CIVIL STORMWATER ENGINEERING GROUP

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Flood Impact & Risk Assessment

Project: Multi Residential Flat Development

Location: 310 Terrigal Drive, Terrigal.

Project ID: CSW2024.23

Governing Council: Central Coast LGA

Development Application #: NA

Title: 27/DP1223375

Property ID: 4023470

Total Lot Area: 4,254 sqm

[redacted]

"Together WE are implementing good ideas to improve people's lives."

Revision Table				
Revision	**Date**	**Issue Description**	**Issued By**	**Signed**
01	12/04/2024	For DA	C SAAD	S HAKIM
02	17/04/2024	For DA	C SAAD	S HAKIM
03	04/09/2024	For DA	S HAKIM	SHAKIM

The information given in this document considers the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Contents

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1. Executive Summary

Civil Stormwater Engineering Group Pty Ltd (CSEG™) has been engaged to prepare a Flood Impact and Risk Assessment (FIRA) for a Development Application (DA) for the proposed Multi Residential Flat Building development proposed at 310 Terrigal Drive, Terrigal.

Central Coast Council's (CCC) has identified this site as flood prone as per the catchment-wide Coastal Lagoon Catchments Overland Flow Study (2020). As a requirement by CCC, our client has engaged CSEG™ to prepare a flood impact assessment report to accompany the development application.

This document is a flood impact assessment report outlining the results of the TUFLOW modelling conducted by CSEG™ including the purposes outlined in Section 2.1. The flood study is to assess the impact of overland flow and mainstream flooding that inundates the site legally described as 27/DP1223375. Designed by CKDS Architects is an eight-story mixed used development plus mezzanine, comprising residential units, a ground floor café, and basement car parking for vehicles.

The proposed development is illustrated in Figure 1 below.

Figure 1- Architectural Design (Source: CKDS Architects)

1.1 Purpose

The Flood Impact and Risk Assessment Report (FIAR) is designed to evaluate and understand the potential effects of flooding on the proposed development by assessing flood behavior and evaluating the possible flood risks associated with this behavior.

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Overall, the FIAR is a crucial tool for managing flood risks effectively and protecting both people and property from the adverse effects of flooding. The context of this FIAR focuses on addressing the requirements of the following Local and State Government legislations:

- Ministerial Direction 4.1 Flooding issued under section 9.1(2) of the Environmental Planning and Assessment Act 1979.
- Assessment of NSW Floodplain Risk Management Manual (FRMM)(2023).
- NSW Draft Shelter in place guidelines December 2022.
- Central Coast Council Development Control Plan in particular:
  - Clause 5.21 of the Central Coast LEP (2022)
  - Part 3.1.11.6 of the Central Coast DCP 2022
  - The pre-DA notes made by CCC

1.2 Introduction

CSEG™ has been engaged by LoftusLane Capital Partners to carry out a Flood Impact Assessment Report in support of the proposed Multi Residential development at 310 Terrigal Rod, Terrigal.

The following tasks were carried out:

- A site visit was undertaken on the 12th of March 2024 to ascertain site conditions and familiarize oneself with the catchment.
- Supplied documents and previous flood studies were reviewed and assessed.
- Council RFI's and comments were reviewed.
- TUFLOW 2D model was prepared to assess existing against proposed scenarios.
- Stormwater management plan applying all relevant local and national standards.
- This report was compiled.

This report has been prepared to accompany the Planning Proposal & Development Application (DA) for the development known as 310 Terrigal Road, Terrigal.

The report discusses the flood risk management strategies and recommendations to address the flood risks and related controls that apply to the development.

The assessment takes into consideration the safety, engineering, environmental and social aspects of the development to effectively address the flood evacuation of people who are within the vicinity of the development site.

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1.3 Limitations

This report is intended solely for Loftuslane Capital Partner as the client of CSEG™ and no liability will be accepted for the use of the information contained in this report by other parties than this client. This report is limited to visual observations and to the information including the referenced documents made available at the time when this report was composed.

1.4 Reference

The following documents have been referenced in this report:

- Site survey plan prepared by Bannister & Hunter.
- Architectural Design prepared by CKDS Developments.
- Engineers Australia, Australian Rainfall & Runoff (AR&R 2016).
- The Bureau of Meteorology 2019.
- Aerial Scanning Data (ALS) for the study area received from NSW department of Land & Property Information (LPI).
- Ministerial Direction 4.1 Flooding issued under section 9.1(2) of the Environmental Planning and Assessment Act 1979.
- Assessment of NSW Floodplain Risk Management Manual (FRMM)(2023).
- NSW Draft Shelter in place guidelines December 2022.
- Central Coast Council Development Control Plan.
- AR&R A guide to flood estimation Book 6 – Flood Hydraulics

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2. Description

2.1 Existing Site

The site is South facing along Terrigal Drive in the suburb of Terrigal New South Wales. The site is governed by a Local Government Area of Central Coast Council and is legally known as 27/DP1223375 with a total lot area of 4,254sqm (approximately).

The site has dual frontage and is bounded by an open channel to the east that leads to Terrigal Lagoon.

The existing site consists of a green field site. The site is of an irregular shape and is characterized by a natural slope at approximately 1.0% longitudinal grade. Figure 2 presents an aerial image of the subject site.

Figure 2 - GIS Map of 310 Terrigal Drive, Terrigal. (Source: Mecone)

A detailed survey has been prepared by Bannister and Hunter in April 2022 outlining the site topography and surrounding structures to Australian Height Datum (AHD). A copy of this survey is found in Appendix B – Catchment Map of this report. Additional topographic data was obtained in the form of ALS (Airborne Laser Scan) from the NSW Government's Land & Property Information Department (LPI). This data was supplied as a 1m Digital Elevation Model (DEM) from the 2020 ALS data set.

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2.2 CCC's 2020 Flood Study

The Coastal Lagoon Catchments Overland Flood Study (2020) (CLCOFS) has been prepared for CCC in accordance with the NSW government's Floodplain Development Manual 2005. The development of CLCOFS is based on information adopted from the following flood studies:

- Wamberal Lagoon Flood Study (WMA, 2001)
- Wamberal Lagoon Floodplain Management Study (WMA, 2001)
- Wamberal Lagoon Floodplain Management Plan (WMA, 2001)
- Terrigal Lagoon Flood Study (WMA, 2001)
- Terrigal Lagoon Floodplain Management Study (WMA, 2001)
- Terrigal Lagoon Floodplain Management Plan (WMA, 2001)
- Terrigal Valley Trunk Drainage Strategy (Kinhill Engineers, 1991)
- Terrigal Valley Trunk Drainage Strategy – Grasslands Ave & Riviera Catchments (WMA, 1995)
- Avoca Lagoon Flood Study (Patterson Consultants, 2008)
- Avoca Lagoon Floodplain Management Study (Patterson Consultants, 2008)
- Avoca Lagoon Floodplain Management Plan (Patterson Consultants, 2008)
- Cockrone Lagoon Flood Study (Patterson Consultants, 2008)
- Cockrone Lagoon Floodplain Management Study (Patterson Consultants, 2008)
- Cockrone Lagoon Flood Study-Addendum One McMasters Beach Drain (Patterson Consultants, 2007)
- Cockrone Lagoon Floodplain Management Plan (Patterson Consultants, 2008)
- The Entrance Dynamics of Wamberal, Terrigal, Avoca & Cockrone Lagoons (AWACS, 1994)
- Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (Worley Parsons, 2014)
- Coastal Zone Management Plan for Gosford Lagoons (BMT WBM, 2015)

The CLCOFS's report outlines the results of the hydrologic and hydraulic for the estimation of overland and mainstream flooding behavior within the catchment area. The study has been overseen and guided by the Waterways & Coastal Protection Unit of the Central Coast Council.

The CLCOFS provides a detailed flood assessment of the flood studies listed above. The study includes hydraulic model results for a full set of events from the 50% AEP to the PMF and presents an envelope of the critical duration/pattern of a selected representative upstream catchment and the critical duration at the lagoon. The CLCOFS had adopted an envelope of two critical durations for the different design events. The upper catchments of the Terrigal lagoon were very flashy with short critical durations of less than 1 hour while the lower catchments had critical durations exceeding two hours as shown in Figure 3.

Table 5-3 Critical durations for each event

Lagoon	Catchment	Event	Adopted Critical Duration	Event Rainfall Depth (mm)
Wamberal	Upper	50% AEP	2 hr	40
		20% AEP	45 min	38
		10% AEP	45 min	47
		5% AEP	20 min	38
		2% AEP	20 min	47
		1% AEP	20 min	55
		1 in 200 AEP	20 min	60
		1 in 500 AEP	20 min	69
		PMF	30 min	230
	Lower	50% AEP	4.5 hr	55
		20% AEP	4.5 hr	77
		10% AEP	4.5 hr	94
		5% AEP	3 hr	95
		2% AEP	2 hr	100
		1% AEP	2 hr	116
		1 in 200 AEP	2 hr	129
		1 in 500 AEP	1.5 hr	133
		PMF	2 hr	510
Terrigal	Upper	50% AEP	45 min	26
		20% AEP	45 min	37
		10% AEP	45 min	46
		5% AEP	45 min	54
		2% AEP	45 min	67
		1% AEP	45 min	77
		1 in 200 AEP	45 min	85
		1 in 500 AEP	45 min	97
		PMF	1 hr	330
	Lower	50% AEP	9 hr	73
		20% AEP	4.5 hr	76
		10% AEP	4.5 hr	92
		5% AEP	3 hr	92
		2% AEP	3 hr	113
		1% AEP	2 hr	112
		1 in 200 AEP	2 hr	123
		1 in 500 AEP	2 hr	139
		PMF	2 hr	500

Figure 3 - Critical Durations for each event, Source Coastal Lagoons Catchments Floody Study.

The results of CLCOFS were relied upon for assessment and comparison only and were not adopted for our flood study. For our site-specific study, the WBNM model showed the critical duration at 310 Terrigal Drive to be 1 Hour for the 1% AEP event. This is in line with the findings of

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the Coastal Lagoons Catchments flood study as the site sat just downstream of the steep areas comprising most of the upper catchments and therefore produced a critical duration slightly exceeding 45 minutes.

