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Civil SSDA - Flood Assessment & Stormwater Management Report

Lang Walker AO Medical Research Building - Macarthur

Prepared for BVN / 20 October 2021

201940CAAA

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1.0 Introduction

Taylor Thomson Whitting (NSW) Pty. Limited has been engaged by BVN to prepare a Civil SSDA - Flood Assessment & Stormwater Management Report in accordance with the in accordance with the requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the State Significant Development (SSD – 17491477) for the proposed development at Parkside Crescent, Campbelltown NSW 2560 (the site).

1.1 Project Objectives and Methodology

The objective of this report is to addresses the flooding and stormwater management requirements of the SEARs (key issues 15 & 16) as follows:

- Identify any flood risk on-site in consultation with Council and having regard to the most recent flood studies for the development area and the potential effects of climate change and an increase in rainfall intensity.
- Assess the impacts of the development, including any changes to flood risk onsite or off-site, and detail design solutions to mitigate flood risk where required.
- Provide a preliminary stormwater management plan for the development that:
  - is prepared by a suitably qualified person in consultation with Council and any other relevant drainage authority.
  - details the proposed drainage design for the site including on-site detention facilities, water quality measures and the nominated discharge point.
  - demonstrates compliance with Council or other drainage authority requirements.
- Provide stormwater plans detailing the proposed methods of drainage without impacting on the downstream properties.
- Where drainage infrastructure works are required that would be handed over to Council, provide full hydraulic details and detailed plans and specifications of 10 proposed works that have been prepared in consultation with Council and comply with Council's relevant standards

TTW methodology in response to above matters is described as follows:

- Prepare a hydraulic model (TUFLOW) for the site under existing and proposed conditions.
- Determine site flood characteristics for the 1% annual exceedance probability (AEP) flood and probable maximum flood (PMF) events.
- Prepare relevant flood maps including flood extents, depths, levels, velocities, hazards and impacts.
- Comment on flood characteristics and model outcomes in existing and proposed conditions.
- Provide a stormwater quantity management plan and a water sensitive urban design (WSUD) consistent with the requirements of Campbelltown Council.

1.2 Site

The site is located at Parkside Crescent, Campbelltown NSW 2560 (an area within Lot 6 DP1058047) and is bounded by Parkside Crescent to the west and Macarthur Clinical School to the south. The site's general location is shown in Figure 1.

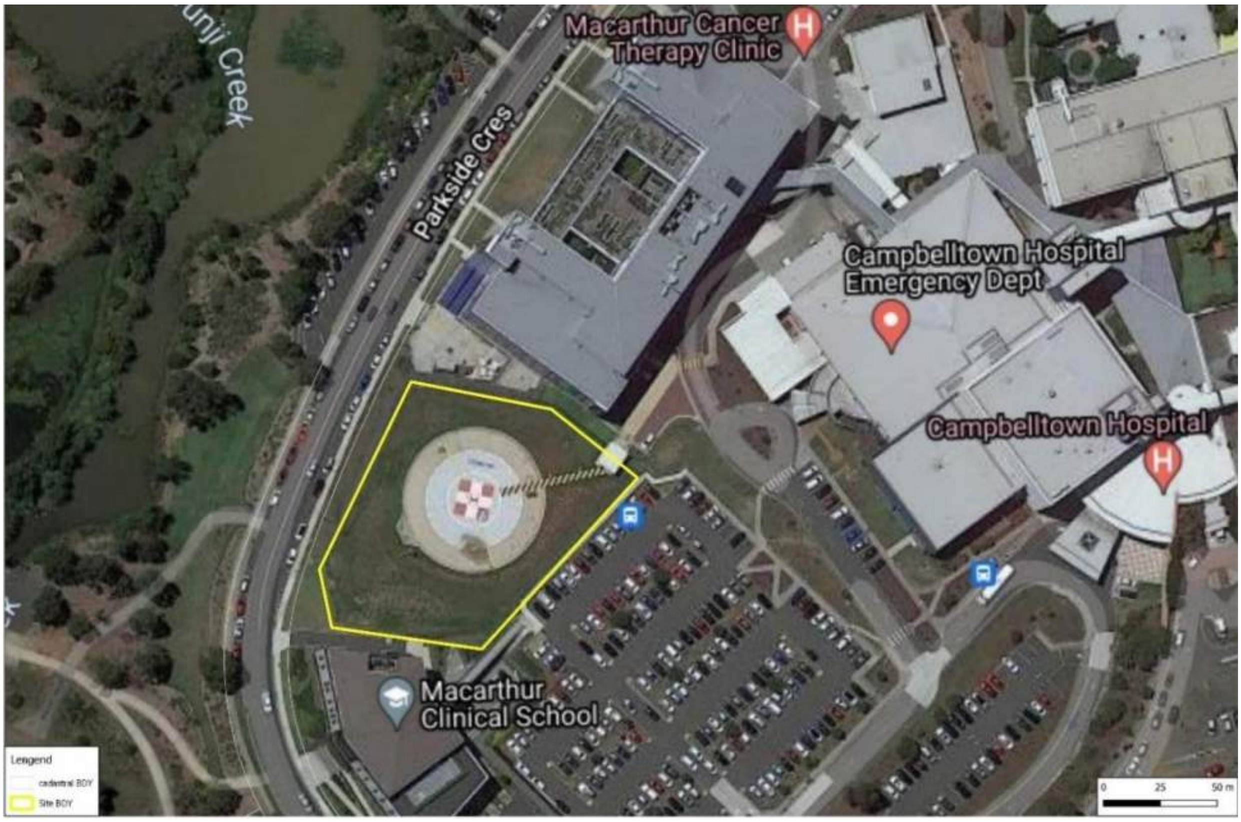

Figure 1 - Site Location and Surrounding area (Google Map)

The site area is 3384 m^2 (Approx.) and typically grades towards Parkside Crescent with highest levels of 83m AHD at north-eastern boundary, falling to 77m AHD towards the south-western boundary.

The site falls within the Campbelltown Council LGA and zoned as SP2 (infrastructure) based on Campbelltown City Council LEP (2015).

The site levels have been raised to 82m AHD along the western boundary and is currently used as helicopter pad. The land is generally covered with grass including an existing concrete helipad.

2.0 Proposed Development

The proposed development is a medical research centre and comprised of a 3-storey building including a ground floor and a basement.

Figure 2 shows the proposed architectural plan provided by BVN.

Figure 2 – Proposed Architectural Plan (Ground Floor) – BVN

2.1 Reference Documents

This report has been prepared in accordance with the following guidelines and policies:

- Australian Rainfall and Runoff Data (2019) with AR&R (2016) rainfall datasets sourced from BoM
- Australian Rainfall and Runoff (2016) – A Guide to Flood Estimation.
- Campbelltown Development Control Plan (DCP, 2015)
- Campbelltown Local Environment Plan (LEP, 2015)
- Engineering Design for Development, Volume 2, Campbelltown DCP (2009)
- NSW Department of Infrastructure, Planning and Natural Resources (2005), Floodplain Development Manual.

3.0 Available Data

This flood study uses topographic and flood related data obtained from a number of sources. The origin and types of information underpinning the assumptions used in this study are presented below.

3.1 Previous Flood Studies

The site falls within Bow Bowing Creek catchment. Molino Stewart Pty Ltd conducted a flood risk management study for this catchment on behalf of the Campbelltown City Council and summarised the outcomes in Bow Bowing Bunbury Curran Creek Strategic Floodplain Risk Management Study and Plan Report (August 2018).

Catchment Simulation Solutions (CSS) have also prepared a flood modelling and assessment for Campbelltown Hospital that covers the site and has been approved by the Campbelltown Council.

Despite enquiries made to receive the latest prepared flood model for the site, TTW was not able to acquire the Council's TUFLOW model. TTW However, have received the CSS flood modelling results for the site proximity subject to a request made through the Campbelltown Council. The provided data includes the CSS flood modelling results for the 1% AEP and PMF events are shown in Figure 3 and Figure 4 respectively.

Based on the CSS flood results, the site is primarily flood free during the 1% AEP flood event as well as the PMF.

Figure 3 - Received flood Results (CSS) - 1% AEP Flood Event

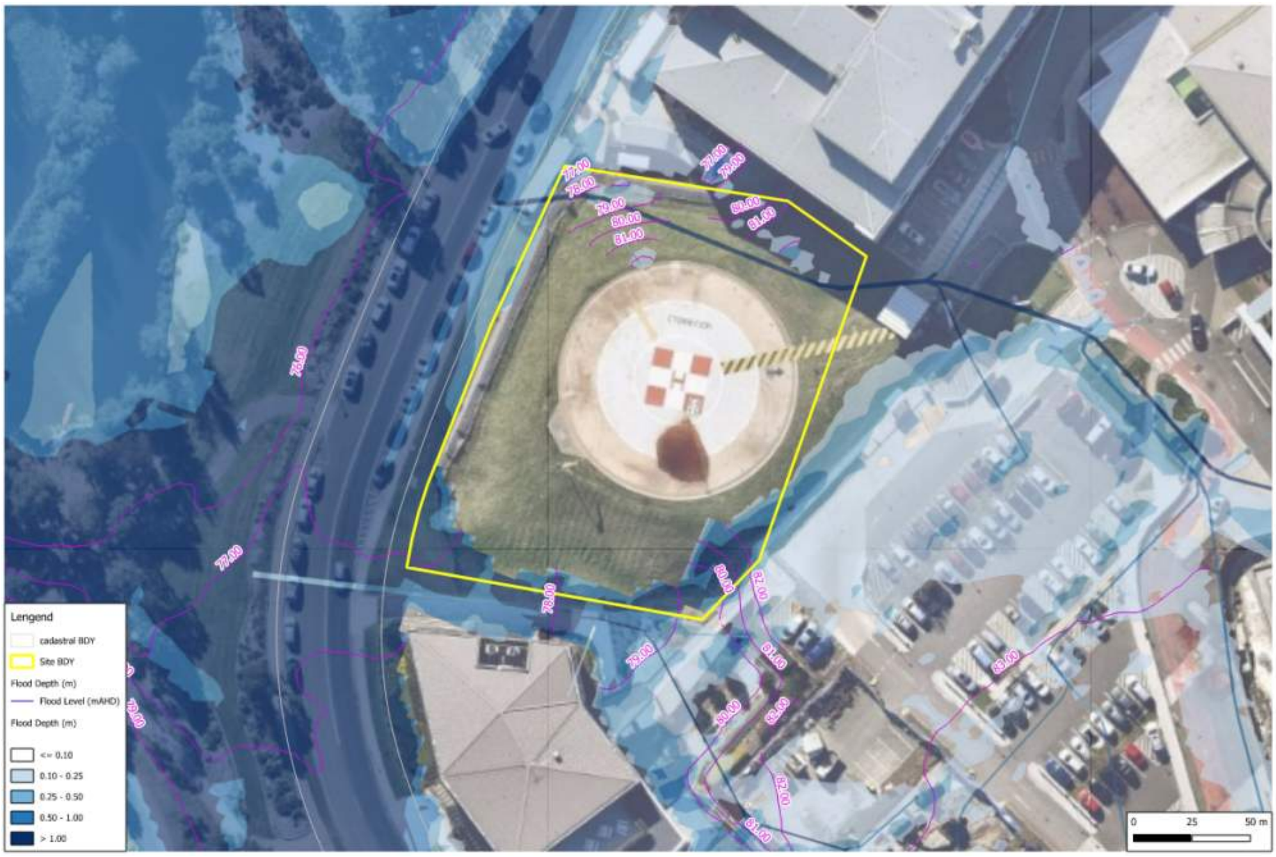

Figure 4 - Received flood Results (CSS) - PMF Flood Event

3.2 Survey Data

Survey information adopted for this study has been collated from the following sources:

- One metre resolution Digital Elevation Model (DEM), ALS.
- Site survey data provided by the LTS Lockley (dated 23/08/2017).
- GIS layers of cadastre and satellite imagery provided by the NSW LPI.

4.0 Hydraulic Model

The TUFLOW hydraulic model with direct rainfall method was used to determine flood extents, levels, depths, velocities and hydraulic hazard during the critical 1% AEP and PMF events for the site in existing and proposed conditions.

4.1 2D Model Domain

The site upstream catchment delineated using Lidar data. Model boundary extents were generally placed along catchment ridgelines and / or connecting catchment high points surrounding the study area. Total model domain area is 299 ha (approx.) as shown in Figure 5. A square grid was utilised for this study, with the grid size of 2m x 2m.

The grid cell size of $2m^2$ is considered to be sufficiently fine to appropriately represent the variations in topography and land use within the study area. It should be noted that TUFLOW samples elevation points at the cell centres, mid sides and corners, therefore a $2m^2$ cell size results in surface elevations being sampled every 1m.

4.2 1D Model Domain

There are a series of interconnected detention basins along the Birunji Creek within the catchment area which are part of the Campbelltown LGA flood management plan to provide flood storage and attenuate flood levels. Floodwaters conveyed through those basins via existing culverts and drainage pipes.

The existing main culverts and drainage pipes along the Birunji Creek were modelled as 1D network to allow water conveyance through the basins to downstream. The size of 1D network throughout the basins were estimated and later calibrated based on the flood results received from CSS.

4.3 Topography

A 1m grid Digital Elevation Model (DEM) generated for the catchment using Lidar data and merged with the site survey DTM triangles data to increase the accuracy of existing model surface for the site as well as for a section of Parkside Crescent adjacent to the site.

4.4 Boundary Conditions

4.4.1 Model Inflows

A direct rainfall boundary condition was applied to the model domain. The 1% AEP Design rainfall intensity-frequency-duration (IFD) data, derived from BoM website ARR (2019) for the upstream catchment.

4.4.2 Downstream boundary

Downstream boundary was defined approximately 500m north of the site along Kellicar Road. Stage-discharge (water level versus flowrate) curves were adopted as the downstream boundary conditions. The stage-discharge relationship was generated by TUFLOW by specifying downstream boundary slopes.

4.5 Building Footprints

The footprints of buildings surrounding critical flow paths are modelled as blocked elements within the 2D domain. Model Cells within the building footprints were deactivated to prevent floodwaters entering the buildings. The building outlines were determined using available survey and aerial photographs.

4.6 Hydraulic Roughness and 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 zones based on Nearmaps aerial photography of the study area with roughness coefficients adopted as per Table 1.

Table 1 Adopted roughness parameters

Land use category	Manning's 'n'
Residential land	0.20
Road and car park areas	0.02
Grass lands and parks	0.045
Bushlands	0.08

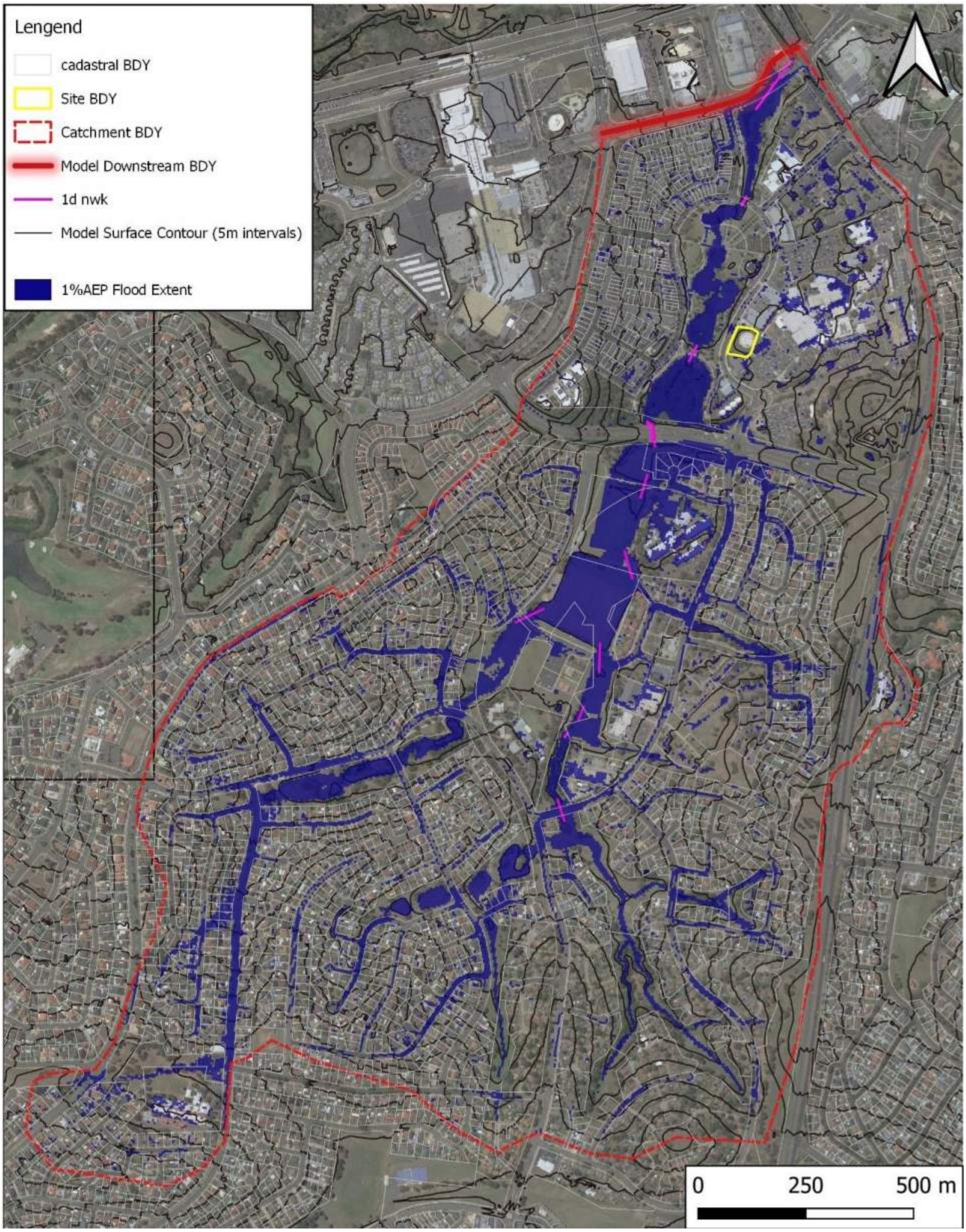

Figure 5 – TUFLOW Model 1D & 2D Domains - 1% AEP Flood Extent

5.0 Flood model results

The model was run for a range of 1% AEP flood durations as well as for a range of PMF durations from 30 minutes to 360 minutes to determine the site critical storm durations. The critical 1% AEP and PMF storm durations for the site were determined to be 180 minutes and 60 minutes, respectively.

The site flood conditions during the critical 1% AEP and PMF events in both existing and proposed site conditions are explained through the following sections and offsite flood impacts due to the proposed development are further investigated.

5.1 Existing Conditions

The peak flood levels depths, velocities and hazards in the critical duration 1% AEP event for existing site conditions are shown in Figure 6, Figure 7 and Figure 8 respectively.

Flood results confirm that the site is generally flood free during both 1% AEP and PMF events and upstream overland flows are majorly contained within the Park Central Basin.

There are only localised overland flows through Parkside Crescent as well as on the existing car park towards the western site boundary. Minor overland flows around the site are very shallow (typical depths of less than 100mm) in the 1% AEP and are of low hazard based on NSW provisional hazard categories.

