Transport
for NSW

Sydney Terminal Building Revitalisation

Hydrology and Flood Assessment

February 2023

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Acknowledgement of Country

We respectfully acknowledge the Traditional Custodians of the land of Central Precinct and the Sydney Terminal Building, the Gadigal. From time immemorial, this Country has been a place where people come to connect and reconnect. We pay our respects to all Aboriginal people who have journeyed and will journey through this place and acknowledge their ongoing connection to Country and culture. We pay our respects to members of the Stolen Generations and their descendants for whom the Sydney Terminal Building will always hold significance. We acknowledge that Platform One played a key role in Aboriginal children being removed from their families and communities.

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Abbreviations

Abbreviation	Definition
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
CPRP	Central Precinct Renewal Project
DEM	Digital Elevation Model
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
GSDM	Generalised Short Duration Method (BoM, 2003)
IFD	Intensity Frequency Duration
LEP	Local Environment Plan
MGA	Map Grid of Australia
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RCPs	Representative Concentration Pathways
SEARs	Secretary's Environmental Assessment Requirements
TfNSW	Transport for New South Wales
The project	Sydney Terminal Building Revitalisation
WSL	Water Surface Level

Definitions

Term	Definition
AEP	Annual Exceedance Probability: the probability of a storm event being equalled or exceeded within a year
AHD	Australian Height Datum. The geodetic datum for altitude measurement in Australia
ARI	Average Recurrence Interval: the average time period between storm event occurrences equalling or exceeding a given value
The project	Sydney Terminal Building Revitalisation
PMP	Probable Maximum Precipitation - the greatest depth of precipitation possible over a given size storm area at a particular location
TUFLOW	Two-dimensional hydraulic modelling software

Non-technical summary

This report provides an overview of the hydrology and flooding assessment of the Eddy Avenue Plaza development for the CPRP (Central Precinct Renewal Project) Environmental Impact Assessment. It describes the existing flood behaviour, assesses the impacts of the proposed project development, and recommends mitigation measures where necessary.

The CPRP is located on the ridge of two main drainage catchments, the Darling Harbour catchment and the Blackwattle Bay catchment. Both catchments fall towards Sydney Harbour to the north-west however, the CPRP site area is relatively flat. The catchments are heavily developed with existing established drainage networks consisting of mostly underground pipe drainage. However due to limited capacity, runoff exceeds the drainage network capacity and results in uncontrolled overland flow flooding.

The assessment of hydrology and flooding impacts was undertaken using a 2D hydrodynamic modelling software package called TUFLOW. The model was originally developed by the City of Sydney as part of the NSW floodplain Management program then further developed for the purposes of the CPRP by Arcadis and documented in the CPRP–Precinct Flood Model Report (2021).

The base flood models provided for this assessment adopted Australian Rainfall and Runoff (ARR) 1987 methodology. Despite the industry shifting to ARR 2019, the scope of this assessment is localised with limited interaction with flooding, therefore the continued use of ARR 1987 is considered conservative and reasonable.

The existing flood behaviour about the Eddy Avenue Plaza region can be described as shallow surface sheet flow approaching from the east within Foveaux Street and the South of Elizabeth Street, before combining and heading west along Eddy Avenue. The combined flooding travelling east to west along Eddy Avenue continues to the west as a split stream through Barlow Street and Rawson Place then heads north along George Street before joining a larger overland flowpath on Hay Street.

The representation of the project in the flood model was based on the existing condition inclusive of the Eddy Avenue Plaza design. The architectural plans developed for this project have been used to represent the proposed condition design given the early stage of the design program. No drainage network updates have been developed at this early stage.

The proposed condition flood depths in the 1%AEP along Eddy Avenue are generally in the order of less than 100mm and confined to the kerb and gutter extents. The 1%AEP velocities are typically in the order of less than 1.5m/s and therefore, the combined depth and velocity can be adopted to calculate a hydraulic hazard classification generally of H1 (generally safe for people, vehicles, and buildings) with a pocket of H2 (un safe for small vehicles) located in front of the Central Station Terminal Building.

Based on the construction works proposed for Eddy Avenue Plaza, the potential impacts are deemed negligible and unlikely to affect the flood behaviour.

The impact of the project was determined by comparing the post development conditions flooding with the existing conditions. The resulting change in flood levels (afflux) was mapped. The results indicated that the proposed Eddy Avenue Plaza works will have negligible influence on flood levels across all modelled events outside of the project footprint. Only localised increases are observed at the interface between Eddy Avenue and Eddy Avenue plaza. The changes in velocities are also limited to within ±0.25 m/s and considered negligible. From a flood hazard perspective, no change in hazard classification has been identified.

With the flood impacts confined solely to the Eddy Avenue Plaza design extent and not affecting the wider area, the flooding impacts due to this development are deemed negligible. Furthermore, the impact of this project will not contribute to a cumulative impact with other CPRP projects and no further mitigation works or residual impacts are currently proposed or anticipated for this assessment respectively. However, to maintain this outcome and mitigate any potential impacts as the project develops, management measures have been prescribed and are presented in Table 8-1

1. Introduction

1.1 Purpose of this report

This report documents the hydrology, surface and groundwater impact assessment conducted to support the Sydney Terminal Building Revitalisation ('the project'). The assessment was completed to support the environmental impact statement (EIS) and address the relevant Secretary's Environmental Assessment Requirements (SEARs) as they relate to hydrology and flooding.

1.2 Project overview

The project comprises the revitalisation of the Sydney Terminal Building and its public domain interfaces, Eddy Avenue Colonnade, Eddy Avenue Plaza, and the Western Forecourt at Central Station (the project) as depicted in Figure 1-1. The project will provide:

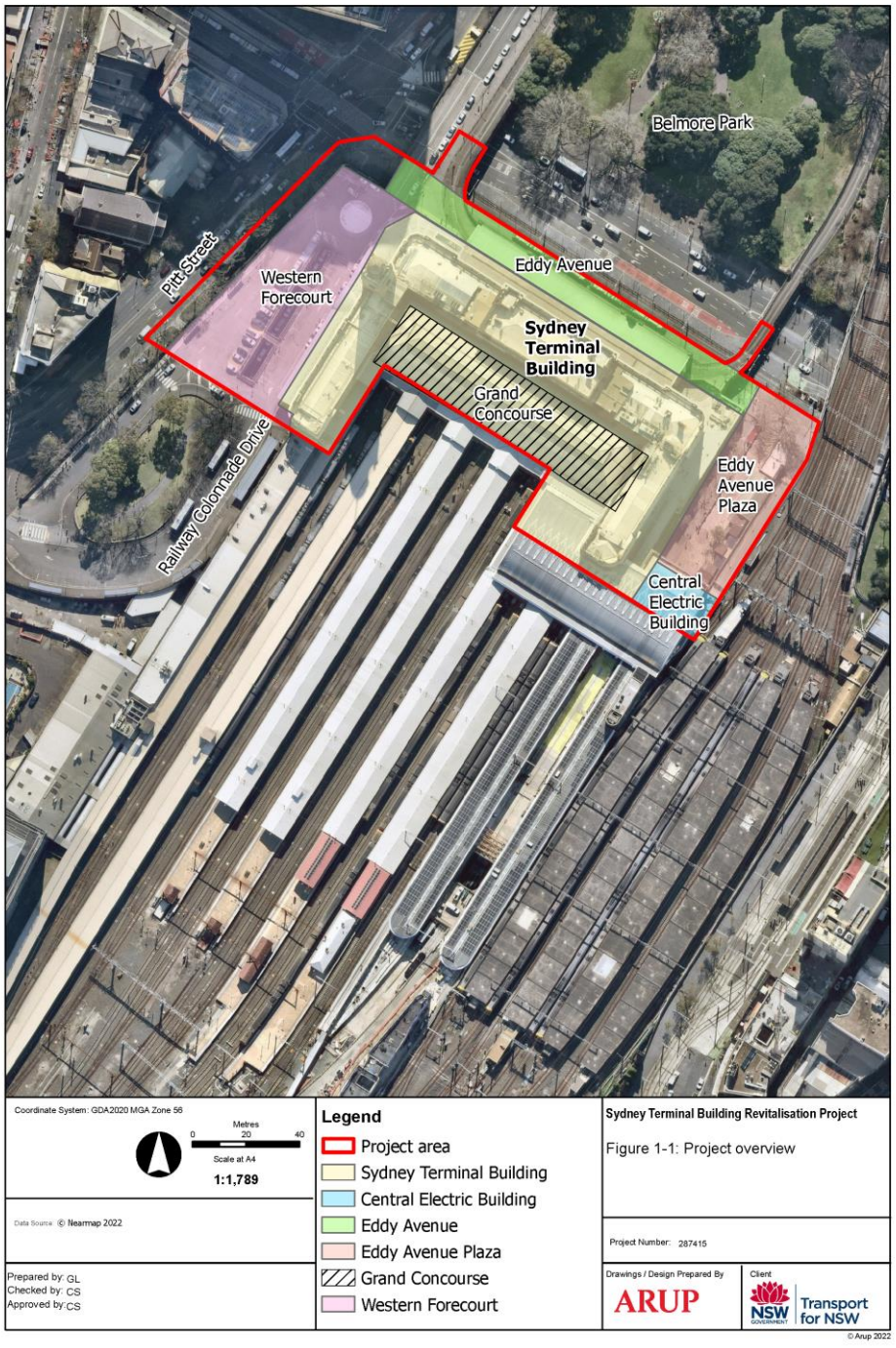
- Improved pedestrian connections and integration with the adjacent public domain areas
- Improved lighting, wayfinding, safety, and accessibility
- Improved customer amenity, public art, and interpretation
- Improved activation of spaces, including high quality retail and community uses that are complementary to the function of the transport interchange
- Heritage conservation and enhancement.

These works will be undertaken as a priority to the wider and longer-term Central Precinct Renewal Program. The project is located on Gadigal Country of the Eora Nation, in Haymarket, in the City of Sydney local government area (LGA).

The detailed description in this chapter is based on the project's concept design and has been developed with consideration of:

- Stakeholder and community feedback as detailed in Chapter 6 and Appendix C of the EIS
- Findings from design, heritage, and Aboriginal engagement activities detailed in several chapters of the EIS
- Placemaking and urban design principles and objectives detailed in Chapter 10 of the EIS
- Avoiding and minimising environmental, heritage, and social impacts.

Figure 1-1 Project overview



1.2.1 Construction stage

All temporary and permanent construction works will be undertaken within the construction footprint shown in Figure 1-2 and bounded by the following:

- North - Sydney Terminal Building colonnade along Eddy Avenue
- South – End of Intercity train lines.

- East - Sydney Trains suburban line viaduct and rail lines

The temporary construction works will also incorporate the existing construction facilities located in the Sydney Trains Yard. These facilities will be used for construction staff amenities and equipment and plant storage.

Construction ancillary facilities and laydown areas will also be included in the western loading dock and Western Forecourt.

All works will be contained within the Sydney Terminal Building area and adjacent areas. As such, there are no permanent or temporary waterway realignments or access roads. Vegetation clearing will be limited to existing trees within Eddy Avenue Plaza.

Figure 1-2 Construction Footprint

1.2.1.1 Site establishment and low impact work

Site establishment and low impact work that will be undertaken prior to the main works include:

- Site surveys, including geotechnical, hydrological, and contamination
- Façade cleaning, painting and other durability and general maintenance repairs

- Removal of redundant services/equipment behind house areas
- Dilapidation surveys identifying and recording the condition and location of buildings, structures, and services
- Removal of redundant services and temporary relocation of services
- Establishment of site compounds (e.g., erect fencing and plant/material storage areas)
- Clearing and pruning of trees in Eddy Avenue Plaza
- Establishment of temporary construction facilities as required.

1.2.1.2 Eddy Avenue Plaza

Proposed construction activities within Eddy Avenue Plaza include:

- Excavation of the eastern side of Eddy Avenue Plaza to remove the level difference
- Demolition of the wall in the centre of Eddy Avenue Plaza
- Demolition of ramp adjacent to rail line behind existing retail shops
- Relocation of fire control room and pump room to the north-eastern corner of Eddy Avenue Plaza
- Rebuild the support colonnade to the eastern terrace of the Sydney Terminal Building.

The proposed uses within Eddy Avenue Plaza have been presented in the plan view in**Error! Reference source not found.** of Chapter 5 of the EIS.

1.3 Secretary's environmental assessment requirements

SEARs were issued by the NSW Department of Planning and Environment (DPE) on 17 October 2022. Table 1-1 outlines the SEARs relevant to hydrology and flooding, and where they have been addressed in this report.

Table 1-1 SEARs relevant to hydrology

SEARs relevant to this technical report	Where addressed
1. General SEARs 3. Detailed Assessment and mitigation of key impacts 3. Where relevant, the assessment of each issue must consider the objectives, principles, recommendations, and mitigation measures in the State Significant Precinct Study - Central State Significant Precinct (including attachments).	Section 3.1
2. Key Issue SEARs 7. Other 1. An assessment of the following issues must be undertaken in accordance with the commitments in Section 6 of *Sydney Terminal Building Revitalisation Project – Scoping Report* (Transport for NSW, June 2022): c) flooding and hydrology	See Table 1-2

Table 1-2: Proposed investigations and assessment as identified in the Sydney Terminal Building Revitalisation Project – Scoping Report

Scoping report commitments	Where addressed
An assessment of potential hydrology and flooding impacts will be included in the EIS will include: • Review of relevant existing flood study reports and description of flood behaviour for the existing conditions	Section 4
• Identification and assessment of potential impacts on stormwater quantity	Section 6.2
• Broad assessment of the potential change in stormwater runoff (increase or decrease) including consideration of changes to flooding behaviour in response to climate change (sea level rise and rainfall intensity)	Section 6.2 Section 3.3.1.3
• Identification of potential impacts because of changes in surface water quantity, with respect to increases or decreases in stormwater runoff and the sensitivity of the downstream waters	Section 6.2
• Identification of any potential changes to flood levels (including flood affectation of other properties, assets, and infrastructure), discharges, velocities, duration of flood inundation and flood hazards for the five per cent and one per cent Annual Exceedance Probability flood events, and the probable maximum flood	Section 6.2
• A review of consistency with applicable Council Floodplain Risk Management Study	Section 2.3 Section 6.2
• A review of compatibility with flood hazard and hydraulic functions of the land	Section 6.2
• Identification of appropriate mitigation and management measures.	Section 6.2

1.4 Qualification

Lee Williams (author & modeller) has 6 years' experience as a qualified civil engineer with a Masters in the field of water engineering. He is a member of Engineers Australia and is a Chartered Professional Engineer.

Jasmine Lee (Verifier) has over 15 years' experience as a civil engineer and holds a Masters in the field of water engineering. She is also a chartered professional engineer.

2. Policy and planning context

The following policies, guidelines, and plans have been considered when undertaking the hydrology and flooding impact assessment:

- Flood Prone Land Policy (NSW DPE, 2005)
- Floodplain Development Manual (NSW Department of Infrastructure Planning and Natural Resources, 2005)
- NSW Floodplain Risk Management Guidelines (NSW DPE, 2022)
- Australian Rainfall and Runoff: A Guide to Flood Estimation (Commonwealth of Australia, 2019)
- Australian Rainfall and Runoff: A Guide to Flood Estimation (Institution of Engineers, 1987).

2.1 NSW Flood Prone Land Policy

The Flood Prone Land Policy is administered by NSW DPE. The main objective of the policy is to reduce the impact of flooding and flood liability on owners and occupiers of flood-prone land and reduce public and private losses. The policy recognises the benefits of use, occupation, and development of flood-prone land.

The project is within and/or near flood prone lands. By default, it must adhere to the policy by considering the impact of the project on flooding and how this impact affects adjacent lands. This assessment then drives suitable mitigation measures to reduce the liability on those adjacent lands as per the policy statement.

2.2 NSW Floodplain Development Manual

The Floodplain Development Manual provides guidance to local and State Government for managing flood risk. It supports the NSW Flood Prone Land policy and guides councils and the NSW Government through the floodplain risk management process. The manual helps councils develop and implement local floodplain risk management plans and outlines the technical assistance provided by the NSW Government.

The Manual details the roles and responsibilities of various NSW agencies and includes information on the following:

- The preparation of flood studies, floodplain risk management studies, and plans
- Floodplain risk management options
- Flood planning levels and areas
- Hydraulic and hazard categorisation
- Emergency response planning.

With respect to the project, the manual provides guidelines when developing in the floodplain. It presents flood risk considerations that should be considered when carrying out development, such as safety, hazard, emergency management, and damages. Given the scope of the project, the manual will only provide general guidance rather than specific input into the project.

It should be noted that the guidance on hydraulic and hazard categorisation is now superseded by the hazard guidance outlined in Australian Rainfall and Runoff (ARR, 2019).

2.3 NSW Floodplain Risk Management Guidelines

The NSW Floodplain Risk Management Guidelines focus on the preparation and implementation of floodplain risk management plans for councils. It complements the Floodplain Development Manual (see section 2.2 above), providing guidance towards the development of floodplain risk management plans and management of flood-prone land with the objective of minimising flood damage.

The project falls within the Darling Harbour floodplain risk management area. Within the Darling Harbour Catchment Floodplain Risk Management Study and Plan, (WMA Water, 2016), no reference to this area is specifically made and no management measures that will impact the project were documented.

However, the impact assessment in this report considers the impact on flooding and how the risk profile of the wider floodplain risk management area will change because of the project. This then informs suitable mitigation measures from a risk management perspective to minimise any impacts on flooding.

2.4 Australian Rainfall and Runoff 1987

The Australian Rainfall and Runoff (ARR, 1987) guideline was published by Engineers Australia and was the governing document for hydrological and hydraulic analysis prior to the publication of ARR, 2019 (see section 2.5 below). One of the main updates from ARR, 1987 to ARR, 2019 was the update to Intensity Frequency Duration (IFD) information.

Following preliminary modelling, the critical storm duration for the Central Precinct Renewal Project (CPRP) project area was deemed to be less than three hours. Based on a comparison between rainfall depths for ARR, 1987 and ARR, 2019 IFD data, as presented in Figure 2-1 for the 5%, 10% and 1% Annual Exceedance Probability (AEP) events, it was concluded that adopting the ARR, 1987 rainfall data will likely produce a more conservative flood depth compared to ARR, 2019. This is why this earlier guideline has been used in the impact assessment.

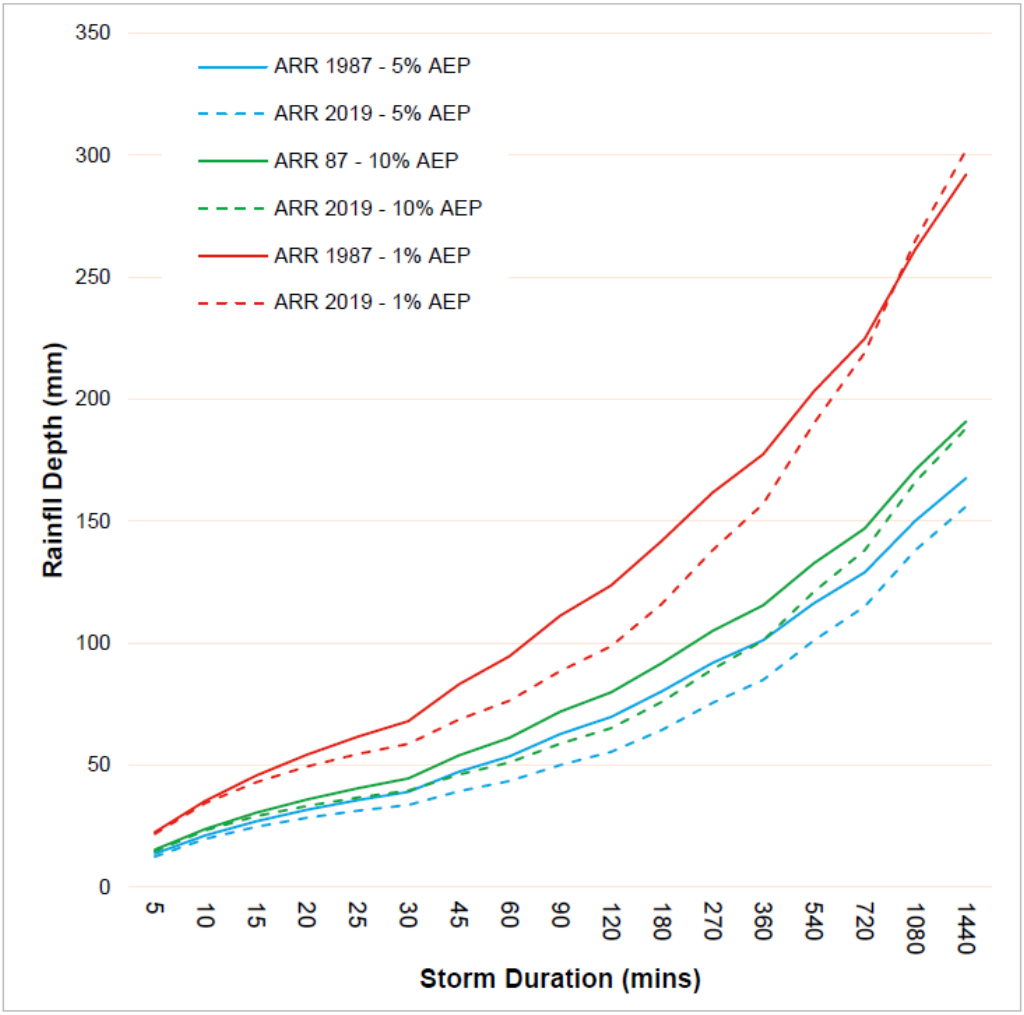


Figure 2-1 IFD Comparison – ARR1987 and ARR2019, Arcadis (2021)

2.5 Australian Rainfall and Runoff 2019

The Australian Rainfall and Runoff (ARR, 2019) is an update on the 1987 document. It provides designers and analysts with tools, information, and data for the assessment of design flood estimation in Australia. With respect to this assessment, ARR, 2019 has informed the climate change predictions.

2.6 Sydney Local Environmental Plan 2012

Flood planning is addressed under Section 5.21 of the Sydney Local Environmental Plan (LEP) 2012. It should be noted that the SSI (the project) is not assessed under the LEP however has been acknowledged and considered as part of the process.

The 2012 LEP provides the following objectives:

a) To minimise the flood risk to life and property associated with the use of land

b) To allow development on land that is compatible with the flood function and behaviour on

c) The land, taking into account projected changes as a result of climate change

d) To avoid adverse or cumulative impacts on flood behaviour and the environment

e) To enable the safe occupation and efficient evacuation of people in the event of a flood.

Given the project is an SSI (State Significant Infrastructure), objectives of the LEP are not required to be addressed, however the project has aimed to align with them.