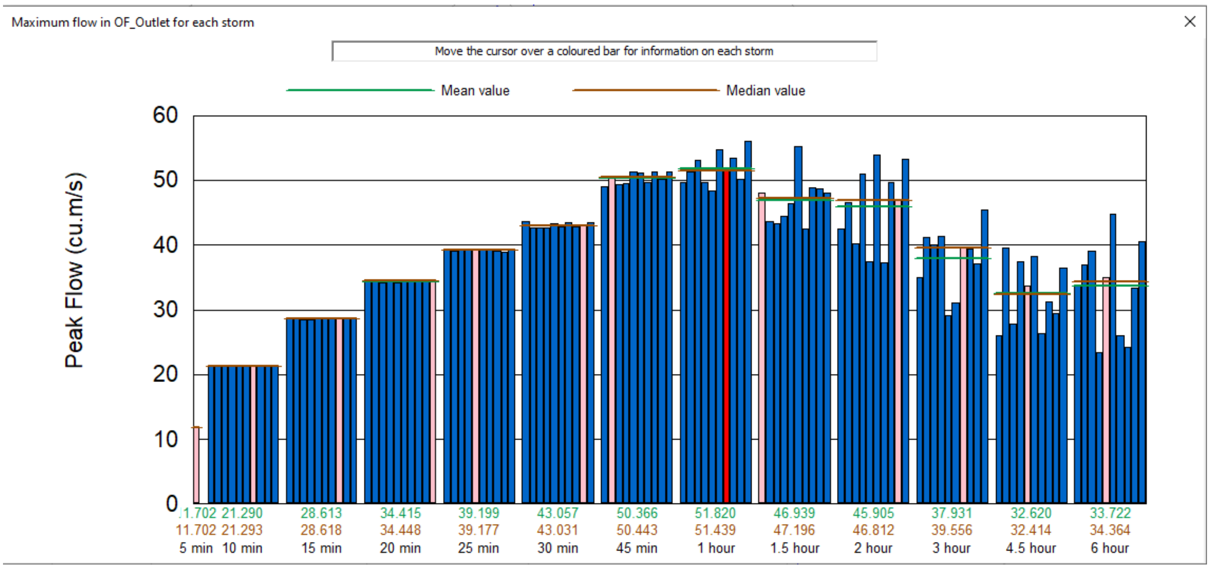

Figure 4 - Peak Flow for different storm durations.

The results of the TUFLOW model prepared by CSEG was compared to the results and information within CLCOFS and was found to contain data and results.

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3. Flood Assessment

3.1 Glossary

	Abbreviation Description
AEP	Annual Exceedance Probability; The probability of a rainfall or flood event of given magnitude being equaled or exceeded in any one year.
AHD	Australian Height Datum: National reference datum for level
ALS	Air-borne Laser Scanning; aerial survey technique used for definition of ground height
ARI	Average Recurrence Interval; The expected or average interval of time between exceedances of a rainfall or flood event of given magnitude.
AR&R	Australian Rainfall and Runoff; National Code of Practice for Drainage published by Institution of Engineers, Australia, 1987.
EDS	Embedded Design Storm; synthesized design storm involving embedment of an AR&R design burst within a second design burst of much longer duration
FPDM	Floodplain Development Manual; Guidelines for Development in Floodplains published by N.S.W. State Government.
FSL	Flood Surface Level;
GIS	Geographic Information Systems: A system of software and procedures designed to support management, manipulation, analysis, and display of spatially referenced. data.
IFD	Intensity-Frequency-Duration; parameters describing rainfall at a particular location.
ISG	Integrated Survey Grid; ISG: The rectangular co-ordinate system designed for integrated surveys in New South Wales. A Transverse Mercator projection with zones 2 degrees wide (Now largely replaced by the MGA).
LEP	Local Environment Plan: plan produced by Council defining areas where different development controls apply (e.g. residential vs industrial)
LGA	Local Government Area; political boundary area under management by a given local council. Council jurisdiction broadly involves provision of services such as planning, recreational facilities, maintenance of local road infrastructure and services such as waste disposal.
MGA	Mapping Grid of Australia; This is a standard 6° Universal Transverse Mercator (UTM) projection and is now used by all states and territories across Australia.
MHI	Maximum Height Indicator: measuring equipment used to record flood levels
PMF	Probable Maximum Flood: Flood calculated to be the maximum physically possible.
PMP	Probable Maximum Precipitation: Rainfall calculated to be the maximum physically possible.
RCP	Reinforced Concrete Pipe;
km	Kilometer; (Distance = 1,000m)
m	Meter; (Basic unit of length)
m2	Square Meter; (Basic unit of area)
ha	Hectare; (Area =10,000 m2)
m3	Cubic Meter; (Basic unit of volume)
m/s	Meters/Second; (Velocity)

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m3/s	Cubic Meter per Second; (Flowrate)
s	Second; (basic unit of time)
Term	Description
Alluvium	Material eroded, transported, and deposited by streams.
Antecedent	Pre-existing (conditions e.g. wetness of soils).
Catchment	Area draining into a particular creek system, typically bounded by higher ground around its perimeter.
Critical Flow	Water flowing at a Froude No. of one.
Culvert	An enclosed conduit (typically pipe or box) that conveys stormwater below a road or embankment.
Discharge	The flowrate of water.
Escarpment	A cliff or steep slope, of some extent, generally separating two level or gently sloping areas.
Flood	A relatively high stream flow which overtops the stream banks.
Flood storages	Those parts of the floodplain important for the storage of floodwaters during the passage of a flood.
Floodways	Those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels and areas. which, if partly blocked, would cause a significant redistribution of flow.
Flood Fringes	Those parts of the floodplain left after floodways and flood storages have been abstracted.
Froude No.	A measure of flow instability. Below a value of one, flow is tranquil and smooth, above one flow tends to be rough and undulating (as in rapids).
Geotechnical	Relating to Engineering and the materials of the earth's crust.
Gradient	Slope or rate of fall of land/pipe/stream.
Headwall	Wall constructed around inlet or outlet of a culvert.
Hydraulic	A term given to the study of water flow, as relates to the evaluation of flow depths, levels and velocities.
Hydrodynamic	The variation in water flow, depth, level and velocity with time
Hydrology	A term given to the study of the rainfall and runoff process.
Hydrograph	A graph of flood flow against time.
Hyetograph	A graph of rainfall intensity against time.
Isohyets	Lines joining points of equal rainfall on a plan.
Manning's n	A measure of channel or pipe roughness.
Orographic	Pertaining to changes in relief, mountains.
Orthophoto	Aerial photograph with contours, boundaries or grids added.
Pluviograph	An instrument which continuously records rain collected
Runoff	Water running off a catchment during a storm.
Scour	Rapid erosion of soil in the banks or bed of a creek, typically occurring in areas of high flow velocities and turbulence.
Siltation	The filling or raising up of the bed of a watercourse or channel by deposited. silt.
Stratigraphy	The sequence of deposition of soils/rocks in layers.
Surcharge	Flow unable to enter a culvert or exiting from a pit as a result of inadequate capacity or overload.
Topography	The natural surface features of a region.
Urbanization	The change in land usage from a natural to developed state.
Watercourse	A small stream or creek.

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3.2 Hydraulic Modelling

A hydraulic model converts runoff (traditionally from a hydrological model) into water levels and velocities throughout the major drainage/creek systems in the study area (known as the model 'domain', which includes the definition of both terrain and roughness). The model simulates the hydraulic behavior of the water within the study area by accounting for flow in the major channels as well as potential overland flow paths, which develop when the capacity of the channels is exceeded. It relies on boundary conditions, which include the runoff hydrographs produced by the hydrologic model and the appropriate downstream boundary.

3.2.1 Catchment Area

The catchment area upstream from the site was delineated using LiDAR data with 1m resolution has been obtained from NSW Spatial Services and found to be 244.5 Hectares. The catchment was further divided to 23 sub catchments to build the WBNM model as shown in Figure 5.

Figure 5 - Catchment Area

3.2.2 Hydrologic Model

A WBNM model has been created for this study to analyze the 20% AEP, 1% AEP, 0.5%AEP, 0.2%AEP and the PMF, and the 2090 climate change factor with a 20% increase in intensity. WBNM model parameter have been adopted from the calibrated "Coastal Lagoon Catchments" overland flood study. Shown below:

Parameter	Value	Comment
Initial loss (pervious surface)	15 mm (design events) 0-40 mm (calibration)	Determined separately for calibration and design events
Initial loss (impervious surface)	1 mm	
Continuing loss (pervious surfaces)	2.9 mm/hr	Per AR&R 2019 with modification to improve calibration
C (Lag parameter)	1.29	Adopted from previous flood study at Wamberal and Terrigal Lagoons.
Stream routing factor	1.0	Natural channel routing factor of 1.0

Figure 6 - Adopted WBNM Hydrologic Model Parameters.

Rainfall IFD's has been downloaded from the ARR Data Hub for the catchment centroid.

3.2.3 Digital Elevation Model (DEM)

A 1-meter DEM obtained from NSW Spatial Services was used to represent the existing ground surface for the hydraulic model. The detailed survey was then patched on top of the DEM. A 2m grid was then used to represent surface data across the model domain. This resolution was adopted based on AR&R Project 15 ***Table 10-2 Typical Grid/Mesh Resolutions – Urban Overland Flow.*** The 1m resolution adopted exceeds the requirement of Table 10.2.

3.2.4 Land Use

Land use throughout the site has been determined through satellite imagery and land use maps. The following land use and roughness were adopted as shown in Table 1& Figure 7.

Surface Type	TUFLOW adopted Roughness Coefficient (n)	Roughness Coefficient (n) as per table 6.1 of CLCOFS	Roughness Coefficient (n) as per AR&R Book 6
Urban (medium density)	0.075	0.075-0.15	
Pavement (Roadways)	0.02	0.020-0.030	
Vegetation (Heavy)	0.1	0.080-0.15	
Grassed	0.035		0.025-0.035
Dwellings	1.0	0.1-10.0	

Table 1 - Roughness of Coefficient.

The adopted roughness coefficients in the TUFLOW model are within the range adopted in CLCOFS as demonstrated in Table 1. Further, data was obtained from AR&R book 6 for roughness coefficients not listed in CLCOFS. Roughness of coefficient for grassed areas was added for a more accurate presentation of the existing terrain.

