PARRAMATTA CIVIC LINK BLOCK 3

Stormwater Management Plan

15/12/2025

Incorporating

CITY OF PARRAMATTA

Parramatta Civic Link Block 3

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
1	04/11/2024	DRAFT Issue	BW / DC	GD
2	25/02/2025	DRAFT Response to Initial Comments	DC	GD
3	15/12/2025	Final Issue	DC	GD

CONTENTS

1 INTRODUCTION

Parramatta City Council are proposing to create a memorable, high-quality Civic Link between the Parramatta Powerhouse and Parramatta Square. This Civic Link is broken up into several sections which are being delivered by separate parties. This report focuses on the section between Phillip Street in the North and George Street in the South and how stormwater is to be managed within this area.

1.1 Purpose of this Report

This report outlines how the proposed improvements to the streetscape between Phillip Street and George Street manage stormwater utilising a pit and pipe network and water treatment to meet Parramatta City Council's requirements. This report will focus firstly on stormwater conveyance and secondly water quality.

1.2 Project Background

The Parramatta Civic Link is a significant public space transformation within the Parramatta CBD, spanning approximately 500 meters from Parramatta Square (Block 1) to the Parramatta River, with major connections through Blocks 2, 3, and 4. The project aims to enhance pedestrian connectivity and urban appeal, establishing a high-quality corridor that links Parramatta Square with the Powerhouse Parramatta. This report documents the drainage works specific to Block 3, centred on the redevelopment of the Erby Place (Eat Street) Car Park. As outlined in the Civic Link Framework Plan, endorsed in 2017, Block 3 will play a pivotal role in providing continuous public access through the Civic Link while integrating essential infrastructure for flood management and stormwater control.

Flood assessments by Parramatta Council highlight this area as prone to significant flood impacts, particularly around the Macquarie Street sag, Smith Street, and Phillip Street. To address these issues, Parramatta Council has identified the augmentation of trunk infrastructure near Civic Link as an opportunity to improve the existing drainage system and mitigate flooding risks. This installation requires collaboration among stakeholders involved in each block, including Transport for NSW (Block 2), the City of Parramatta Council (Block 3), and Infrastructure NSW (Block 4), to achieve a coordinated drainage solution. This report does not address potential flood mitigation options outside of the Block 3 works, as those options are discussed in a separate report.

The Civic Link's development is a collaborative effort, with each block purposefully designed to contribute to the Parramatta CBD's urban renewal. The drainage and stormwater infrastructure proposed for Block 3 is designed to meet regulatory standards and support increased demands resulting from public domain improvements. This approach aims to enhance flood resilience, manage stormwater discharge, and promote sustainable water use where possible. The drainage works detailed in this report align with the Civic Link Design Brief and Council's broader planning controls, ensuring cohesive public domain outcomes and resilient stormwater management strategies for the precinct.

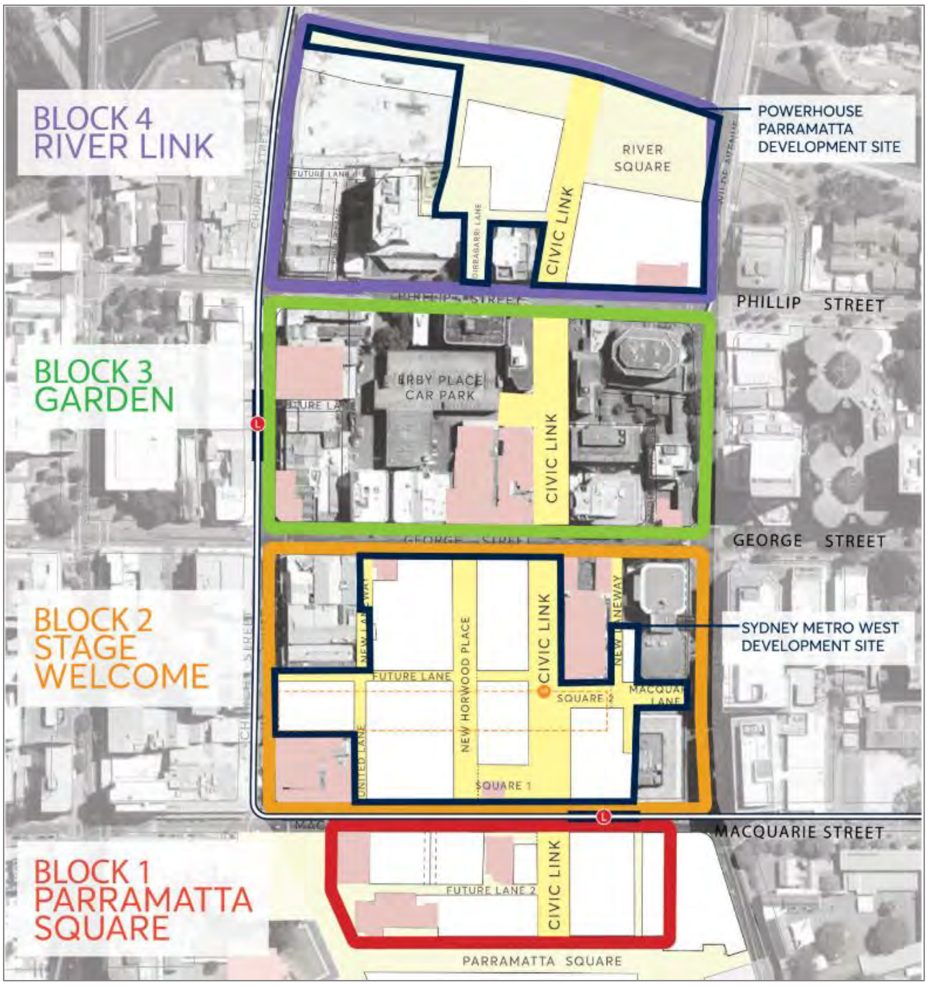


Figure 1-1 Parramatta Civic Link Block Layout

2 STORMWATER CONVEYANCE ASSESSMENT

To assess the stormwater conveyance of the area Arcadis have adopted a Major/Minor system design in line with Parramatta City Council’s Development Engineering Design Guidelines and Australian Rainfall and Runoff. This assessment considers the existing condition prior to the proposed works and the proposed condition once Horwood Place has been pedestrianised.

2.1 Flood Criteria

Parramatta Council Flood Smart provides public information about the flood risks across the Council's Local Government Area. The flood-prone area is categorised into one of the following categories.

High-Risk Area – High-hazard flood area within the 1% AEP flood extent, subject to frequent flooding, commonly located near the main river and creeks where water flows during a flood, including overflow from drainage.

Medium-Risk Area – Medium and low hazard areas within the 1% AEP flood extent, subject to less frequent flooding, where flood water reaches the area once the creek or river areas overflow, these areas have the potential for deep and fast-flowing water in rare flood events.

Low-Risk Area – Area from the 1% AEP up to the Probable Maximum Flood, flooding of this area is rare, generally located away from the river and creek and is on higher ground.

The figure below shows the flood risk information available from the Flood Smart online system, the project site is generally within a Medium to Low risk zone.

It is our understanding that especially around Phillip Street, where Councils Flood Smart mapping shows Medium Flood Risk, some properties have reported issues with flooding. Arcadis has identified a few properties where freeboard requirements are not met (Parramatta DCP 2023, C.03 1% AEP Flood Level + 500mm).

For the purposes of this assessment, the below criteria have been adopted to assess flood conditions and impacts associated with the Civic Link works.

- Improve (lessen the hazard associated with) overland flooding issues where possible.
- Hazard Assessment based on ARR 2019 flood hazard classifications.

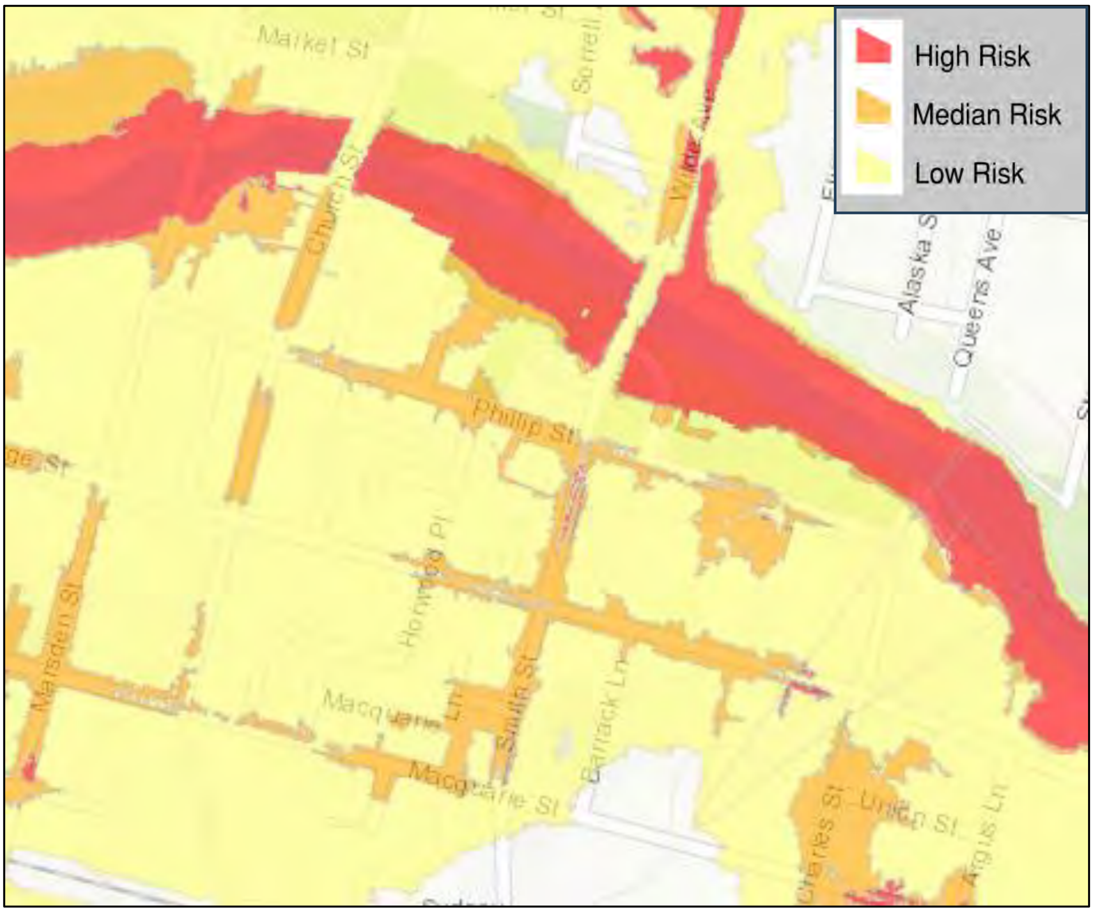


Figure 2-1: Parramatta City Council Online Flooding Information

2.2 Existing Condition Assessment

Arcadis have created a hydraulic model in DRAINS to assess the existing drainage network in detail – this model accompanies this report. Rainfall data for the DRAINS model was downloaded from the ARR Data Hub and BOM Design Rainfall Data System. This provided hydrology in accordance with AR&R2019. An AR&R 87 sensitivity assessment has not been completed as this was included in Council's regional model.

2.2.1 DRAINS Modelling Parameters

Arcadis have based their modelling parameters on the following documents in order of authority:

Table 2-1 - Adopted Documents Reference Table

Reference	Short Reference
Civic Link Design – Scope for Stormwater Management	SSM
City of Parramatta – Development Engineering Design Guidelines	CoP
Australian Rainfall and Runoff 2019	ARR
Austroads Guide to Road Design	AGRD
TfNSW Austroads Design Guide Supplements	TfNSW

The following values have been used for the key parameters in the DRAINS model.

Table 2-2 – DRAINS Adopted Parameters

Parameter	Value	Source
Rainfall IFD Parameters	Calculated from BOM and ARR data hub	AGRD 5A 6.5.4
PMP	Based on GDSM	ARR
Minimum Time of Concentration	5mins	AGRD 5 Table 6.25
Minimum Pipe Cover	Based on Survey but when lacking information assumed minimum 450mm	AGRD 5A Table 6 .1
Pipe Roughness	0.6 Colebrook-White	AGRD
Pit Losses	Missouri charts. Assumed well aligned in absence of survey	CoP 5.4
Pit Blockage	On Grade 20% Sag 50%	SSM 2.c
Increase in Rainfall (%) as a result of Climate Change	The proposed model scenario is to include Climate change impact as per ARR 2019. Reference year to be 2100 while sensitivity for 2150 to also be included. RCP8.5 to be adopted. This is to be included in design case and not only as a sensitivity test.	SSM 2.f
Impervious Area Depression Storage	1mm	
Pervious Area Depression Storage	5mm	
Overland Flow Calculation	Kinematic Wave	
Antecedent Moisture Condition	3	

2.2.2 Pit and Pipe Network

The pit and pipe network in the DRAINS model was created using the data listed below in order of precedence:

1. Stormwater drainage CCTV provided by Parramatta Council on 15/12/23
2. Utility Survey by DURKIN Construction, dated 17/11/23;
3. Parramatta Light Rail – Stage 1 Infrastructure Works Stormwater Drainage – Section 2 As Built Drawings, dated 13/04/22;
4. Powerhouse Precinct Concept Design Civil Drawings, dated 25/09/20;
5. Feature Survey by Survey Plus, dated 13/10/23;
6. Lidar surface information from Geoscience Australia, received 30/10/23; and
7. Google Maps Satellite imagery and Google Street View.

2.2.3 Catchment Delineation

The existing sub catchments from the regional flood model, shown below, that cover the project site and surrounding area have been split to provide additional detail to the area. The split was based on site survey, lidar surface information, Google Maps Satellite imagery, Google Street View, and cadastral boundaries. Where it was unclear where a roof catchment drained to, a judgement call was been made based on the available information. The split catchment boundaries adopted are shown in yellow in the figure below.

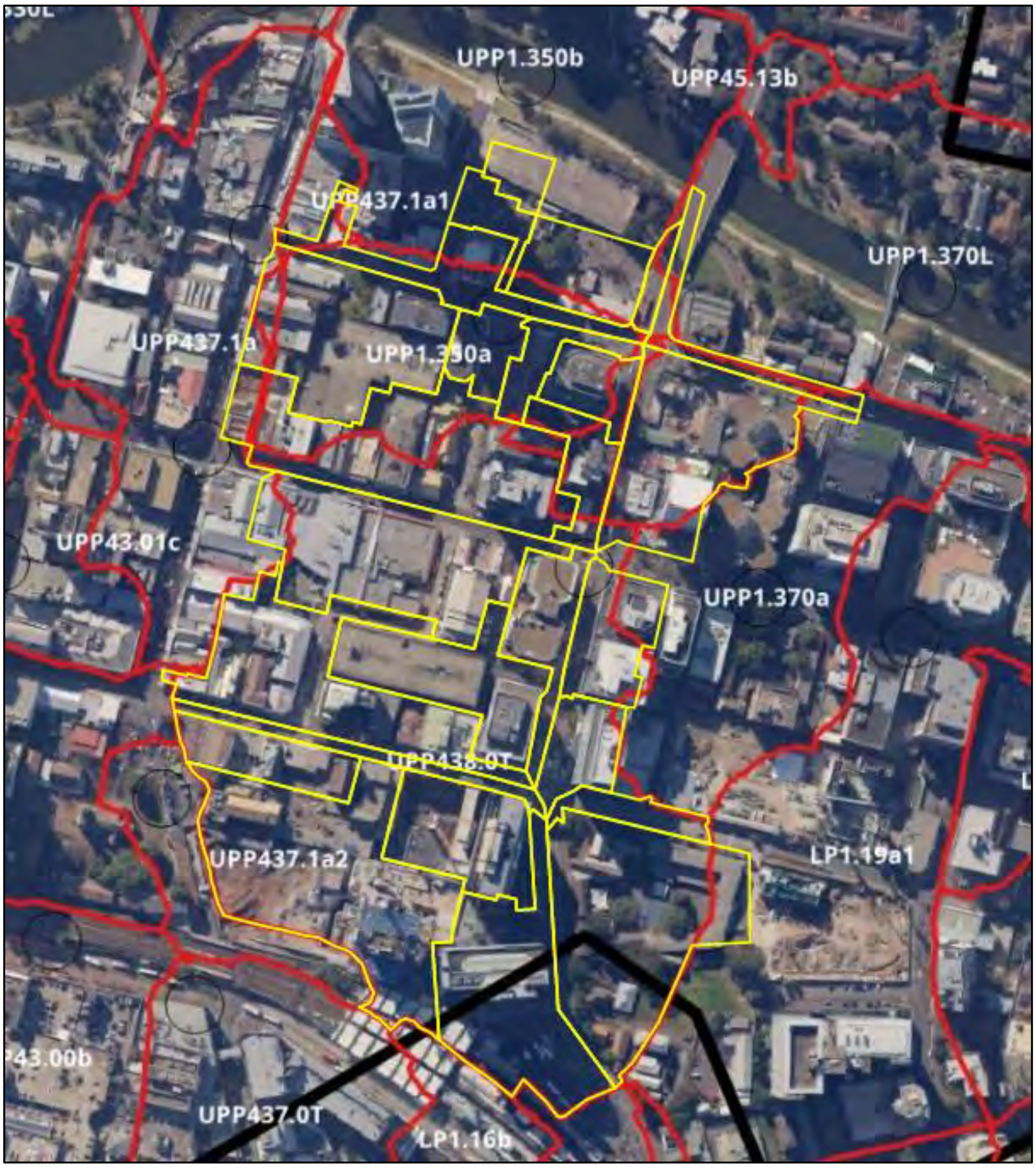


Figure 2-2: Split of regional flood model catchments

The figure below shows the split catchment boundaries, with labels that indicate the name of the pit to which each catchment has been applied to in DRAINS.

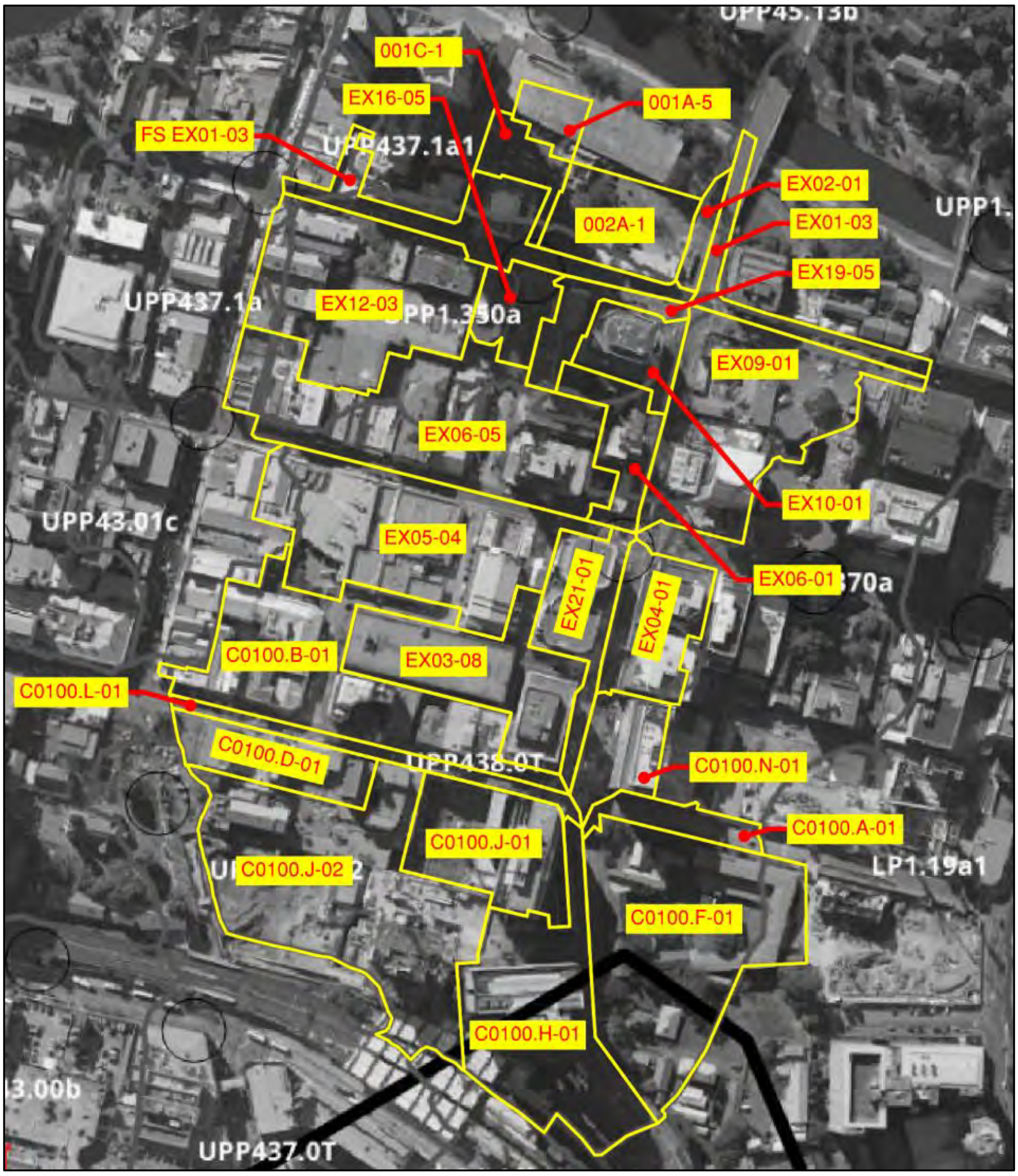


Figure 2-3: Labelled split catchment boundaries.

These catchments were used to produce hydrographs for the existing TUFLOW modelling.

2.2.4 Existing Case Flood Assessment

The City of Parramatta Council has provided a regional model of the area to be used in assessing the trunk drainage augmentation. To effectively evaluate various options for drainage network augmentation, multiple design iterations of a hydraulic model need to be run. However, the run times for the provided S1_ParraR Parramatta River regional model are too lengthy for this purpose. As a solution, Arcadis has trimmed the provided model to create a smaller, site-specific TUFLOW model based on the regional parent model. This section of the report outlines the process of creating this trimmed flood model.

2.2.4.1 Parameters

In creating a site-specific model, Arcadis has utilised the same parameters as the parent model. This includes maintaining the same values for Manning's roughness, blockage, and grid size. Additionally, all bridge and weir elements within the proposed trimmed boundaries from the regional model have been incorporated without any modifications for correlation purposes. Similarly, all 1D elements such as pits, pipes, and culverts within the proposed trimmed boundaries have been adopted unchanged from the regional model. This approach ensures consistency and allows for accurate comparisons between the site-specific model and the parent model.

The trimmed version of the model has maintained the 2m grid size of the parent model, with the SGS (Sub-Grid Scale) setting turned off and the TUFLOW version unchanged. This decision was made because matching the grid size, SGS setting, and TUFLOW version yielded results that closely correlated with the parent model. However, since the runtimes of the trimmed model have been significantly reduced compared to the parent model, it is possible to explore options such as reducing the grid size to 1m, turning on SGS, and updating the TUFLOW version for future model runs if required.

A verification check on the Manning's 'n' roughness mapping within the trimmed model area has been conducted, and it has been deemed appropriate for use with the trimmed model.

2.2.4.2 Site Specific TUFLOW Model

To enhance model accuracy and decrease run times, Arcadis has developed a trimmed site-specific TUFLOW model using the following methodology:

1. Identification of the site-specific TUFLOW model boundary.
2. Identification of the appropriate boundary conditions.
3. Running the trimmed model and validating its results against the regional model.

In addition to the above methodology, the site-specific model has been augmented in the following ways:

1. Refinement of internal catchments.
2. Refinement of the pit and pipe network.
3. Update to topography and building extents.
4. Static river boundary conditions for consistent assessment of all storm events / design options.
5. Assessment of all 10 temporal patterns per ARR 2019 for 30 minute duration storms.

These augmentation processes will be further explained in detail below.

2.2.4.3 Site Specific TUFLOW Model Boundary

The trimmed model boundary has been carefully determined to ensure that both the upstream and downstream boundaries do not affect the flow in and around the project site. For the upstream boundary, a distance of 1200m from the site was chosen, while for the downstream boundary, a distance of 880m from the site was selected. Since the regional S1_ParraR model is relatively narrow, the 2D_code boundaries of the regional model were adopted for the trimmed model within the 2km modelled segment of the Parramatta River.

The selection of the upstream and downstream boundary locations for the trimmed model was guided by the following criteria:

- The boundaries are perpendicular to the flow.
- They are located at a sufficient distance from the project site in both upstream and downstream directions.
- The trimmed boundaries effectively capture flows from the Probable Maximum Flood (PMF) event with clearly defined catchment boundaries.
- The boundaries do not cut through any 1D elements (such as pits or pipes) in the model.
- The boundaries take into consideration the local and total inflow polygons.
- They are positioned at a safe distance from significant hydraulic controls, such as weirs and bridges.

The figure below illustrates the adopted trimmed 2D_code boundary, as well as the model's Digital Elevation Model (DEM) and boundary conditions.

2.2.4.4 Boundary Conditions

Hydraulic conditions at the trimmed model boundary have been obtained from po_lines and points related to the relevant storm events. At the upstream end of the trimmed model, these conditions have been applied as a QT boundary using a po_line, while at the downstream end, they have been applied as an HT boundary using a po_point.

Sub-catchments that fall within the trimmed model code but are outside the re-defined boundaries mentioned above have also been incorporated. The hydrographs derived from these subcatchments have been applied to the trimmed model without any changes from the parent model.

Inflows originating from the Parramatta River have been determined using po_lines from the parent model, specifically at the upstream end of the trimmed model code. These inflows have been incorporated into the trimmed model.

2.2.4.5 Site Specific Model Validation

To ensure that the trimming process did not alter the hydraulic results, it was crucial to verify that the trimmed model performed in line with the parent model. The figure below illustrates the comparison between the two models by presenting a water level comparison along the river centerline for the entire model space during the 1% AEP, 1-hour event. This comparison demonstrates the correlation between the trimmed model and the parent model.

Importantly this validation maintains the same catchments as per the regional model.

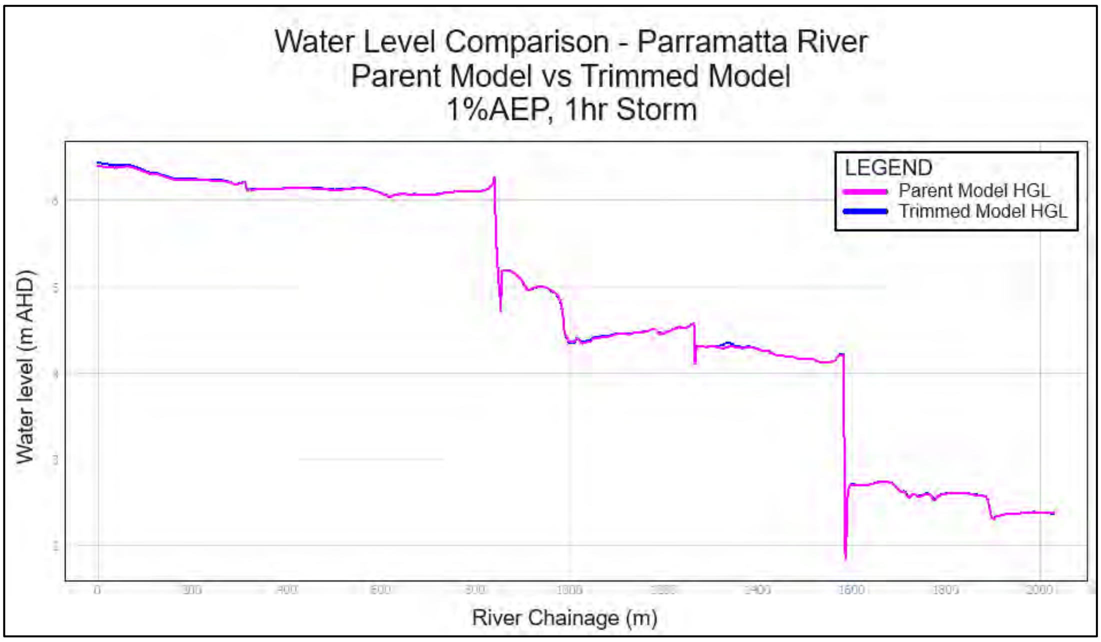


Figure 2-4: Water Level Comparison: Parent Model vs Trimmed Model

While there is some minor variance in these results Arcadis believes that the trimmed model is suitable for the proposed assessment.

It should be further noted the static boundary conditions applied for the purposes of the local drainage assessment as discussed below.

2.2.4.6 Site / Assessment Specific TUFLOW Model Augmentation

Arcadis enhanced the trimmed site-specific TUFLOW model by increasing the level of detail for both the catchments, topography and the pit and pipe network. The specific augmentations are described below.

Of importance to the assessment undertaken within this report, the change in river boundary conditions should be noted – this is to provide a consistent downstream condition for all assessed scenarios to verify the network performance in either free draining or regional flooding scenarios.

Table 2-3: Site and Assessment Specific TUFLOW Model Augmentations

Model Element	Remarks
Drainage	• The latest drainage network information provided by Council has been adopted (setup imported from the updated DRAINS model).
Building footprints	• Refinement of the building footprints in the vicinity of the Civic Link study area to generally reflect the latest building footprints at the timing of this report (mainly along Phillip Street, Smith Street and Macquarie Street).
Topography	• Removal of some topography from the PLR TUFLOW edits, including various artificial bunds adjacent / on Macquarie Street and shortening of strings causing interfacing errors on Lennox Bridge (refer Section 2). • A 2m grid cell size was used for initial 1% AEP simulations to test model stability. Final 1% AEP runs were completed with a 1m grid cell size. Other AEP events used a 2m grid cell size. Some instabilities can be seen in the river peak scenario for the coarser grid sizing.
Local catchment hydrology	• Inclusion of the latest DRAINS hydrology for the local area (per the DRAINS model update described within this report). Flows are applied to the network at the same location as the DRAINS model. These are applied as 1d inflow

Model Element	Remarks
	polygons to the base of the pits to mimic the same inflow condition setup as the DRAINS model.
River boundary conditions	• River boundary conditions have been modified to suit two different scenarios to provide consistent conditions between the assessed drainage design options. – “Low boundary” – No flow in Parramatta River. Base initial water level only as per regional model setup. This is to assess the design options under free draining conditions. – “River peak” – Consistent peak flow rate in Parramatta River matching the peak 1% AEP regional flood (12hr flood event). This is to assess the design options under peak regional flood conditions ensuring the local storm peak will coincide with the river peak.
Assessed hydrological events	• All 10 TP’s were assessed. • The 30min duration storm was found to be the critical duration throughout the assessment area (comparison of 30 minute to 3 hour storm events) irrespective of the river boundary conditions applied.

2.3 Existing Condition Outcomes

Based on the above investigation Arcadis have identified that there is an existing flooding issue at the intersection of Phillip Street and Horwood Place, particularly when the Parramatta River is in flood. With the river in flood, the intersection experiences ponding in excess of 200mm and some properties appear to have water ingress. Arcadis note that the flood planning levels, as directed by CopC is 1% AEP + 500mm Freeboard, however this is not achieved for properties surrounding the intersection of Phillip Street and Horwood Place.

The southwest corner of the intersection with Phillip Street has an existing trapped sag in the verge in front of the property. Even in frequent events water ponds in this area and floods the neighbouring property. Due to this, Paramatta Council requested Arcadis to investigate ways in which flooding could be improved. This investigation is presented in Appendix B with the outcome being upsized pipes on the northwest corner of the intersection.

Flood mapping results have been provided in Appendix A of this report, with the “Base” scenario representing existing flood conditions. Depth and hazard results have been provided for the Base scenario. The below figures provide an illustration of the existing flood depths (highlighting depth >200mm, overtopping kerb) within Phillip Street and Horwood Place (noting that conditions within George Street fronting Horwood Place are generally consistent between low and peak river level scenarios).

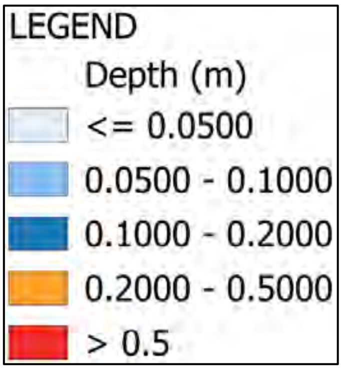


Figure 2-5: Flood Depth Legend

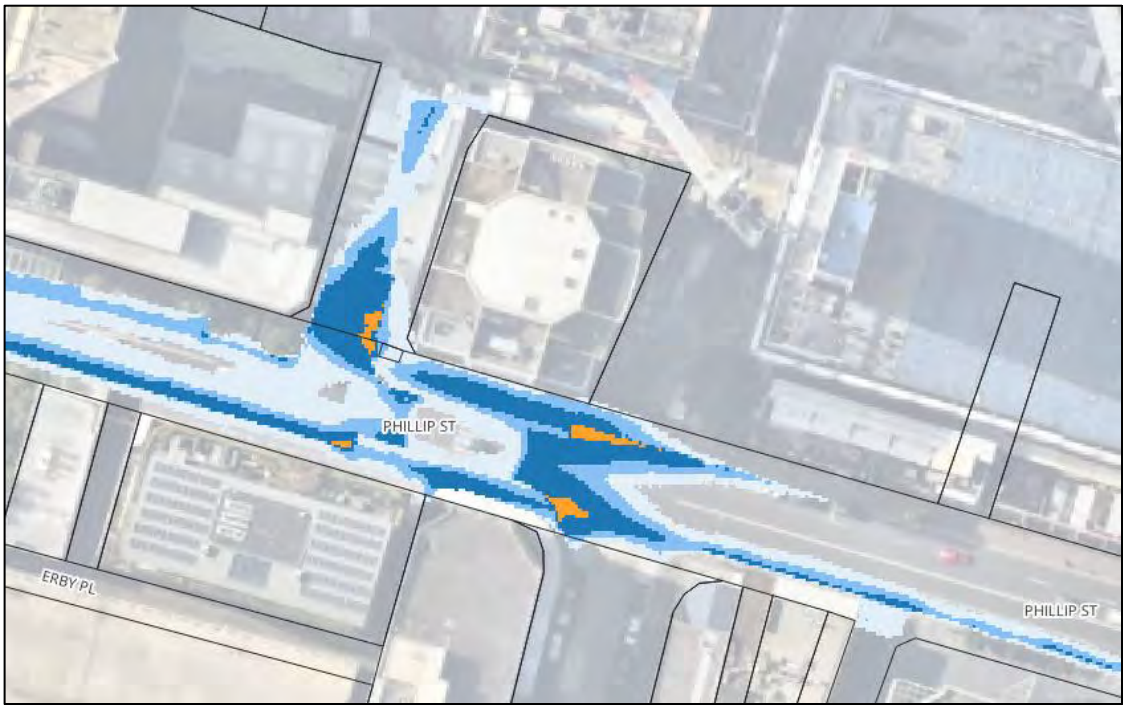


Figure 2-6: Base Scenario – Flood Depth for the 1% AEP Event, Low River Level – Phillip Street

Figure 2-7: Base Scenario – Flood Depth for the 1% AEP Event, Peak River Level – Phillip Street

Figure 2-8: Base Scenario – Flood Depth for the 1% AEP Event – Horwood Place / George Street

2.4 Developed Condition Assessment

Arcadis has updated the existing DRAINS model to incorporate proposed drainage modifications associated with Block 3 works. These changes include extending the existing George Street drainage system westward to facilitate a new pedestrian crossing and adjusting portions of the Phillip Street drainage system to accommodate the relocation of an existing pedestrian crossing further east.

In addition to these Civic Link improvements, an augmentation scenario was modelled to assess the potential benefits of further drainage enhancements. This scenario includes not only the Civic Link-related changes but also an augmentation of the existing outlet system to the Parramatta River to improve drainage efficiency and flood resilience. The augmented scenario includes a 900mm-diameter outlet to the Parramatta River, positioned near Dirrabarri Lane adjacent to the Parramatta Powerhouse.

Given the influence of Parramatta River levels on the overall performance of the drainage network, the assessment of each scenario includes analysis under both low tailwater conditions (no river flood) and high tailwater conditions (representing a 1% AEP 12-hour storm event). These tailwater conditions are fixed, as the DRAINS model does not support dynamic tailwater levels.

2.4.1 Developed Case DRAINS

In the developed case, the DRAINS model includes updated configurations to reflect the relocated pedestrian crossings and minor adjustments to the pit and pipe network within George and Phillip Streets. These modifications are limited to minor relocations to align with the new Civic Link crossings, with no substantial capacity upgrades implemented in this scenario.

2.4.2 Developed TUFLOW Model

Arcadis also updated the TUFLOW model to capture the modifications associated with Civic Link improvements (Civic Link Only scenario) and the augmented drainage option (Option 1).

Topographic data for the developed condition was exported from 12d to TUFLOW, accurately representing the changes associated with the relocated pedestrian crossings and related verge works. Minor adjustments were made to the pit and pipe network to accommodate the crossing relocations, with no hydrological modifications deemed required, as these changes are not expected to significantly alter the catchment contributions to the local drainage network.

A separate sensitivity assessment was also conducted for the Civic Link Only scenario, where some localised upgrades were made for the pit and pipe network within Phillip Street to assess network sensitivity, ideally looking to reduce local flood depths.

2.5 Hydraulic Assessment Results

For more extreme events, such as the 1% AEP, the DRAINS model reported that excess flows from the Macquarie Street sag exceeded the system's capacity, causing overflow down Smith Street. This excess flow overwhelmed the Smith Street drainage system, further impacting Phillip Street with worsened ponding depths. However, TUFLOW results for the same flood event showed flows contained within the Macquarie Street sag, consistent with findings from the Parramatta Light Rail Flood Study and Parramatta City Council's latest regional flood assessment.

A review of these results revealed that DRAINS struggled to accurately model the flow splits at the Macquarie Street sag. Even when using unsteady calculation mode, DRAINS cannot fully capture the complex conditions in areas like the Macquarie Street sag, where multiple pits are affected simultaneously, especially near the light rail station. Consequently, DRAINS underestimates the area’s inlet capacity, restricting flows from effectively draining into the system.

Due to these limitations, Arcadis recommends that the DRAINS model be primarily used for frequent events (up to the 10% AEP), where the influence of the Macquarie Street sag on network performance is less critical. This report prioritises the TUFLOW results as a more reliable indicator for assessing flood risk, though the DRAINS model’s results remain relevant for frequent events (20% and 10% AEP) when Parramatta River is not in flood.

The TUFLOW model results provide a comparative analysis of existing and proposed conditions, assessing how the Block 3 works would impact flood behaviour around the project site. This is described in further detail below, accompanied by mapping within Appendix A.

2.5.1 Developed Scenario

The below sub sections provide discussions on flood depth and flood afflux (change in flood water level) for the Developed scenario. This includes sensitivity testing for local drainage within Phillip Street to address existing non-compliant water depths and afflux immediate to the relocated crossing.

