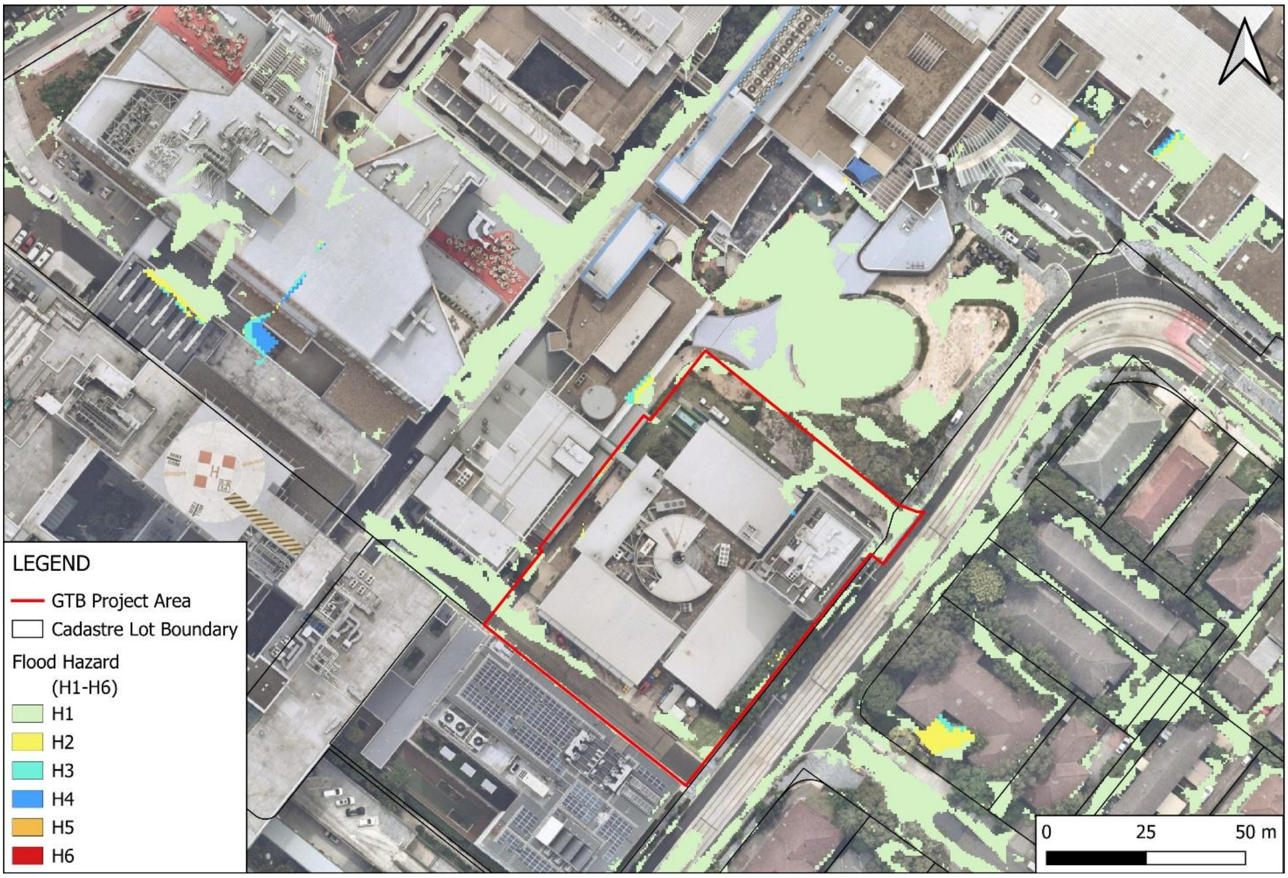

Figure 37 - 1% AEP Flood hazards – Post-Development Conditions

PMF Event

The estimated PMF flood depths, flood levels, flow velocities and flood hazards for the post-development site conditions are depicted in Figure 38, Figure 39, Figure *40* and Figure *41* respectively.

Flood results confirm that:

- The local flood behaviour in the post development conditions is generally similar to predevelopment conditions for the PMF event.
- The surrounding road areas in close proximity to the site, Hawkesbury Road and Research Lane, are estimated to generally experience flood depths of less than 200mm in the PMF event.
- Overland flows over the area near the north-western site boundary are as deep as 0.8m during the PMF event.
- The existing carpark to the north experiences flow depths of up to 0.75m in the PMF event.
- The crest of the ramp to the proposed basement carparking area of the Gene Technologies Building (i.e. near south-west corner of GTB site) has been set (i.e. at 21.13mAHD) to remain higher than the flood level estimated for the PMF event assessed, hence preventing the basement carparking area to be inundated by floodwater.
- Pools of floodwater are observed along the proposed building boundary and flood mitigation measures have been proposed (i.e. in the form of flood barriers or flood doors) on openings around the perimeter of the proposed building, to increase flood immunity and prevent floodwater from entering the building area. Refer to TTW's civil design drawings attached within TTW's SSDA Civil Engineering Report Revision B (Appendix B) for the proposed flood mitigation measures proposed.

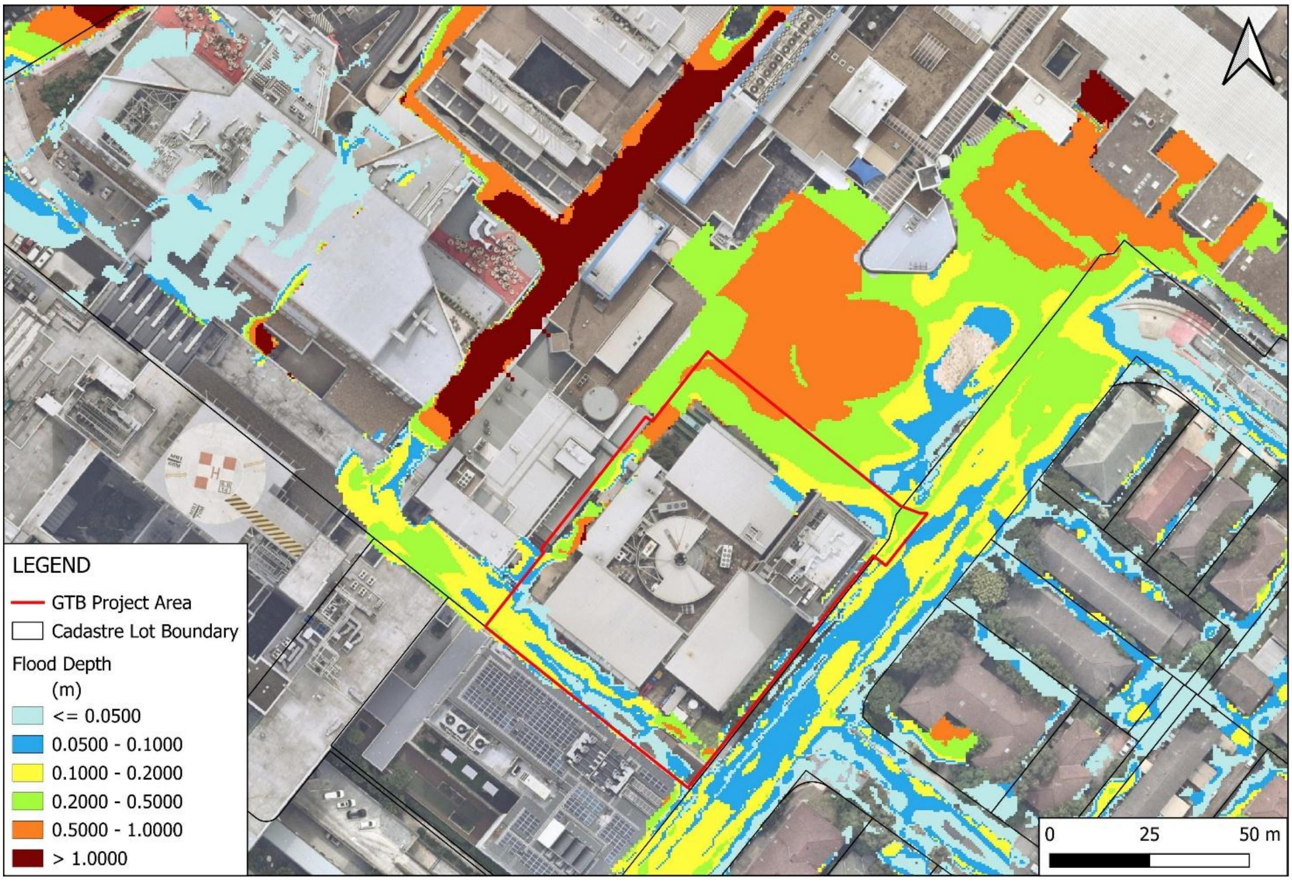

Figure 38 - PMF Flood Depths – Post-Development Conditions

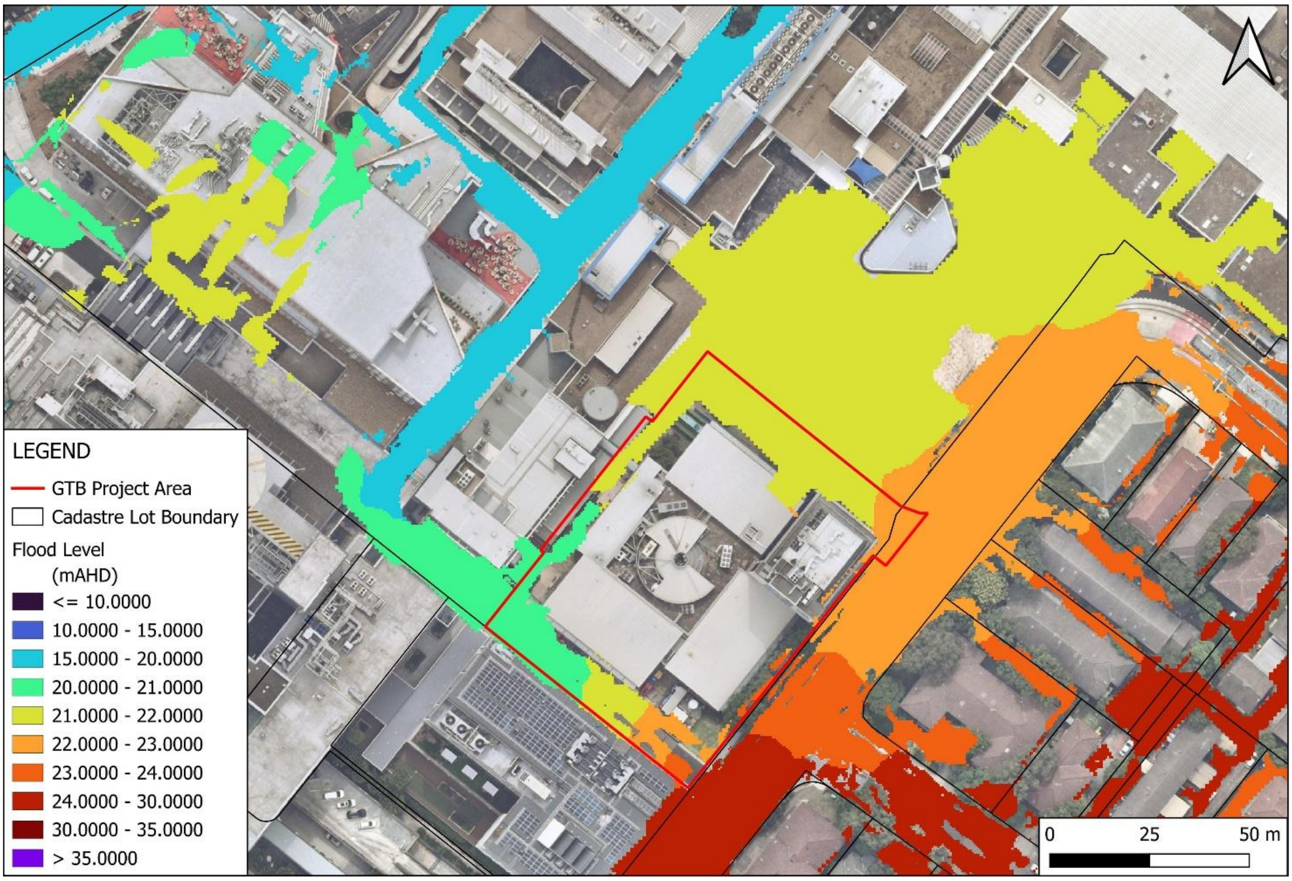

Figure 39 - PMF Flood Levels – Post-Development Conditions

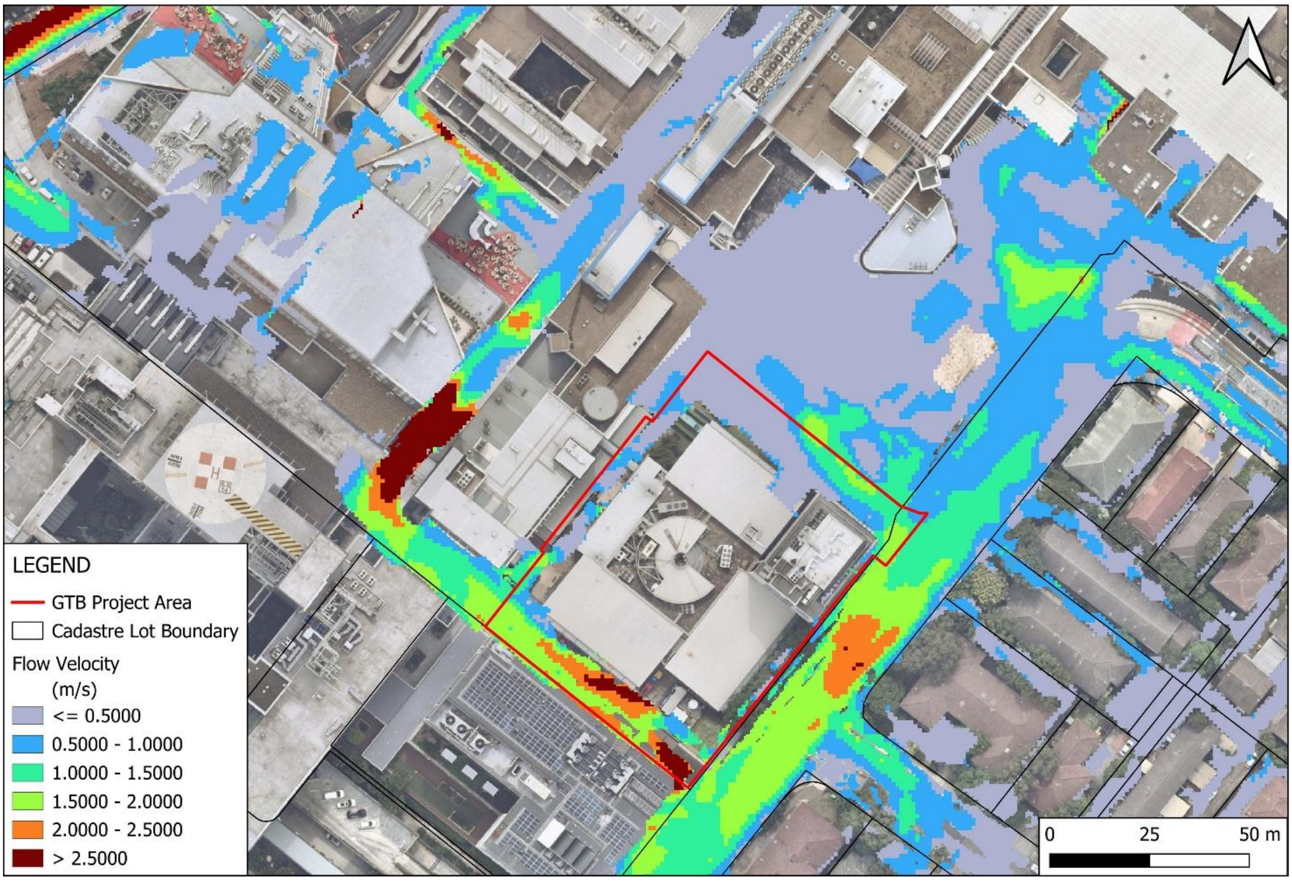

Figure 40 - PMF Flow Velocities – Post-Development Conditions

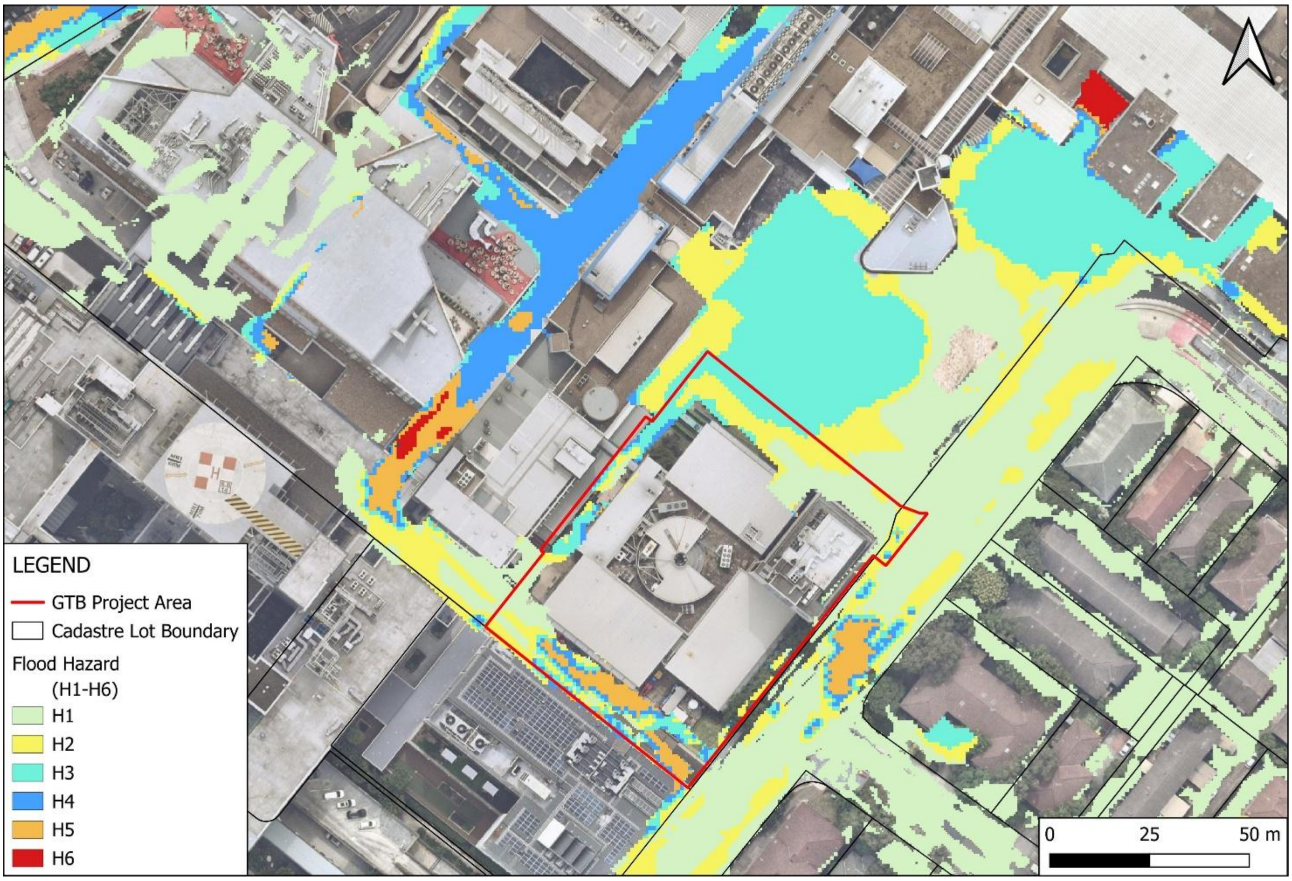

Figure 41 - PMF Hazards – Post-Development Conditions

4.4 Summary of Results

Table 4 provides a summary of the change in flood level and flood hazard in the existing and post-development scenarios across various point locations across the site. Refer to Figure 42 for location reference.

Table 4 - Summary of 1% AEP and PMF flood levels and hazards in existing vs post-development scenarios. Refer to Figure 42 for point location.

Point Location		1% AEP				PMF			
		*Level (m AHD)		*Hazard		*Level (m AHD)		*Hazard	
		Existing	Post	Existing	Post	Existing	Post	Existing	Post
A	Basement entry	20.5	20.5	H1	H1	20.6	20.6	H2	H1
B	Main entry	21.6	-	H1	-	22.0	22.0	H2	H1-2
C	Fire stair exit & loading dock	-	-	-	-	-	-	-	-
D	Fire stair exit	-	21.5	-	H1	22.0	22.0	H3	H2
E	Pedestrian entry	-	-	-	-	-	-	-	-
F	Existing car park	21.4	21.4	H1	H1	22.0	22.0	H3	H3
G	Kids park	21.4	21.4	H1	H1	22.0	22.0	H3	H3
H	Research Lane	-	-	-	-	21.2	21.2	H5	H5
I	Hawkesbury Road	-	-	-	-	23.0	23.0	H5	H5

* Note that a dash (-) indicates that the area is not affected by flooding.

Figure 42 - Point locations for levels and hazard information included within Table 4

4.5 Offsite Flood Impact Assessment

A flood impact assessment was carried out to ensure the proposed development would not cause any offsite impact beyond the accepted +10mm on nearby roads and properties in the 1% AEP event. The results show that increases in flood levels as high as 22mm are estimated over some areas north of the GTB project boundary, within the existing carpark and Kids Park areas. Although this estimated flood level afflux area is located outside the GTB project boundary, it remains within the lot boundary owned by the Children's Hospital Westmead (i.e. within Lot 101 DP 1119583). It is therefore considered acceptable.

Furthermore, a small area on Hawkesbury Road corridor north-east of Ainsworth Tower is estimated to be inundated in the 1% AEP event (i.e. flood free in the pre-development conditions). The inundation of this small area on Hawkesbury Road corridor is unavoidable due to the lowering of the area to tie-in with the road levels. Although this is so, the estimated flood hazard in this newly impacted area is categorised as H1 which is considered to be safe for traffic. It is therefore also considered to be acceptable.

Based on the above, the offsite flood impacts due to the proposed GTB redevelopment are considered to be within the accepted range and will not result in additional flood risks in the 1% AEP event. Further, previous flood studies of the area (as discussed in Section 2.2) have confirmed that the site is not impacted by mainstream flooding (i.e. flooding from the nearby Toongabbie Creek and Parramatta River). As such, the proposed development will not have any adverse offsite impacts, nor will it impact hydrology, drainage lines, downstream assets or watercourses. The 1% AEP flood level affluxes map is shown in Figure *43*.