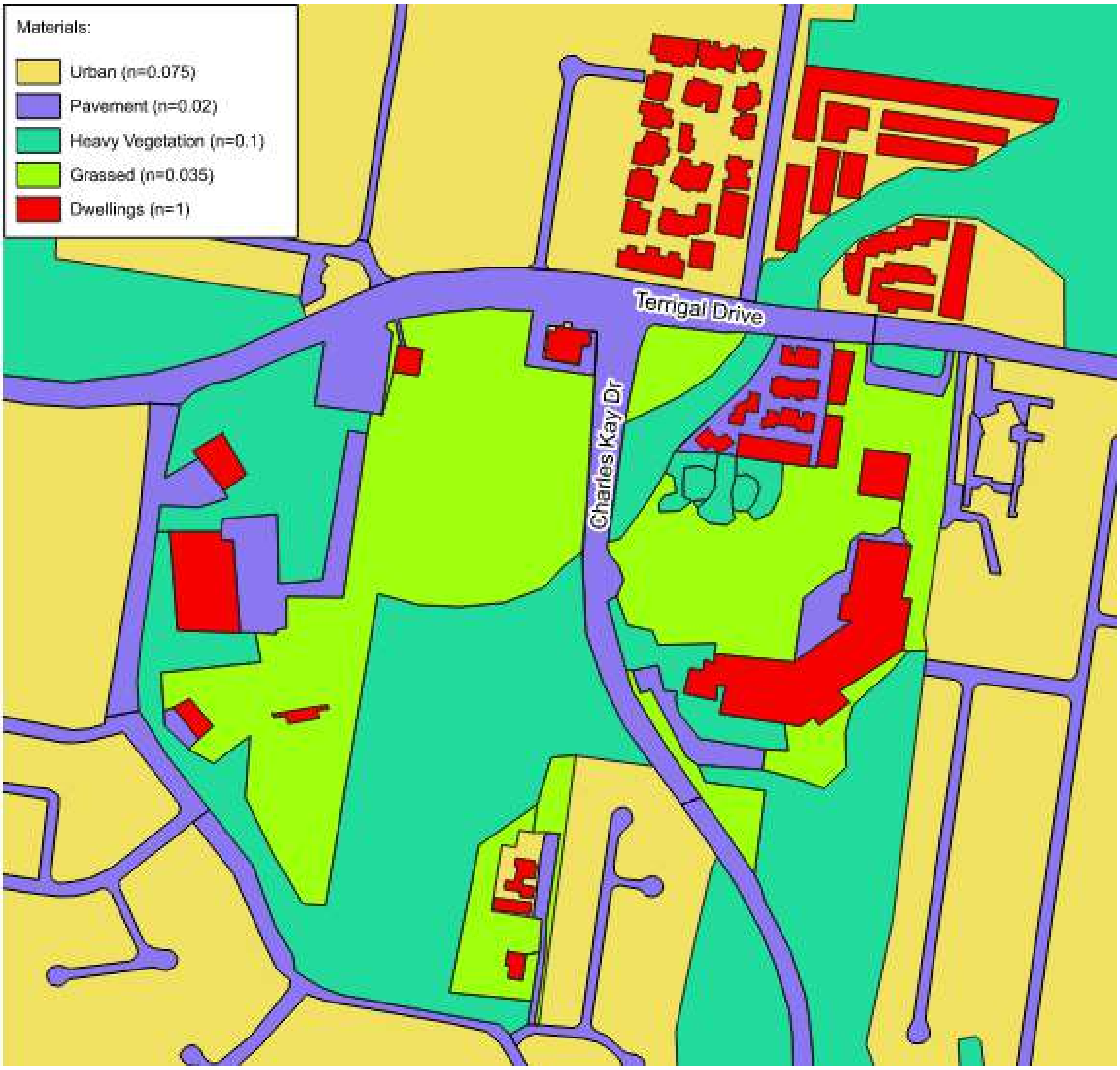

Figure 7 - Land use and Mannings Coefficient 'n'

3.2.5 Buildings

Existing building footprints adjoining our proposed site were determined from satellite imagery and have been modelled with increased manning's roughness while the proposed building footprint has been modelled as an "ineffective area" to simulate blockages.

3.2.6 Existing Stormwater Drainage Infrastructure

The following structures were included in the hydraulic model. Their details were taken from the ground survey and based on site measurements taken by the author.

- Culvert under Terrigal Drive – rectangular culvert having 4x4 meters (w) and 1.4m (h) cells (downstream of the site).
- Culvert under Charles Kay Drive – rectangular culver having 1x3.0 meters (w) x 1.85m (h) cells (upstream of the site).
- Culvert under Terrigal Drive – Circular Culvert having 5 x 900mm (diameter) cells (west of playing fields).

Existing stormwater drainage infrastructure pits and pipes were modelled in TUFLOW with a blockage factor **1.0 (100%)** on downstream stormwater systems. The results from the simulation will be conservative as the full effect from the existing drainage infrastructure was reduced.

3.2.7 Upstream Boundary Conditions

Upstream inflow boundaries were extracted from the WBNM model and input into TUFLOW at 4 locations in the lower floodplain as shown in Figure 8.

Figure8 - Grid & Boundary Condition Details

3.2.8 Downstream Boundary Condition

The downstream boundary conditions are adequately located downstream of the subject site to allow for satisfactory flood behavior results and are located well downstream of the Terrigal Drive. The downstream boundary reflects the peak water surface level in the lagoon for each event, as published in the CLCOFS. The adopted downstream lagoon levels are as follows:

Storm Event	Levels
20%AEP	2.1mAHD
1%AEP	2.5mAHD
PMF	4.3mAHD

Table 2 - Downstream Lagoon Levels

3.3 TUFLOW Results

3.3.1 Existing Flood Behavior

The existing model addressed the 20%AEP, 1%AEP, 0.5%AEP, 0.2%AEP, PMF, and 1%AEP 2090 climate change.

The following flood levels (within the property where development is proposed) were obtained for the **20%AEP**:

- Fronting Terrigal Drive western boundary = 3.58m AHD
- Fronting Terrigal Drive center boundary = 3.56m AHD
- Fronting Terrigal Drive eastern boundary = 3.47m AHD

The following flood levels (within the property where development is proposed) were obtained for the **1%AEP**:

- Fronting Terrigal Drive western boundary = 3.85m AHD
- Fronting Terrigal Drive center boundary = 3.78m AHD
- Fronting Terrigal Drive eastern boundary = 3.74m AHD

The following flood levels (within the property where development is proposed) were obtained for the **0.5%AEP**:

- Fronting Terrigal Drive western boundary = 3.95m AHD
- Fronting Terrigal Drive center boundary = 3.91m AHD
- Fronting Terrigal Drive eastern boundary = 3.86m AHD

The following flood levels (within the property where development is proposed) were obtained for the **0.2%AEP**:

- Fronting Terrigal Drive western boundary = 4.09m AHD
- Fronting Terrigal Drive center boundary = 4.05m AHD
- Fronting Terrigal Drive eastern boundary = 4.00m AHD

The following flood levels (within the property where development is proposed) were obtained for the **PMF**:

- Fronting Terrigal Drive western boundary = 5.5m AHD
- Fronting Terrigal Drive center boundary = 5.4m AHD
- Fronting Terrigal Drive eastern boundary = 5.4m AHD

The following flood levels (within the property where development is proposed) were obtained for the **1%AEP 2090 climate change**:

- Fronting Terrigal Drive western boundary = 4.04m AHD
- Fronting Terrigal Drive center boundary = 3.99m AHD
- Fronting Terrigal Drive eastern boundary = 3.96m AHD

Refer to Appendix A – TUFLOW Flood Maps for further information.

3.3.2 Proposed Scenario Flood Behavior

The proposed model addressed the 20%AEP, 1%AEP, 0.5%AEP, 0.2%AEP, PMF, and 1%AEP climate change 2090.

The following flood levels (within the property where development is proposed) were obtained for the **20%AEP:**

- Fronting Terrigal Drive western boundary = 3.49m AHD
- Fronting Terrigal Drive center boundary = 3.49m AHD
- Fronting Terrigal Drive eastern boundary = 3.47m AHD

The following flood levels (within the property where development is proposed) were obtained for the **1%AEP:**

- Fronting Terrigal Drive western boundary = 3.97m AHD
- Fronting Terrigal Drive center boundary = 3.76m AHD
- Fronting Terrigal Drive eastern boundary = 3.75m AHD

The following flood levels (within the property where development is proposed) were obtained for the **0.5%AEP**:

- Fronting Terrigal Drive western boundary = 4.02m AHD
- Fronting Terrigal Drive center boundary = 3.90m AHD
- Fronting Terrigal Drive eastern boundary = 3.86m AHD

The following flood levels (within the property where development is proposed) were obtained for the **0.2%AEP**:

- Fronting Terrigal Drive western boundary = 4.11m AHD
- Fronting Terrigal Drive center boundary = 4.05m AHD
- Fronting Terrigal Drive eastern boundary = 4.00m AHD

The following flood levels (within the property where development is proposed) were obtained for the **PMF:**

- Fronting Terrigal Drive western boundary = 5.48m AHD
- Fronting Terrigal Drive center boundary = 5.47m AHD
- Fronting Terrigal Drive eastern boundary = 5.47m AHD

The following depths (within the property where development is proposed) were obtained for the **1%AEP 2090 climate change:**

- Fronting Terrigal Drive western boundary = 4.17m AHD
- Fronting Terrigal Drive center boundary = 3.97m AHD
- Fronting Terrigal Drive eastern boundary = 3.94m AHD

Refer to Appendix A – TUFLOW Flood Maps for further information.

3.3.3 1%AEP Development Impact – Afflux

The proposed development resulted in minor impacts on the existing flood conditions for the 1%AEP. These impacts were mainly within the subject site's perimeter. The minor impacts outside the site's perimeter were found on the north-western boundary and did not extend past the footpath. These impacts reached a maximum level of approximately 13mm at peak time, a level greater than the council's acceptable threshold by 3mm.
In accordance with 3.5.1, post development hazards for the 1%AEP event have not changed, therefore the increase of water levels for the 1%AEP are considered minor and negligible.