2.7 Interim Floodplain Management Policy 2014

The City of Sydney's Interim Floodplain Management Policy provides controls to facilitate a consistent, technically sound, and best practice approach for the management of flood risk in the local government area. The policy offers direction with respect to how floodplains are managed and has been prepared in accordance with the guidelines provided in the NSW Government Floodplain Development Manual (see section 2.2 above). The policy offers the means for implementing Council's Floodplain Risk Management Plans.

Aims and objectives of the policy are to:

- Inform the community of Council Policy about the use of flood prone land
- Establish guidelines for the development of flood prone land that are consistent with the NSW Flood Policy and NSW Floodplain Development Manual as updated by the Floodplain Management Guides (see section 2.3 above)
- Control development and activity within each of the individual floodplains within the City (in this case) having regard to the characteristics and level of information available for each of the floodplains
- Minimise the risk to human life and damage to property by controlling development on flood prone land
- Apply a merit-based approach to all development decisions taking into account ecological, social, and environmental considerations
- Ensure that the development or use of floodplains does not adversely impact upon the aesthetic, recreational, and ecological values of the waterway corridors
- Ensure that all land uses and essential services are appropriately sited and designed in recognition of all potential floods
- Ensure that all development on the floodplain complies with Ecologically Sustainable Development (ESD) principles and guidelines
- Promote building design that considers requirements for the development of flood prone land and to ensure that the development of flood prone land does not have significant impacts upon the amenity of an area.

In addition to performance criteria and general requirements, the policy defines flood planning levels, meaning the permissible minimum building floor level. The policy describes a flood planning level as the combinations of flood levels and freeboards

selected for floodplain risk management purposes, as determined in flood studies and floodplain risk management studies and plans.

The policy has defined different flood planning levels for different development types and flooding categories. The flood planning levels are relative to the 1% Annual Exceedance Probability (AEP) and/or the Probable Maximum Flood (PMF) flood level or the surrounding ground levels and apply to the following types of development:

- Residential, industrial, and commercial development
- Above and below ground parking
- Critical facilities.

2.8 Central Precinct Climate Adaptation Plan 2021

The Central Precinct Climate Adaptation Plan (Atelier Ten & Integral Group, 2021) has been developed for the wider Central Precinct. Related to stormwater, the Plan identifies extreme rainfall events, sea level rise, and discharge runoff as climate change variables with potential impacts. A risk assessment has been documented for the various climate change variables identifying the potential impact and level of risk considering 2036, 2056 and 2090 horizons. An adaptation plan is presented specifying adaptation measures. For the purposes of this assessment, climate change was considered as part of this assessment in the form of an increase of 20% rainfall intensity for the 1%AEP flood event across the three horizon dates.

3. Methodology

3.1 Assessment criteria (General SEARs)

This report provides an overview of the CPRP flood modelling undertaken to assess the Eddy Avenue Plaza development project in isolation, as it was the only area of the CPRP project that involved changes with a potential to impact flood conveyance. This is in accordance with the commitments in the General SEARs, detailed assessment, and mitigation of key impacts. The general SEARs require the consideration of recommendations, and mitigation measures in the State Significant Precinct Study - Central State Significant Precinct (including attachments), where relevant and have been summarised in Table 3-1.

Table 3-1 Flood Planning recommendations from the Central Precinct Renewal Program Water Quality, Flooding and Stormwater Report (Arcadis, 2022)

Scoping report commitments	Response
a) Site flood study to be developed addressing: Flood impacts: The site flood study is to determine under present day climate conditions, any change because of the development in: • peak flood levels (+/- 0.05 m) • flood extents • flood risk precincts • flood hazard categories	Flood impacts have been considered in Section 6
The site flood study is to assess present day climate conditions 20% AEP, 5% AEP, 1% AEP and PMF design rainfall events for the full range of standard duration design rainfall events from 10 mins to six hours.	This assessment has considered the 5%AEP, 1% AEP and PMF events for the critical duration ARR, 1987 design rainfall events as identified in Section 4. The assessment of the 20% AEP event and a full range of standard duration rainfall events from 10 minutes to six hours has been assessed qualitatively due to limited data at the time of assessment. This is presented in Section 4.3.
An assessment of the impact of the proposed development with a Representative Concentration Pathway (RCP) 8.5 climate change scenario is to be undertaken to inform flood planning levels.	The proposed development with an RCP 8.5 climate change scenario was considered in Section 3.3.1.3
It is recommended that the CPRP Precinct Flood Model is to be used as the base assessment tool for all flood assessments and maintained to reflect the latest approved developments. Technical guidance to be provide to applicants to ensure consistency in assessment methodology.	The CPRP model was adopted as the base assessment tool and utilised for the existing condition in Section 4
The existing condition flood model is to be refined based on recent detailed ground survey that defines flow paths, storage areas and hydraulic controls.	No detailed ground survey was available at the time of this assessment. Given the scope of the assessment focuses on Eddy Avenue, the inclusion of existing ground survey will not impact the assessment outcomes as there is no change in flood behaviour. Refer Section 3.3
The site flood study to be prepared by a suitably qualified and experienced professional engineer. Verification of the flood modelling and assessment is to	The site flood study was prepared and verified by a suitably qualified and

Scoping report commitments	Response
be undertaken by a suitably qualified and experienced chartered engineer.	experienced chartered professional. Refer Section 1.4
b) Flood planning levels: The City of Sydney Council's Interim Floodplain Management Policy 2014 is to be used to determine appropriate flood planning levels across the precinct.	Flood planning levels in accordance with the City of Sydney's Interim Floodplain Management Policy 2014 states that businesses and retail should adopt a minimum of the 1%AEP flood level as the flood planning level. The proposed development only experiences localised flooding and is not considered flood prone in a 1% AEP event (refer Appendix A).
Flood level data to be used for deriving flood planning levels it to be sourced from the CPRP Precinct Flood Model but a suitably qualified and experienced professional engineer. Flood planning levels are to be based on an RCP 8.5 climate change scenario.	
It is not considered appropriate to extract, assign and finalise specific flood planning levels at this early stage of the design. The flood level information will be updated as the design progresses to accurately determine the flood planning level requirements. The existing flood level information is currently used to identify where flood constraints apply and provide estimates of the flood planning levels in accordance with the City of Sydney Council's Interim Floodplain Management Policy (2014).	

3.2 Approach

3.2.1 Scope of Works

This report details the flood assessment of the Eddy Avenue Plaza component for CPRP, to address the requirements specified within the Sydney Terminal Building Revitalisation Project – Scoping Report. It specifically addresses the flood impact criteria.

The scope of works was to:

- Review the precinct flood model report prepared for Transport (Arcadis, 2021) to acquire an understanding of the flooding mechanism in the study area, identify the main hydraulic controls in the study area, and understand the design criteria including the required track flood immunity and the acceptable flood impacts
- Review the TUFLOW models developed by Arcadis (2021), provided by Transport, to establish an understanding of the models for adoption and application for this current study
- Develop the design case TUFLOW model incorporating the proposed architectural Eddy Avenue Plaza design
- Run the existing case and design case TUFLOW models for a range of events (5%AEP, 1%AEP and PMF) consistent with the reference model
- Assess the proposed Plaza works based on the modelled results and undertake a flood impact assessment
- Prepare a technical report to discuss the assumptions, method, and outcomes of the study in support of the Stage 3 design phase for the proposed CPRP upgrade.

The assessment also includes mitigation measures for the next phase of the design.

3.2.2 Assumptions and limitations

The following assumptions and limitations relate to this study:

- The TUFLOW model developed for the Central Precinct Renewal Project; Precinct Flood Model Report (Arcadis, 2021) and provided by Transport is assumed to be generally reliable. However, Arcadis has assumed that the flood model parameters adopted are reasonable and suitable for the catchment area and should these parameters be adjusted, this will impact the assessment outcome.
- The TUFLOW model provided by Transport for this study adopted a two-metre grid cell size, which is deemed appropriate considering the width of Eddy Avenue Plaza proposed works.
- All results presented are subject to the limitations of the modelling packages and the currency of best practice methods adopted and applied. It is acknowledged that these methods may change over time with improvements to modelling techniques.
- Impact of changes to underground drainage has not been captured due to limited design information at the time of this assessment. To mitigate this, management measures capture requirements to mitigate impacts of any drainage impacts once design information becomes available however, modelling results indicate that the inclusion of underground drainage is unlikely to impact the outcome of this assessment as there is no change in flood behaviour as a result of the development .
- The architectural surface design for Eddy Avenue Plaza and the proposed building location were provided in a non-geographical projection or elevation. To adopt the surface design into the TUFLOW flood model, the surface Triangular Irregular Network (TIN) was rectified into the correct geographical projection location (as shown in Figure 3-2) using three reference points. Furthermore, the height data was lowered from the reduced level (RL) (RL 7,700m, 12,800m and 14,200m) to the appropriate Australian Height Datum (AHD) elevation (7.70m, 12.80m and 14.20m). These tasks were undertaken within a geographical information system (GIS) software.

3.2.3 Available Information

Information sourced from the CPRP – Precinct Flood Model Report, (Arcadis, 2021) and the associated flood model was used to assess the Eddy Avenue Plaza design. The CPRP flood model was informed by the information from multiple previous studies and models. These studies and models overlap all or part of the project extent and considered relevant for consideration and integration. Information available is presented in Table 3-2.

Table 3-2: Available Information

Information	Description
Blackwattle Bay Catchment Flood Study, WMA Water, 2015	The study defines the flood conditions on the regional level and highlights areas that are susceptible to flooding.
Blackwattle Bay Catchment Floodplain Risk Management Study and Plan, WMA Water, 2015	The risk management study and plan investigate potential flood mitigation options for the catchment.

Information	Description
Darling Harbour Catchment Flood Study, BMT WBM, 2014	The study defines the flood conditions on the regional level and highlights areas that are susceptible to flooding.
Darling Harbour Catchment Floodplain Risk Management Study and Plan, WMA Water, 2016	The risk management study and plan investigate potential flood mitigation options for the catchment.
SICEEP Flood Model, Lendlease Development	The Sydney International Convention Exhibition and Entertainment Precinct (SICEEP) development is located downstream of the CPRP and incorporates the development and reconfigured stormwater design works.
Flood Immunity and Flood Mitigation Report, City South, Sydney Light Rail – Detailed Design, Acciona Infrastructure Australia, 2017	The Sydney Light Rail project involved the construction of the 12-kilometre-long CBD and South-East Light Rail track and modified stormwater drainage network. The likely final design stage was adopted however, the completed design nor work-as-executed information was not made available.
Sydney Metro – City & Southwest – Civil, Structures, Utilities, Drainage, Geotechnics and Constructability – Volume 4, Reference Design, Transport for NSW, 2017	Sydney Metro commenced construction in early 2017 with an expected completion due around 2025. While some design information has been made available, Transport has been unable to confirm elements that will be constructed at this stage.
Central Precinct Renewal Project; Precinct Flood Model Report, Transport for NSW, 2021	The CPRP (Arcadis, 2021) report and the associated TUFLOW model was completed. This forms the basis of this assessment.
The architectural surface design for Eddy Avenue Plaza and proposed building location	The surface design data is provided in a non-geographical projection or elevation. To adopt the surface design into the TUFLOW flood model, the surface TIN was rectified into the correct geographical projection location using three reference points. Furthermore, the height data was lowered from the RL to the appropriate elevation. These tasks were undertaken within a GIS software.

3.3 Existing Condition Model Development

The overall CPRP project overlaps the Darling Harbour and Blackwattle Bay catchments. As such, a combination of the Darling Harbour (DHFS) and Blackwattle Bay (BBFS) council flood studies formed the basis of the flood model development as part of the CPRP project by Arcadis (2021). Given the overlap of the two council flood studies, the two models were merged into one overall model.

The merged model was also modified to include the Sydney International Convention Exhibition and Entertainment Precinct (SICEEP) and the Sydney Light Rail designs. These projects do not overlap the CPRP project extent however as it is located downstream of the project, within the Darling Harbour catchment, the decision was made by the CPRP project to incorporate the design. The extent and location of the flood model, the Darling Harbour and Black Wattle Bay catchments and the SICEEP has been illustrated below in Figure 3-1.

The CPRP flood model has adopted an approach mostly in line with the DHFS in preference to the BBFS as most of the CPRP site is within the DHFS extent. Impacts are

more likely to occur within the DHFS and therefore the approaches from the DHFS are considered more relevant.

The CPRP flood model has been updated to adopt the latest TUFLOW build (2020-01-AB version) with the HPC (Highly Parallelised Compute) functionality. This was updated as part of the CPRP assessment which allowed access to the latest TUFLOW features and updates.

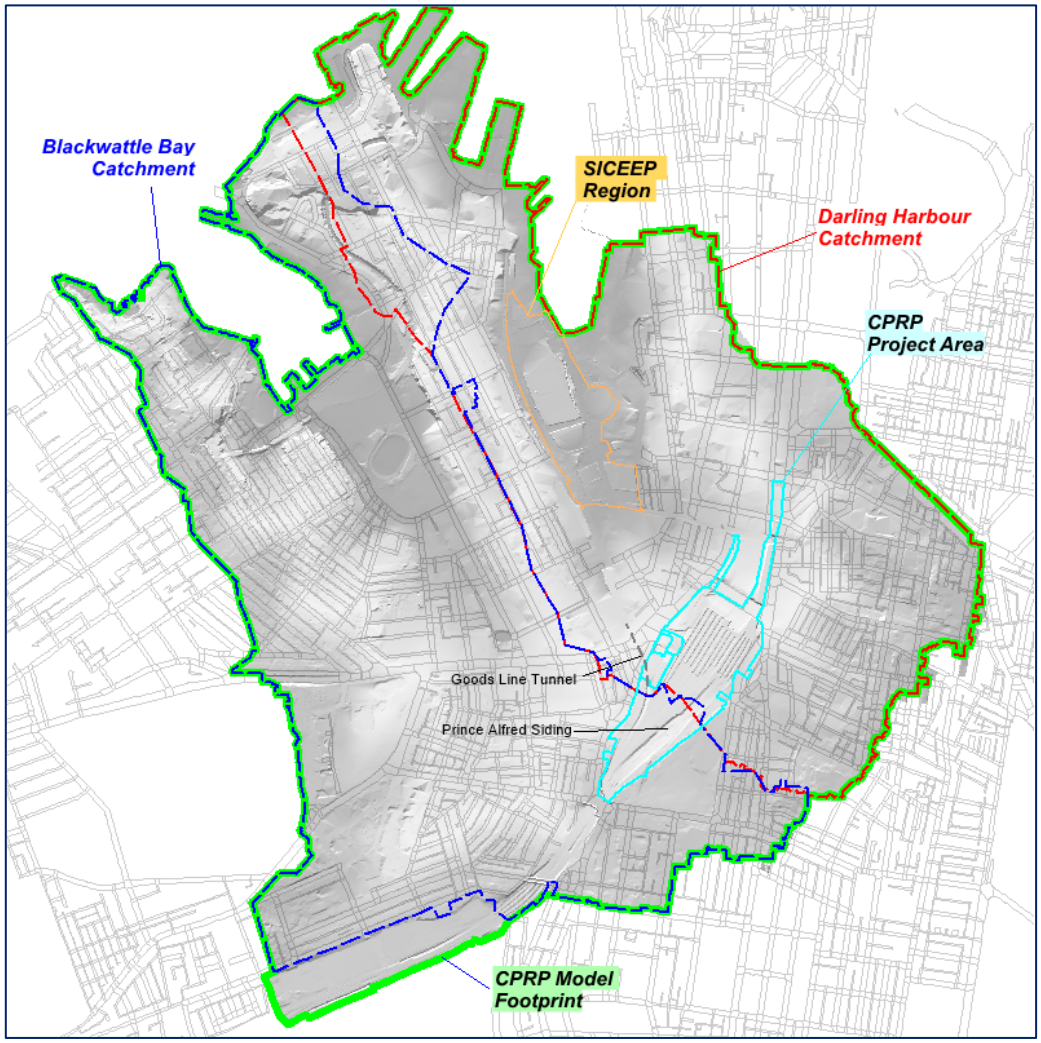


Figure 3-1 DHFS and BBFS model extents with merged CPRP Flood Model extent

No updates to the existing terrain or drainage were undertaken as no data were available at the time of assessment. Incorporation of existing ground survey within the scope of this project will unlikely influence the outcome of the assessment. This is based on the following factors:

- There is limited flooding interaction with the Eddy Avenue Plaza extent (see Appendix A) therefore incorporating detailed ground survey will not influence flood behaviour.
- The area is an open-air hardstand, therefore the existing terrain representation using LiDAR data will be relatively accurate in capturing the general terrain formation.

3.3.1 Design Rainfall Data

3.3.1.1 Intensity Frequency Duration

The base flood models of DHFS and BBFS adopted the ARR, 1987 method, namely the rainfall intensity, frequency, and duration data, along with the respective temporal patterns. Adopting the same approach is considered reasonable based on the following reasons:

- ARR, 1987 is more conservative (see section 2.4) and therefore will present the worst case with respect to flood depths in the area of interest.
- The extent of works is localised and has limited influence on flooding (see section 6).
- As this project is only a small proportion of the overall precinct, it is critical to maintain consistency in the method between this assessment and that of other assessments for the precinct.

3.3.1.2 Probable Maximum Precipitation (PMP) Estimates

The CPRP project has an upstream catchment area of about 1.3 km^2. Adopting a point rainfall approach, PMP depths were estimated following the Bureau of Meteorology Generalized Short-Duration Method (GSDM) procedure. The GSDM is a method of estimating the PMP for small areas and small durations within Australia, up to and including a six hour event. This allows the hydraulic assessment to account for the PMP with reference to location about Australia, catchment elevation, moisture index and terrain category to determine the spatial distribution of precipitation over a range of storm durations within the catchment for "*the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year*". BOM, 2003

3.3.1.3 Climate Change

Flood modelling of climate change is typically assessed through either consideration of sea level rise and/or increased rainfall intensities. Sea level rise is unlikely to impact the project due to the location. As such, the impact of increases in rainfall intensities has been considered for the project.

Despite adopting ARR, 1987 for this assessment, ARR, 2019 provides the latest guidance on future projections for rainfall intensities. These projections are based on two RCPs for greenhouse gas and aerosol concentrations driving climate change – RCP4.5 and RCP8.5. The climate change projections for each RCPs are presented in Table 3-3.

In accordance with the general SEARs, RCP8.5 and has been specified for this assessment. Considering the design life of the project (i.e., 100 years), the planning horizon of 2090 has been adopted. This aligns with an increase in rainfall of 19.7% (i.e., 20%), which has been adopted for this assessment.

Table 3-3 Rainfall Intensity Projections with Climate Change (ARR, 2019)

RCPs	2030	2060	2090
4.5	4.3%	7.5%	9.5%
8.5	4.9%	11.5%	19.7%

3.3.2 Critical Storm Durations

The CPRP – Precinct Report (Arcadis, 2021) identified the critical duration, which produces the peak flood level result for the existing condition as the 25 minutes, one hour and two hours events for the 1% AEP for the CPRP surrounding area. It has been assumed that the 5% AEP critical storm durations are equivalent to the 1% AEP events flood modelling simulations. Furthermore, the 15-minute, 45-minute and 1.5-hour events were deemed critical storm durations for the PMF.

3.4 Proposed Condition Model Development

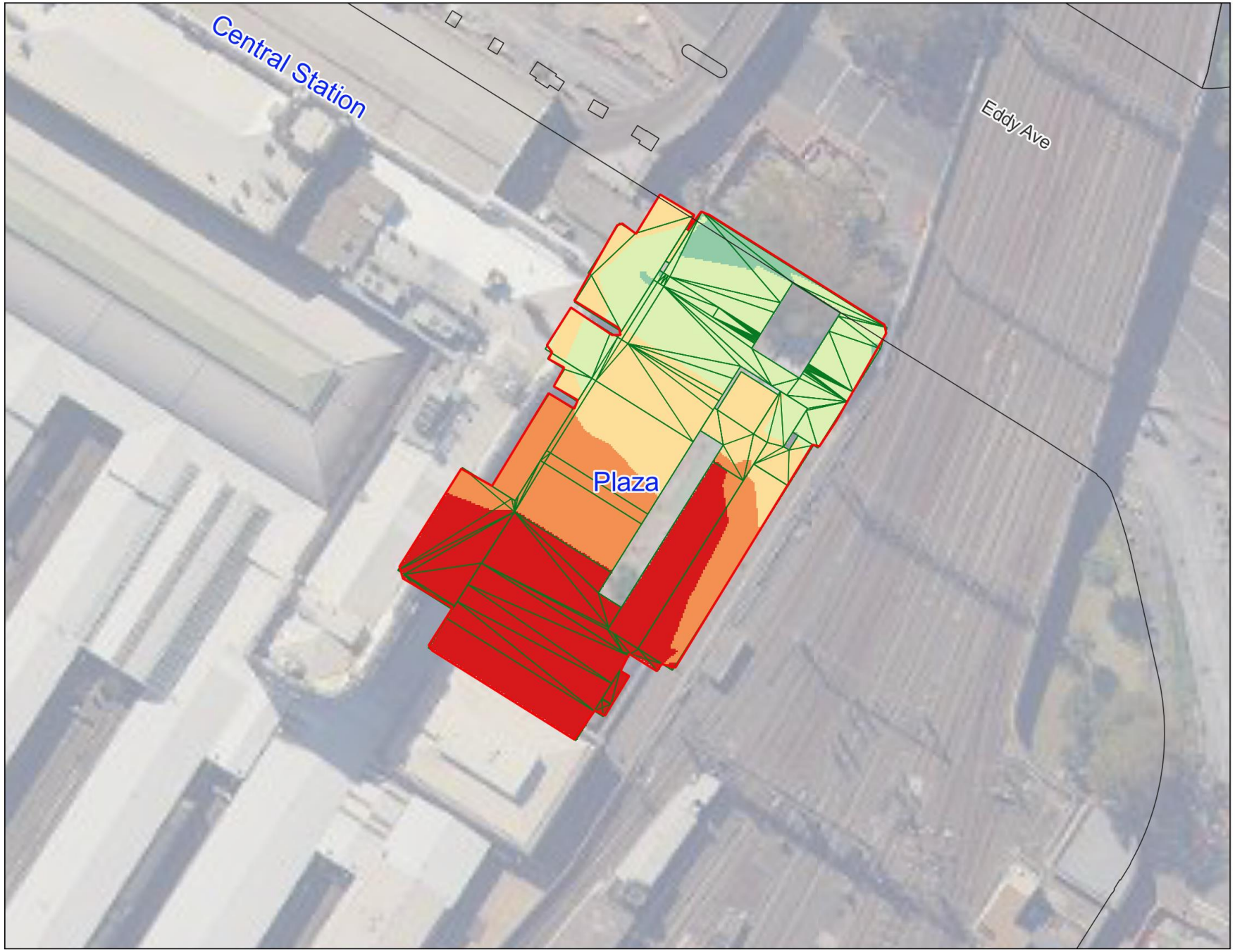
The CPRP flood model proposed condition was a development of the existing condition, inclusive of the Eddy Avenue Plaza design. The architectural plans developed for this project have been used to represent the proposed condition design given the early stage of the design program. These plans do not include the drainage design. This means this information has not been included in the assessment. That said, given there is no proposed change in hardstand area, gradients, or catchments proposed by the design the runoff conditions should be unaffected. This means the assessment has considered the current drainage arrangements in the area as they are unlikely to change other than to accommodate future climate change requirements (see Appendix E of the EIS).