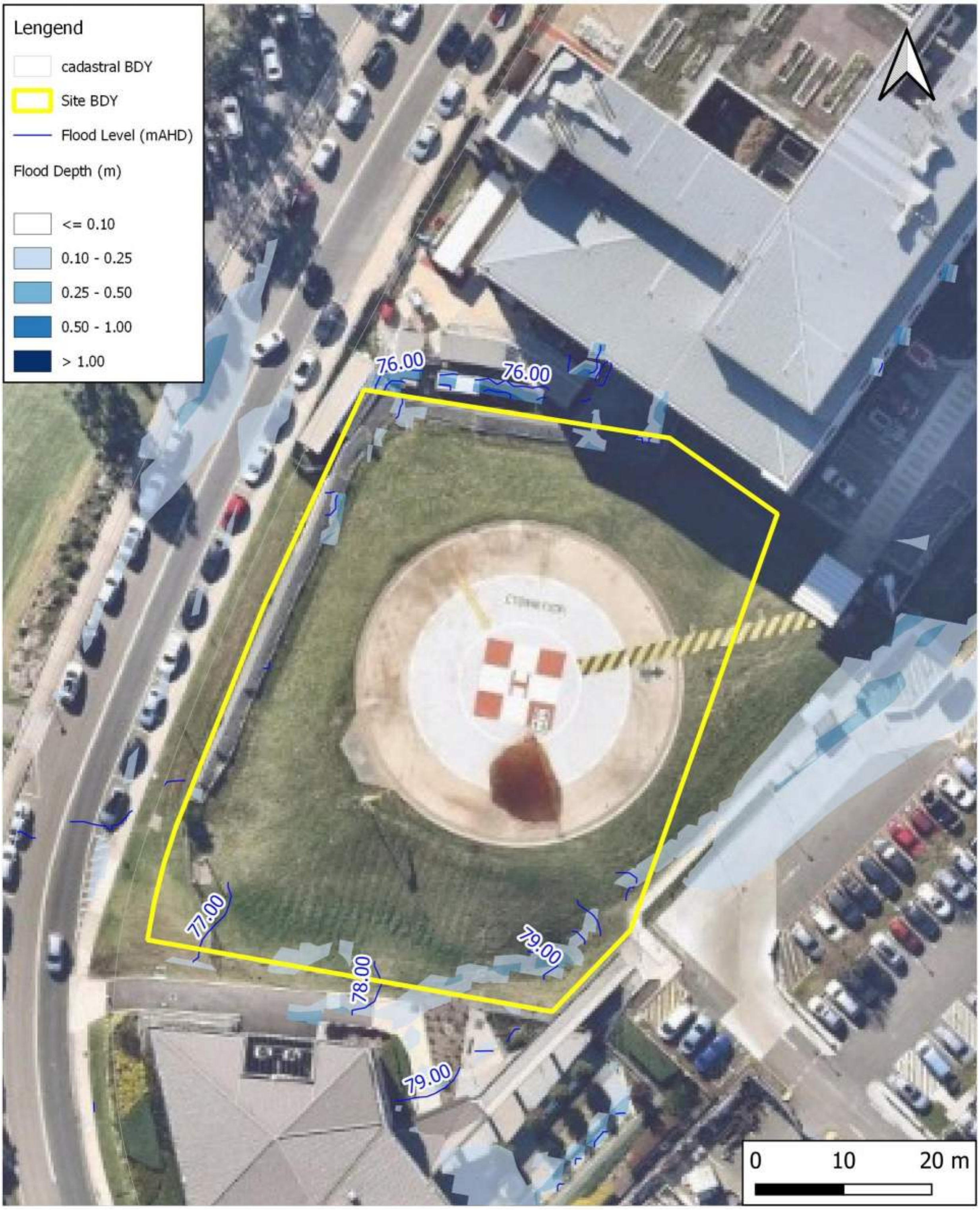

Figure 6 - Flood Levels & Depths (1% AEP) – Existing Conditions

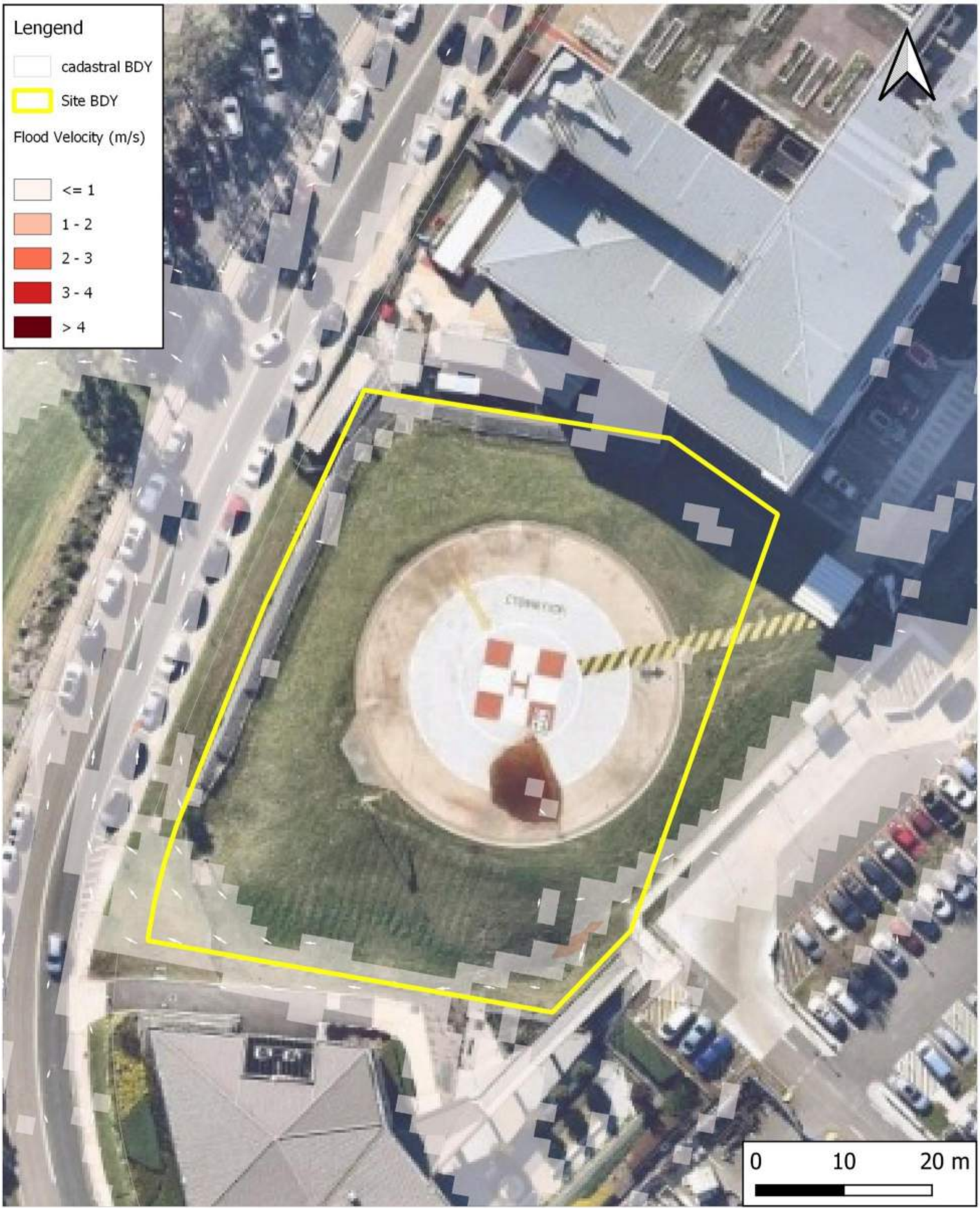

Figure 7 - Flood Velocities (1% AEP) – Existing Conditions

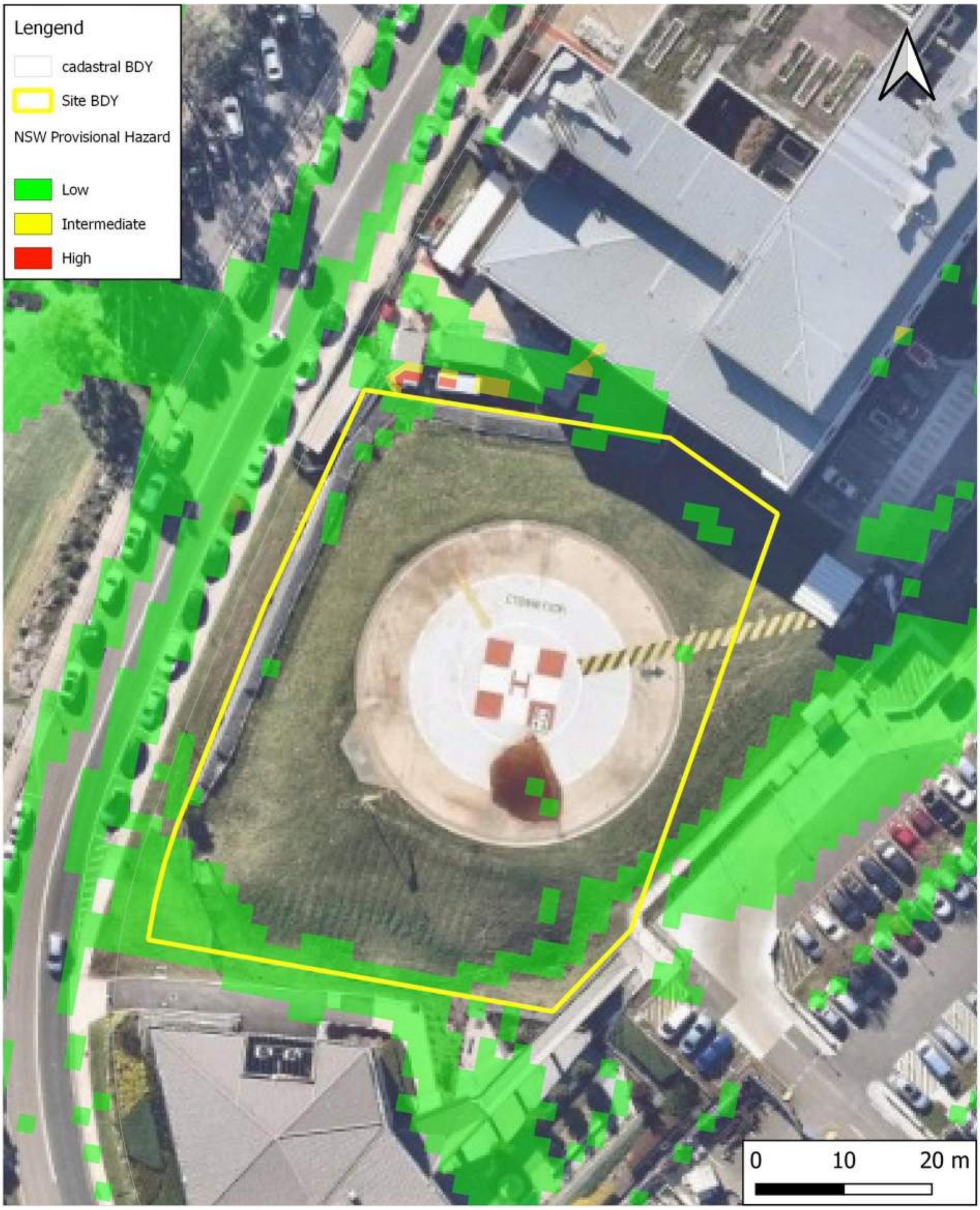

Figure 8 - Provisional Flood Hazards (1% AEP) – Existing Conditions

Flood depths during the PMF event though, raise up to the level of 77m AHD (750mm deep) on Parkside Crescent adjacent to the site and are of high hazard with flood velocities varying from 0.5m/s to 4.5m/s.