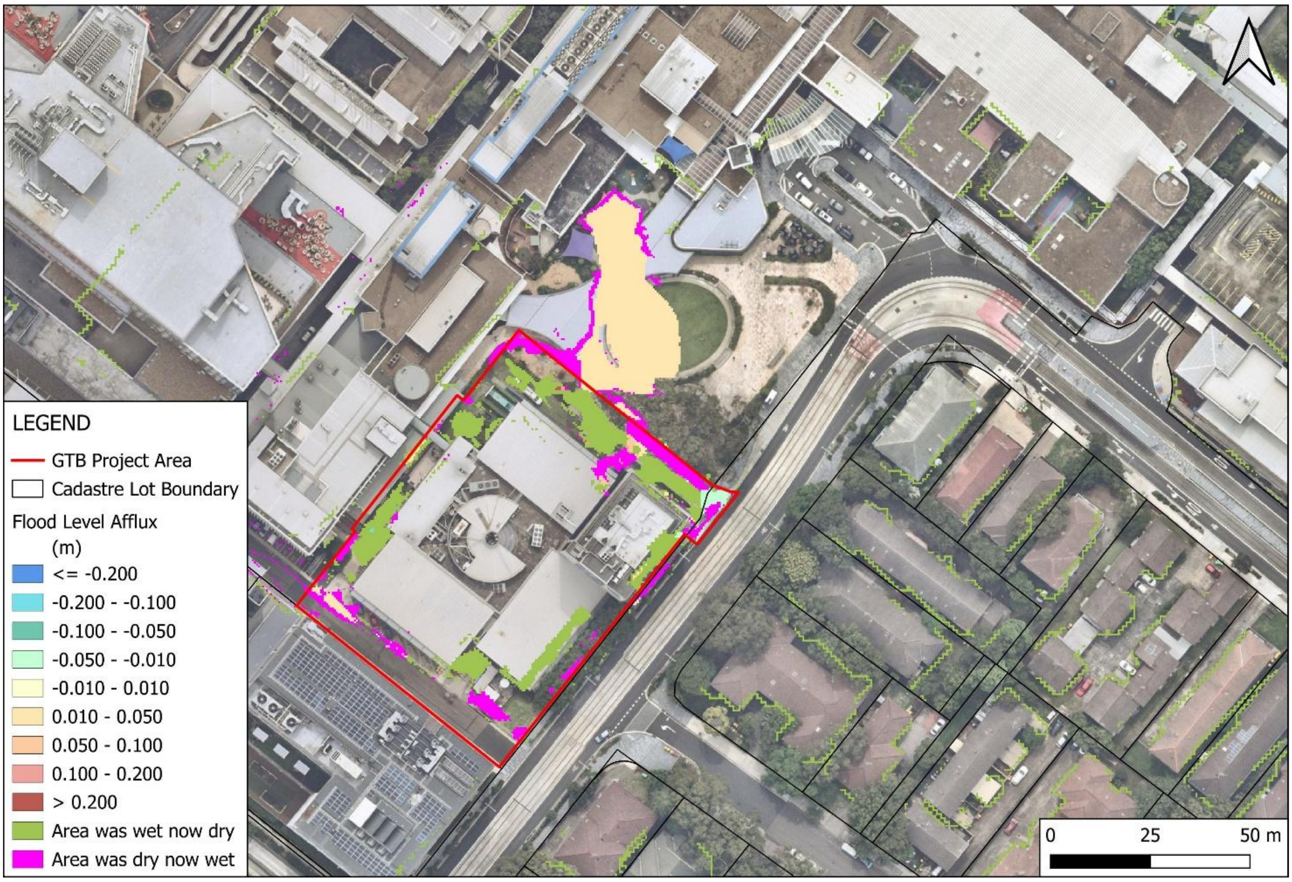

Figure 43 - 1% AEP Flood Level Impact (Post-Development – Pre-Development)

It is understood that flood impact assessment (especially to assess the likely flood level increases) will generally not be required for the PMF event, but for consistency of reporting and to understand the full spectrum of likely flood impacts the proposed GTB redevelopment works will have to the surrounding areas, flood level affluxes map has also been prepared for the PMF event. These affluxes are shown in Figure *44*. The results show that a much larger area (especially to the north of GTB project boundary) experiences increases in flood levels of more than 10mm. Despite these additionally impacted areas, the maximum flood level increases for the areas to the north is 27mm.

The maximum flood level increases on the Hawkesbury Road corridor, north-east of Ainsworth Tower is estimated to be around 50mm in the PMF event. The maximum flood level increases near the main entrance to the Children's Hospital Westmead (i.e. road where Hawkesbury Road and Hainsworth Street meet) is estimated to be 17mm or less. Nonetheless, the estimated PMF flood hazards for the GTB site's surrounding areas remained generally similar to that of the pre-development conditions.

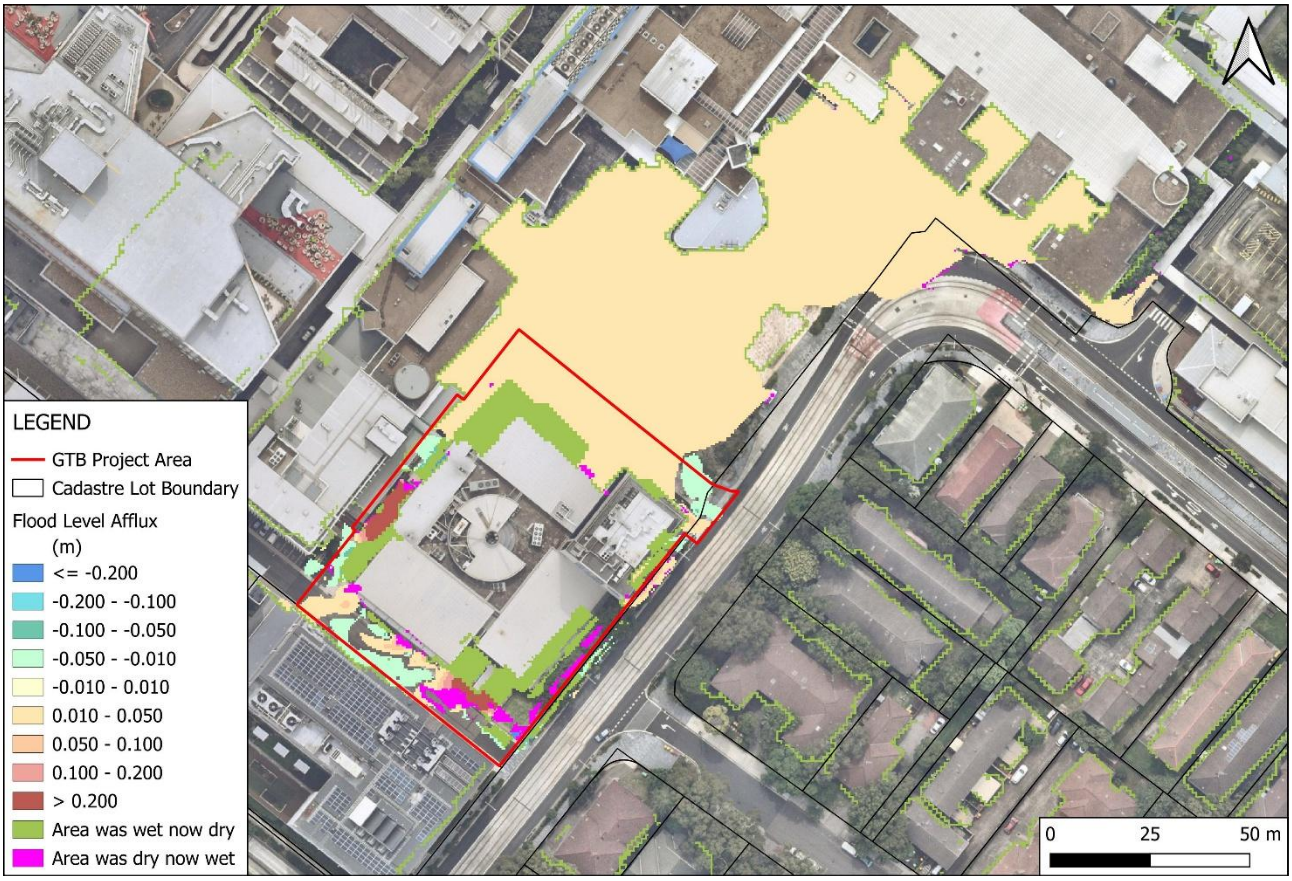

Figure 44 - PMF Flood Level Impact (Post-Development – Pre-Development)

4.6 Climate Change

Based on a previous Flood Impact Assessment reports prepared by Arup for the Children's Hospital Westmead Paediatric Services Building and Kids Park developments (2021 and 2023 respectively), the 0.5% AEP and 0.2% AEP events have been adopted in the modelling as proxy of the 1% AEP climate change event.

As this GTB redevelopment assessment is based on the TUFLOW model provided by Arup and used for the above studies, the same approach to storms used for climate change has been adopted. As such, three storm events (15min, 30min and 540min storms) have been simulated for both the 0.5% AEP and 0.2% AEP events, similar to the 2021 and 2023 Arup's assessments.

The modelling results show that the overland flow flooding, in the CMRI threshold, do not change noticeably from 1% AEP to the 0.5% AEP and 0.2% AEP events (i.e. within 100mm). The 0.5% AEP and 0.2% AEP flood levels for the post-development site conditions are depicted in Figure 45 and Figure 46 respectively.

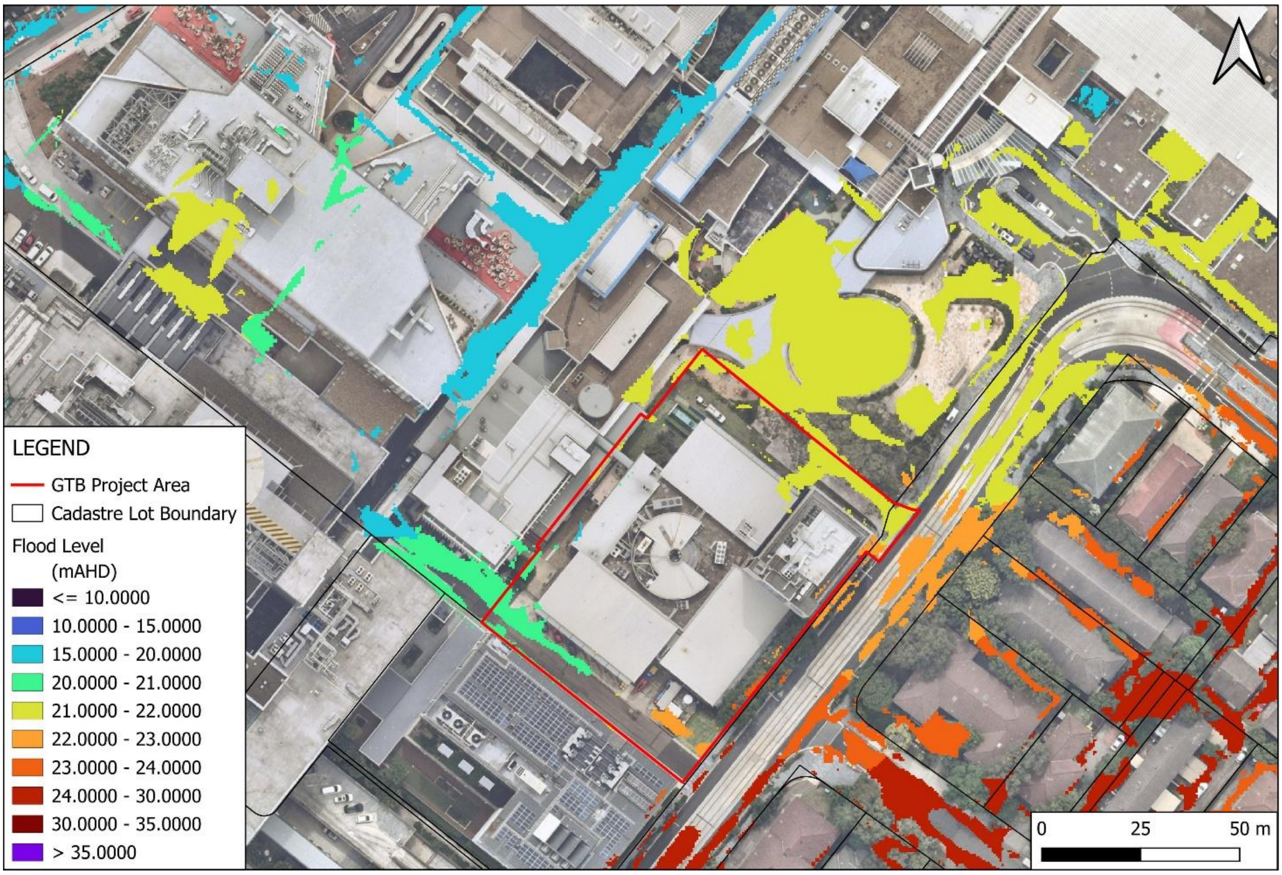

Figure 45 - 0.5% AEP Flood Levels – Post-Development Conditions

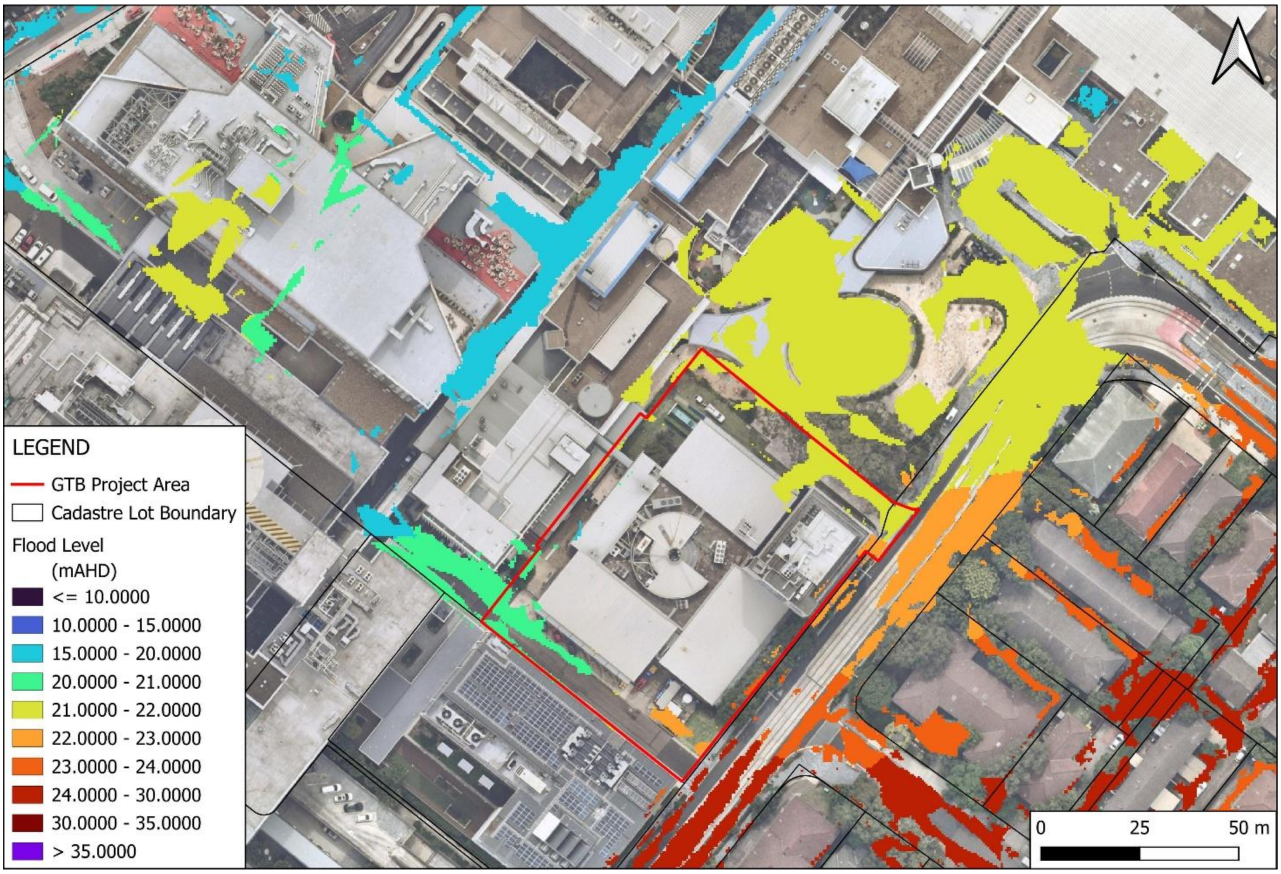

Figure 46 - 0.2% AEP Flood Levels – Post-Development Conditions

5.0 Parramatta River Flood Study Modelling

As outlined in Section **Error! Reference source not found.**, CPHR have requested additional flood modelling works are carried out that are based on the 2024 Parramatta River Flood Study (PRFS) TUFLOW model.

TTW contacted Parramatta Council in February 2026, who advised that the modelling assessment should be conducted using the Main Parramatta River Flood Study TUFLOW model. The model was subsequently obtained in March 2026 for use in this assessment. The PRFS flood model is simulated using TUFLOW version 2020-10-AA single precision in HPC scheme, similar to the version adopted in the CHW TUFLOW model discussed in sections above. However, the PRFS TUFLOW model does not adopt the SGS function to further improve its topographical representation of the modelled area.

A summary of the key differences in the CHW and PRFS model set up is outlined in Table 5.

Table 5 - Comparison of CHW and PRFS model setup

	CHW Model	PRFS Model
Hydrology	ARR 1987	ARR 2019
Model inflow	Rainfall-on-grid (ROG)	Source area (SA)
Grid resolution	1 metre with SGS	2 metres
1% AEP storm durations assessed	15 min, 25 min, 90 min, 120 min, 540 min	2hr, 6hr, 12hr
1% AEP critical duration	15 min	2hr

The model domain adopted in the PRFS TUFLOW model covers an area of approximately 26.4km^2, which extends approximately 7km upstream and 12km downstream of the Parramatta River from the GTB site. The extent of the PRFS TUFLOW model is shown in Figure 47.

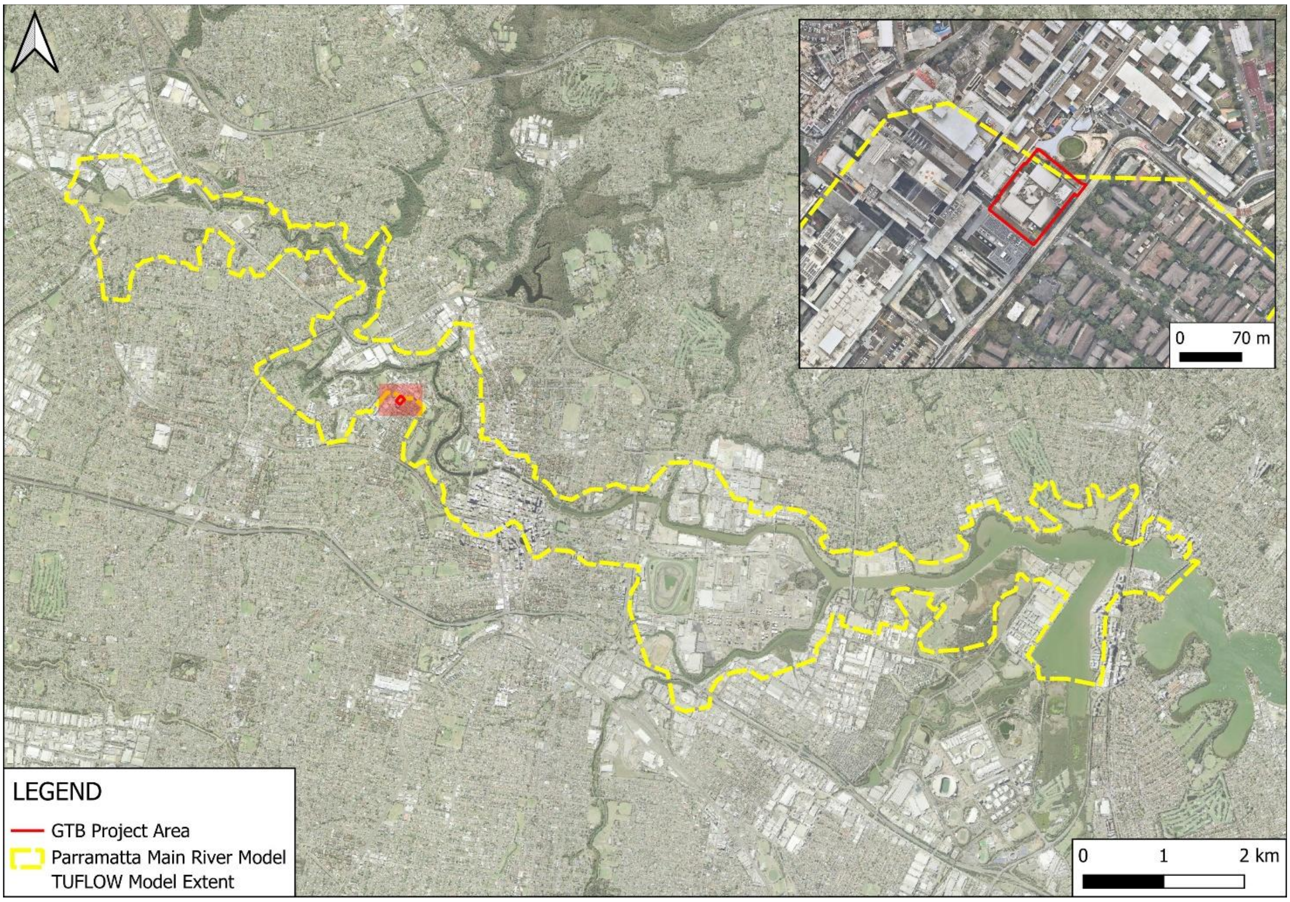

Figure 47 - PRFS TUFLOW Model Extent

5.1 Methodology

The PRFS TUFLOW model uses a 2m grid cell size, which is considered to be sufficiently fine for the purpose of the PRFS study area. The footprints of buildings within the model domain were defined with nulled cells to prevent floodwater from flowing through. There are some stormwater pipes, culverts, manholes and pits included as 1D components within the PRFS TUFLOW model. As the PRFS is a river catchment wide study, it does not consider all individual urban local stormwater network system in the TUFLOW model. In particular, stormwater network upgrades as part of the Parramatta Light Rail project on Hawkesbury Road and the surrounding Westmead Health Precinct are not considered. It is also worth noting that the PRFS adopted the 2019 ARR design rainfall methodology.

The original PRFS TUFLOW model were initially simulated for all the design storm durations provided within the Council model, for the 1% AEP, 1% AEP with climate change consideration (1% AEP CC) and PMF events, to determine the design storm that is considered critical for the GTB site area. This is to minimise the amount of simulation times required, given the size of the PRFS model. Initial modelling shows that the 2-hour storm is critical in the 1% AEP and 1% AEP CC events, while the 3-hour storm is critical in the PMF event. Therefore, these critical design storm events have been adopted in the subsequent flood assessment works. As the PRFS TUFLOW model is not using the rainfall-on-grid method, no cutoff depth has been adopted in the PRFS modelling.

While TTW implemented some changes to the original PRFS TUFLOW model provided by Council, the majority of the modelling parameters adopted within the PRFS TUFLOW model have been maintained in this GTB assessment, including the version of TUFLOW adopted for the simulation. Changes made to the original PRFS TUFLOW model are discussed in Section 5.1.1 below.