3.4.1 Eddy Avenue Plaza design Surface

The Eddy Ave Plaza design surface was sourced from the architectural design. The surface was not developed in a projection and coordinate system, instead adopting model space coordinates of 0,0,0 (x,y,z). The initial format was not fit for purpose and was therefore rectified to the appropriate GDA94 MGA56 projection. Furthermore, the elevation attribute was lowered to the surveyed registered levels to tie in with the surrounding terrain data. Figure 3-2 depicts the design surface tin and elevation in mAHD.

3.4.2 Design Building Locations

The available design has informed the location of the proposed Eddy Avenue Plaza building location. This has been illustrated within Figure 3-3. The outline of the building was represented as a blockage to overland flow with its roof runoff redistribute to the area surrounding the building, simulating a surcharging of the roof drainage system.



NSW GOVERNMENT

Legend

Eddy Ave Plaza Design Surface
- <= 14.5
- 14.5 to 15.0
- 15.0 to 15.5
- 15.5 to 16.0
- 16.0 to 16.5
- > 16.5

- Lot
- Design Surface Extent
- Design Surface TIN

Notes:

Map by: LW

0 20 40 m

A3 Scale: 1:500

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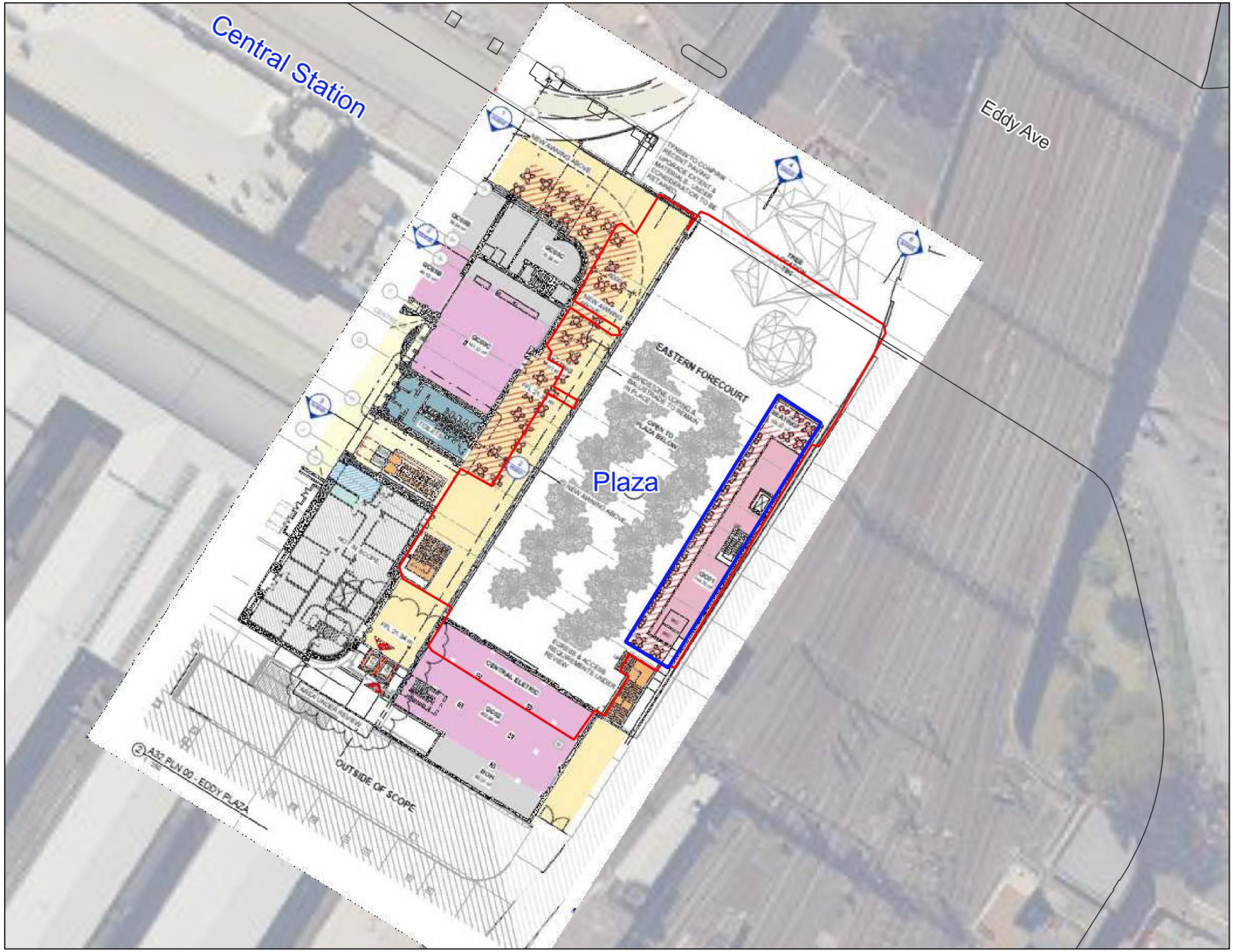
CPRP - Eddy Avenue Plaza

Figure 3-3: Design Surface TIN



NSW GOVERNMENT

Legend

- Lot
- Design Surface Extent
- Design Building Location

Notes:

Map by: LW

0 20 40 m

A3 Scale: 1:500

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CPRP - Eddy Avenue Plaza

Figure 3-4: Design Building Location

4. Existing environment

4.1 Flooding

The existing flood behavior at the Eddy Avenue Plaza region can be described as shallow surface sheet flow approaching from the east within Foveaux Street and the South of Elizabeth Street before combining to convey west along Eddy Avenue. The combined flooding travelling east to west along Eddy Avenue continues downstream of the project to the west as a split stream through Barlow Street and Rawson Place, then heads north along George Street before joining a larger overland flow path on Hay Street.

The flooding that would interact with the project is considered local drainage or shallow sheet flooding adjacent to the project on Eddy Avenue. Due to it's minor magnitude, these flooding characteristics and behaviour would have minimal influence on the project design.

4.2 Hazard (depth and velocity)

The flood depths in the 1%AEP along Eddy Avenue are generally in the order of less than 100mm and confined to the kerb and gutter extents (e.g., do not flow over the road or footpath). The 1%AEP velocities are typically in the order of less than 1.5m/s.

The Australian Emergency Management Institute (AEMI) hydraulic hazard framework depends upon a combination of flood depth and flow velocity. The hazard can be classified under six different categories from H1 to H6, with H6 as the most hazardous. The AEMI flood category curves are identified in **Error! Reference source not found.**.

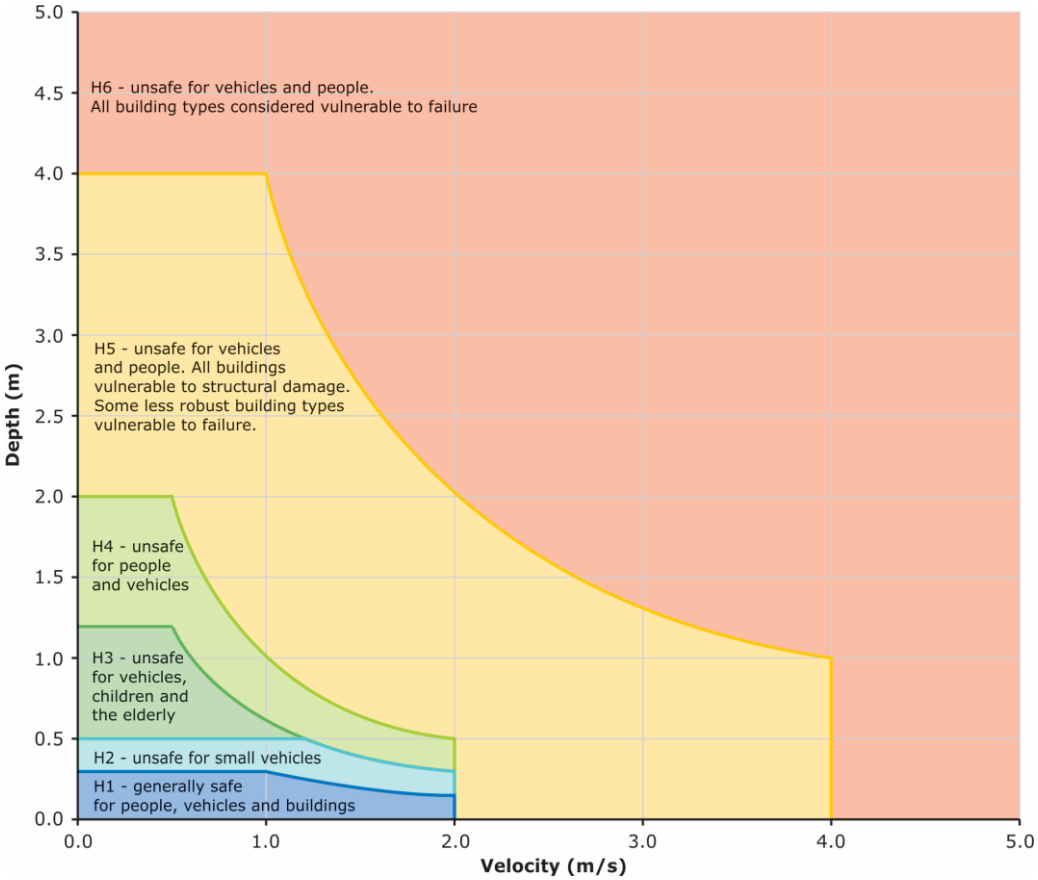

Figure 4-1 Flood hazard vulnerability curves (Book 6 Chapter 7, ARR2019)

The combined depth and velocity are used to define the hydraulic hazard classification of the flooding. In the area, the hydraulic hazard classification is generally H1 (generally safe for people, vehicles, and buildings) with a pocket of H2 (unsafe for small vehicles) located in front of the Central Station Terminal Building. Given the minor level of hazard (ie. Mostly safe for people, vehicles and buildings), it is not anticipated to influence the project design.

4.3 Flood mapping

Figure 4-2 presents the 1% AEP flood map about the Eddy Avenue region showing the flood depth, extent, and flood levels as 0.5m contours.

Flood mapping for the existing condition flood depth, water surface elevation, velocity, and hydraulic hazard for the 5% AEP, 1% AEP and PMF events are presented in Appendix A. The mapping presents the maximum of the critical durations assessed whilst the extents are limited to a flood depth greater than 50mm.

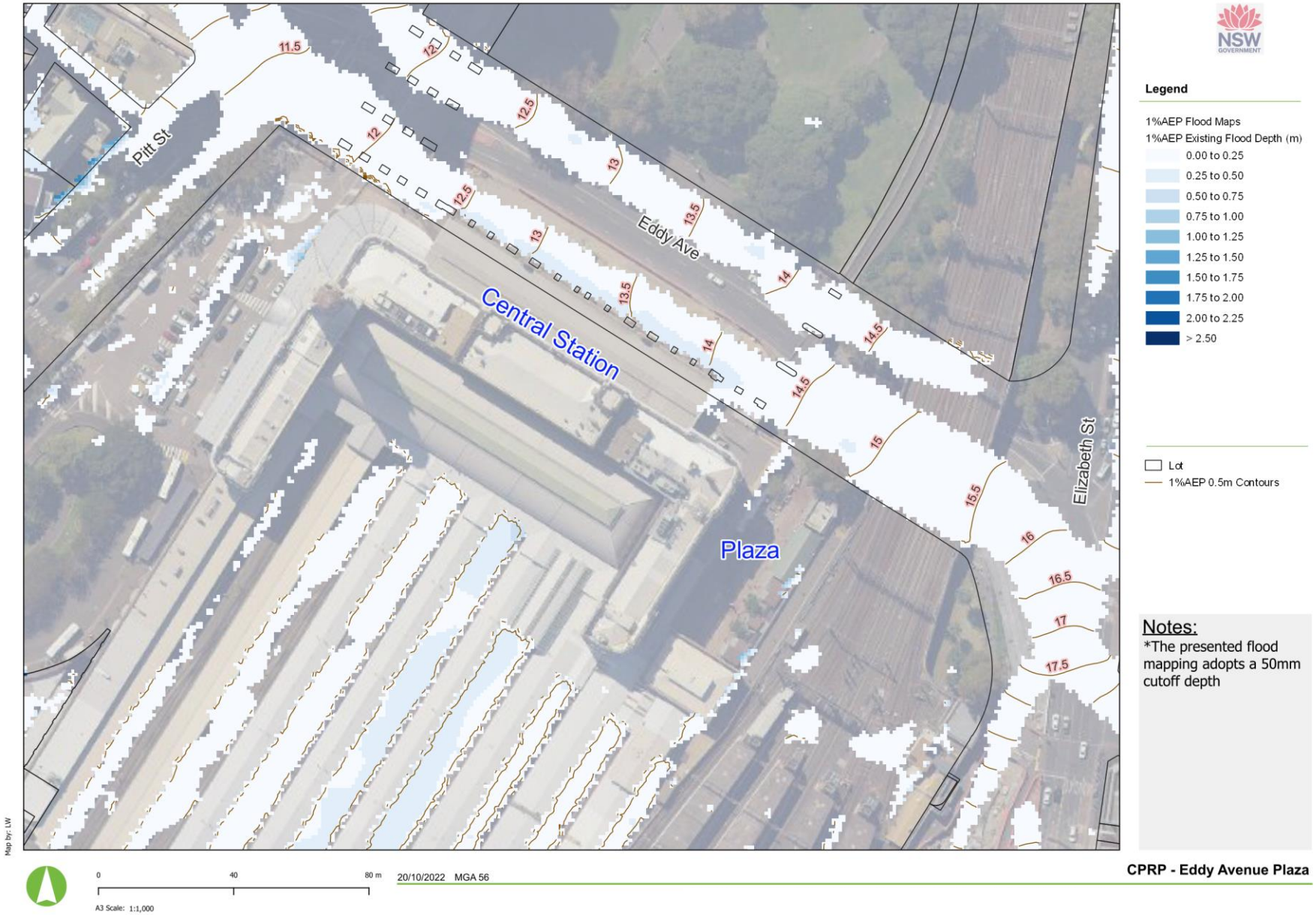

Figure 4-2 1% AEP Existing Condition Flood Depth and extent with 0.5m flood height contours

The 20% AEP event was not quantitatively assessed due to limited data available for the flood analysis. However, based on the assessment of the 5% AEP event for the critical storm durations (see Appendix A), it can be clearly seen that Eddy Avenue is not subject to flooding in the 5% AEP event. Therefore, as the 20% AEP event has a lower rainfall volume, flood depths, and extents will be less than the 5%AEP results presented in Appendix A. Consequently it confirms that Eddy Avenue will not be subject to flooding in this event (i.e., the flood risk to Eddy Avenue will be no worse in the 20% AEP event compared to the 5% AEP event).

5. Construction impacts

The proposed construction footprints are shown in Figure 1-2. There are two distinct areas: north around the Sydney Terminal Building, and one area to the south.

Each location is not predicted to be at risk of flooding up to the 1% AEP event. This is demonstrated in Appendix A for the northern area and Figure 5-1 for the southern area.

Since these areas are not at risk of flooding, no flood impact on construction activities or on flooding is anticipated. Furthermore, as the construction work is not at risk of flooding, there is no indirect impact.

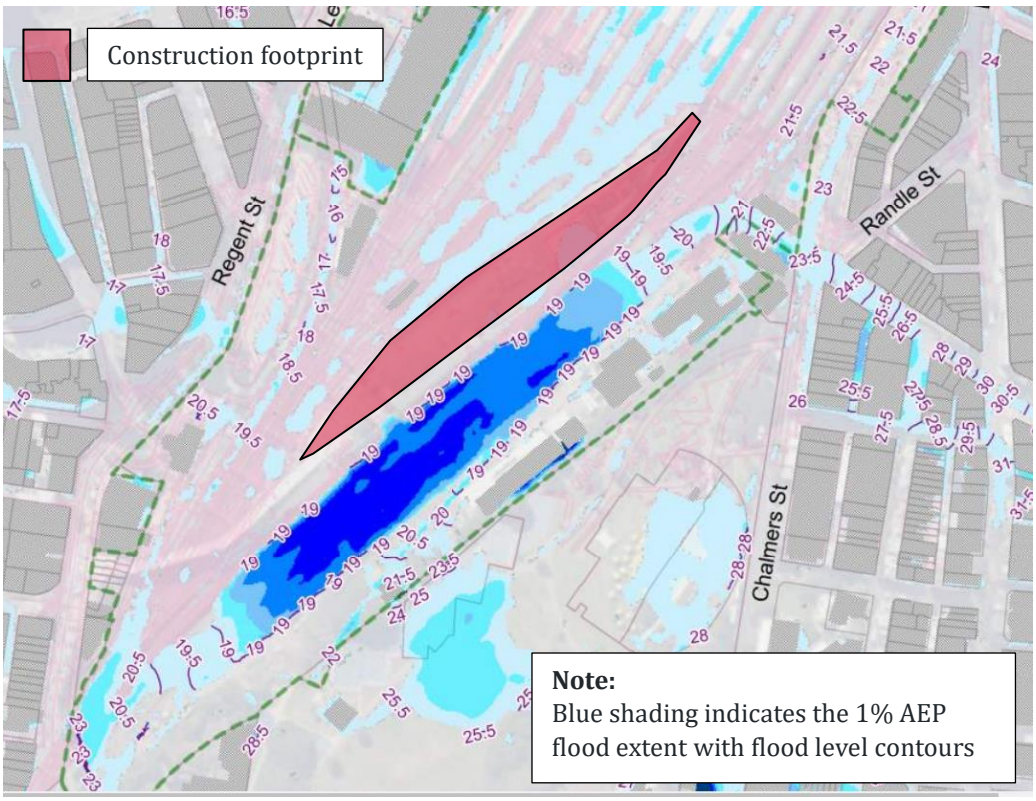

Figure 5-1 Southern construction footprint overlayed with the 1%AEP Existing Condition Flood Depth and extent with 0.5m flood height contours (Base data source: Arcadis, 2022)

At a local scale, there may be local ponding and drainage risk within the construction footprint. Potential impacts associated with local drainage can include:

- An increased surcharge (water backing up) in the stormwater system because of:
    - Temporarily changing runoff rates and flow paths, and therefore discharging more water to certain drainage lines
    - Reducing the capacity of the existing drainage infrastructure through sediment discharge
- Localised ponding, pooling, and flooding during and following heavy rainfall.

The above may lead to the following temporary impacts:

- Additional erosion and loss of soil quality from equipment trafficking over waterlogged ground
- Stockpile materials and demolition waste from additional washout
- Loss of landscape planting due to wash out
- Collection of water in open excavations and associated worker safety risks
- Downstream water quality impacts
- Basement flooding.

The construction methodology and proposed works have yet to be finalised and will be determined by the contractor in the next stage of the project.

6. Operational impacts

6.1 Proposed Condition Flood Mapping

The proposed condition flood mapping of flood depth, water surface elevation, velocity, and hydraulic hazard for the 5% AEP, 1% AEP and PMF events are in Appendix A.

The mapping presents the maximum of the critical durations assessed whilst the extents are limited to a flood depth greater than 50mm.

6.2 Flood Impact

Flood impact mapping is in Appendix A. Impacts to flood levels and velocities between the design and the existing conditions are also in Appendix A.

The change in flood levels from the proposed Eddy Avenue Plaza design indicate negligible (+/-10mm) changes in flood levels across all modelled events outside of the project footprint. Only localised increases are observed at the interface between Eddy Avenue and Eddy Avenue Plaza in the PMF event. No adverse impacts are predicted (see Appendix A) in the modelled events up to the 1% AEP event. No resulting flood level impacts are precited given the limited interaction with flooding and the minor variation in proposed design levels compared to existing conditions.

Changes in velocities are localised (e.g., within the project area) and limited to within ±0.25 m/s. This magnitude of impact is negligible on the basis that the change in velocity will not increase scour potential. Furthermore, the area is paved. It therefore has a significant resistance to increases in velocity (e.g., it is not subject to scour or erosion).

The assessment of flood hazard indicated no change in hazard classification. This is because there is no precited changes in flood behaviour.

Eddy Avenue Plaza has no hydraulic function based on the predicted flood behaviour (e.g. does not convey overland flood flow or functions as an on-site storage detention feature) as it is not at risk of flooding (see Appendix A). As such, it can be concluded that with respect to flooding, the project will be compatible with the hydraulic function of the area.

With a negligible change in peak flood levels, velocities, and hydraulic hazard classification, impacts to inundation duration will be unaffected. This means there will be no change in inundation duration, removing the need to carry out modelling to validate this. This will be the case all modelled events (ie. 5%, 1% AEP and PMF events).

No changes in discharges are predicted based on the current assessment because:

- The proposed design at this stage does not increases the proportion of imperviousness (e.g., the area of hardstand) from existing conditions therefore the stormwater quantity is not predicted to increase
- Catchment areas have not increased compared to existing conditions, which will also not result in an increase in stormwater quantity
- Point(s) of discharge are consistent with existing conditions, which limits changes in stormwater discharges and flood behaviour.
- Proposed design surface is graded towards Eddy Avenue. This is consistent with existing conditions. This results in stormwater runoff and flood behaviour that will be consistent between existing and proposed scenarios.

Based on the above findings and justification of no impact on flooding to adjacent properties, no mitigation works are proposed. Furthermore, with no impact predicted, the project is consistent with the Darling Harbour Catchment Floodplain Risk Management Study and Plan, (WMA Water, 2016). Should the design have the potential to impact on stormwater quantity, points of discharge or flood behaviour, further modelling will be required to assess any changes in impacts.

The impacts on drainage and stormwater due to climate change are assessed in Appendix Q of the EIS.

7. Cumulative impacts

The assessment of operational impacts has identified that the proposed project will not result in an adverse impact on flooding on adjacent properties (see section 6).

Flood impacts are observed within the Eddy Avenue Plaza design extent only and as a result, the impact on flooding due to this development are deemed negligible.