The site levels in existing conditions are approximately 6 metres higher than Parkside Crescent therefore, floodwaters along the western site boundary are contained within the Parkside Crescent during the PMF event.

The peak flood levels depths, velocities and hazards in the critical duration PMF event for existing site conditions are shown in Figure 9, Figure 10 and Figure 11 respectively.

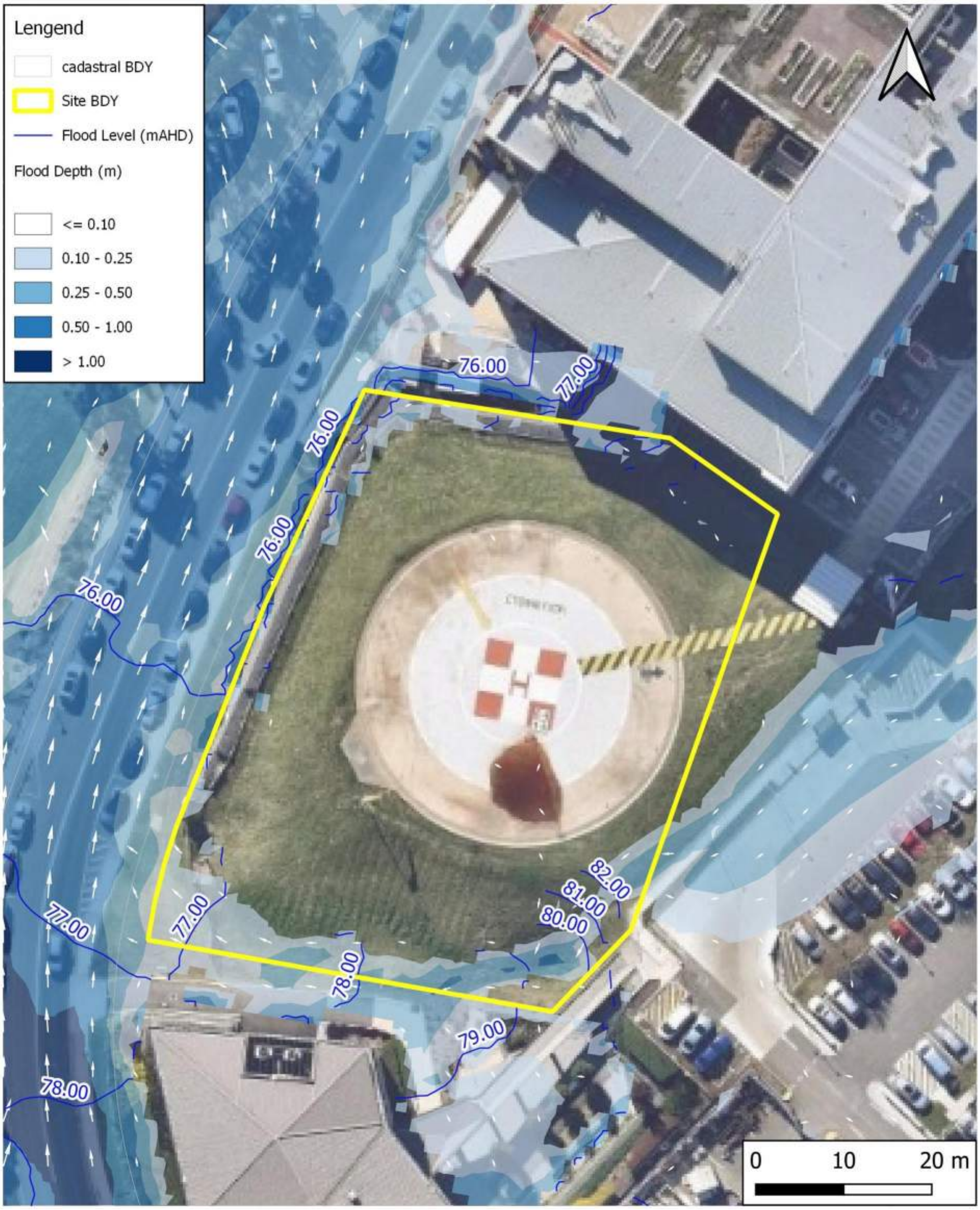

Figure 9 - Flood Levels & Depths (PMF) – Existing Conditions

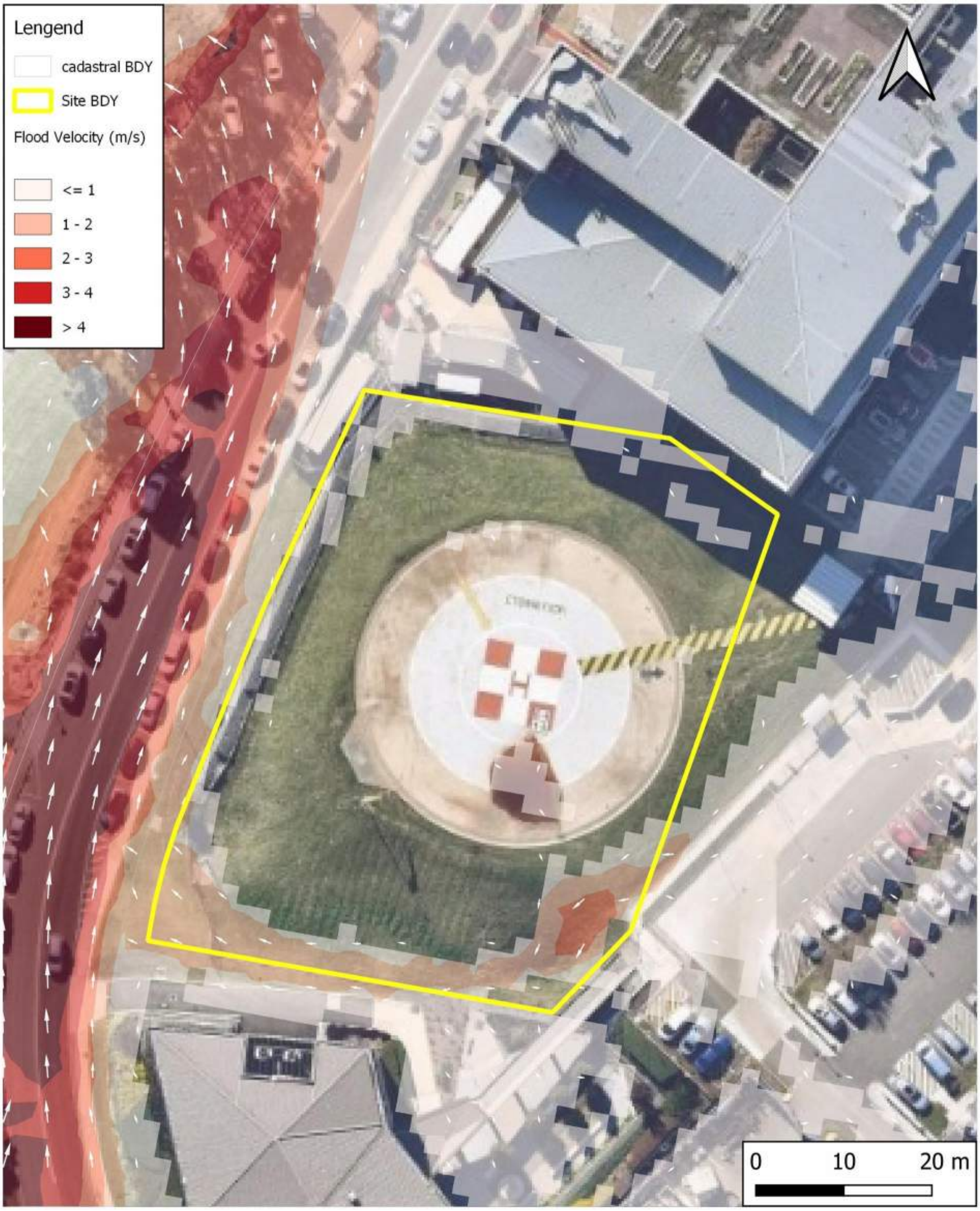

Figure 10 - Flood Velocities (PMF) – Existing Conditions

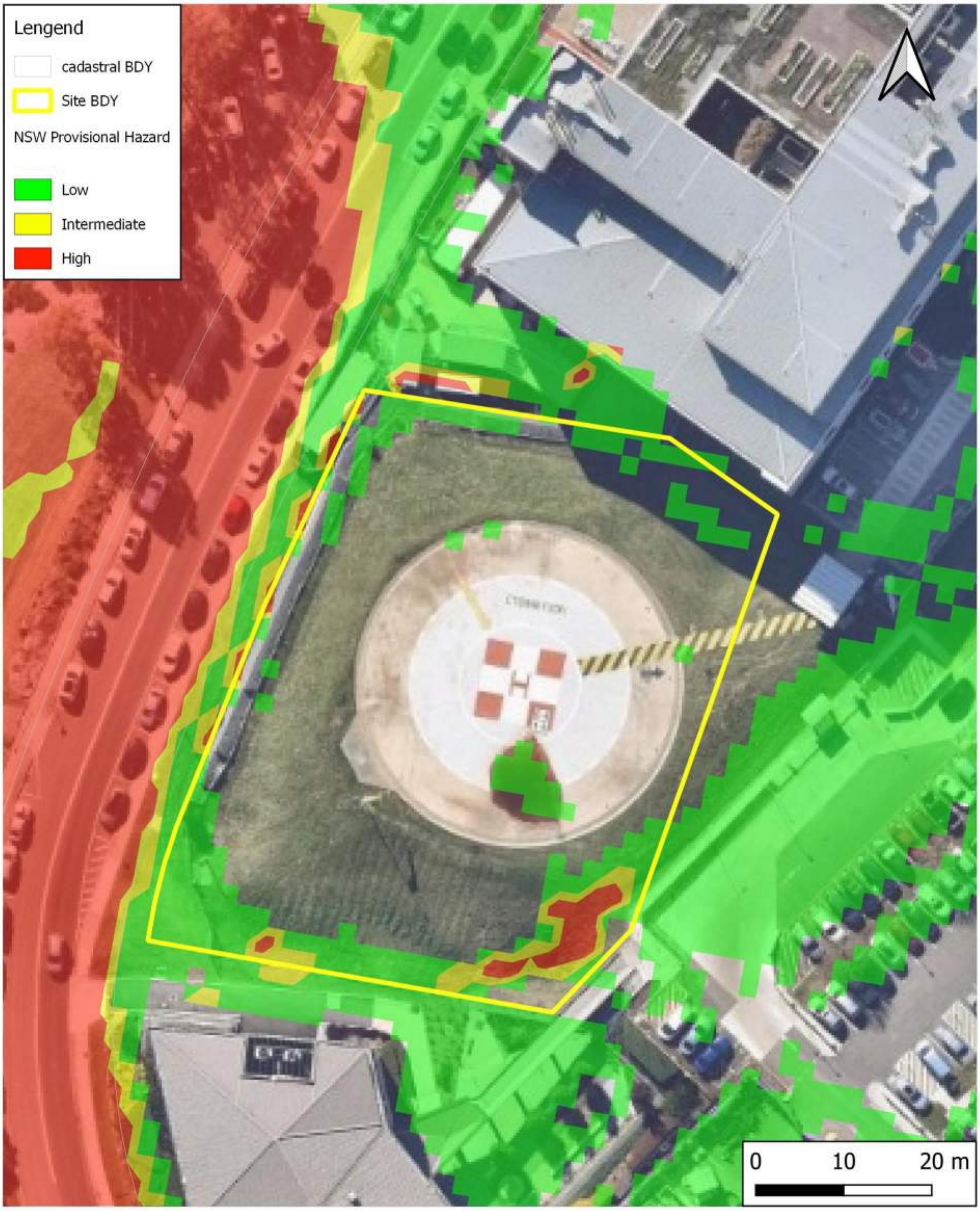

Figure 11 - Provisional Flood Hazards (PMF) – Existing Conditions

5.2 Model Validation

Flood model data and information provided by Council was used in the TTW flood model for to establish the 1% AEP existing flood condition.

Results of the TTW model were compared with the flood results provided by CSS. The comparison shows that although the TTW flood results agree well with those of provided by CSS.

Although the results show some discrepancies through the Birunji Creek basins (as TTW didn't have access to the basin and associated connection details), flood levels and depths agree well across the site and its proximities.