5.1.1 Modelling Scenarios and Updates Adopted

Similar to the CHW modelling carried out (i.e. as discussed in Section 3.8), two modelling scenarios were assessed using the PRFS TUFLOW model as part of this GTB assessment, and include:

- Pre-development Scenario – the GTB site has been represented as it exists now. In this scenario, the GTB site, Westmead Hospital Kids Park, surrounding Parramatta Light Rail and the immediate surrounding Westmead Health Precinct areas have been updated with the surface representation adopted in the CHW model. The surface elevation data adopted in the CHW model for these areas are either based on as-constructed data, surveyed data or design data. This is considered to more accurately represent the GTB and its immediate surrounding areas when compared to the original PRFS model. The extent and surface tins updated in the PRFS TUFLOW model are summarised in Figure 48. Further, the stormwater networks within the Westmead Health Precinct area, including the upgrade works carried out as part of the Parramatta Light Rail project (i.e. as adopted in the CHW modelling) have been incorporated into the original PRFS TUFLOW model. Figure 49 shows the location and extent of the stormwater networks incorporated into the original PRFS TUFLOW model for this GTB assessment.
- Post-development Scenario – in this scenario, the works proposed as part of the GTB redevelopment have been considered and incorporated into the pre-development model. Design levels for the areas surrounding the proposed building footprint of GTB were incorporated into the pre-development model. The design TIN adopted is the same as that adopted in the CHW model, as shown in Figure 24. The GTB building footprint has also been adjusted to reflect the proposed building extent, similar to that adopted in the Post-Development Scenario of the CHW modelling.

Figure 48 - CHW Model Surface TINS Updated in the PRFS TUFLOW Model

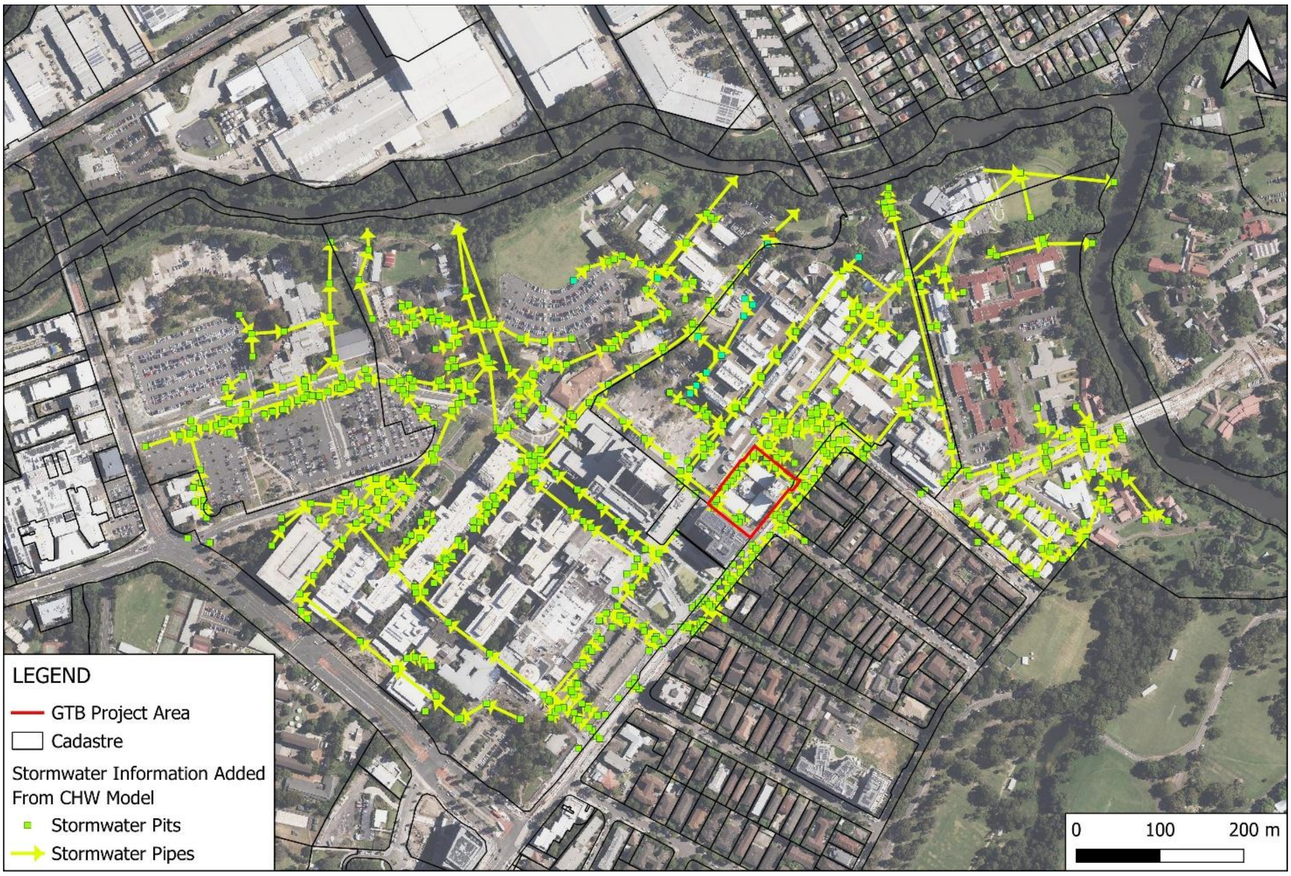

Figure 49 - Westmead Health Precinct Stormwater Networks Incorporated into the PRFS TUFLOW Model

As described above, the relevant surface elevation data contained within the CHW model were incorporated into the PRFS model to more accurately represent the subject site and surrounding vicinity. The ground surface area in both models is therefore similarly represented, as shown in the cross-sectional elevation profile across the Kids Park area in Figure 50.

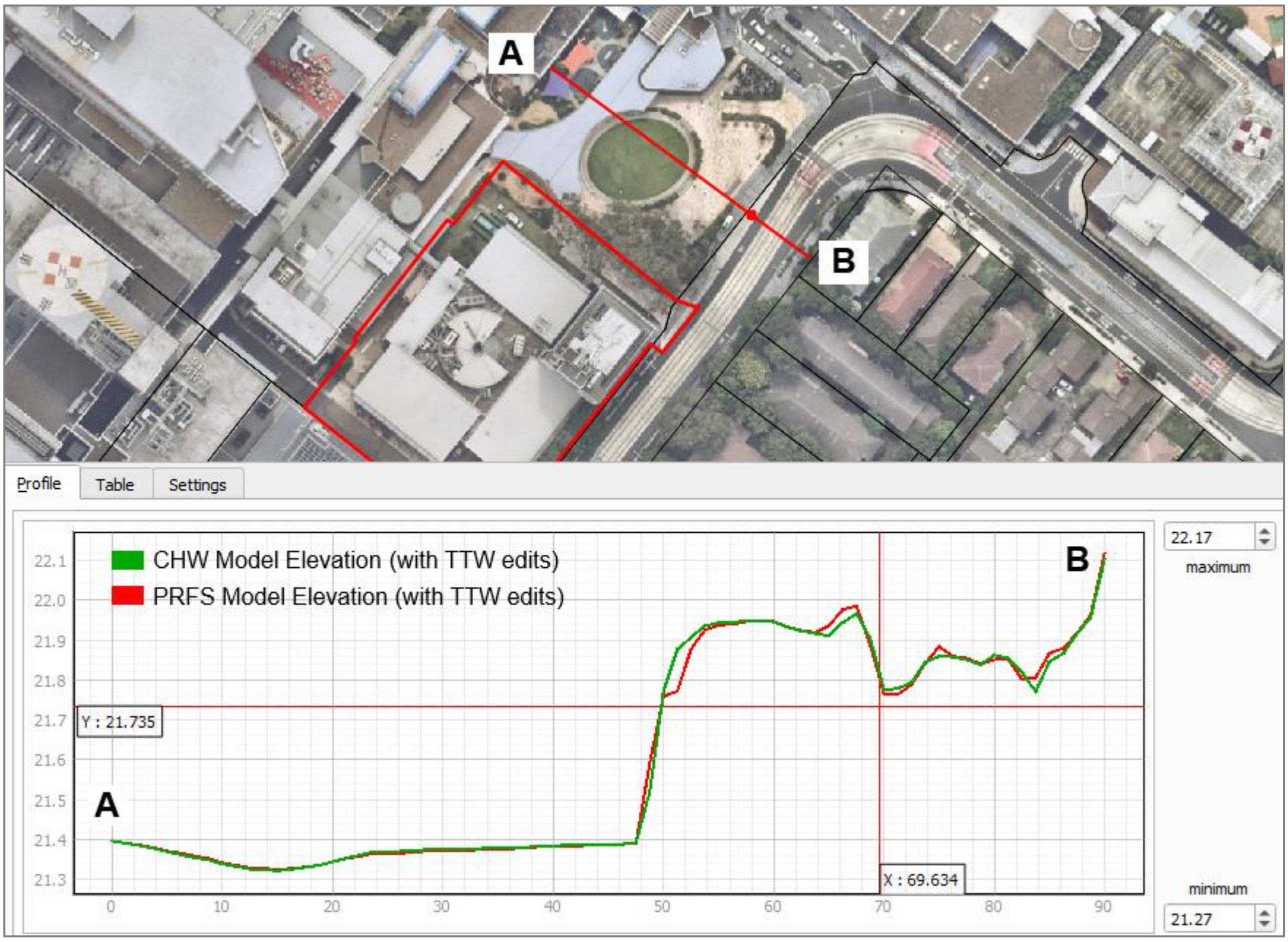

Figure 50 - Elevation profile (m AHD) across the Kids Park area in the Existing Scenario CHW Model (green line) and in the PRFS Model (red line).

5.1.2 Modelling Limitations and Assumptions

Initial modelling of the Pre-Development Scenario PRFS TUFLOW model developed as part of this GTB assessment indicates that there are instability issues related to the 1D/2D interface of the added stormwater networks within the Westmead Health Precinct area, which are not present in the CHW modelling. Further investigations show that such instability issues are mainly caused by the frequent wet-dry conditions at pits and the sudden increased in flows at pits within the Westmead Health Precinct. The instability issues are also attributed to the considerably coarser model grid adopted in the PRFS modelling (i.e. without SGS) when compared to the CHW modelling (i.e. with SGS at 1m interval). The instability has resulted in unrealistic estimated flood levels at some locations within the Westmead Health Precinct area, therefore some adjustments were made to the model simulation parameters (i.e. not stormwater networks or surface representation data in the model) to minimise the instability and ensure that estimated flood levels within the Westmead Health Precinct area are reasonable.

Further, stormwater networks within the Westmead Health Precinct area that were incorporated into the PRFS TUFLOW model as part of this GTB assessment have been assumed to be fully blocked in the PMF event to avoid the instability induced as a result of sudden increase in excessive flows being applied to the pits and stormwater networks. This is considered appropriate and generally adopted assumptions, as ignoring the stormwater networks in the modelling for the PMF event will not have significant effects on the estimated flood levels since the PMF flows will be significantly greater than the capacity of the underground stormwater networks.

Other aspects of the PRFS model setup significantly impact on the representation of flood behaviour at the site, including the method of inflow application (incorporation of Source Areas) and the coarser grid resolution. This is discussed in further detail in Section 6.2.

Nonetheless, flood and impact assessments have been carried out for the PRFS modelling to determine the likely impacts that the proposed GTB development will have to the surrounding properties, in response to CPHR's requirements. PRFS modelling and assessment completed for the GTB development are discussed in the following Section 5.2.

5.2 Modelling Results

5.2.1 Pre-Development Conditions

<u>1% AEP Event</u>

1% AEP flood depths, flood levels, flow velocities and flood hazards for the pre-development conditions are represented in Figure 51, Figure 52, Figure 53 and Figure 54 respectively.

Flood results for existing conditions show that Hawkesbury Road and Research Lane are generally not affected by flooding in the 1% AEP flood event assessed. As discussed in Section 5.1.2, this is mainly due to the catchment inflow's method being adopted in the PRFS modelling where all catchment inflow is being applied to the Kids Park area (i.e. north-east of proposed development area). Flood depths at majority of the Kids Park area and northern end of the existing GTB building are generally greater than 200mm, with floodwater trapped within the Kids Park area. The modelling results show that flooding at the GTB site area is not affected by flooding in the Parramatta River system in the 1% AEP event assessed, as the flood levels at the GTB site area are at the order of 21.6mAHD whereas flood levels at the Toongabbie Creek (i.e. approximately 310m north of the GTB site) are estimated to be in the order of 11.5mAHD.

The 1% AEP flow velocities for the GTB project area and its immediate surrounding areas are generally estimated to be less than 0.5m/s.

Hazard is generally low at H1, although higher flood hazards of H2 are estimated at the low points of the Kids Park and flood hazards of H3 are estimated at the west in the 1% AEP event assessed. These higher than H1 flood hazards estimated for the GTB site and Kids Park area are mainly due to the high flood depths estimated.

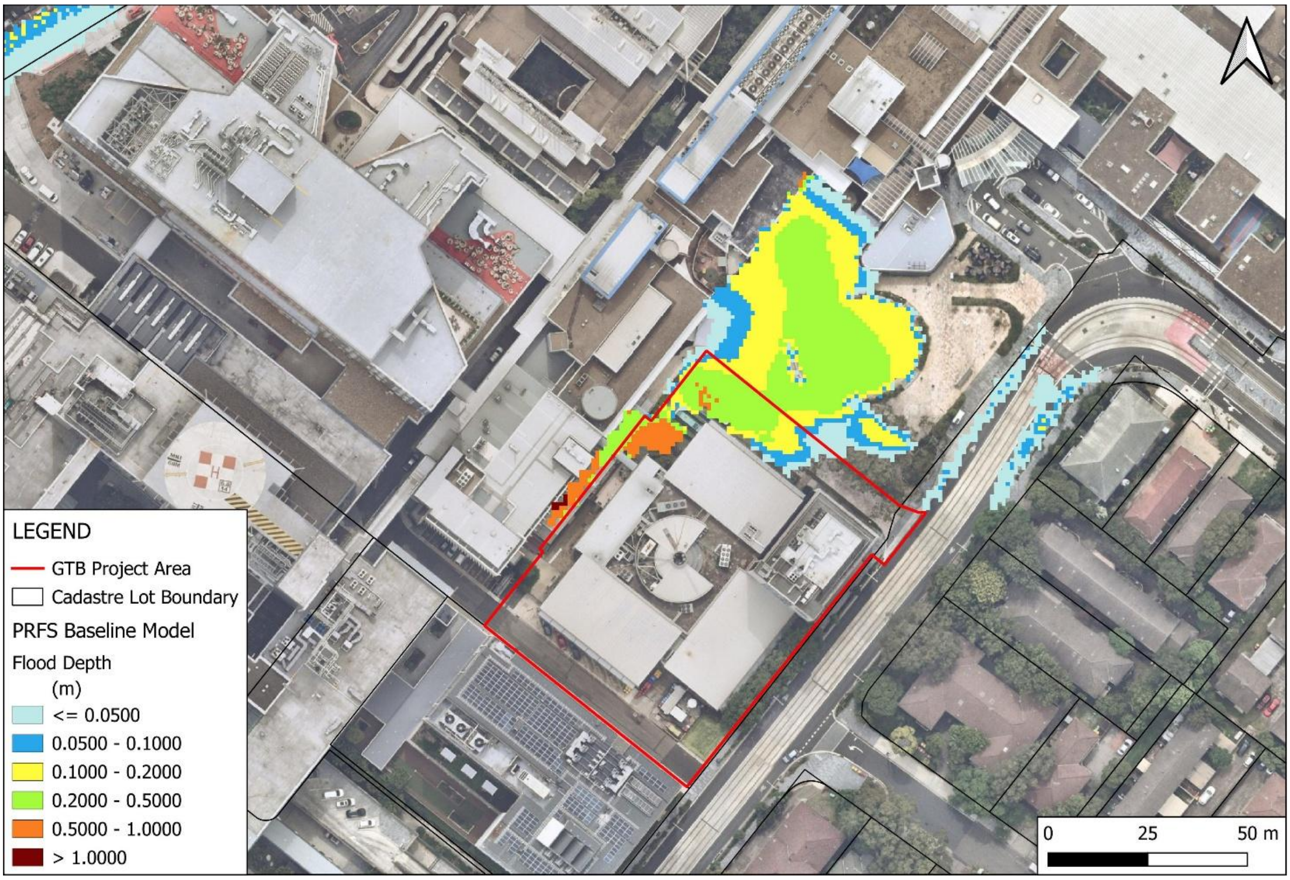

Figure 51 - 1% AEP Flood Depths – Pre-Development Conditions – 2024 PRFS Baseline Model

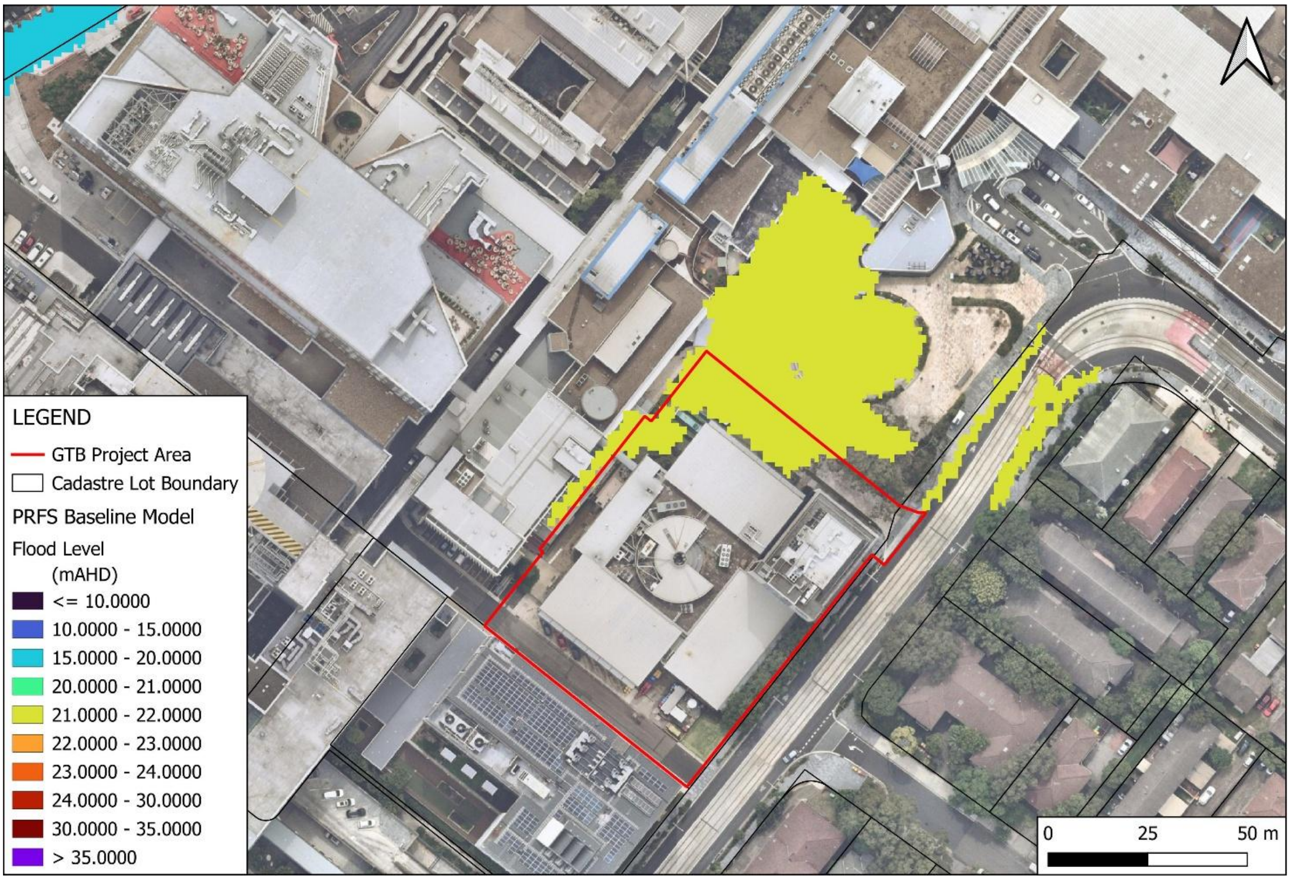

Figure 52 - 1% AEP Flood Levels – Pre-Development Conditions – 2024 PRFS Baseline Model

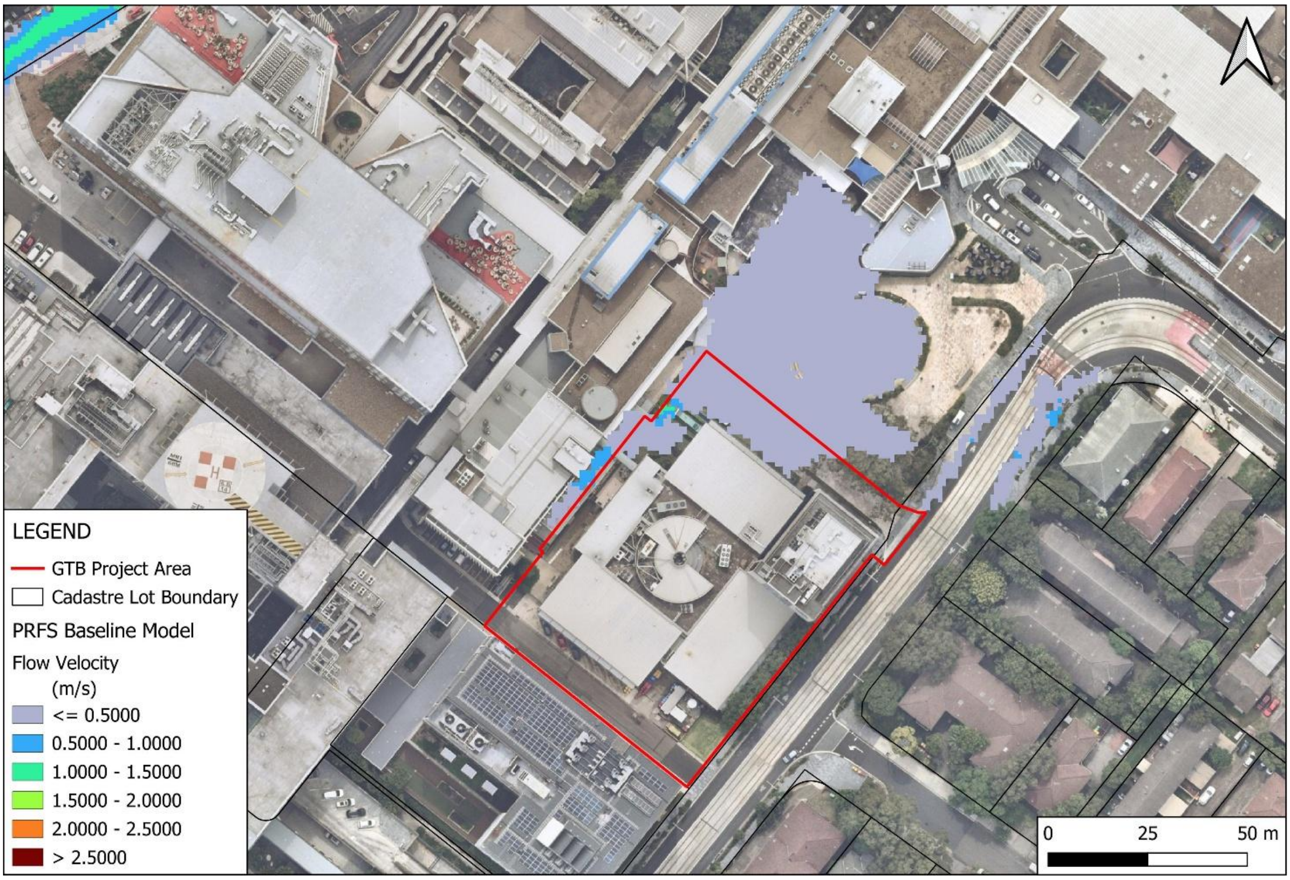

Figure 53 - 1% AEP Flow Velocities – Pre-Development Conditions – 2024 PRFS Baseline Model