8. Environmental management measures

As no construction and operational management measures were required to mitigate against hydrology and flood impacts, this section provides a summary of requirements for the next stage of analysis.

Table 8-1: Environmental management measures for hydrology and flooding impacts

Impact	Management measure	Responsibility	Timing
Construction phase impact on flooding	A review of the flood risk against the adopted method, proposed activities, and temporary designs will be carried out.	Transport	Detailed Design
Impact on stormwater and flooding	Increase in site discharge will not exceed pre-development conditions.	Transport	Detailed Design
Impact of flooding on existing and proposed development	Finished surface grading to slope away from entrances to limit flooding into buildings.	Transport	Detailed Design
Impact on existing flood levels and hazard	Overland flows spilling on to Eddy Avenue will not exceed predevelopment peak flows and not increase the hazard classification in accordance with Book 6 Chapter 7, ARR, 2019.	Transport	Detailed Design
Inclusion of detailed ground survey	The existing condition flood model will be refined based on recent detailed ground survey that defines flow paths, storage areas and hydraulic controls.	Transport	Detailed Design
Design development	The proposed design will be represented in the flood models and the impact to flooding and drainage be re-evaluated.	Transport	Detailed Design
Design development	City of Sydney Council will be consulted during the detailed design to ensure the mitigation is effective in managing flood impacts on adjacent lands.	Transport	Detailed Design
Construction phase impact on drainage	A Stormwater Management Plan (SWP) will be developed and implemented as part of the CEMP. The Plan will manage and mitigate stormwater drainage impacts onsite. As a minimum the Plan will ensure that all new or modified drainage associated with the SSI will be design to:	Contractor	Detailed Design/Pre-construction

Impact	Management measure	Responsibility	Timing
	a. Meet the capacity constraints of the City of Sydney Council's stormwater drainage system to receive and convey the proposed flows from the SSI, or otherwise upgrade council's drainage system at the Proponent's expense, in consultation with the City of Sydney Council b. Not worsen localised flooding, including around Eddy Avenue Plaza and along Eddy Avenue.		
SWF01 Impact | Flooding	The following will be reviewed during the detailed design to validate the flooding impact: • Ground levels, gradients, catchment size, points of discharge and extent of paving (hardstand) remain unchanged • Adopted method, proposed activities, and temporary designs are consistent with the model inputs.	Transport	Detailed design
SWF02 Uncertainty | Design development	Flood modelling will be updated if there is a material change in the design that will affect the flooding risk. Where needed additional flood mitigation will be included to maintain the flood levels, runoff rates and inundation times.	Transport	Detailed design

9. Summary of residual impacts

No residual impacts have been identified for this project.

10. References

Arcadis, 2021, Central Precinct Renewal Project – Precinct Flood Model Report

Arcadis, 2022, Central Precinct Renewal Program - Water Quality, Flooding and Stormwater Report

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

BOM, 2003, *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*, Bureau of Meteorology (BoM), Melbourne, Australia, June 2003

Appendix A – Flood Mapping

NSW GOVERNMENT

Legend

5%AEP Flood Maps

5%AEP Design Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

Lot

5%AEP Existing 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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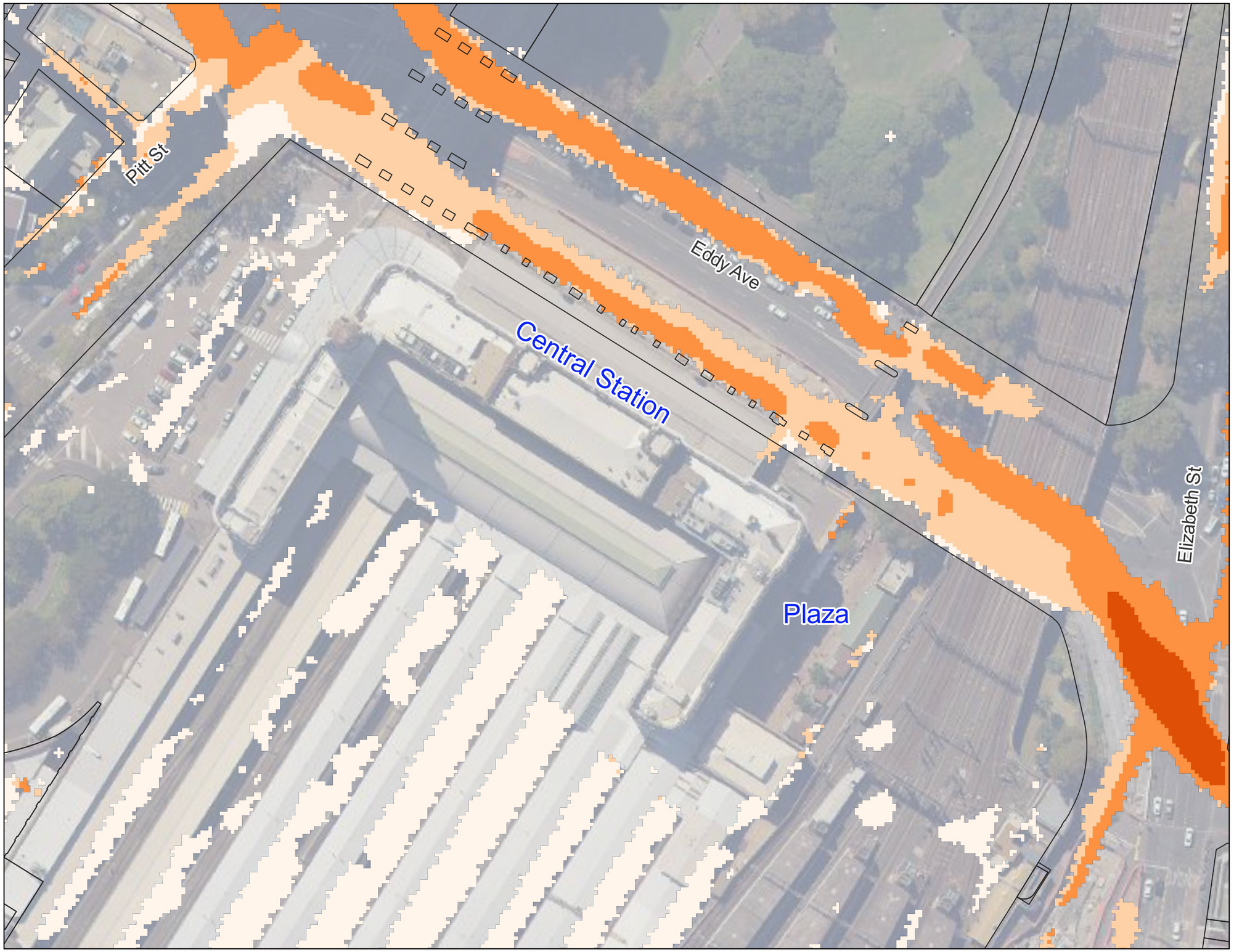
CPRP - Eddy Avenue Plaza

Figure 1-1.1: Existing Condition 5%AEP Peak Flood Depths and 0.5m Water Level Contours



Legend

5%AEP Flood Maps

5%AEP Existing Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

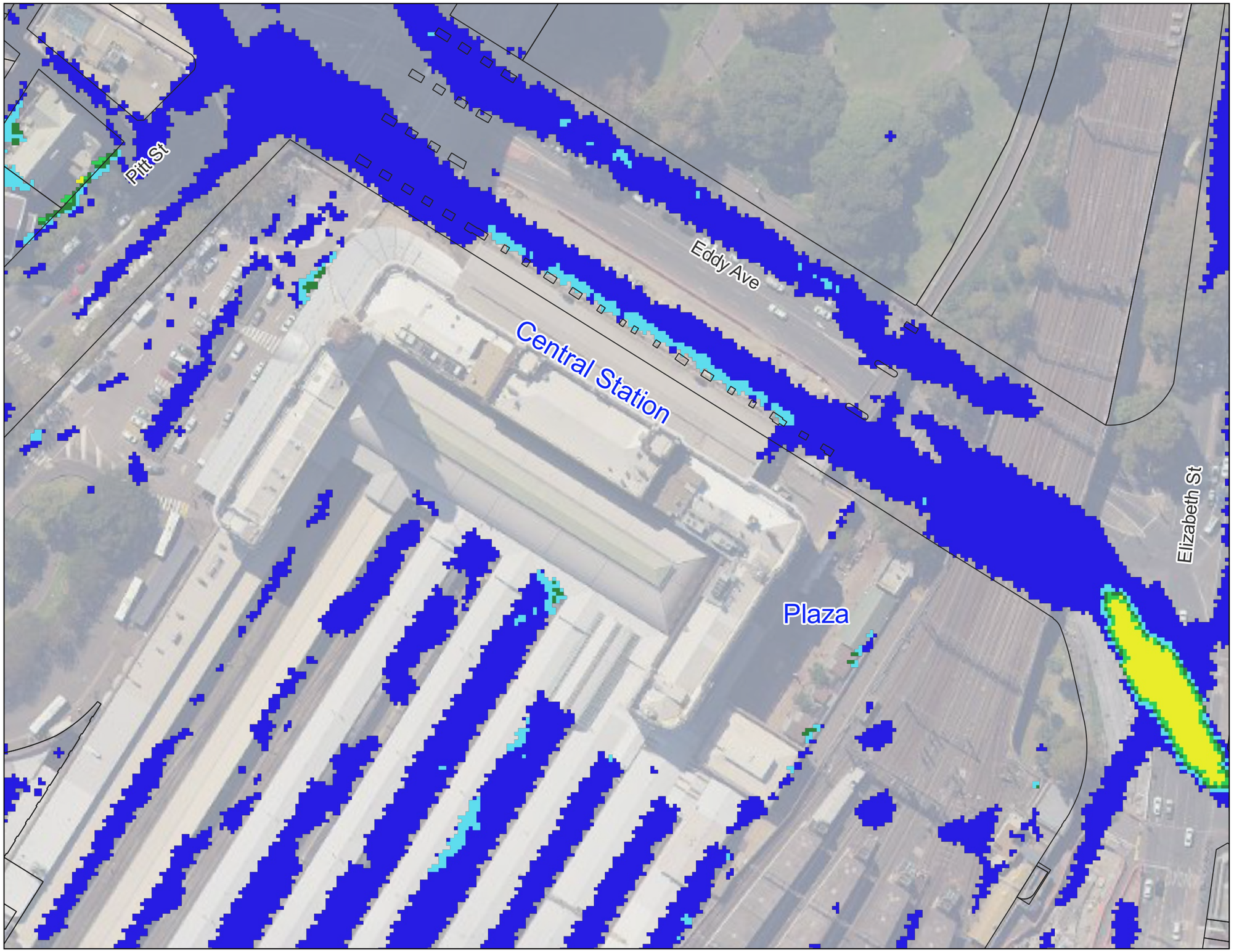
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 1-1.2: Existing Condition 5%AEP Peak Flood Velocity



Legend

5%AEP Flood Maps

5%AEP Existing Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

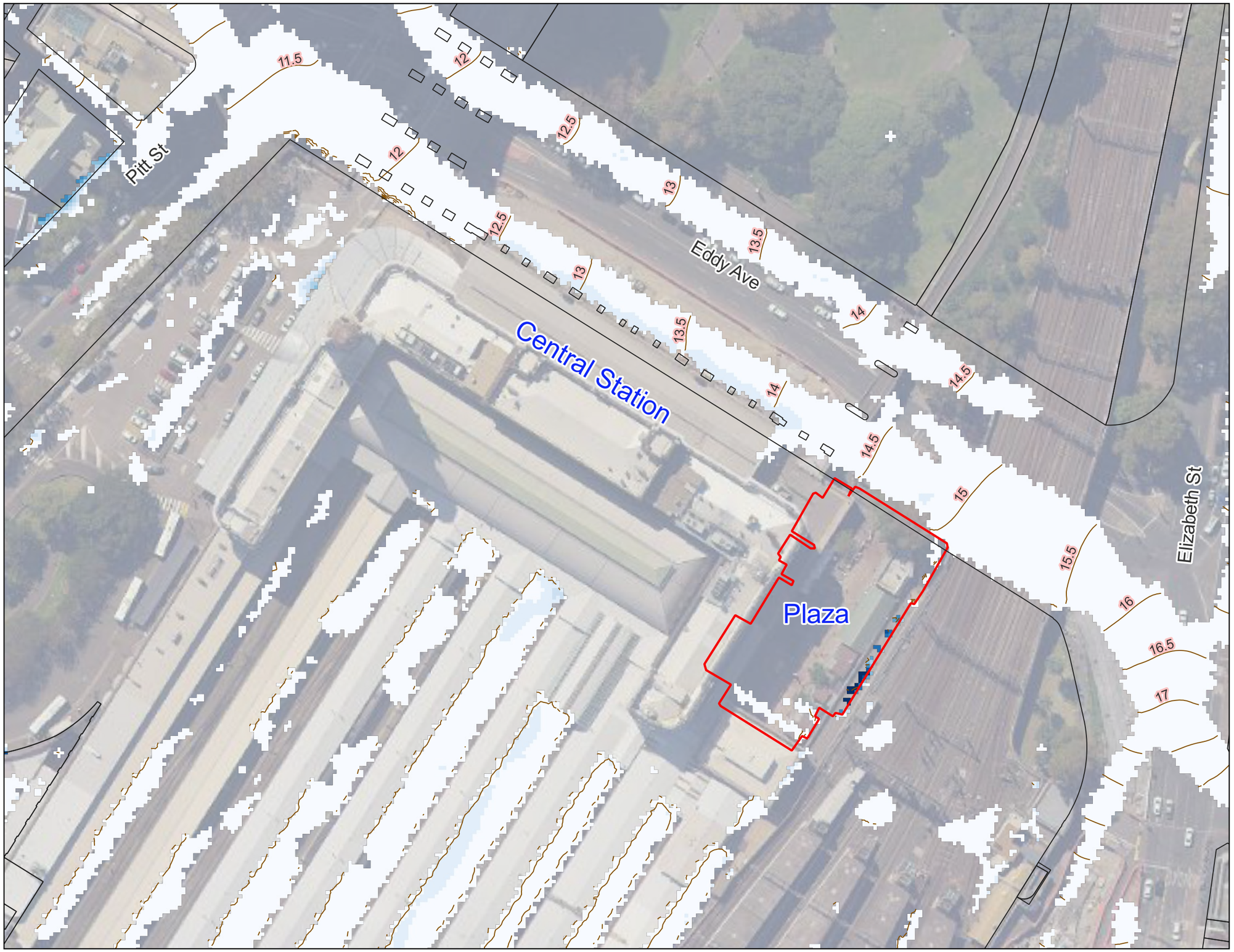
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 1-1.3: Existing Condition 5%AEP Peak Flood Hazard



NSW GOVERNMENT

Legend

5%AEP Flood Maps

5%AEP Design Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

- Lot
- Design Surface Extent
- 5%AEP Design 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

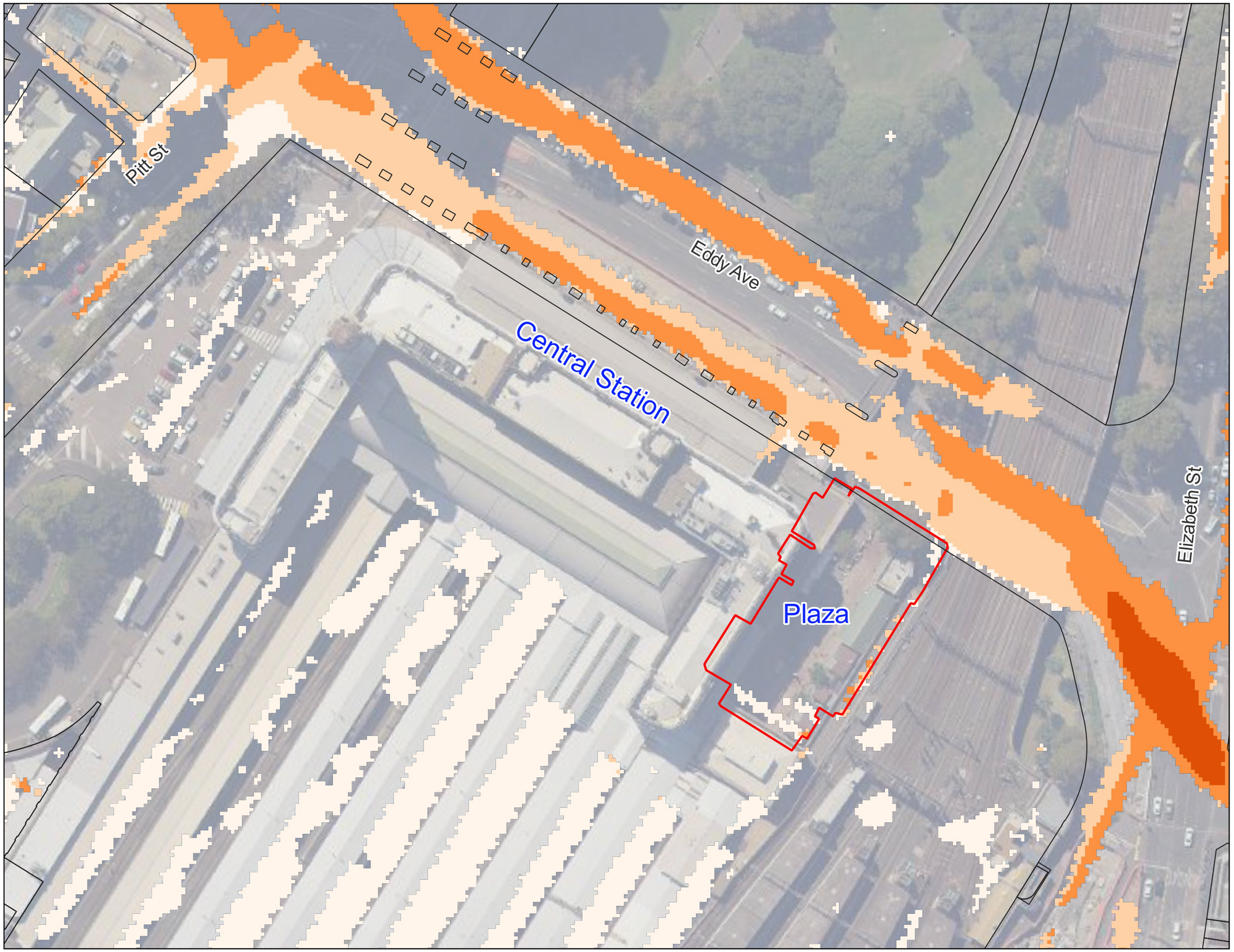
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 1-2.1: Design Condition 5%AEP Peak Flood Depths and 0.5m Water Level Contours



Legend

5%AEP Flood Maps

5%AEP Design Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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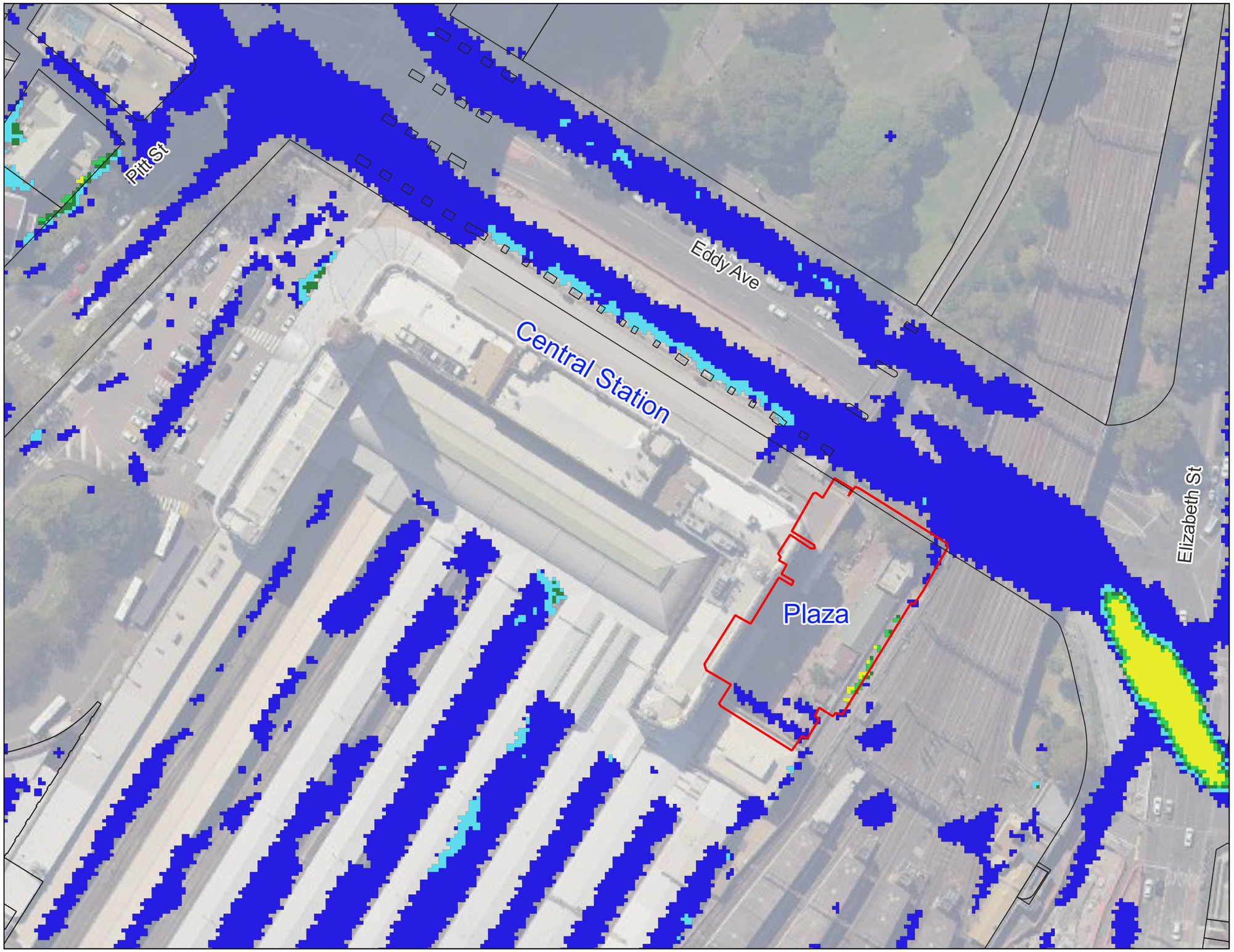
CPRP - Eddy Avenue Plaza