A few minor discrepancies on and around the site are likely due to the incorporation of the site survey (as opposed to pure lidar data) as well as the potential model cut-off depth differences (TTW's model cut-off depth is 20mm).

Figure 12 and Figure 13 show the comparison of flood levels (CSS and TTW model results) for the site during the 1% AEP and PMF events respectively.

TTW consider the model acceptable for the purposes of detailed site modelling and used this model as the base case scenario for the existing flood conditions.

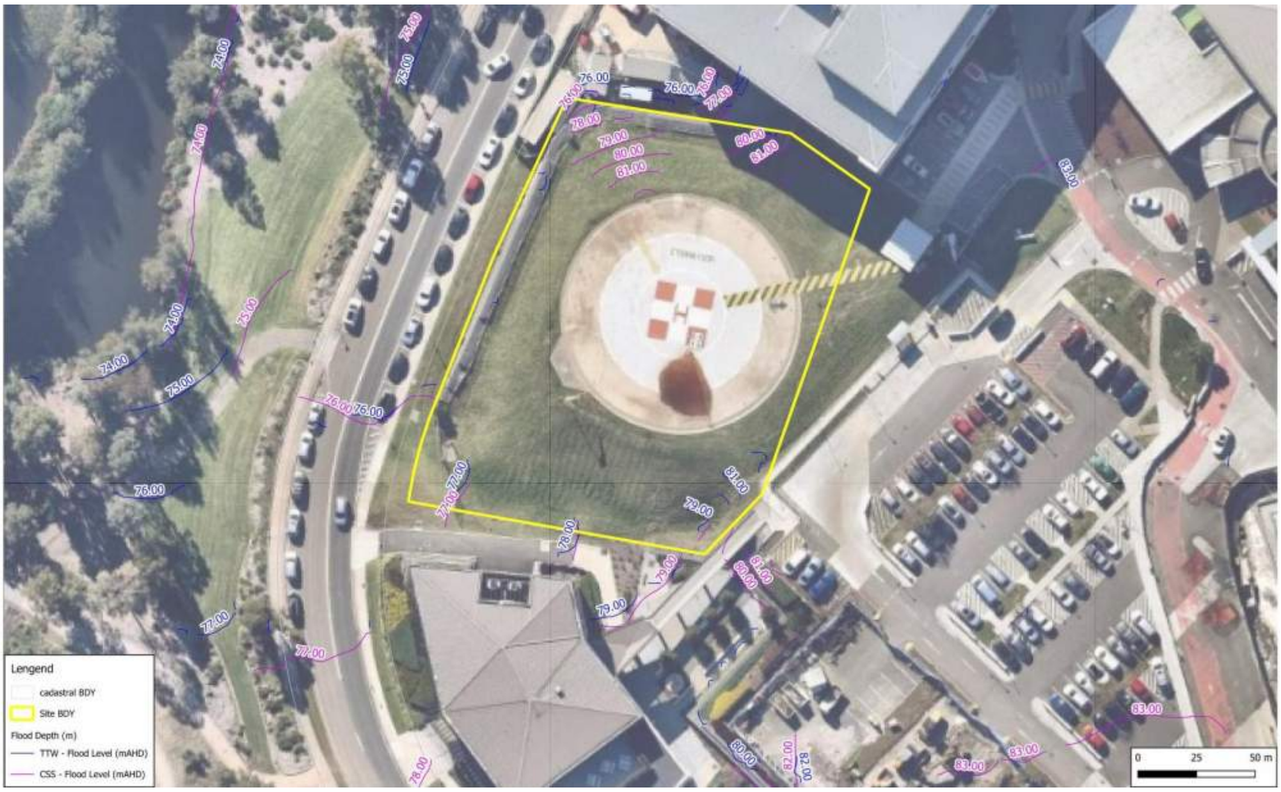

Figure 12 - Flood Level Comparison (CSS vs TTW Model Results) - 1% AEP

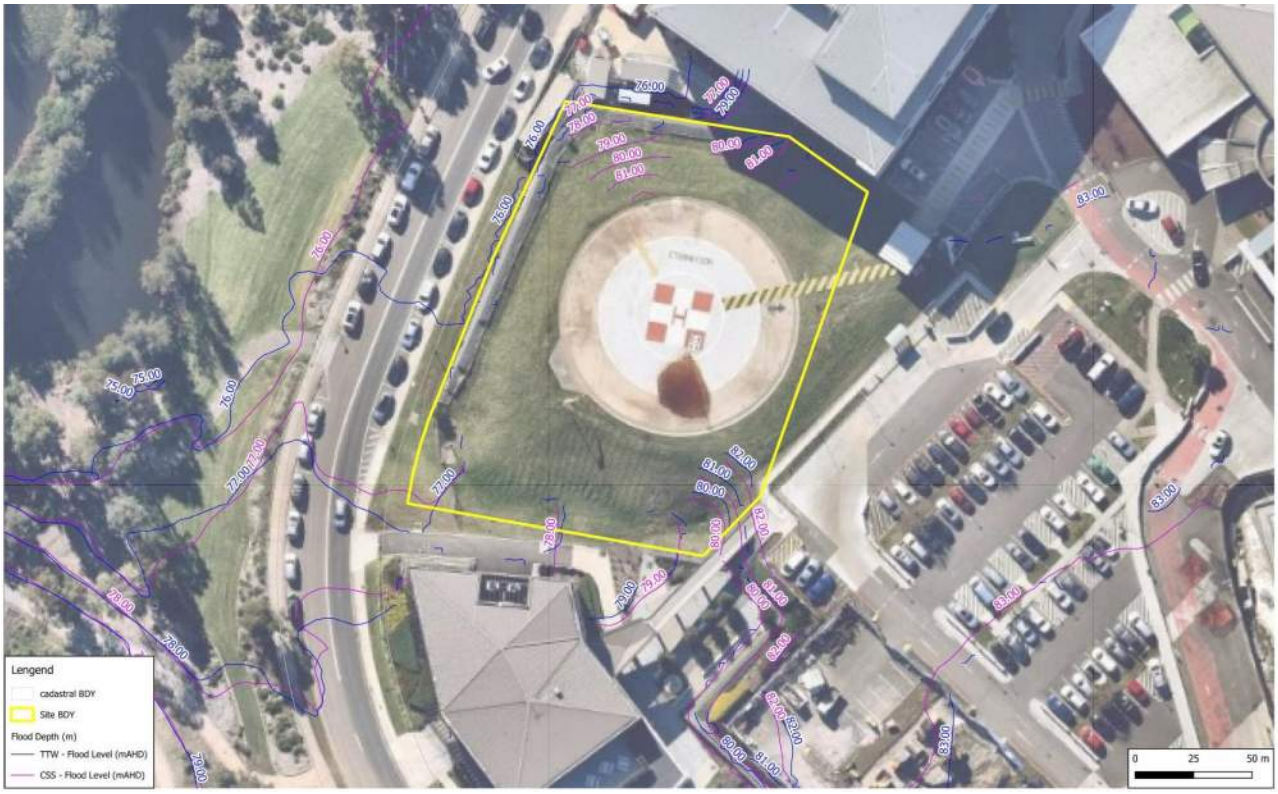

Figure 13 - Flood Level Comparison (CSS vs TTW Model Results) - PMF

5.3 Proposed Conditions

Peak flood levels, depths, velocities and hazards for proposed site conditions in the critical duration 1% AEP event are presented in Figure 14, Figure 15 and Figure 16 respectively. Figure 17, Figure 18 and Figure 19 also show peak flood levels, depths, velocities and hazards for proposed site conditions in the critical duration PMF event.

The flood modelling results confirm that the overland flow behaviour in the proposed conditions is relatively consistent with the existing conditions. The site is generally flood free in the proposed conditions during the 1% AEP as well as the PMF event.