Moreover, the proposed scenario witnessed a reduction in flood levels within Terrigal drive to the northern boundary of the site. Flood levels were reduced by 10-50mm

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compensating for the minor increase on the western boundary. As per the results, it can be carefully concluded that these impacts are negligible and that the proposed development does not cause an increase in risk to adjacent and downstream properties.

3.3.4 1%AEP 2090 Climate Change Factor Development Impact – Afflux

As per the council's request, an assessment of the 1%AEP 2090 Climate change increase has been modelled and assessed. Comparing the existing 1%AEP 2090 scenario with the proposed, the results demonstrated a similar result outcome to the 1%AEP no climate change. Refer to Appendix A – TUFLOW Flood Maps.

3.3.5 PMF Development Impact - Afflux

The proposed development resulted in increases of flood levels within the property by up to 260mm. This was witnessed on the western boundary due to a low point in the topography. These levels were contained between the footpath and the eastern boundary. Afflux was also witnessed at the intersection of Terrigal Drive and Charles Kay Drive. The proposed development resulted in an increase of up to 10mm - 40mm within the intersection. In accordance with 3.5.1, post development hazards for the PMF event have not changed, therefore the increase of water levels for the PMF are considered minor and negligible.

Figure9 - Afflux for the PMF Event

3.4 Flood Planning Levels (FPL)

New flood planning levels for the 1%AEP were adopted based on the TUFLOW model:

Dwelling	Required RL	Achieved RL	Event
Habitable area	4.5m (4.0 + 500mm)	5.80m	1% AEP
Non-Habitable area	4.3m (4.0 + 300mm)	5.80m	1% AEP
Evacuation	5.60m	5.80m	PMF

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Table 3 - Flood Planning Levels

The proposed development has been revised architecturally to incorporate the results of this flood study. The site has been designed to act as a safe refuge during flood events up to and including the PMF event. Refer to section 3.3.1, 3.3.2 and Appendix A for further details.

3.5 Flood Classification

Three Flood Classifications have been defined as follows:

1. **High Flood Risk Precinct;** This has been defined as the area of land below the 100-year flood event that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties.
The high flood risk precinct is where high flood damages, the potential risk to life or evacuation. problems would be anticipated, or development would significantly and adversely affect flood behaviour. Most development should be restricted in this precinct. In this precinct, there would be a significant risk of flood damages without compliance with flood-related building and planning controls.

2. **Medium Flood Risk Precinct;** This has been defined as the land below the 100-year flood event that is not within a High Flood Risk Precinct. This island that is not subject to a high hydraulic hazard or where there are no significant evacuation difficulties.
In this precinct there would still be a significant risk of flood damage, but these damages can be minimised by the application of appropriate development controls.

3. **Low Flood Risk Precinct;** This has been defined as all land within the floodplain (i.e. Within the extent of the probable maximum flood) but not identified within either a High Flood Risk or a Medium Flood Risk Precinct. The Low Flood Risk Precinct is that area above the 100-year flood event.
The Low Flood Risk Precinct is where risk of damages is low for most land uses. The Low Flood Risk Precinct is that area above the 100-year flood and most land uses would be permitted within this precinct.

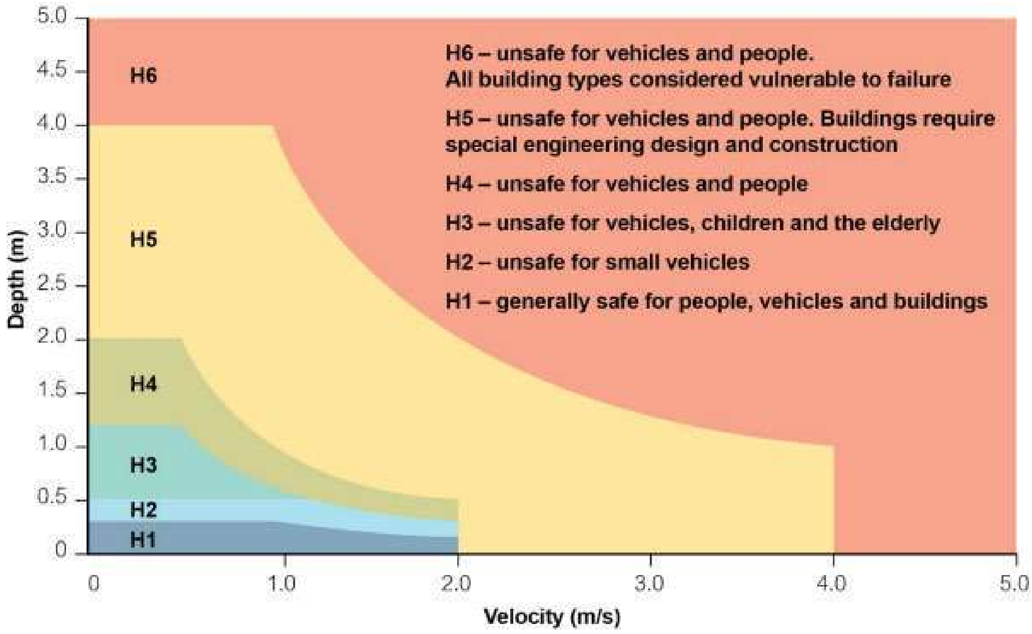

Figure 10 - Flood Hazard Classification

3.5.1 Site Hazard Classification

The site's risk level within the development zone has been categorized for each flood event as follows and in accordance with the Flood Risk Management Guide FB03:

- 20%AEP Existing condition = H3 (Low)
- 20%AEP Proposed condition = H3 (Low)
- 1%AEP Existing condition = H4 (Low)
- 1%AEP Proposed condition = H4 (Low)
- 0.5%AEP Existing condition = H4 (Low)
- 0.5%AEP Proposed condition = H4 (Low)
- 0.2%AEP Existing condition = H4 (Low)
- 0.2%AEP Proposed condition = H4 (Low)
- 1%AEP 2090 Existing condition = H4 (Low)
- 1%AEP 2090 Proposed condition = H4 (Low)
- PMF Existing condition = H5 (High)
- PMF Proposed condition = H5 (High)

In accordance with Figure 10 - Flood Hazard Classification, for the 1%AEP flood event the site is predominantly categorised as H3 (Low) with some minor H4 areas for both the existing and proposed scenarios. This indicates that the proposed development has negligible effects on flood hazards on the site and adjacent properties, refer to Appendix A – TUFLOW Flood Maps for further details.

3.5.2 Flood Function

In floodplain management, terms like "floodway," "flood storage," and "flood fringe" are used to describe different areas within a floodplain and their respective functions. Here's a brief explanation of each:

a. Floodway:

- Definition: The floodway is the central, most hazardous portion of a floodplain where the flow of floodwaters is the most intense. It includes the area required to convey floodwaters and is critical for managing high-flow conditions.
- Function: The primary function of the floodway is to allow the rapid and unobstructed flow of floodwaters to minimize the risk of flooding in other areas. It is often kept clear of structures and development to maintain its ability to manage high water flows and prevent significant flood damage.

b. Flood Storage:

- Definition: Flood storage areas are regions of a floodplain designated to temporarily hold and absorb excess floodwater. These areas can include natural or constructed features like wetlands, floodplain ponds, or detention basins.
- Function: The main function of flood storage is to reduce the peak flow of floodwaters by temporarily capturing and holding water during flood events. This helps to lessen the intensity of downstream flooding, manage runoff, and support groundwater recharge.

c. Flood Fringe:

- Definition: The flood fringe refers to the outer areas of the floodplain that are less prone to high-velocity floodwaters but can still experience periodic flooding. It's usually the area between the floodway and the boundary of the floodplain.
- Function: The flood fringe provides a buffer zone where floodwaters can spread out more gradually. While it may experience flooding, the waters are generally less intense compared to the floodway. This area can be utilized for development with appropriate floodplain management measures, such as elevating structures or implementing flood-resistant design features.

Flood function maps for the 1%AEP can be found in Appendix A – TUFLOW Flood Maps. The flood function was prepared in accordance with the Coastal Lagoon Catchments Overland Flood Study (2020), hydraulic categories have been defined as:

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- Floodway - Velocity x Depth > 0.25 m2/s
- Flood Storage - Depth > 0.5 m, Not Floodway
- Flood Fringe - Depth < 0.5 m, Not Floodway or Flood Storage

The 1%AEP pre-development flood function map found in Appendix A – TUFLOW Flood Maps, categorizes the flood function into three colours. All areas in shaded red represent a flood way, all areas in green represent a flood storage, and all areas in blue represent a flood fringe.

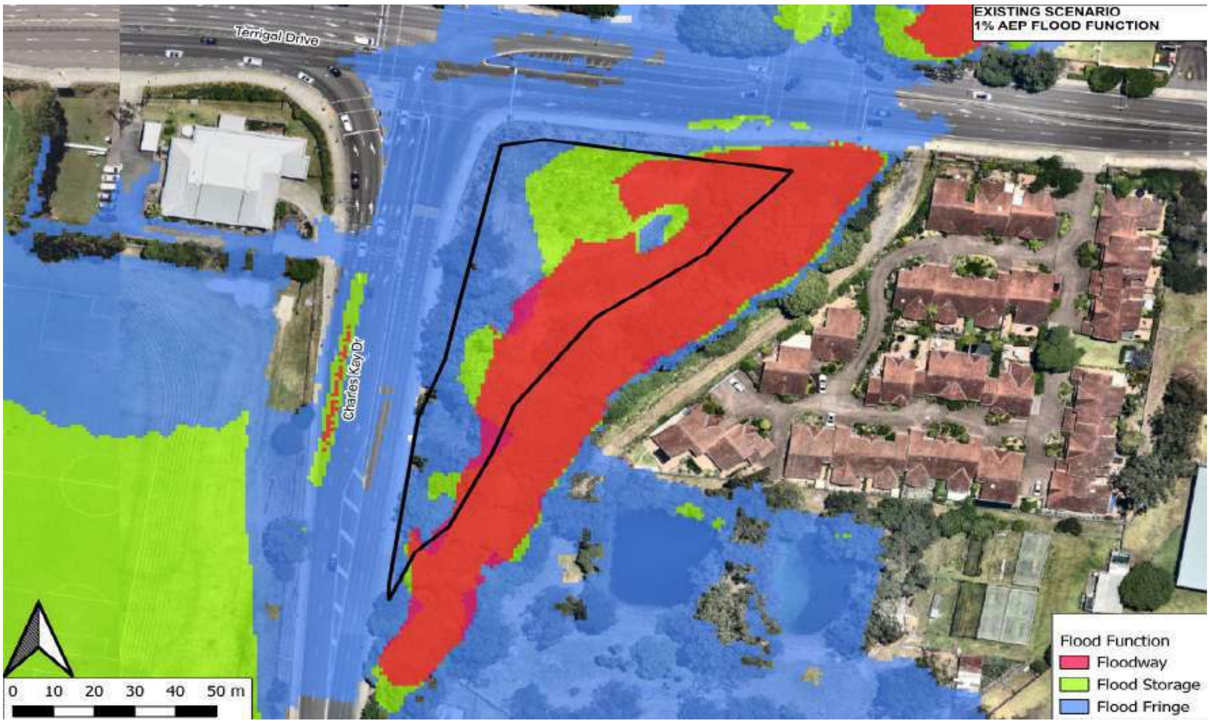

Figure 11- 1%AEP_Pre-Development Flood Function

In Figure 11, the floodway is concentrated at the eastern boundary along the open channel, with an approximately equal area of flood storage and flood fringe at the western boundary.