Figure 1-2.2: Design Condition 5%AEP Peak Flood Velocity



Legend

5%AEP Flood Maps

5%AEP Design Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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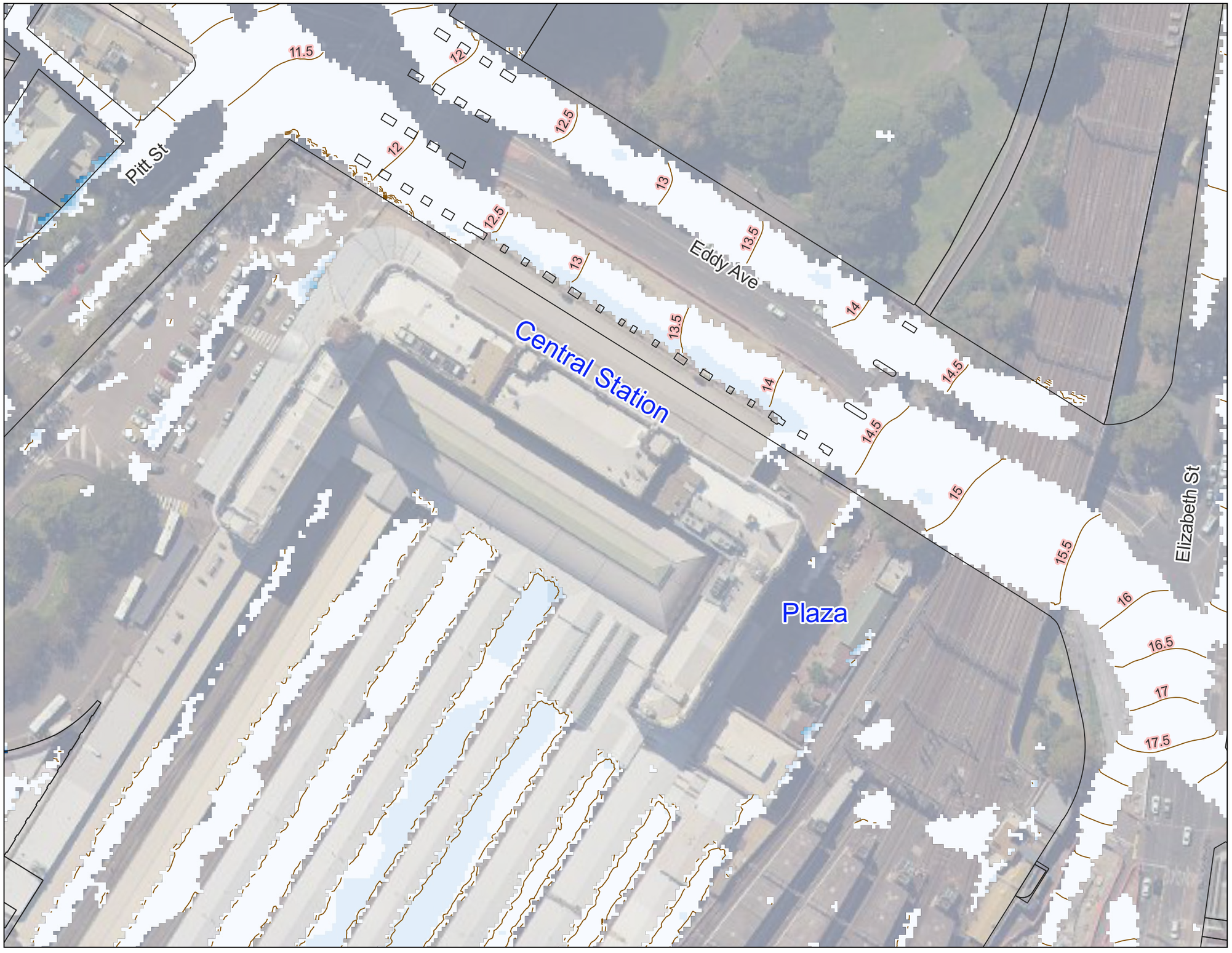
CPRP - Eddy Avenue Plaza

Figure 1-2.3: Design Condition 5%AEP Peak Flood Hazard



NSW GOVERNMENT

Legend

1%AEP Flood Maps

1%AEP Existing Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

Lot

1%AEP Existing 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 2-1.1: Existing Condition 1%AEP Peak Flood Depths and 0.5m Water Level Contours

Legend

1%AEP Flood Maps

1%AEP Existing Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

Lot

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

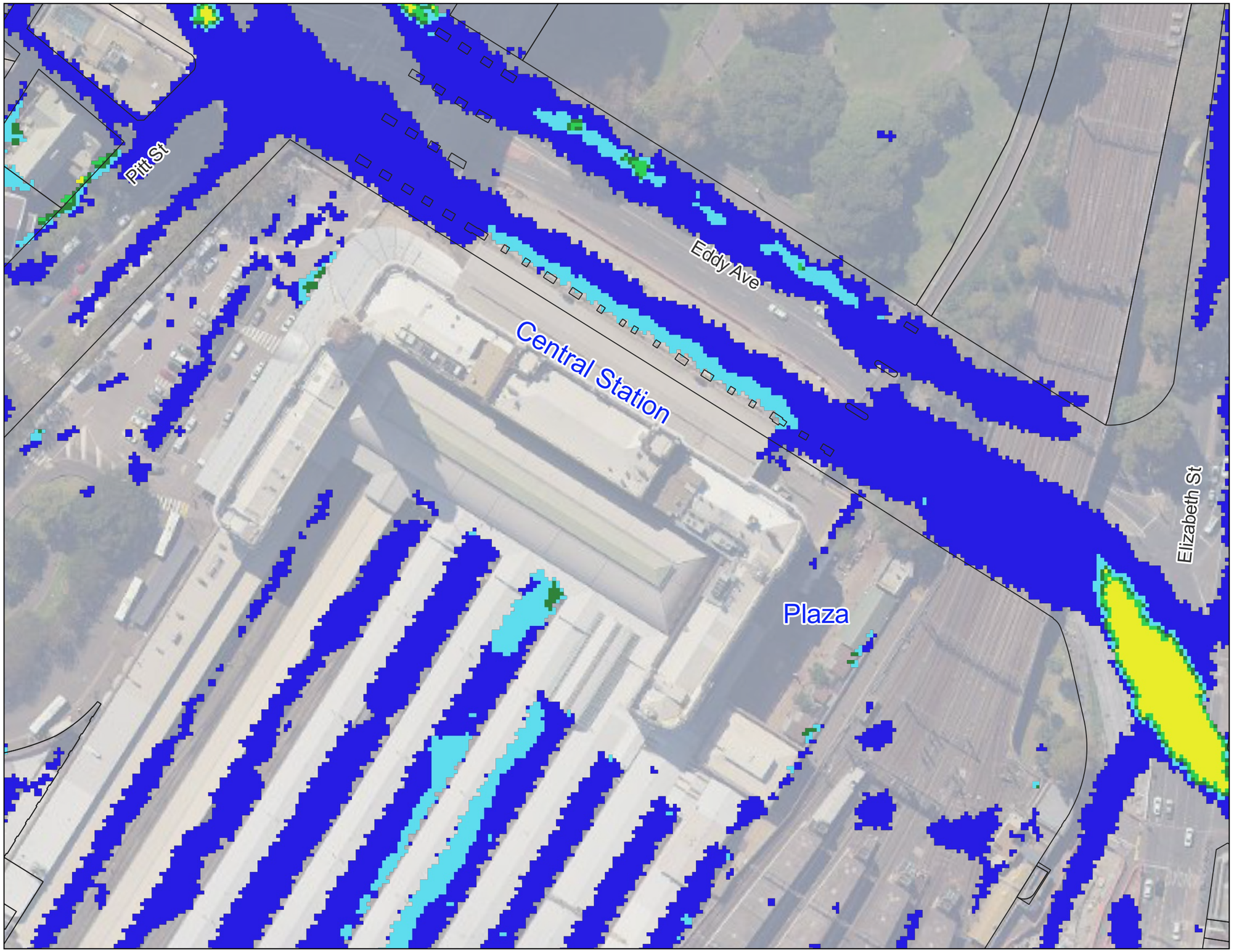
20/10/2022 MGA 56

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

CPRP - Eddy Avenue Plaza

Figure 2-1.2: Existing Condition 1%AEP Peak Flood Velocity



NSW GOVERNMENT

Legend

1%AEP Flood Maps

1%AEP Existing Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

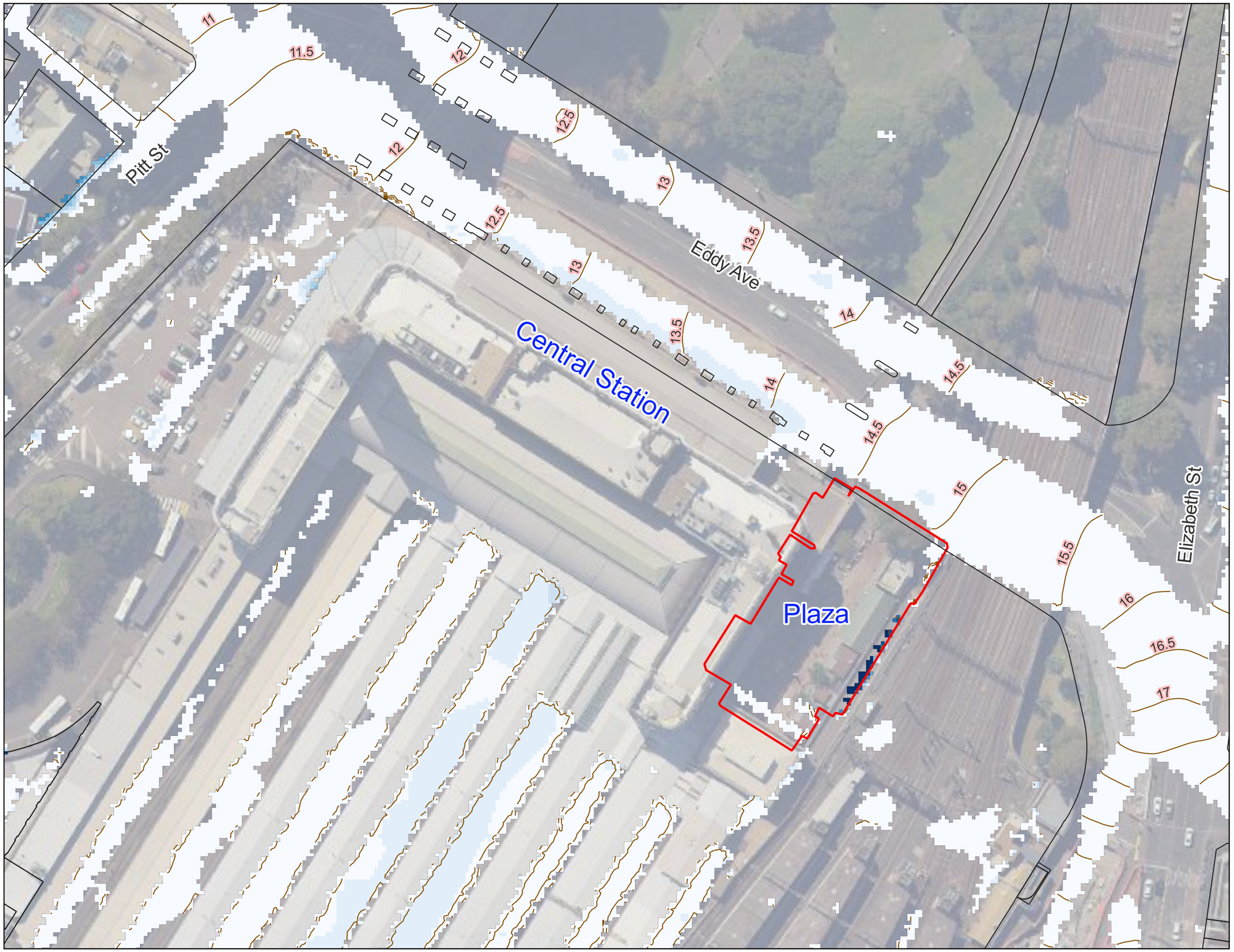
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 2-1.3: Existing Condition 1%AEP Peak Flood Hazard



Legend

1%AEP Flood Maps

1%AEP Design Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

- Lot
- Design Surface Extent
- 1%AEP Design 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

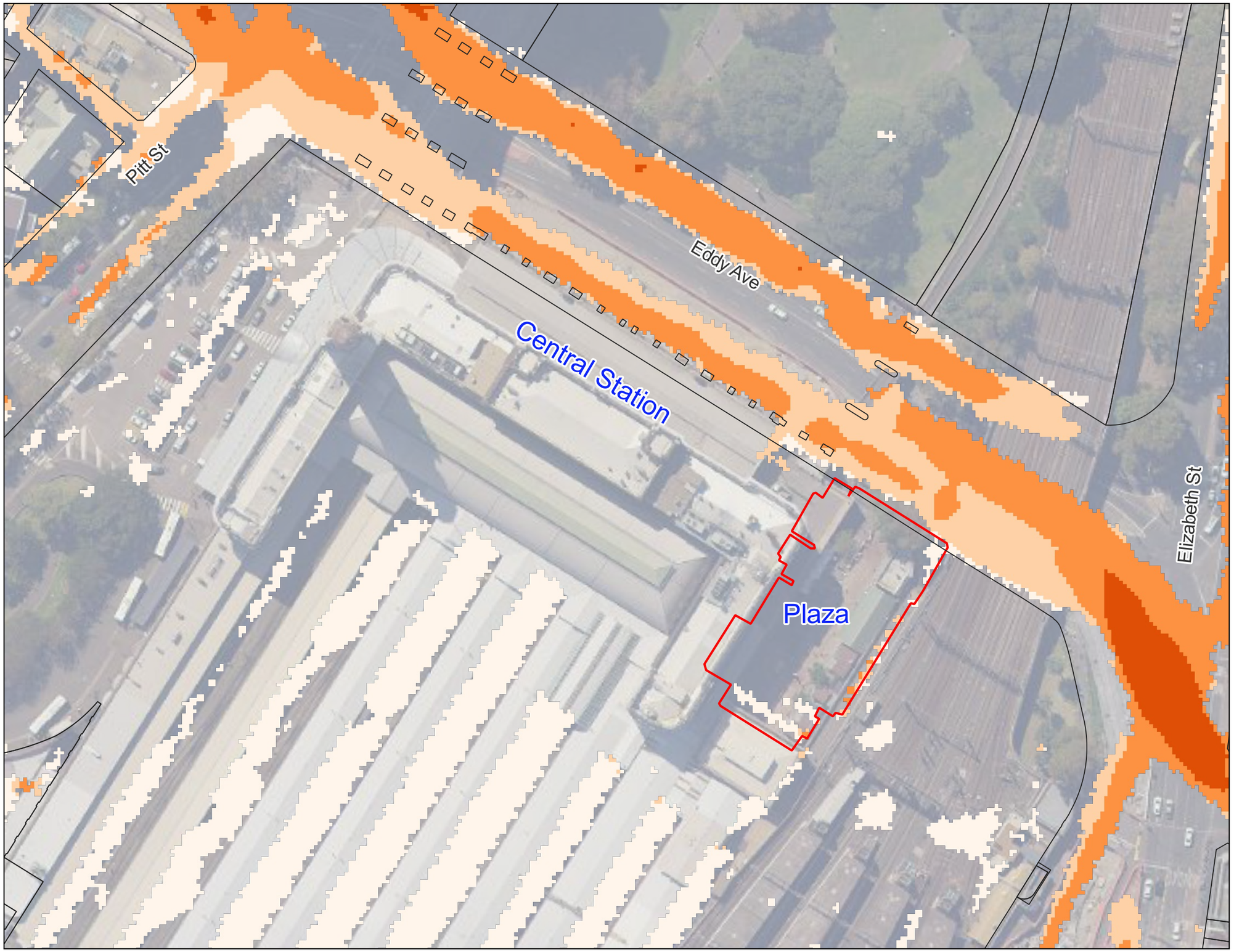
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 2-2.1: Design Condition 1%AEP Peak Flood Depths and 0.5m Water Level Contours



Legend

1%AEP Flood Maps

1%AEP Design Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

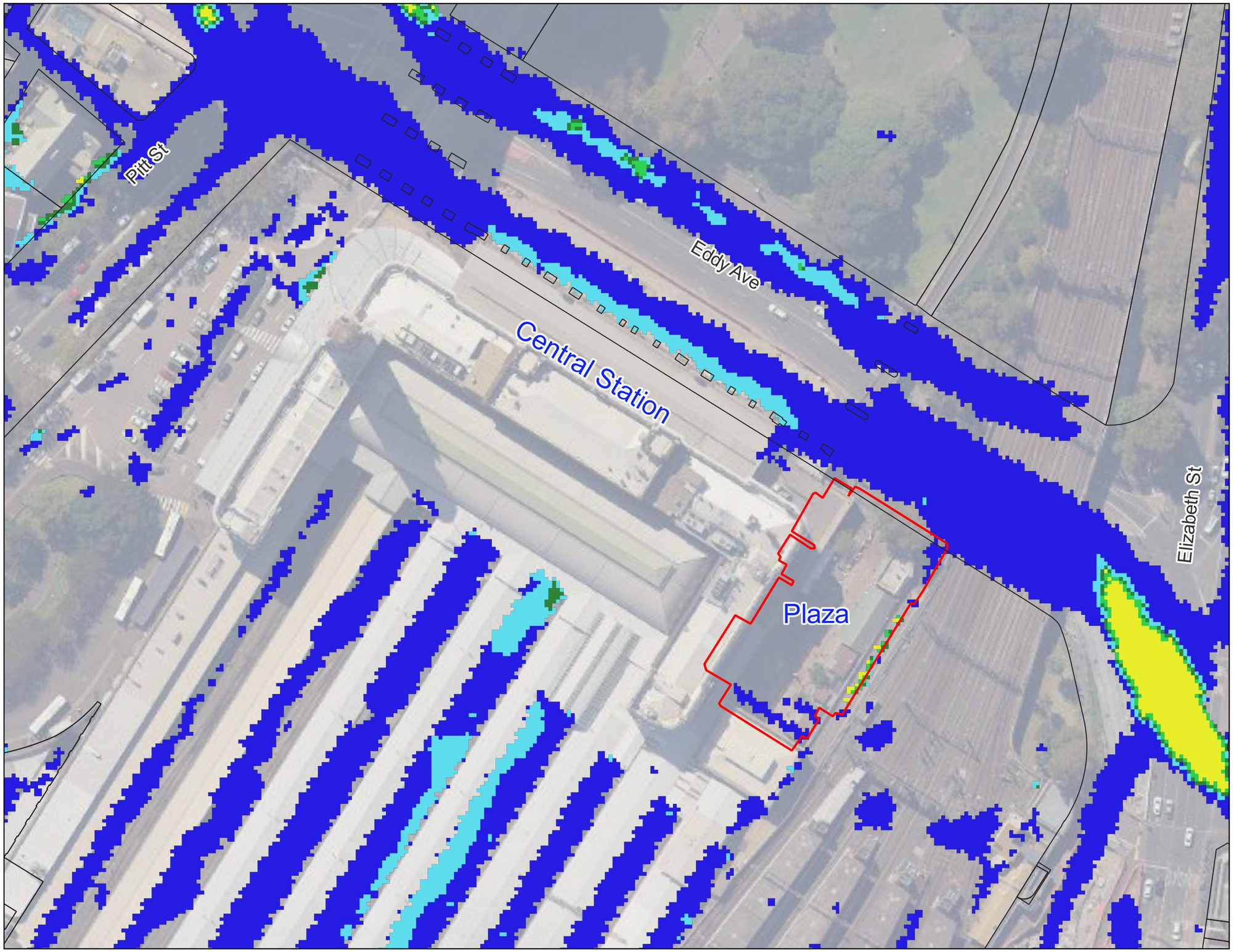
0 40 80 m

A3 Scale: 1:1,000

20/10/2022 MGA 56

CPRP - Eddy Avenue Plaza

Figure 2-2.2: Design Condition 1%AEP Peak Flood Velocity



Legend

1%AEP Flood Maps

1%AEP Design Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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CPRP - Eddy Avenue Plaza

Figure 2-2.3: Design Condition 1%AEP Peak Flood Hazard

Legend

1%AEP + CC Flood Maps

1%AEP +CC Existing Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

- Lot
- 1%AEP +CC Existing 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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CPRP - Eddy Avenue Plaza

Figure 3-1.1: Existing Condition 1%AEP +CC Peak Flood Depths and 0.5m Water Level Contours

Legend

1%AEP + CC Flood Maps

1%AEP +CC Existing Flood Velocity (m/s)
Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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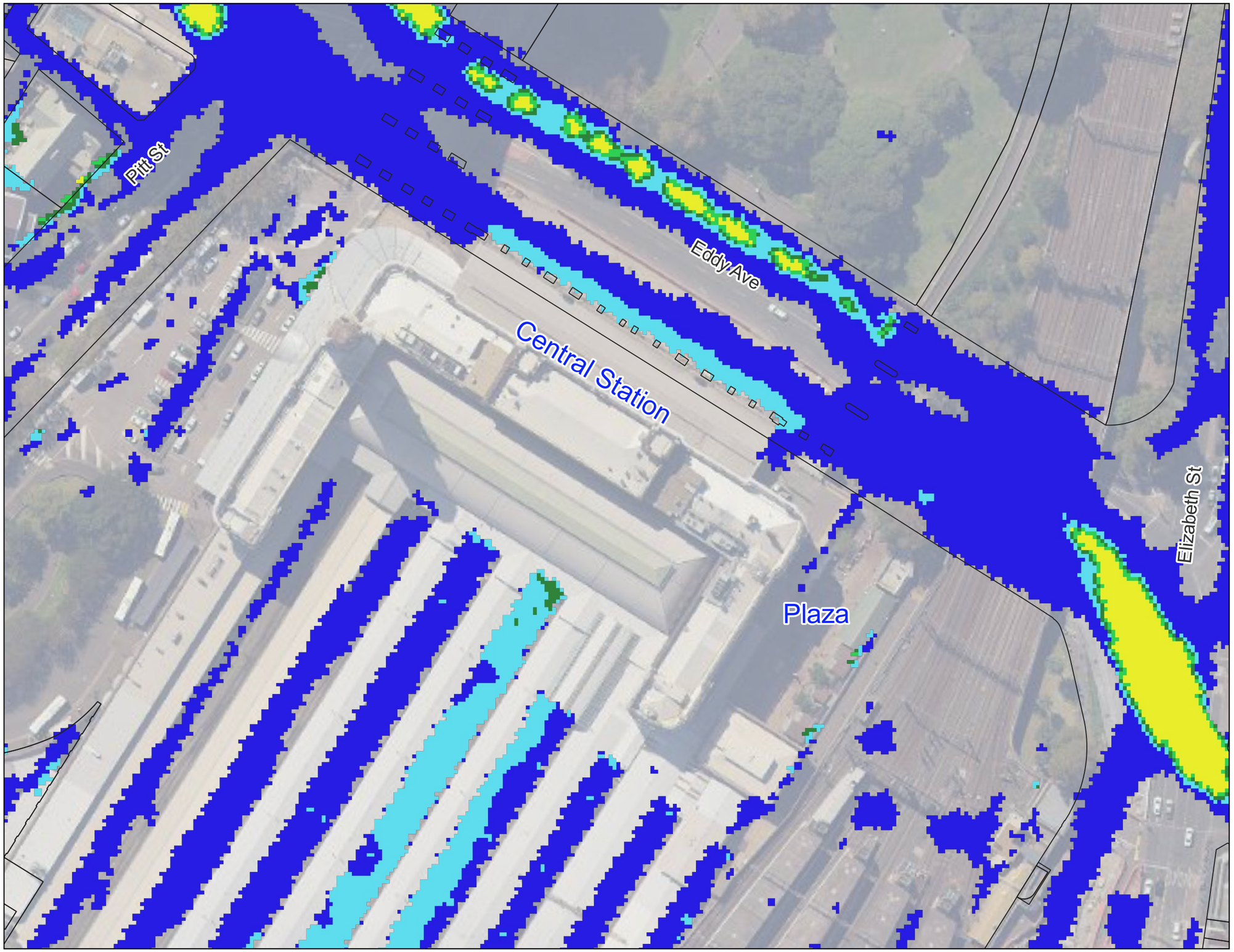
CPRP - Eddy Avenue Plaza