2.5.1.1 Flood Depth – Developed Scenario

Flood depths throughout the local area that are >200mm (deemed non-compliant) have been highlighted within the flood mapping results within Appendix A.

From review of the result mapping, it is evident that the Civic Link modifications do not result in a significant increase in flood depth or non-compliant flood depths within the local area beyond the existing scenario. It is noted that the relocated pedestrian crossing within Phillip Street results in increased depths at the existing crossing location, and lessens flood depths at the new crossing location (resulting from translation in topography).

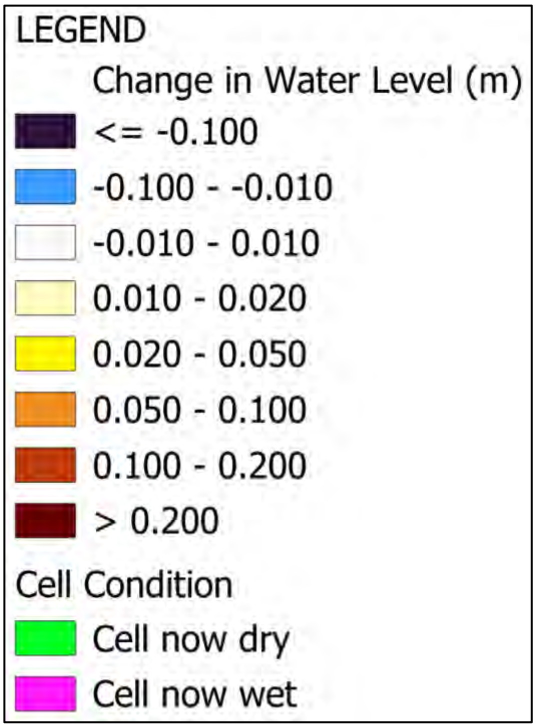
As a result of the proposed works no external properties are adversely affected however the existing issue is not resolved.

A sensitivity test was completed where the relocated pits immediate to the Phillip Street crossing were increased to 3x inlet grates as opposed to a single inlet grate per the existing scenario. It was found that this had little to no benefit with a low boundary condition, suggesting that trunk drainage upgrades would be required to address the existing non-compliant flood depths within Phillip Street.

2.5.1.2 Flood Afflux (Change in Water Level) – Developed Scenario

The figures below illustrate flood afflux (changes in flood water levels) resulting from the topographic and drainage adjustments associated with Civic Link Block 3 works. The flood afflux is relatively minor and appears to be confined within the kerb and channel of the surrounding streets.

- **Low Boundary Condition:** Some minor afflux is observed on Phillip Street, generally linked to ground level changes for the new pedestrian crossings.
- **Peak River Condition:** No significant changes are observed on Phillip Street, suggesting that the design modifications do not substantially alter flood conditions under peak river scenarios.



LEGEND

	Change in Water Level (m)
■	<= -0.100
🟦	-0.100 - -0.010
⬜	-0.010 - 0.010
🟨	0.010 - 0.020
🟨	0.020 - 0.050
🟧	0.050 - 0.100
🟥	0.100 - 0.200
🟫	> 0.200
Cell Condition	
🟩	Cell now dry
🟪	Cell now wet

Figure 2-9: Flood Afflux Legend

Figure 2-10: Civic Link Modifications Only – Flood Afflux for the 1% AEP Event, Low River Level

Figure 2-11: Civic Link Modifications Only – Flood Afflux for the 1% AEP Event, Peak River Level

2.5.2 Augmentation Scenarios

As identified in Section 2.3 there is an existing flooding issue at the sag on Phillip Street sag which sits slightly to the west of the intersection of Horwood Place and Phillip Street. Arcadis have investigated two potential augmentations to the local network to address the flooding at this location. Firstly, increasing the capacity of the downstream network installed by Parramatta Powerhouse down Dirrabarri lane and secondly by increasing capacity within the intersection of Phillip Street and Horwood Place itself.

2.5.2.1 Dirrabarri Lane Augmentation

The existing outlet to the Parramatta River from the Phillip Street network is via a 600mm diameter pipe, additionally to get to the outlet the trunk main has two 90 degree bend. This augmentation option aims to increase the capacity of the downstream network by increasing the area of the outlet to the same as the trunk main, equivalent to a 900mm pipe, and by connecting straight to the river under the existing boardwalk removing the two 90-degree bends improving hydraulic performance. This augmentation shows limited benefits for overland flow reduction in the local drainage network for both the low and peak river scenarios. During a peak river flood, the outlet becomes drowned out and there is no improvement to the Phillip Street sag. When the river is not in flood there is also minimal change as the constriction on the network is not the downstream. The 20% AEP afflux results in Appendix A indicate that this option does not yield significant benefits for frequent flood events.

Given these outcomes, Arcadis does not believe that the existing flood issue on Phillip Street can be resolved through an upgrade to the Dirrabarri Lane drainage.

- **Low River Conditions:** No surcharge from the drainage network is noted at the northern end of Dirrabarri Lane adjacent to the Powerhouse.
- **Peak River Conditions:** No apparent changes to overland flow conditions.

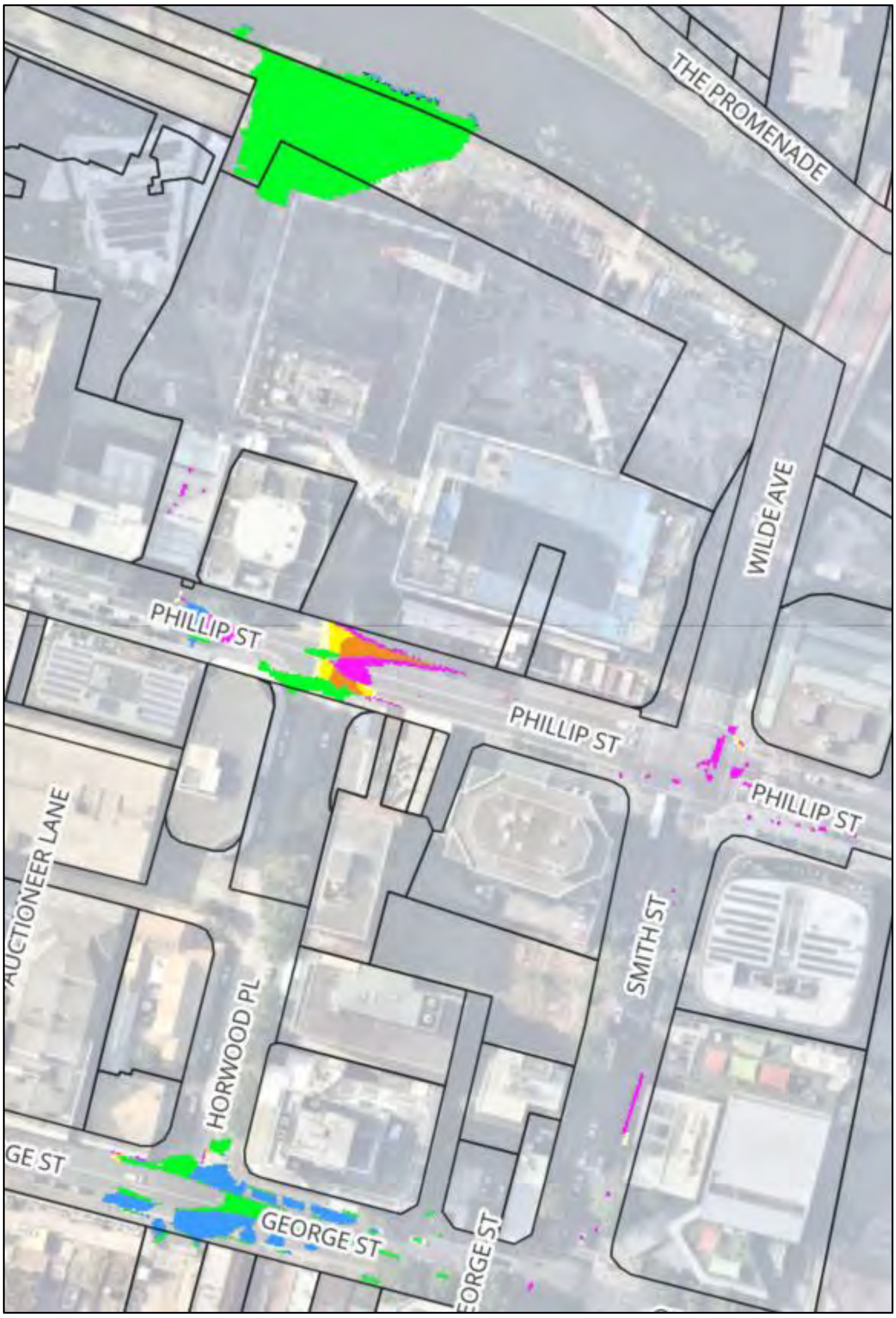


Figure 2-12: Augmentation – Flood Afflux for the 1% AEP Event, Low River Level

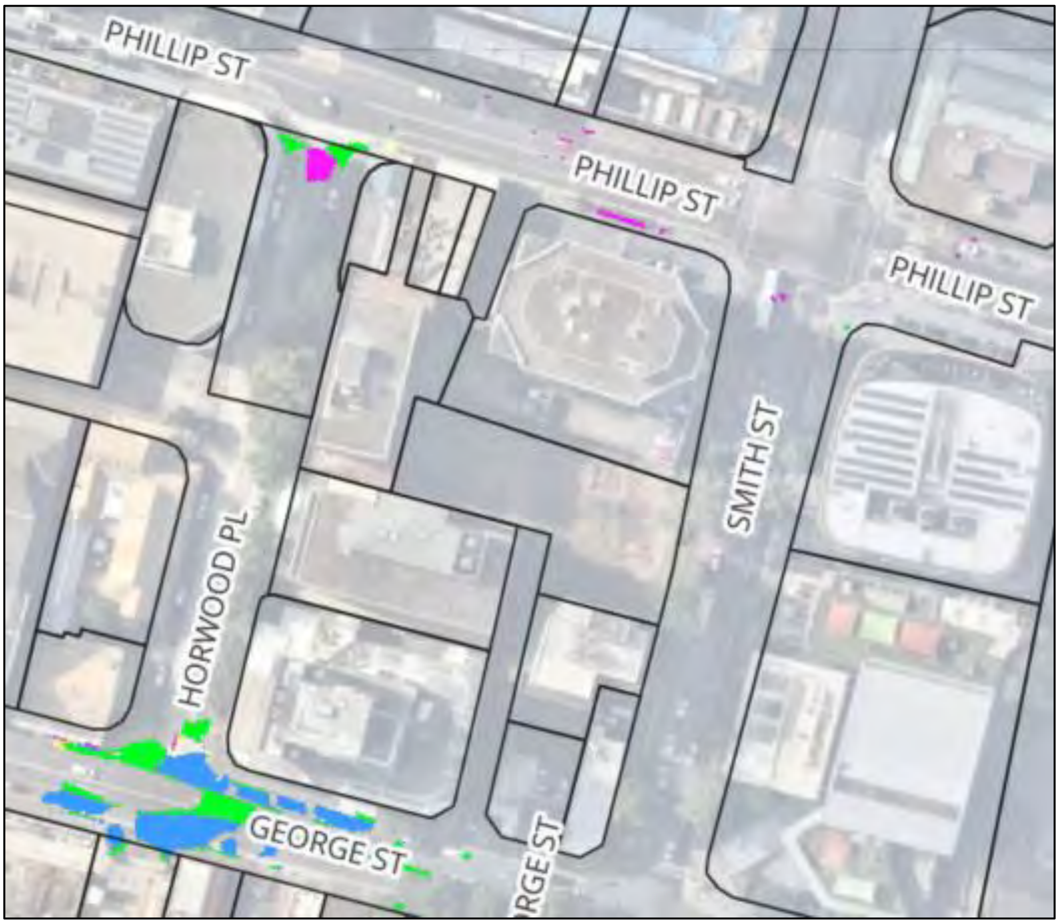


Figure 2-13: Augmentation – Flood Afflux for the 1% AEP Event, Peak River Level

2.5.2.2 Local Phillip Street Drainage

The Phillip Street sag is located just to the west of the intersection Horwood Place and Phillip Street and this is the location of the flooding issue. The Civic Link Block 3 works includes the south-western portion of this intersection and so Arcadis has investigated potential augmentation to the drainage in this area to improve the local flooding issues. Upon investigation Arcadis identified two items impacting the problem, firstly the floor level of the buildings adjacent to this area are below the top of kerb on Phillip Street. This makes it challenging to allow water to fall away from the property. Secondly the drainage in this area is quite shallow limiting the capacity of the drainage network. While it is not within the scope of the Civic Link Block 3 project to change existing floor levels, lowering of the drainage network was investigated.

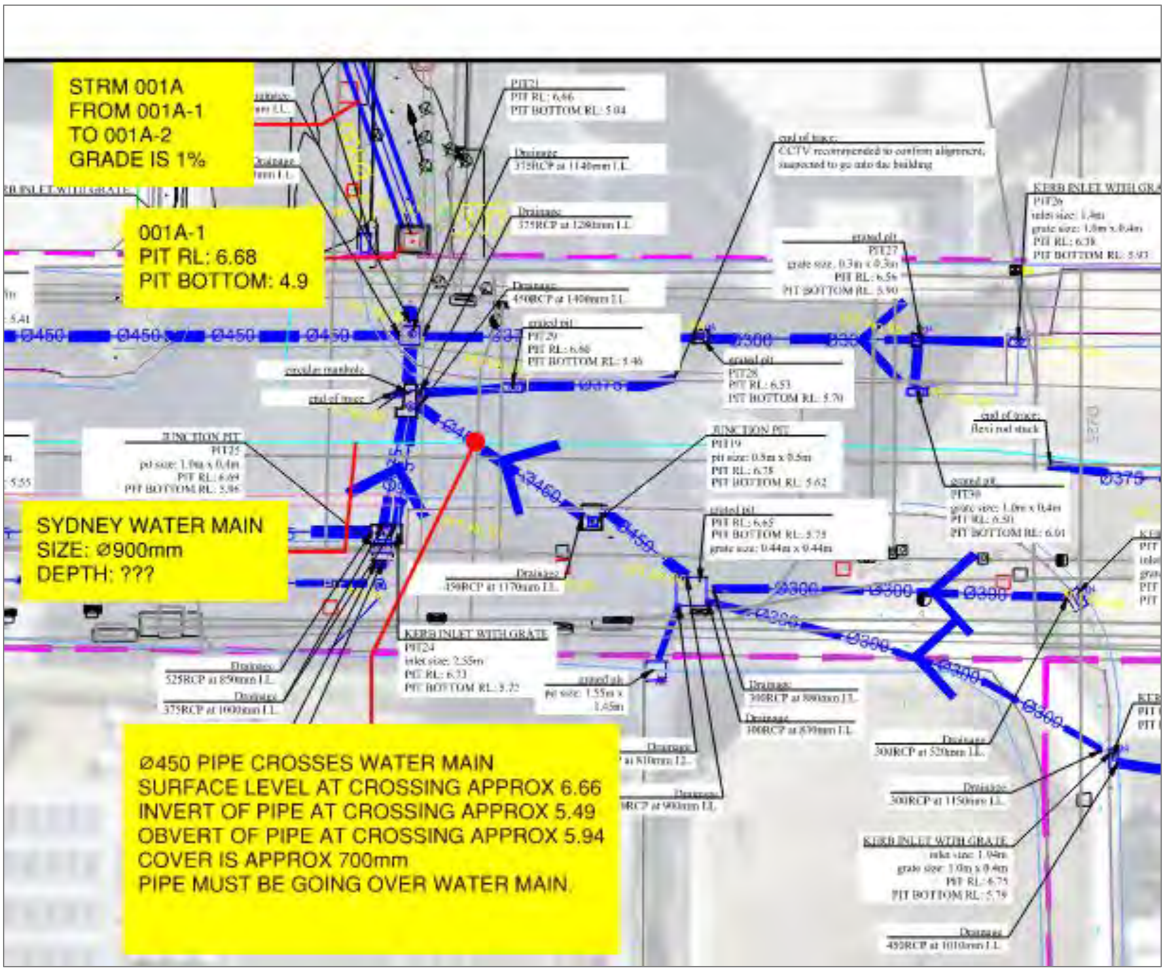


Figure 2-14: Existing Pipe System Survey

As per the above excerpt from the site survey. The south-western corner of the Phillip Street and Horwood place intersection is serviced by a 450mm pipe crossing Phillip Street. This 450mm stormwater pipe must be passing over the 900mm water main in the centre of the road. To pass under the water main would require lowering the pipe over 1.5m to an invert of at least 3.85. This below more than a metre below the downstream network recently constructed by Parramatta Powerhouse and as such this option was deemed infeasible.

Arcadis investigated how to improve flooding in this area in frequent events. This investigation is outlined in Appendix B. As a result of this investigation, Arcadis has increased the pipe sizes at the north western corner of the Philip Street intersection and included gutter bridges in the proposed pedestrian crossing.

2.6 Summary and Recommendations

In summary the proposed Civic Link works from a stormwater quantity perspective do not have adverse impacts on external properties. Minor afflux is expected within Phillip Street as a result of moving the pedestrian crossing and the associated changes to the ground levels. Arcadis have investigated potential augmentation within the project extents and this has been shown to be ineffective when the river is in flood. Pipes on the north west corner have been upsized to assist with flooding in frequent events. Arcadis recommend investigation augmenting the larger CBD trunk drainage network to possibly resolve the flooding issues at Phillip Street.

3 STORMWATER QUALITY

The Parramatta Development Control Plan (DCP) 2023, Section 5.1.2, provides general guidelines and standards for stormwater management within the Parramatta Local Government Area (LGA), including the implementation of Water Sensitive Urban Design (WSUD) principles.

In a meeting on Tuesday 1 July (confirmed in writing on 2 July) City of Parramatta Council confirmed that the project is not required to meet a specific water quality reduction target, but did encourage the incorporation of WSUD treatment where possible without compromising an overall “lush verdant garden” theme for the precinct.

The Civic Link Block 3 project covers the conversion of existing public domain areas and as such there is limited opportunity for water quality improvement. The introduction of the central green space for the conveyance of surface water will be utilised to provide a bioretention basin at the northern end. The southern catchment where the road access is maintained does not present any significant opportunities for water quality improvement due to the retention of existing trees and the surface grading.

3.1 Water Quality Assessment

The industry standard MUSIC (Version 6.4) software has been used to develop a model to assess the performance of the water quality strategy. The layout of the MUSIC model is shown in Figure 3-1. Parameters used for modelling were derived from *NSW MUSIC Modelling Guidelines* (BMT WBM, August 2015) and details of these parameters are summarised in the following sections.

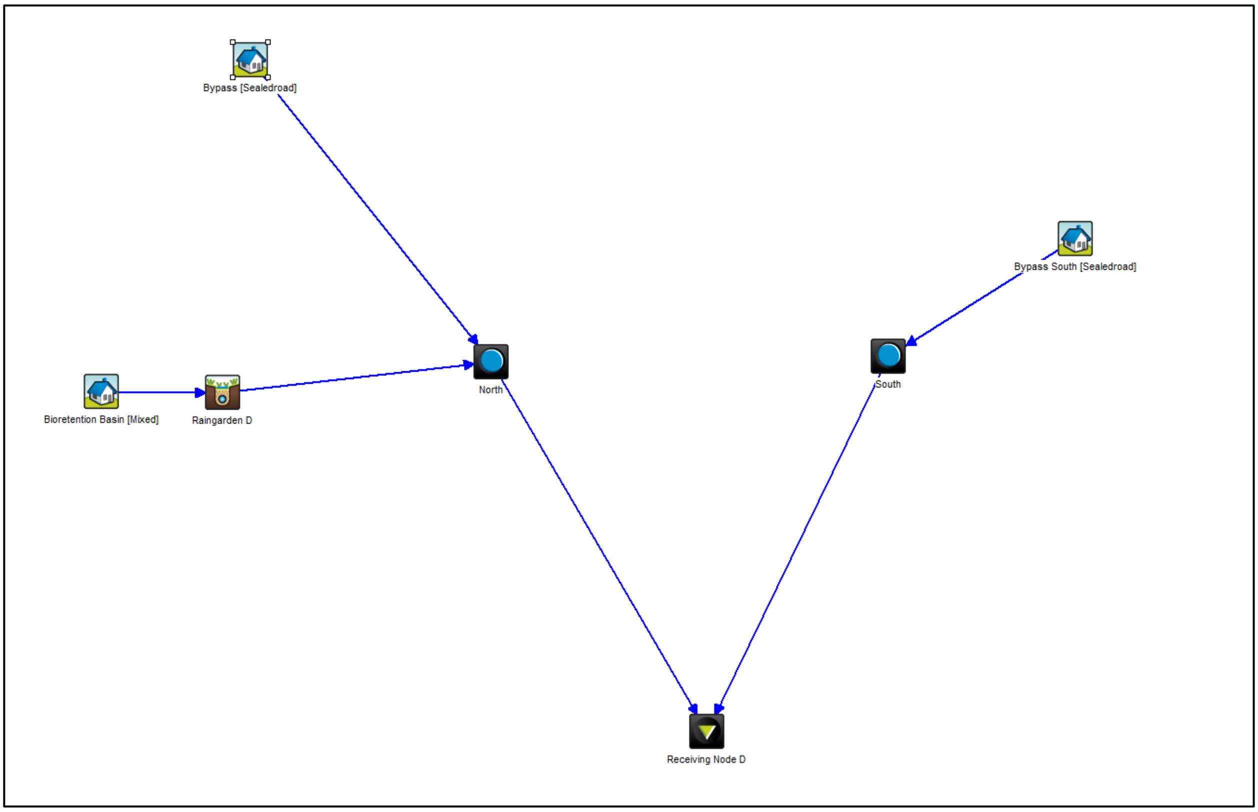


Figure 3-1 - MUSIC Model Setup

3.2 Catchments

Catchment areas were determined based on the proposed layout and grading for Horwood Place and Phillip Street. Table 3-1 summarises the percentage imperviousness assumed for each catchment type for the MUSIC modelling.

Table 3-1 – Catchment Areas and Imperviousness Assumed

Catchment	Land Use	Assumed % imperviousness	Total Area (ha)
Bioretention Basin	Road	84%	0.162
Bypass North	Road	90%	0.252
Bypass South	Road	90%	0.143

3.3 Climate Data

Rainfall data includes historical 6-minute interval pluviograph data from Parramatta North Masons Dr (Station No. 066124) for the 10-year period from 1 January 1988 until 31 December 1997. The mean annual rainfall for this period is 900mm.

Monthly average potential evapotranspiration (PET) data for Sydney was used in the MUSIC model.

A plot of the 10-year of pluviograph and evapotranspiration data is shown in Figure 3-2.

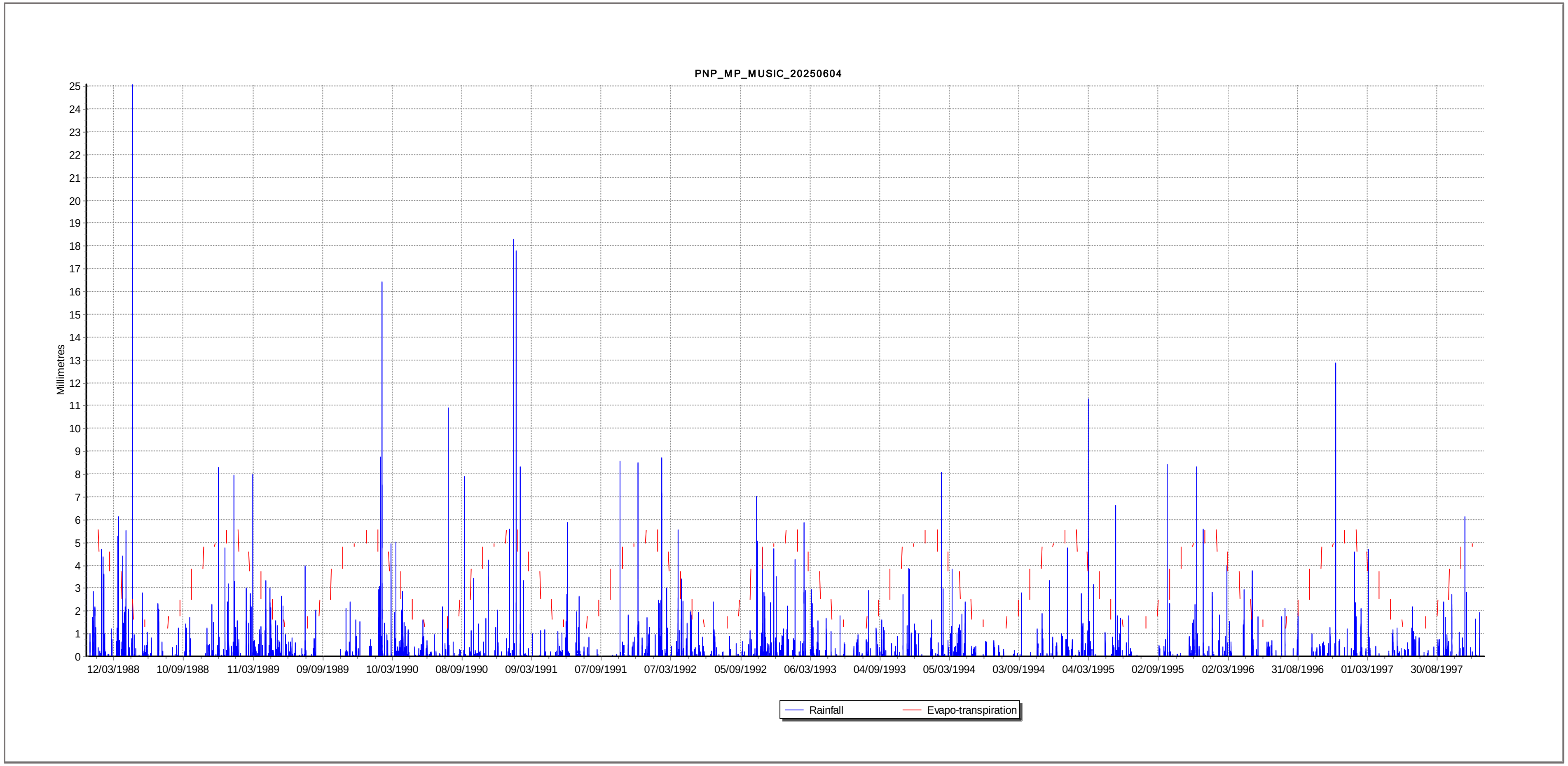


Figure 3-2 – Rainfall and potential evapotranspiration data for 1998-1997

3.4 Rainfall-Runoff and Pollutant Concentration Data

Rainfall-runoff parameters for sandy loam soil were derived from the *NSW MUSIC Modelling Guidelines* (BMT WBM, August 2015) and are summarised in Table 3-2.

Table 3-2 – Rainfall-Runoff Parameters

Parameter	Units	Value
Impervious Areas		
Rainfall Threshold	mm	1.0 (Urban Areas) 1.5 (Roads, Commercials)
Pervious Areas		
Soil Storage Capacity	mm	98
Initial Storage	% of Storage Capacity	30
Field Capacity	mm	70
Infiltration Capacity Coefficient – a	-	250
Infiltration Capacity Coefficient – b	-	1.3
Groundwater Properties		
Initial Depth	mm	10
Daily Recharge Rate	%	60
Daily Baseflow Rate	%	45
Daily Deep Seepage Rate	%	0

Pollutant concentration parameters for urban areas were derived from the *NSW MUSIC Modelling Guidelines* (BMT WBM, August 2015) and are summarised in Table 3-3.

Table 3-3 – Pollutant Concentration Parameters

Pollutant	Pollutant Concentration (log mg/L)* - Roads	
	Storm Flow	Base Flow
TSS (Total Suspended Solids)	2.43 (0.32)	1.20 (0.17)
TP (Total Phosphorus)	-0.30 (0.25)	-0.85 (0.19)
TN (Total Nitrogen)	0.34 (0.19)	0.11 (0.12)

3.5 Proposed Treatment Measures

The stormwater management strategy proposes a bioretention basin at the northern end of the green spine in Horwood Place at the downstream end of the proposed swale. The proposed garden areas surrounding the raised crossing at Phillip Street were investigated to provide additional bioretention areas. Due to existing utilities within the footprint on the gardens, these areas are not suitable for bioretention.

The design parameters of the Bioretention Basin adopted for the MUSIC modelling is summarised in Table 3-4.

Table 3-4 – Bioretention Basin Parameters

Parameter	Value – Bioretention Basin
Extended Detention Depth (m)	0.15
Saturated Hydraulic Conductivity (mm/hr)	100
Filter Depth (m)	0.4
Total Nitrogen Content (mg/kg)	400
Orthophosphate Content (mg/kg)	40
Exfiltration Rate (mm/hr)	0.0
Base Lined	Yes
Submerged Zone	No

3.6 WSUD Design Outcome

Total average annual pollutant loads generated and removed by the proposed treatment train were derived using MUSIC, and this is summarised in Table 3-5. While we do not achieve percentage reduction targets for the overall site due to large amounts of bypass catchments.

Table 3-5 – MUSIC Modelling Results Total Site

Parameter	Load Generated (kg/yr)	Residual Load after Treatment (kg/yr)	Reduction Modelled (%)
Gross Pollutants	106	77.6	26.8
Total Suspended Solids	1,410	1,080	23.7
Total Phosphorus	2.37	1.88	20.6
Total Nitrogen	9.67	8.26	14.6

4 CONCLUSION

This Stormwater Management Plan has outlined the stormwater management for conveyance and water quality proposed in Civic Link Block 3.

The conveyance assessment has identified that there is a flooding issue at the intersection of Phillip Street and Horwood Place in the existing case. This issue appears to be caused by the flooding of Parramatta River and insufficient trunk drainage capacity in the larger CBD network. The proposed works within Civic Link do not make flooding worse on any of the impacted properties but they do not resolve the flooding issue. Level changes, in particular the movement of the raised pedestrian crossing, do slightly increase overland flow levels but these are contained within the road reserve. Arcadis have investigated augmentation of the local stormwater network and identified that without works outside of the project extents it is not possible to resolve the flooding issue on Phillip Street.

APPENDIX A – FLOOD MAPS

ARCADIS

PROJECT:

PARRAMATTA CIVIC LINK

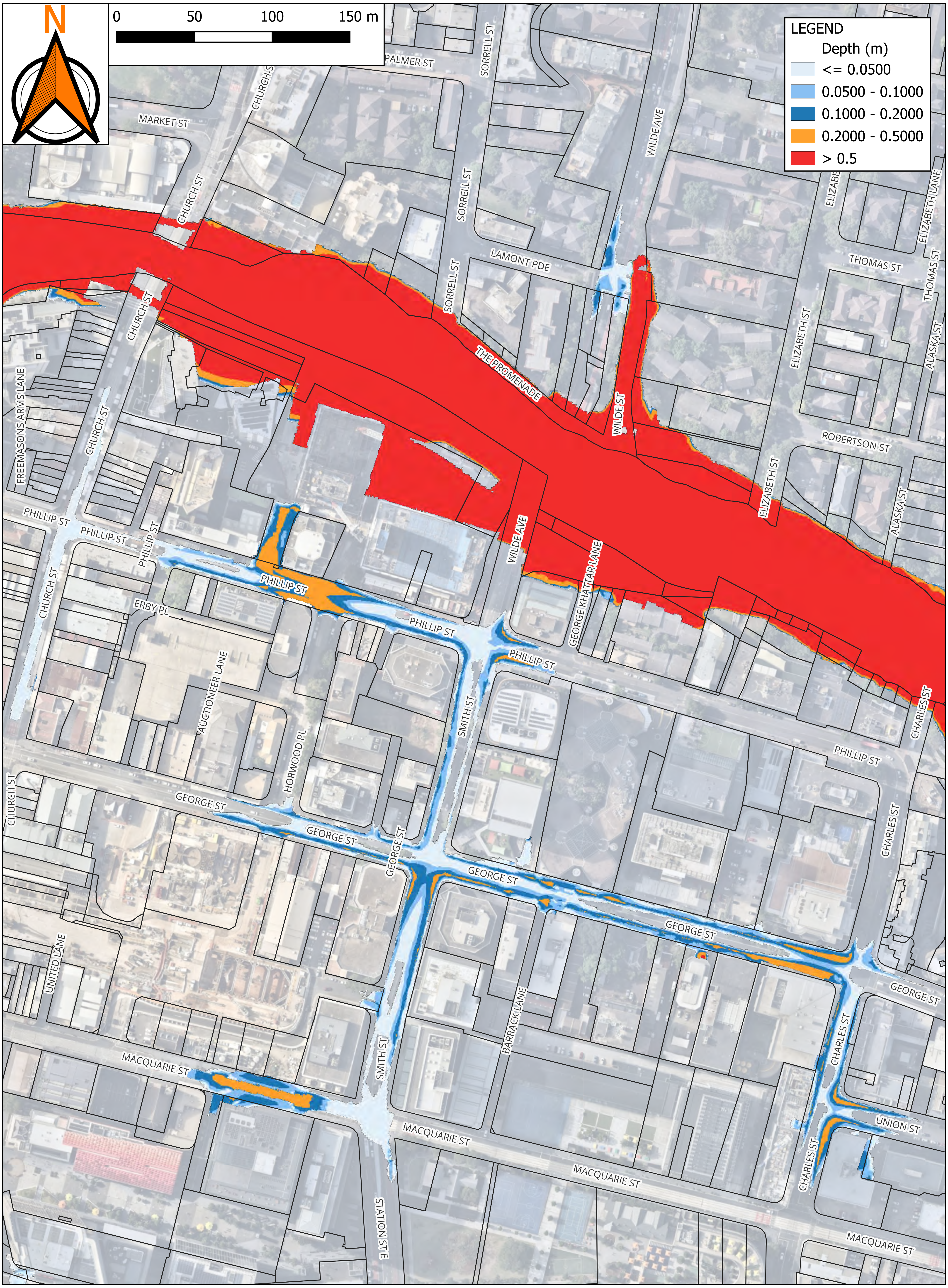
TITLE:

FLOOD DEPTH

BASE, 1% AEP 30mins, LOW BOUNDARY

MAP: F0001

PROJECT NUMBER: 30190380



PROJECT:

PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

BASE, 1% AEP 30mins, RIVER PEAK

MAP: F0002

PROJECT NUMBER: 30190380

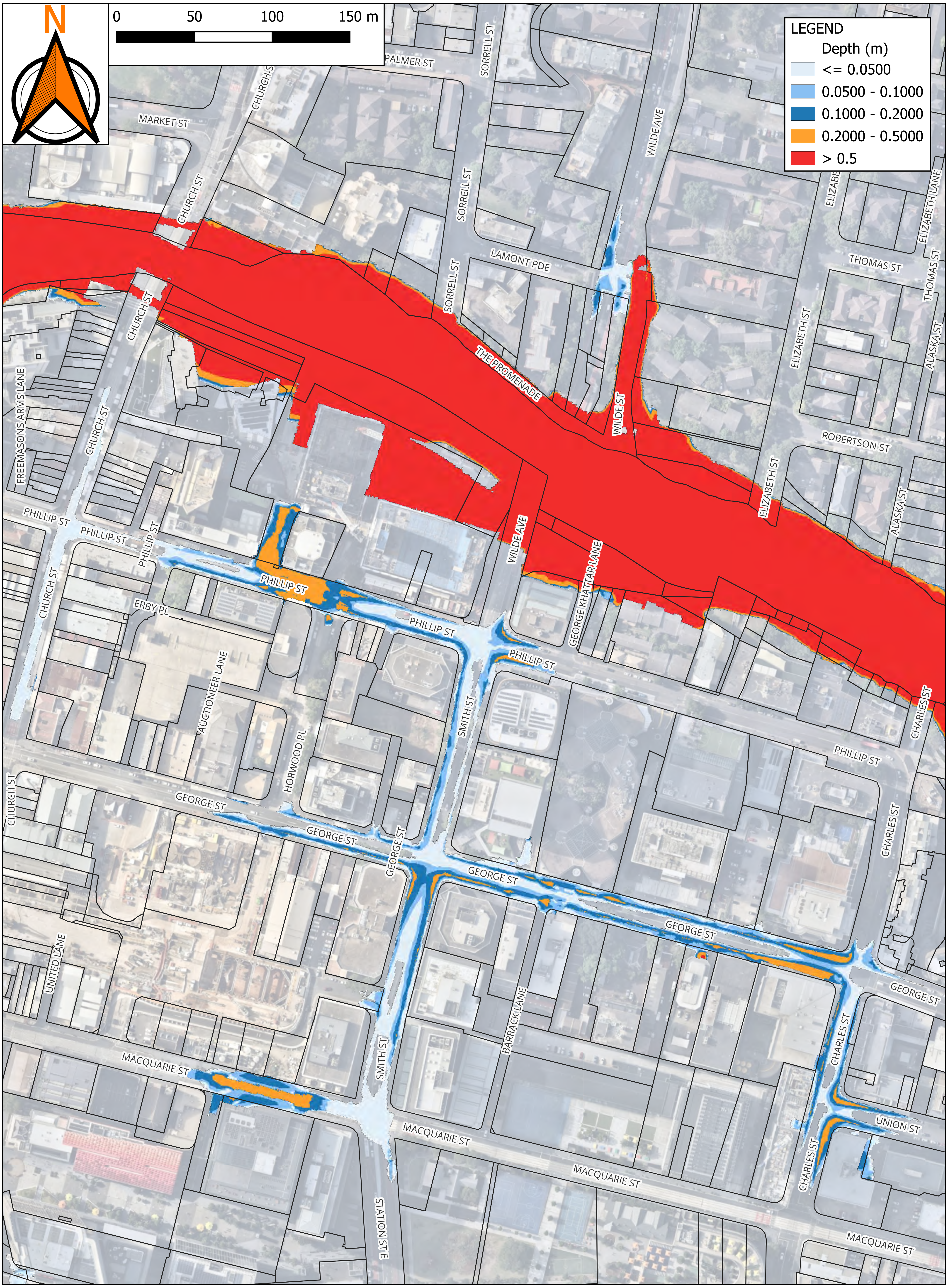
ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD DEPTH
CIVIC LINK ONLY, 1% AEP 30mins, LOW BOUNDARY

MAP: F0003

PROJECT NUMBER: 30190380



PROJECT:

PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

CIVIC LINK ONLY, 1% AEP 30mins, RIVER PEAK

MAP: F0004

PROJECT NUMBER: 30190380

ARCADIS

PROJECT:

PARRAMATTA CIVIC LINK

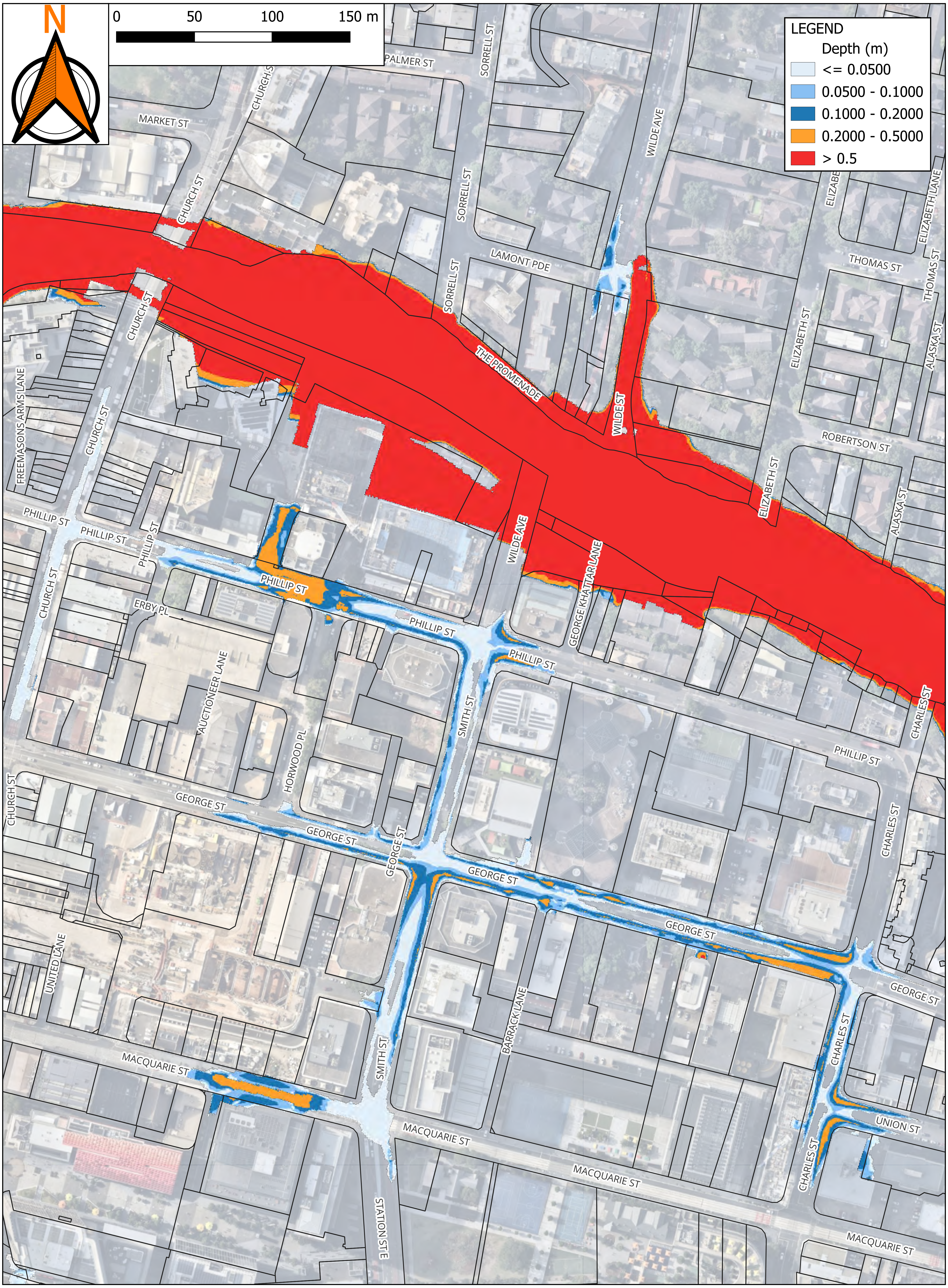
TITLE:

FLOOD DEPTH

OPTION1, 1% AEP 30mins, LOW BOUNDARY

MAP: F0005

PROJECT NUMBER: 30190380



ARCADIS

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PARRAMATTA CIVIC LINK

TITLE:
FLOOD DEPTH
OPTION1, 1% AEP 30mins, RIVER PEAK

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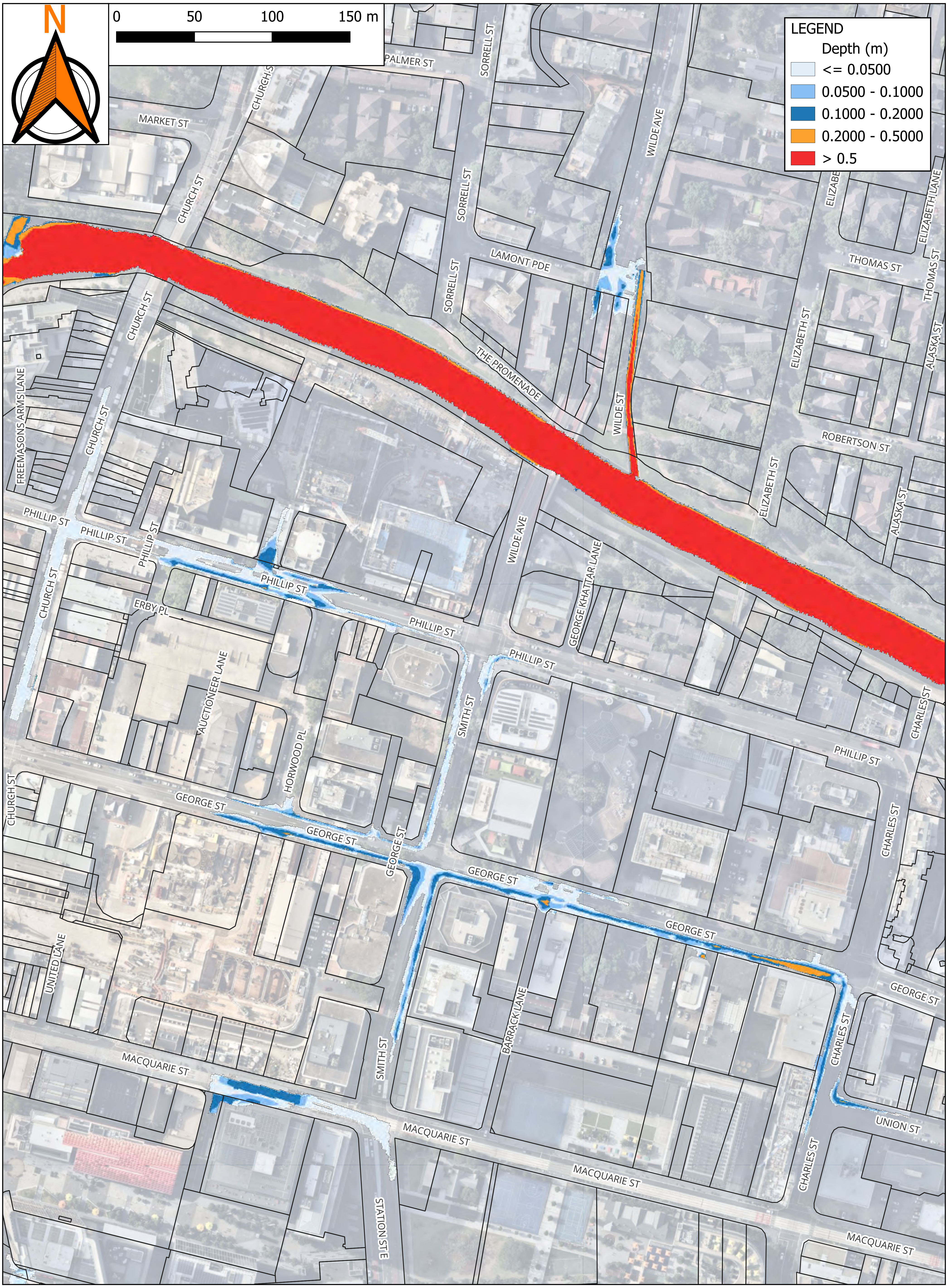

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PARRAMATTA CIVIC LINK

TITLE:
FLOOD DEPTH
BASE, 5% AEP 30mins, LOW BOUNDARY

MAP: F0007

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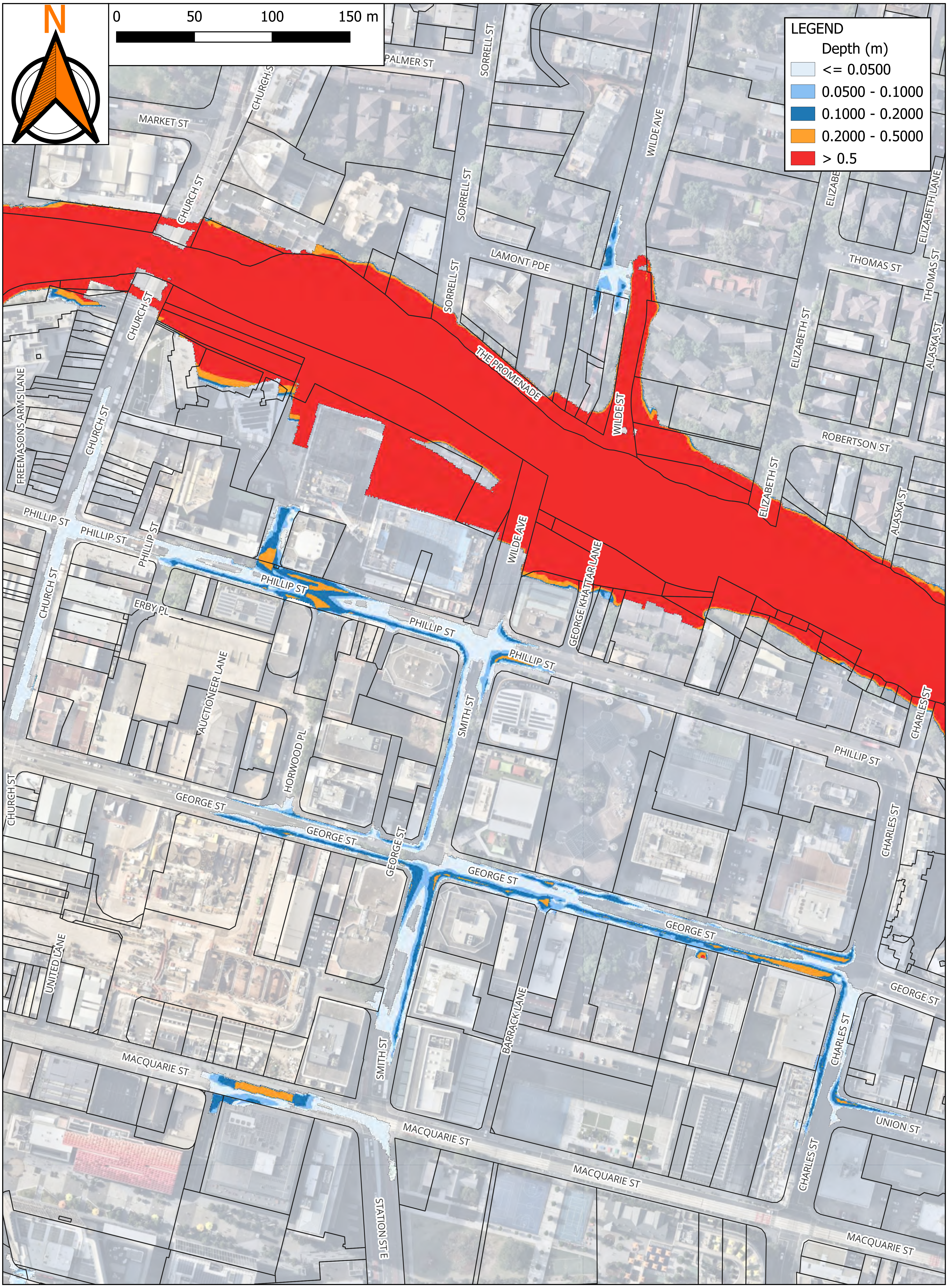

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PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

BASE, 5% AEP 30mins, RIVER PEAK

MAP: F0008

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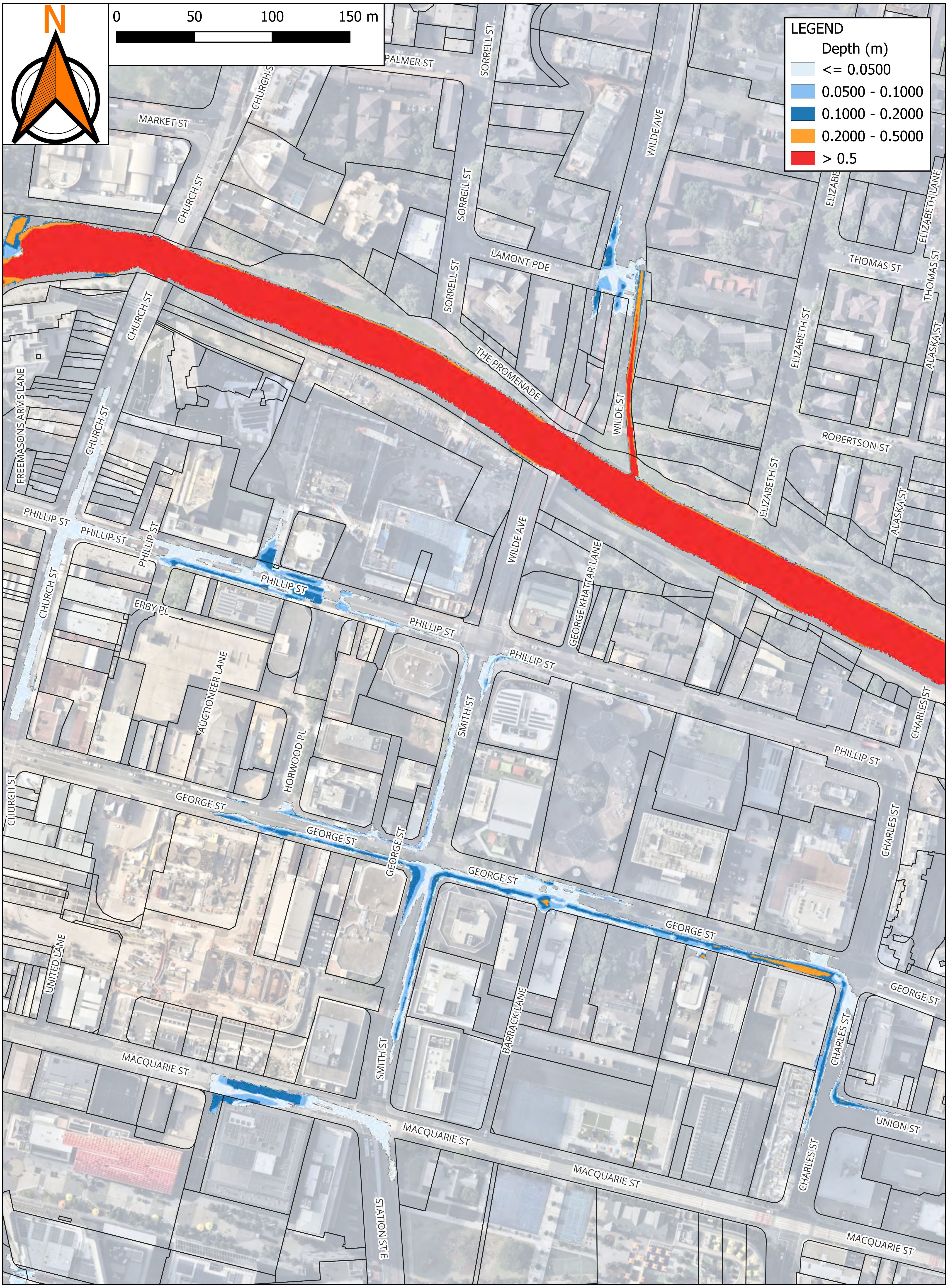

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FLOOD DEPTH

CIVIC LINK ONLY, 5% AEP 30mins, LOW BOUNDARY

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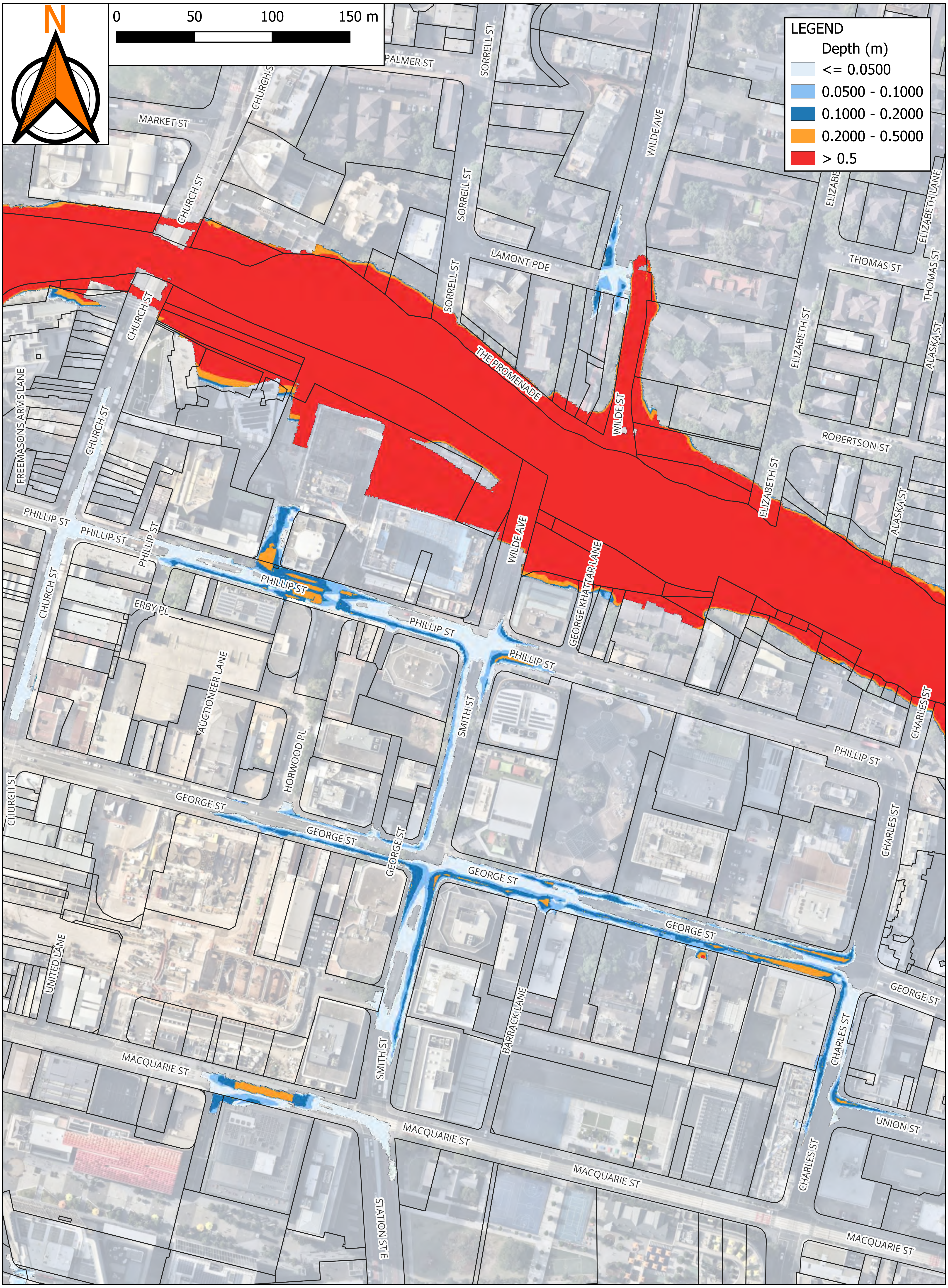

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PARRAMATTA CIVIC LINK

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FLOOD DEPTH
CIVIC LINK ONLY, 5% AEP 30mins, RIVER PEAK
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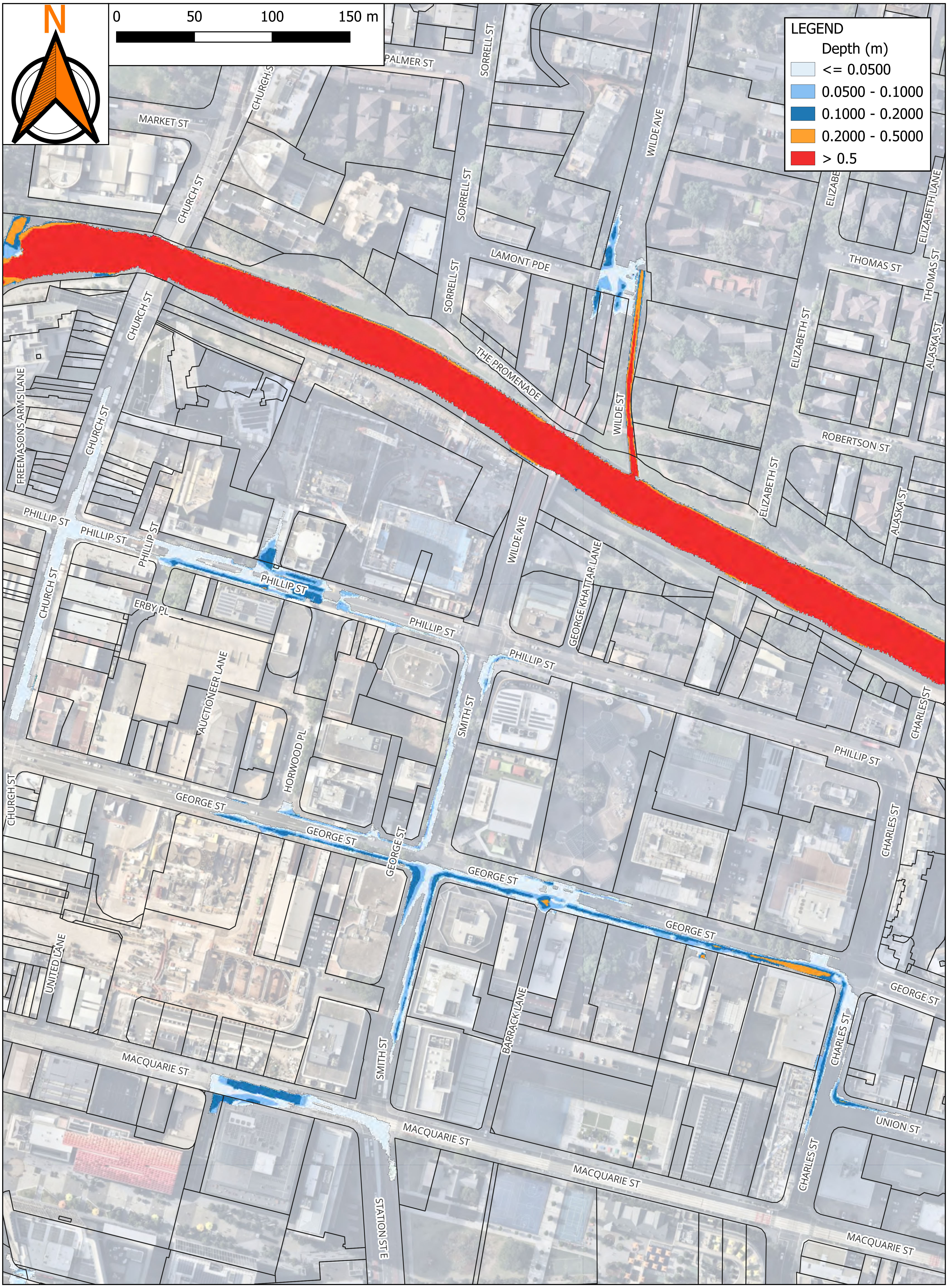

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PARRAMATTA CIVIC LINK

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FLOOD DEPTH

OPTION1, 5% AEP 30mins, LOW BOUNDARY

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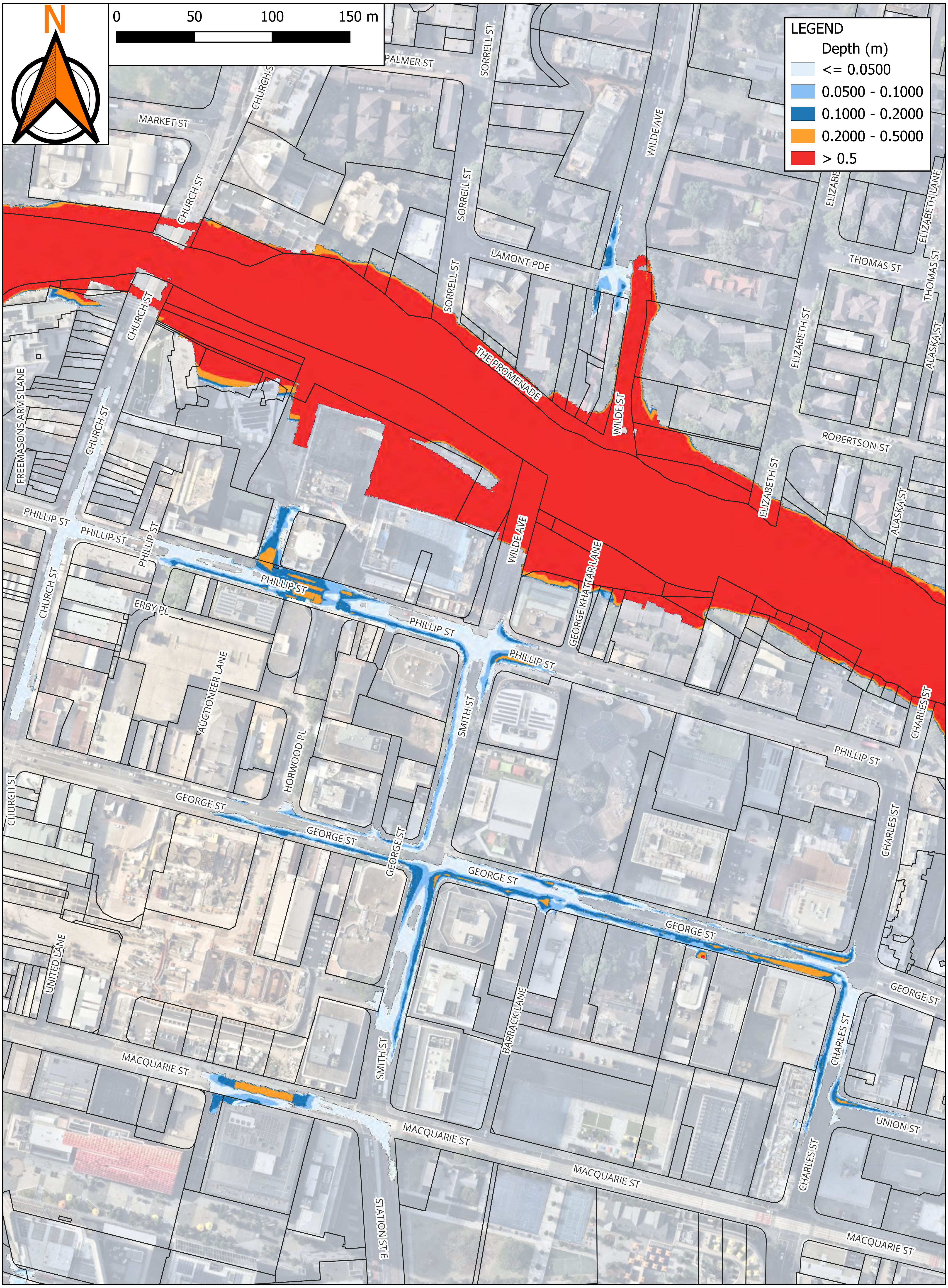


PROJECT:

PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

OPTION1, 5% AEP 30mins, RIVER PEAK

MAP: F0012

PROJECT NUMBER: 30190380

PROJECT:

PARRAMATTA CIVIC LINK

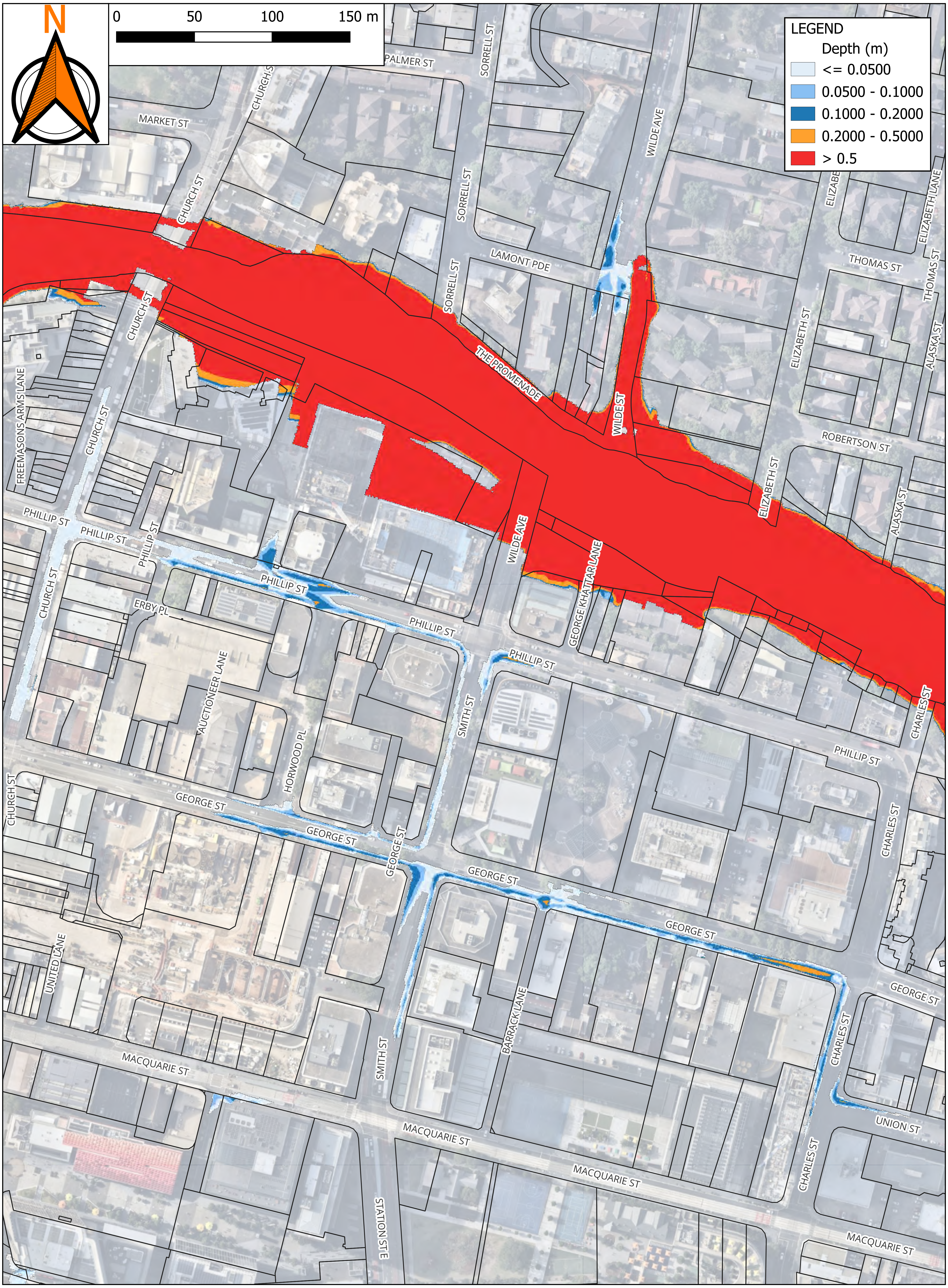
TITLE:

FLOOD DEPTH

BASE, 20% AEP 30mins, LOW BOUNDARY

MAP: F0013

PROJECT NUMBER: 30190380



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PROJECT:

PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

BASE, 20% AEP 30mins, RIVER PEAK

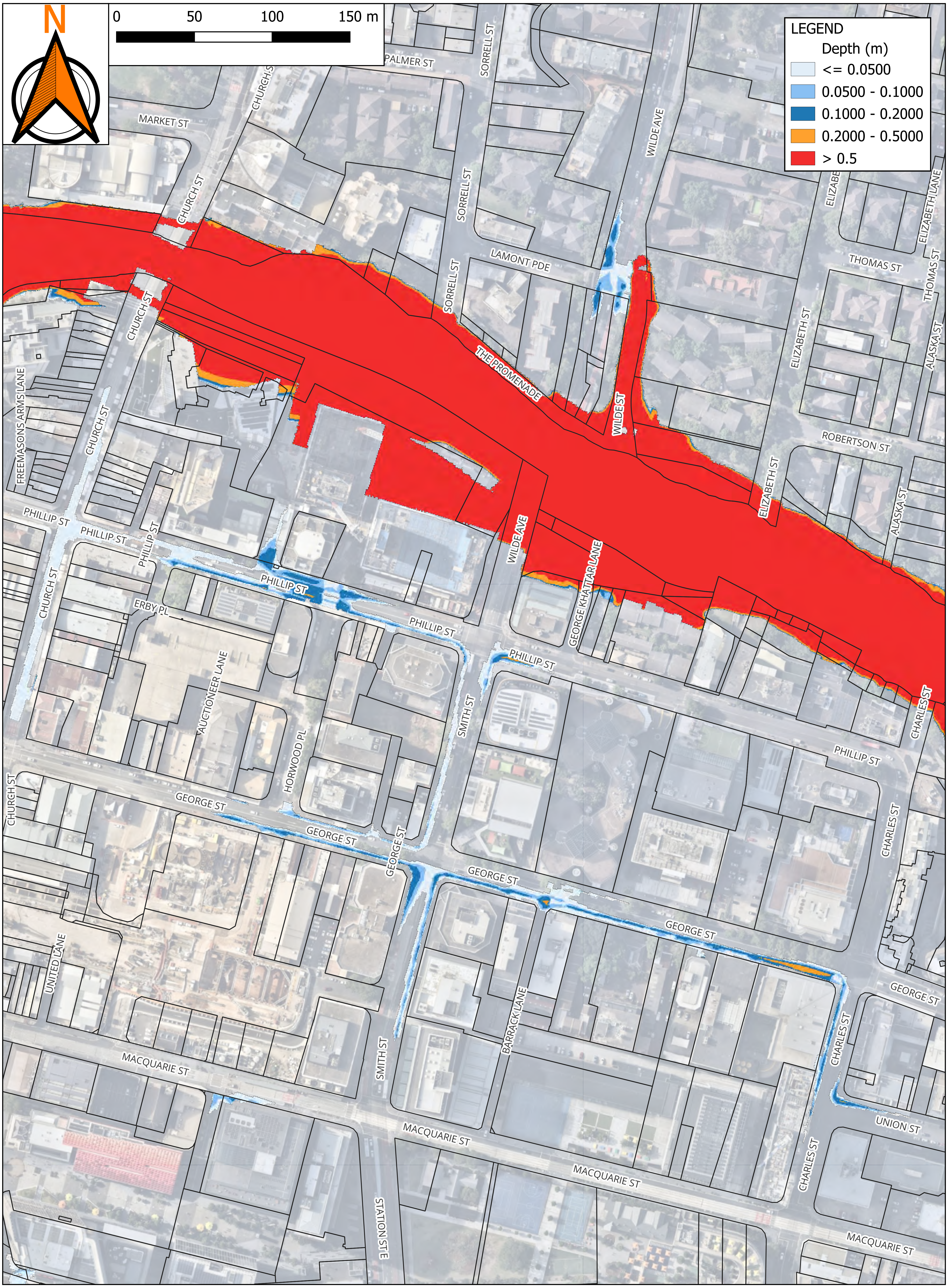
MAP: F0014

PROJECT NUMBER: 30190380

ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD DEPTH
CIVIC LINK ONLY, 20% AEP 30mins, LOW BOUNDARY
MAP: F0015
PROJECT NUMBER: 30190380



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PARRAMATTA CIVIC LINK

TITLE:

FLOOD DEPTH

CIVIC LINK ONLY, 20% AEP 30mins, RIVER PEAK

MAP: F0016

PROJECT NUMBER: 30190380

ARCADIS

PROJECT:
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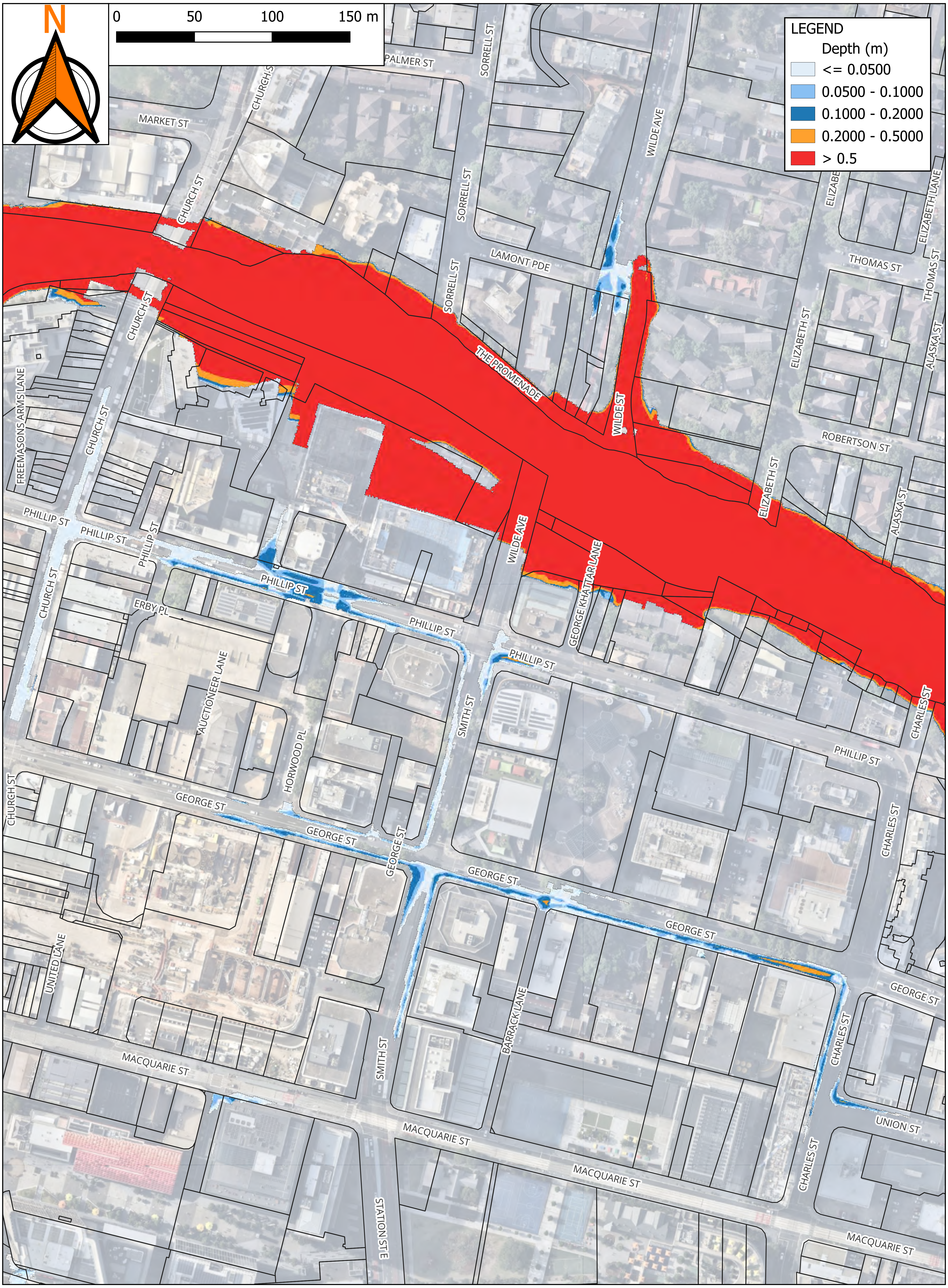
TITLE:
FLOOD DEPTH
OPTION1, 20% AEP 30mins, LOW BOUNDARY