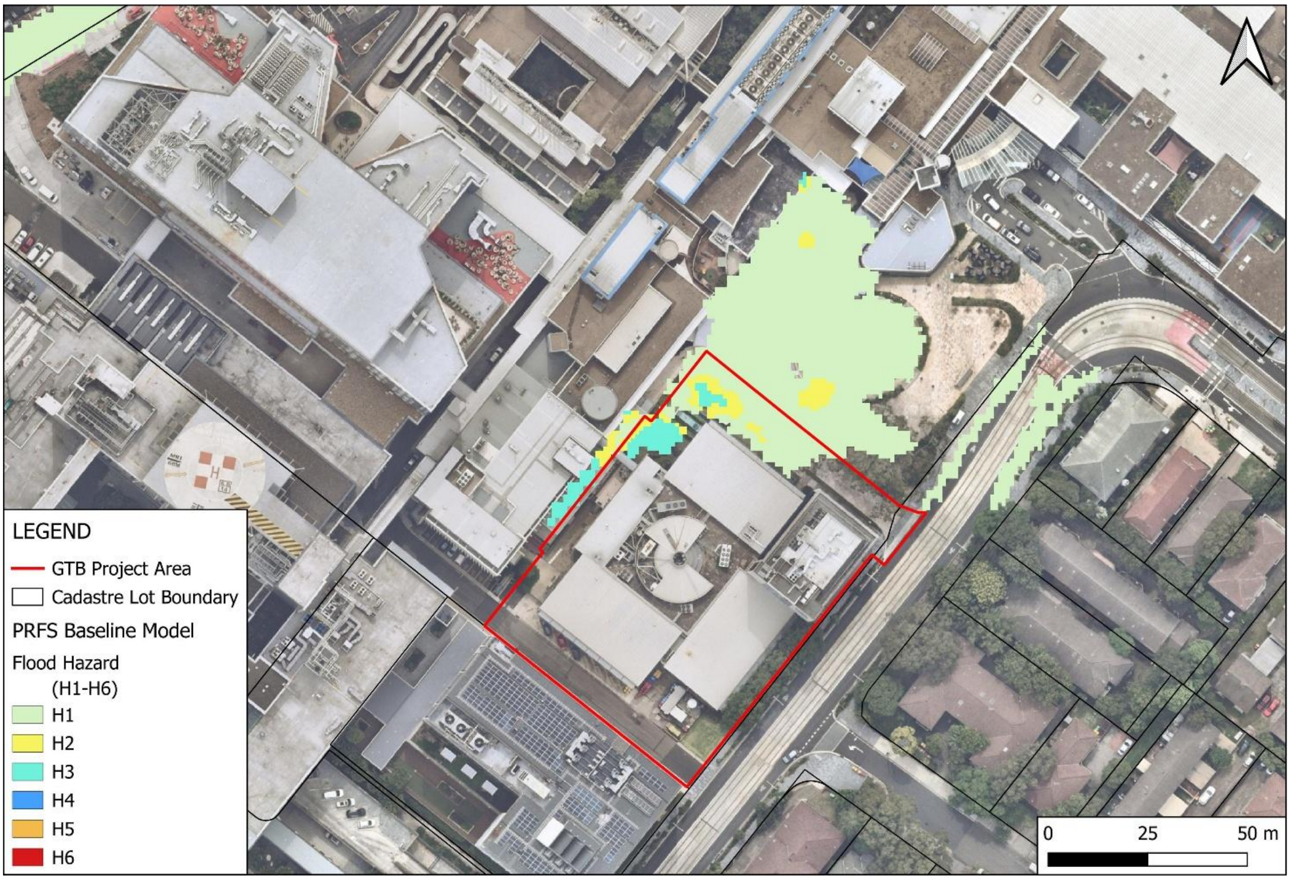

Figure 54 - 1% AEP Flood Hazard – Pre-Development Conditions – 2024 PRFS Baseline Model

<u>PMF Event</u>

Estimated flood depths, flood levels, flow velocities and flood hazards in the PMF event are shown in Figure 55, Figure 56, Figure 57 and Figure 58 for existing site conditions respectively.

Flood results for existing conditions show that the northern section of Hawkesbury Road and northern section of Research Lane are affected by flooding in the PMF flood event assessed. Modelling results show that floodwater initially ponded within the Kids Park area until flood level in the park is high enough to overtop the high points surrounding the Kids Park and inundate the Hawkesbury Road (i.e. north-east of GTB site) and Research Lane (i.e. south-west and west of GTB site).

Flood depths at parts of the Kids Park area and northern end of the existing GTB building are generally greater than 600mm. The modelling results show that flooding at the GTB site area is not affected by flooding in the Parramatta River system in the PMF event assessed, as the flood levels at the GTB site area are at the order of 22.0mAHD whereas flood levels at the Toongabbie Creek (i.e. approximately 310m north of the GTB site) are estimated to be in the order of 18.7mAHD.

The PMF flow velocities for the GTB project area and its immediate surrounding areas are generally estimated to be less than 0.5m/s, with pockets of higher velocities estimated near the western side of existing GTB building.

Flood hazards onsite as well as over the Hawkesbury Road and Research Lane range from H1 to H4 in the PMF event, based on the Australian Emergency Management Institute hazard categories. The high flood hazards in these areas are mainly due to the high flood depths.

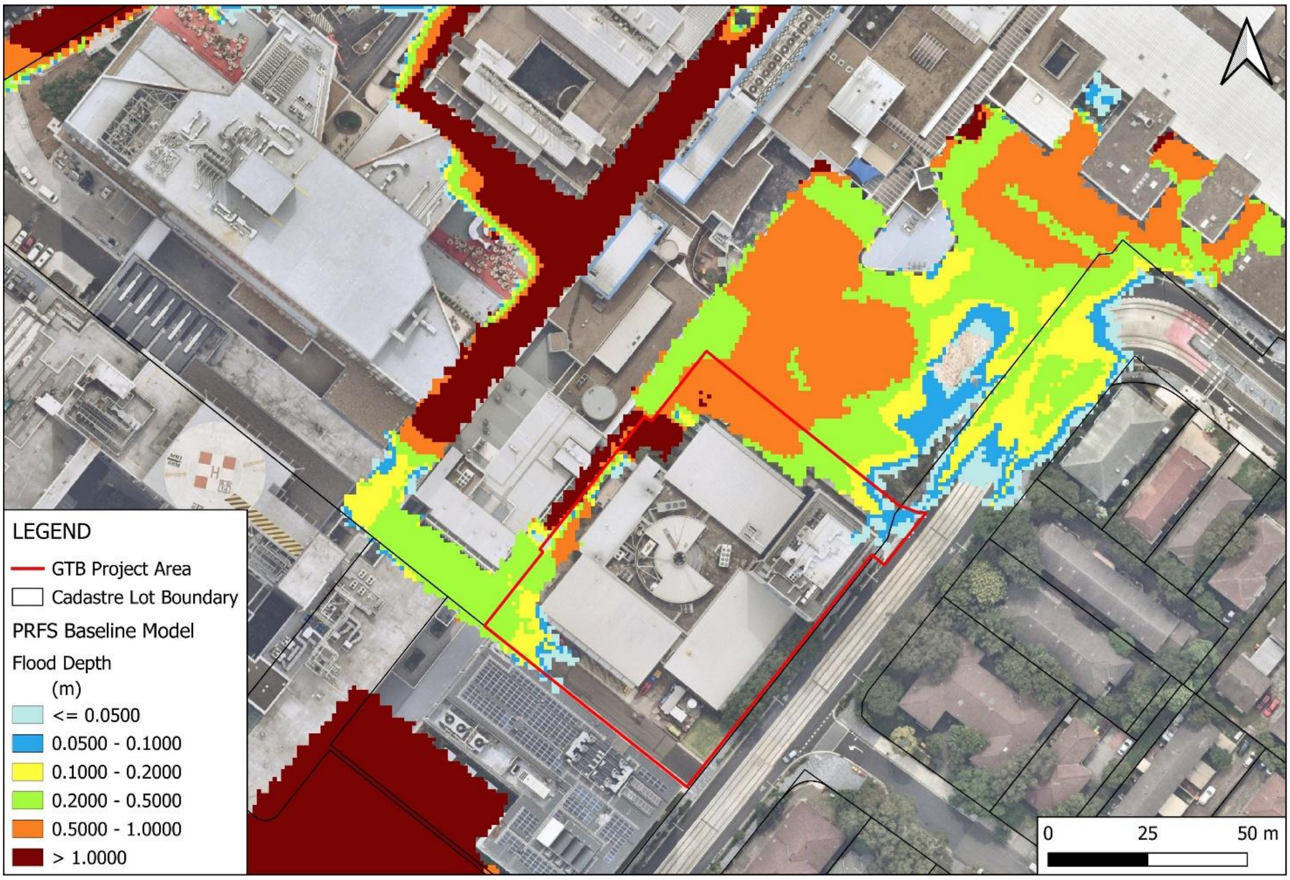

Figure 55 - PMF Depths – Pre-Development Conditions – 2024 PRFS Baseline Model

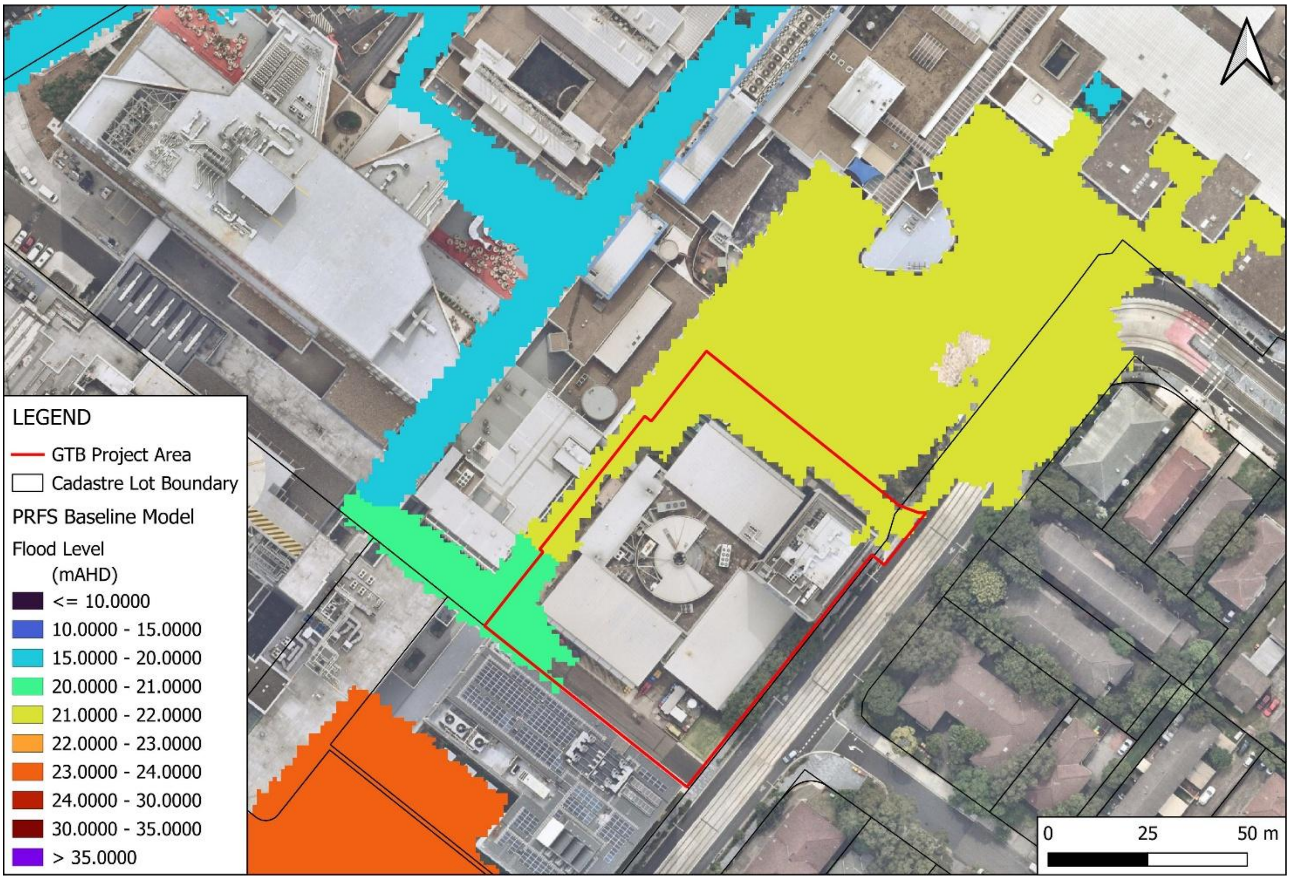

Figure 56 - PMF Levels – Pre-Development Conditions – 2024 PRFS Baseline Model

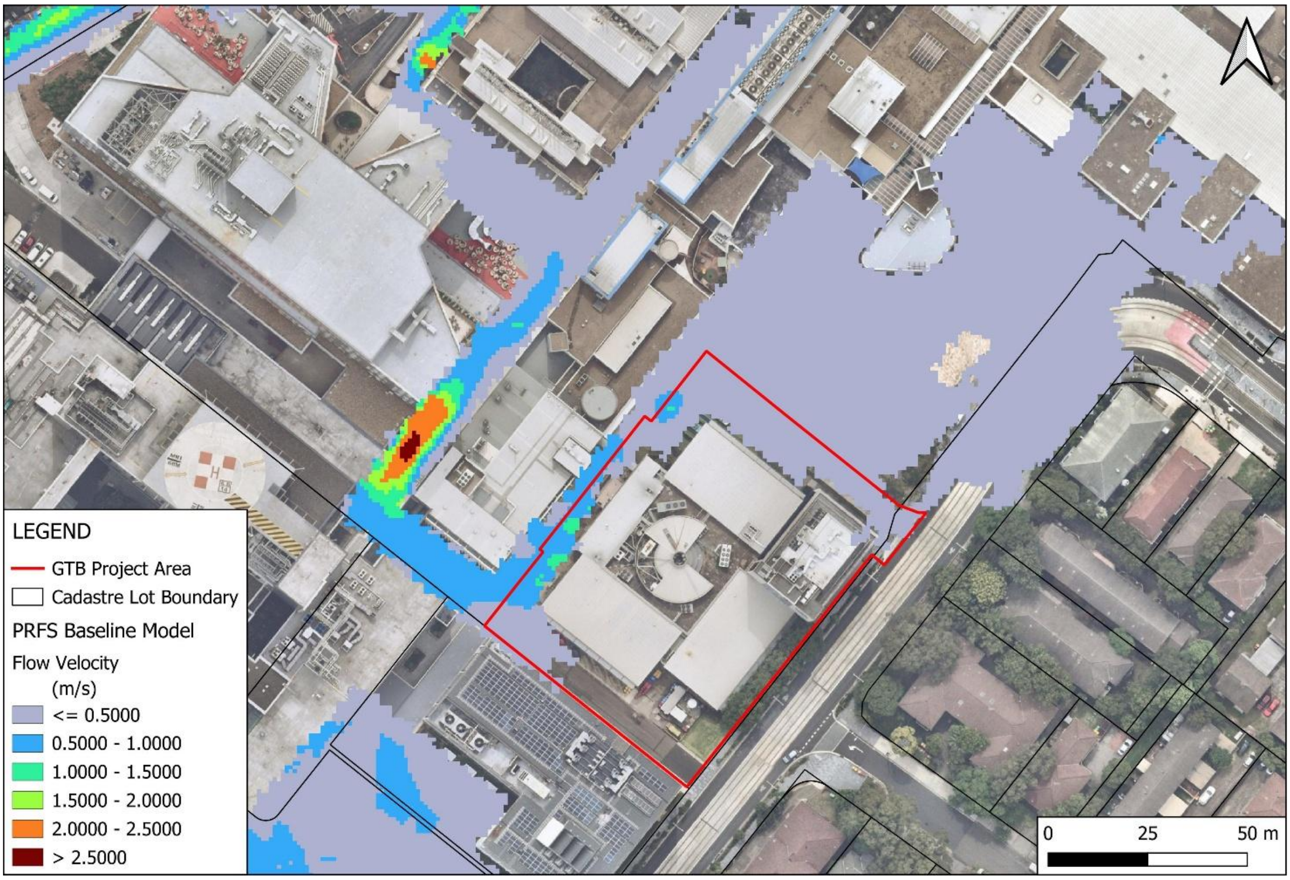

Figure 57 - PMF Flow Velocities – Pre-Development Conditions – 2024 PRFS Baseline Model

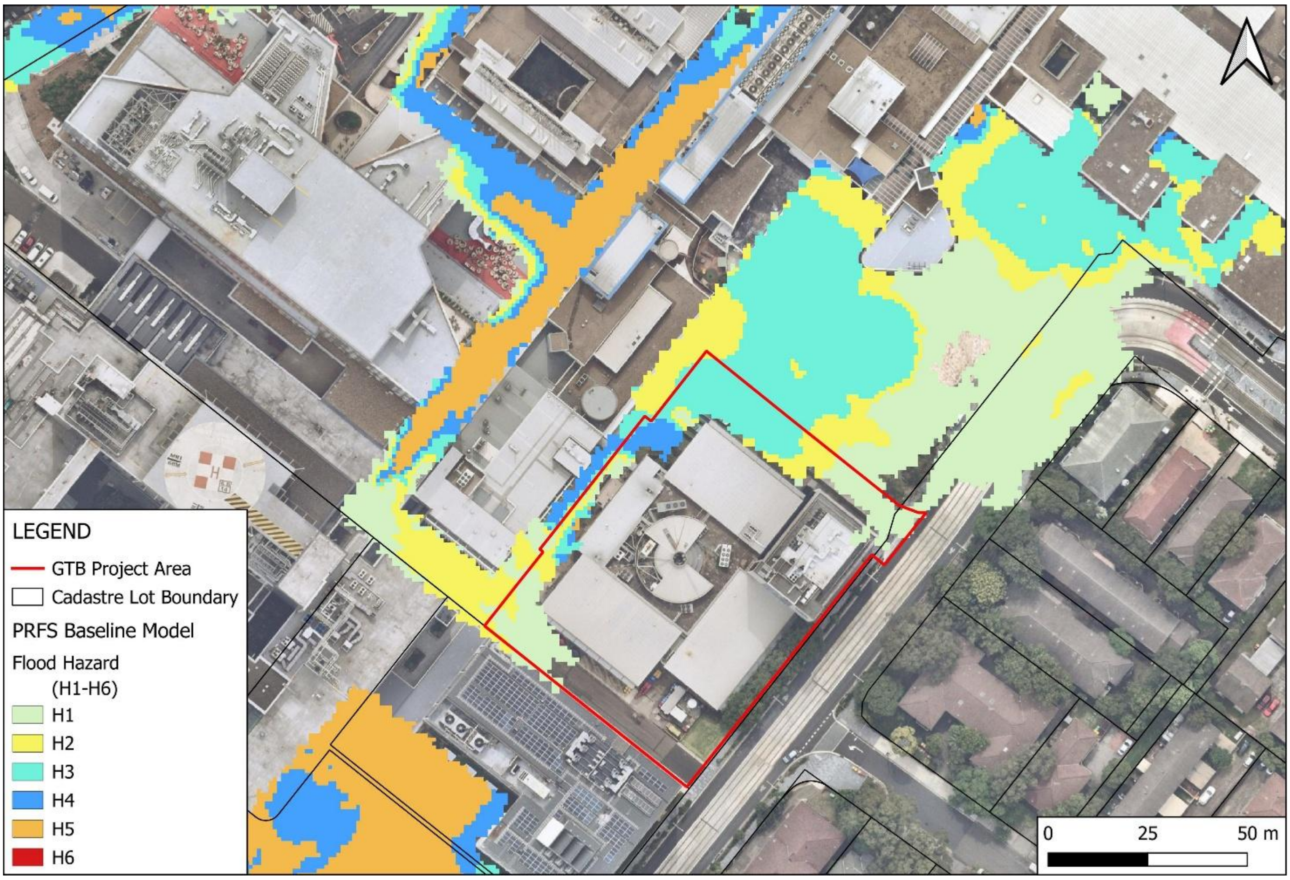

Figure 58 - PMF Hazard – Pre-Development Conditions – 2024 PRFS Baseline Model

5.2.2 Post-Development Conditions

1% AEP Event

1% AEP flood depths, flood levels, flow velocities and flood hazards for the post-development site conditions are represented in Figure 59, Figure 60, Figure 61 and Figure 62 respectively.

Flood results for the post-development scenario show that Hawkesbury Road and Research Lane have remained unaffected by flooding in the 1% AEP flood event assessed. Flood extent at the GTB site and Kids Park area are generally similar to that estimated for the pre-development scenario with the exception that there is additional inundation at the north and northeast of the development, while there are otherwise sections of 'was wet now dry' close to the building as a result of the change in building footprint.

Flood depths at majority of the Kids Park area and northern end of the proposed GTB building are generally greater than 300mm. The modelling shows that floodwater is being trapped within the Kids Park area in the 1% AEP event assessed. As discussed in Section 5.1.2, flooding in the Kids Park area is mainly due to the catchment inflow's method being adopted in the PRFS modelling where all catchment inflow is being applied to the Kids Park area (i.e. north-east of proposed development area). Similar to the pre-development scenario, the modelling results show that flooding at the GTB site area is not affected by flooding in the Parramatta River system in the 1% AEP event assessed, as the flood levels at the GTB site area are at the order of 21.7mAHD whereas flood levels at the Toongabbie Creek (i.e. approximately 310m north of the GTB site) are estimated to be in the order of 11.5mAHD.

The 1% AEP flow velocities for the GTB project area and its immediate surrounding areas are generally estimated to be less than 0.5m/s.

Higher flood hazards of H2 are estimated at the low points of the Kids Park. These higher than H1 flood hazards estimated for the GTB site and Kids Park area are mainly due to the high flood depths estimated.