Figure 3-1.2: Existing Condition 1%AEP +CC Peak Flood Velocity



Legend

1%AEP + CC Flood Maps

1%AEP +CC Existing Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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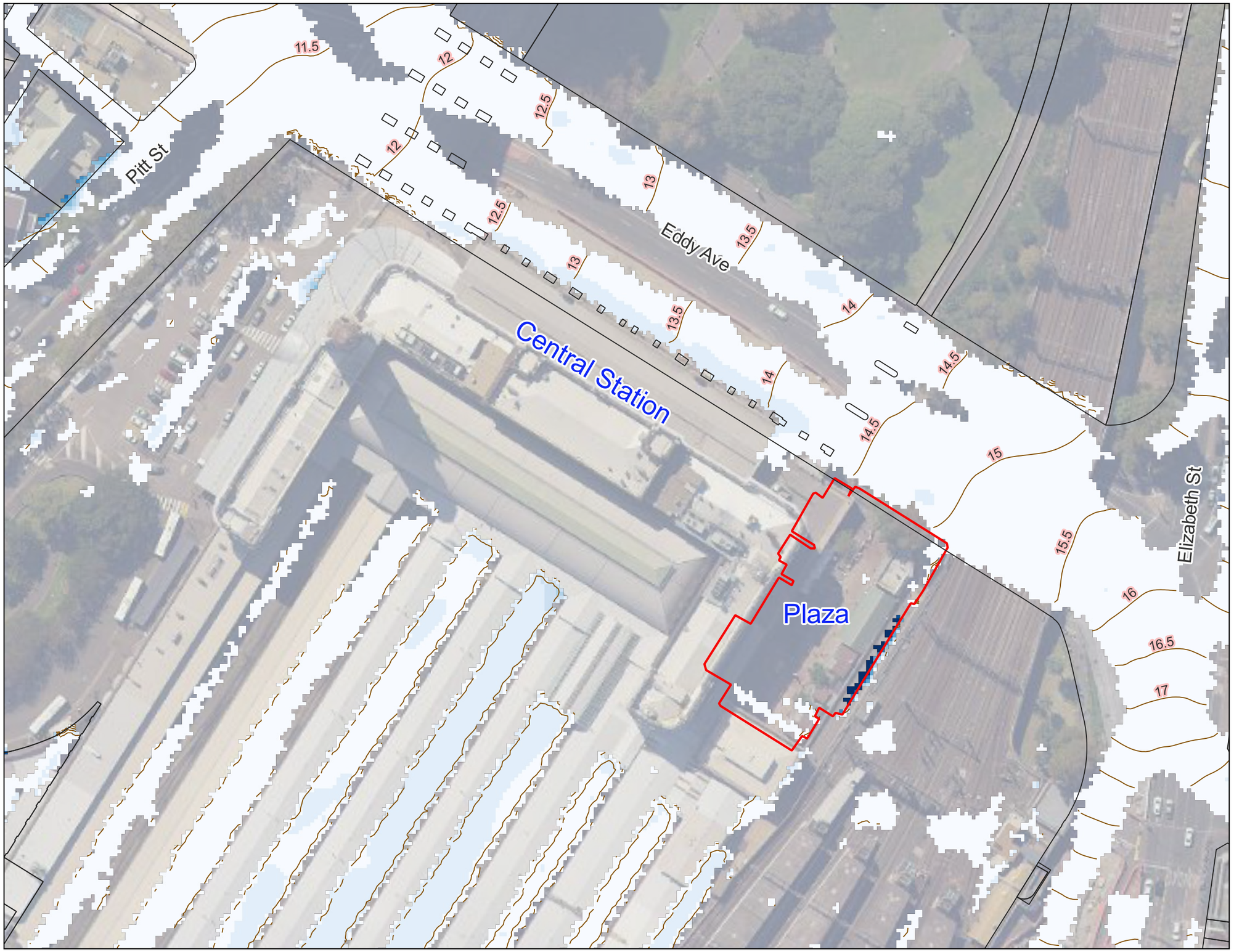
CPRP - Eddy Avenue Plaza

Figure 3-1.3: Existing Condition 1%AEP +CC Peak Flood Hazard



Legend

1%AEP + CC Flood Maps

1%AEP +CC Design Flood Depth (m)
Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

- Lot
- Design Surface Extent
- 1%AEP +CC Design 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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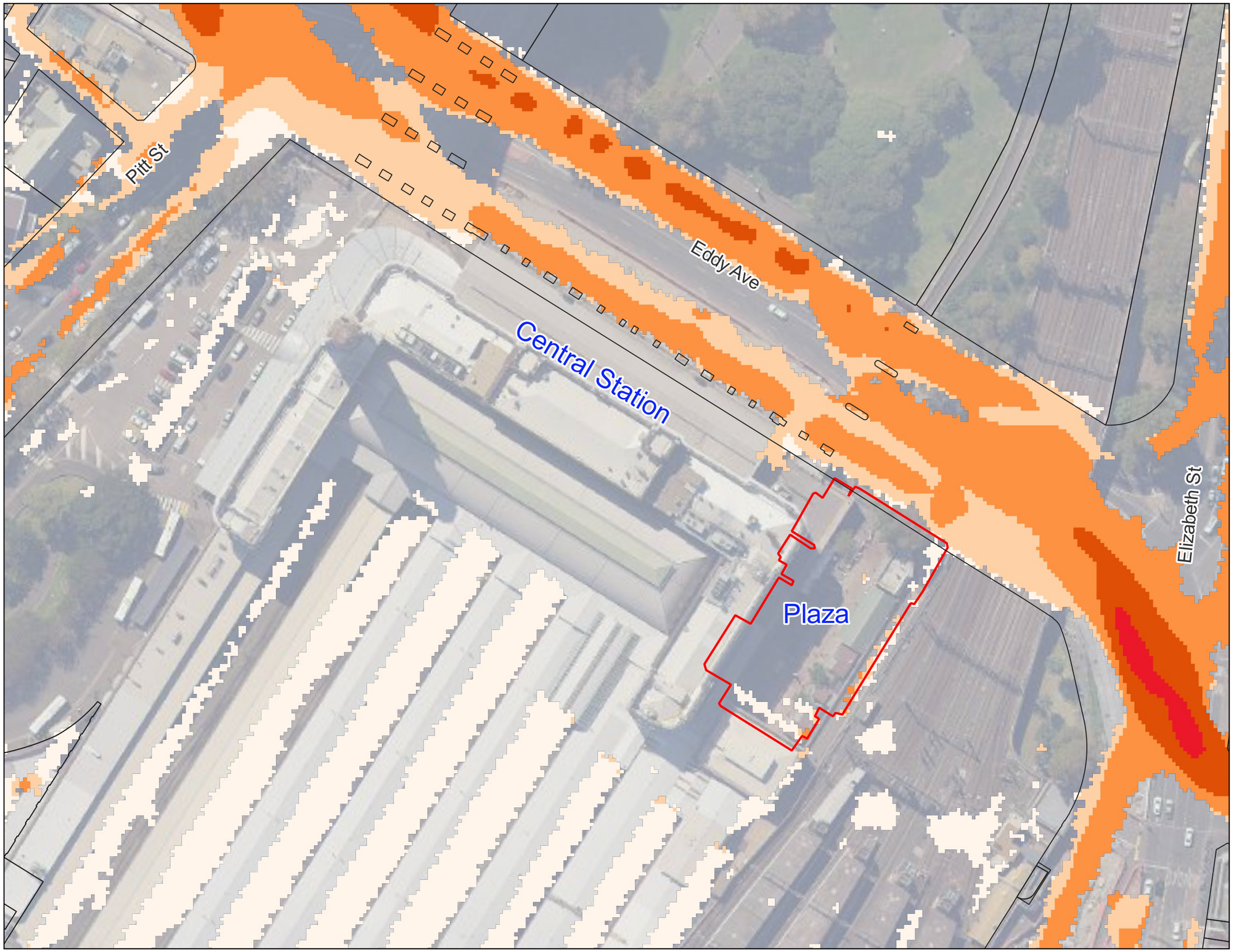
CPRP - Eddy Avenue Plaza

Figure 3-2.1: Design Condition 1%AEP +CC Peak Flood Depths and 0.5m Water Level Contours



Legend

1%AEP + CC Flood Maps

1%AEP +CC Design Flood Velocity (m/s)
Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

- Lot
- Design Surface Extent

Notes:
*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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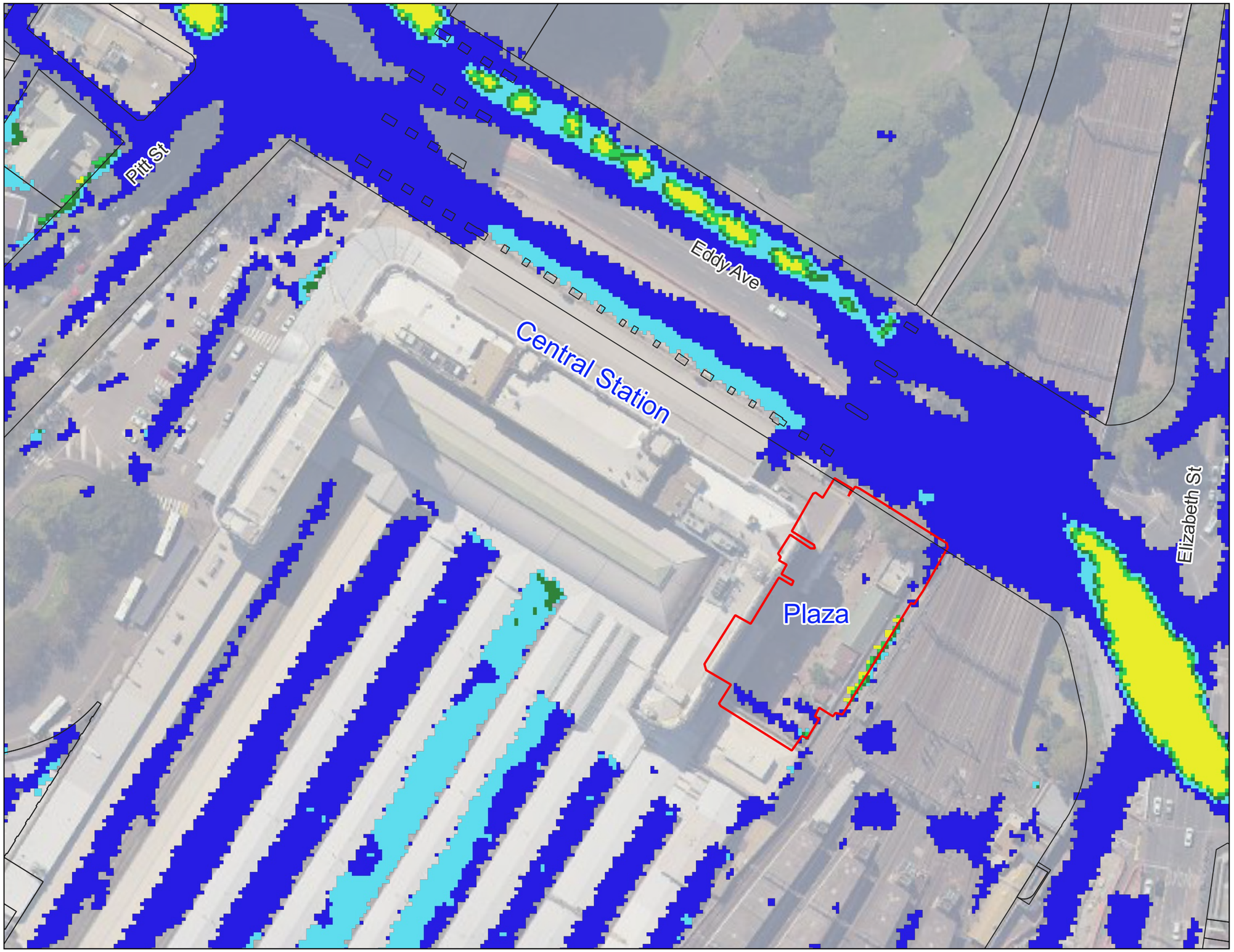
CPRP - Eddy Avenue Plaza

Figure 3-2.2: Design Condition 1%AEP +CC Peak Flood Velocity



Legend

1%AEP + CC Flood Maps

1%AEP +CC Design Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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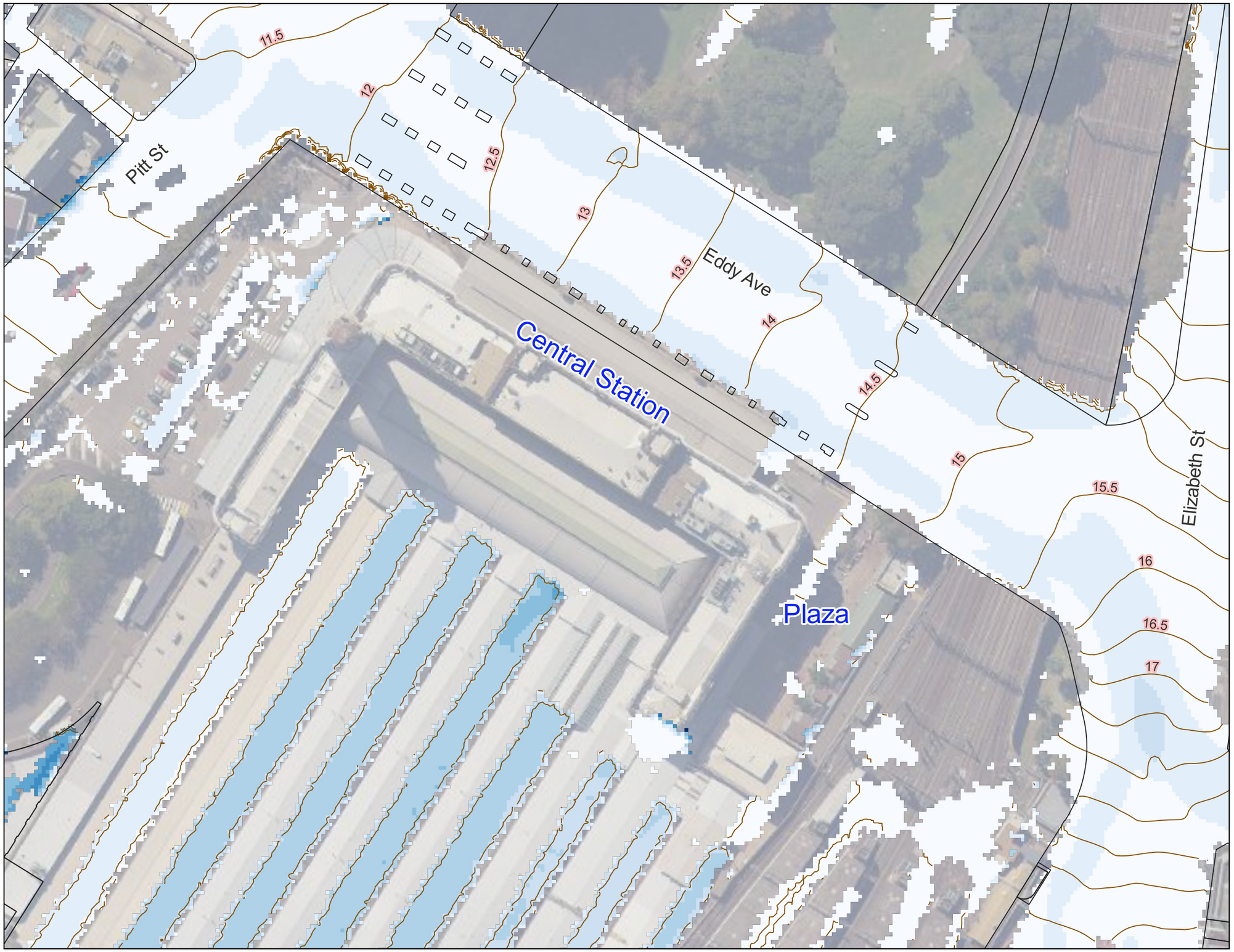
CPRP - Eddy Avenue Plaza

Figure 3-2.3: Design Condition 1%AEP +CC Peak Flood Hazard



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Legend

PMF Flood Maps

PMF Existing Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

Lot

PMF Existing 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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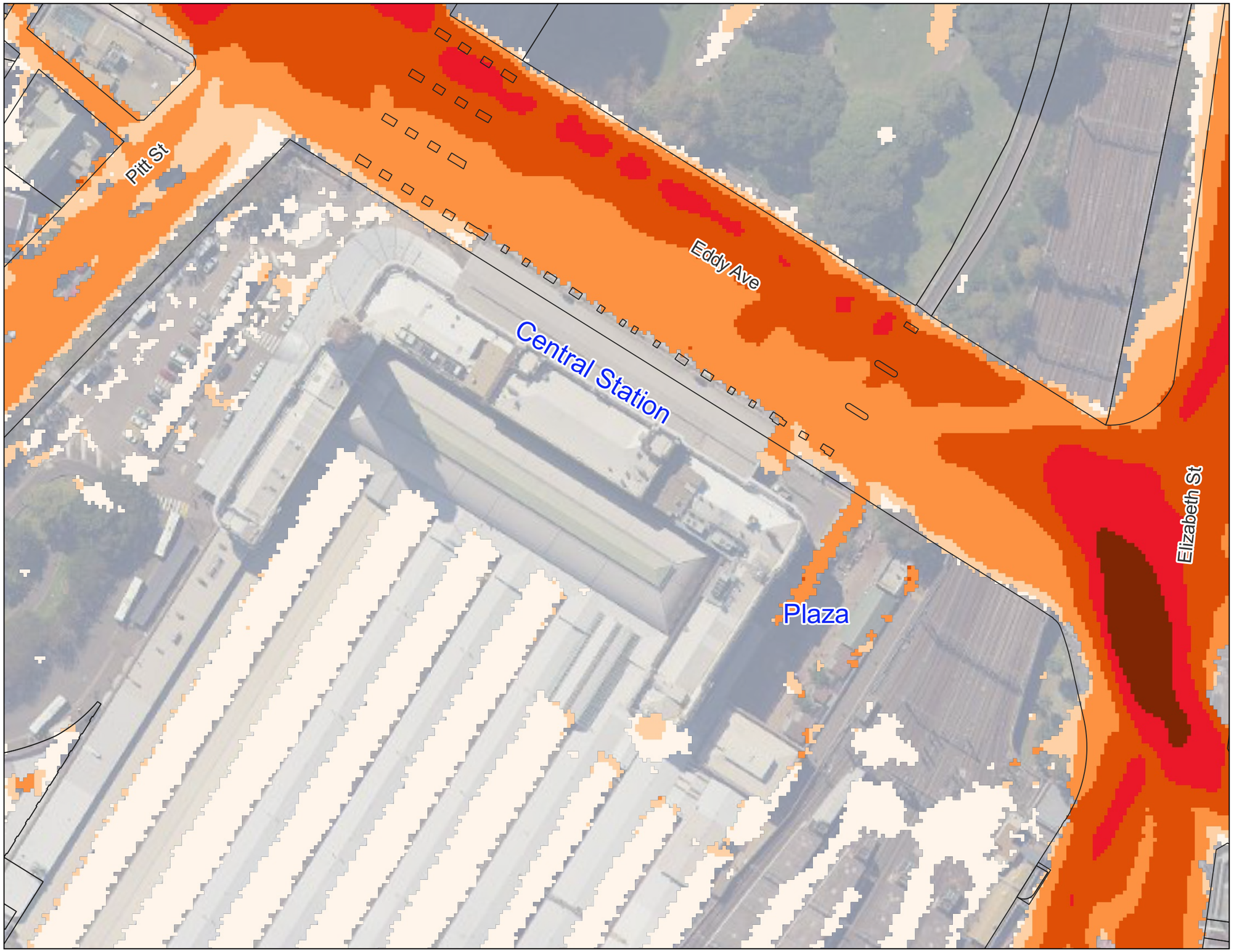
CPRP - Eddy Avenue Plaza

Figure 4-1.1: Existing Condition PMF Peak Flood Depths and 0.5m Water Level Contours