Figure 12 - 1%AEP_Post Development Flood Function

In Figure 12, the development is proposed mainly within the flood storage and flood fringe area with some sections within the floodway. To reduce impacts on flood waters, structures within the floodway are proposed to be suspended to allow for little obstruction of flood waters within this region. This mitigation technique resulted of minimal afflux mainly concentrated within the property's boundaries and the open channel while maintaining a H3 risk level. Therefore, the proposed development causes no plausible change to the flood function of the site and no nuisance to adjacent properties.

3.6 Flood Risk & Behaviour

Effective flood risk management involves assessing and mitigating flood risks to protect lives and property. This chapter dissects each flood event based on time series and events. This will allow us to understand the extent of risks between duration 0 hours to duration 3 hours of the flood event.

3.6.1 20% AEP Flood Event

- At 0 hours water levels rise in downstream lagoons and open channels. Surrounding roads are flood free.

- At 25 minutes, water levels rise within the property partially inundating the eastern boundary but not reaching the proposed development. Surrounding roads are flood free.
- At 55 minutes, water levels rise within the property reaching the proposed development. Surrounding roads are flood free.
- At 70 minutes, flooding reaches peak level. West bound on Terrigal drive becomes partially blocked with east bound flood free. Charles Kay Drive remains flood free.
- At 100 minutes, flooding gradually subsides. Local ponding of 117mm is visible on west bound Terrigal Drive with zero velocity reducing risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.

3.6.2 1% AEP Flood Event

- At 0 hours water levels rise in downstream lagoons and open channels. Surrounding roads are flood free.
- At 20 minutes, water levels rise within the property reaching the proposed development. Surrounding roads are flood free.
- At 45 minutes, water levels proceed to rise blocking Terrigal drive but Charles Kay Drive remains flood free.
- At 60 minutes, water levels proceed to rise blocking Terrigal Drive and Charles Kay Drive. No horizontal evacuation permitted. Shelter in place is activated.
- At 80 minutes, flooding reaches peak level with surrounding roads remaining blocked. No horizontal evacuation permitted. Shelter in place is activated.
- At 105 minutes, flooding gradually subsides. Local ponding of 20mm is visible on Charles Kay Drive with 0.141m/s velocities and a reduction in risk levels to H1. Normal vehicle movement can resume.
- At 145 minutes, flooding continues to subside. Local ponding of 168mm is witnessed at Terrigal Drive with zero velocity and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.

3.6.3 0.5% AEP Flood Event

- At 0 hours, water levels rise in downstream lagoons and open channels. Surrounding roads are flood free.
- At 20 minutes, water levels rise within the property reaching the proposed development. Surrounding roads are flood free.
- At 40 minutes, water levels proceed to rise blocking Terrigal drive but Charles Kay

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Drive remains flood free.

- At 55 minutes, water levels proceed to rise blocking Terrigal Drive and Charles Kay Drive. No horizontal evacuation permitted. Shelter in place is activated.
- At 70 minutes, flooding reaches peak level with surrounding roads remaining blocked. No horizontal evacuation permitted. Shelter in place is activated.
- At 105 minutes, flooding gradually subsides. Local ponding of 20mm is visible on Charles Kay Drive with 0.074m/s velocities and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.
- At 145 minutes, flooding continues to subside. Local ponding of 183mm is witnessed at Terrigal Drive with zero velocity and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.

3.6.4 0.2% AEP Flood Event

- At 0 hours, water levels rise in downstream lagoons and open channels. Surrounding roads are flood free. Localised ponding witnessed within the property.
- At 20 minutes, water levels rise within the property reaching the proposed development. Surrounding roads are flood free.
- At 35 minutes, water levels proceed to rise blocking Terrigal drive but Charles Kay Drive remains flood free.
- At 50 minutes, water levels proceed to rise blocking Terrigal Drive and Charles Kay Drive. No horizontal evacuation permitted. Shelter in place is activated.
- At 65 minutes, flooding reaches peak level with surrounding roads remaining blocked. No horizontal evacuation permitted. Shelter in place is activated.
- At 105 minutes, flooding gradually subsides. Local ponding of 38mm is visible on Charles Kay Drive with 0.104m/s velocities and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.
- At 150 minutes, flooding continues to subside. Local ponding of 148mm is witnessed at Terrigal Drive with zero velocity and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.

3.6.5 1% AEP 2090 Climate Change Flood Event

- At 0 hours, water levels rise in downstream lagoons and open channels. Surrounding roads are flood free.
- At 20 minutes, water levels rise within the property reaching the proposed

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development. Surrounding roads are flood free.

- At 35 minutes, water levels proceed to rise blocking Terrigal drive but Charles Kay Drive remains flood free.
- At 50 minutes, water levels proceed to rise blocking Terrigal Drive and Charles Kay Drive. No horizontal evacuation permitted. Shelter in place is activated.
- At 70 minutes, flooding reaches peak level with surrounding roads remaining blocked. No horizontal evacuation permitted. Shelter in place is activated.
- At 105 minutes, flooding gradually subsides. Local ponding of 110mm is visible on Charles Kay Drive with 0.110m/s velocities and a reduction in risk levels to H1.
- At 150 minutes, flooding continues to subside. Local ponding of 189mm is witnessed at Terrigal Drive with zero velocity and a reduction in risk levels to H1. Normal vehicle movement can resume towards Scenic Hwy.

3.6.6 PMF Flood Event

- At 0 hours, water levels rise in downstream lagoons and open channels. Subject site inundated including blocking Terrigal Drive. Charles Kay Drive is flood free.
- At 25 minutes, water levels proceed to rise blocking Terrigal Drive and Charles Kay Drive. No horizontal evacuation permitted. Shelter in place is activated.
- At 45 minutes, flooding reaches peak level with surrounding roads remaining blocked. No horizontal evacuation permitted. Shelter in place is activated.
- At 100 minutes, flooding gradually subsides but roads remain inundated. Risk Levels within Charles Kay Drive reduce to H1 with water levels at 183mm and velocity at 0.767m/s.
- At 180 minutes, flooding continues to subside. Terrigal Drive remains blocked, and Charles Kay Drive becomes flood free. Normal vehicle movement can resume towards Scenic Hwy.

Referring to Afflux results listed within section 3.3, the hazard categories listed in section 3.5.1, and the flood behaviour listed within this chapter we can conclude the following:

1. During the **20% AEP flood event**, the proposed development presents no changes to risk levels and nuisance to the subject site and surrounding properties. Horizontal evacuation is safe during this event even at the flood peak hours. Emergency services have safe and unobstructed access to the site via Charles Kay Drive through to the basement access ramp.

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2. During the **1% AEP flood event**, the proposed development presents no changes to risk levels to the subject site and surrounding properties despite minor Afflux. The proposed development results in a reduction in flood levels within Terrigal Drive. From time 0 minutes to 59 minutes, safe horizontal evacuation to Scenic HWY can be achieved via Charles Kay Drive. From 60 minutes to 104 minutes, roads and access points become blocked and horizontal evacuation is no longer feasible. Shelter in place will be mandatory. Shelter in place will be required for approximately 44 minutes and at 105 minutes risk reduces to hazard category H1 within Charles Kay Drive allowing for horizontal evacuation to Scenic HWY and safe access for emergency services.

3. During the **0.5% AEP (200 year) flood event**, the proposed development presents no changes to risk levels to the subject site and surrounding properties despite minor Afflux. The proposed development results in a reduction in flood levels within Terrigal Drive. From time 0 minutes to 54 minutes, safe horizontal evacuation to Scenic HWY can be achieved via Charles Kay Drive. From 54 minutes to 104 minutes, roads and access points become blocked and horizontal evacuation is no longer feasible. Shelter in place will be mandatory. Shelter in place will be required for approximately 50 minutes and at 105 minutes risk reduces to hazard category H1 within Charles Kay Drive allowing for horizontal evacuation to Scenic HWY and safe access for emergency services.

4. During the **0.2% AEP (500 year) flood event**, the proposed development presents no changes to risk levels to the subject site and surrounding properties despite minor Afflux. The proposed development results in a reduction in flood levels within Terrigal Drive. From time 0 minutes to 49 minutes, safe horizontal evacuation to Scenic HWY can be achieved via Charles Kay Drive. From 50 minutes to 104 minutes, roads and access points become blocked and horizontal evacuation is no longer feasible. Shelter in place will be mandatory. Shelter in place will be required for approximately 54 minutes and at 105 minutes risk reduces to hazard category H1 within Charles Kay Drive allowing for horizontal evacuation to Scenic HWY and safe access for emergency services..