MAP: F0017

PROJECT NUMBER: 30190380



![ARCADIS]

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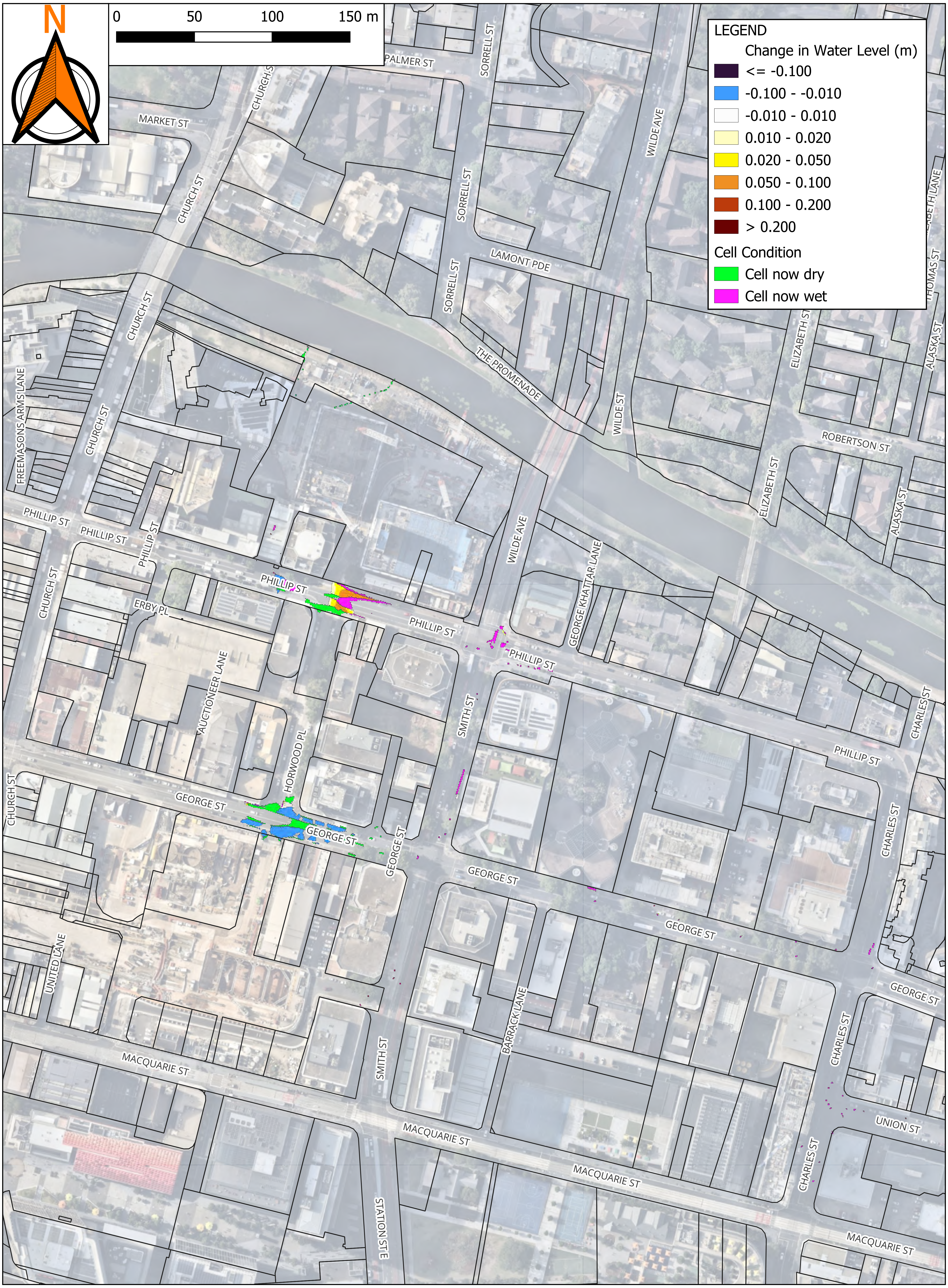
PARRAMATTA CIVIC LINK

TITLE:
FLOOD DEPTH
OPTION1, 20% AEP 30mins, RIVER PEAK

MAP: F0018

PROJECT NUMBER: 30190380



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FLOOD AFFLUX
CIVIC LINK ONLY, 1% AEP 30mins, LOW BOUNDARY
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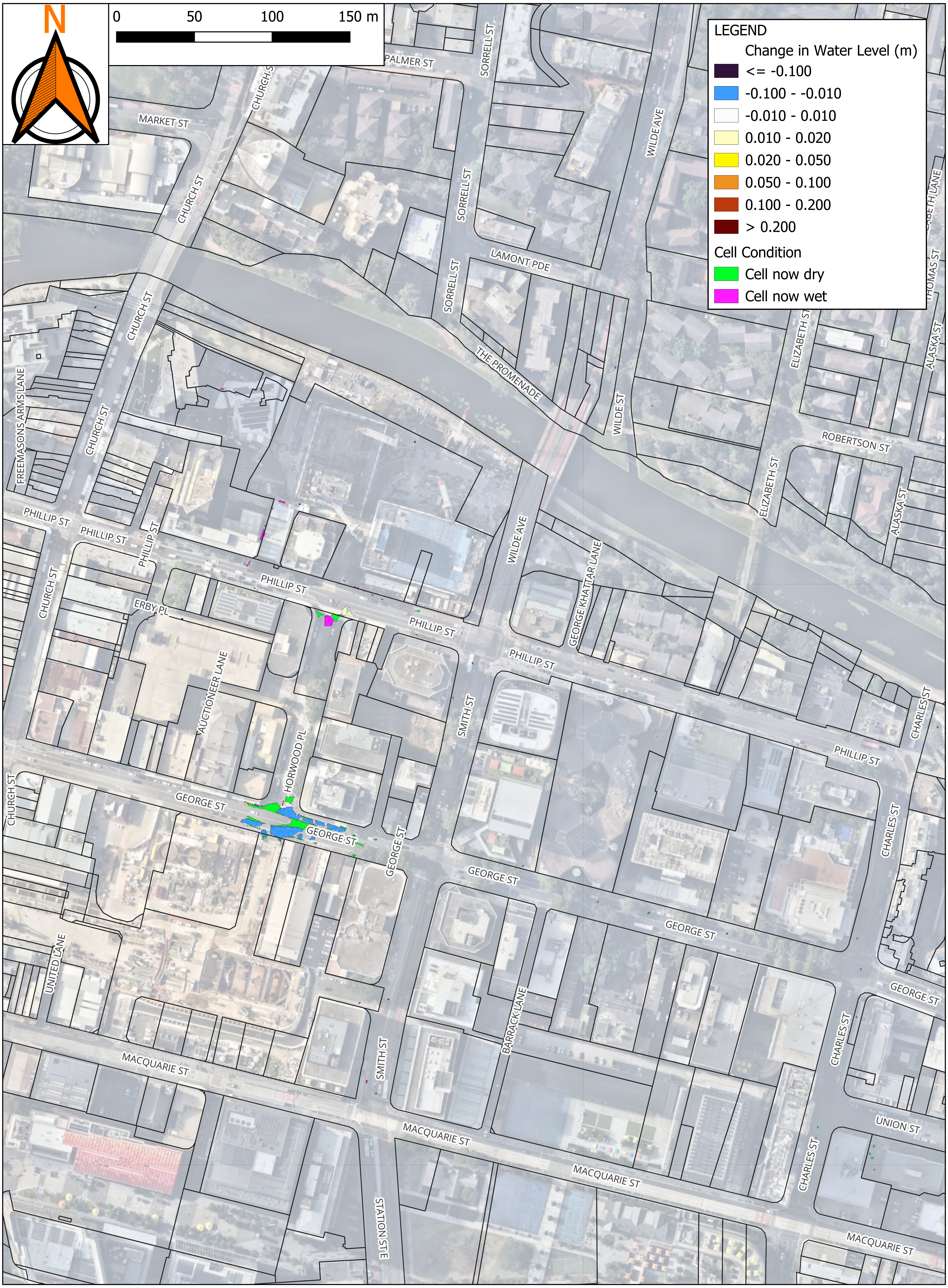

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FLOOD AFFLUX

CIVIC LINK ONLY, 1% AEP 30mins, RIVER PEAK

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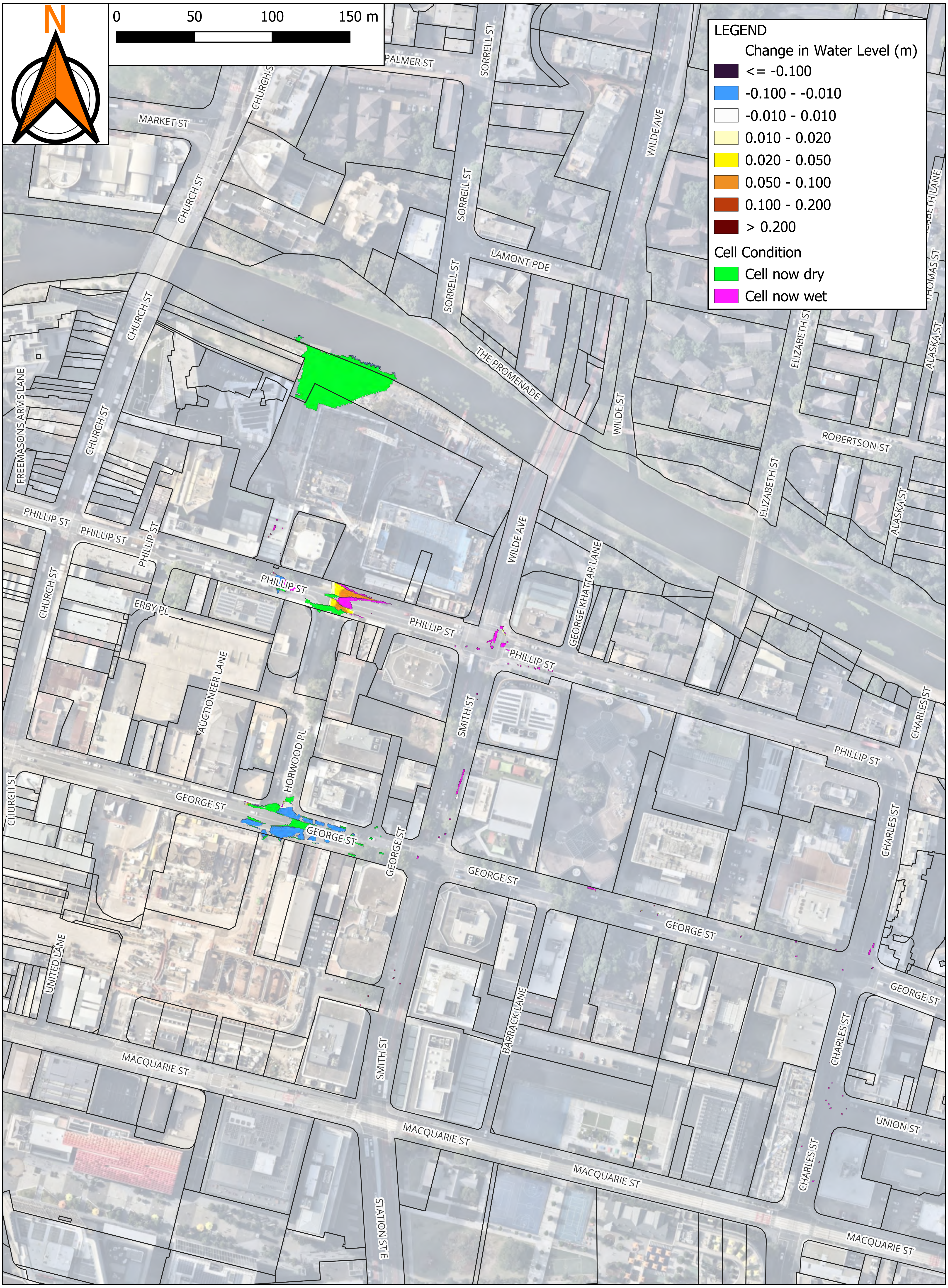

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FLOOD AFFLUX

OPTION1, 1% AEP 30mins, LOW BOUNDARY

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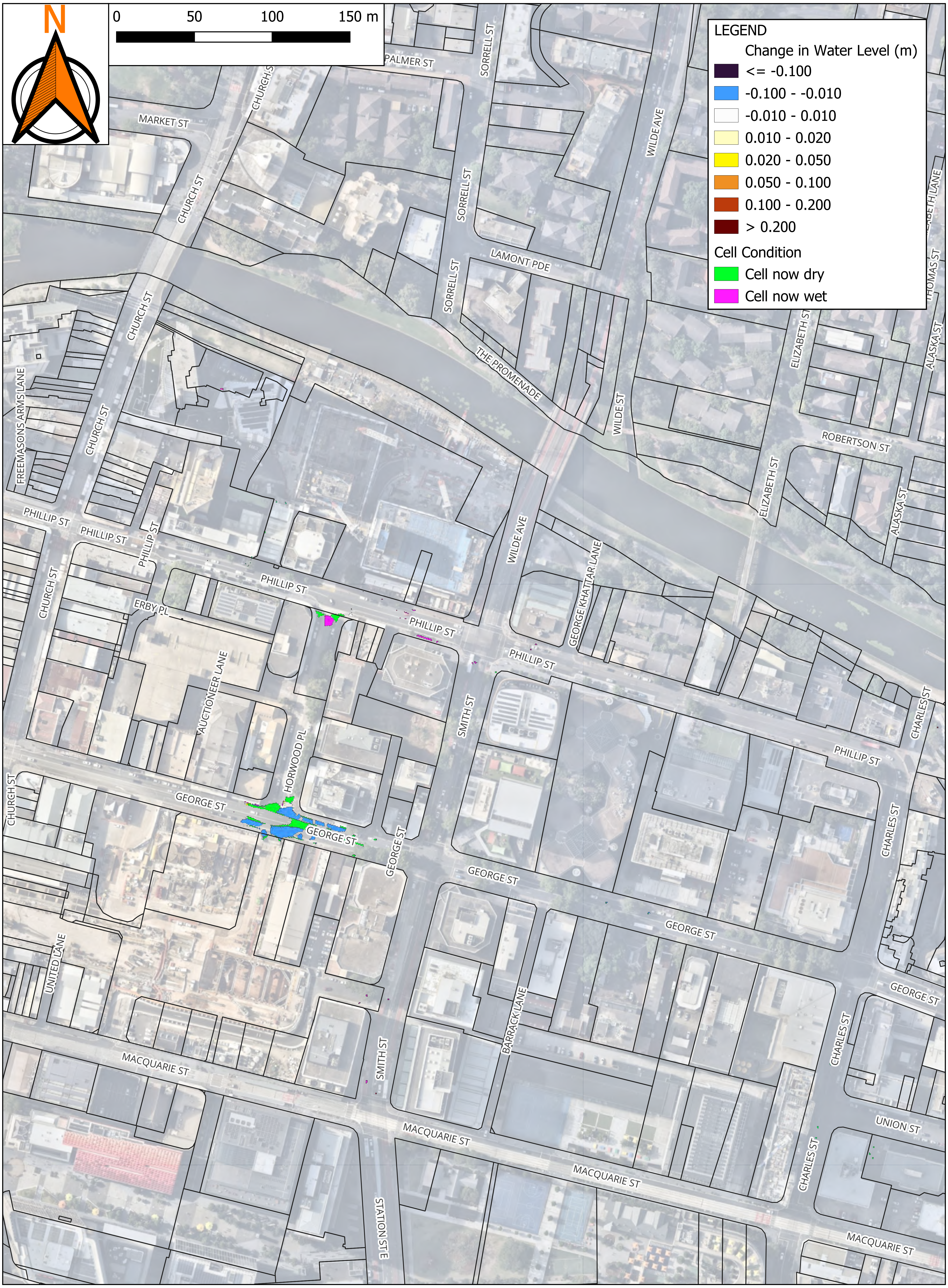

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FLOOD AFFLUX

OPTION1, 1% AEP 30mins, RIVER PEAK

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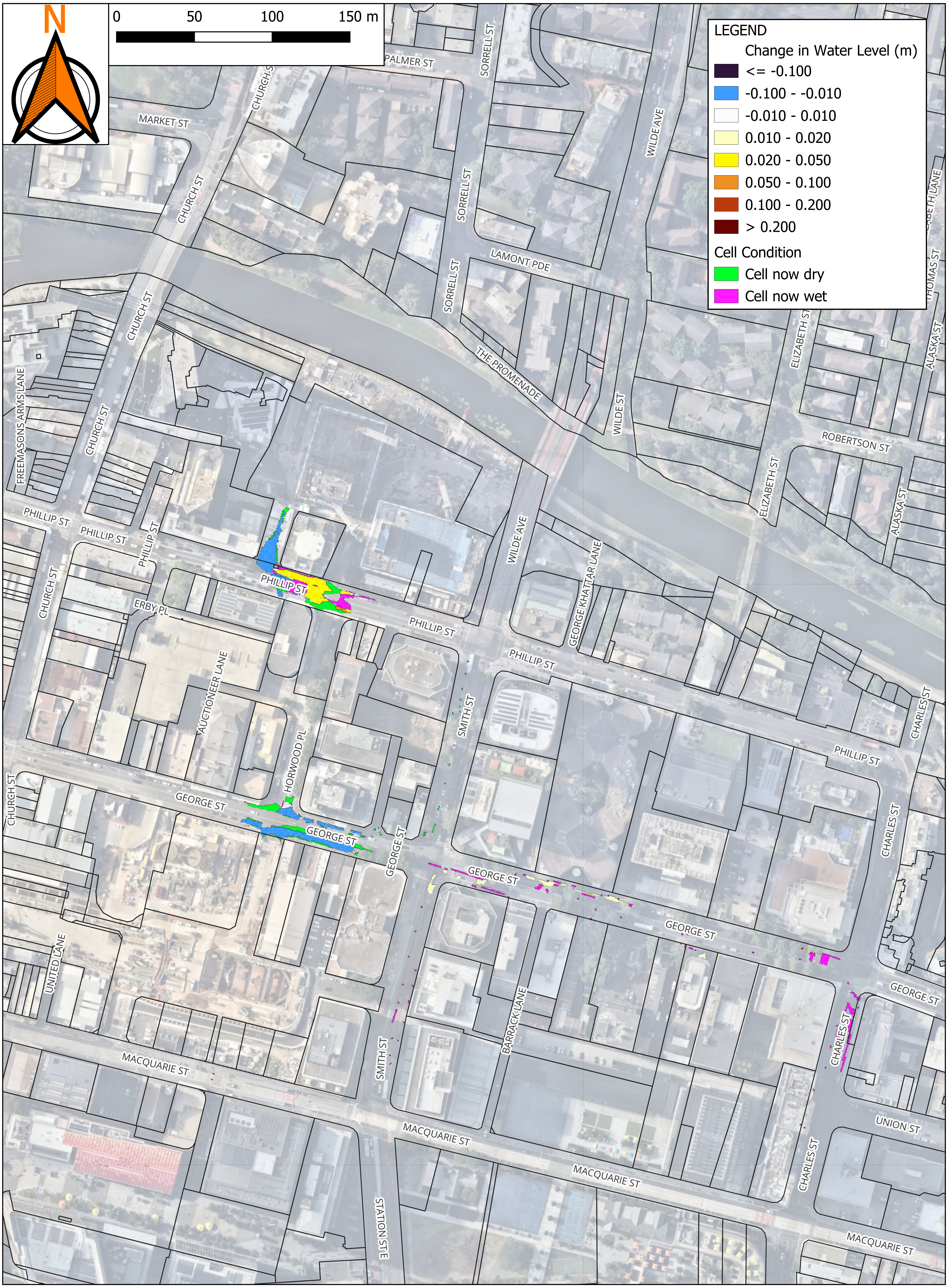

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FLOOD AFFLUX
CIVIC LINK ONLY, 5% AEP 30mins, LOW BOUNDARY

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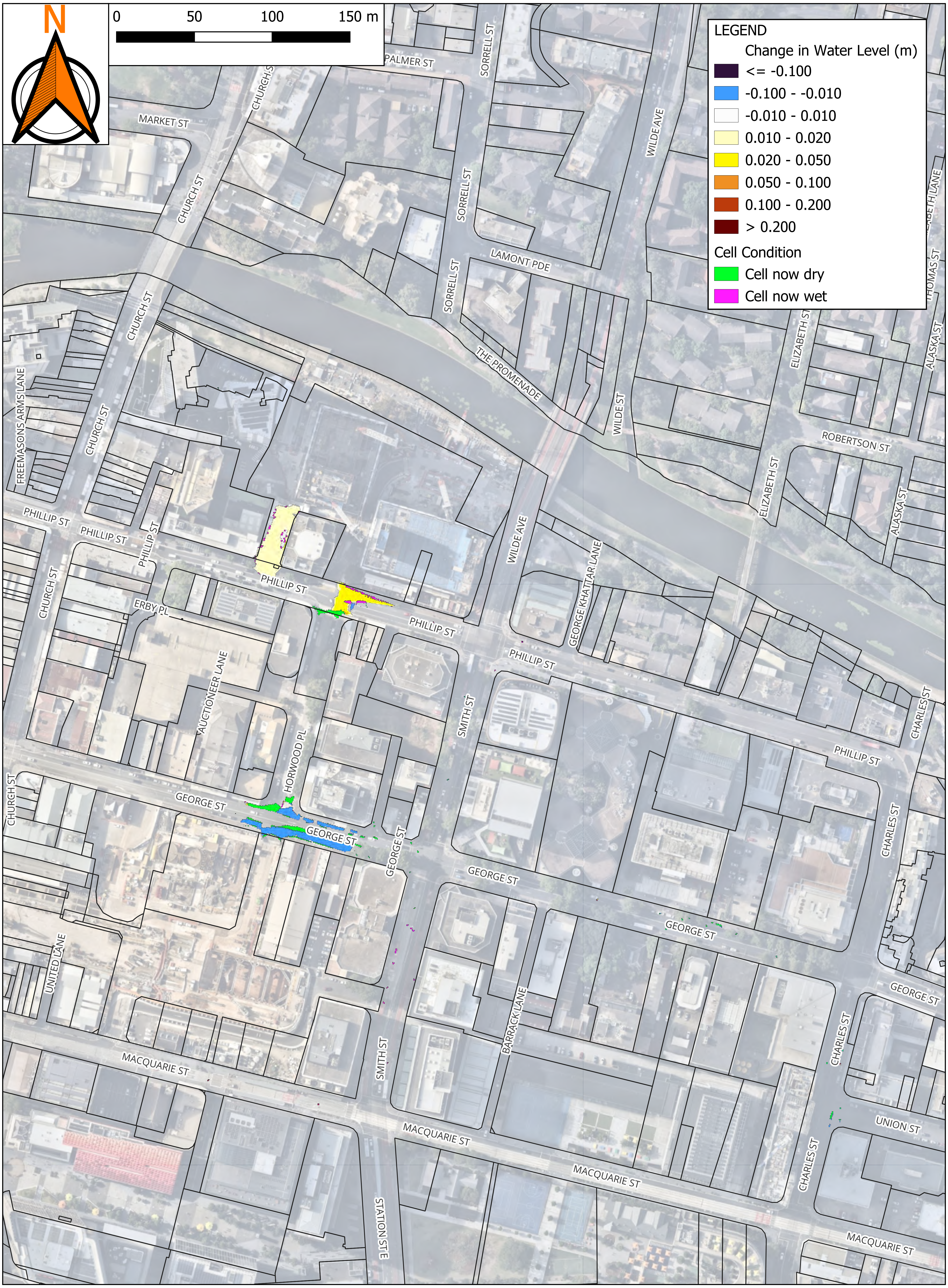

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FLOOD AFFLUX

CIVIC LINK ONLY, 5% AEP 30mins, RIVER PEAK

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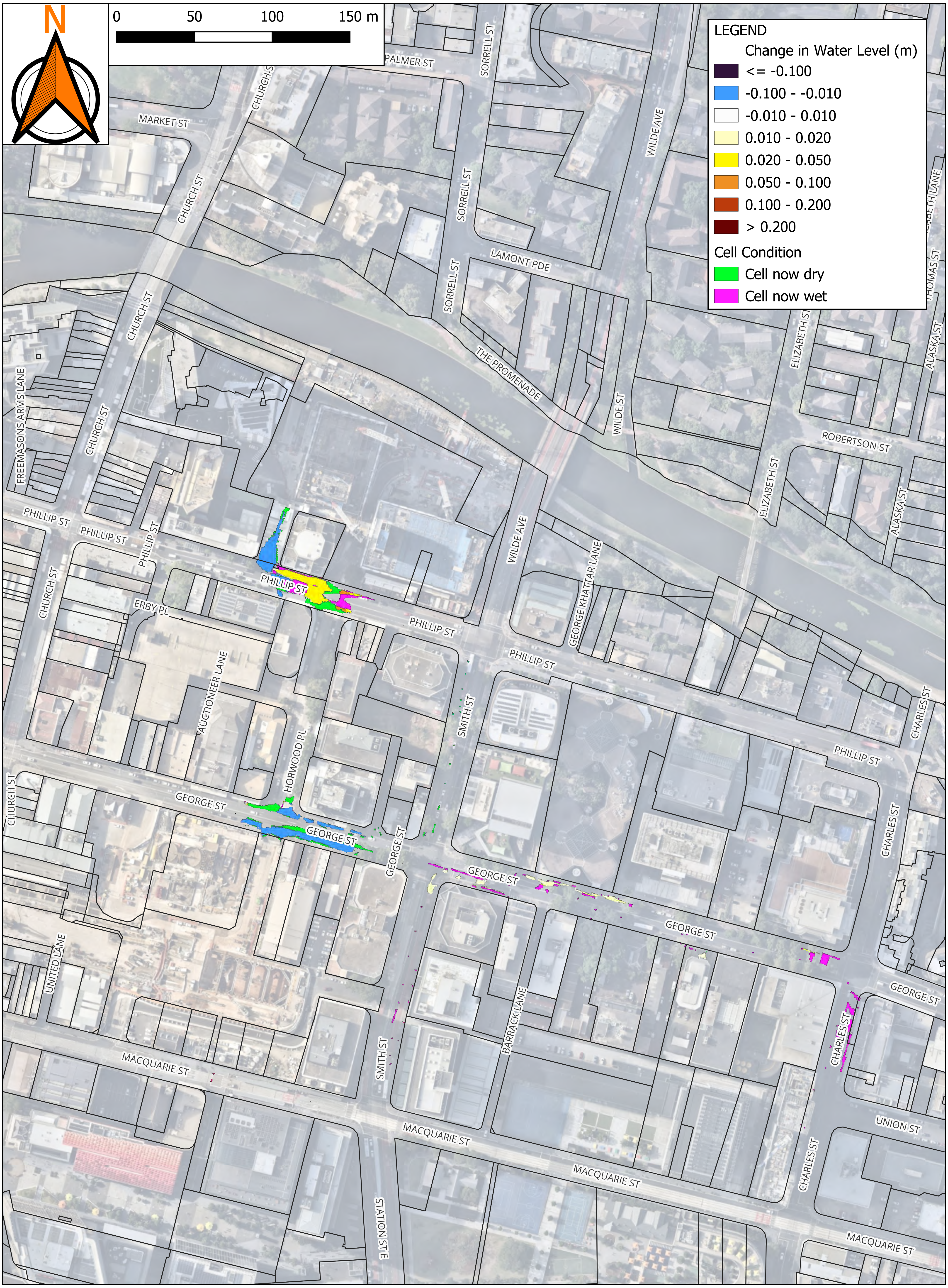

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FLOOD AFFLUX
OPTION1, 5% AEP 30mins, LOW BOUNDARY

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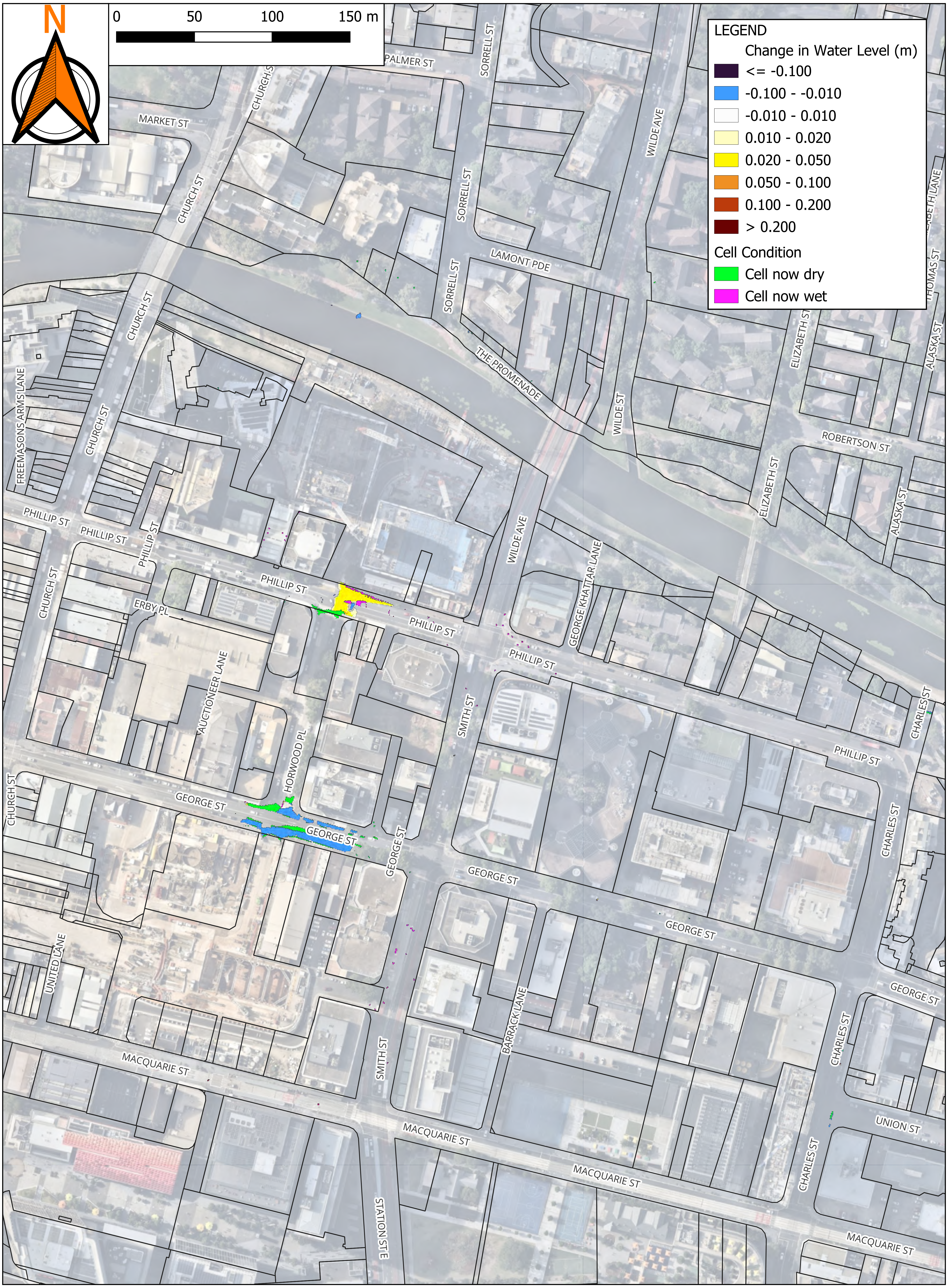

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PARRAMATTA CIVIC LINK

TITLE:
FLOOD AFFLUX
OPTION1, 5% AEP 30mins, RIVER PEAK

MAP: F0026

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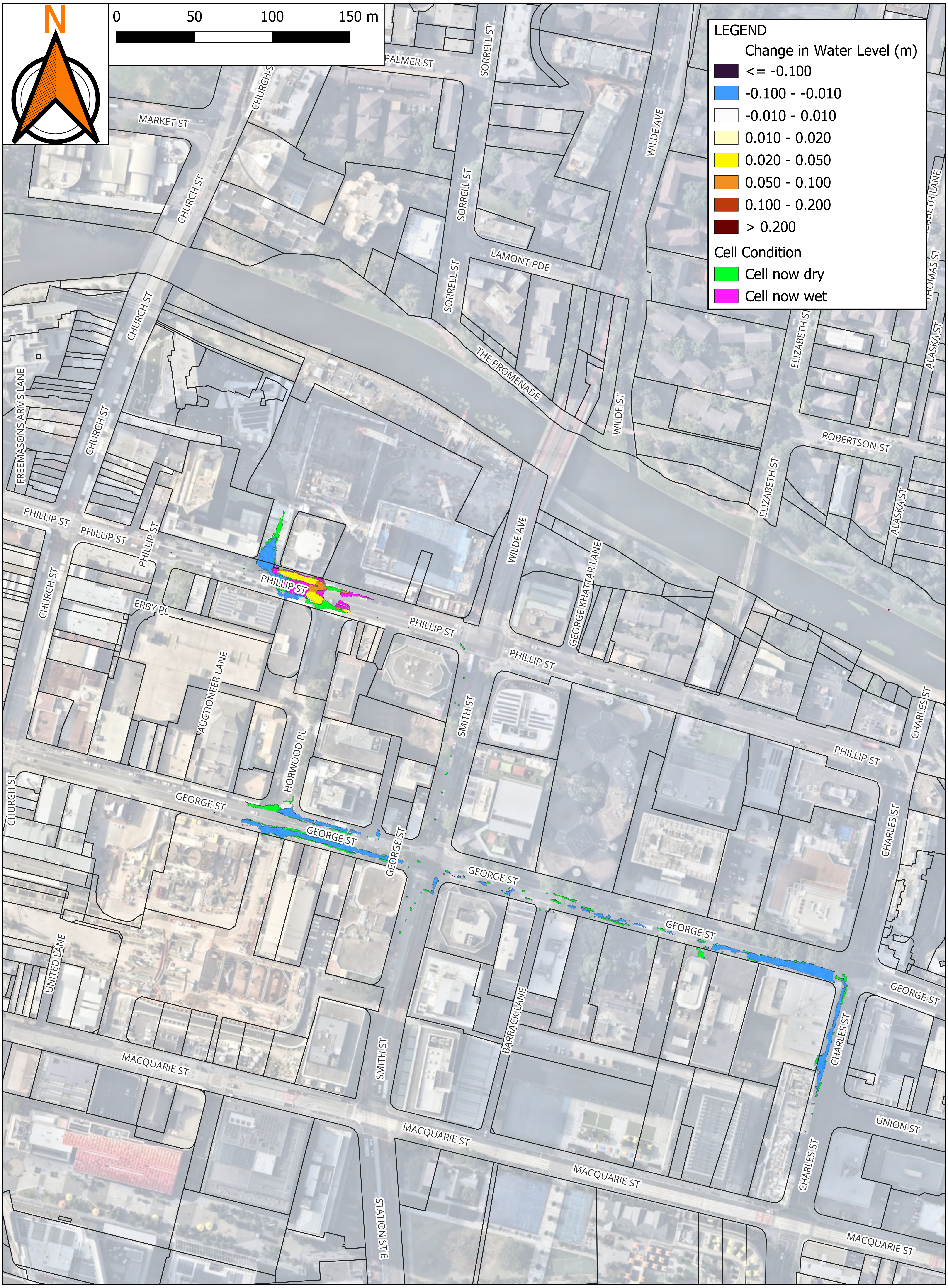


PROJECT:

PARRAMATTA CIVIC LINK

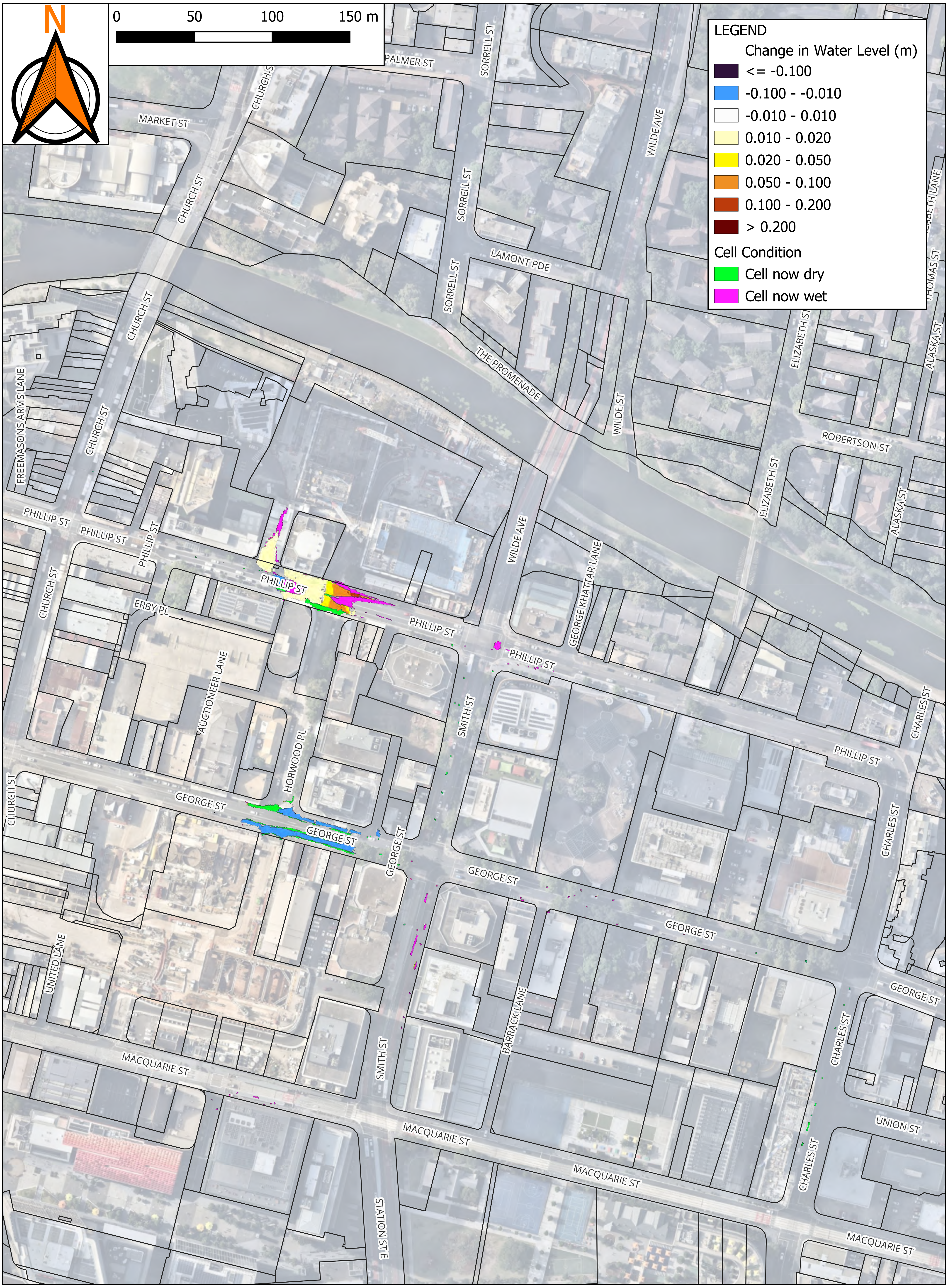
TITLE:

FLOOD AFFLUX

CIVIC LINK ONLY, 20% AEP 30mins, LOW BOUNDARY

MAP: F0027

PROJECT NUMBER: 30190380



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PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD AFFLUX
CIVIC LINK ONLY, 20% AEP 30mins, RIVER PEAK
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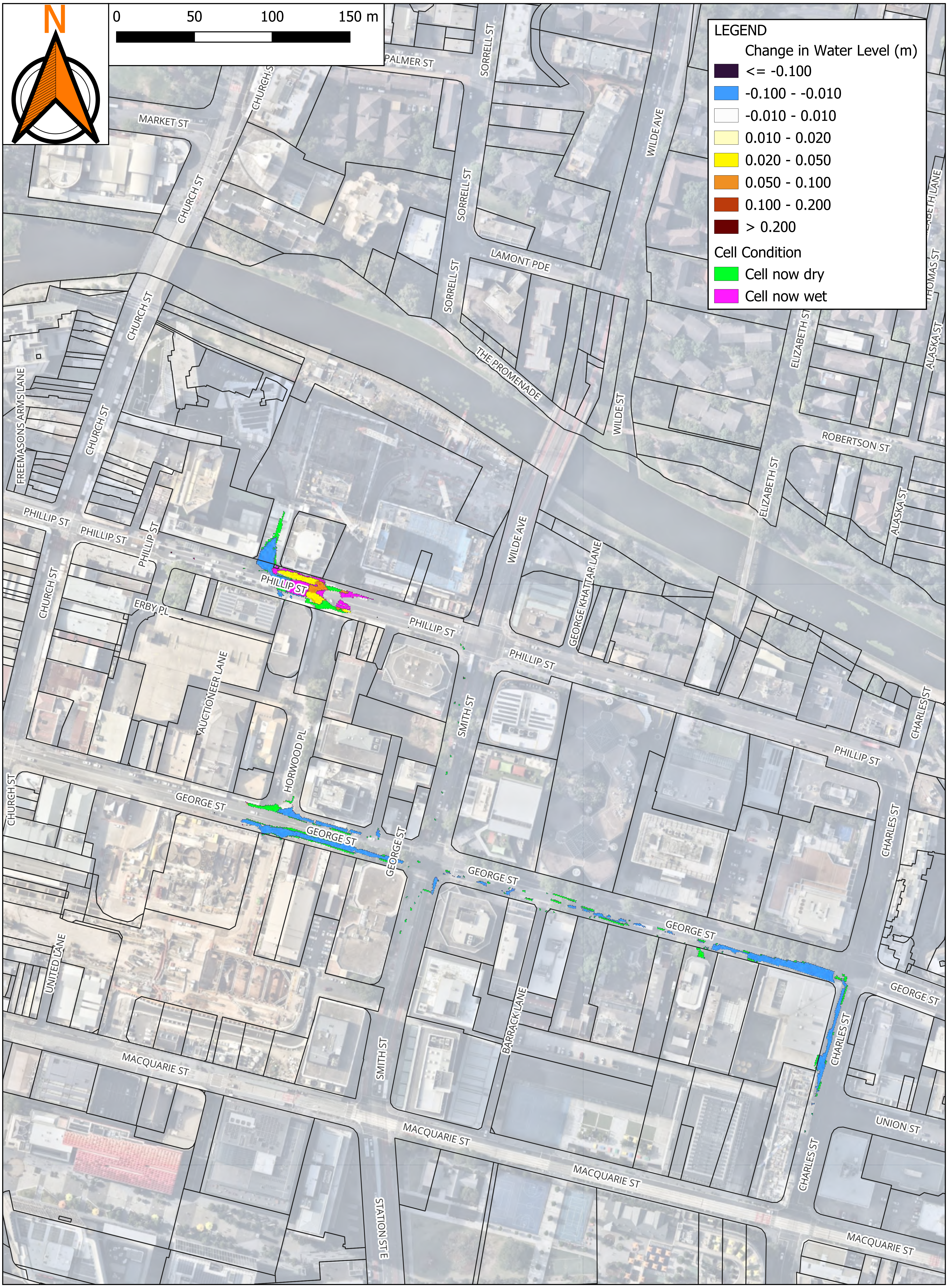

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PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD AFFLUX
OPTION1, 20% AEP 30mins, LOW BOUNDARY

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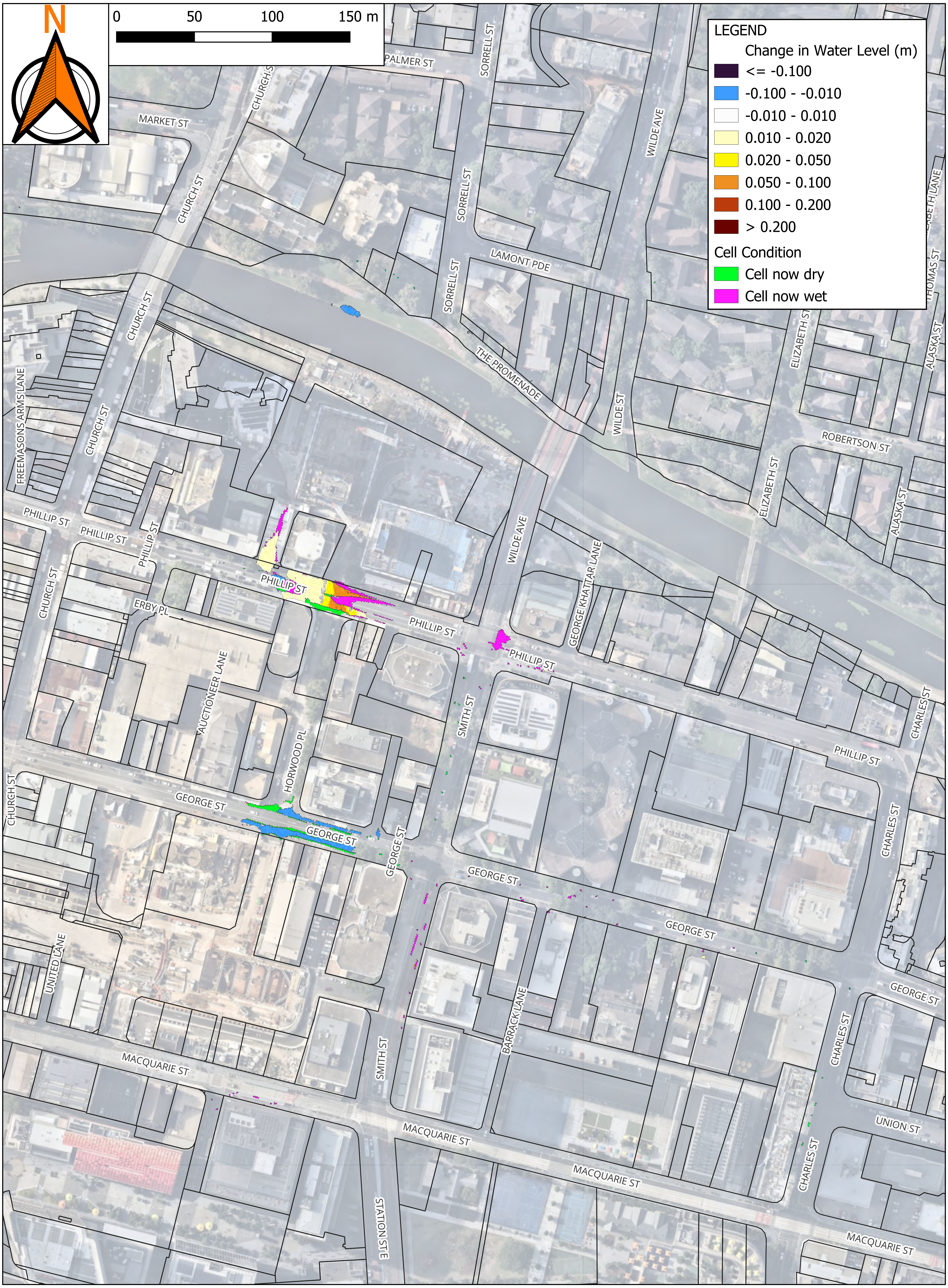

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PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD AFFLUX
OPTION1, 20% AEP 30mins, RIVER PEAK

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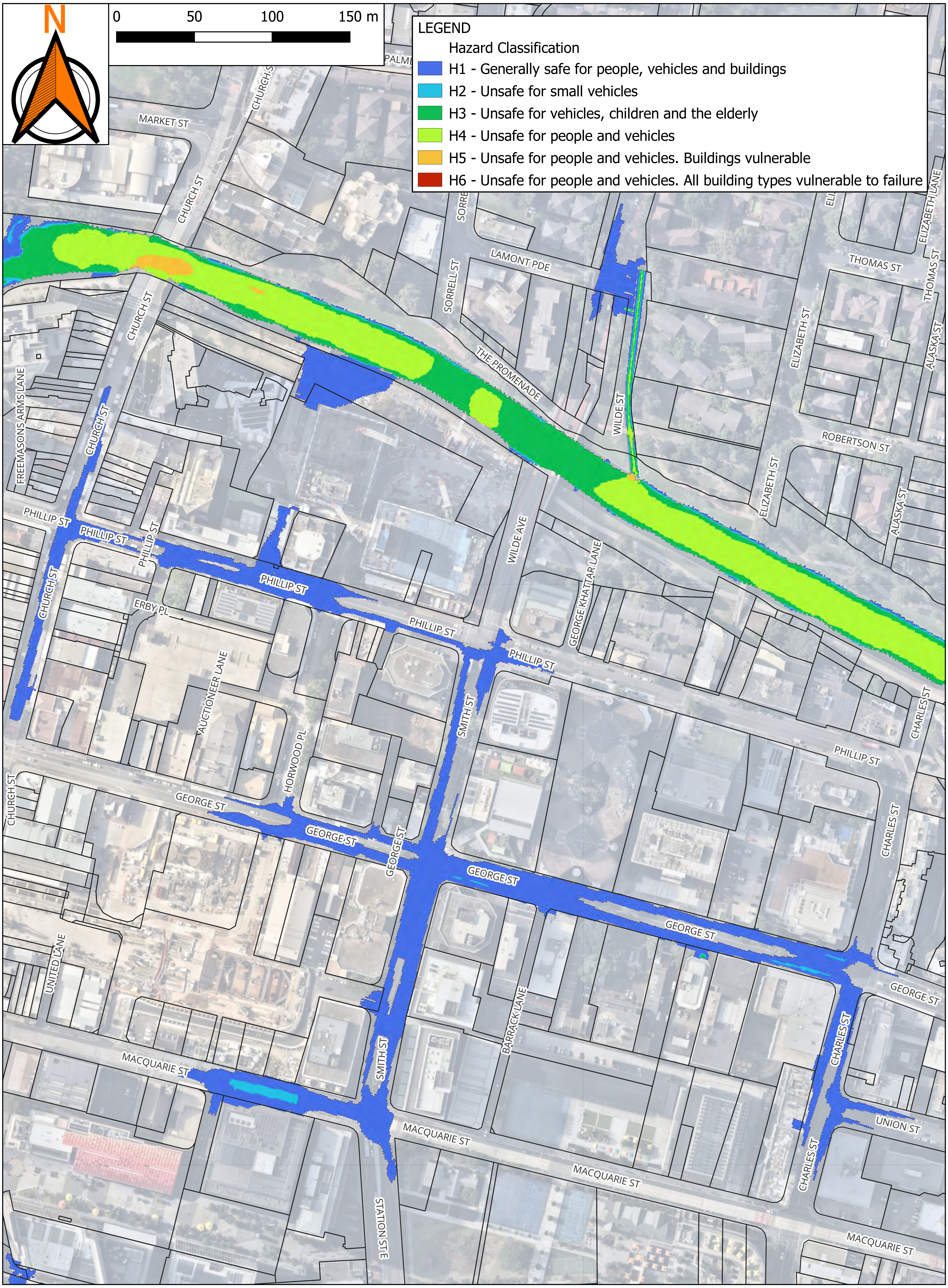

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PROJECT:

PARRAMATTA CIVIC LINK

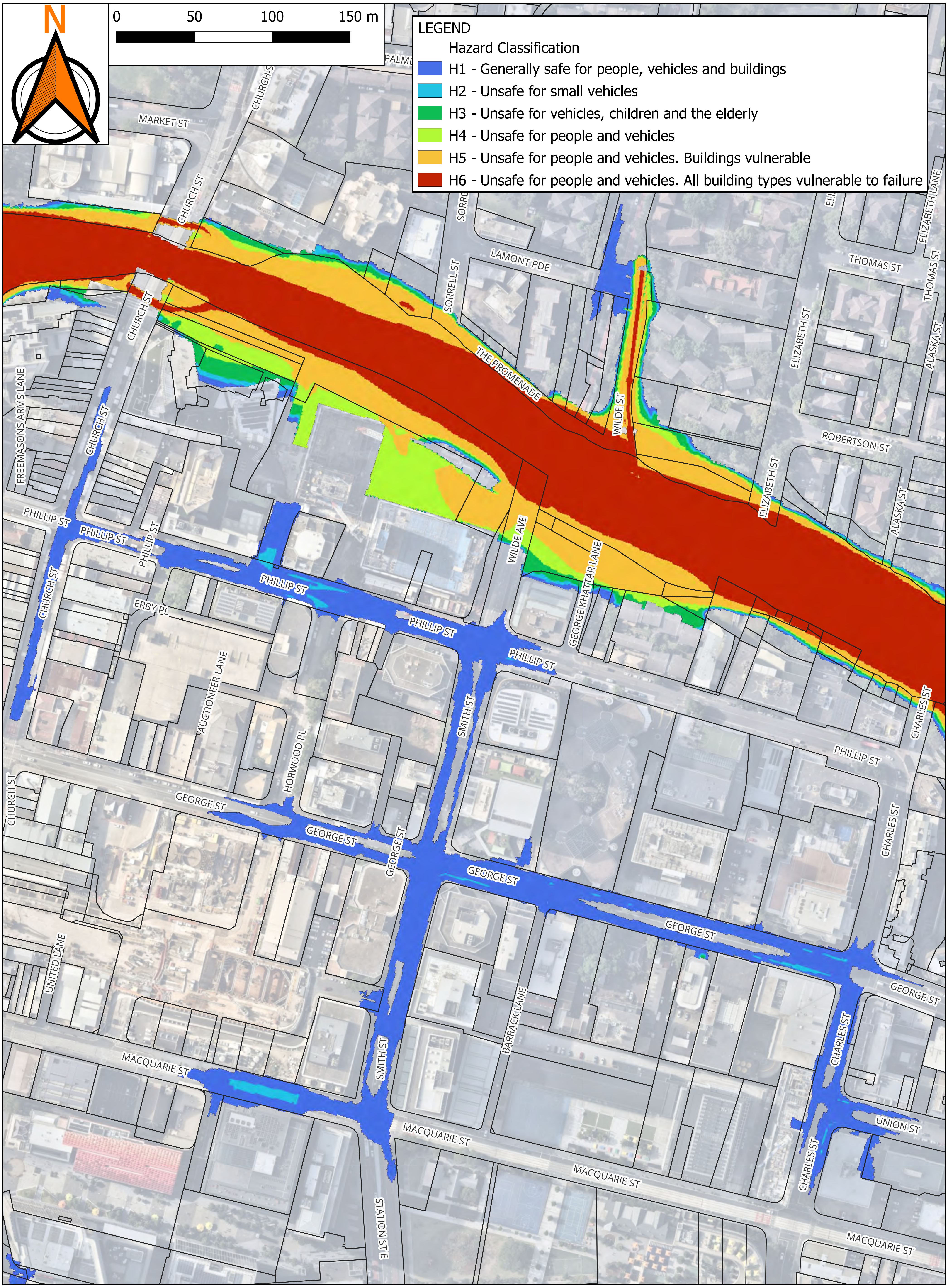
TITLE:

FLOOD HAZARD

BASE, 1% AEP 30mins, LOW BOUNDARY

MAP: F0031

PROJECT NUMBER: 30190380



PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
BASE, 1% AEP 30mins, RIVER PEAK

MAP: F0032

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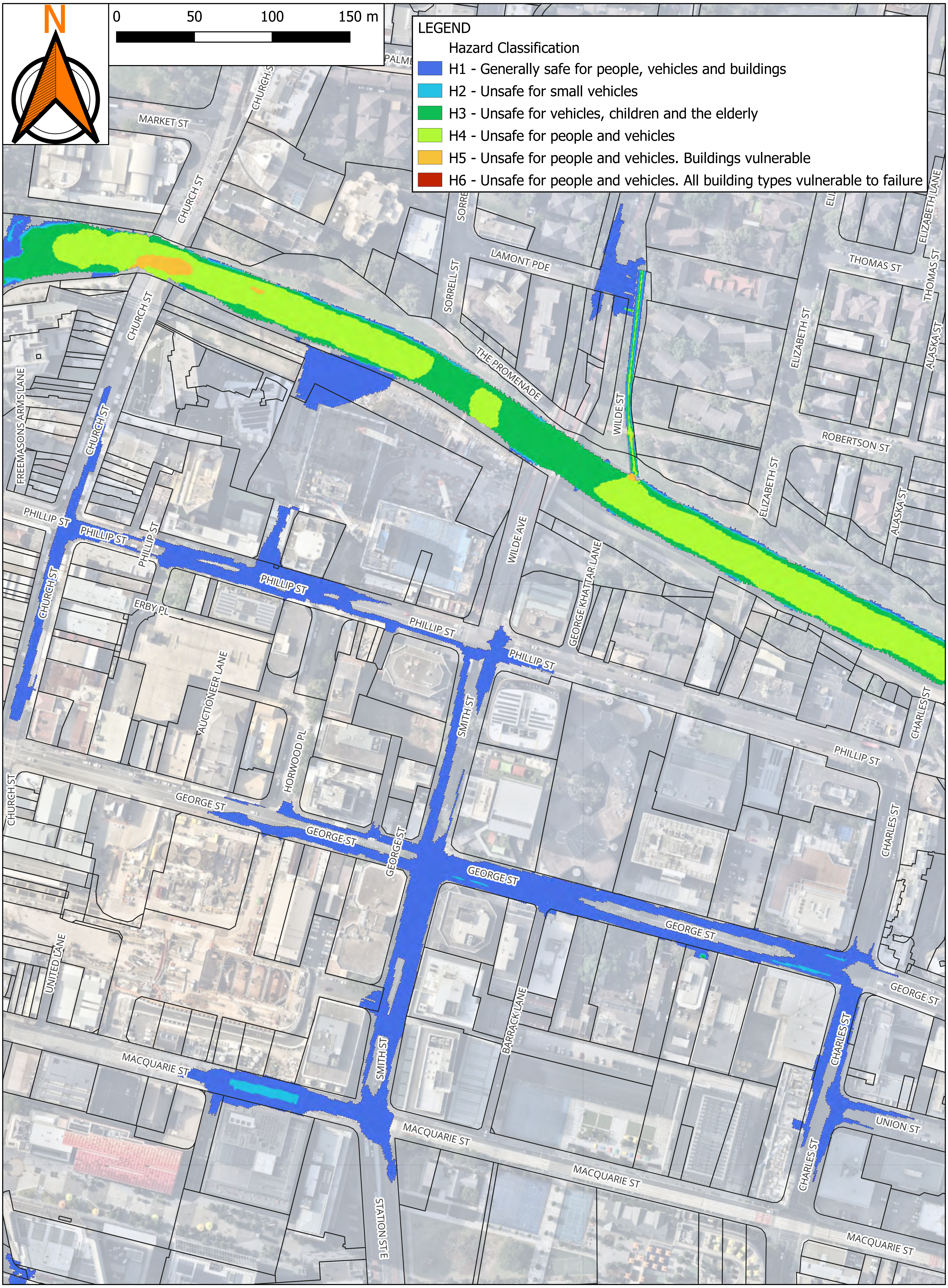


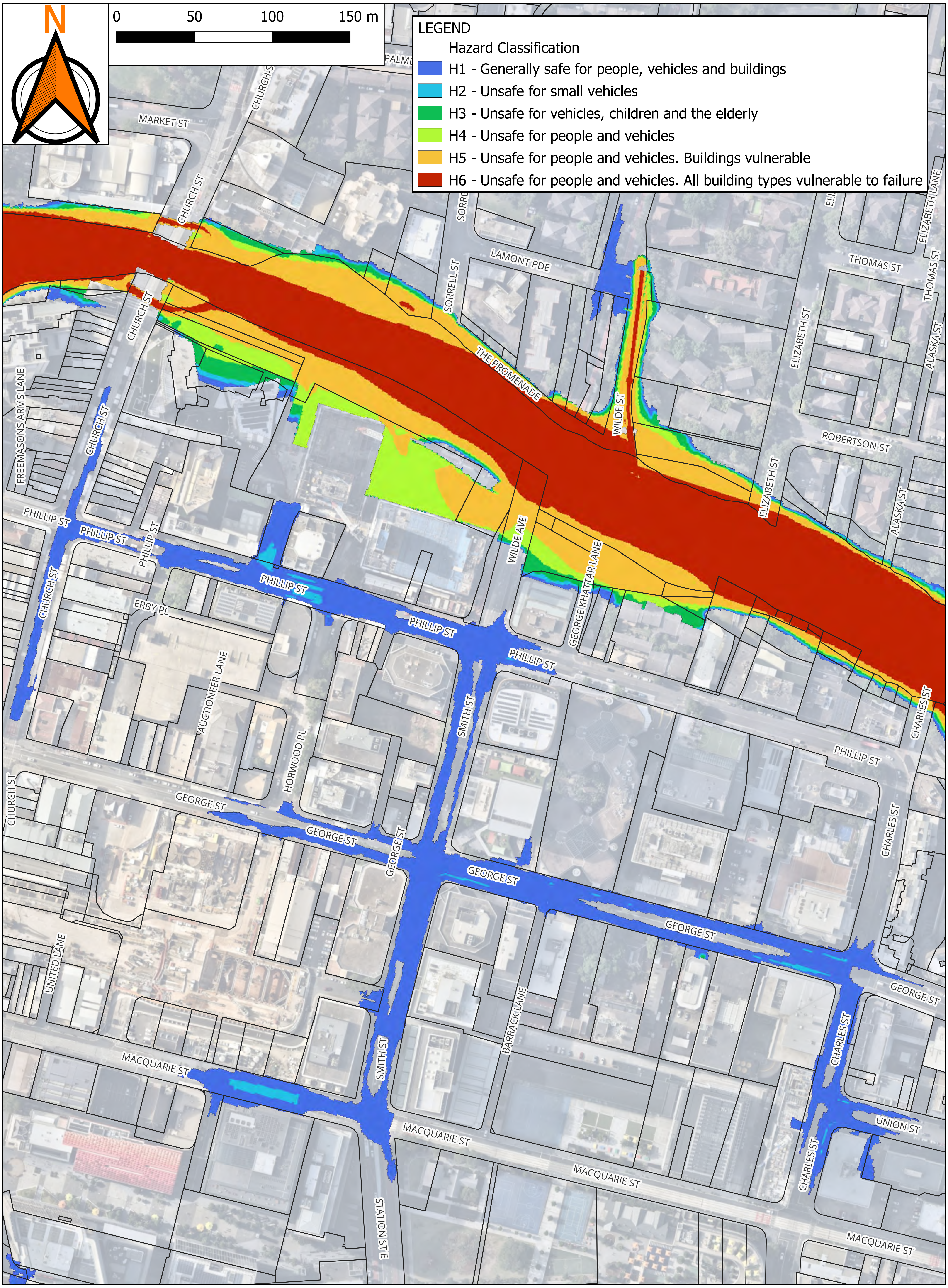
ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
CIVIC LINK ONLY, 1% AEP 30mins, LOW BOUNDARY

MAP: F0033

PROJECT NUMBER: 30190380



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TITLE:
FLOOD HAZARD
CIVIC LINK ONLY, 1% AEP 30mins, RIVER PEAK

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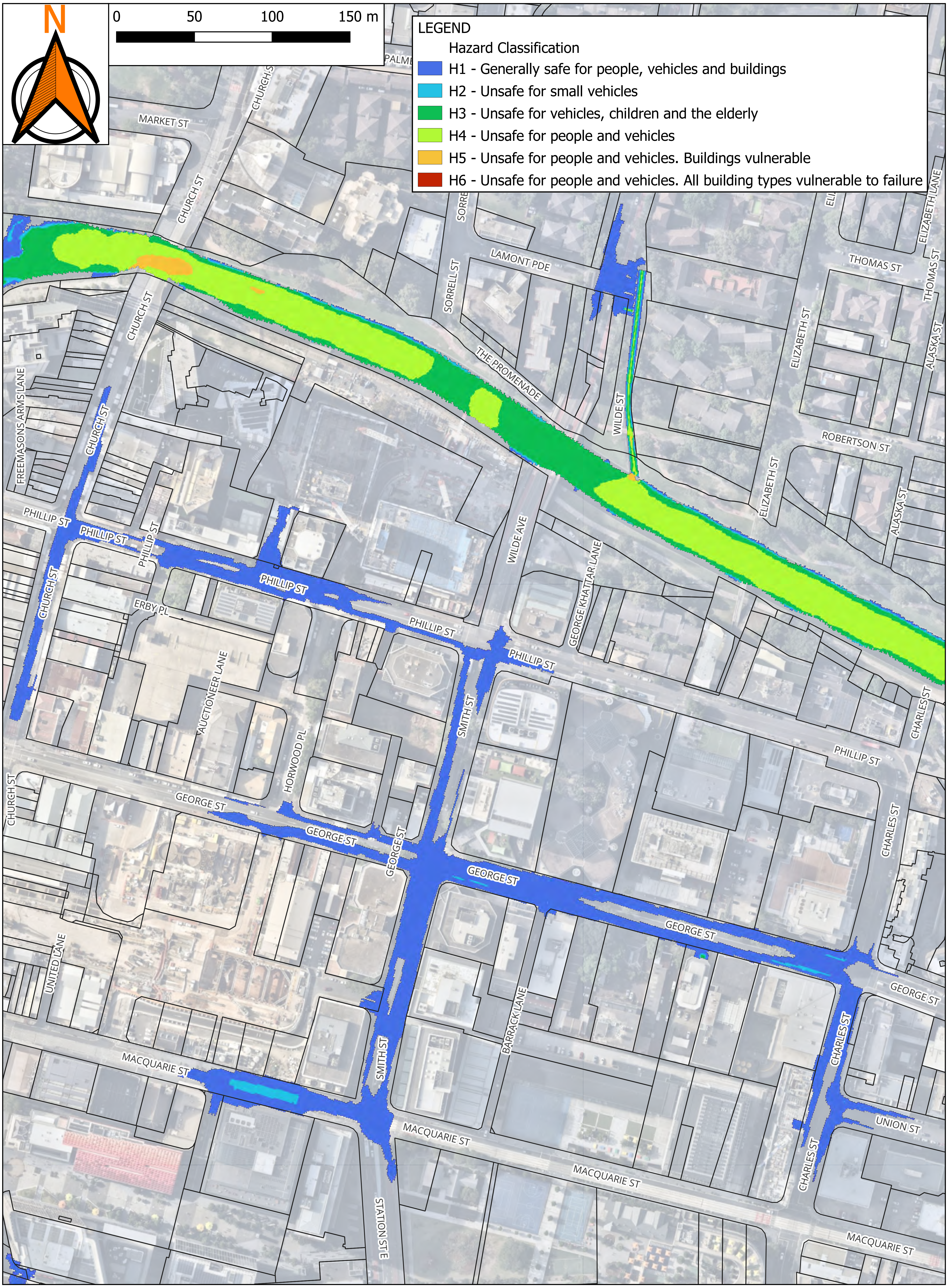

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PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
OPTION1, 1% AEP 30mins, LOW BOUNDARY

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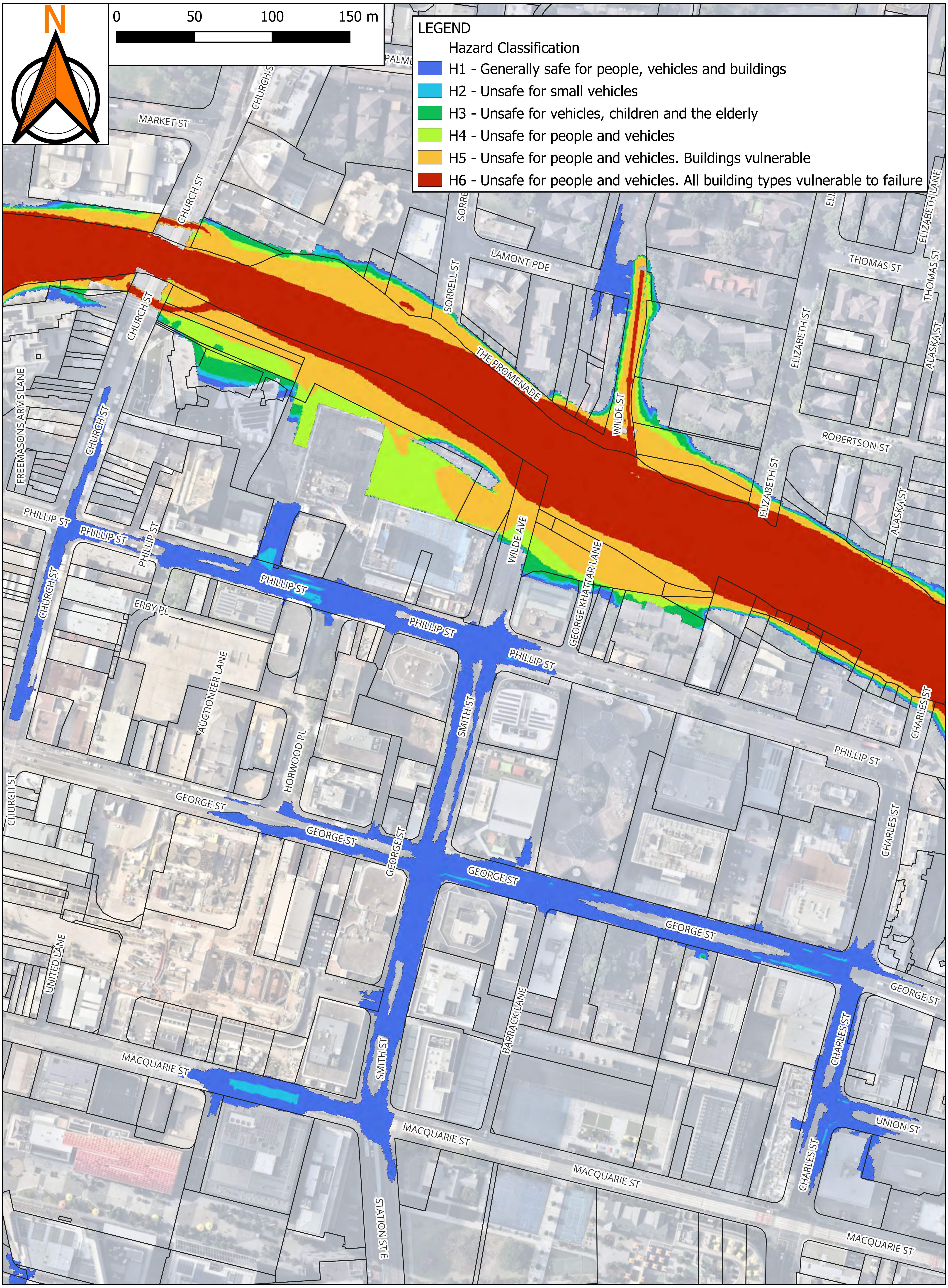
PROJECT NUMBER: 30190380



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FLOOD HAZARD
OPTION1, 1% AEP 30mins, RIVER PEAK
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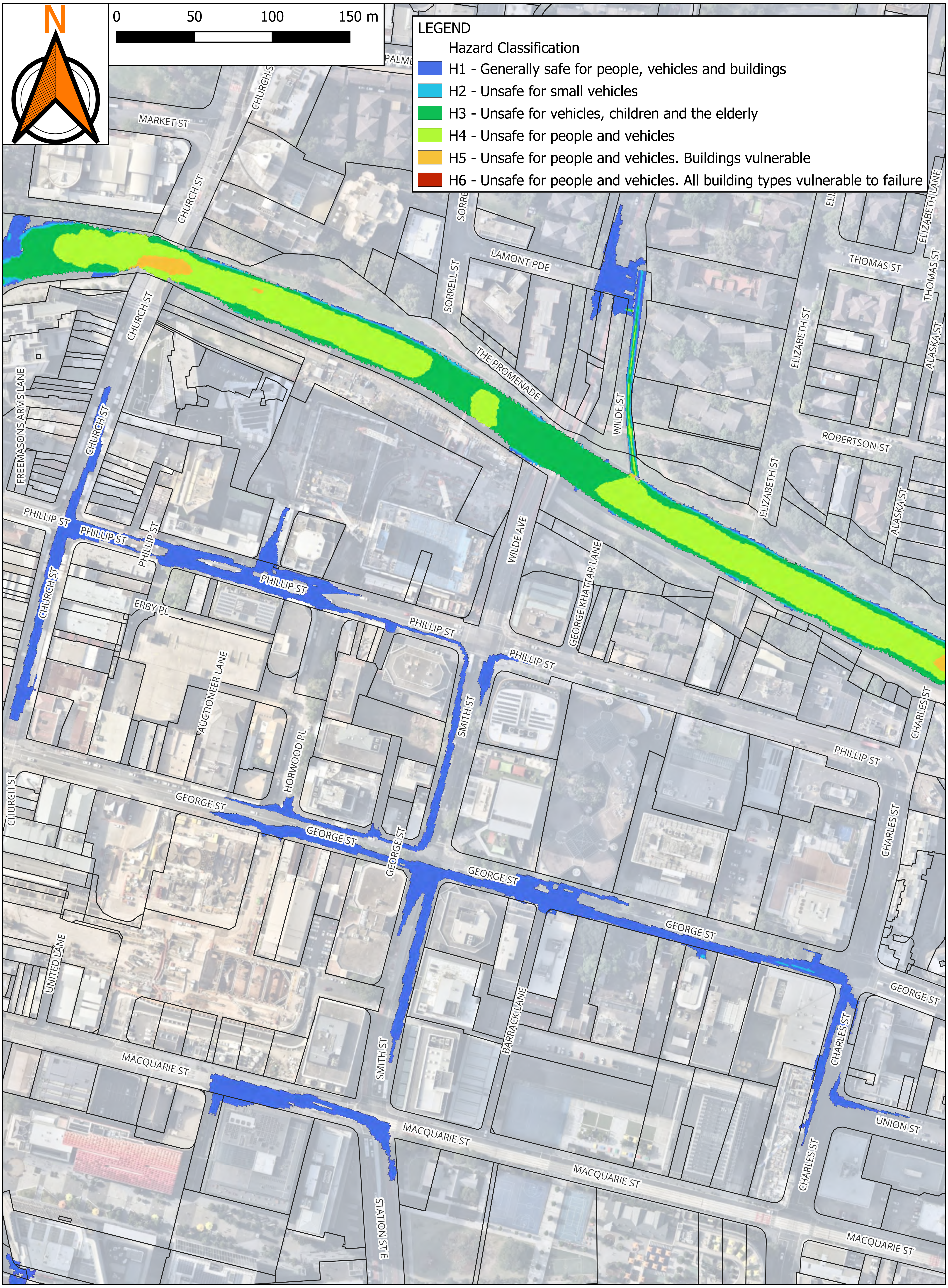

ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
BASE, 5% AEP 30mins, LOW BOUNDARY

MAP: F0037

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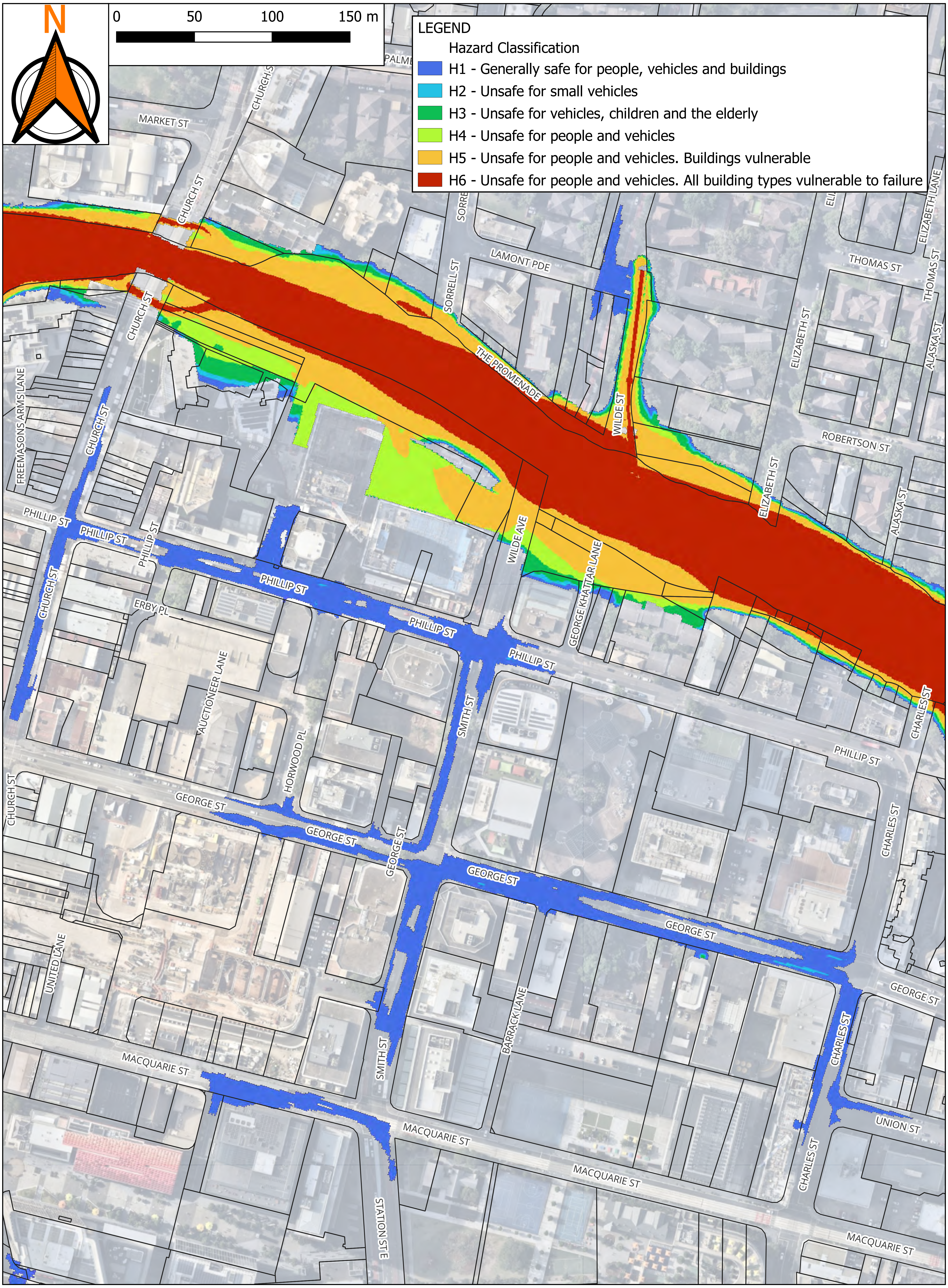