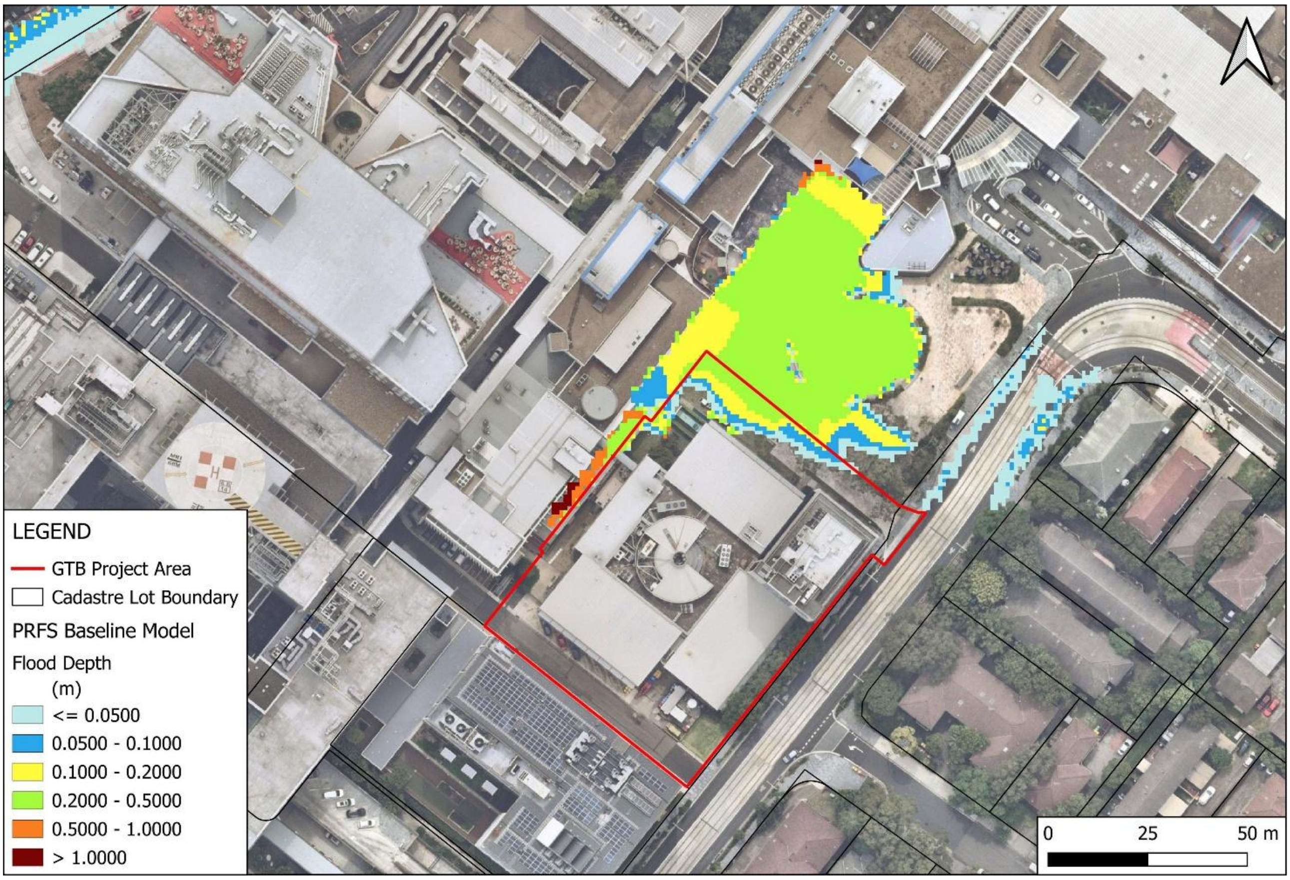

Figure 59 - 1% AEP Flood Depths – Post-Development Conditions – 2024 PRFS Baseline Model

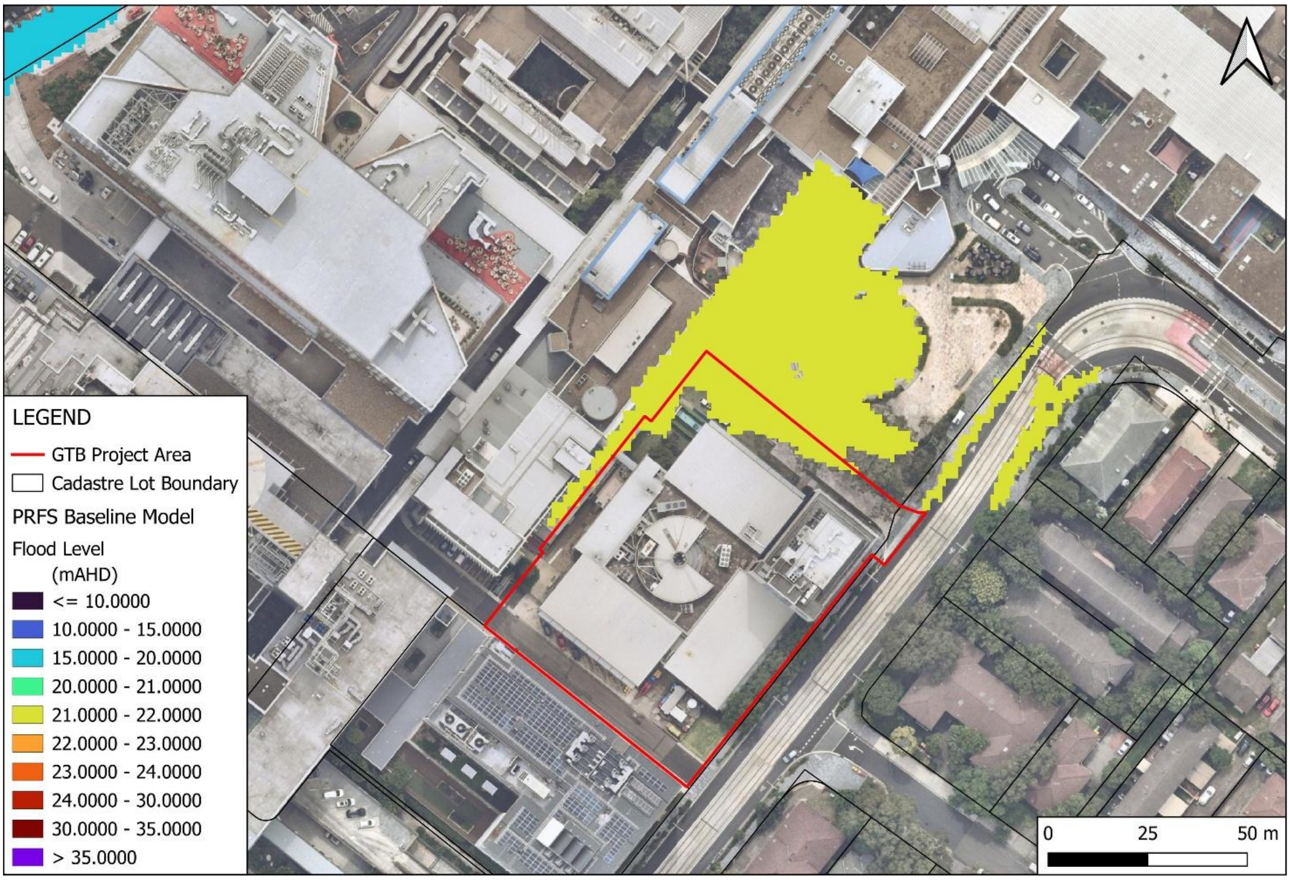

Figure 60 - 1% AEP Flood Levels – Post-Development Conditions – 2024 PRFS Baseline Model

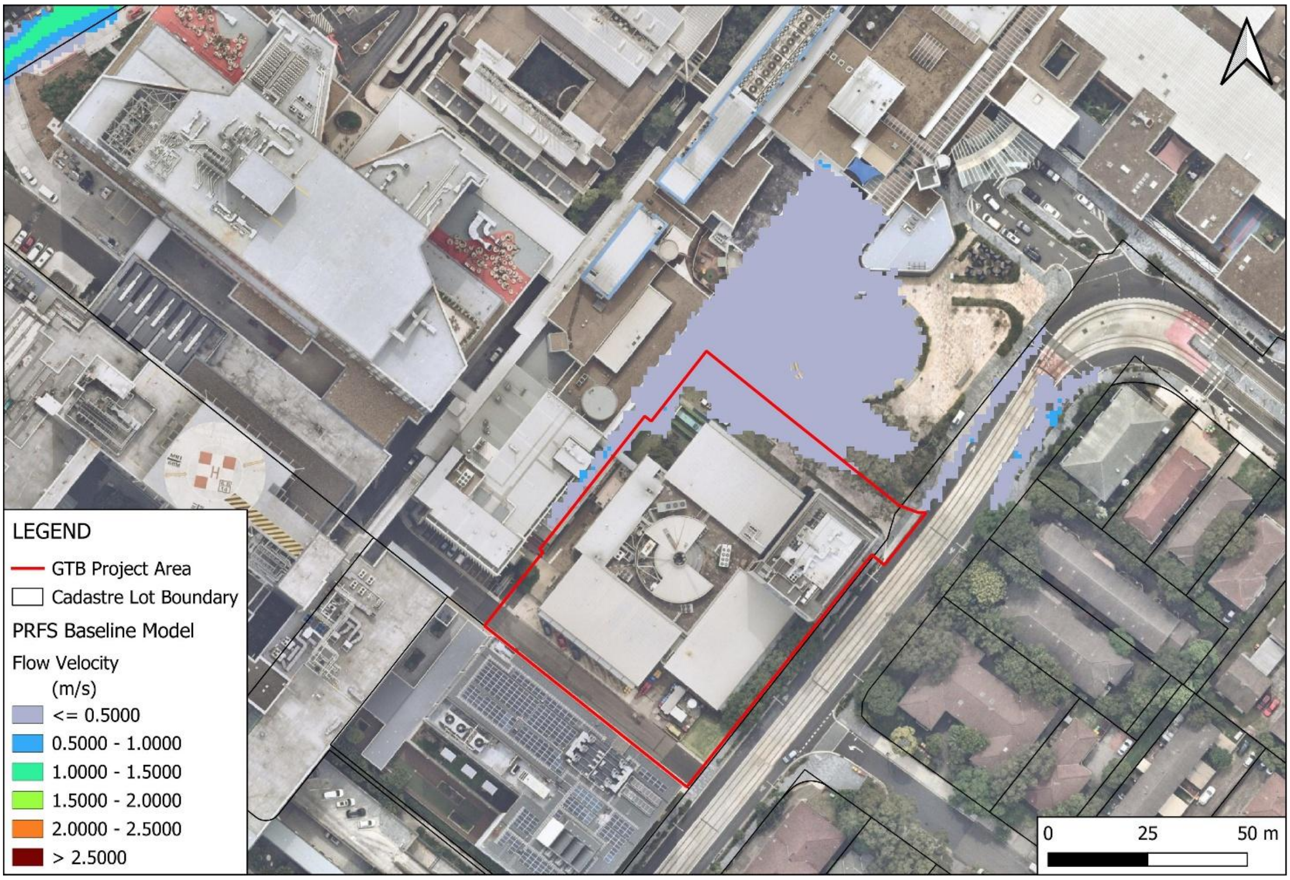

Figure 61 - 1% AEP Flow Velocities – Post-Development Conditions – 2024 PRFS Baseline Model

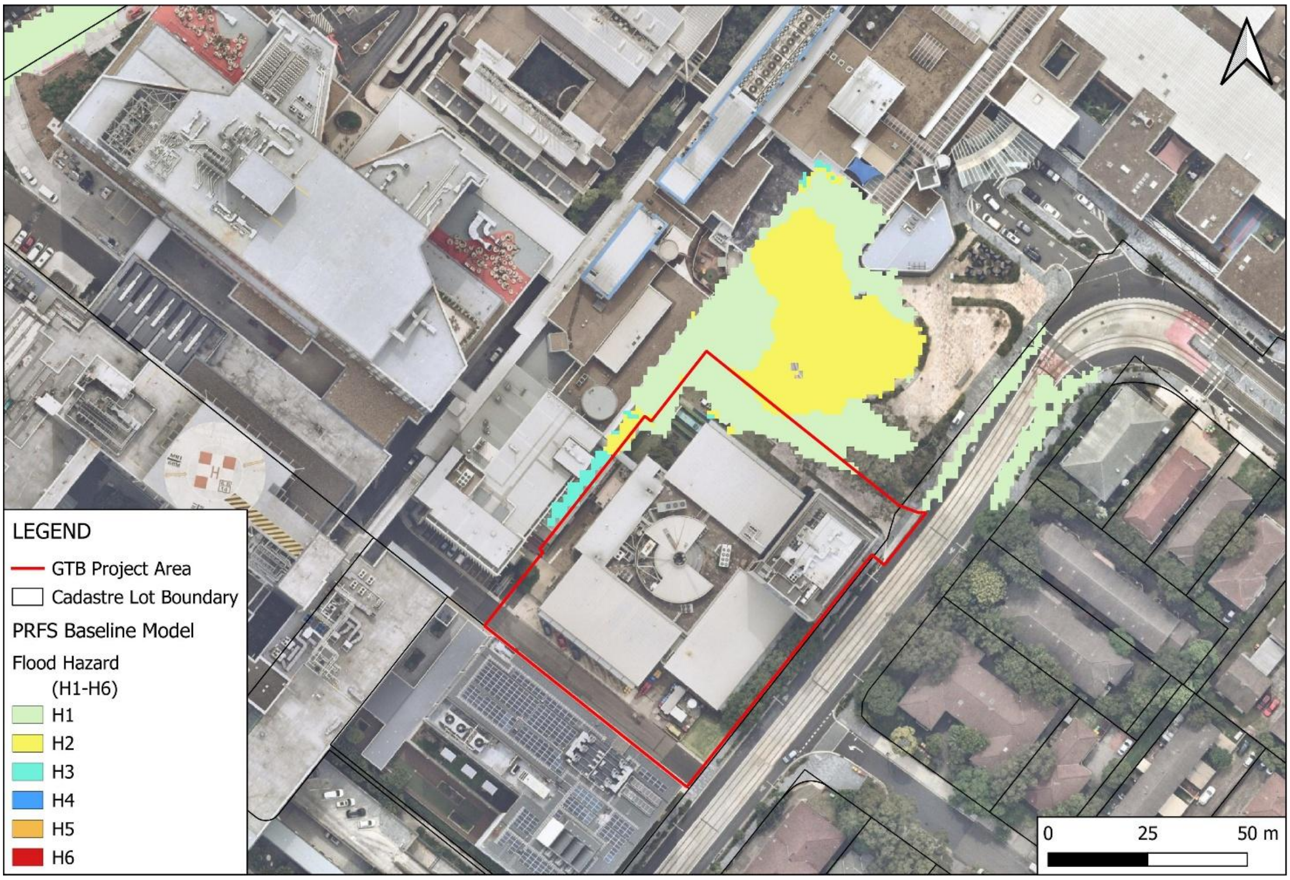

Figure 62 - 1% AEP Flood Hazard – Post-Development Conditions – 2024 PRFS Baseline Model

PMF Event

Estimated flood depths, flood levels, flow velocities and flood hazards in the PMF event are shown in Figure 63, Figure 64, Figure 65 and Figure 66 for post-development site conditions respectively.

Similar flooding regime to that of the pre-development scenario are estimated for the GTB site and its immediate surrounding area in the PMF event assessed, where the results show that the northern section of Hawkesbury Road and northern section of Research Lane are affected by flooding in the PMF flood event assessed. Modelling results show that floodwater initially ponded within the Kids Park area until flood level in the park is high enough to overtop the high points surrounding the Kids Park and inundate the Hawkesbury Road (i.e. north-east of GTB site) and Research Lane (i.e. south-west and west of GTB site).

Flood depths at parts of the Kids Park area and northern end of the proposed GTB building are generally greater than 600mm. The modelling results show that flooding at the GTB site area is not affected by flooding in the Parramatta River system in the PMF event assessed, as the flood levels at the GTB site area are at the order of 22.1mAHD whereas flood levels at the Toongabbie Creek (i.e. approximately 310m north of the GTB site) are estimated to be in the order of 18.7mAHD.

The PMF flow velocities for the GTB project area and its immediate surrounding areas are generally estimated to be less than 0.5m/s, with pockets of higher velocities estimated near the western side of the proposed GTB building and eastern of Kids Park.

Flood hazards onsite as well as over the Hawkesbury Road and Research Lane generally range from H1 to H5 in the PMF event, based on the Australian Emergency Management Institute hazard categories. Flood hazards at the GTB site and Kids Park are generally similar to those estimated for the pre-development scenario in the PMF event assessed. The high flood hazards in these areas are mainly due to the high flood depths.