5. During the **1% AEP 2090 Climate Change flood event**, the proposed development presents no changes to risk levels to the subject site and surrounding properties despite minor Afflux. The proposed development results

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in a reduction in flood levels within Terrigal Drive. From time 0 minutes to 49 minutes, safe horizontal evacuation to Scenic HWY can be achieved via Charles Kay Drive. From 50 minutes to 104 minutes, roads and access points become blocked and horizontal evacuation is no longer feasible. Shelter in place will be mandatory. Shelter in place will be required for approximately 54 minutes and at 105 minutes risk reduces to hazard category H1 within Charles Kay Drive allowing for horizontal evacuation to Scenic HWY and safe access for emergency services.

6. During the **PMF flood event**, the proposed development presents no changes to risk levels to the subject site and surrounding properties despite minor Afflux. The proposed development results in a reduction in flood levels within Terrigal Drive. From time 0 minutes to 24 minutes, safe horizontal evacuation to Scenic HWY can be achieved via Charles Kay Drive. From 25 minutes to 99 minutes, roads and access points become blocked and horizontal evacuation is no longer feasible. Shelter in place will be mandatory. Shelter in place will be required for approximately 74 minutes and at 100 minutes risk reduces to hazard category H1 within Charles Kay Drive allowing for horizontal evacuation to Scenic HWY and safe access for emergency services.

The data presented in this chapter allows for horizontal evacuation during the earlier stages of the flood event. But due to the short periods of flood events and short peak hazard time ranging up to 74 minutes for the PMF, it is recommended for shelter in place to be adopted at all time. With horizontal evacuation rises the risk of underestimating surrounding conditions causing unforeseen danger to lives.

A flood emergency response plan (FERP) to be provided to all residents enforcing shelter in place. Refer to section 6 of this report for a detailed outline of the FERP.

4. Governing Legislations

4.1 Requirements of Section 9.1 Direction.

The aim of a flood impact assessment is to ensure that the proposed development, which includes ancillary structures, in flood prone areas does not adversely impact on the flood regime and that the development is designed to minimise the flood impact.

In accordance with Focus area 4 'Resilience & Hazards' of the local planning directions issued by the Minister for Planning authorities under section 9.1(2) of the Environmental Planning and Assessment Act 1979, the following directions need to be met for flood prone properties:

Section 9.1 Requirements	How the Proposal Addresses the Requirement
1) A planning proposal must include provisions that give effect to and are consistent with: (a) the NSW Flood Prone Land Policy, (b) the principles of the Floodplain Development Manual 2005, (c) the Considering flooding in land use planning guideline 2021, and (d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.	The Planning Proposal seeks to amend the Central Coast LEP 2022 by increasing the maximum permissible height of buildings to 25m, and the maximum floor space ratio to 1.3:1
(2) A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.	The planning proposal does not seek to do this.

(3) A planning proposal must not contain provisions that apply to the flood planning area which & (4) A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which: (a) permit development in floodway areas, (b) permit development that will result in significant flood impacts to other properties, (c) permit development for the purposes of residential accommodation in high hazard areas, (d) permit a significant increase in the development and/or dwelling density of that land, (e) permit development for the purpose of centre- based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate, (f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent, (g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or (f) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	The Planning Proposal seeks to amend the Central Coast LEP 2022 by increasing the maximum permissible height of buildings to 25m, and the maximum floor space ratio to 1.3:1 Increasing the maximum permissible height of buildings (and therefore, the FSR) does not permit development that is in a floodway or high hazard area any more than the current zone facilitates such development. a) The adopted modelling proves that despite the Affluxes between pre and post scenarios for all stormwater events, the risk category for these events remain predominantly the same. Measures have been taken to minimise structures within the floodway by suspending these structures over the floodway. In accordance with section 3.5.2 of this report, the development is predominantly proposed within the flood storage and flood fringe zone minimising obstruction to the floodway and its behaviour. b) The Planning Proposal will not result in significant flood impacts to other properties, as quantified in the detailed modelling in this report. Hazard levels are shown to be consistent between pre and post scenario with no significant changes. c) As per section 3.5.1 of this report it is demonstrated that the site is considered a H4 hazard category for both pre and post development. As per the Flood Risk Management Guide FB03, categories H1 to H4 are identified as low hazard. Despite this, the proposed development has been designed to address risks associated for all storm events up to and including the PMF event. Structural letter has been provided by JSBC consulting engineers confirming that this development can be constructed to withstand flood forces up to and including the PMF event. d) The proposal will result in a modest

	increase in density by 37 dwellings, however noting that residential flat buildings are permitted on the site and the proposal would be contained within the footprint that is permitted. The proposed changes will lead to increased height and FSR in the air space which is well and truly above the flood levels and in a land that is already zoned for residential. Hence this planning proposal does not permit any development as per the directions that the subject land is not already approved for. e) None of the developments listed in this clause are proposed f) None of the listed works will be carried out g) Will not require government spending on updating emergency services. h) Hazardous materials for a residential development are minimal. Regardless, hazardous materials will be stored within the basement that is protected from floods by an elevated ramp and on ground levels that are proposed above PMF flood levels.
(5) For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the *Flood Risk Management Manual 2023* or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.	This report constitutes *a floodplain risk management plan prepared in accordance with the principles and guidelines of the Flood Risk Management Manual 2023,* and the planning proposal is in accordance with it.

Table 4 - Requirements of Section 9.1 of the NSW local planning direction.

4.2 Central Coast Council LEP section 5.21 Flood Planning

Section 5.21 of the Local Environmental Plan sets requirements applicable to flood prone that need to be adhere. Below are the list of regulations and how the proposed development adheres to these conditions:

5.21 Flood Planning Requirements	Response
(1) The objectives of this clause are as follows— (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 the land, taking into account projected changes as a result of climate change, (c) to avoid adverse or cumulative impacts on flood behaviour and the environment, (d) to enable the safe occupation and efficient evacuation of people in the event of a flood.	This flood impact assessment report has demonstrated through hydraulic and hydrologic modelling analysis that the proposed development does not significantly alter the functionality of the existing flooding behaviour. It is also demonstrated that despite the negligible increase in flood levels for the 1%AEP, the proposal does not increase risk levels on adjacent and downstream properties and remains within the H4 risk category, therefore is considered satisfactory.
(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development— (a) is compatible with the flood function and behaviour on the land, and (b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and (c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and (d) incorporates appropriate measures to manage risk to life in the event of a flood, and (e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	The flood behaviour for the subject development has been assessed for the 20%AEP, 1%AEP,0.5%AEP, 0.2%AEP, PMF and 1%AEP 2090 climate change. As per the results presented in this report, the proposed development does not cause adverse effects to adjacent and downstream properties. Further, the proposed development has been proposed with a ground floor at a level greater than PMF. This allows for ground floor level to be a safe refuge during all flood events up to and including the PMF. Moreover, the flood assessment presented minor increase in velocity within the site perimeters (~0.3m/s) but velocity decrease within the banks and watercourse adjacent to the subject site (~-0.05m/s). As per the Department of Primary Industries and Regional Development, the suggested maximum velocity for sand, the least resistant soil, is 0.4m/s. This suggests that the increase in flood velocity due to the proposed development is negligible and will not cause significant erosion.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters— (a) the impact of the development on projected changes to flood behaviour because of climate change, (b) the intended design and scale of buildings resulting from the development, (c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood, (d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	In addition to the responses above, the 1%AEP 2090 climate change factor has been modelled and assessed. The results present the same outcome as the 1%AEP flood event with minor increase in flood levels within the property and negligible increases within the road reserve. The 1%AEP 2090 climate change presented flood levels slightly higher than the 1%AEP but lower than the PMF proving the building to be a safe refuge in year 2090. The results of the TUFLOW modelling for the proposed scenario have presented minor increase in flood levels and velocities but not increase in flood risk. This indicates that the proposed size of the development is consistent with the objectives of the zone. Moreover, these results also negate the requirement of modifying, relocating, or removing buildings as a result of the development. Therefore, the certifying authority can be satisfied that these matters have been successfully considered and addressed.

4.3 Objectives of CCC's Development Control Plan 2022

The purpose of this flood impact report is to ensure the development is designed and built in accordance with requirements addressed in Central Coast Council's Development Control Plan. The DCP provides the fine grain detail of the planning framework and applies in conjunction with LEP. It assists in the preparation of development applications and ensures development takes place in a quality and orderly manner. For residential development rebuild the following requirements need to be addressed and met:

4.3.1 Flood Levels

"Habitable floor levels to be equal to or greater than the 100-year flood planning level plus freeboard." All habitable floor levels have been designed at RL 5.8m AHD. A level greater than all flood levels including PMF.

4.3.2 Building Components

"All structures to have flood compatible building components below or at 100-year flood level plus freeboard." The building structure has been proposed of flood compatible materials and in accordance with Table 4.

4.3.3 Flood Affectation

The development must not:

a) Affect the safe occupation of any flood prone land.

The proposed development has been designed to act as a safe refuge during flood events up to PMF. A structural letter has been prepared by JSBC Consulting confirming the structure can be designed to withstand flood forces up to PMF.

b) Be sited on the land such that flood risk is increased.

The conducted hydraulic assessment of the proposed site indicated no increase in flood risk to the subject site or adjacent and downstream properties.

c) Adversely affect flood behaviour by raising predevelopment flood level by more than 10mm.

The post development hydraulic model indicated minor increase in levels and velocity within the site and immediately adjacent to the western boundary bounded by the footpath. The model witnessed depth increase by up to 13mm within the footpath. The 3mm exceedance is considered negligible as it takes place momentarily at peak flood time. Peak changes in flood characteristics do not alter the flood risk for the subject site and adjacent properties.

d) Result in an increase in the potential of flooding detrimentally affecting other development or properties.

Refer to condition c)

e) Significantly alter flow distributions and velocities to the detriment of other properties or the environment of the floodplain.

Refer to condition c)

f) Significantly and detrimentally affect the floodplain environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of any riverbank or watercourse.

The flood assessment presented minor increase in velocity within the site perimeters (~0.3m/s) but velocity decrease within the banks and watercourse adjacent to the subject site (~-0.05m/s). As per the Department of Primary Industries and Regional Development, the suggested maximum velocity for sand, the least resistant soil, is 0.4m/s. This suggests that the increase in flood velocity due to the proposed development is negligible.

g) Be likely to result in unsustainable social and economic costs to the flood affected community or general community as a consequence of flooding (including damage to public property and infrastructure, such as roads, stormwater, water supply, sewerage, and utilities).