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TITLE:
FLOOD HAZARD
BASE, 5% AEP 30mins, RIVER PEAK

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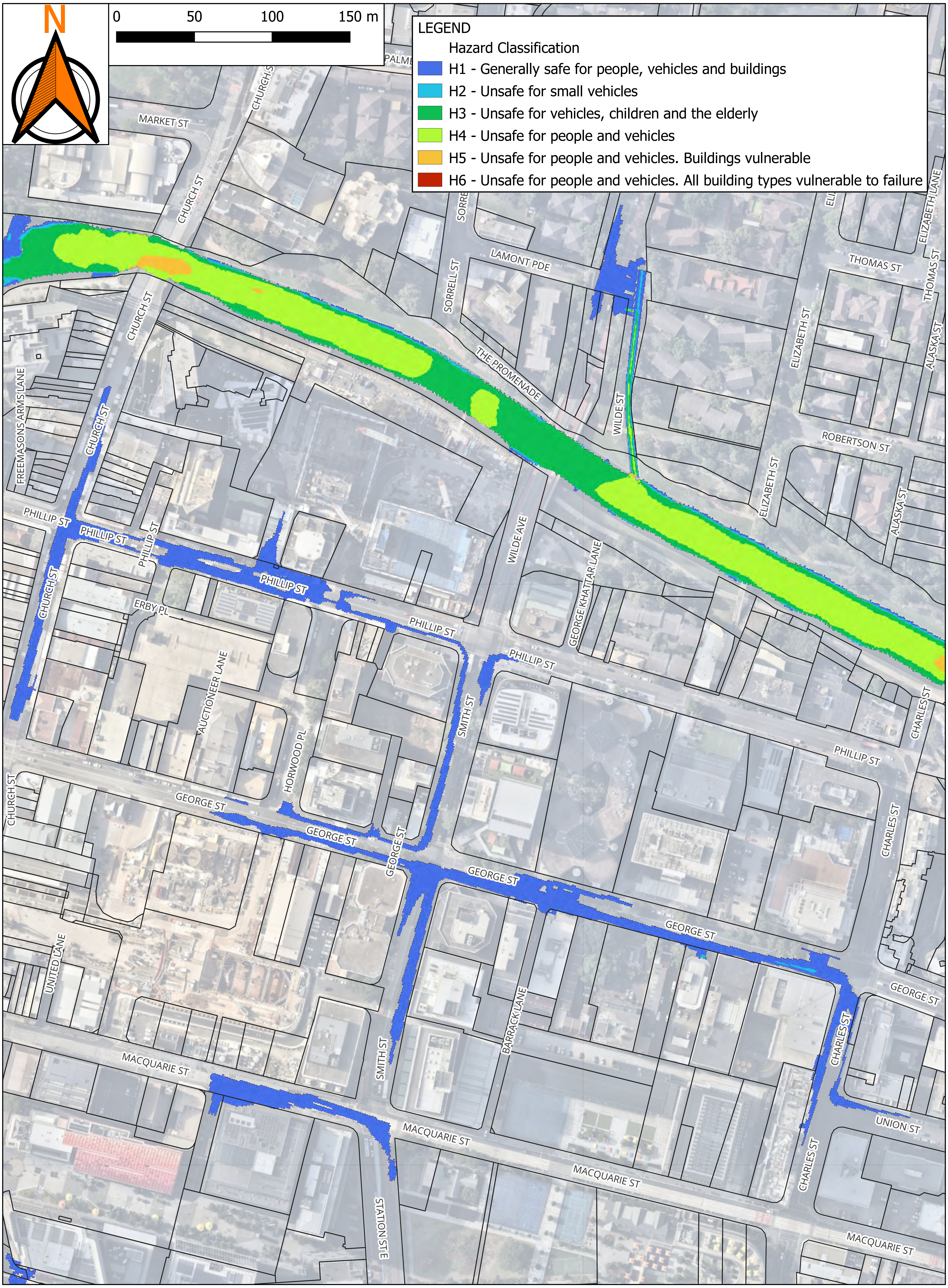


PROJECT:

PARRAMATTA CIVIC LINK

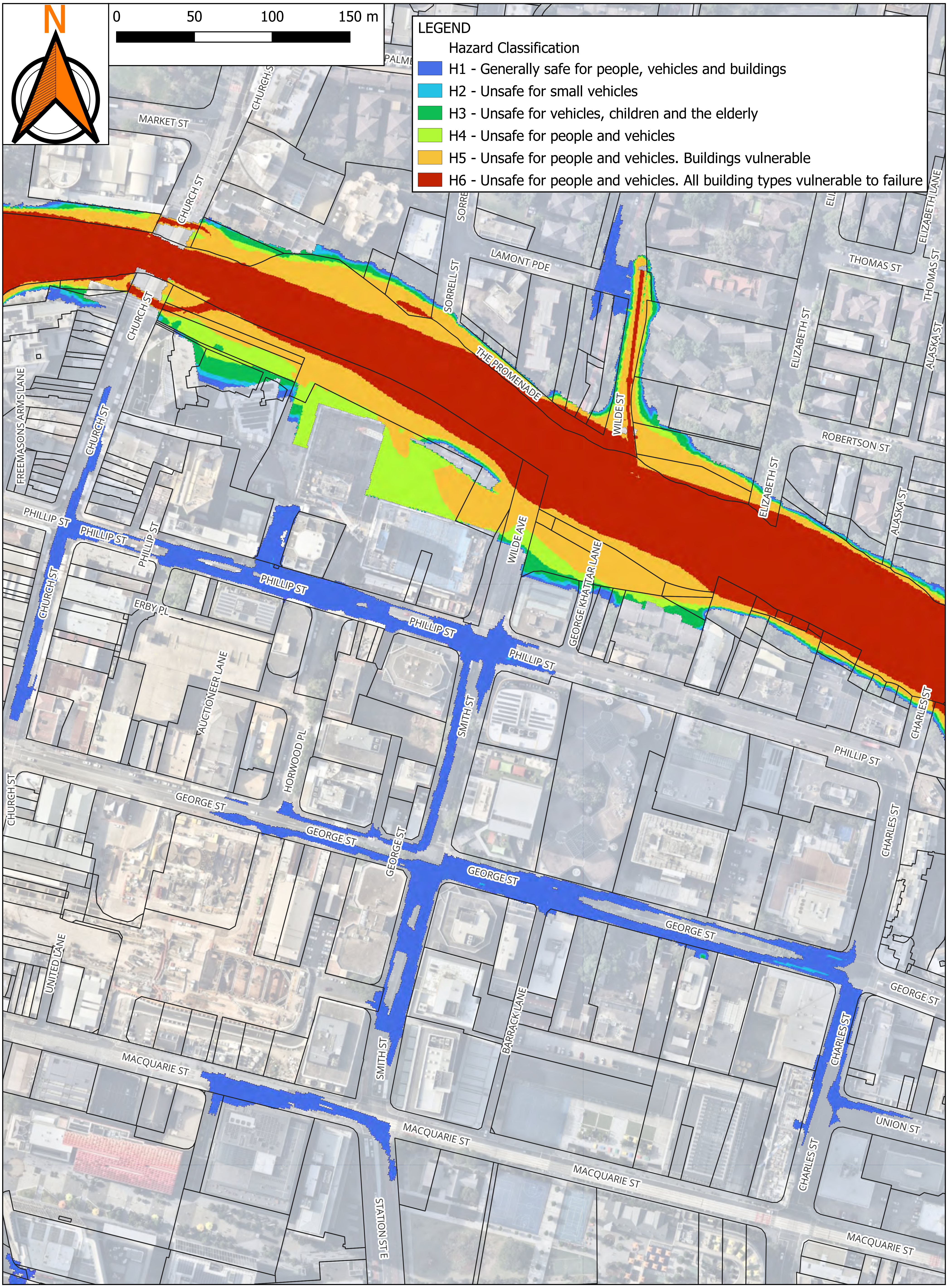
TITLE:

FLOOD HAZARD

CIVIC LINK ONLY, 5% AEP 30mins, LOW BOUNDARY

MAP: F0039

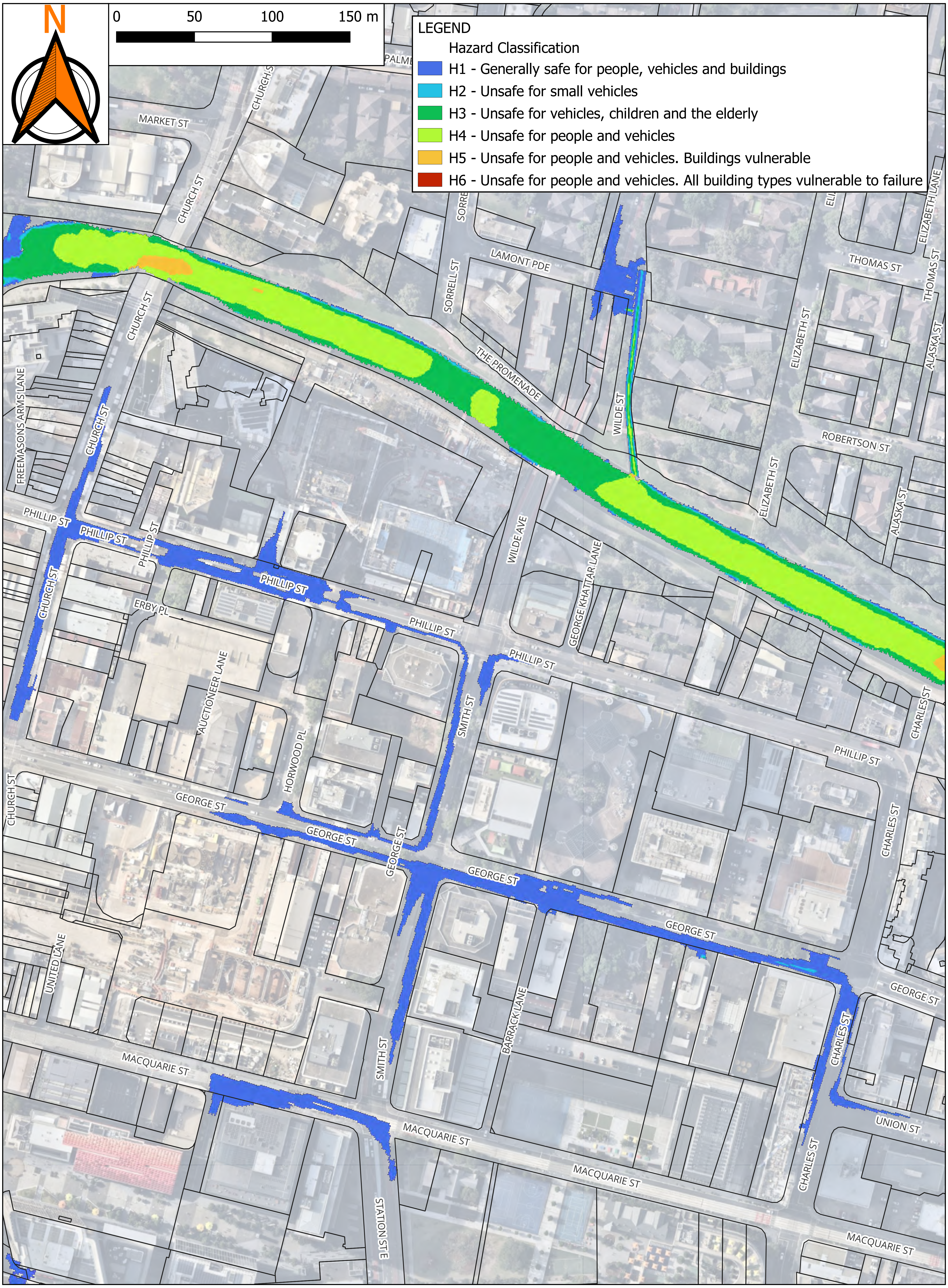
PROJECT NUMBER: 30190380



PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
CIVIC LINK ONLY, 5% AEP 30mins, RIVER PEAK
MAP: F0040
PROJECT NUMBER: 30190380

ARCADIS



ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
OPTION1, 5% AEP 30mins, LOW BOUNDARY

MAP: F0041
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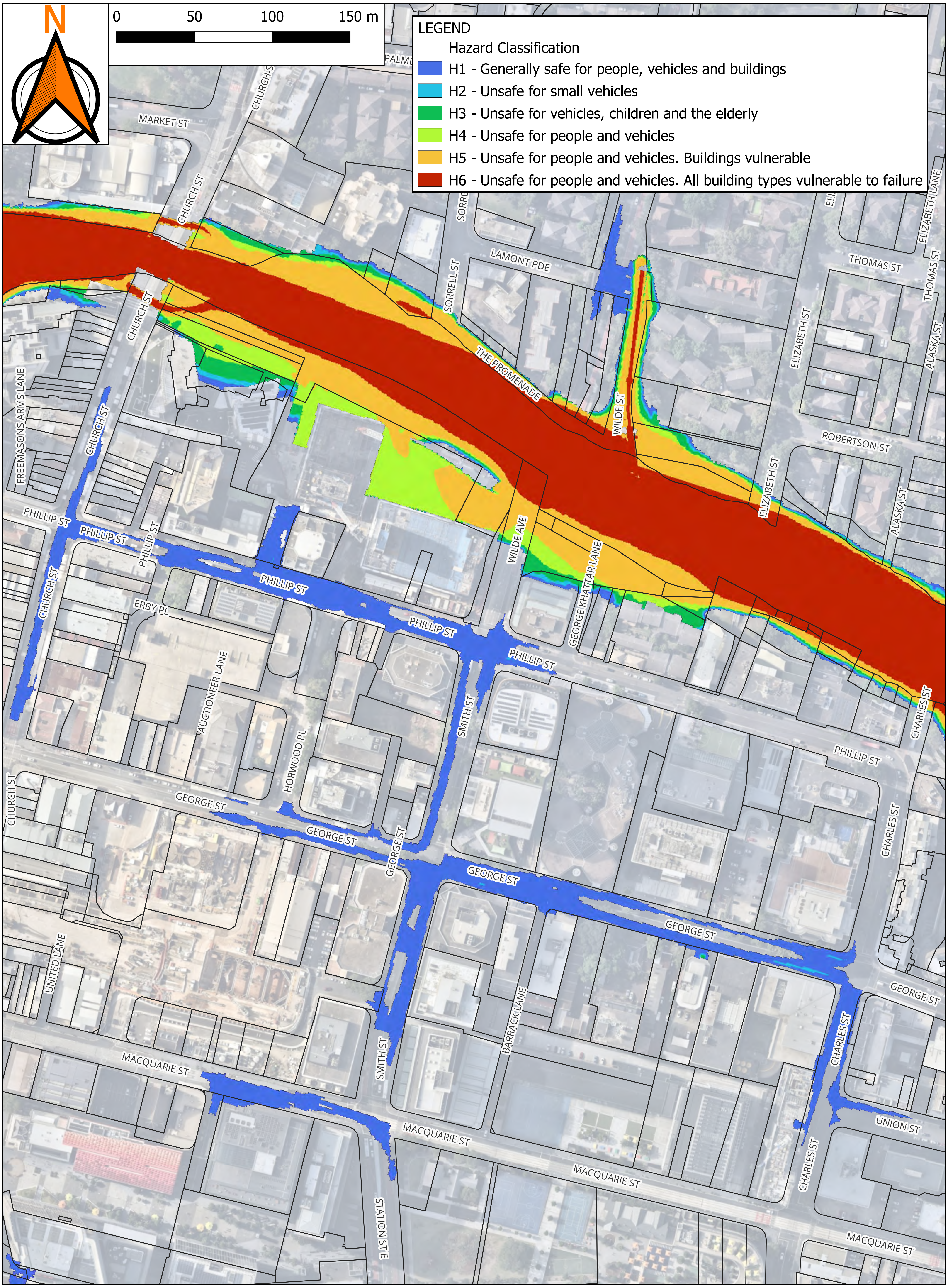


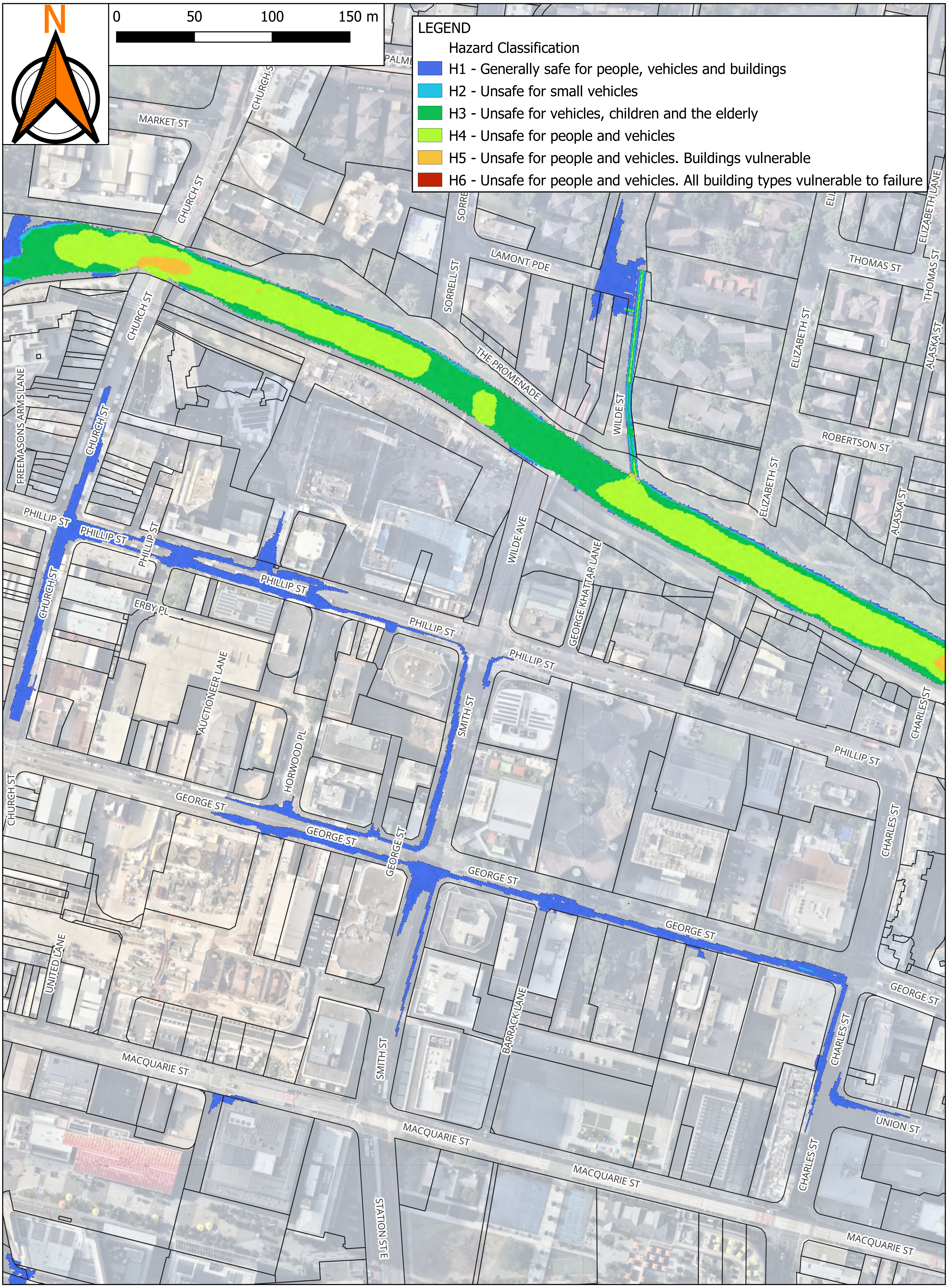
ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
OPTION1, 5% AEP 30mins, RIVER PEAK

MAP: F0042

PROJECT NUMBER: 30190380



LEGEND

Hazard Classification

- 🟦 H1 - Generally safe for people, vehicles and buildings
- 🟦 H2 - Unsafe for small vehicles
- 🟩 H3 - Unsafe for vehicles, children and the elderly
- 🟩 H4 - Unsafe for people and vehicles
- 🟧 H5 - Unsafe for people and vehicles. Buildings vulnerable
- 🟥 H6 - Unsafe for people and vehicles. All building types vulnerable to failure

ARCADIS

PROJECT:

PARRAMATTA CIVIC LINK

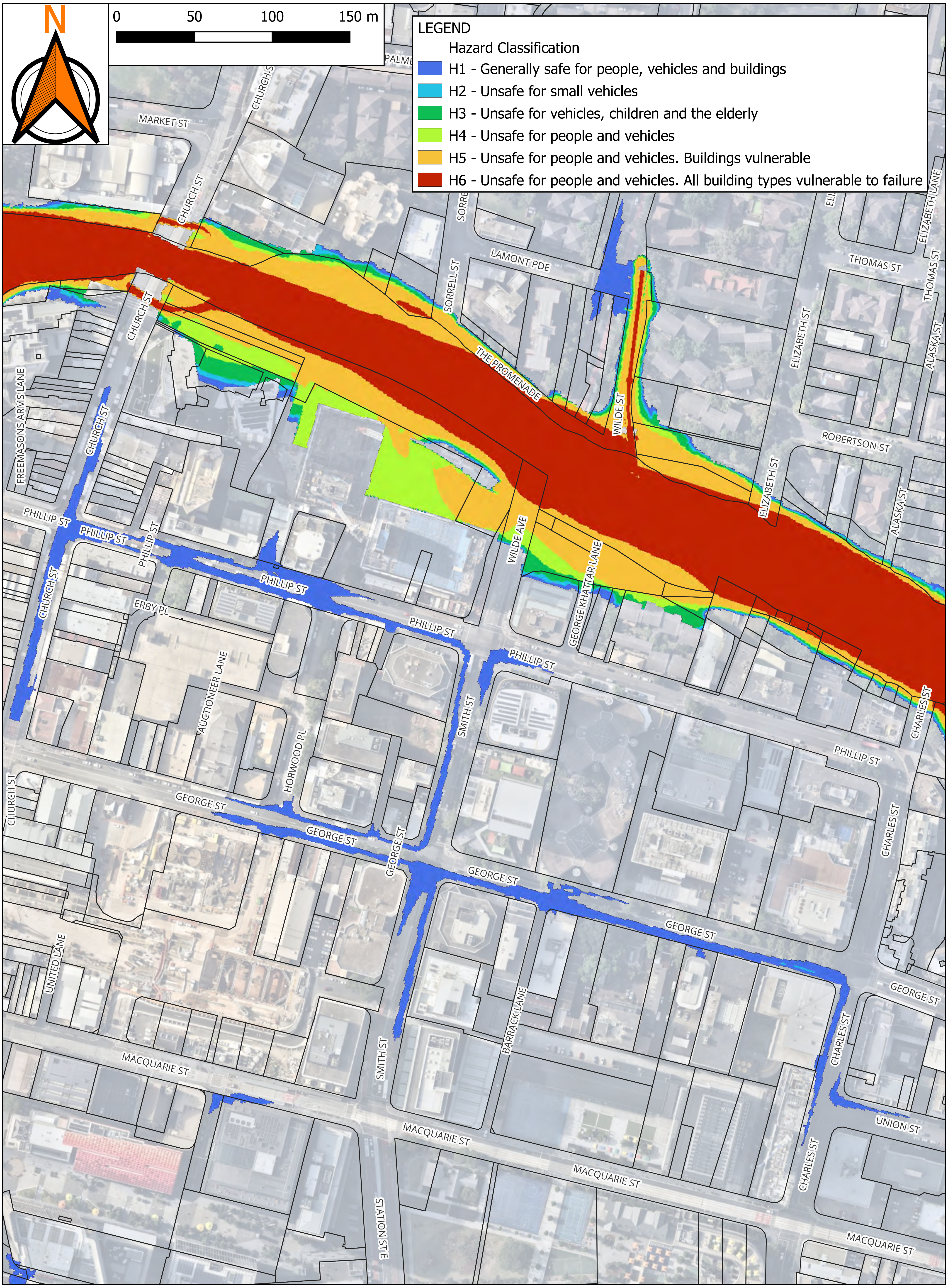
TITLE:

FLOOD HAZARD

BASE, 20% AEP 30mins, LOW BOUNDARY

MAP: F0043

PROJECT NUMBER: 30190380



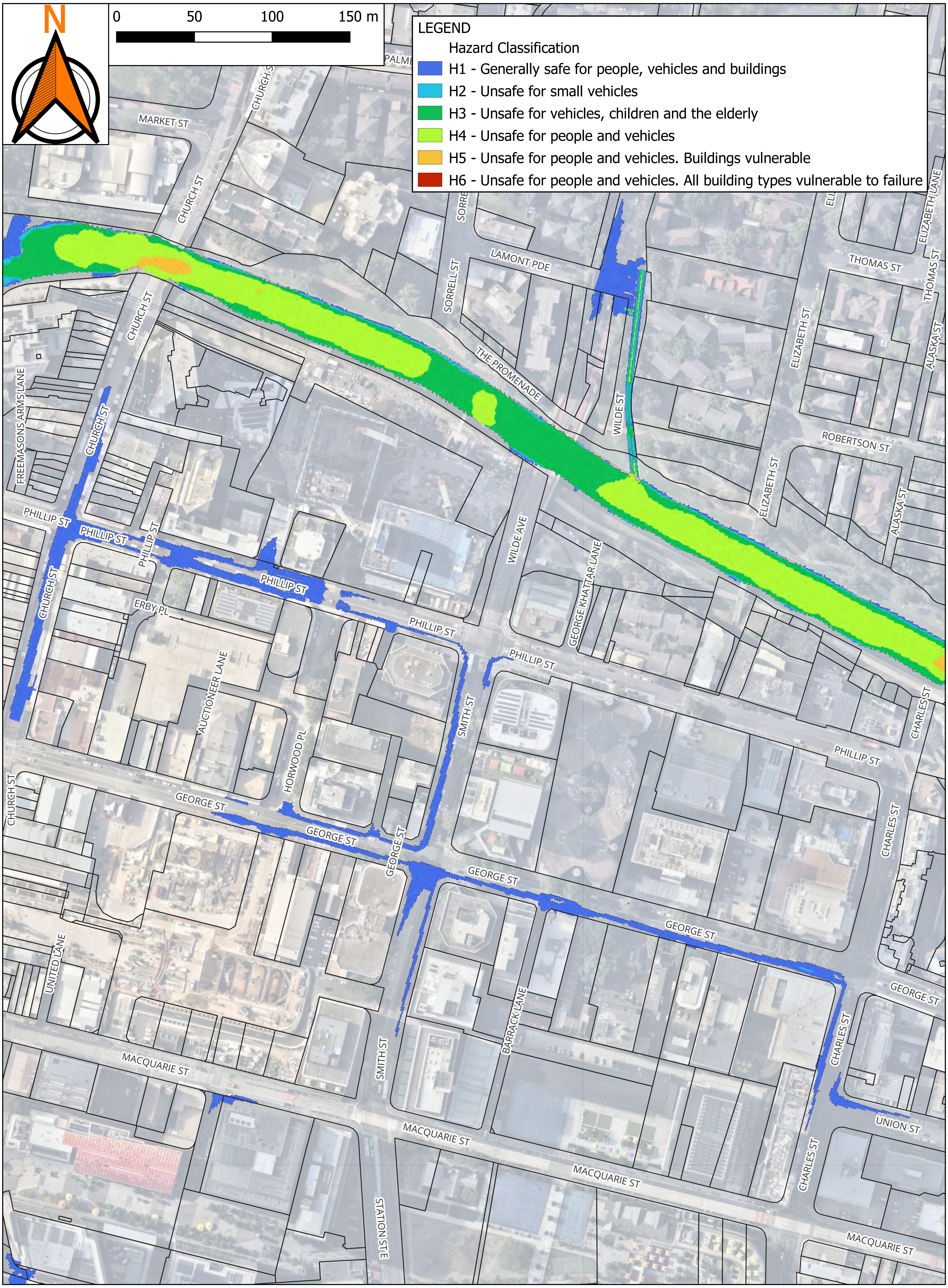
ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
BASE, 20% AEP 30mins, RIVER PEAK

MAP: F0044

PROJECT NUMBER: 30190380

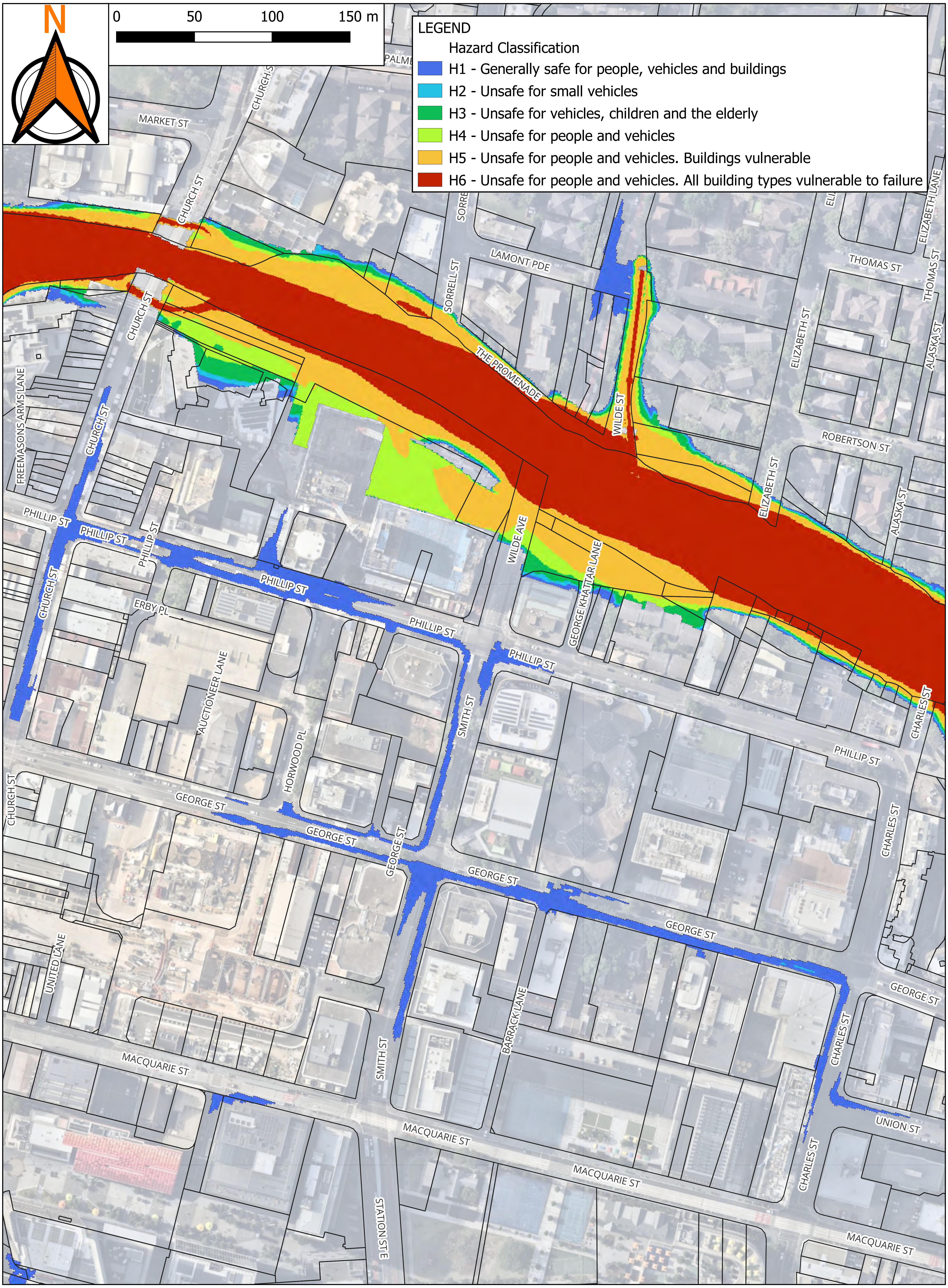


PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
CIVIC LINK ONLY, 20% AEP 30mins, LOW BOUNDARY

MAP: F0045

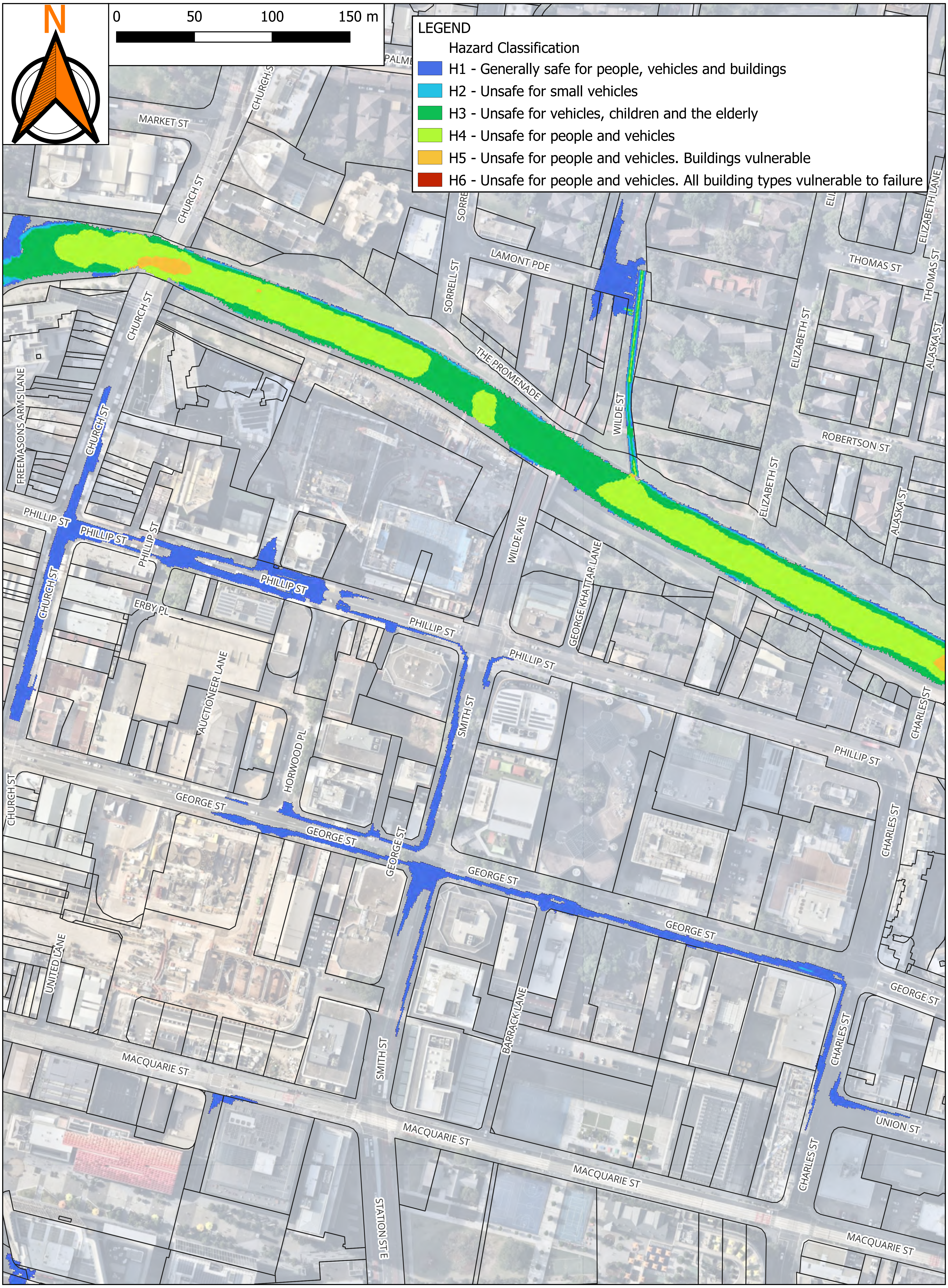
PROJECT NUMBER: 30190380



ARCADIS

PROJECT:
PARRAMATTA CIVIC LINK

TITLE:
FLOOD HAZARD
CIVIC LINK ONLY, 20% AEP 30mins, RIVER PEAK
MAP: F0046
PROJECT NUMBER: 30190380



PROJECT:

PARRAMATTA CIVIC LINK

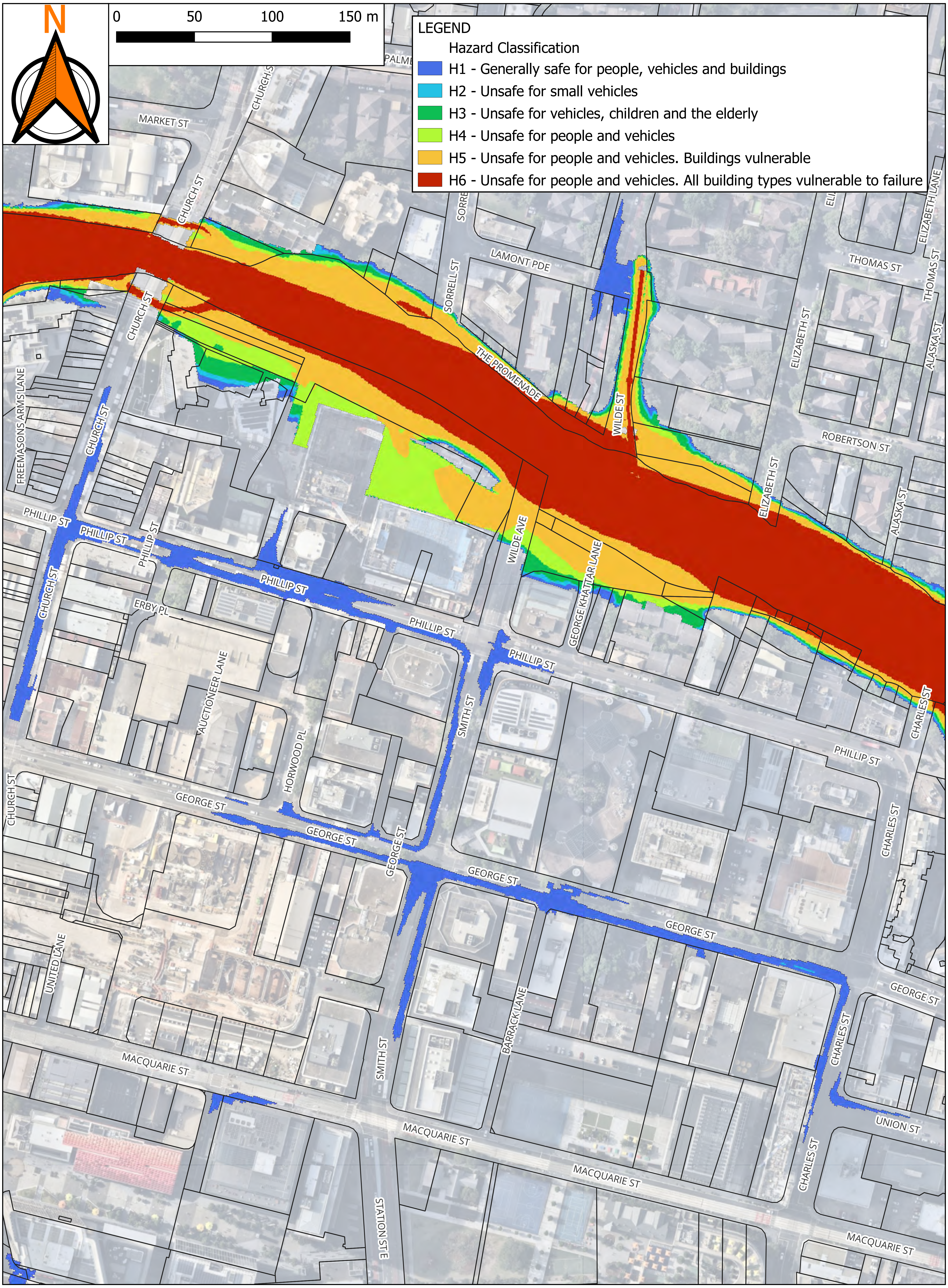
TITLE:

FLOOD HAZARD

OPTION1, 20% AEP 30mins, LOW BOUNDARY

MAP: F0047

PROJECT NUMBER: 30190380



PROJECT:

PARRAMATTA CIVIC LINK

TITLE:

FLOOD HAZARD

OPTION1, 20% AEP 30mins, RIVER PEAK

MAP: F0048

PROJECT NUMBER: 30190380

APPENDIX B – PHILLIP STREET OPTIONS ASSESSMENT

Memo

SUBJECT
Phillip Street Stormwater Options

DATE
01/10/2025

TO
Emily Forrest

CLIENT
City of Parramatta

FROM
Michelle Fletcher

COPY TO
George Dunstan

This memo has been prepared to outline the results of the stormwater options investigation for Phillip Street Parramatta as outlined in the letter dated 13/08/2025 to City of Parramatta. The options assessed are as follows:

- Option 1 – Upsize of pipe in northern footpath.
- Option 2 – Investigate duplication of existing 450mm crossroad drainage above watermain. Consultation with SMEC required to assess possible protection measures for existing DN900 watermain, constructability and Sydney Water approval requirements.
- Option 2A – Investigate increasing the extent of upgrade east (extra run of pipe to inlet (shown in turquoise on plan)). Increase inlet capacity for this line.
- Option 2B – Investigate option of connecting south side gutter inlet drain to the north (shown in purple on plan). Consultation with SMEC required to assess possible protection measures for existing DN900 watermain, constructability and Sydney Water approval requirements.
- Option 2C – Investigate inclusion of trench grates placed in gutter line of raised pedestrian crossing to ensure continuous gutter flow (shown in yellow below).
- Option 7 – Investigate whether it is possible to divert some of the Horwood Place flow to the first pit located in the centre of Phillip St, without having to chase further east along Phillips St (shown in orange below).