Figure 14 - Flood Levels & Depths (1% AEP) – Proposed Conditions

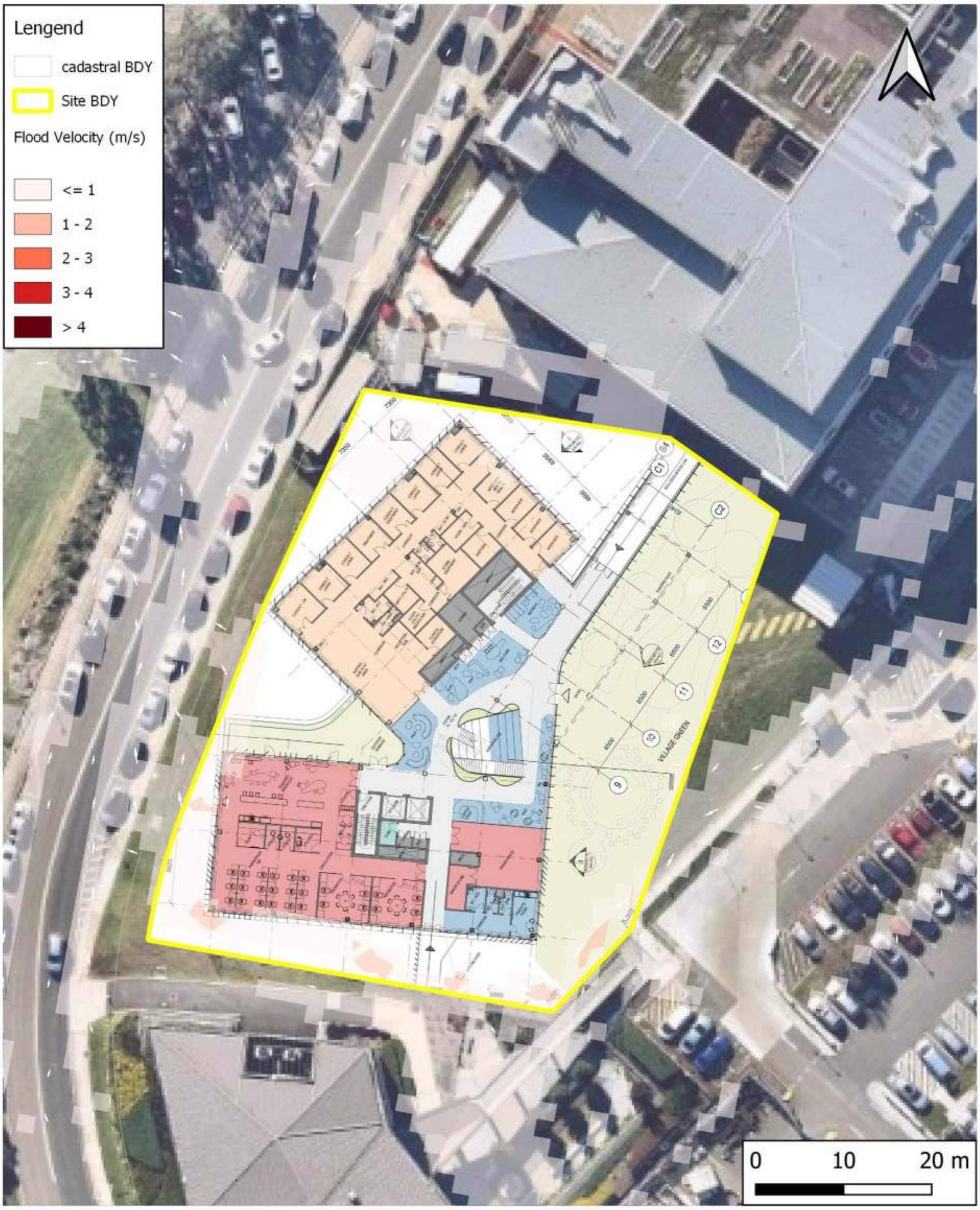

Figure 15 - Flood Velocities (1% AEP) – Proposed Conditions

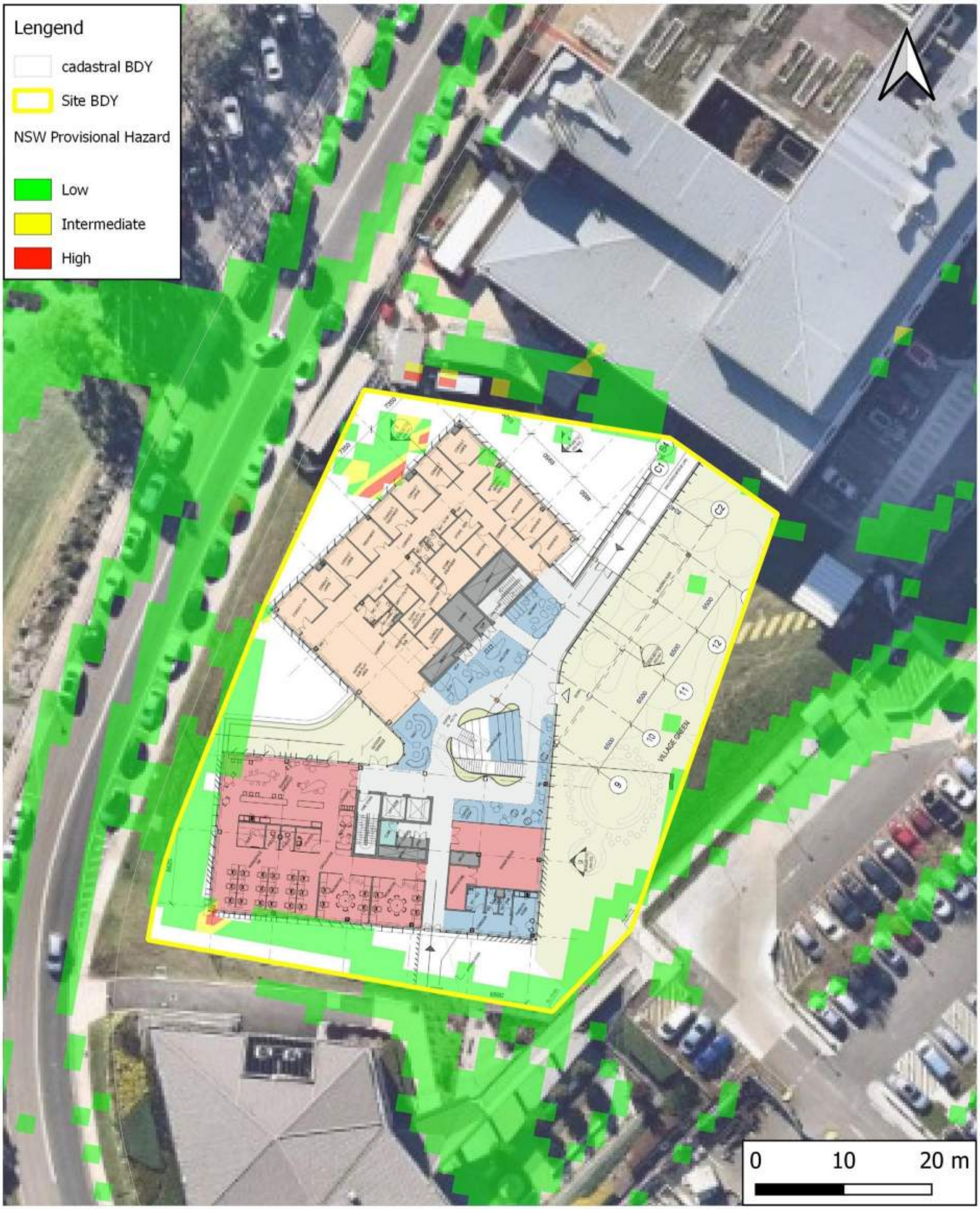

Figure 16 - Provisional Flood Hazards (1% AEP) – Proposed Conditions

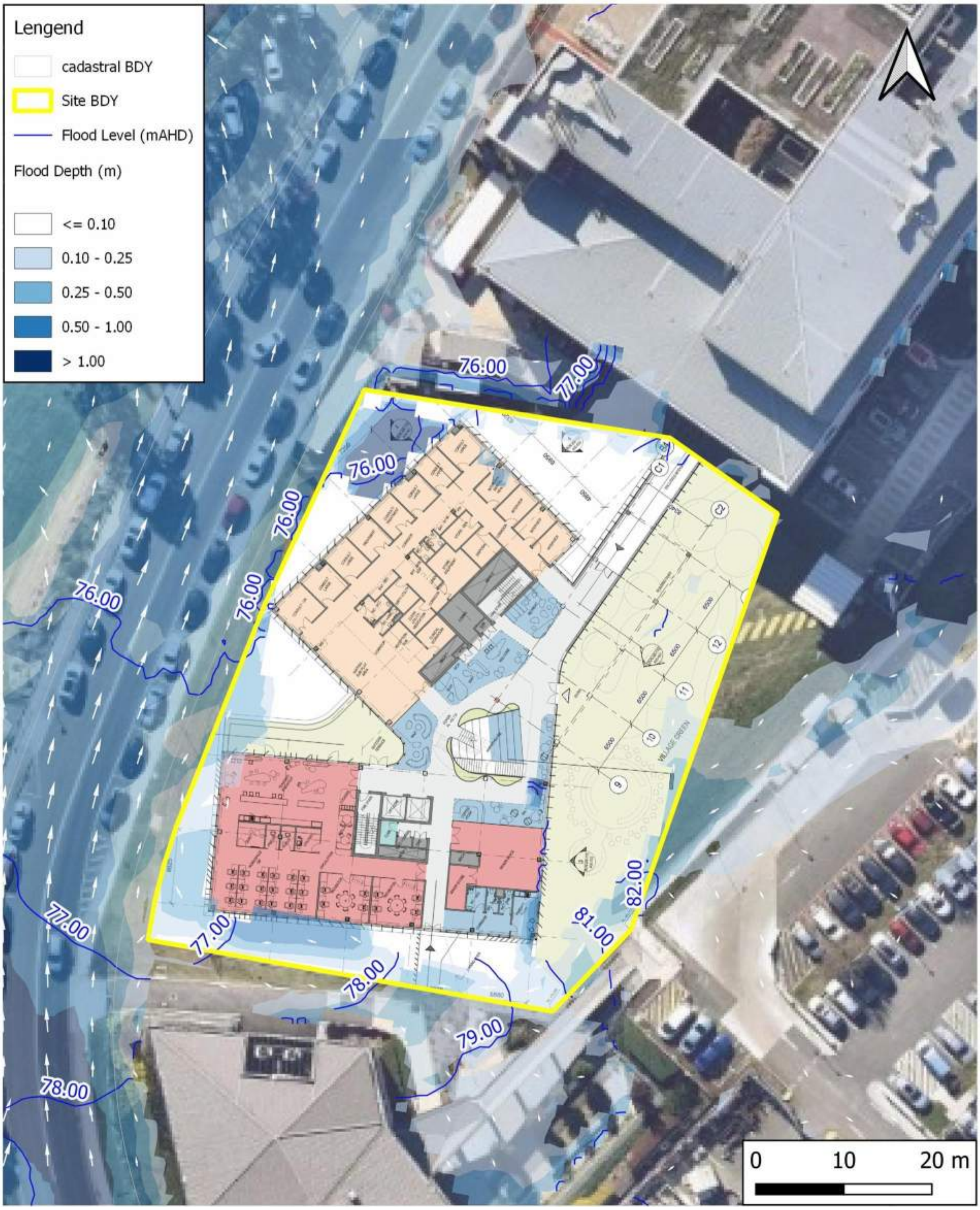

Figure 17- Flood Levels & Depths (PMF) – Proposed Conditions

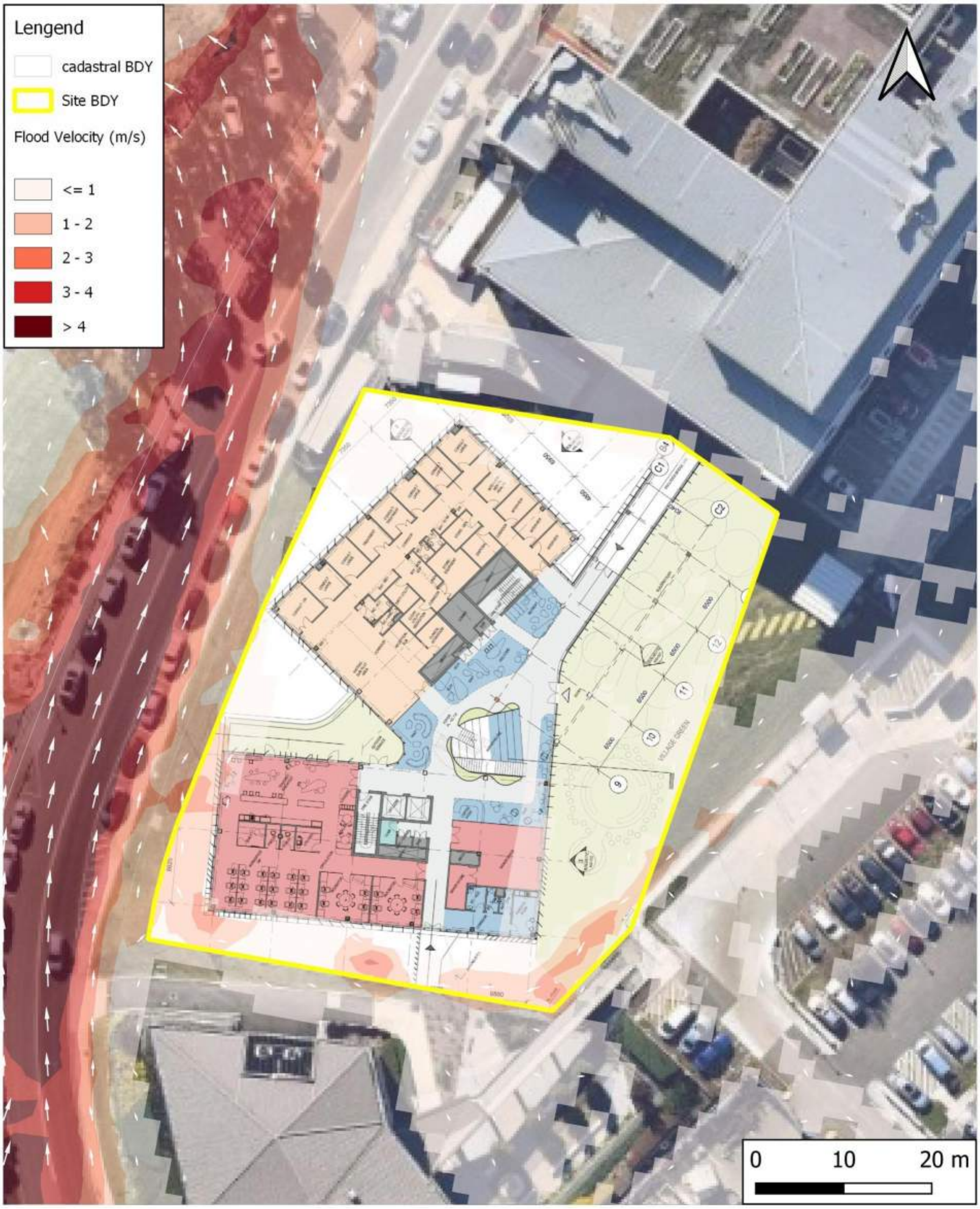

Figure 18 - Flood Velocities (PMF) – Proposed Conditions

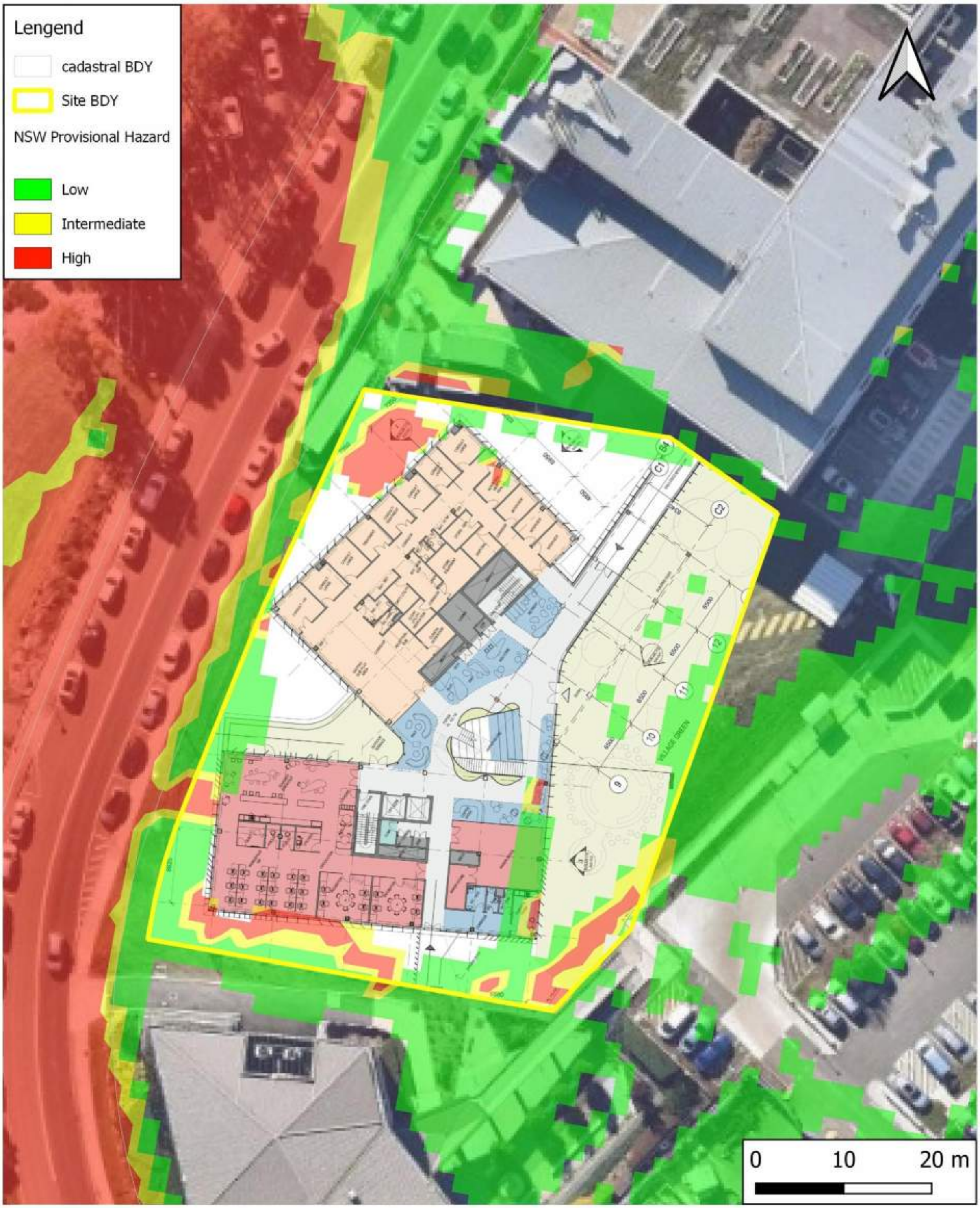

Figure 19 - Provisional Flood Hazards (PMF) – Proposed Conditions

5.3.1 Flood Levels Adjacent to the Proposed Building's Openings

Received architectural plans indicate that the proposed entry level to Lower Ground 02 is 76.10m AHD which is 0.23m above the 1%AEP flood level of 75.88m AHD and 4mm above the adjacent PMF flood level of 76.06m AHD.

The proposed Finished Floor Level (FFL) for the Lower Ground 02 is 76.55m AHD which is above the minimum required FFL of 76.38m AHD (1%AEP flood level of 75.88m AHD plus 500mm freeboard).

5.4 Flood Impacts

The site ground levels in existing conditions are in average 6 metres higher than Parkside Crescent surface levels. So that, the site acts as a blockage during large flood events and redirects upstream floodwaters onto Parkside Crescent. The proposed development would not impose additional fil to the existing flood storage area and therefore, unlikely to inflict negative offsite impacts.

Nevertheless, a flood impact assessment was undertaken to ensure no negative flood impacts caused by the proposed development. As depicted in Figure 20, the flood impact map shows no offsite impacts as a result of the proposed development.