The development will not result in unsustainable social and economic costs to the flood affected community or general community because of flooding, as flood damages will be minimal due to the use of flood compatible materials and the FFL and basement controls.

h) Be incompatible with the flow of floodwaters on flood prone land (considering any structures, filling, excavation, landscaping, clearing, fences, or any other works).

Refer to condition g)

i) Cause or increase any potential flood hazard (considering the number of people, their frailty, as well as emergency service and welfare personnel).

The proposed development does not change the trafficability or hazard on Terrigal Drive or cause an increase in flood hazard for other sites.

4.3.4 Evacuation and parking

a) Reliable and failsafe access for pedestrians required at or above the 100-year flood level, and not more than 0.5m below the highest floor level. This access is to be adjacent the side boundary.

The proposed development has been designed with a habitable floor level at RL5.8m AHD, a level greater than the 1%AEP plus freeboard and greater than PMF. Access to basement parking is proposed via a suspended ramp with a crest level greater than PMF flood level, protecting the basement from flooding.

b) All access roads and driveways, and external parking areas to be above the 100-year ARI Flood Level (FPL less 0.5m) to provide the ability to safely receive and evacuate occupants.

The proposed parking and basement entry has been designed at RL5.8m AHD, a level greater than the 1%AEP plus freeboard and greater than PMF. Access to the basement parking is proposed via a suspended ramp that allows for the passage of flood waters below.

4.3.5 Management & Design

a) Fencing within a floodway will not be permissible except for security/ permeable/ open type/ safety fences of a type approved by Council. Fencing in certain areas may also be restricted by current Floodplain Risk Management Plans.

Open style fencing to be proposed at crucial locations for pedestrian safety. Fencing to consist of vertical louvers spaced at 100mm intervals maximum.

b) Applicant to demonstrate that area is available to store goods above the 100-year flood level plus freeboard.

Habitable levels have been designed above flood planning plus freeboard. Basements have been designed with an entry above PMF level. These two areas are considered a safe area to store goods.

c) No external storage of materials below the 100-year flood level plus freeboard, which may cause pollution or be potentially hazardous during a flood.

Refer to condition b)

The table below outlines the flood compatible materials up to maximum flood level for each building component considered acceptable by standards.

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL

Flooring and Sub-floor Structure	• Concrete slab-on-ground monolith construction • Suspension reinforced concrete slab.	**Doors**	• Solid panel with waterproof adhesives • Flush door with marine ply filled with closed cell foam. • Painted metal construction • Aluminum or Galvanised steel frame
Floor Covering	• Clay tiles • Concrete, precast or in situ • Concrete tiles • Epoxy, formed-in- place • Mastic flooring, formed-in-place • Rubber sheets or tiles with chemical- set adhesives • Silicone floors formed-in-place • Vinyl sheets or tiles with chemical-set adhesive • Ceramic tiles, fixed with mortar or chemical-set adhesive • Asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	• Fibro-cement board • Brick, face or glazed • Clay tile glazed in waterproof mortar • Concrete • Concrete block • Steel with waterproof applications • Stone, natural solid or veneer, waterproof grout • Glass blocks • Glass • Plastic sheeting or wall with waterproof adhesive
Wall Structure	• Solid brickwork, blockwork, reinforced concrete or mass concrete	**Insulation** **Windows**	• Foam (closed cell types) • Aluminum frame with stainless steel rollers or similar corrosion and water-resistant material.
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	• **Reinforced concrete construction.** • **Galvanized metal construction**	Nails, Bolts, Hinges and Fittings	• Brass, nylon or stainless steel • Removable pin hinges • Hot dipped Galvanized steel

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			wire nails or similar

Electrical and Mechanical Equipment **For dwellings constructed on land to which this Policy applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.**	**Heating and Air Conditioning Systems** **Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the relevant flood level.** **When this is not feasible every precaution should be taken to minimize the damage caused by submersion according to the following guidelines.**
Main power supply - Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply.	**Fuel -** Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.
Wiring - All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.	**Installation -** The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 500 millimeters above the relevant flood level.

Equipment - All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	**Ducting -** All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection - Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	

Table 5 - Flood Compatible Materials

4.4 In response to PRE-DA assessment notes

Request for information was made by council's assessing officer after the PRE-DA assessment meeting. These RFI's regarding flooding and stormwater and corresponding response are summarised below.

Matter Raised in CCC's Current Assessment of the Proposal	How the Matter has been integrated into this report / the proposal
The consultant has elected to undertake a new Hydrological and 2D Hydraulic Flood Study in lieu of the adopted Coastal Lagoons Overland Flood Study 2020 for the purpose of the assessment. The consultant has provided valid reasons for undertaking the new Flood Study and these reasons are understandable. The methodology and assumptions for the purpose of the study are acceptable. Does the downstream Lagoon level during a 1%AEP event influence flood levels	The tailwater level influences the extent of backwater effects within the lagoon and upstream properties. Backwater occurs when upstream flow is restricted or slowed, causing water levels to rise upstream. Considering tailwater levels as part of the assessment provides a more conservative outcome.

at this location? Is it reasonable not to consider the tailwater from the model?	
The consultant states that the 1%AEP impact is not considered to be adverse, significant or detrimental. The result mapping appears to show the impact on the roadway to be somewhere between 0.02 and 0.05m. It is generally accepted that a development shall have a flood impact of no more than 0.01m during the 1%AEP event. The design should be revisited to reduce the impact on the roadway to be no more than 0.01m.	CSEG™ conducted a TUFLOW model adopting the same principals adopted by RIENCO Consulting and Council flood model. The results presented in our model were significantly similar to RIENCO's with marginal differences. CSEG™ flood model was able to reduce the Afflux within the road down to 0.013m. The excess 0.003m is considered insignificant and is a result of software marginal errors. Further, the excess flood depth of 0.003m does not change the risk hazard category of the site in comparison to pre-development conditions.
The building obstruction significantly increases the velocity of water to the west of the building. The building results in a flow path with velocity of over 4m/s traveling north through the site before discharging onto Terrigal Drive. In the opinion of the consultant does this result in an increased flood risk to people or property compared to the existing. Can the design be modified to reduce the velocity impact caused by the building?	The flood model conducted by CSEG™ presented minor increase in velocity within the site perimeters (~0.3m/s) and velocity decrease within the banks and watercourse adjacent to the subject site (~-0.05m/s). These results are negligible.
The consultant states that the basement carpark access is designed for access to be above the 1% AEP surface level. For new basement carparks Council requires that the driveway crest shall be at the PMF level to ensure that the basement will not inundate. Can this be achieved at this location?	Basement access has been designed at RL5.8m AHD a level higher than PMF by 320mm approximately.
Update the flood assessment report to include the hazard category during the post and pre-development PMF event.	An updated flood model has been prepared by CSEGtm to address this requirement. Flood hazard category for the PMF event is found in Appendix A of this report.

Update the flood assessment report to include appropriate arrangements for shelter-in-place, and/or evacuation in a PMF event, in consideration of the Draft Shelter-in-place Guideline 2023.	Please refer to section 6 of this report.

5. Site Development

5.1 Architecture

The architectural design of the multi residential development prepared by CKDS architects demonstrate the following compliances:

a) Habitable floor levels have been set to above PMF level. A level greater than the standard required level.

b) Non-Habitable floor levels have been set to above PMF level. A level greater than the standard required level.

c) Parking levels and access to parking have been set to above PMF level. A level greater than the standard required level.

d) Building has been proposed of flood compatible materials.

e) Elevated planter boxes have been proposed. Architectural plans to be amended to show non elevated planter boxes. Elevated planter boxes resulted of an increase in afflux.

f) Safe access in the form of stairs and ramps to habitable floor levels has been proposed.

g) Boundary setbacks have been maintained to allow for the passage of unobstructed overland flow.

h) The design to be amended to outline fence type and location.

5.2 Engineering

The stormwater management report was prepared by Targo Engineering Consultants, revision 04 dated September 2023. CSEG™ has assessed this report and makes the following recommendations:

a) The proposed OSD system would be beneficial in reducing flood impacts of the site and downstream properties. The OSD system is to be placed at a level higher than the 1%AEP with an unobstructed emergency overflow route. The OSD system to capture the entire impervious area if possible.

b) A 10kl rainwater tank has been proposed to meet WSUD requirements. It would be highly advisable to increase the rainwater tank volume for greater storage promoting greater water quantity re-use. In addition to toilet flushing and irrigation, we propose rainwater re-use car washing and for laundry. Rainwater tank to be equipped with a 3-stage filtration system to be designed by a qualified hydraulic engineer.

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6. Flood Emergency Response Plan (FERP)

A Flood Emergency Response Plan is a crucial document designed to guide communities, organizations, and individuals in effectively managing and responding to flood events. The plan outlines procedures and strategies to minimize the impact of flooding, protect lives and property, and facilitate a coordinated response. A copy of the FERP to be provided to each resident and management. Yearly meetings to be held discussing the content of the FERP to residents and the conditions they are bound by.

6.1 Risk Assessment

Providing an effective response plan requires understanding the level and extent of risk the site is subject to. Below we will assess the risks associated with the 1%AEP and the PMF event.

6.1.1 1% AEP

The flood model produced similar results for the pre and post development. Both scenarios were categorized as flood risk H4 (Low). At peak flood time, surrounding access points and roads are submerged with depths varying between 100mm to 550mm, blocking surrounding roads and preventing ingress or egress to the proposed property. Moreover, the subject site also witnessed flood inundation with depths varying between 250mm up to 1.3m.

Despite H4 risk level being identified as low risk, in accordance with the FRMG FB03, it is still considered unsafe for people and vehicles and as per the general flood hazard vulnerability curve chart in Figure 11 - Flood Hazard Classification.

6.1.2 PMF

The flood model produced similar results for the pre and post development. Both scenarios were categorized as flood risk H5 (High). At peak flood time, surrounding access points and roads are submerged with depths varying between 900mm up to 2200mm, blocking surrounding roads and preventing ingress or egress to the proposed property. Moreover, the subject site also witnessed flood inundation with depths varying between 2.20m up to 2.7m.