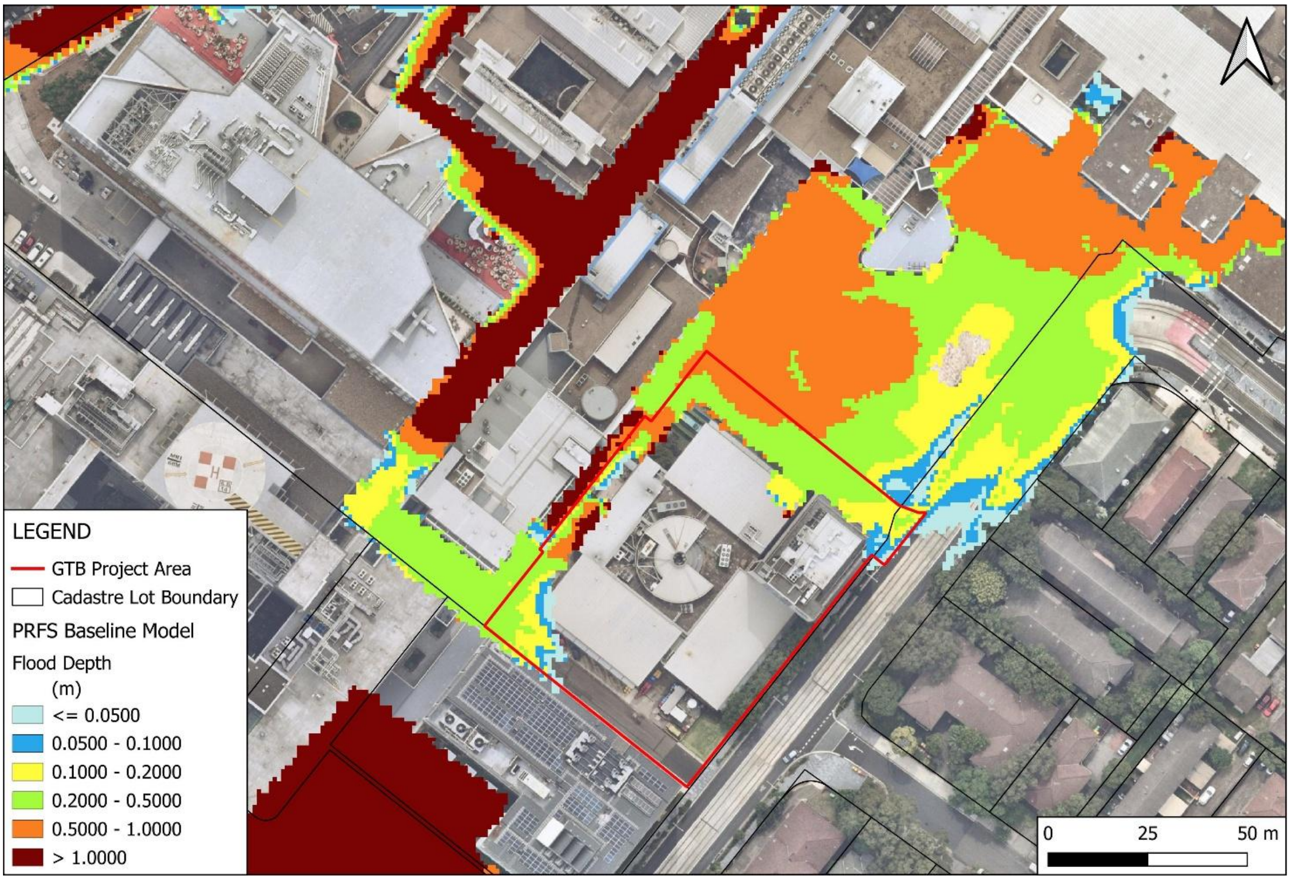

Figure 63 - PMF Depths – Post-Development Conditions – 2024 PRFS Baseline Model

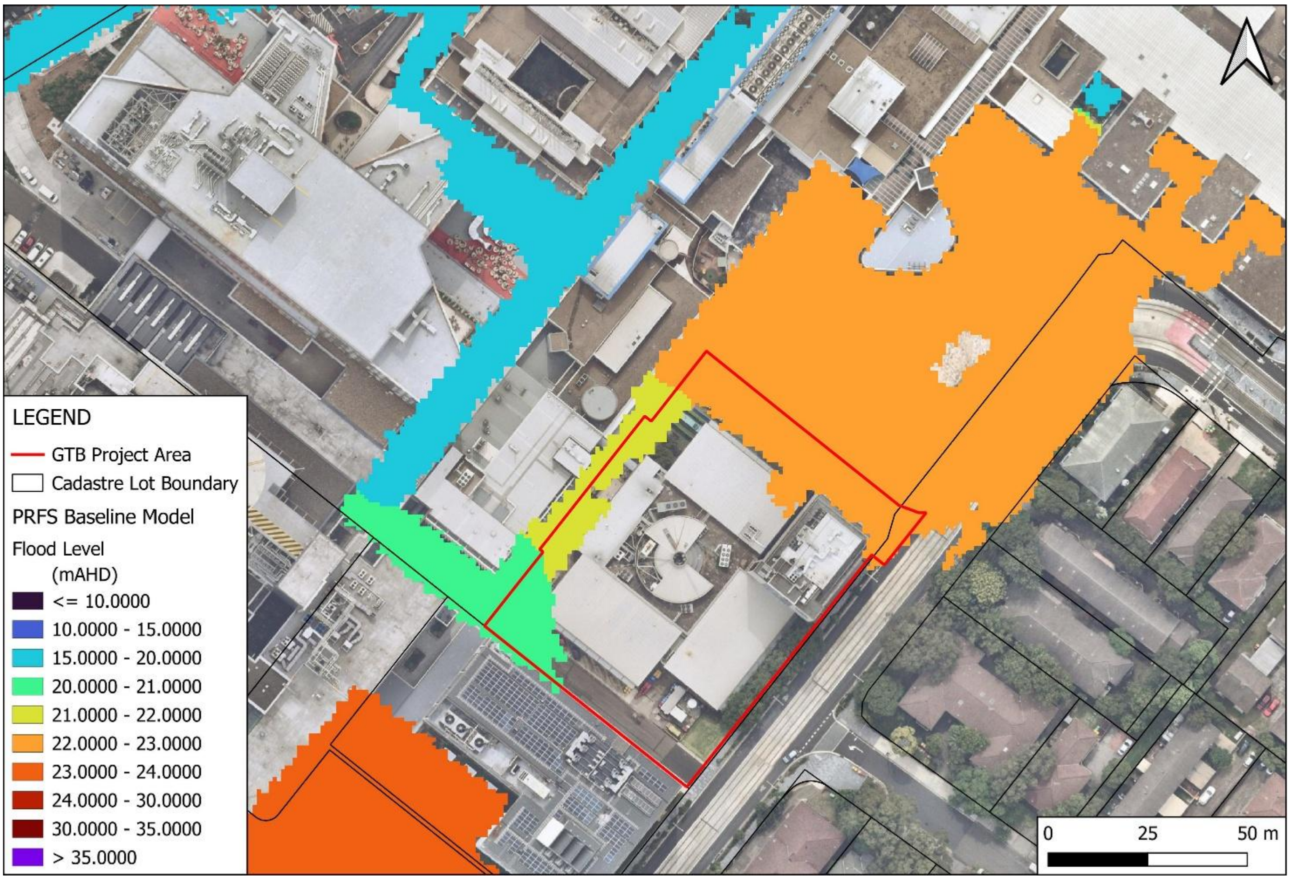

Figure 64 - PMF Levels – Post-Development Conditions – 2024 PRFS Baseline Model

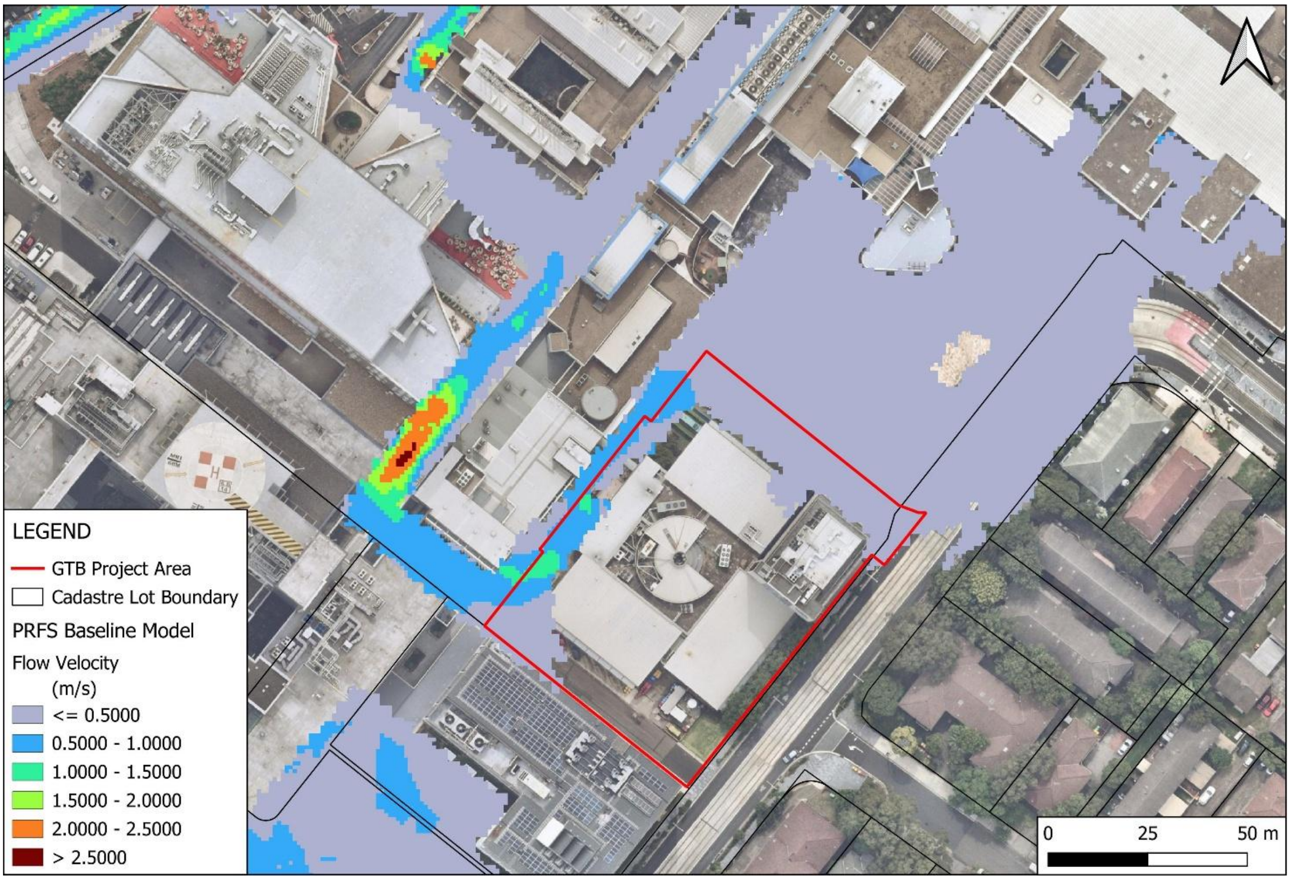

Figure 65 - PMF Flow Velocities – Post-Development Conditions – 2024 PRFS Baseline Model

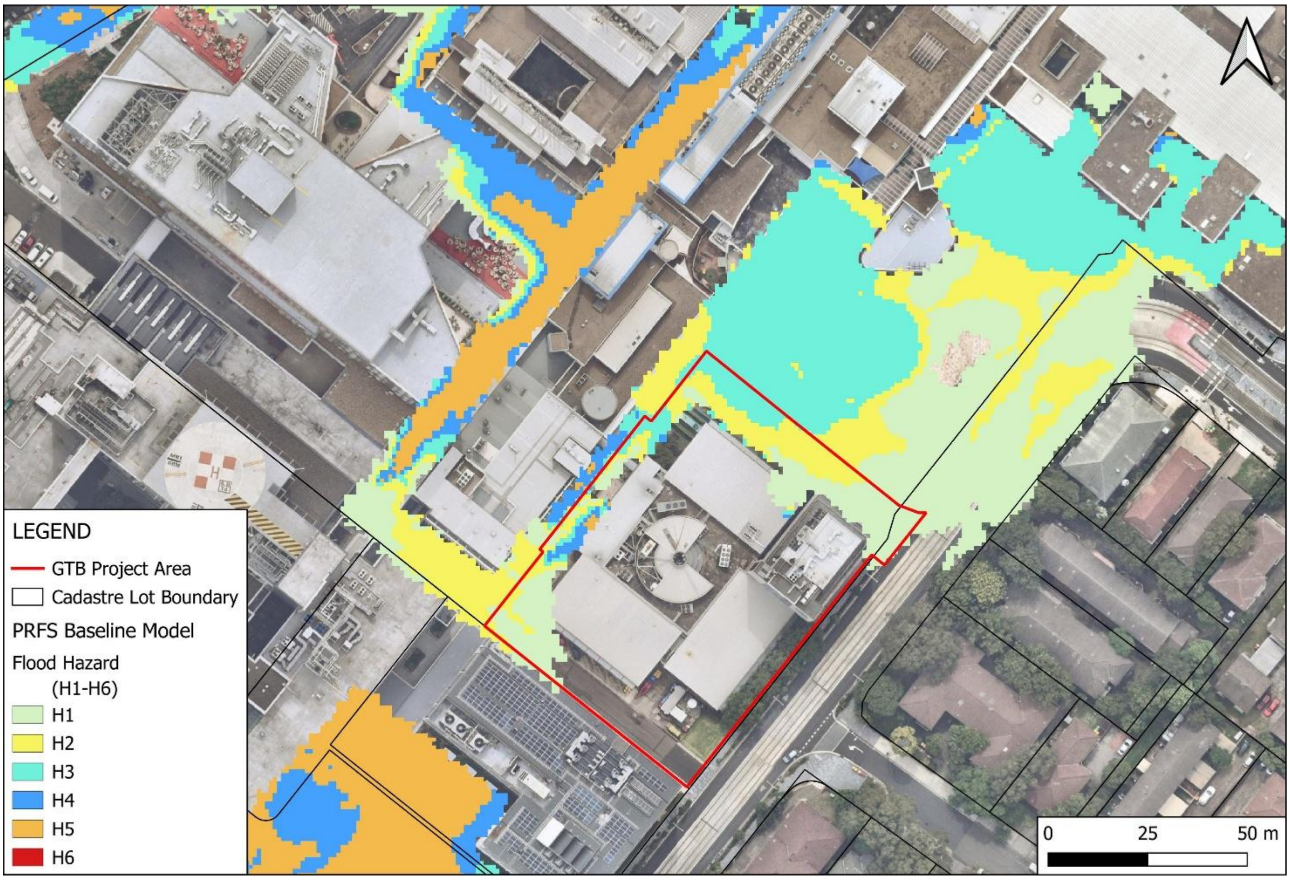

Figure 66 - PMF Hazard – Post-Development Conditions – 2024 PRFS Baseline Model

5.2.3 Impact of Development in PRFS Modelling

The 1% AEP flood level affluxes map is shown in Figure 67.

The results show that increases in estimated flood levels as high as 137mm are estimated over some areas north of the GTB site and the Kids Park area. The additional flooding is mainly due to some loss of flood storage around the GTB site's north and north-east corner as a result of the proposed development, resulting in some increases in flood levels at the Kids Park area that allow floodwater to overtop and inundate these areas. Although this estimated flood level afflux area is located outside the GTB site, it remains within the lot boundary owned by the Children's Hospital Westmead (i.e. within Lot 101 DP 1119583). It is therefore considered acceptable.

Based on the above, the offsite flood impacts due to the proposed GTB redevelopment are limited to within the Westmead Hospital boundary and will not result in additional flood risks to external properties in the 1% AEP event.

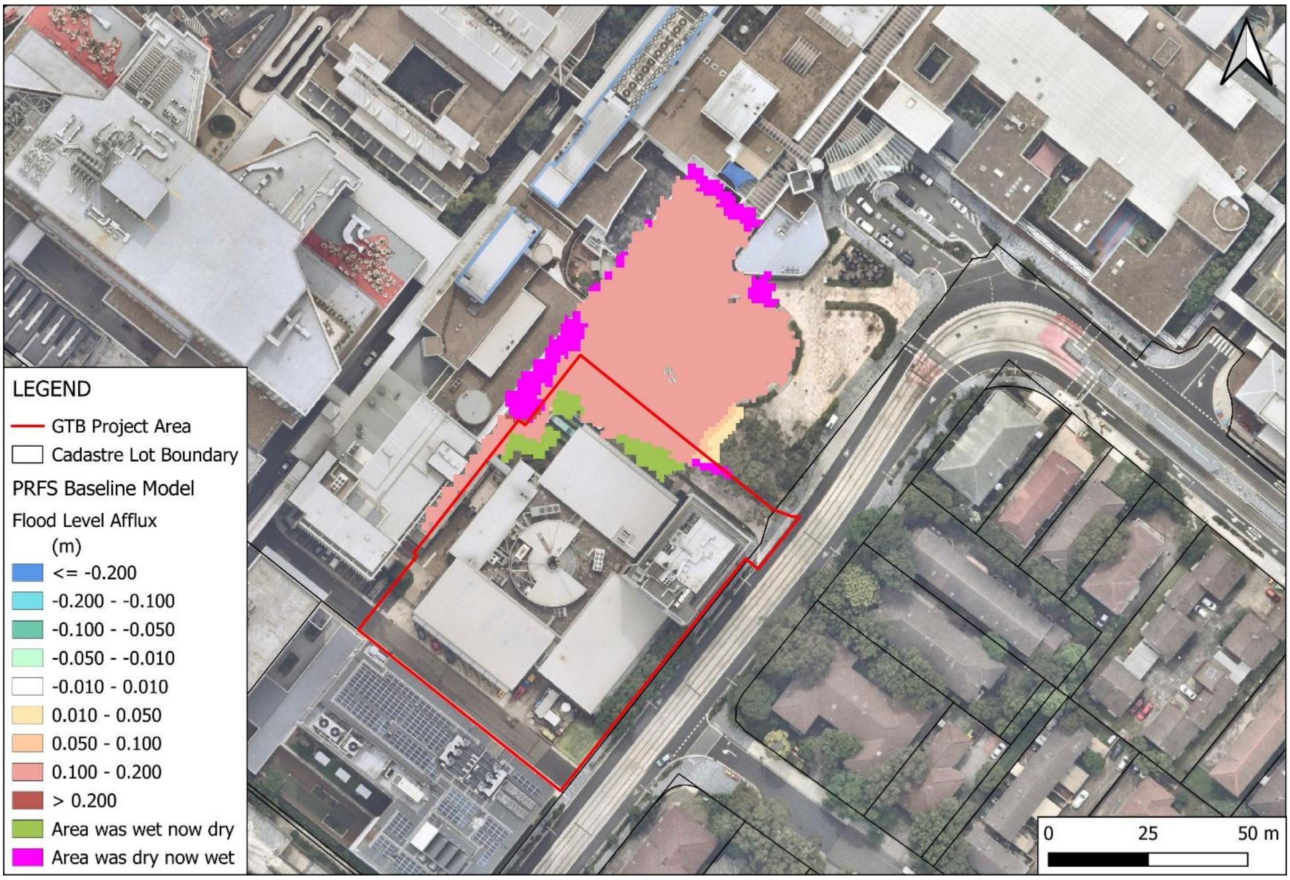

Figure 67 - 1% AEP Level Impact (Post-Development – Pre-Development) – PRFS Baseline Model

Flood level affluxes in the PMF event are shown in Figure 68.

Similar to the CHW modelling, it is understood that flood impact assessment (especially to assess the likely flood level increases) will generally not be required for the PMF event, but for consistency of reporting and to understand the full spectrum of likely flood impacts the proposed GTB redevelopment works will have to the surrounding areas, flood level affluxes map has also been prepared for the PMF event. The results show that a much larger area (especially to the north of GTB project boundary) experiences increases in flood levels of more than 10mm (i.e. when compared to that of the 1% AEP event). The maximum flood level increases for these impacted areas to the north are around 88mm, including the Hawkesbury Road corridor. Nonetheless, the estimated PMF flood hazards for the GTB site's surrounding areas remained generally similar to that of the pre-development conditions. Hence, the proposed GTB redevelopment is considered not to result in additional flood risks to these impacted properties to the north-east (i.e. of GTB site) in the PMF event assessed.

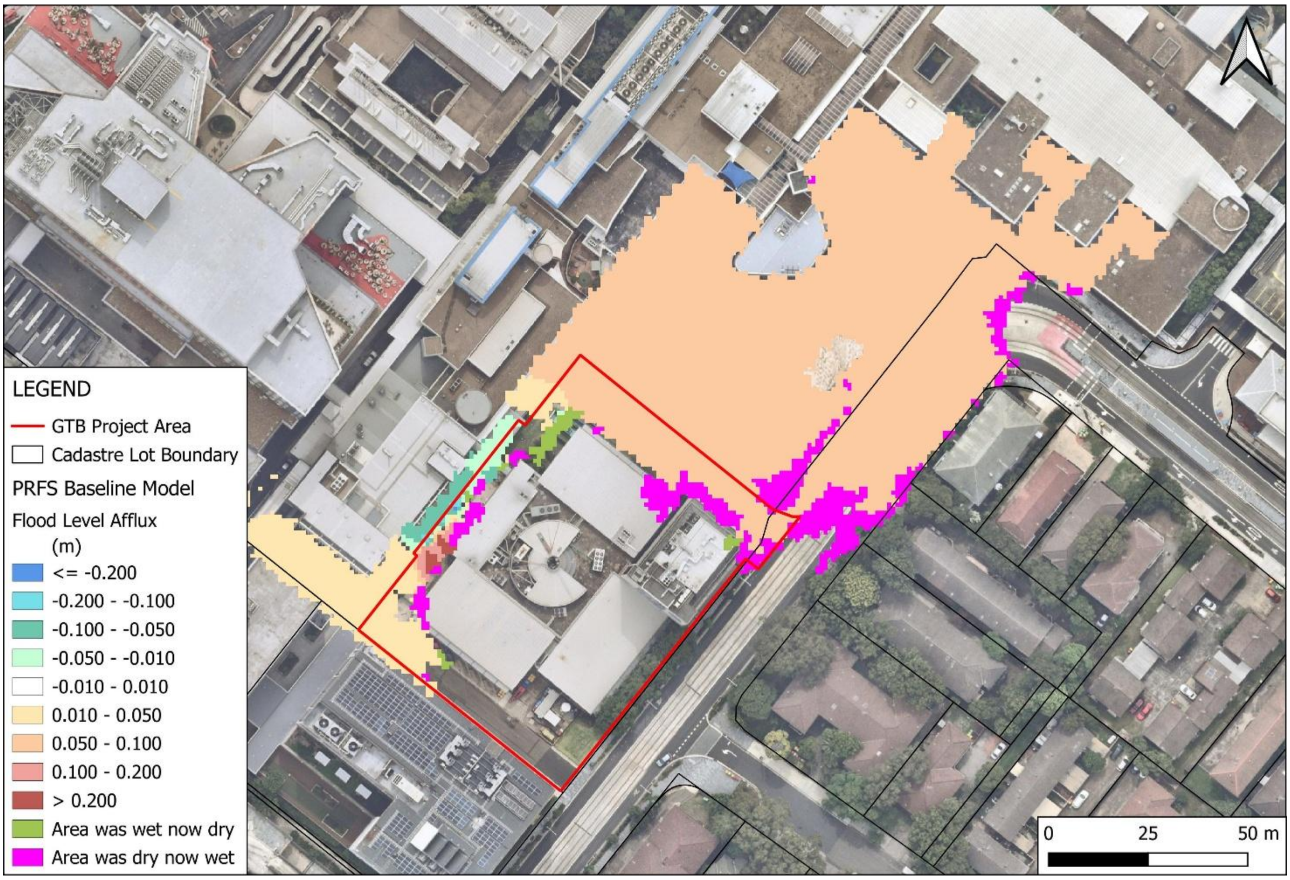

Figure 68 - PMF Level Impact (Post-Development – Pre-Development) – PRFS Baseline Model

5.2.4 Climate Change

The PRFS modelling includes assessment of the impact of climate change on the 1% AEP event, based on the RCP8.5 climate change condition for the year 2090 scenario. The modelling results show that the adopted climate change scenario will result in some increases in estimated peak flood levels in the Kids Park area, but increases are limited to within 55mm when compared to that of the 1% AEP event. As a result, additional inundation areas are estimated and the increases in estimated flood levels as a result of climate change for the 1% AEP event assessed are summarised in Figure 69.

The modelling results show that flood inundation is mainly contained within the Kids Park area. As discussed in Section 5.1.2, this is mainly due to the catchment inflow's method being adopted in the PRFS modelling where all catchment inflow is being applied to the Kids Park area (i.e. north-east of proposed development area).

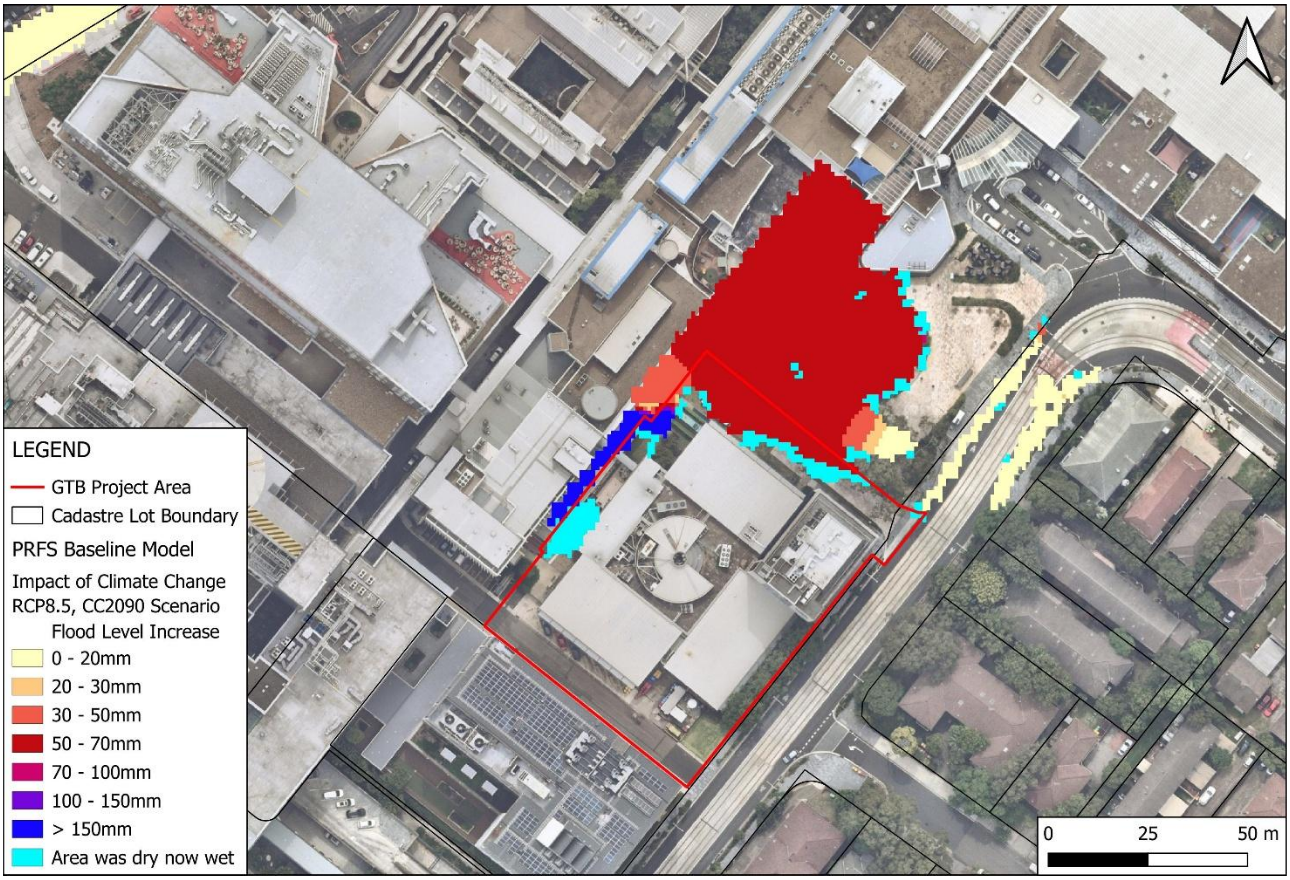

Figure 69 - Impact of Climate Change (CC2090, RCP8.5 Scenario) on 1% AEP Flood Level in Post-Development Scenario

6.0 Comparison of CHW and PRFS Model Results

6.1 Summary of Results

To quantify the differing results within the two models, an assessment location has been selected within the Kids Park area north of the proposed GTB as shown in Figure 70. Table 6 compares the 1% AEP and PMF flood levels derived from the CHW and PRFS models for both the pre- and post-development scenarios at this location.