Figure 20 – Flood Impact Assessment Map (1% AEP Flood event)

6.0 Site Stormwater Management Plan

6.1 Stormwater Quantity Management

Site stormwater quantity performance objectives are based on Campbelltown City Council Engineering Design Guide for Development (2015), Part 2.10. Water Cycle Management and Campbelltown City Development Control Plan (2009), Part 4. Stormwater Design as follows:

- All stormwater systems shall be sized to accommodate the 100-year ARI event
- On-site detention (OSD) is to be provided to ensure the maximum discharge from the post-development site is not to exceed the pre-developed flows for all storms up to the 100-year ARI event.
- Major design storm event being 1% AEP.
- Minor design storm event being 5% AEP (refer to Table 4-5 of Engineering Design for Development, 2015).
- DRAINS hydrological and hydraulic modelling package was used with the IL-CL engine to determine preliminary site storage requirements and ensure post development discharge is less than or equal to pre-development discharge of the site. DRAINS input data are as follows:
- Intensity Frequency Duration (IFD) data and rainfall temporal patterns were based on the Bureau of Meteorology (BoM 2016) Rainfall IFD Data System and the Australian Rainfall & Runoff (ARR 2019) Data Hub.
- Model parameters are consistent with those of recommended in Campbelltown City Council Engineering Design for Development, 2015.
- Impervious and pervious fractions were based on aerial maps for the predevelopment condition model and based on architectural plan (provided by BVN) for the post development condition model.

The site pervious / impervious fractions for predevelopment and post development conditions are detailed in Table 2.

Table 2 - Site Catchment - Pervious / Impervious Areas

Catchment	Impervious Area (m^2)	Pervious Area (m^2)	Impervious (%)	Pervious (%)
Existing (site)	2284	1100	33	67
Proposed (site)	1949	1435	58	42

DRAINS models were developed for predevelopment and post development site conditions to assess the site peak discharges under a range of storm durations between 5 minutes to 30 minutes. An onsite detention (OSD) was proposed to ensure the site discharge flow rates in proposed conditions would not exceed of those in the existing conditions.

6.1.1 DRAINS Model Results

DRAINS modelling results indicate that approximately 60m^3 of on-site detention is required to ensure post development peak flowrates do not exceed predevelopment values. Table 3 summaries the site peak discharge flowrates in existing and proposed conditions for a range of storm events from 50%AEP up to 1% AEP. It is notable that the proposed stormwater management plan will be further optimised during the detail design stage.

Table 3 - Site Pick Discharge Flow Rates in Existing and Proposed Conditions

Storm Event (AEP)	Peak Discharge (m^3/s)		Change (m^3/s)
	Existing	Post Development	
50%	0.023	0.022	-0.001
20%	0.068	0.029	-0.039
10%	0.094	0.056	-0.038
5%	0.114	0.103	-0.011
2%	0.132	0.122	-0.01
1%	0.165	0.163	-0.002

6.2 Stormwater Quality Management

The Campbelltown City Council Engineering Design for Development (2015) has provided pollutant reduction targets as water quality criteria which are applicable to all urban developments. The targets (detailed in Table 4) are total values to be achieved from a development site.

Table 4 Pollutant reduction targets based the Campbelltown City Council Engineering Design for Development (2015)

Pollutant	Desired Target
Reduction in annual total suspended solids (TSS) export load	80%
Reduction in average annual total phosphorus (TP) export load	45%
Reduction in average annual total nitrogen (TN) export load	45%

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was developed to assess the pollutant generation from the proposed development and to evaluate the effectiveness of proposed treatment train. Model parameters are as follows:

- 6-minute pluviograph rainfall data from the Lucas Heights was used.
- Catchment areas and pervious / impervious fractions for the proposed development are as per Table 5.

Table 5 Catchment Parameters - MUSIC Modelling

Surface	Area (m^2)	Pervious (%)	Impervious (%)
Roof	1710	0	100
Landscape	1534	70	30
Bypass	140	80	20

To achieve the pollutant reduction targets, an iterative approach was used for post-development modelling to determine appropriate types and sizes of stormwater treatment devices.

To satisfy the required treatment objectives in accordance with principles of WSUD, the proposed preliminary treatment train was designed as detailed in Table 6.

It is notable that the proposed treatment train arrangement is preliminary and be further optimised during detail design stage.

Table 6 Proposed Treatment Train

Treatment Device	Number of Device	Device Model	Max Flow Rate (l/s)
GPT	1	Ocean Save (OS-0806)	28
Cartridge Filter	12	Ocean Protect (Psorb 690mm)	10.8

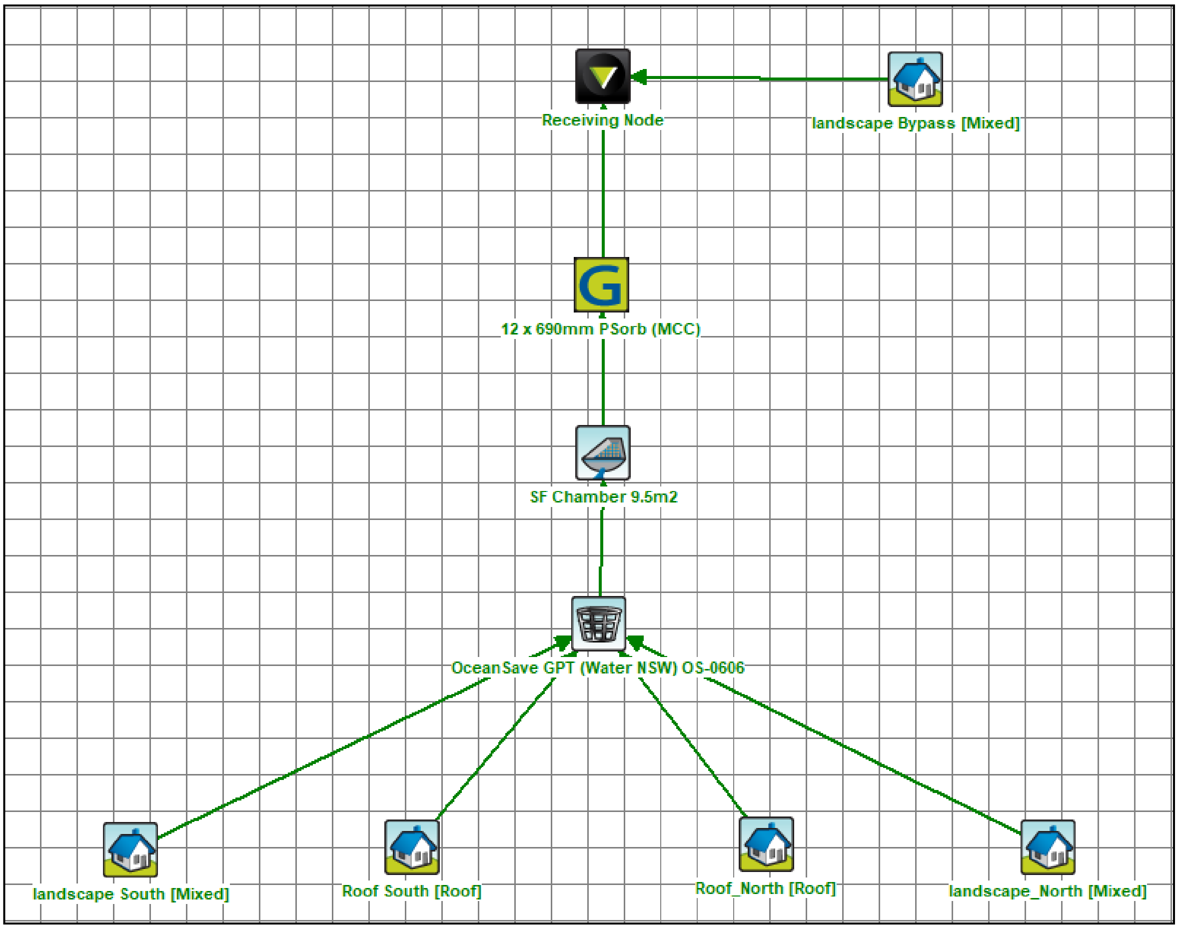

Figure 21 Proposed Treatment Train Layout

6.2.1 MUSIC Model Results

MUSIC modelling results demonstrate that the required reduction criteria can be achieved for the site with the implementation of the proposed treatment train. Proposed treatment effectiveness is represented in Table 7.

Table 7 Proposed Treatment Train Effectiveness

Pollutant	Sources	Residual Load	Reduction (%)
Flow (ML/yr)	2.45	2.45	0
Total Suspended Solids (kg/yr)	128	25.6	80
Total Phosphorus (kg/yr)	0.451	0.111	75
Total Nitrogen (kg/yr)	5.27	2.36	55
Gross Pollutants (kg/yr)	62.5	1.23	98

MUSIC results demonstrate that the required reduction criteria can be achieved for the site with the implementation of the proposed treatment train.

7.0 Construction Phase Stormwater Management

During the construction phase of the project, an erosion and sediment control plan will be implemented to prevent sediment laden stormwater from entering the council drainage network. A conceptual Erosion and Sediment control plan will be included in the civil drawing set and is in accordance with the "Blue Book" - Managing Urban Stormwater: Soils and Construction (Landcom NSW). The controls include:

- Sediment fences;
- Vehicle shaker grid and wash down; and
- Sandbags or geotextile filter surrounding pits.

8.0 Conclusions and Recommendations

The proposed development is outside the flood planning area based on the Campbelltown LEP (2015) flood planning map.

A detailed hydraulic model has been developed to assess local flood characteristics for the site in the 1% AEP and PMF events under both existing and proposed conditions. Modelling concluded that:

1. The site is generally flood free during both 1% AEP and PMF events.
2. Minor overland flows on Parkside Crescent (to the west) and on the existing car park (to the east) are very shallow (typical depths of less than 100mm) in the 1% AEP and are of low hazard.
3. The site levels in existing conditions are approximately 6 metres higher than Parkside Crescent therefore, floodwaters along the western site boundary are contained within the Parkside Crescent during the PMF event.
4. Flood depths during the PMF event raise up to the level of 77m AHD (750mm deep) on Parkside Crescent adjacent to the site and are of high hazard.
5. Proposed Finished FFL for the Lower Ground 02 is at 76.55m AHD which is above the minimum required FFL of 76.38m AHD (1%AEP flood level of 75.88m AHD plus 500mm freeboard).
6. All openings and penetrations to the lower ground levels are to be protected up to 1% AEP flood levels plus freeboard.
7. Flood refuge up to the PMF flood levels will be available on the proposed floor levels.
8. Preliminary hydraulic modelling indicates that water quantity objectives are achieved through provision of an onsite detention tank with 60m^3 volume capacity.
9. Water quality assessment results indicate that post development water quality objectives will be met through the proposed stormwater treatment train.

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