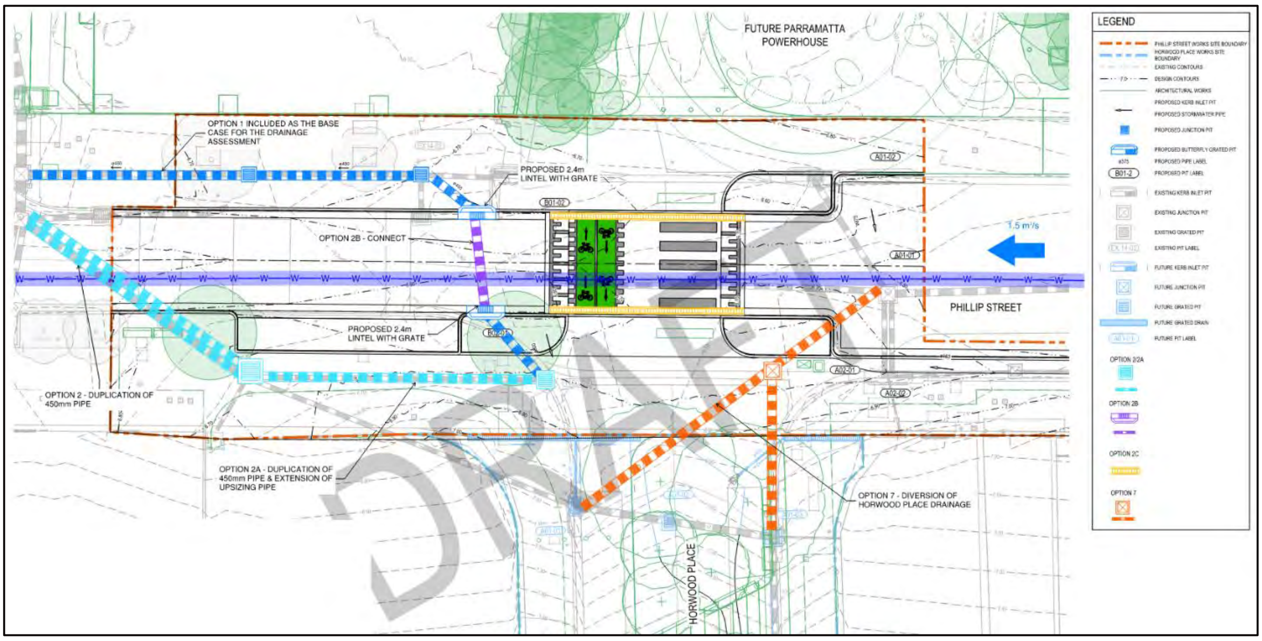


Figure 1 – Stormwater Options at Phillip Street

Assessment Process

Options 1, 2, 2A, 2B and Option 7 will be assessed in 12d for spatial constraints including clearance to existing utilities and DRAINS to determine if they have an impact on the water levels in the drainage network on Phillip Street. The existing flood conditions are caused by an overland flow from the eastern end of Phillip Street. Only one overland flow path can be drawn from each pit in DRAINS which limits the quality of the assessment when significant overland flows are involved. TUFLOW will also be used which is better at assessing the extent of surface flows along Phillip Street.

The spatial assessment was completed based on the information in the Durkin survey (dated 21/11/2023). Drainage invert levels have been based on the levels surveyed at the pits. As per Durkin's advice the levels for the utilities are ±0.3m.

Option 1

Option 1 consists of upsizing the pipe behind the northern kerb in Phillip Street. A 450mm diameter pipe has been provided with a minimum grade of 1%. The invert level of the proposed pipe has also been lowered to allow for additional head to develop in the drainage network. The proposed Option 1 alignment clashes with existing optical fibre conduit. It is not possible to provide an increase in pipe size without lowering the invert of the pipes due to the limited cover to existing, therefore the optical fibre conduit will need to be adjusted to allow for the installation of the proposed drainage.

Option 1 was compared to the proposed DRAINS model (including the proposed grading for Horwood Place and Phillip Street) to determine the impact of the modelling shows existing overland flows from the east along Phillip Street of 1.63 m^3/s at the raised pedestrian crossing which has been modelled to flow across the road and along the northern low point.

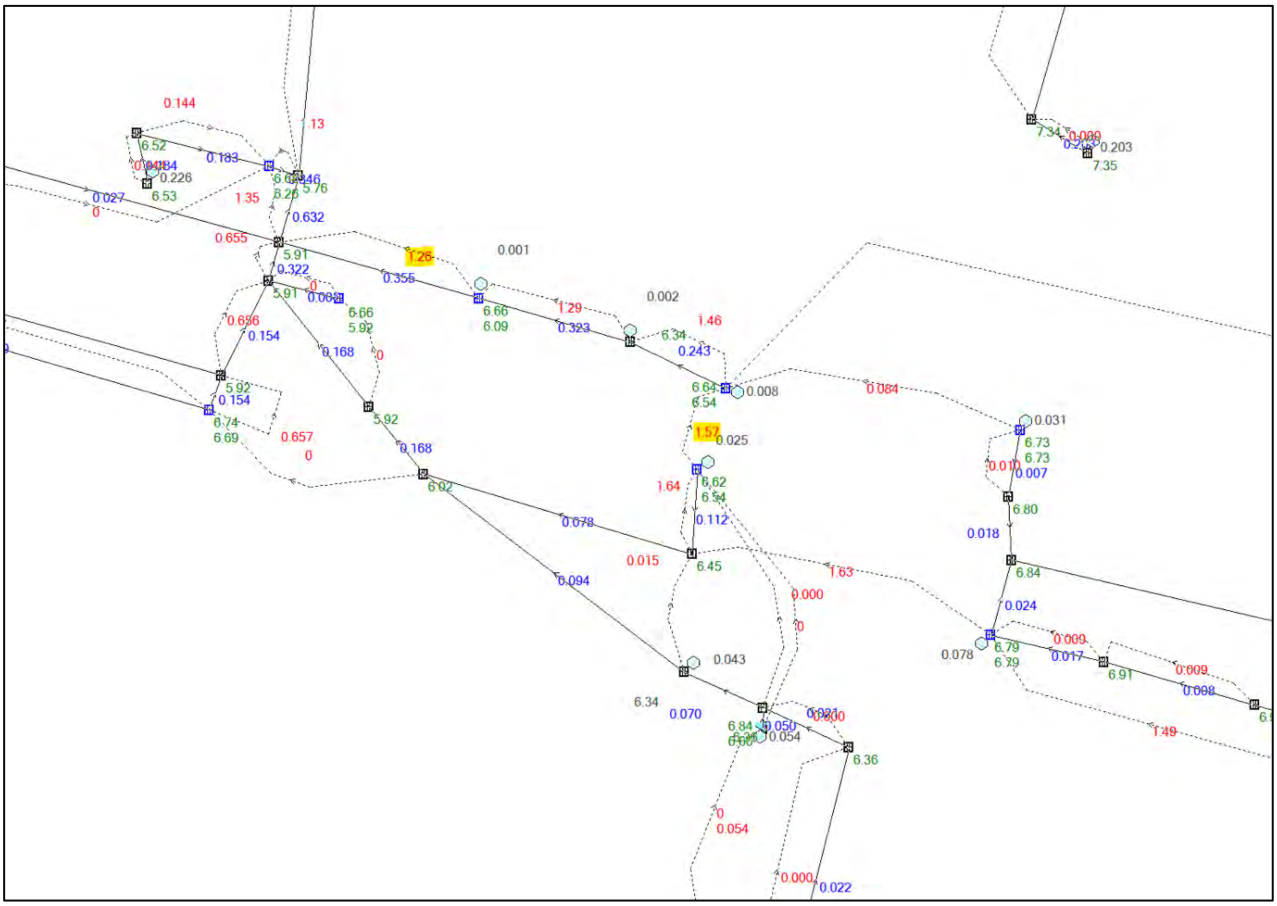


Figure 2 - Option 1 DRAINS Model

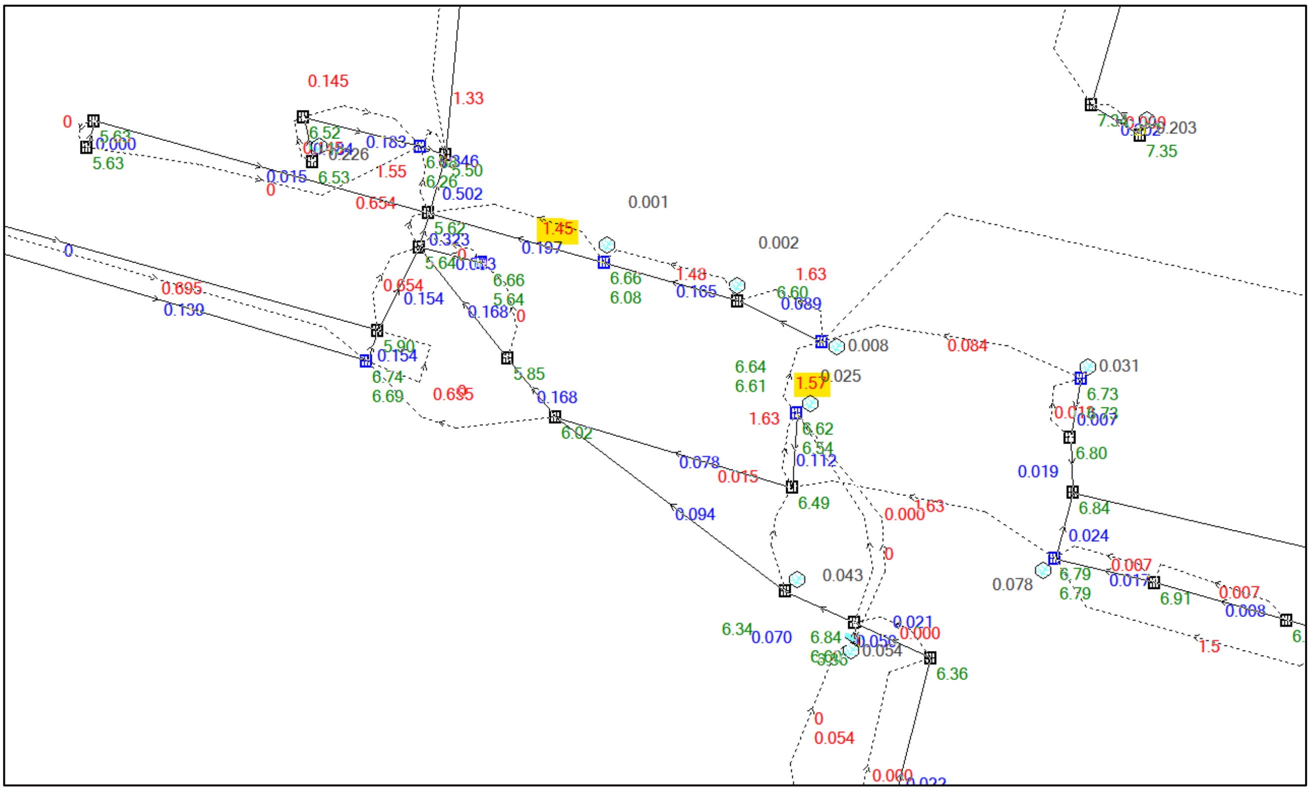


Figure 3 - Proposed DRAINS Model

Table 1 – Option 1 Comparison to Proposed Model

Location / Option	Proposed Model (5% AEP m^3/s)	Option 1 (5% AEP m^3/s)
Across Phillip Street	1.57	1.57
In north-western footpath	1.45	1.26

As shown in Table 1, the Option 1 upgrade of the existing pipe results in a reduction of the overland flows by approximately $0.19m^3/s$.

Option 2

The duplication of the existing 450mm diameter pipe crossing Phillip Street as shown in Figure 1 has been assessed as Option 2. The longitudinal section shown in Figure 4 is based on the current survey information available. The invert of this pipe appears to clash with the existing Sydney Water 900mm diameter water main. It is likely that the levels of the water main do not reflect the actual levels in this location (survey is ±0.3m) however, it is unlikely that there will be sufficient clearance to install a second 450mm diameter pipe.

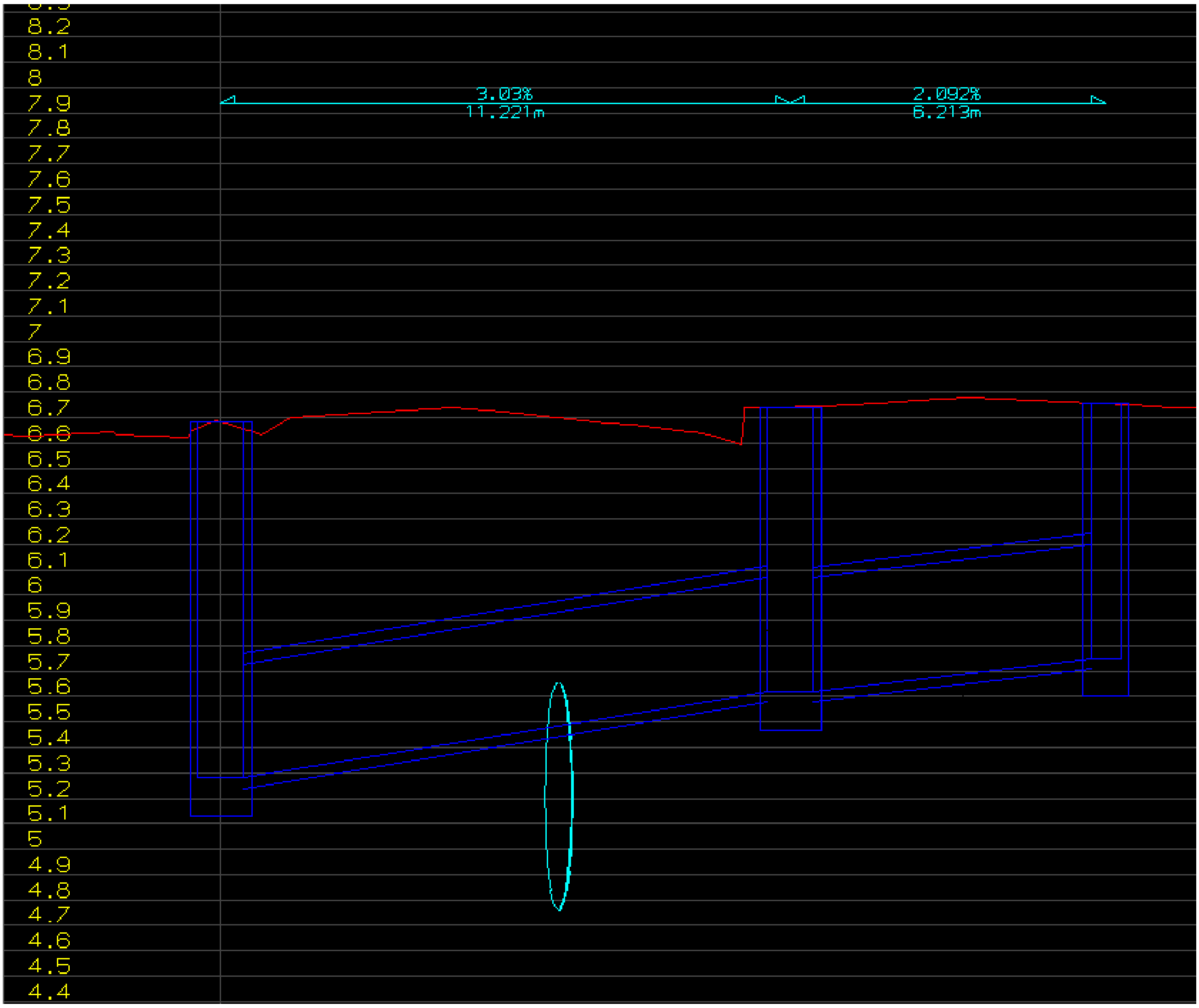


Figure 4 – Option 2 Longitudinal Section

DRAINS has been used to assess whether this Option has an impact on the water levels in the drainage network on Phillip Street compared to Option 1. Due to a limited inlet capacity along Phillip Street, the model does not show any reduction in overland flows by duplicating this pipe.

Table 2 – Option 2 Comparison to Option 1

Location / Option	**Option 1 (5% AEP m^3/s)**	**Option 2 (5% AEP m^3/s)**
Across Phillip Street	1.57	1.60
In north-western footpath	1.26	1.33

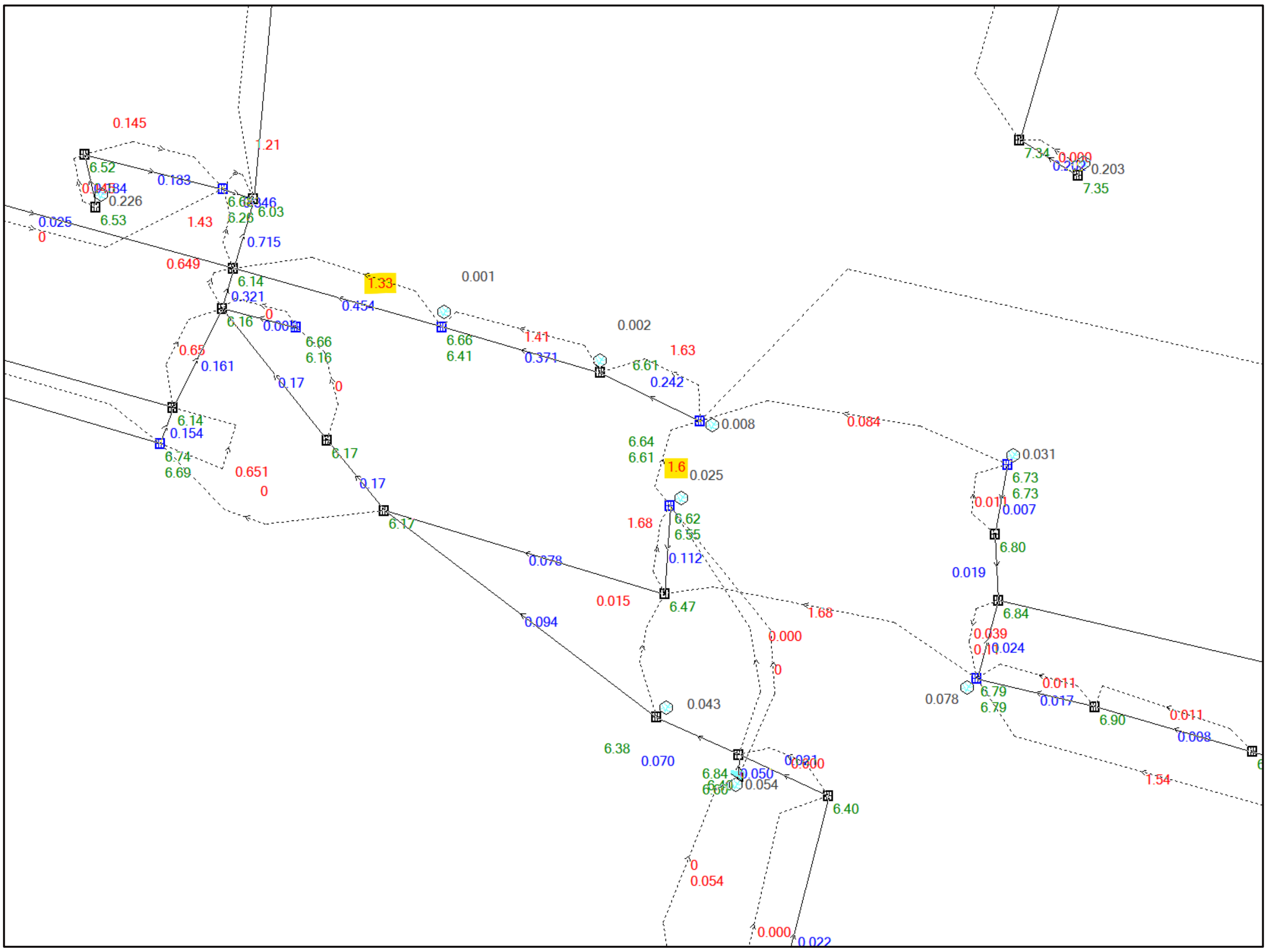


Figure 5 – Option 2 DRAINS Results

Option 2A

Option 2A increases the extend of the upgrade further upstream of Option 2. This increases the pipe capacity closer to where the inlet capacity is larger, however the improvement is still limited by the inlet capacity within Phillip Street.

Table 3 – Option 2A Comparison to Option 1

Location / Option	**Option 1 (5% AEP m^3/s)**	**Option 2A (5% AEP m^3/s)**
Across Phillip Street	1.57	1.54
In north-western footpath	1.26	1.24

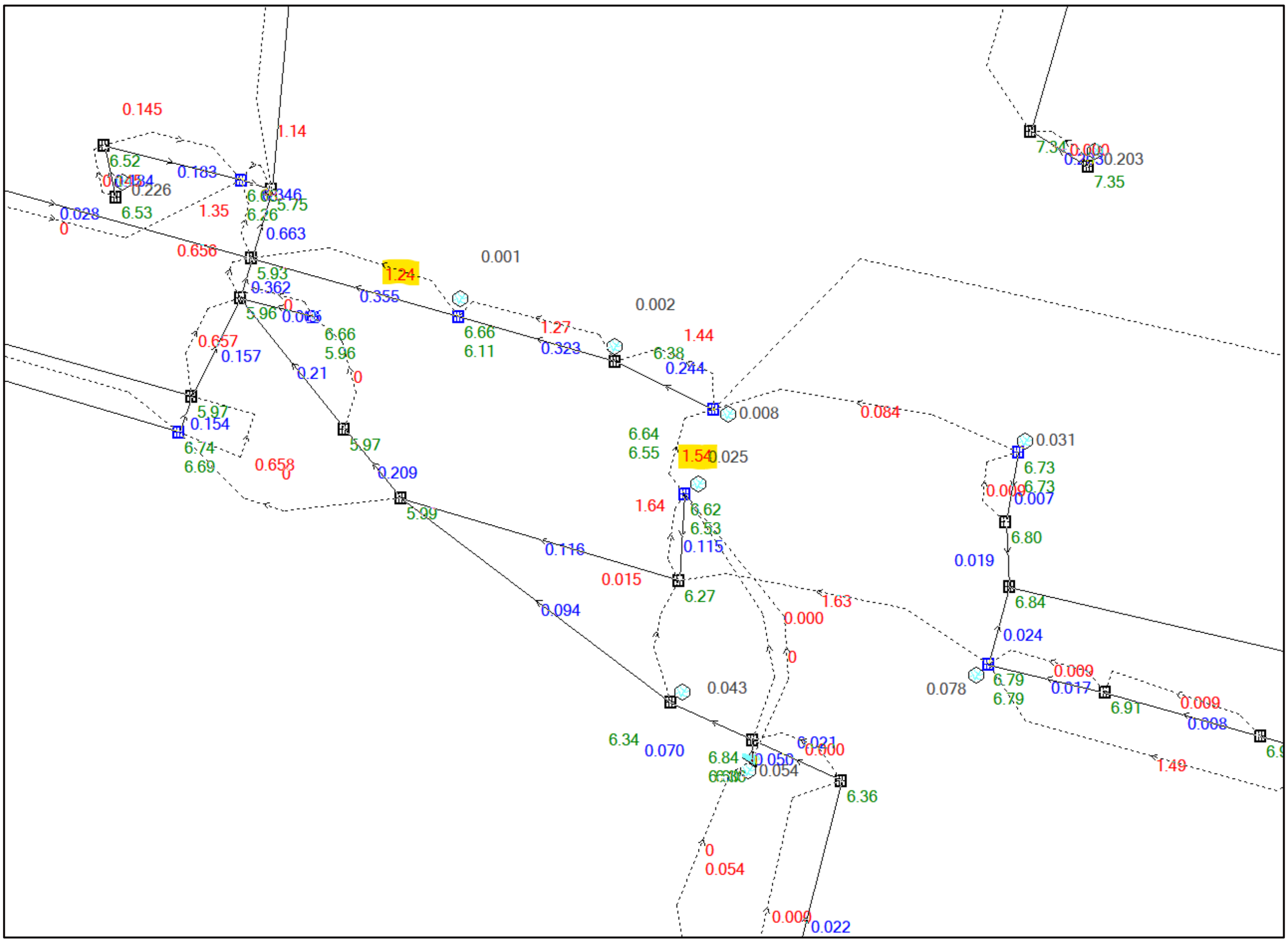


Figure 6 – Option 2A DRAINS Results

Option 2B

Option 2B proposes a change to the connection of the sag pit located on the south-western side of the raised pedestrian crossing. A 375mm pipe is proposed to cross Phillip Street and connect to the sag pit located on the north-western side of the raised pedestrian crossing. The intent of this was to divert additional flows away from the low point on the southern side of Phillip Street.

Modelling of this option shows an increase in the overland flows along Phillip Street and minor reductions in the HGL levels at the pits on the southern side of Phillip Street.

Table 4 – Option 2B Comparison to Option 1

Location / Option	Option 1 (5% AEP m^3/s)	Option 2B (5% AEP m^3/s)
Across Phillip Street	1.57	1.73
In north-western footpath	1.26	1.44

The longitudinal section shown in Figure 7 is based on the current survey information available. The levels of the proposed drainage are limited by the level of the 900mm diameter water main. Clearance of 300mm is achievable with the 375mm diameter pipe with reduced cover of 400mm. Further increases in the pipe diameter result in a reduction of clearance and non-compliant cover.

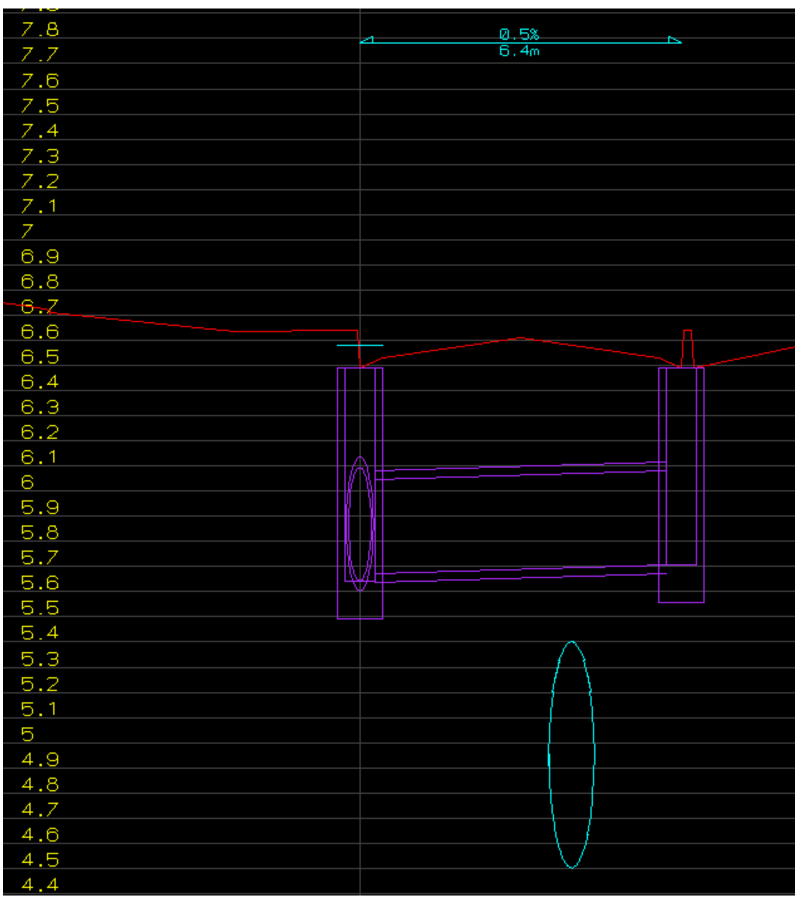


Figure 7 - Option 2B Longitudinal Section

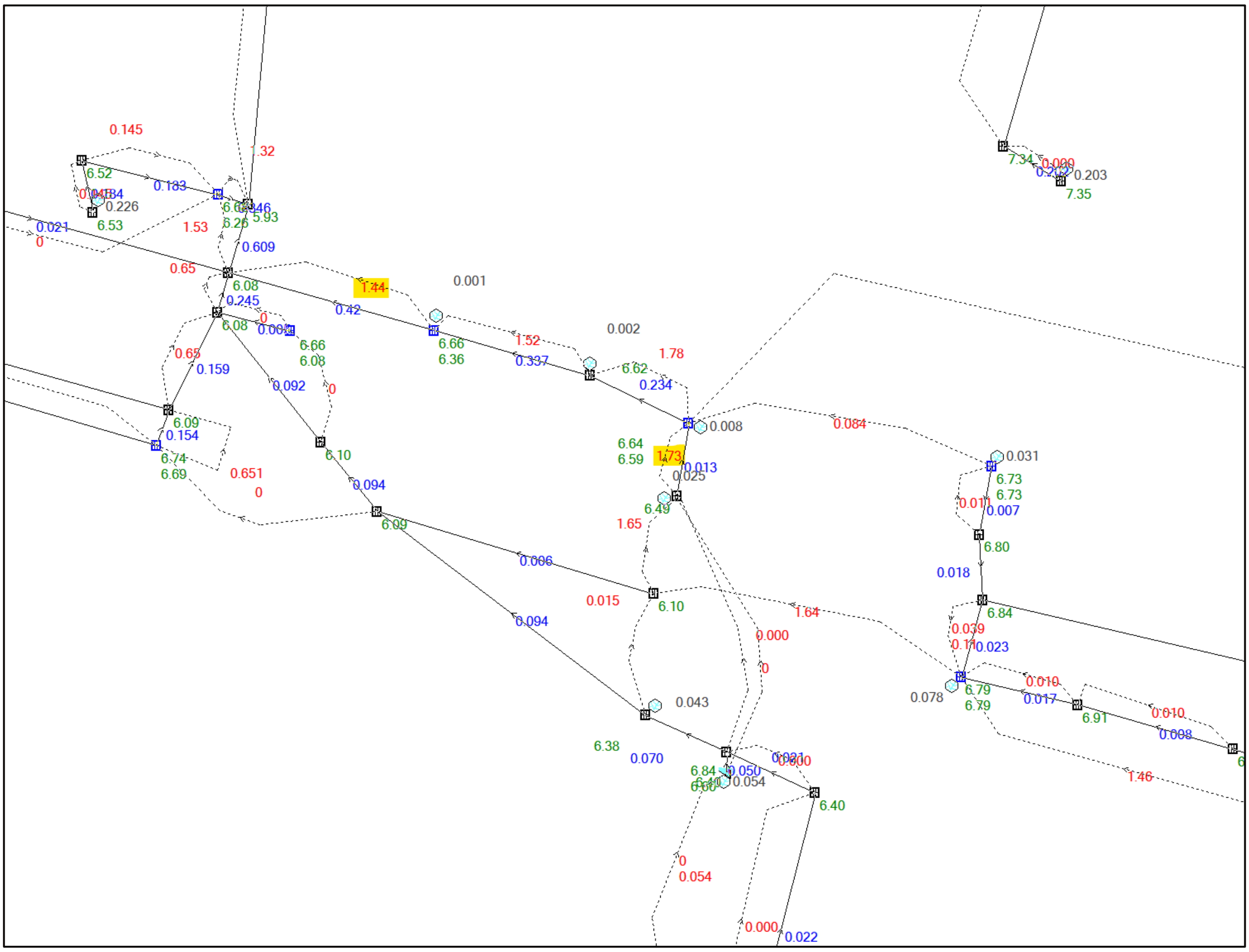


Figure 8 – Option 2B DRAINS Results

Option 7

Option 7 was proposed to divert the Horwood Place flow to the drainage network on the eastern side of Phillip Street. The total flows off Horwood place are small in comparison to the overland flow coming from the eastern side of Phillip Street. The existing pipe in the centre of Phillip street is running full therefore, the DRAINS modelling shows minor increases in the overland flow for the western section of Phillip Street in Option 7.

Table 5 – Option 7 Comparison to Option 1

Location / Option	Option 1 (5% AEP m^3/s)	Option 7 (5% AEP m^3/s)
Across Phillip Street	1.57	1.68
In north-western footpath	1.26	1.41

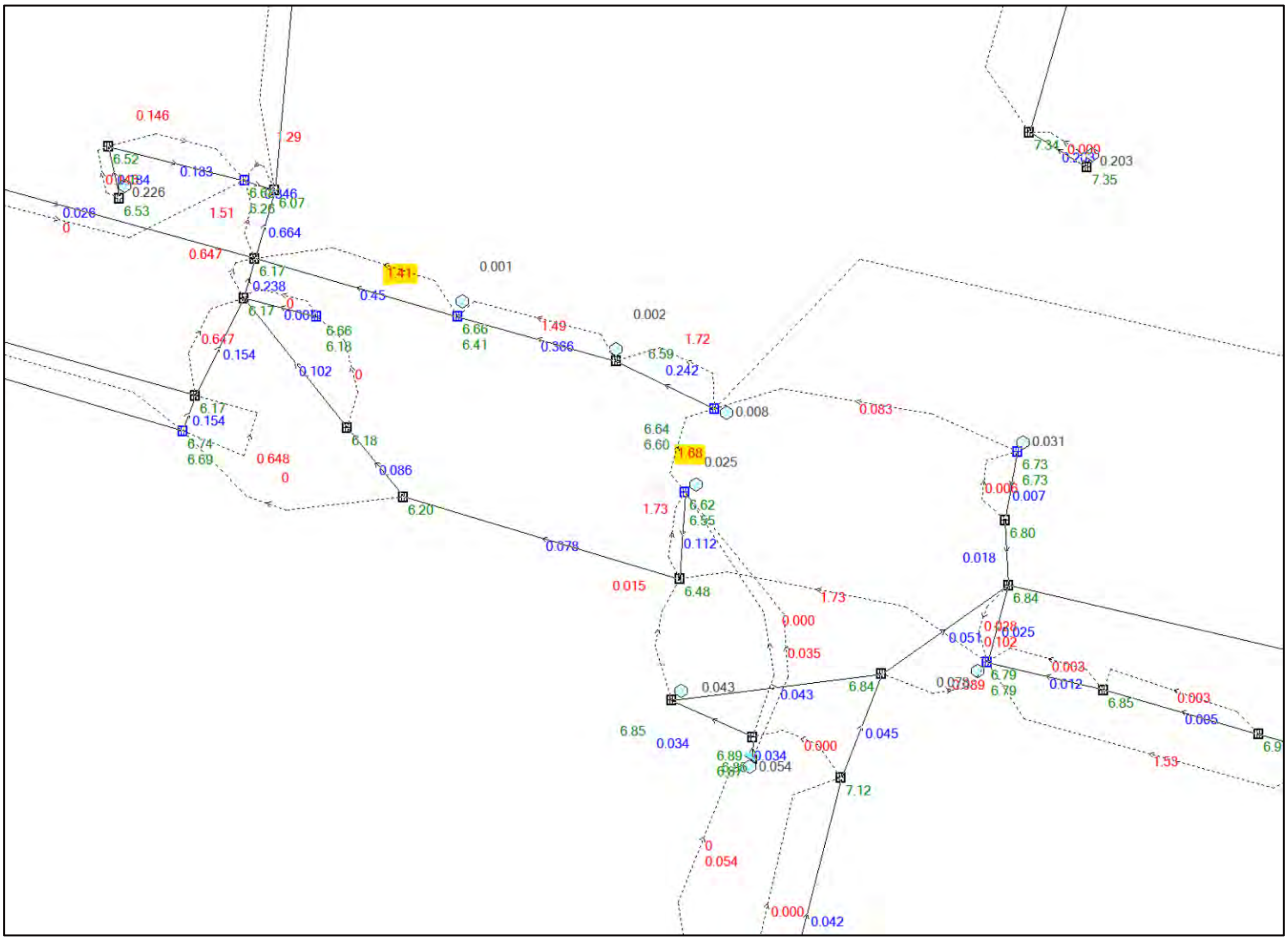


Figure 9 – Option 7 DRAINS Results

Additional TUFLOW Assessment

As part of this investigation, an additional assessment was undertaken using the TUFLOW hydraulic model to validate the DRAINS results and to provide further insight into the interaction between underground drainage and surface flows along Phillip Street. Consistent with the DRAINS findings, Option 1 was adopted as the base case, with additional testing of Option 1 in combination with Options 2, 2B, and 7.