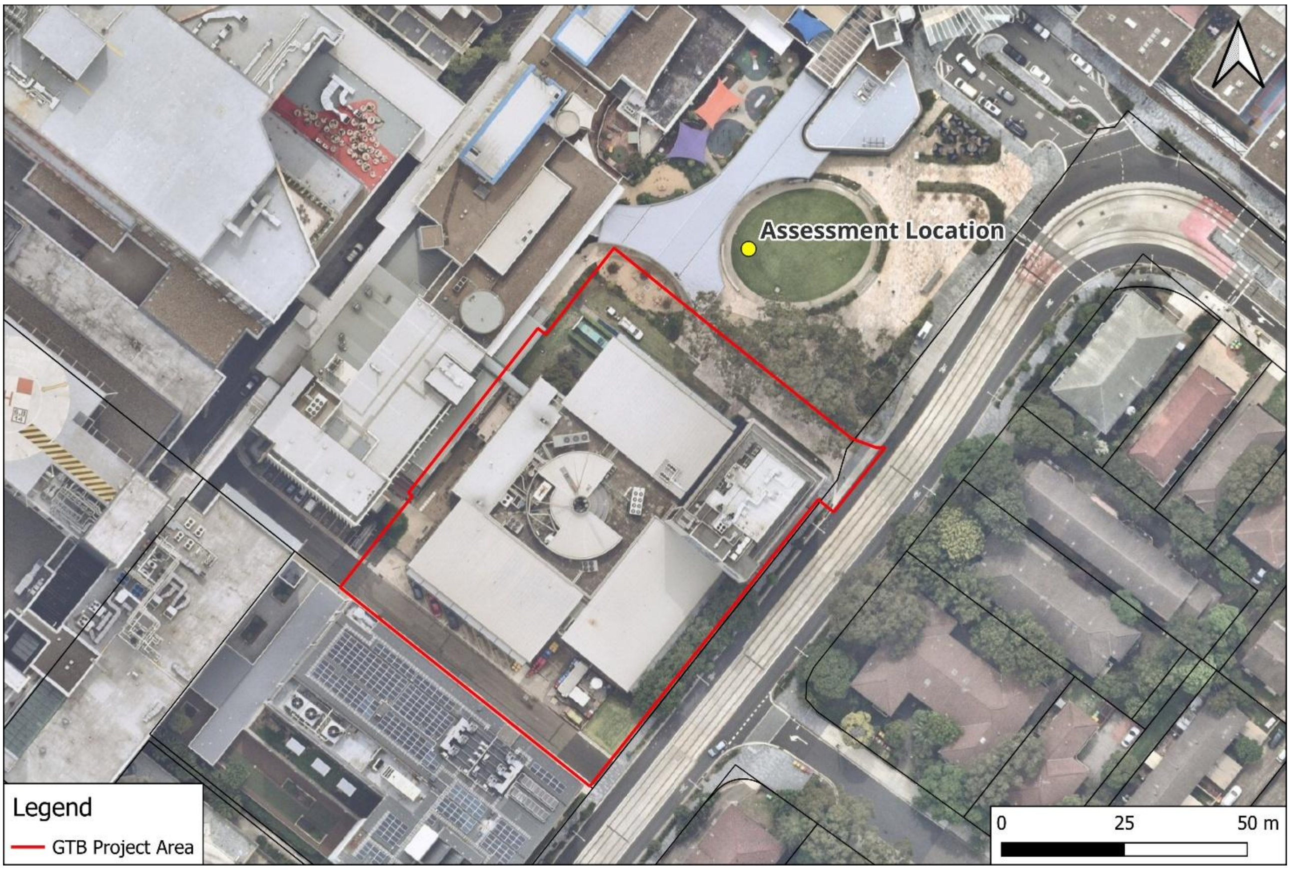

Figure 70 - Assessment location described in Table 6

Table 6 - Comparison of flood level (m AHD) between the CHW and PRFS models in the pre- and post-development scenario. Refer to Figure 70 for assessment location

Scenario	CHW Model		PRFS Model		Level increase in PRFS model	
	1% AEP	PMF	1% AEP	PMF	1% AEP	PMF
Pre	21.36	21.96	21.58	21.99	+ 0.22	+ 0.03
Post	21.38	21.99	21.71	22.07	+ 0.4	+ 0.08

This assessment indicates that there is a significant uplift in flood levels when comparing the PRFS model results with the CHW results, particularly in the 1% AEP event. An increase of 220mm is observed in the pre-development conditions scenario, and approximately 400mm in the post-development scenario. The magnitude of flood level increase is less apparent in the PMF event (around 30-80mm).

It should be acknowledged that the ground surface at the site and surrounding vicinity are generally consistent, as the PRFS model was updated with the latest surface information contained within the CHW model. The surface information at the Kids Park area is therefore generally similar in both models, as shown in the elevation profile provided in Figure 50. The flood level increase therefore cannot be attributed to inconsistencies in the ground elevation, and flood depth mapping indicates there is a significant increase in depths at this location in the PRFS model. Side-by-side mapping of the pre-development 1% AEP depths in both models is depicted in Figure 71. 1% AEP flood depths are shown to be significantly increased in the PRFS model, rising from approximately 61mm at the assessment location in the CHW model to 275mm in the PRFS model.

The uplift in flood levels/depths at this location can be attributed to the method of model inflow application, as discussed in Section 6.2.

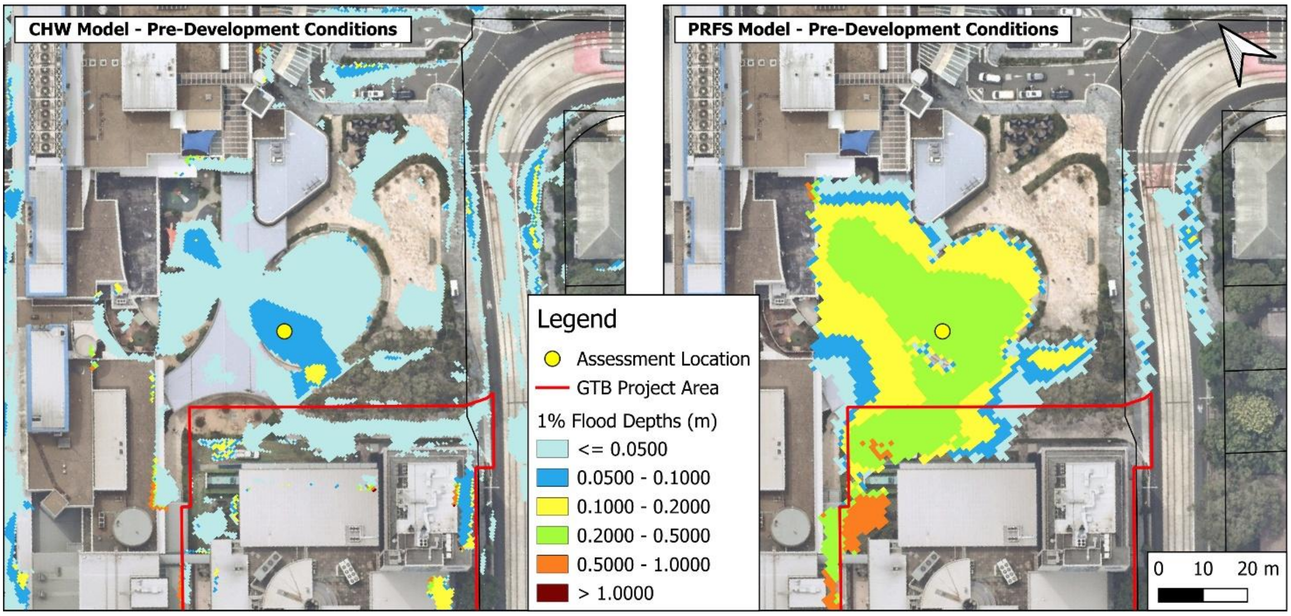

Figure 71 - Comparison of pre-development 1% AEP depths in the CHW model (left) and the PRFS model (right)

6.2 Limitations of PRFS Model

Although the instability issues in the PFRS model which resulted in unrealistic estimated flood levels were largely resolved for the GTB assessment (as described in Section 5.1.2), the PRFS modelling has other limitations which produce an inaccurate representation of flood behaviour at the site.

6.2.1 Inflow Methodology

The PRFS TUFLOW model adopted the 2d_sa inflows method where catchment inflows are applied at localised areas (i.e. mostly at the outlet of sub-catchments). Therefore, locations where the inflows are being applied will likely be estimated to have higher flood levels (i.e. due to flows being concentrated locally) when compared to that of a rainfall-on-grid method adopted in the CHW modelling, in which rainfalls are equally spread out across the entire sub-catchments.

The PRFS baseline model results indicate that this is the case, as total catchment flows (i.e. total flow from Catchment UPP1.290c) have been applied directly to the 2D domain at the Westmead Hospital Kids Park, adjacent and directly north-east of the GTB site in the PRFS TUFLOW model.

It should be acknowledged that this source area contains the flow for three catchments in total – UPP1.290c, UPP1.290d and UPP1.290e. There is a total upstream catchment area of approximately 9.8ha, with a notable peak flow rate of 2.342m^3/s. The location of these sub catchments in relation to the site and the location of the model inflow (source area) is shown in Figure 72. Based on the catchment topography, much of the overland flow produced within these catchments would not be conveyed towards the source area location, with some flow likely directed to adjacent catchments to the northwest, in the direction of Toongabbie Creek.

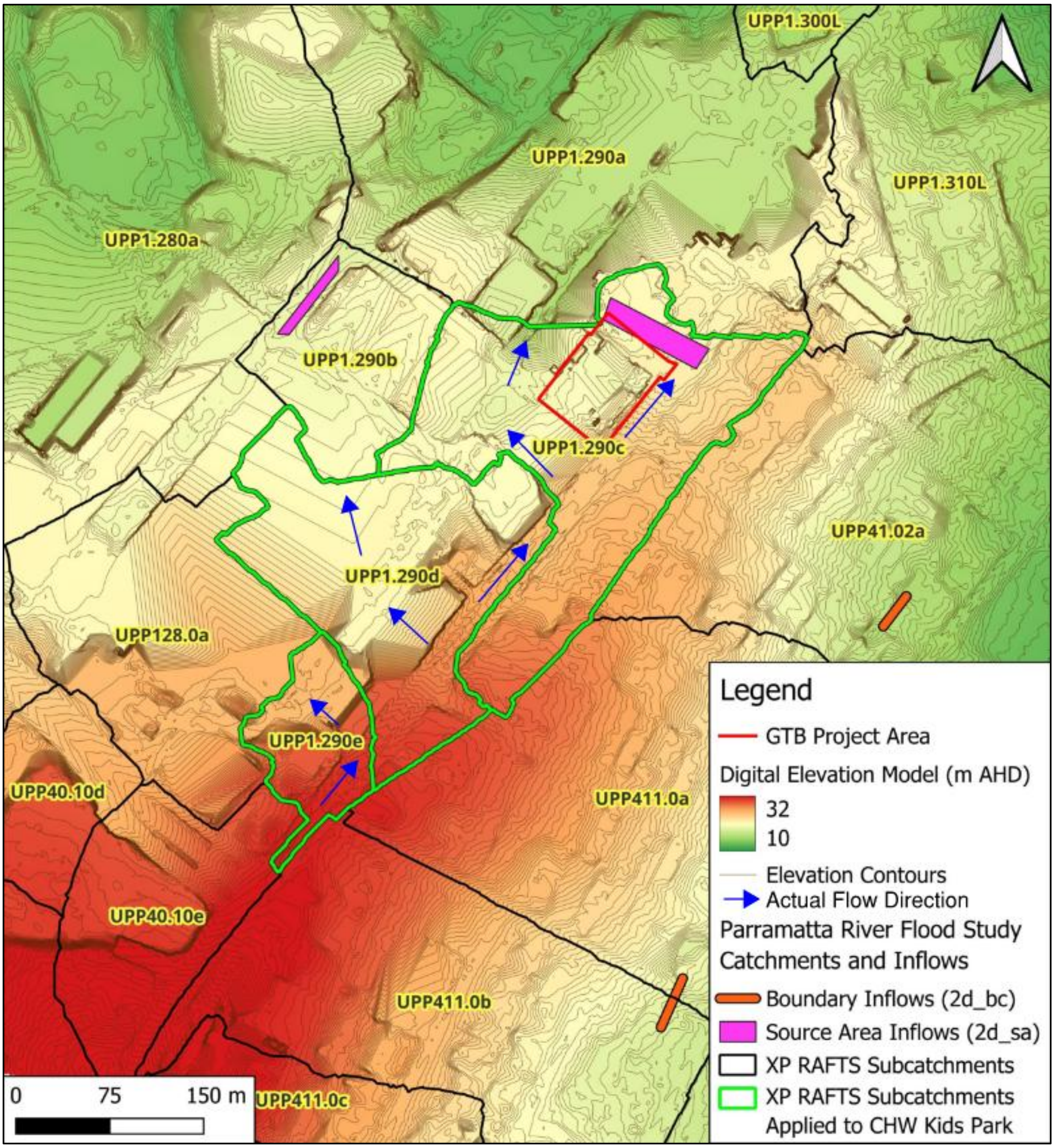

Figure 72 – the contributing XP Rafts subcatchments (green) applied to the source area northeast of the site. Flow direction arrows shown in blue.

The application of these flows to the Kids Park area is both a conservative and inaccurate representation of flood behaviour at the site, as the Westmead Hospital Kids Park area is set slightly lower than the surrounding southern areas, including the Hawkesbury Road, as shown in the digital elevation model in Figure 73, shown against the inflow location. The inflow is subsequently forced to be detained within the Kids Park until overtopping occurs. This results in higher flood levels being estimated for the GTB area when compared to the CHW modelling, where rainfall is being equally spread over the entire modelled area.

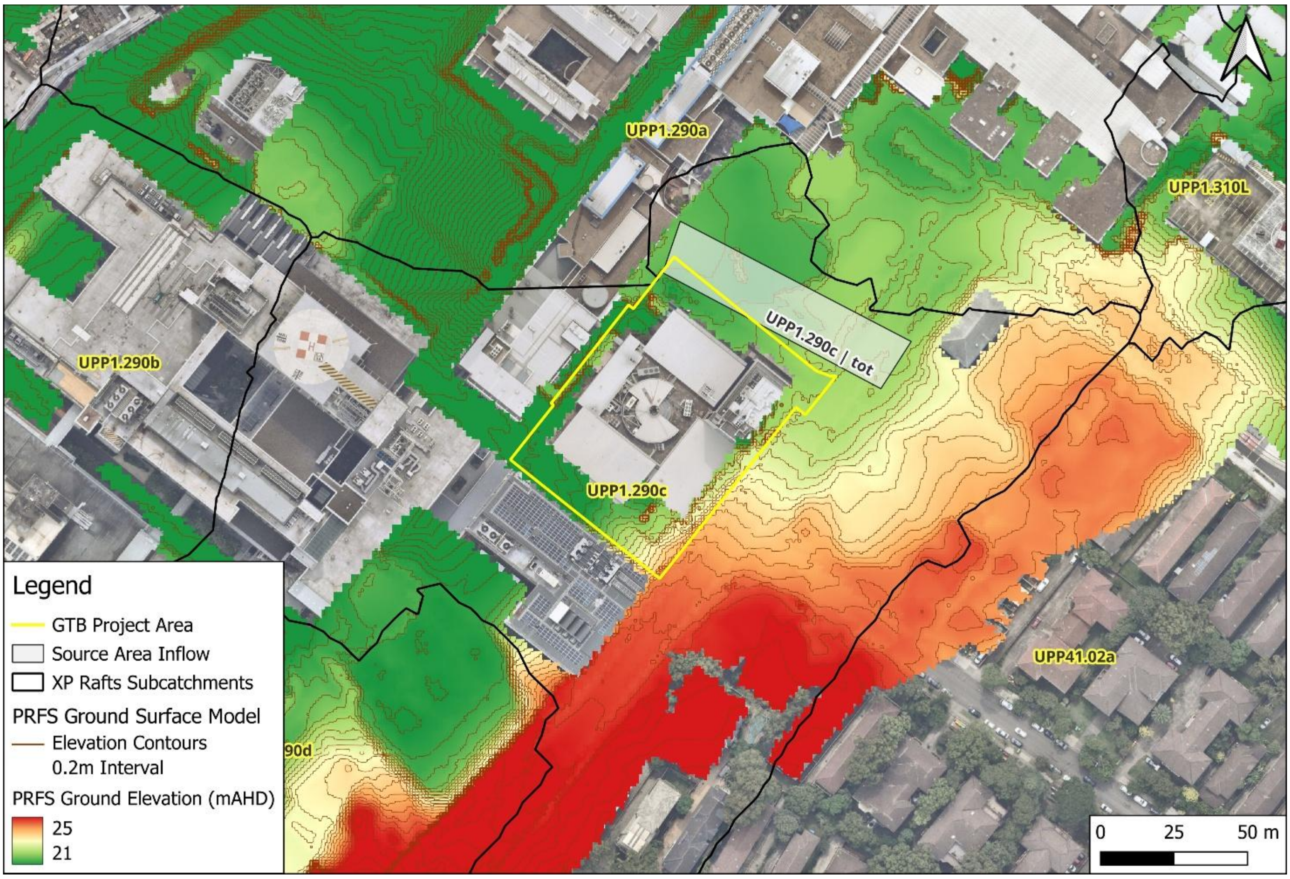

Figure 73 - Location of inflow (2d_sa) applied to model in relation to ground surface elevation. Flow is applied to trapped low point in Kids Park area

6.2.2 Grid Resolution

The PRFS modelling adopted a 2m grid. While this is considered adequate for the purpose of the PRFS, it remains coarser than the CHW modelling where a 1m SGS sampling is adopted. Based on this, the CHW modelling is considered to provide a better representation of flood storage and conveyance behaviours of the GTB and entire Westmead Health Precinct area than that of the PRFS modelling. The modelling has shown that the PRFS modelling tends to result in lesser flood storage and conveyance capacities than that of the CHW modelling for the GTB and its immediate surrounding areas, hence resulting in generally higher estimated flood levels for these areas.

6.3 Summary

In summary, the PRFS model's use of localised 2D source inflows and coarser grid resolution results in an overly conservative representation of flood behaviour at the GTB site that does not accurately reflect the true distribution of flows across the catchment. The CHW model's rainfall-on-grid approach and finer resolution more realistically distribute flows and represent conveyance processes, and is therefore the more appropriate model to be adopted for the assessment

Based on the above limitations of the PRFS modelling, it is recommended that estimated flood levels of the GTB area be based on the CHW modelling to avoid over estimation of flood levels due to the concentrated catchment inflow's method adopted in the PRFS modelling.

7.0 Flood Planning Requirements

As stated in Section 5.1.2, it is recommended that estimated flood levels of the GTB area be based on the CHW modelling to avoid over estimation of flood levels due to the concentrated catchment inflow's method adopted in the PRFS modelling. The flood planning requirements and the compliance of the design has subsequently been reviewed using the initial flood model results derived from the CHW TUFLOW model.

The current Development Control Plan (DCP) in place in the City of Parramatta was published in 2023, providing additional planning and design guidelines to support the aims and objectives of the Local Environment Plan (LEP). DCPs provide detailed controls and standards for addressing development issues at a local level and cover various development types, including residential, commercial and industrial.

Under Section 4.15 of the Environmental Planning and Assessment Act 1979, the consent authority is required to take into consideration the relevant provisions of the DCP in determining a development application. Section 5.11 of the City of Parramatta's DCP provides a risk-based approach to planning and development in the flood prone lands of the LGA. The New South Wales State Government flood prone land policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. The objectives of the City of Parramatta's DCP in relation to flooding are:

- Manage the floodplain in an economically, environmentally, and socially sustainable manner.
- Allow development in the floodplain that is appropriate to the flood hazard and risk at a particular location.
- Ensure that development minimises the risk to life and property from flooding and its impacts.
- Deliver a risk-based approach to floodplain development and mitigation of potential harm based on a merit assessment consistent with the current Floodplain Development Manual.
- Ensure the proponents of development and the community in general are aware of the potential flood hazard and consequent risk associated with the use and development within the floodplain.
- Ensure that the proposed development does not expose existing development to unacceptable risks or impacts associated with flooding.
- Require hazard, risk and safety assessments to demonstrate how risk and potential for harm to people, property, buildings, and the environment from floodwaters will be adequately mitigated.
- Ensure development does not adversely increase the potential flood affectation on other development or properties, either individually or in combination with similar developments that are likely to occur within the same catchment.
- Ensure development on flood prone land does not result in unreasonable impacts upon the amenity or ecology of an area.
- Ensure buildings and uses are compatible with the identified flood risk. Development with a lower sensitivity to the flood hazard may be considered for location within the floodplain subject to appropriate design and siting controls provided that the potential risks and consequences that could still arise from flooding remain acceptable.
- Ensure early site planning and consideration of flood conditions to achieve an integrated flood response that manages flood risk and provides optimum development design outcomes to provide adequate amenity on and off site, and interface with the public domain.
- Avoid intensification of development and land use within high flood risk or floodways.
- Achieve adequate, safe flood conveyance and management of floodwaters while providing for the rehabilitation, conservation, embellishment, naturalisation of floodways and other flood affected lands where appropriate.
- Ensure the risks associated with car park basements in flood prone areas are adequately mitigated.
- Prevent any changes to landform that would adversely impact flood behaviour or the course of its natural conveyance.

The stringency of development controls is dependent on the land use type of the development alongside the Flood Risk Precinct the site is located in.

7.1 Land Use Type

Whilst CMRI GTB is located on the Westmead Hospital site, due to its research function it can be assessed as 'Commercial or Industrial' based on Table 5.1.1.1 from the Parramatta DCP. An extract of the Commercial or Industrial land uses is presented in Figure 74.

Commercial or Industrial	• Advertising structures; • Agriculture; • Amusement centres; • Business Premises; • Car parks; • Correctional centres; • Crematorium; • Depots; • Entertainment facilities; • Food and drink premises; • Freight transport facilities; • Funeral homes; • Function centres; • Hardware and building supplies; • Health consulting rooms; • Heavy industries; • Hotel accommodation; • Industries; • Information and education facilities; • Industrial retail outlets; • Kiosks; • Landscape and garden supplies; • Light industries; • Markets; • Materials recycling or recovery centres; • Medical centres; • Mixed-use development; • Mortuaries; • Office premises; • Passenger transport facilities; • Places of public worship; • Public administration buildings (other than essential uses and facilities); • Pubs; • Recreation facilities (indoor); • Recreation facilities (major); • Registered clubs; • Restricted premises; • Retail Premises; • Service stations; • Sex services premises; • Shop top housing; Signage; Specialised retail premises; • Storage premises; • Transport depot; • Truck depot; • Tourist and visitor accommodation; • Vehicle body repair workshops; • Vehicle repair stations; • Vehicle showrooms; • Veterinary hospitals; • Warehouse or distribution centres; • Waste or resource management facilities; • Wholesale supplies.

Figure 74 - Commercial or industrial land uses, as outlined in the City of Parramatta DCP, 2023.

7.2 Flood Risk Precinct Categorisation

The Flood Risk Precincts are outlined in Table 7.

Table 7 - City of Parramatta Council Flood Risk Precincts (adapted from Stantec, 2023)

Flood Risk Precinct	Description
High Flood Risk	Includes 1% AEP high hazard area, defined as H4 and above (hazards that are unsafe for all people and vehicles). These are areas where high flood damages, potential risk to life, or evacuation difficulties are anticipated, or development would significantly and adversely affect flood behaviour. Most development is restricted within these areas.
Medium Flood Risk	Includes medium and low hazard areas within the 1% AEP extent. These are areas where there is still a significant risk of flood damage or safety concerns, but where this risk can be minimised by the application of appropriate development controls.
Low Flood Risk	Includes the remaining area within the PMF extent that is not identified as either High Flood Risk or Medium Flood Risk Precinct. The risk of flood damage in these areas is low and most land uses would be permitted.
Everywhere Else	Areas outside the PMF. There may still be isolated impacts from local overland flow.

Low Flood Risk Category means all other land within the extent of the Probable Maximum Flood but not identified within either the High Flood Risk or the Medium Flood Risk Category. Based on the flood modelling overland sheet flows through and adjacent to the site are shallow and of low hydraulic hazard during the 1% AEP event (refer Section 4.3, Section 4.4 of report). Therefore, the site is generally classified as Low to Medium Flood Risk.

7.3 Flood Planning and Development Controls

The following discuss the development controls that are applicable to the GTB site development, as set out in the Parramatta DCP 2023 Part 5 C24.

BUILDING COMPONENTS AND METHOD
1. All structures to have flood compatible building components and construction below the 1% AEP (100 year ARI) flood level plus freeboard.
2. All structures to have flood compatible building components and construction below the PMF.

It is recommended that all habitable floor levels are located above the 100-year ARI flood level plus 500mm freeboard. The results show that the site to be generally flood free in the 1% AEP flood event. Small ponding areas near the proposed building are normally due to application of 'rainfall-on-grid' approach and could be not considered flooding. Entrance levels to the proposed building will still require higher levels in relation to adjacent external ground levels to redirect shallow overland flows away from the entrances.

STRUCTURAL SOUNDNESS
1. Unless otherwise approved by Council, a structural engineer's report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP (100 year ARI) flood level plus freeboard.
2. A structural engineer's report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including the PMF level.