Legend

PMF Flood Maps

PMF Existing Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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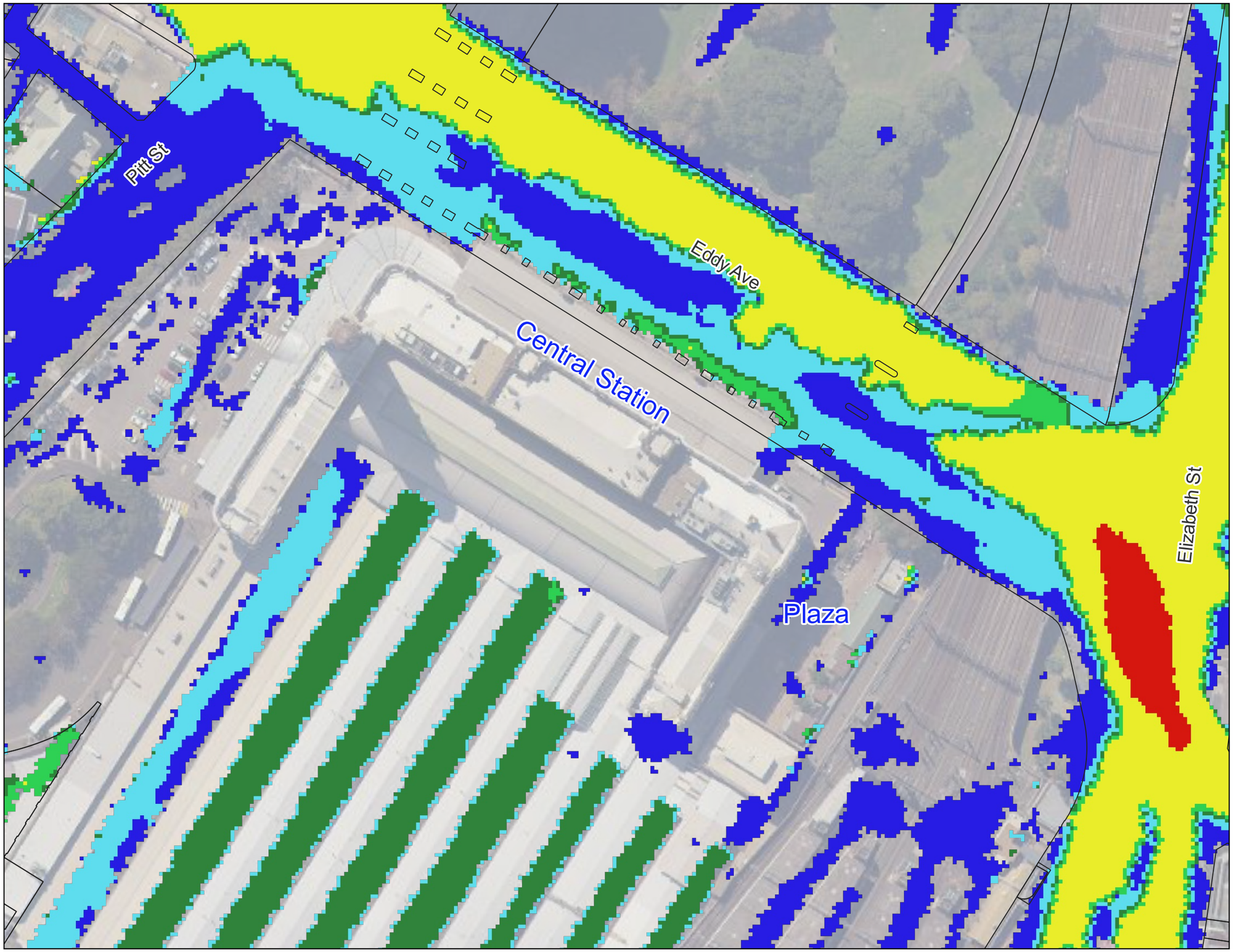
CPRP - Eddy Avenue Plaza

Figure 4-1.2: Existing Condition PMF Peak Flood Velocity



Legend

PMF Flood Maps

PMF Existing Flood Hazard

Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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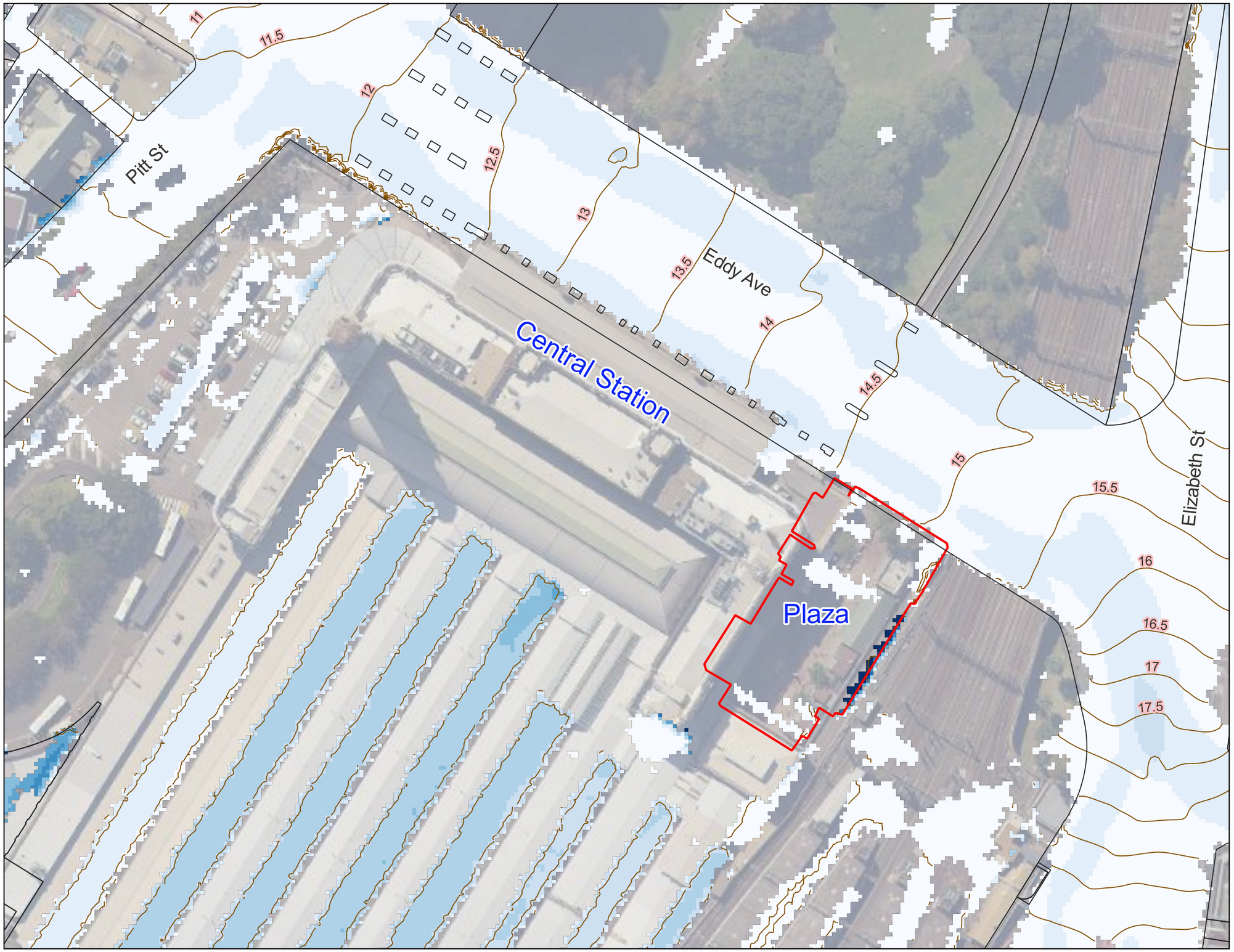
CPRP - Eddy Avenue Plaza

Figure 4-1.3: Existing Condition PMF Peak Flood Hazard



Legend

PMF Flood Maps

PMF Design Flood Depth (m)

Band 1

- 0.00 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- 1.50 to 1.75
- 1.75 to 2.00
- 2.00 to 2.25
- > 2.50

- Lot
- Design Surface Extent
- PMF Design 0.5m Contours

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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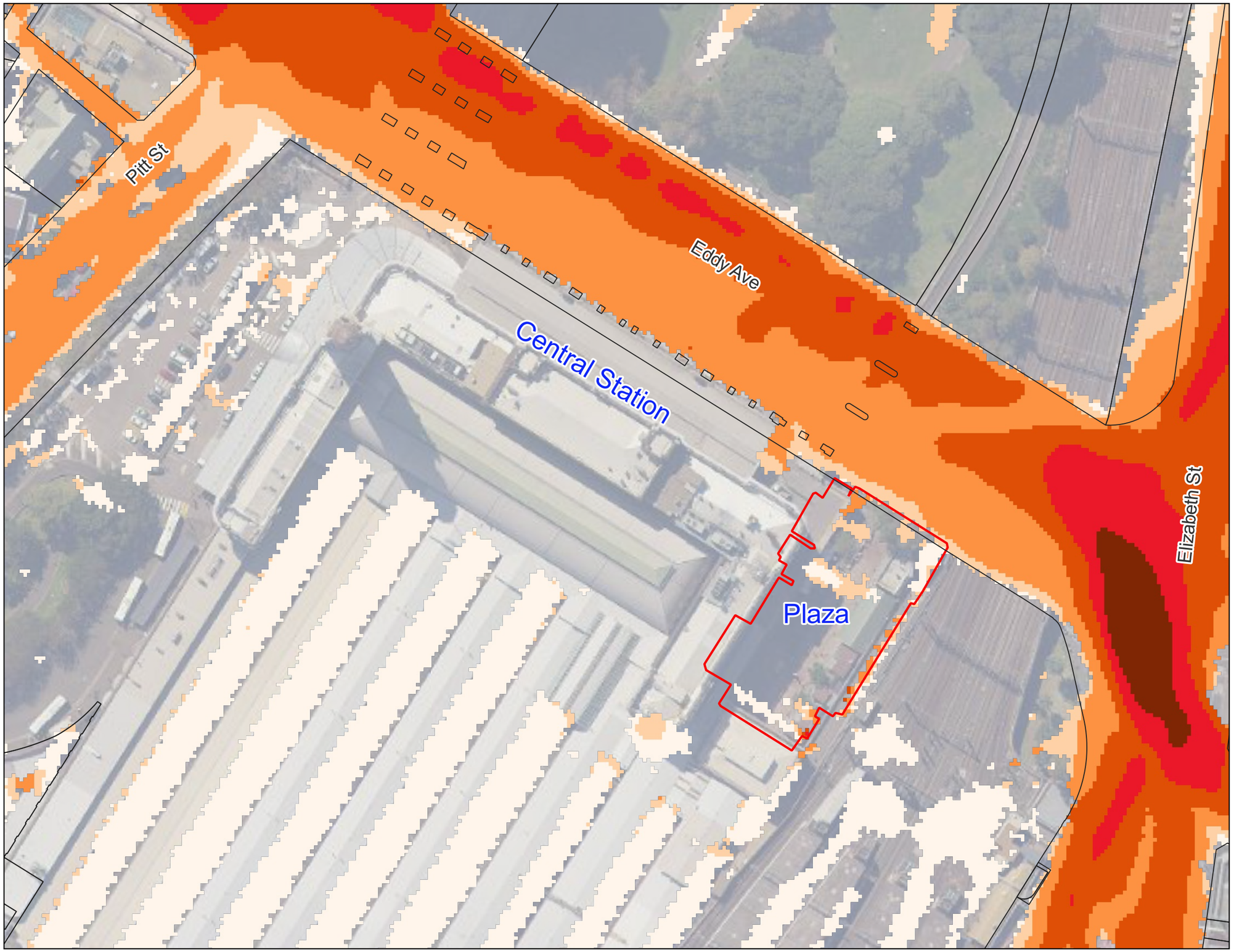
CPRP - Eddy Avenue Plaza

Figure 4-2.1: Design Condition PMF Peak Flood Depths and 0.5m Water Level Contours



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Legend

PMF Flood Maps

PMF Design Flood Velocity (m/s)

Band 1

- 0.00 to 0.50
- 0.5 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- > 4.00

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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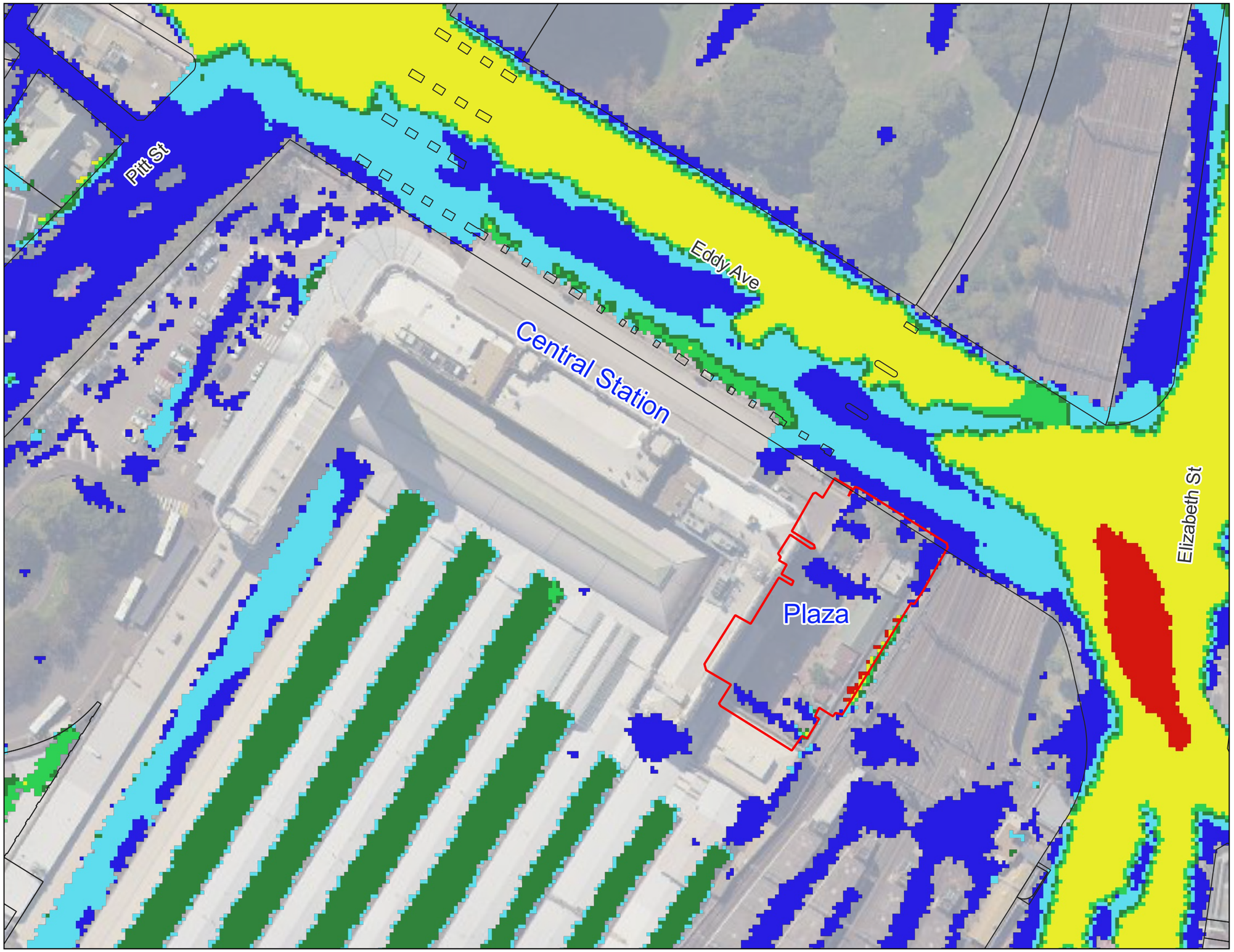
CPRP - Eddy Avenue Plaza

Figure 4-2.2: Design Condition PMF Peak Flood Velocity



Legend

PMF Flood Maps

PMF Design Flood Hazard Band 1

- H1 no restrictions
- H2 unsafe for small vehicles
- H3 unsafe for vehicles & children
- H4 unsafe for people & vehicles
- H5 unsafe for people & all vehicles
- H6 unconditionally dangerous

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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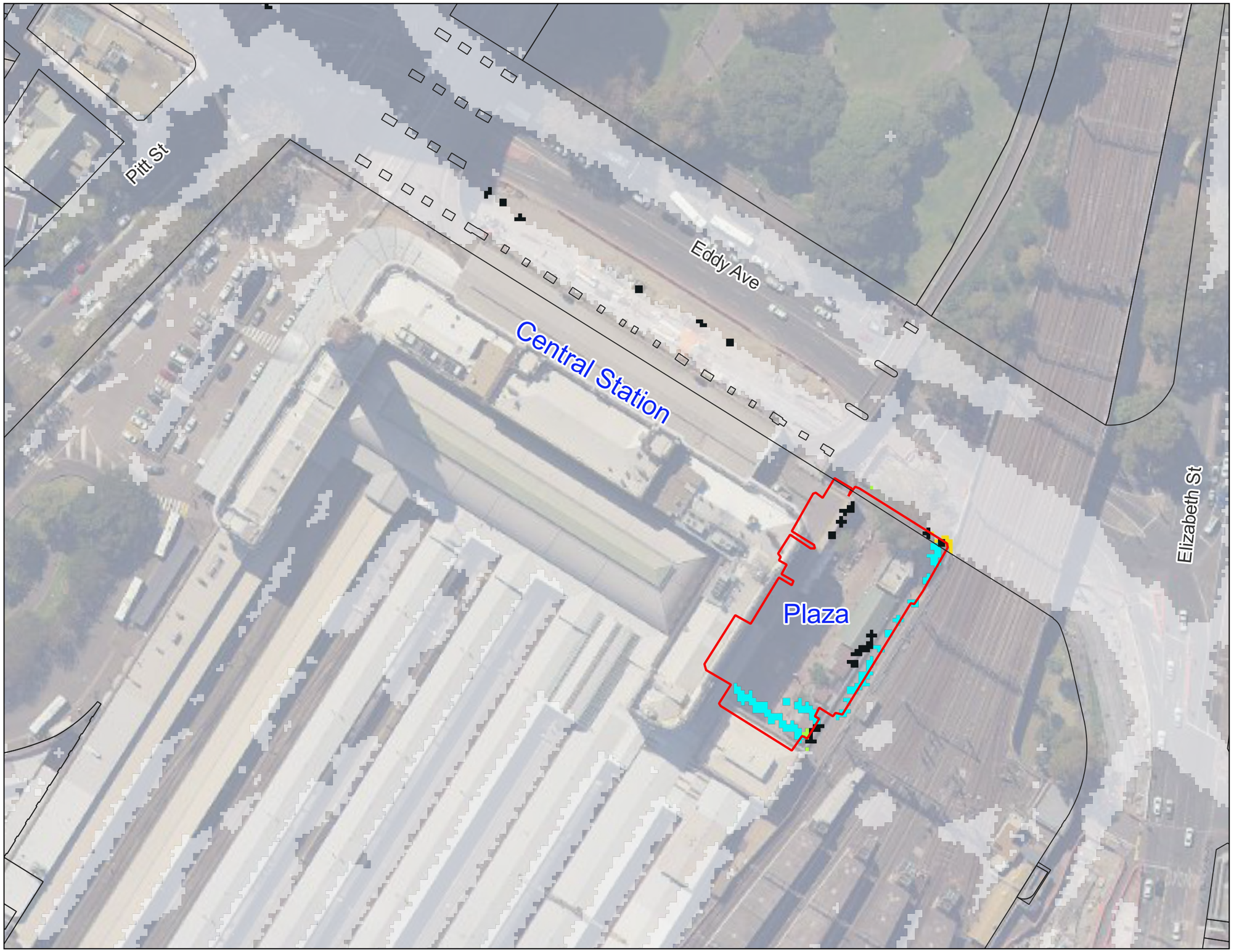
CPRP - Eddy Avenue Plaza

Figure 4-2.3: Design Condition PMF Peak Flood Hazard



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Legend

Change in Water Levels

5%AEP Change in Water Level (m)
Band 1

- < 0.01
- -0.01 to 0.01
- 0.01 to 0.03
- 0.03 to 0.05
- 0.05 to 0.10
- > 0.10

5%AEP Change in Water Level_wd
Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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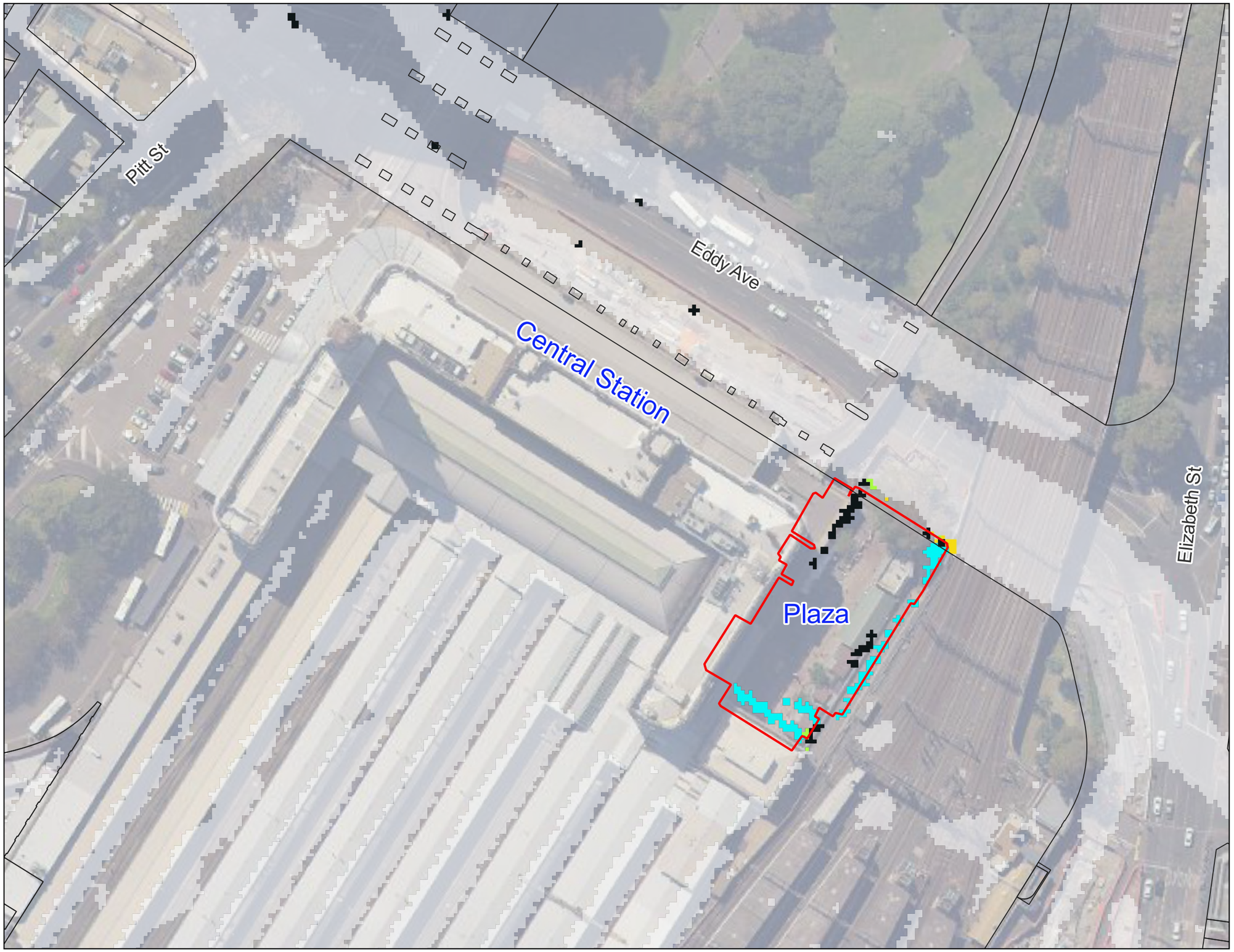
CPRP - Eddy Avenue Plaza