Two boundary conditions were modelled:

- Low Flood Level Boundary – representing a lower Parramatta River level.
- High Flood Level Boundary – representing the Parramatta River at peak flood level.

The key findings are summarised below:

- Low Flood Level Boundary:
  All options produced broadly similar results, with localised changes in flood behaviour primarily driven by ground level modifications such as the relocation of the pedestrian crossing. In this condition, flood levels east of the pedestrian crossing tended to increase slightly, while flows were redirected northwards away from known problem areas. The most favourable outcomes were achieved with combinations of Option 1+2 and Option 1+7.
- High Flood Level Boundary:
  Under this condition, a minor increase in flood levels of approximately 14 mm was observed east of the pedestrian crossing during the 1% AEP event. This effect is attributed to the complexity of the

local pipe and overland flow system, with the proposed pipe upgrades within George Street influencing overland flows at the Phillip Street Sag. Importantly, when Option 1 was combined with other measures, particularly Option 7, this localised increase was reduced and the overall flood behaviour improved.

Overall, the TUFLOW assessment supports the DRAINS conclusions that surface levels and flow paths are the dominant controls on local flooding, with pipe upgrades alone offering limited benefit. The preferred outcome is the combined implementation of Option 1 and Option 7, which provides the most balanced improvement without introducing adverse downstream impacts.

Recommendations

Based on the outcomes of this assessment for the drainage options presented in this memo, Options 2, 2A, 2B and 7 are not recommended as they do not provide any measurable improvement to the overland flows in Phillip Street. While outside the scope of this project and this assessment, an increase in the capacity of the downstream drainage network on Smith Street would likely provide the most improvement to the overland flows in Phillip Street.

Kind regards

Michelle Fletcher
Principal Stormwater Engineer

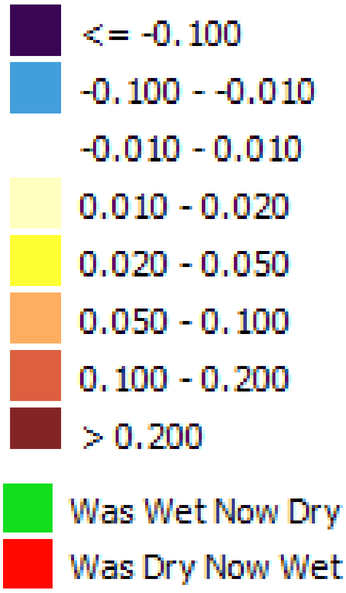
Email: michelle.fletcher@arcadis.com
Direct Line: +61 (2) 8907 3952

APPENDIX A

TUFLOW RESULTS

The Below Change in water level (Afflux) has been maped in accordace with following legend.

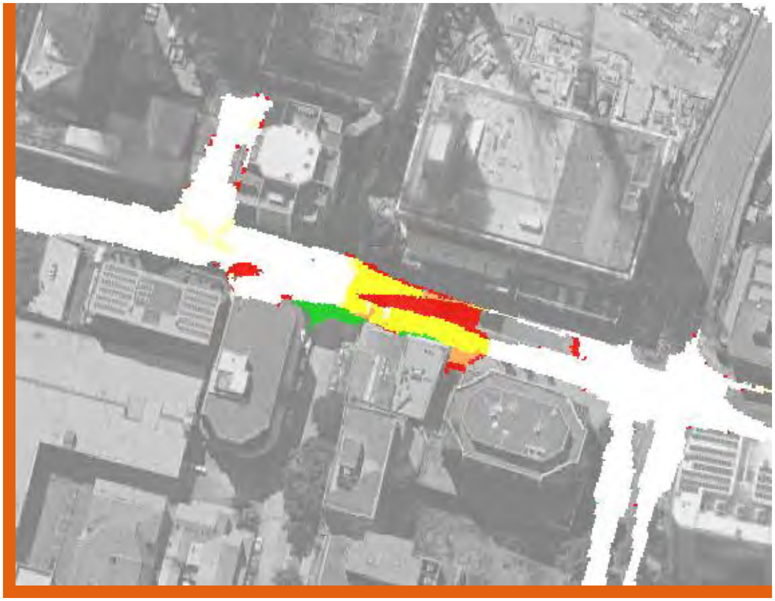
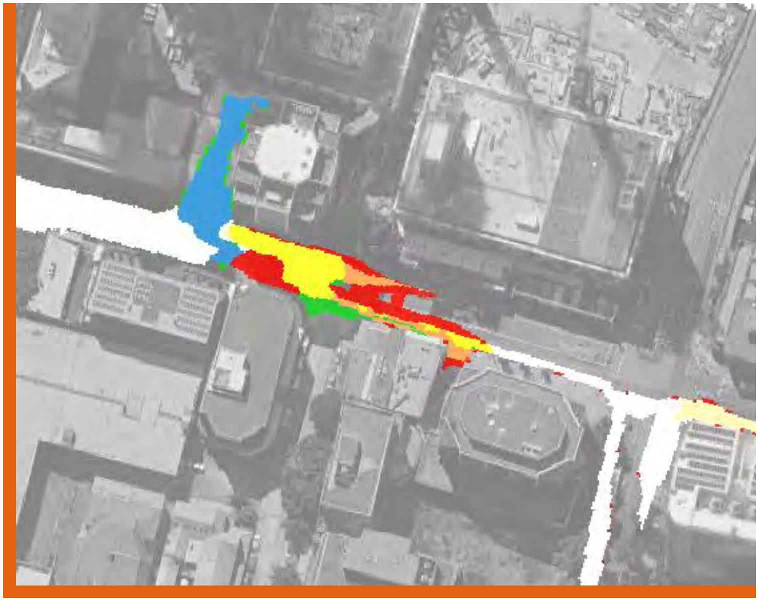
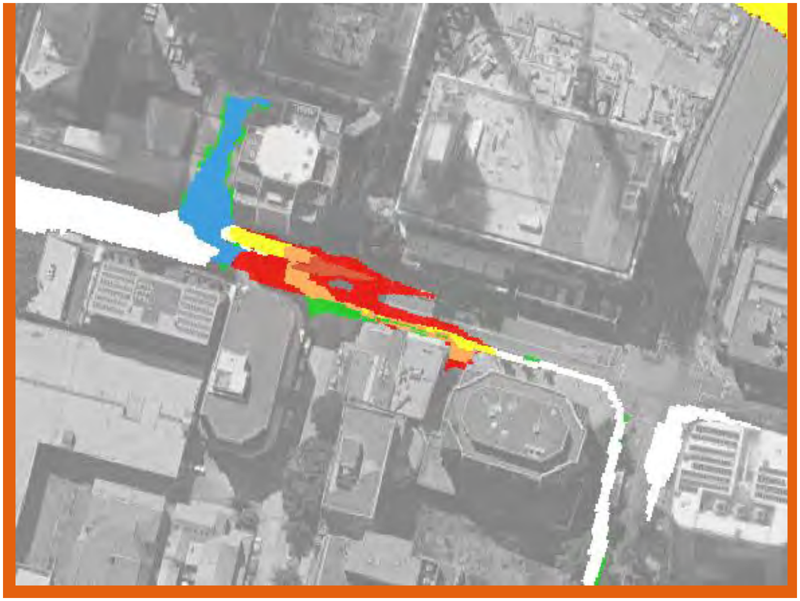
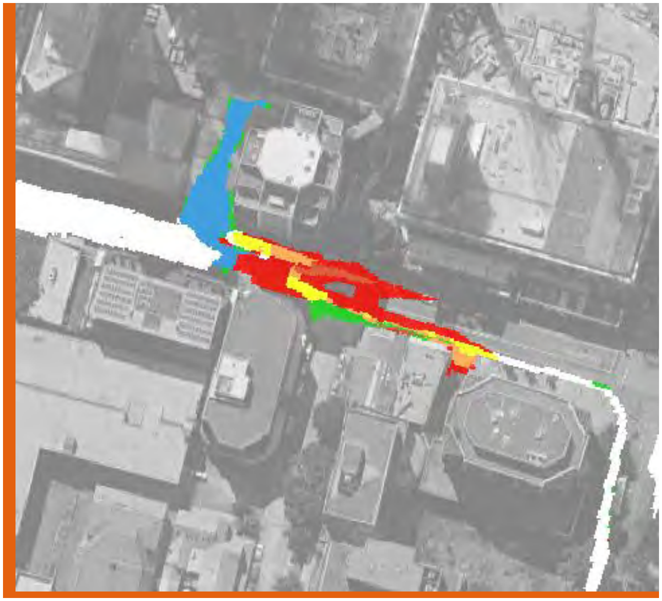
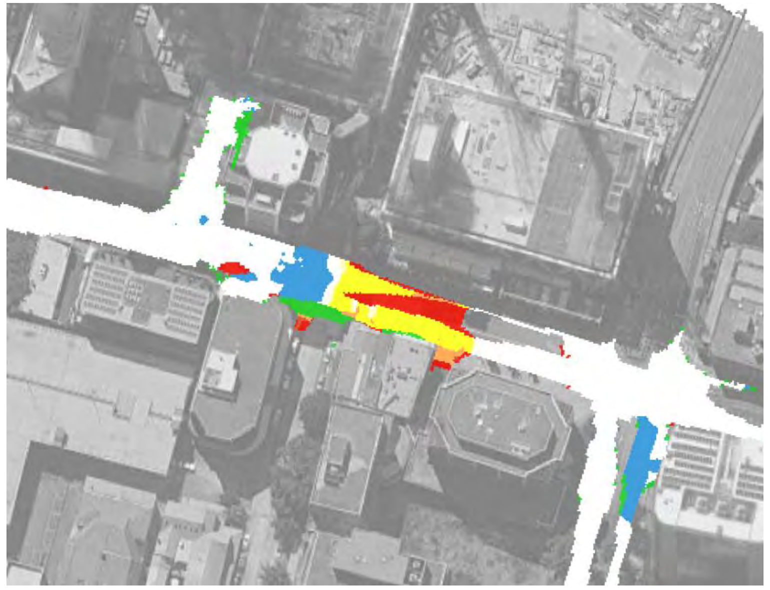
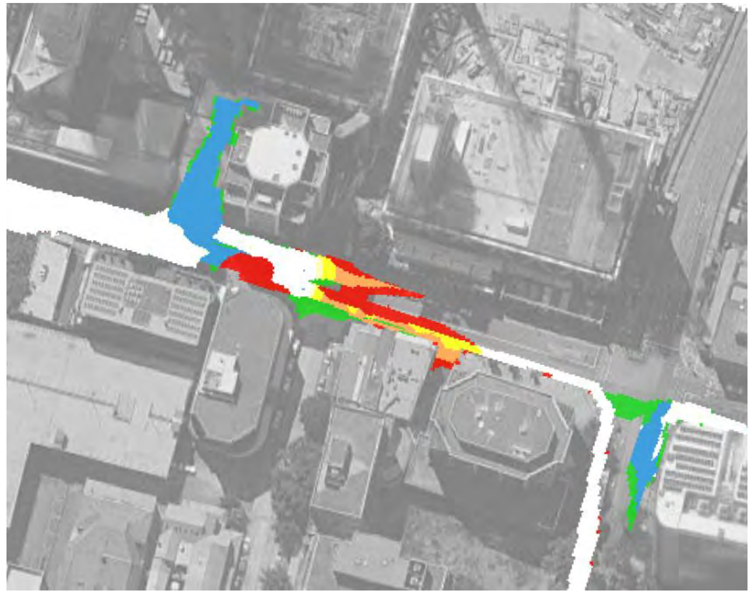
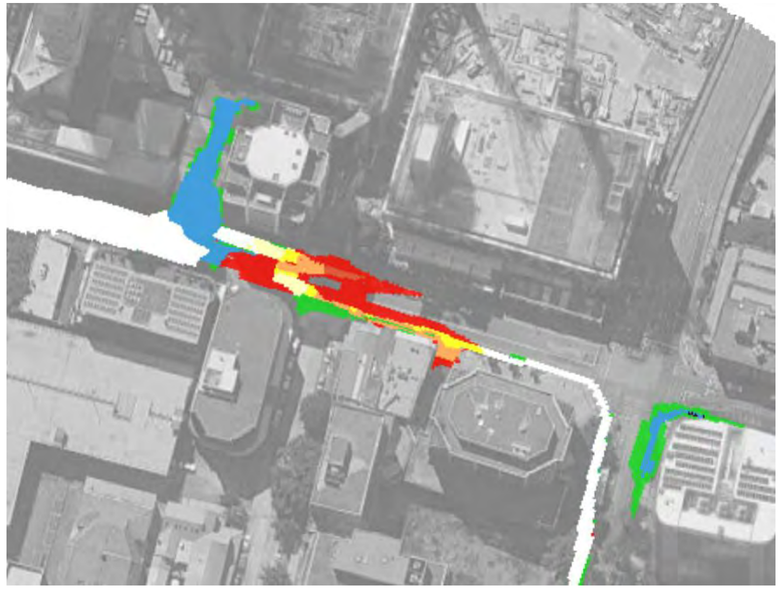
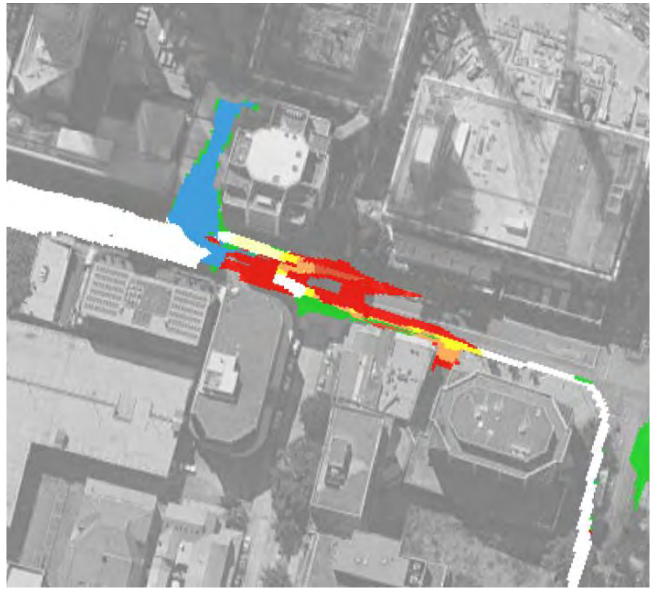
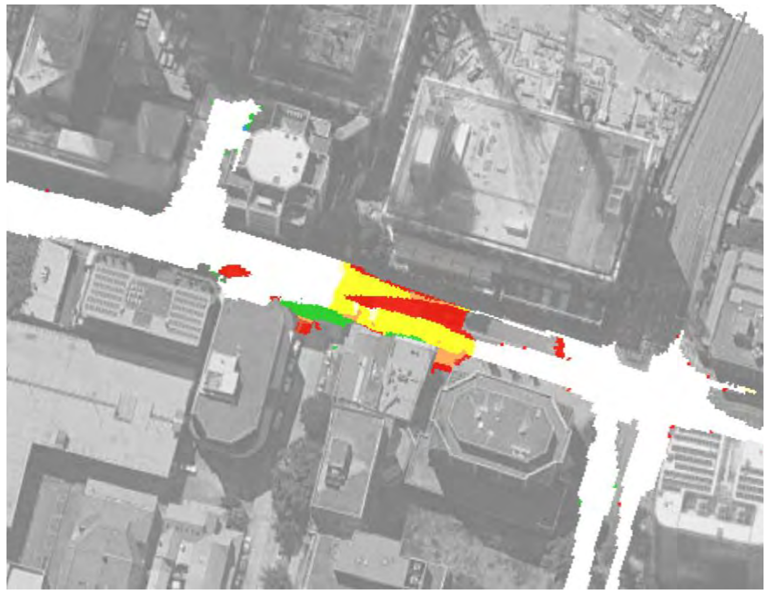
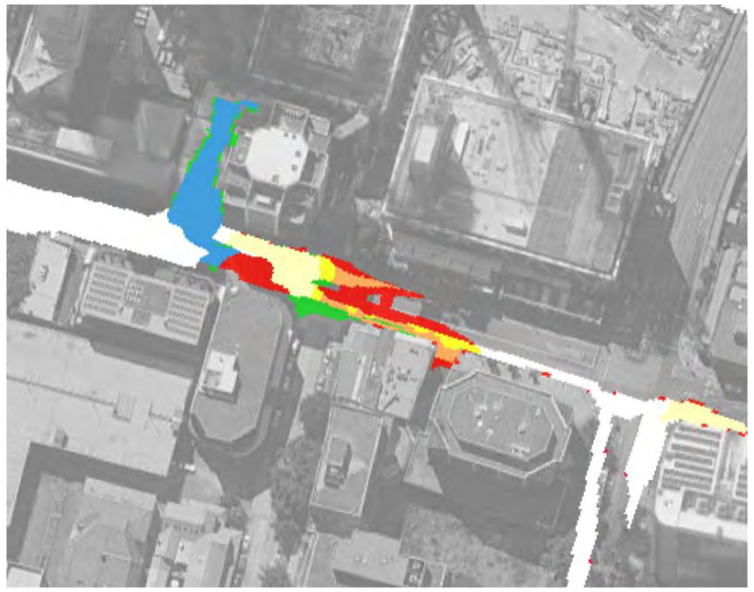
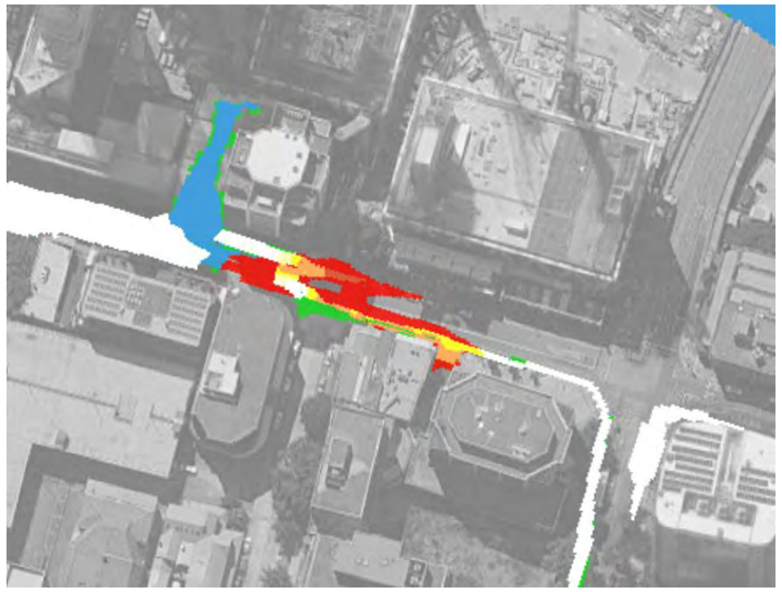
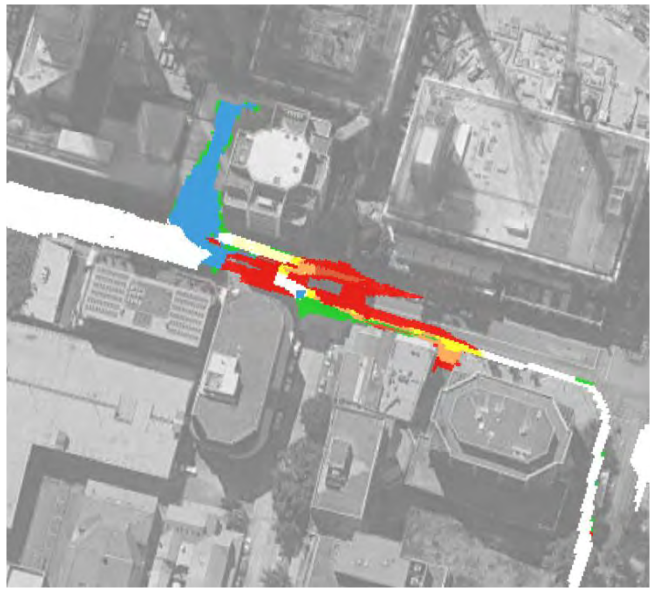
Change in elevation is noted in meters (m)



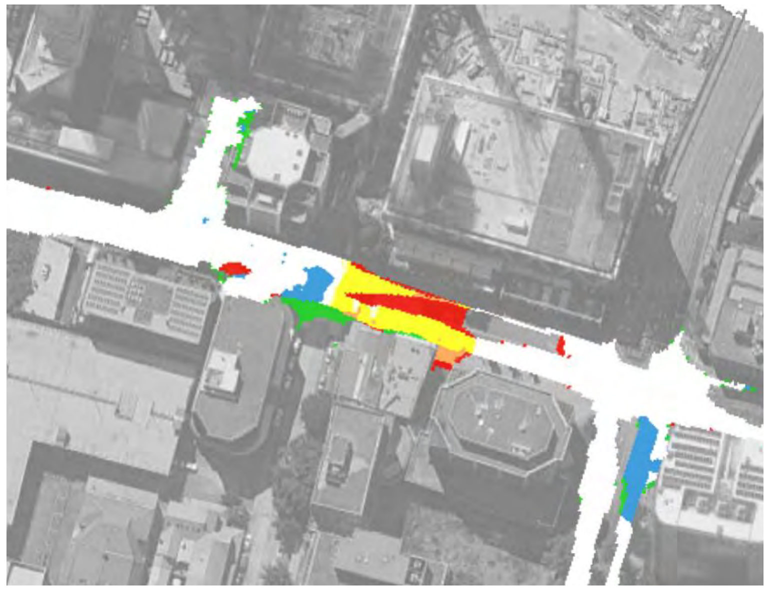
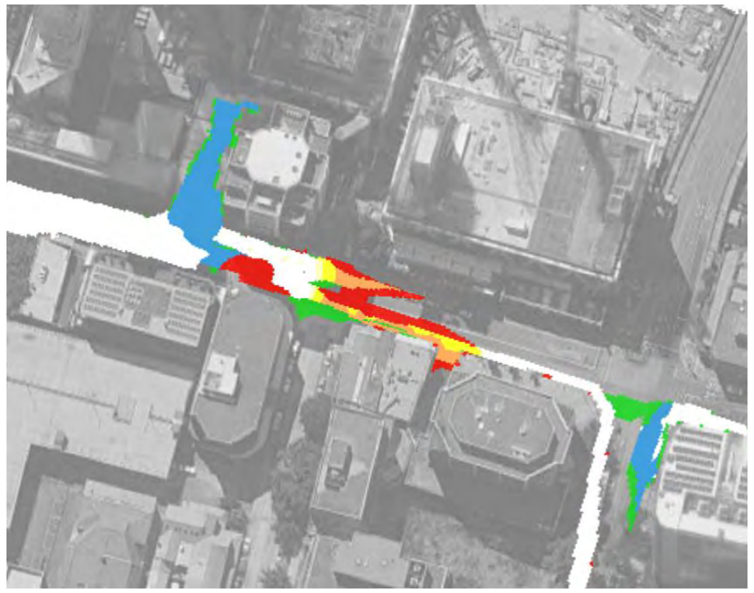
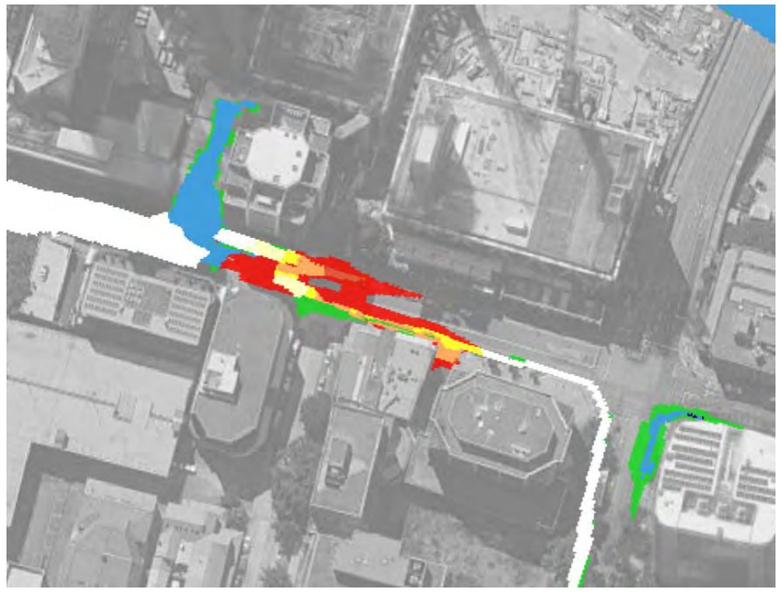
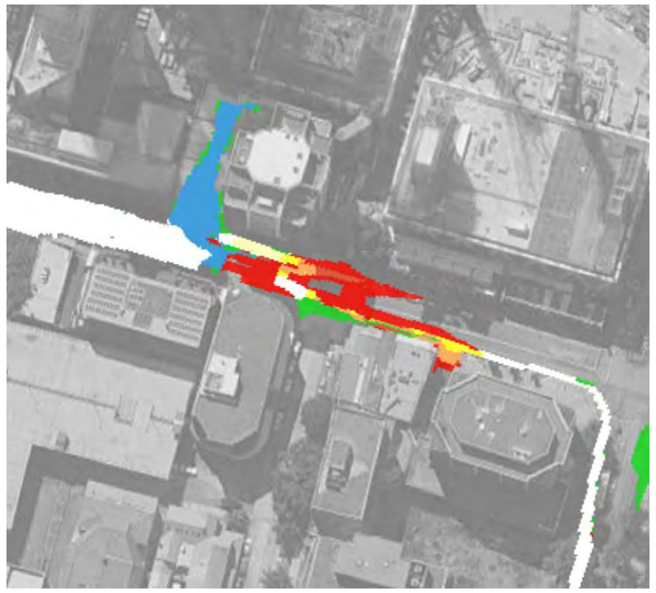
🟪 <= -0.100
🟦 -0.100 - -0.010
-0.010 - 0.010
🟨 0.010 - 0.020
🟨 0.020 - 0.050
🟧 0.050 - 0.100
🟧 0.100 - 0.200
🟫 > 0.200

🟩 Was Wet Now Dry
🟥 Was Dry Now Wet

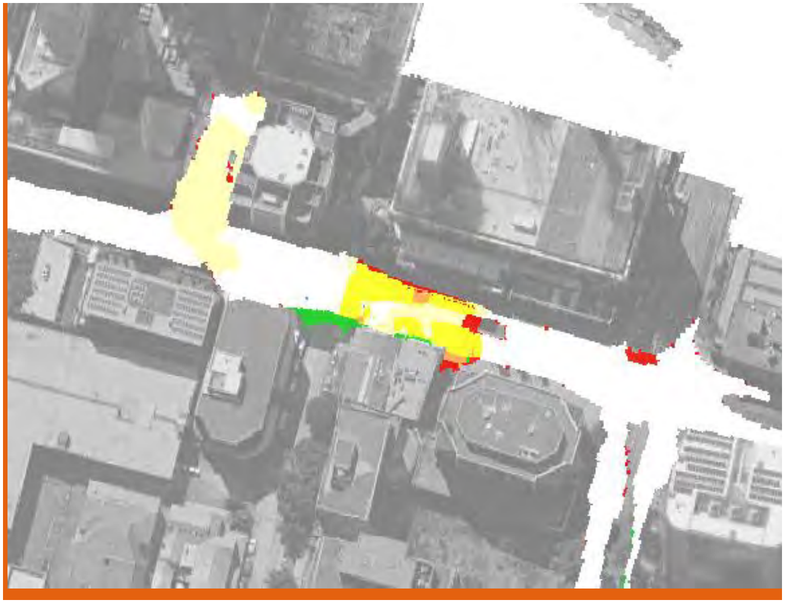
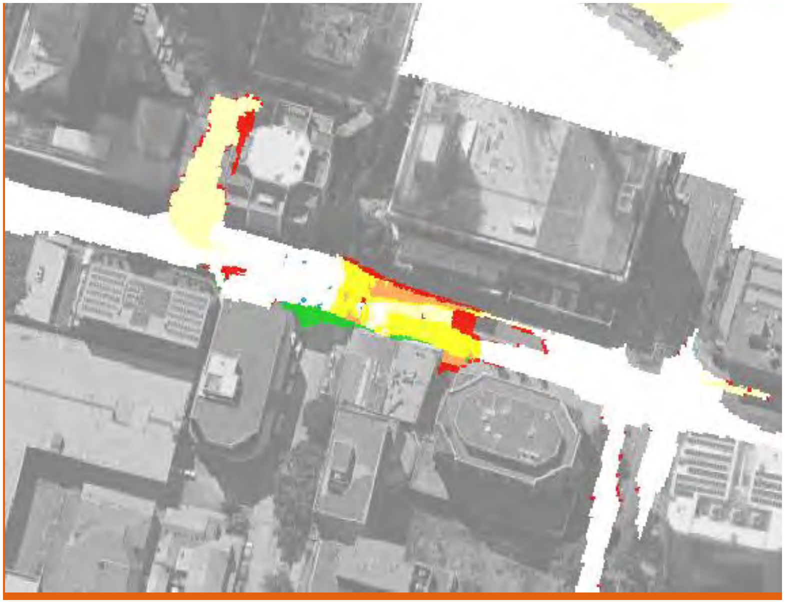
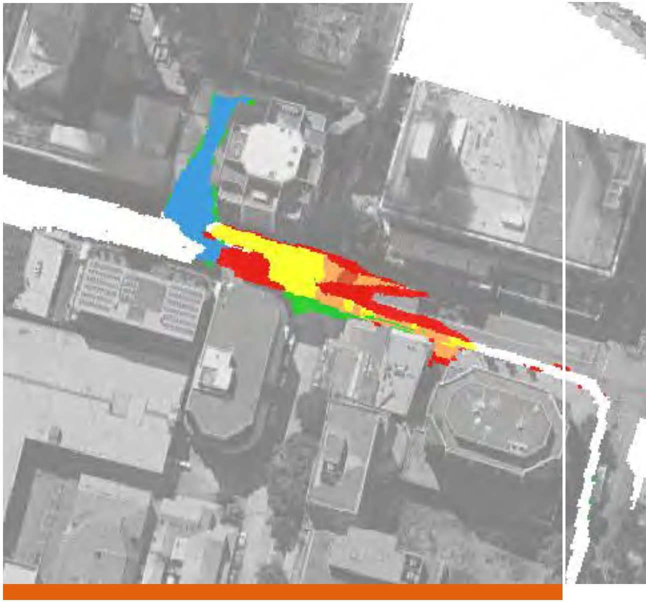
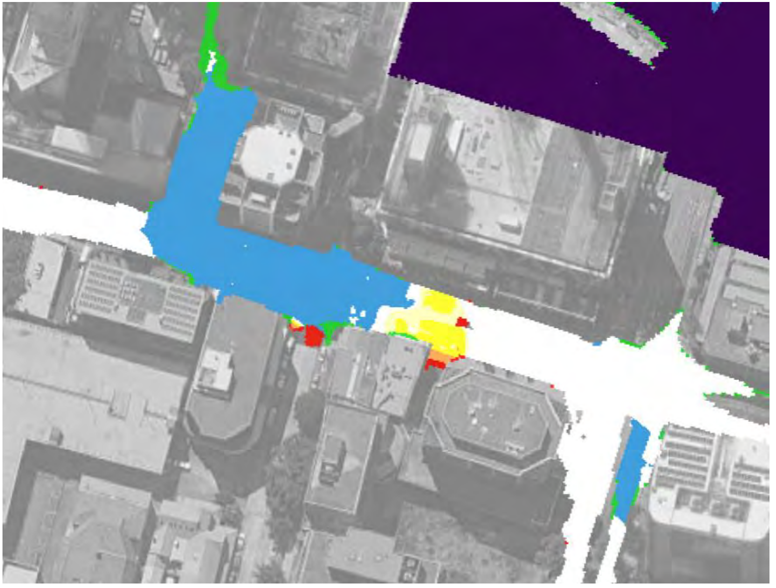
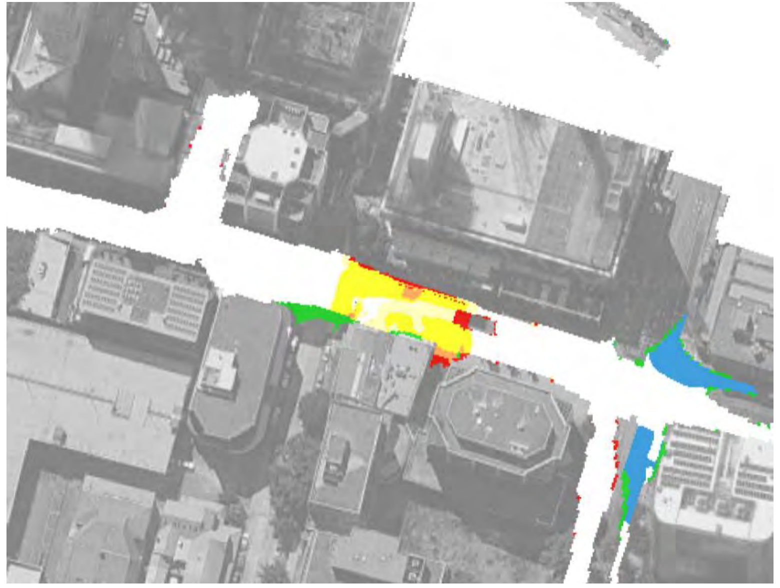
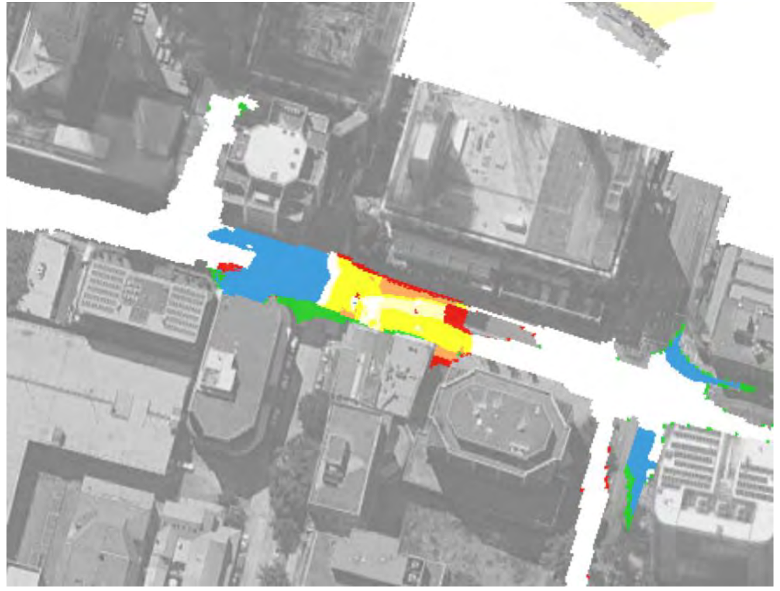
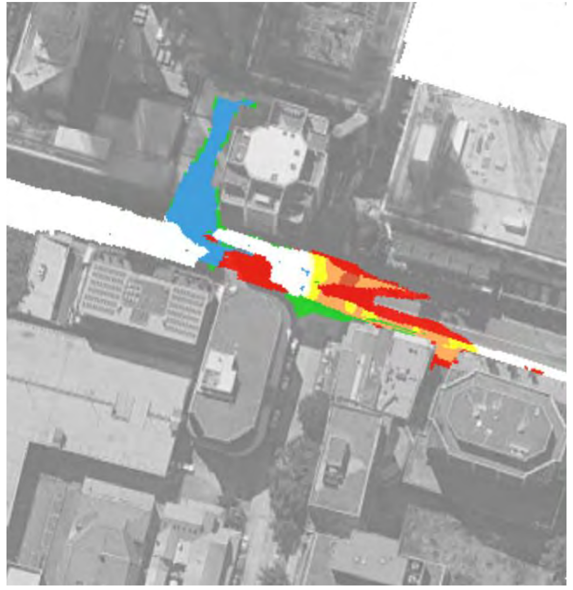
Low Boundary Condition

OPTION	1%	5%	10%	20%
Option 1 – No Aug				
Option 1 and 2 – No Aug				
Option 1 and 2B – No Aug				

Phillip Street Stormwater Options
1/10/2025

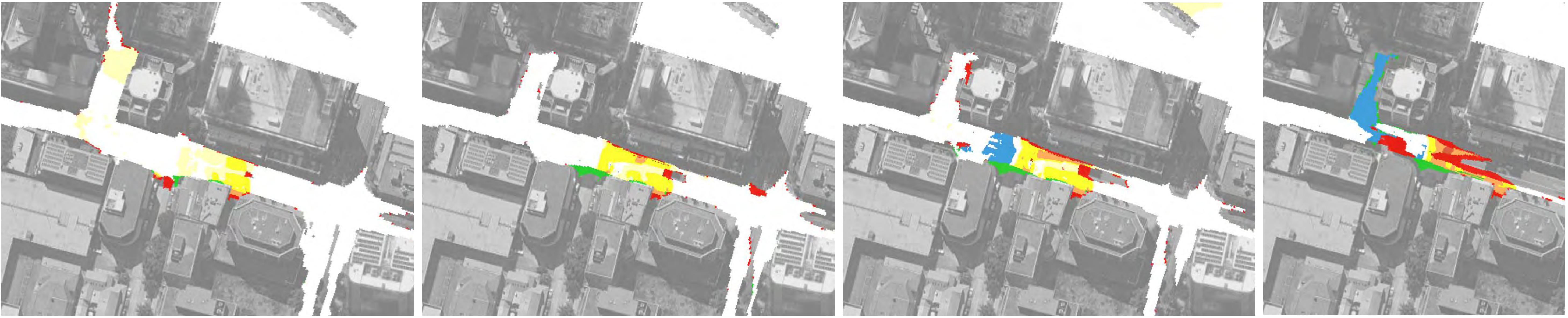
Option 1and 7 – No Aug				

River Peak Boundary Condition

OPTION	1%	5%	10%	20%
Option 1 – No Aug				
Option 1 and 2 – No Aug				

Phillip Street Stormwater Options
1/10/2025

Option 1 and 2B – No Aug



Option 1 and 7 – No Aug