As discussed in Section 4.2 to 4.4, the modelling results show the site to be generally flood free in the 1% AEP flood event and any structures would not be adversely impacted by floodwaters up to and including the 100 year ARI flood event.

FLOOD AFFECTATION
1. A hydraulic engineer's report is required to certify that the development will not increase flood affectation elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels, flows and velocities caused by alterations to flood flows; and (iii) the cumulative impact of multiple potential developments in the vicinity.
2. The impact of the development on flooding elsewhere is to be considered having regard to: (i) loss of flood storage; (ii) changes in flood levels, flows and velocities caused by alterations to flood flows; and (iii) the cumulative impact of multiple potential developments in the vicinity.

Based on this site-specific flood assessment, the proposed GTB redevelopment will not materially change the local flood behaviour and offsite flood impacts as the proposed GTB redevelopment works are considered to be minimal and non-actionable.

CAR PARKING AND DRIVEWAY ACCESS
1. The minimum surface level of unenclosed parking spaces or carports shall be as high as practical, but no lower than 0.1 metres below the 1% AEP (100 year ARI) flood level. In the case of garages and other enclosed parking areas for less than 3 motor vehicles, the minimum surface level shall be as high as practical, but no lower than the 1% AEP (100 year ARI) flood level, plus 0.15 metres freeboard.
2. The minimum surface level of unenclosed parking spaces or carports shall be as high as practical and shall not significantly interfere with the overland flow path.
3. Garages, and other enclosed car parking areas, capable of accommodating more than 3 motor vehicles, must be protected from inundation by floods equal to or greater than the 1% AEP (100 year ARI) flood. Ramp levels to be no lower than 0.5m above the 100 year ARI flood level. Where below ground car parking is proposed additional measures must achieve protection up to the PMF.
4. The driveway footpath crossing providing access between the road and property boundary shall be as high as practical and generally rising in the egress direction, providing this does not obstruct or displace floodwaters.
5. Unless otherwise approved by Council and provided this does not obstruct or displace floodwaters, the level of the driveway providing access between the road and parking spaces shall be no lower than 0.2 metres below the 1% AEP (100 year ARI) flood level.
6. Enclosed car parking, and car parking areas accommodating more than 3 motor vehicles, with a floor below the 1% AEP (100 year ARI) flood level, shall have adequate warning systems, signage, exits and evacuation routes. Refer to Flood Warning and Emergency Response Planning section for requirements.
7. Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 1% AEP (100 year ARI flood).

Based on the modelling results, as discussed in Section 4.2-4.4, the site is estimated to be generally flood free in the 1% AEP flood event. The entrance to the proposed basement carpark area has been raised to provide freeboard to the external level. Levels are raised providing a crest to the basement entry ramp to ensure no overland flow from Research Lane enters the basement. The proposed site levels tie in with the Hawkesbury Road upgrade and PLR works.

Table 8 outlines the Finished Floor Levels (FFLs) at various entry points around the site, alongside the DCP floor level requirements. Refer to Figure 75 for the point locations. This indicates that the development complies with the requirements of the DCP. Openings to the basement area (i.e. vents etc.) are anticipated to be set above the PMF levels.

Table 8 - Council DCP Floor Requirements Alongside Proposed Finished Floor Levels. Refer to below Figure.

Location		Design FFL (m AHD)	*1% AEP Flood Level (m AHD)	*PMF Level (m AHD)	Council DCP Floor Level Requirements (m AHD)
A	Main entry	22.00	-	21.98	N/A (1% AEP+500mm)
B	Egress stair (east) Leads into basement car park	22.00	21.50	22.00	22.00 (PMF)
C	Entry to proposed courtyard	22.00	20.90	22.00	21.40 (1% AEP+500mm)
D	Entry to existing courtyard	22.00	-	21.95	N/A (1% AEP+500mm)
E	Access ramp to basement	21.13	20.5	20.6	20.6 (PMF)
F	Egress stair (west) Leads into basement car park	21.37	-	21.05	N/A (PMF)
G	Entry into south corridor (adjacent to mechanical plant)	23.33	-	23.31	N/A (1% AEP+500mm)
H	Staff entry / entry to fire hydrant and pump room	22.00**	-	22.85	N/A (1% AEP+500mm)
I	Staff entry / entry to fire hydrant and pump room	22.70	-	22.68	N/A (1% AEP+500mm)

* Note that a dash (-) indicates that the area is not affected by flooding.
** High point on the property boundary adjacent to Hawkesbury Rd is set to 22.985m AHD to prevent floodwaters inundating the staff entry

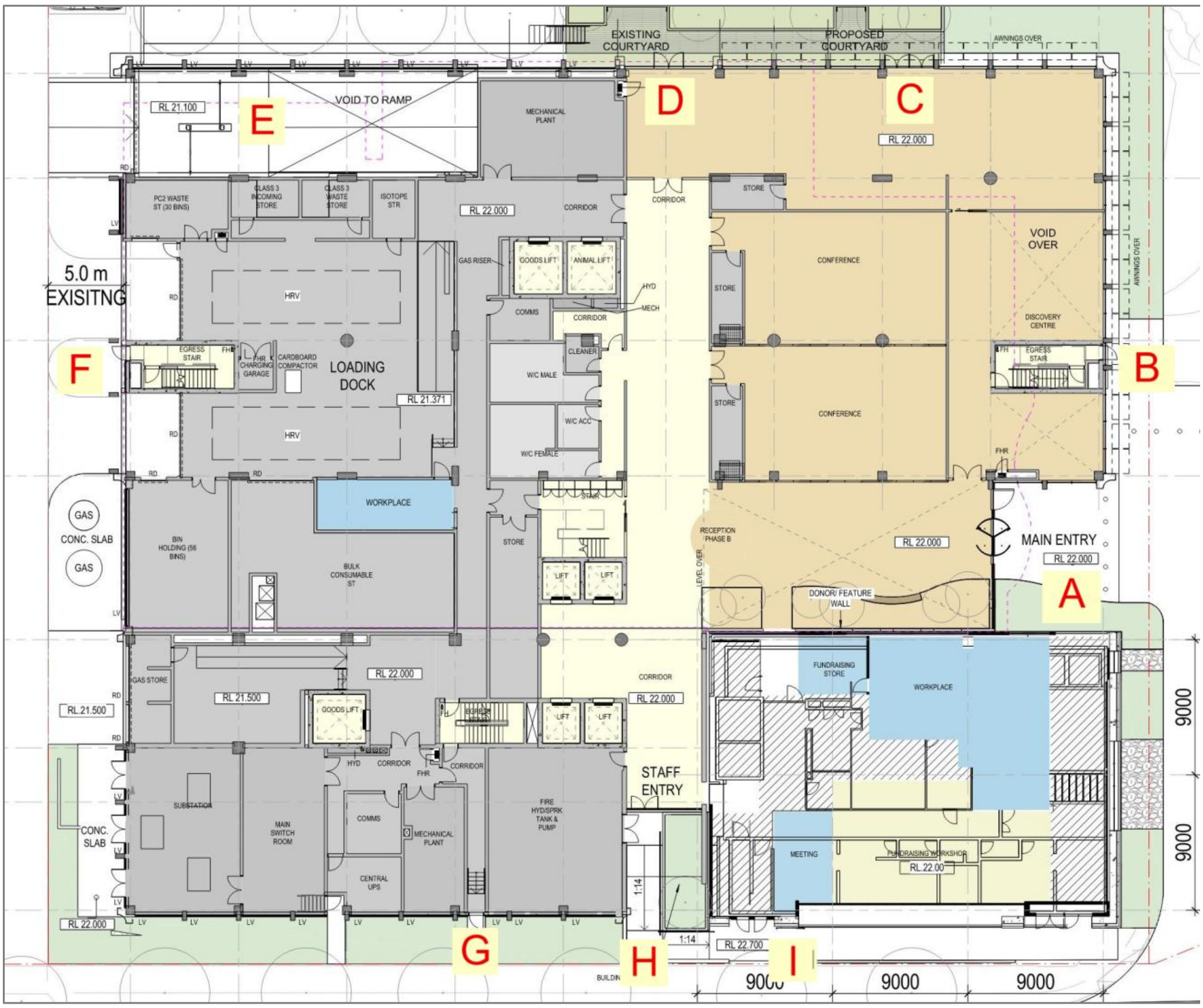

Figure 75 - Location of points discussed in Table 8

8.0 Flood Emergency Response Plan

EVACUATION
1. Reliable access and egress for pedestrians is required during a 5% AEP (20 year ARI) flood.
2. Reliable access for pedestrians and vehicles required to a publicly accessible location during the PMF peak flood.
3. Reliable access for pedestrians required from the site to an area of refuge (including shelter in place) above the PMF level, on site (e.g. second storey) or off site.
4. Applicant is to demonstrate the development is consistent with any relevant flood emergency response plan, flood risk management plan or similar plan.
5. Applicant is to demonstrate that evacuation in accordance with the requirements of this DCP is available for the potential development resulting from the subdivision.
6. Adequate flood warning is to be available to allow safe and orderly evacuation without increased reliance upon SES or other authorised emergency services personnel.

Flood hazards remain low over the adjacent roads during the 1% AEP event with low velocities and depths. Therefore, evacuation routes remain accessible during all events up to and including the 1% AEP event. In addition, vertical evacuation to higher floors via internal stairs is available during all events including the PMF allowing refuge to be taken in the critical rare events from local and regional events.

Furthermore, the PMF flood hazards on Hawkesbury Road to the south (i.e. towards Queens Road) generally remains low (i.e. H1 and H2) meaning vehicular evacuation remains possible at all times, although pedestrians will need to remain at the site, on the higher elevation floors, until pavements and roads become safe for pedestrians. Modelling results of the PMF storms assessed have indicated that the surrounding roads will be deemed unsafe for traffic (i.e. flood hazards of H2 or higher) less than 10 minutes from the onset of storm, but these roads will return to H1 flood hazards (i.e. safe for traffic) in less than 5 hours.

With less than 10 minutes from the onset of the critical PMF storm until the surrounding roads are deemed unsafe and isolation time of less than 6 hours, it is recommended that the facility is prepared for a shelter-in-place strategy.

Shelter-in-place (SIP) Guidance for Flash Flooding, published by the NSW Department of Planning and Environment (DPE) in January 2025 provides considerations that can inform whether SIP is an appropriate response strategy in a flash flood environment, alongside design considerations that should be met. Table 9 outlines the varying factors that must be considered when proposing SIP, and how this site meets the recommendations.

Table 9 – DPE SIP Guidelines

SIP Guideline	Response
Initial assessment	
1. Does shelter in place align with existing emergency management strategies for the area, as determined through the flood risk management process and by the NSW SES?	The main flood mechanism impacting the immediate area around the site is flash flooding via overland flow. Pre-emptive closure of the site is recommended when there is advanced warning of a major storm event. However, flash flood events are characterised by minimal warning times and therefore there may not be sufficient warning time to achieve evacuation at the site, as discussed below.
2. Has evacuation off-site (the primary emergency management strategy) been investigated and determined to be unachievable?	With less than 10 minutes from the onset of the critical PMF storm until inundation of the adjoining roads of the proposed GTB site, there is little warning time to implement evacuation off-site in the event of flooding. NSW SES state that evacuation of a site must not require people to drive or walk through flood water. It is therefore recommended that the facility is prepared for a shelter-in-place strategy in the event of flooding that affects the proposed GTB site.
3. Does the development include medical centres, emergency service and community facilities, and sensitive and hazardous land uses, some of which may not be suitable for shelter in place?	While the facility is a medical research facility, it does not receive hospital patients. It is also deemed more hazardous to attempt to evacuate the site once a severe storm event has already commenced, as this would involve moving vulnerable site users from a safe environment onto roads of medium to high hazards.
4. Shelter in place for greenfield development is not supported	N/A, the development is not a greenfield development.
5. Whether there is existing government developed flood warning systems that give advanced detailed forecasts of flash flooding to allow sufficient time to evacuate to the proposed refuge locations[2] [2] Flash flood warning systems are not failsafe and should not be the only mechanism to get people to shelter in place.	While there are flood warnings issued by the Bureau of Meteorology and the Australian Warning System, the flash flooding nature at the site (and the inherently limited warning time associated with this type of flooding) limits the capacity of NSW SES to issue flood notifications and action statements with sufficient lead time. There is less than 10 minutes from the onset of the critical PMF storm until inundation of the surrounding roads. Therefore, warnings may not be available or occur with advanced warning to accomplish evacuation.
6. Can the community effectively be informed of the risks associated with the emergency management strategy?	Education and signage are important ways to inform site users of the flood risks present on site and the flood protocols and procedures involved in the SIP strategy. These should be considered and implemented prior to the facility becomes operational.
Following satisfaction of the above, the following must be assessed:	
7. Detailed assessment of evacuation off-site (the primary emergency management strategy) to determine that evacuation off-site is not achievable	With less than 10 minutes from the onset of the critical PMF storm until inundation of the surrounding roads for the proposed GTB site, there is little warning time to implement evacuation off-site. NSW SES state that evacuation of a site must not require people to drive or walk through flood water.

	It is therefore recommended that the facility is prepared for a shelter-in-place strategy.
8. The flood behaviour at the site, with consideration of climate change and assessment of the potential maximum duration of isolation up to and including the PMF to identify that: a) flash flooding is the only flood risk present at the site, whether it be from overland flooding, local creek or riverine flooding, and b) the flooding occurs within less than 6 hours from the commencement of causative rain and the duration of shelter in place due to isolation by floodwaters is less than 12 hours from the commencement of rainfall, and c) the development is not subject to high hazard flooding (e.g. floodways, high hazard H5 or H6 areas) or surrounding roadways are not subject to high hazard flooding.[3] [3] Flood Risk Management Guideline FB03 Flood Hazard, DCCEEW, 2023.	Impacts of climate change have been considered and assessed as part of the flood assessment and discussed in Section 4.6. a) The site is impacted by flash flooding derived from rainfall runoff. The site is not impacted by mainstream flooding. b) There is less than 10 minutes from the onset of the critical PMF storm until inundation of the surrounding roads for the proposed GTB site. The duration of isolation is short due to the flash nature of flooding in the area, with the facility only cutoff from access roads for less than 5 hours. c) While the GTB building itself is not impacted by flooding, its surrounding areas are subject to medium to high hazards flooding, as indicated in 39, in the PMF event. Nonetheless, it is deemed more hazardous to attempt to evacuate the site once a severe storm event has already commenced, as this would involve moving vulnerable site users from safe refuge into roads of medium to high hazards.
9. How shelter in place will be: a) used as part of the site's emergency management response, including actions before, during and after sheltering in place, and b) communicated to occupants and visitors of the building and how this communication will be maintained for the life of the development.	a) This will be outlined in a standalone Flood Emergency Response Plan (FERP) for the site. The FERP will be prepared prior to the GTB building becomes operational. b) This will be discussed and included in a standalone Flood Emergency Response Plan (FERP) for the site. The FERP will be prepared prior to the GTB building becomes operational.
10. An understanding of the secondary risks and how the proponent proposes they will be managed is outlined in the FIRA. Secondary risks include medical emergencies, building fire, health and wellbeing. a) Table 12 of EM01 should be used to consider whether the risks could be effectively managed.	This will be considered and discussed in a standalone Flood Emergency Response Plan (FERP) for the site. The FERP will be prepared prior to the GTB building becomes operational. a) Table 12 of the EM01 notes that, for a day hospitals, a key consideration for SIP is as follows: '*Where possible, new day hospitals should be located above the PMF level. However, at a minimum there should be access to adequate space above the PMF within a day hospital building for patients, staff and visitors where the facility is not intended to be evacuated outside the floodplain*.' With the proposed GTB ground level to be protected from PMF flooding and remaining higher floor levels free from flooding, there will be sufficient areas to shelter in place and meeting Table 12 SIP requirement above. Table 12 of the EM01 also notes "*Consider developing a PA system to communicate directions and safety messages to the population in the lead-up to and during a flood to assist*

	in improving the safety of the community." A PA system will be available for the proposed GTB building, as part of the building fire response strategy.
Design criteria for consideration	
i. the floor level of the shelter in place part of the development be above the PMF, and	Table 6 summarises the proposed FFL and estimated flood levels around the GTB building, and confirmed that the ground floor of the proposed GTB building is set at or above the PMF levels and is therefore safe for refuge across all floors.
ii. structural soundness for conditions in a PMF event, considering flood and debris forces, be verified by a suitably qualified structural engineer, and	As a medical research facility, structural soundness of the GTB building will be achieved.
iii. area and access to the area does not rely on access to electricity, is self-directing, and have clearly marked internal access for all people on site, including consideration of access for potential occupants and/or visitors	As a medical research facility, access and clearly marked internal access will be achieved.
iv. protection from weather and appropriate heating and cooling	As a medical research facility this will be achieved.
v. access to personal hygiene facilities such as a toilet	As a medical research facility this will be achieved.
vi. a minimum floor space of 2 m² per person	Given that the facility will not accept hospital patients, this will be achieved.
vii. items for self-sufficiency that are stored, maintained and are regularly updated in an accessible location above the PMF, including sufficient drinking water and food for occupants, fire extinguishers, radios and torches with spare batteries, and a first aid kit with an automated external defibrillator (AED)	As a medical research facility this will be achieved.
viii. centralised communal shelters may be considered but must be freely accessible internally at all times and externally accessible during events	As the proposed GTB building are set above the PMF, with meeting rooms, office rooms, and common areas available for shelter.
ix. access is provided to onsite systems that generate power of the shelter in place location during and after the event for a full range of flood events up to the PMF	This will be achieved as the electrical room of the GTB building is protected against inundation up to (and including) the PMF event.
x. detail how these requirements will be maintained and enforced for the life of the development.	A standalone Flood Emergency Response Plan (FERP) for the site will be prepared and available prior to the operation of the GTB building. This will be a 'living documents which need to be regularly reviewed once the GTB building is operational to ensure they remain appropriate to address the risk to the site, can be practically implemented, and consider changing

	information and lessons learnt from any floods since the last review. It is recommended that the FERP is reviewed following staff changes, flood drills as well as flood events to ensure that the details remain relevant for the site.

Based on the above and with less than 10 minutes from the onset of the critical PMF storm until the surrounding roads are deemed unsafe, it is recommended that the proposed GTB building is prepared for a shelter-in-place strategy. NSW SES state that evacuation of a site must not require people to drive or walk through flood water. The duration of isolation is short due to the flashy nature of flooding in the area, with the proposed GTB building being cut off from access roads for less than 5 hours in PMF event. It should also be noted that all proposed building areas on ground floor will not experience above-floor inundation in the PMF event, hence are safe to shelter in from the ground floor and upwards.

The site will be prepared for the short-term refuge required in terms of provisions, facilities and first aid, which will be located above the PMF event level, and will be managed by staff on site who will have designated responsibilities. During the shelter-in-place strategy, all staff and students are to remain indoors.

Weather warnings and BOM will be required to be monitored to give advanced warning of flooding although the short response time at the site will mean that there will unlikely be time to evacuate the building and why a shelter in place strategy is proposed.

All users of the site and known visitors to the site will be given advance warning of closure of the site. Users of the site will be directed by staff and signage to the higher levels. Constant users of the site will also be drilled in the flood emergency response procedures.

There will be no increased reliance on NSW SES or any other emergency services.

MANAGEMENT AND DESIGN
1. Applicant is to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP and the relevant FRMS and FRMP.
2. Flood emergency response plan required where the site is affected by the 1% AEP (100 year ARI) flood level. Plan is to detail procedures that would be in place for an emergency (such as warning systems, signage and evacuation emergency drills) and should consider the following aspects: (i) preparing for a flood, (ii) responding when a flood is likely, (iii) responding during a flood, and (iv) recovery after a flood. Must be consistent with Flood Warning and Emergency Response Planning requirements outlined in DCP.
3. Applicant is to demonstrate that sufficient area is available to store goods above the 1% AEP (100 year ARI) flood level plus 0.5 metre freeboard.
4. No Storage of materials below the Flood Planning Level (1% AEP flood plus 0.5 metre freeboard) which may cause pollution or be potentially hazardous during any flood.

As discussed above, and in Section 4.2-4.4, the modelling results show that the site to be generally flood free in the 1% AEP flood event and as such the DCP does not require a full Flood Emergency Response Plan. Adequate space is available within the building to store goods, and it is recommended that hazardous materials are not stored in the basement level and ideally on Level 1 and above.

9.0 Summary

TTW has been engaged to carry out a flood assessment in relation to the Children's Medical Research Institute (CMRI) - Gene Technologies Building (GTB) development and support a State Significant Development application. Hydraulic modelling has been carried out based on the TUFLOW developed by Arup as part of the Children's Hospital Westmead Paediatric Services Building (2021) and Kids Park Flood Impact Assessment (2023).

In Revision G of this report, TTW completed a flood assessment of the site using the Parramatta River Flood Study TUFLOW model, as requested by CPHR in their Response to Submission. The PRFS model's use of localised 2D source inflows and coarser grid resolution results in an overly conservative representation of flood behaviour at the GTB site that does not accurately reflect the true distribution of flows across the catchment. The CHW model's rainfall-on-grid approach and finer resolution more realistically distribute flows and represent conveyance processes and is therefore the more appropriate model to be adopted for the assessment. It is therefore recommended that estimated flood levels of the GTB area be based on the CHW modelling to avoid over estimation of flood levels due to the concentrated catchment inflow's method adopted in the PRFS modelling. The flood planning requirements and the compliance of the design has subsequently been reviewed using the initial flood model results derived from the CHW TUFLOW model. Nonetheless, flood and impact assessments have been carried out for the PRFS modelling to determine the likely impacts that the proposed GTB development will have to the surrounding properties, in response to CPHR's requirements.

The results show that the proposed GTB redevelopment works will not result in unacceptable flood impacts for areas outside the Children's Hospital Westmead property boundary in the 1% AEP event.

Further, the CHW model results show that flood hazards for the surrounding areas of the GTB site generally remained similar to the pre-development scenario, for areas external to the Children's Hospital Westmead property boundary. Nonetheless, further checks and assessments should be carried out in the detailed design phase (i.e. prior to construction) of the project to confirm that the modelling outcome discussed within this report is maintained and that appropriate levels have been set for the key locations within the GTB site.

Flood hazards surrounding the site are low in the 1% AEP event and suitable for pedestrians and vehicles. Council's DCP does not require a Flood Emergency Response Plan for sites not within the 1% AEP, however, during the larger and very rare PMF event, a shelter in place strategy is proposed due to the higher hazards simulated and the potential speed and lack of suitable warning time available. This will be in line with the Department of Environment's 'Shelter in place Guideline' as outlined in Section 6.0.

Users of the site will have shelter available on the higher floors of the building and vertical evacuation will be suitably prepared for, in terms of provisions and facilities, and managed by onsite staff. Ongoing education of flood risk and hazards will be given and emergency drills carried out periodically. Observation of online BOM weather warnings and radar will be used to inform of large weather events that may cause inundation at the site and its surrounds.

Prepared by
TTW (NSW) PTY LTD

RachelCaldwell

RACHEL CALDWELL
Civil Flood Modeller

Prepared by
TTW (NSW) PTY LTD

MICHAEL KOI
Associate (Flood)

Authorised by
TTW (NSW) PTY LTD

TIM MOORE
NSW Civil Manager