Figure 5-1.1: 5%AEP Change in Peak Flood Water Levels (Design less Existing Condition)



NSW GOVERNMENT

Legend

Change in Water Levels

1%AEP Change in Water Level (m)
Band 1

- < 0.01
- -0.01 to 0.01
- 0.01 to 0.03
- 0.03 to 0.05
- 0.05 to 0.10
- > 0.10

1%AEP Change in Water Level_wd
Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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CPRP - Eddy Avenue Plaza

Figure 5-1.2: 1%AEP Change in Peak Flood Water Levels (Design less Existing Condition)

Legend

Change in Water Levels

1%AEP +CC Change in Water Level (m) Band 1

- < 0.01
- -0.01 to 0.01
- 0.01 to 0.03
- 0.03 to 0.05
- 0.05 to 0.10
- > 0.10

1%AEP +CC Change in Water Level_wd Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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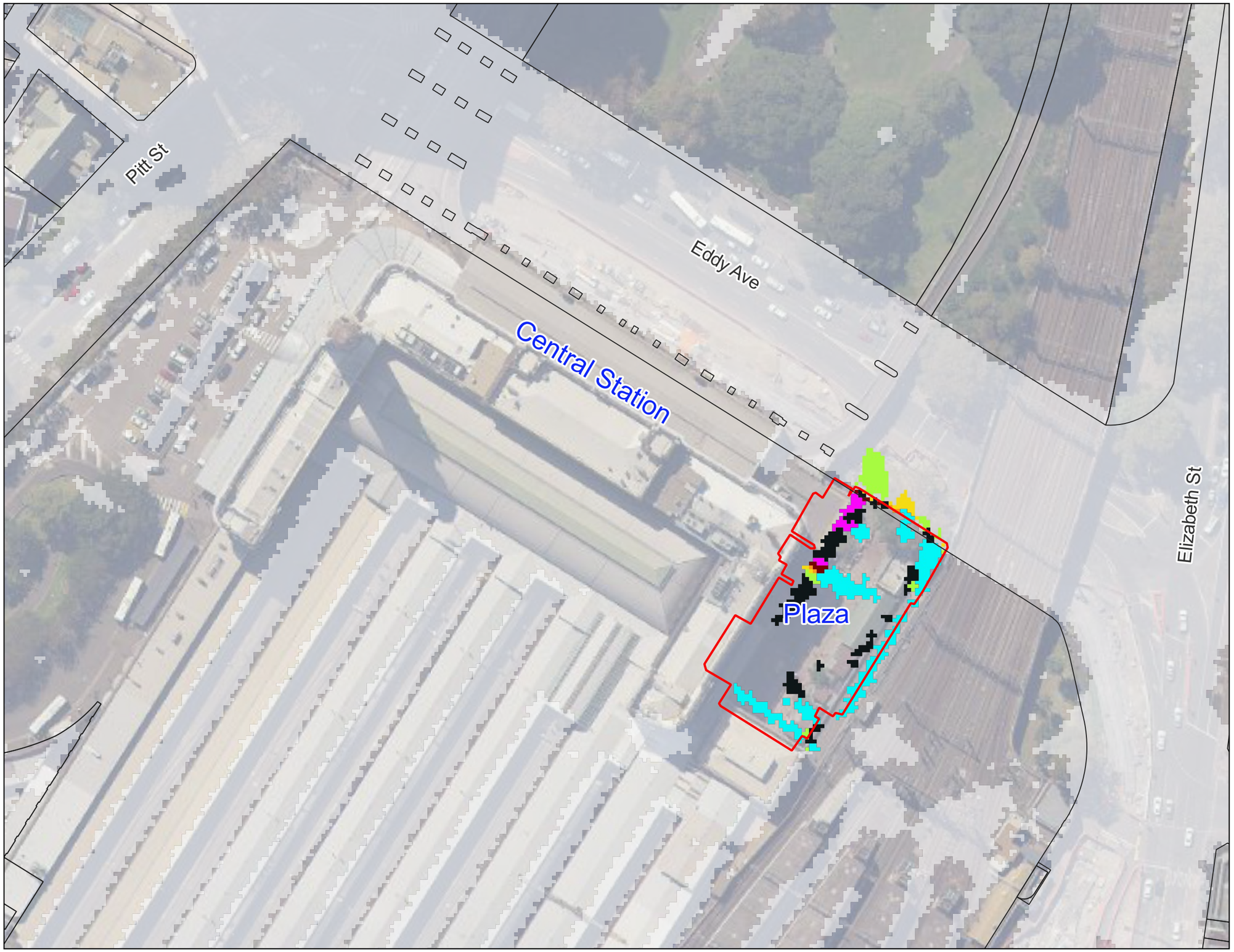
CPRP - Eddy Avenue Plaza

Figure 5-1.3: 1%AEP +CC Change in Peak Flood Water Levels (Design less Existing Condition)



Legend

Change in Water Levels

PMF Change in Water Level (m)

Band 1

- < 0.01
- -0.01 to 0.01
- 0.01 to 0.03
- 0.03 to 0.05
- 0.05 to 0.10
- > 0.10

PMF Change in Water Level_wd

Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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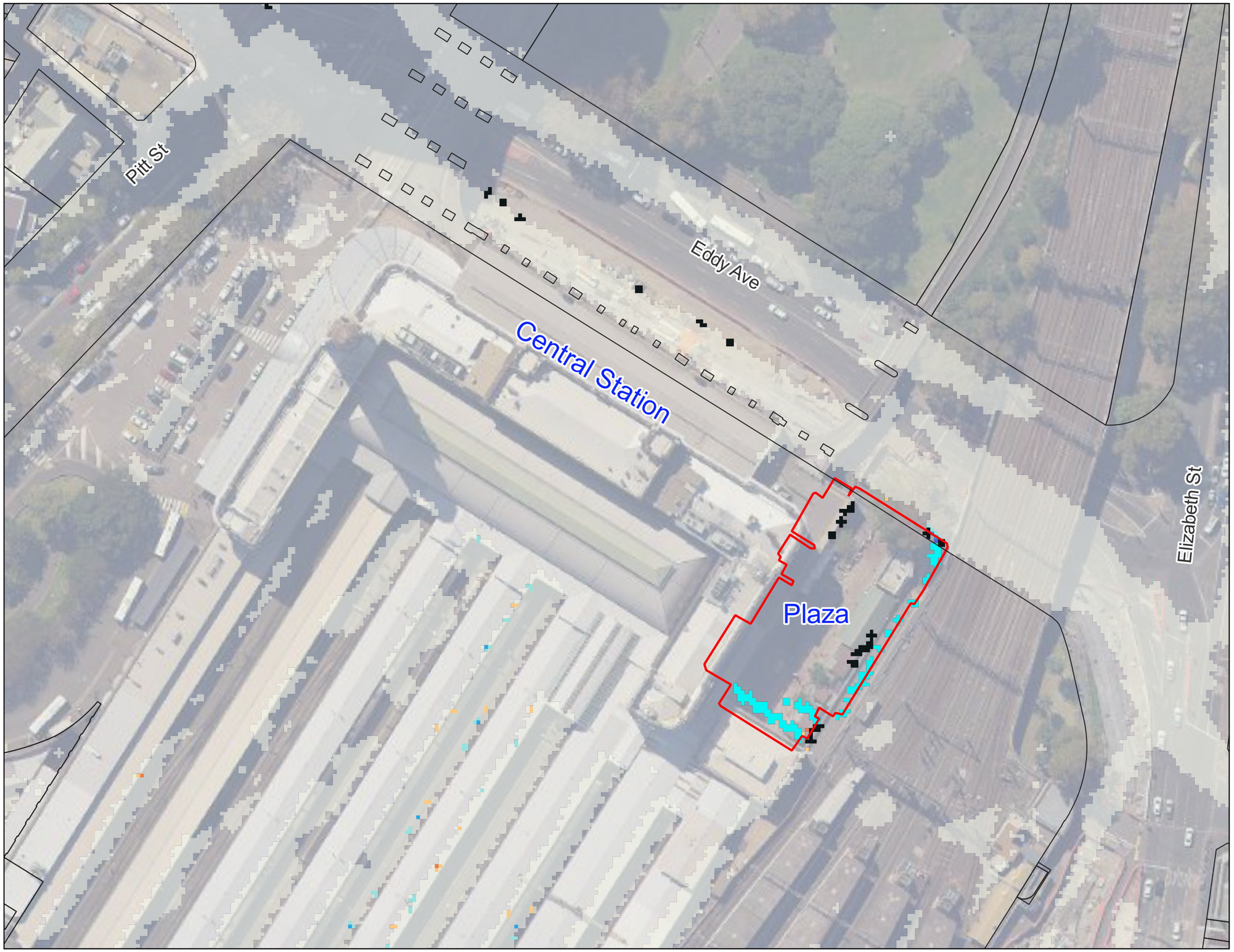
CPRP - Eddy Avenue Plaza

Figure 5-1.4: PMF Change in Peak Flood Water Levels (Design less Existing Condition)



Legend

Change in Flood Velocity

5%AEP Change in Flood Velocity (m/s) Band 1

- < -2.00
- -1.50 to -2.00
- -1.00 to -1.50
- -0.2000 - -0.1000
- -1.00 to 1.00
- 1.00 to 1.50
- 1.5 to 2.00
- > 2.00

5%AEP Change in Flood Velocity_wd Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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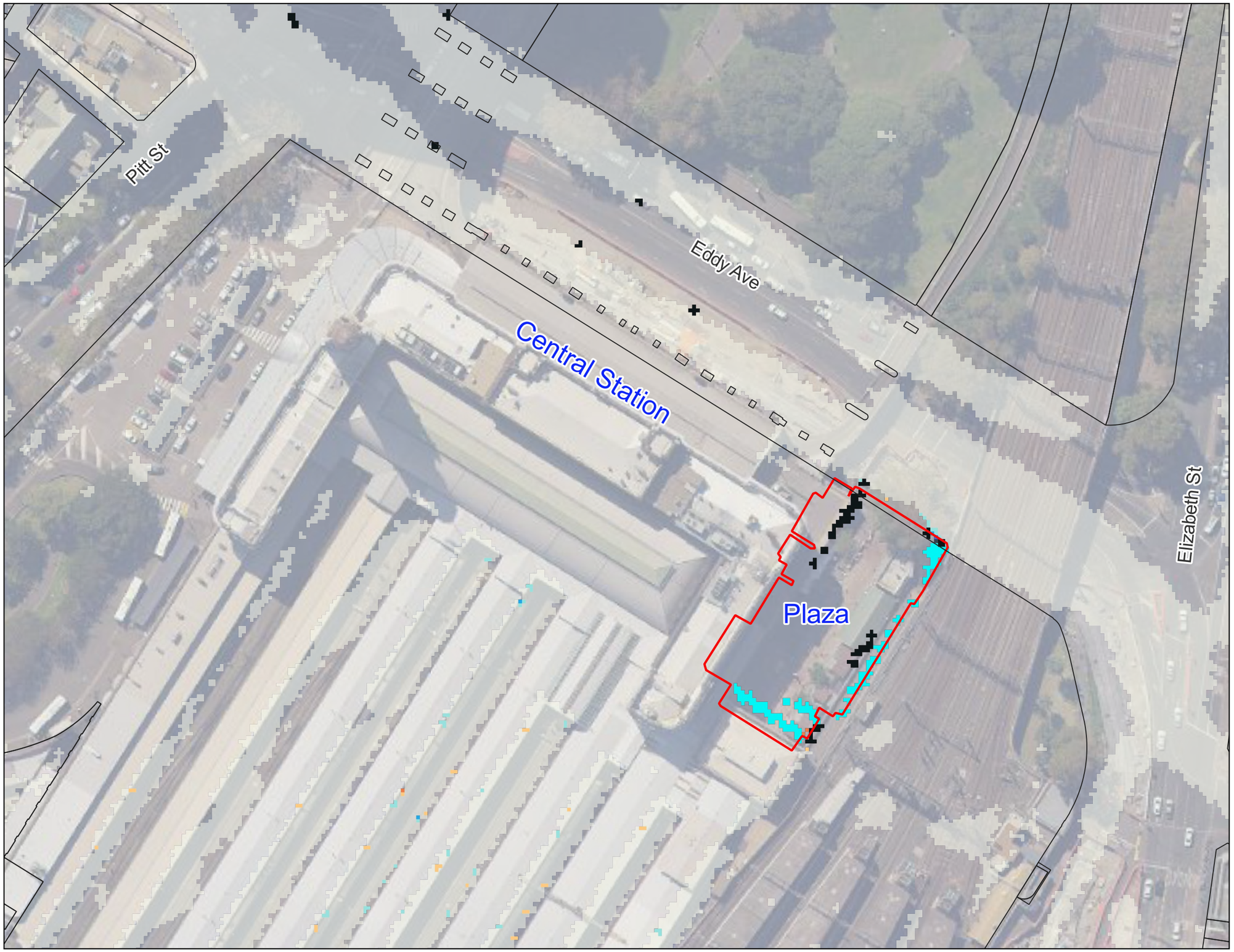
CPRP - Eddy Avenue Plaza

Figure 5-2.1: 5%AEP Change in Peak Flood Velocity (Design less Existing Condition)



Legend

Change in Flood Velocity

1%AEP Change in Flood Velocity (m/s) Band 1

- < -2.00
- -1.50 to -2.00
- -1.00 to -1.50
- -0.2000 - -0.1000
- -1.00 to 1.00
- 1.00 to 1.50
- 1.5 to 2.00
- > 2.00

1%AEP Change in Flood Velocity_wd Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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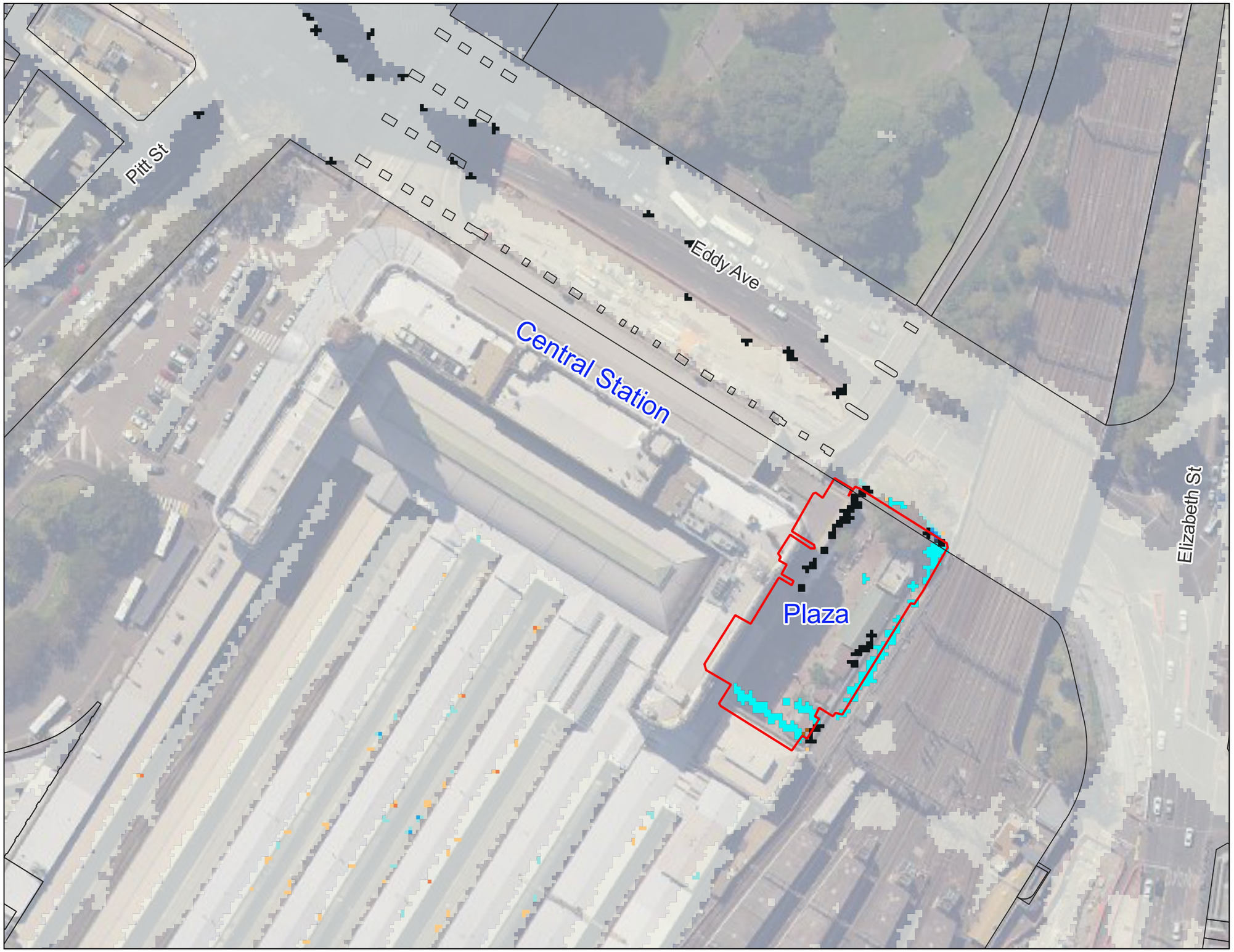
CPRP - Eddy Avenue Plaza

Figure 5-2.2: 1%AEP Change in Peak Flood Velocity (Design less Existing Condition)



Legend

Change in Flood Velocity

1%AEP +CC Change in Flood Velocity (m/s) Band 1

- < -2.00
- -1.50 to -2.00
- -1.00 to -1.50
- -0.2000 - -0.1000
- -1.00 to 1.00
- 1.00 to 1.50
- 1.5 to 2.00
- > 2.00

1%AEP +CC Change in Flood Velocity_wd Band 1

- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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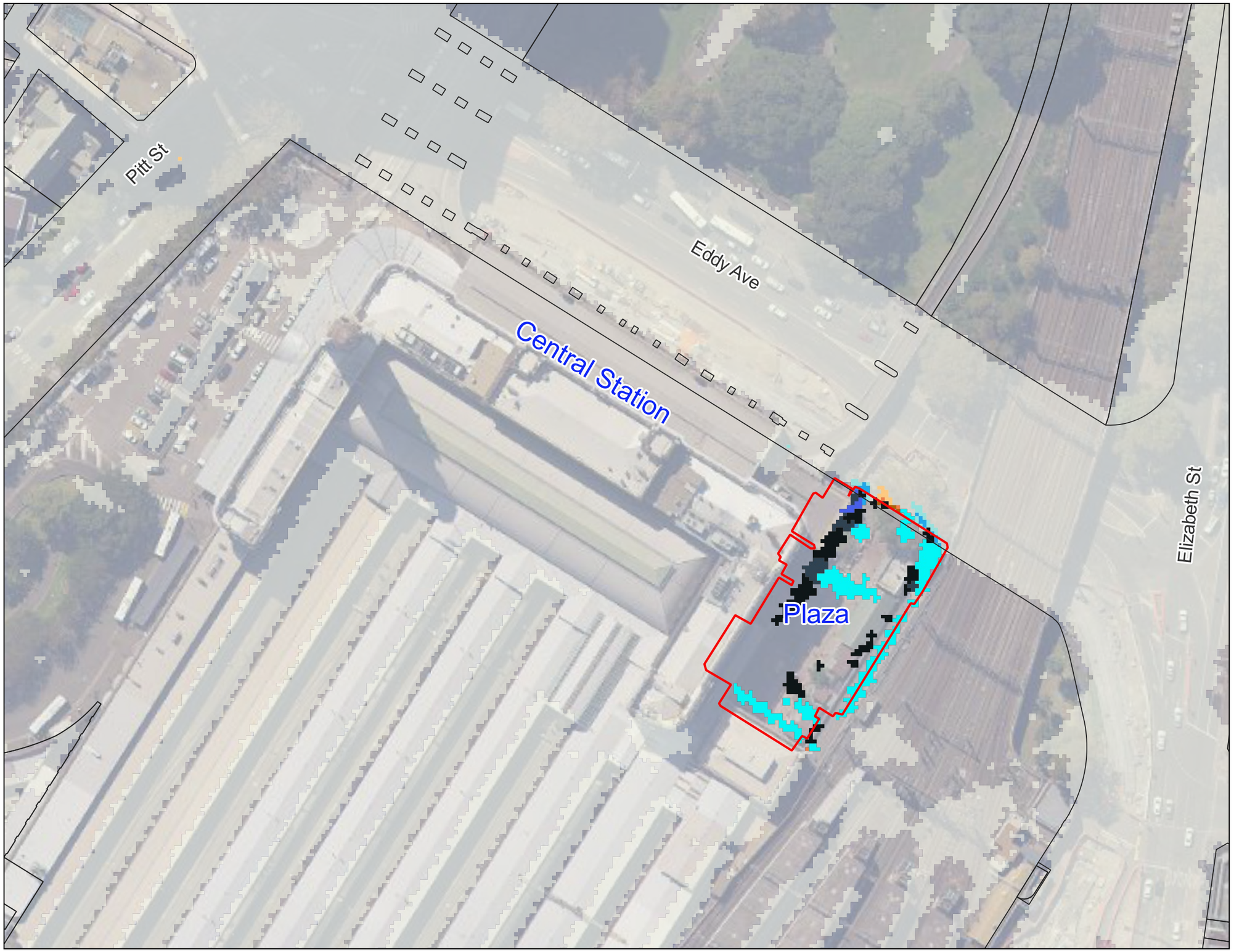
Notes:

*The presented flood mapping adopts a 50mm cutoff depth

CPRP - Eddy Avenue Plaza

Figure 5-2.3: 1%AEP +CC Change in Peak Flood Velocity (Design less Existing Condition)



Legend

Change in Flood Velocity

PMF Change in Flood Velocity (m/s)
Band 1
- < -2.00
- -1.50 to -2.00
- -1.00 to -1.50
- -0.2000 - -0.1000
- -1.00 to 1.00
- 1.00 to 1.50
- 1.5 to 2.00
- > 2.00

PMF Change in Flood Velocity_wd
Band 1
- Was Wet Now Dry
- Was Dry Now Wet

- Lot
- Design Surface Extent

Notes:

*The presented flood mapping adopts a 50mm cutoff depth

Map by: LW

0 40 80 m

A3 Scale: 1:1,000

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CPRP - Eddy Avenue Plaza

Figure 5-2.4: PMF Change in Peak Flood Velocity (Design less Existing Condition)

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