In accordance with the FRMG FB03,PMF is considered unsafe for people, vehicles and all building types considered vulnerable to failure as per the general flood hazard vulnerability curve chart in Figure 11 - Flood Hazard Classification.

Flood events between the 1%AEP and the PMF also presented similar outcomes promoting risk to people, vehicles and building structure. Since the development has been proposed with habitable floor levels greater than PMF, the ideal method of response to flood risk is shelter in place.

6.2 Shelter In Place

The department of Planning and Environment has prepared guidelines to keep people safe during flood events. One of these risk management strategies is to allow for shelter within the proposed development for the PMF event, also known as vertical evacuation.

The proposed development has been designed with a finished habitable level of RL 5.80m AHD. The adopted level is set to achieve a level greater than PMF by approximately 320mm. This design approach promotes safety for residents within their own habitable area.

Moreover, the hydraulic model has presented the peak flows for the PMF to peak from 45 minutes through to approximately 2 hours. During this time frame the roads surrounding the development, Terrigal Drive & Charles Kay Drive, would be submerged. Post 2 hours to 3 hours the PMF flood levels commence descending, and the hazard levels commence to subside. At 3 hours, Charles Kay Drive becomes flood free and safe vehicle ingress and egress.

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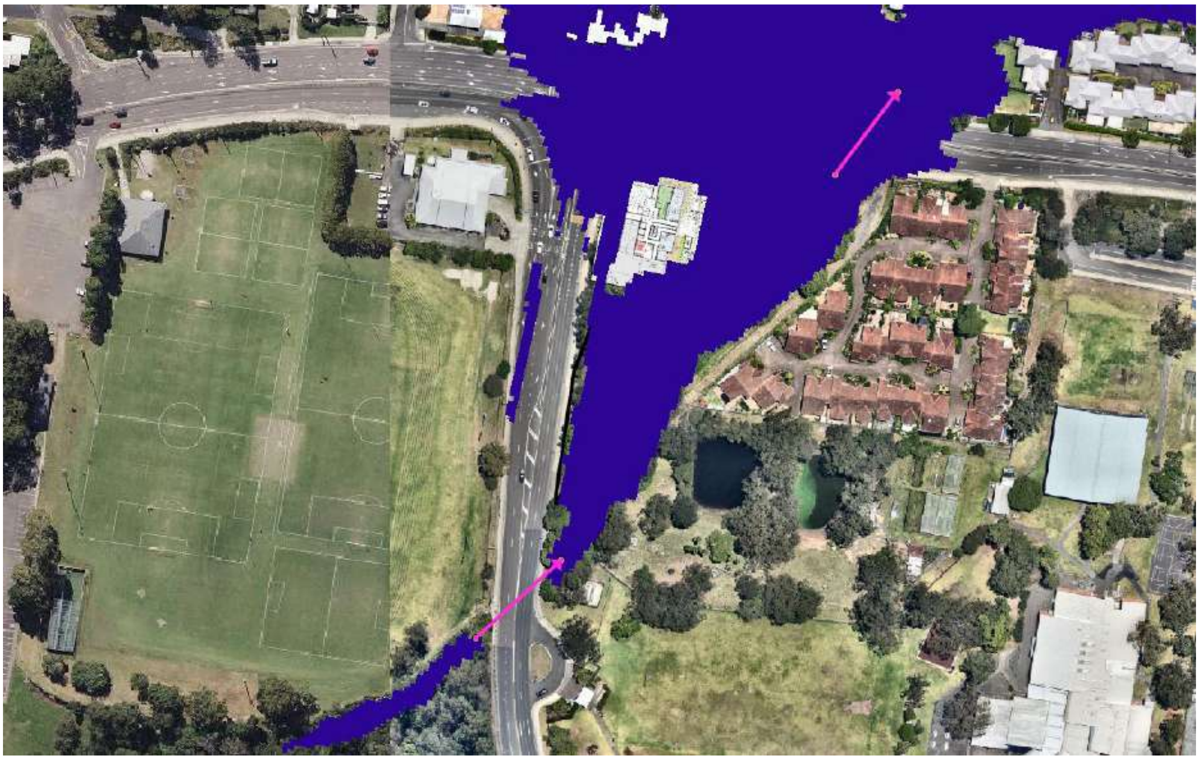

Figure13 - PMF Extent at time 0 hours.

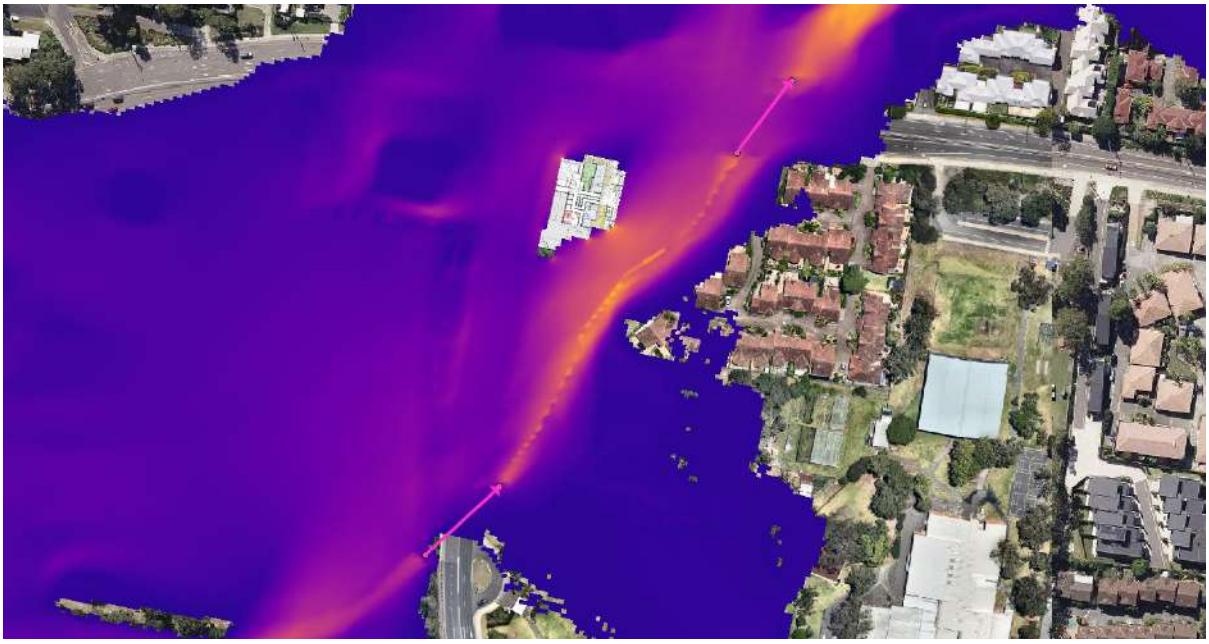

Figure14 - PMF extent at 45 minutes

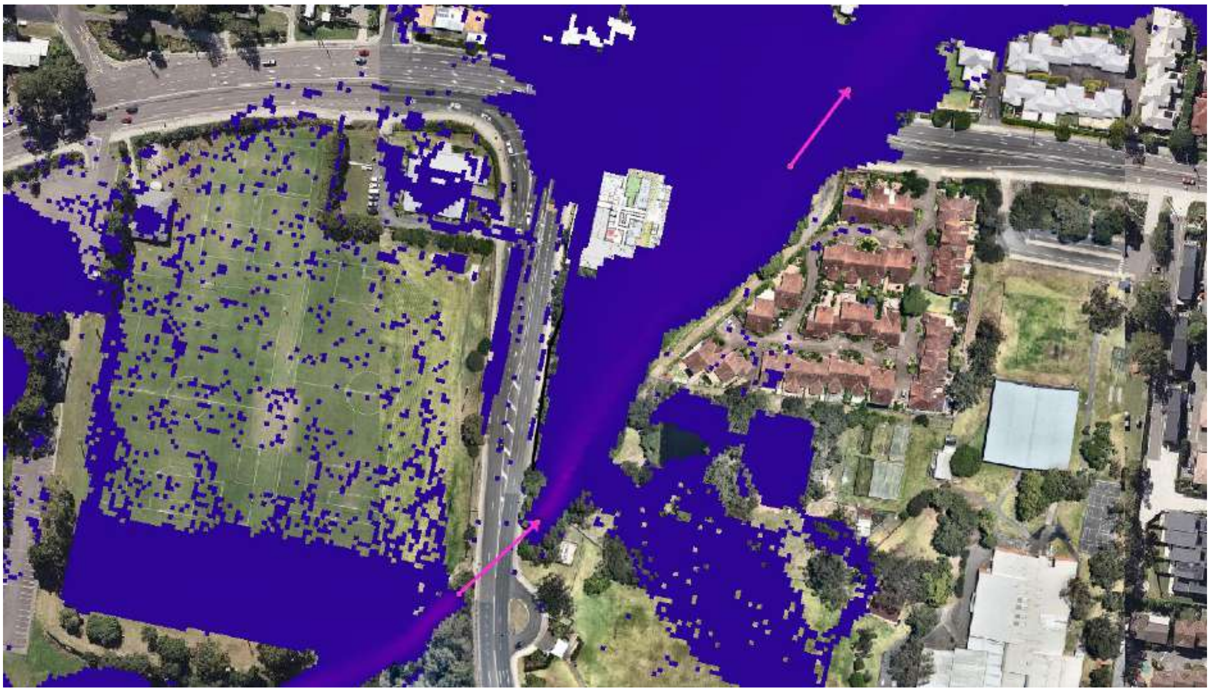

Figure15 - PMF extent at 3 hours

6.2.1 When SIP is appropriate

- SIP is an emergency management response, especially when the flood warning time and flood duration are both less than six hours (typically called flash floods).

The hydraulic modelling results indicated the PMF exhibited a short warning time and short peak flow duration. PMF events reach peak flows within 45 minutes and subside to acceptable risk levels within approximately an hour of peak flow. Considering emergency response time in busy situations, this is equivalent or greater than the duration of a flood event subsiding from peak flows, therefore SIP is considered to be a suitable strategy for this site.

- These flooding events are dangerous because of the short timeframes, as well as the flood speed and depth.

Vertical evacuation is the most suitable strategy as accessible routes within the vicinity become completely submerged making horizontal evacuation unsafe for people and vehicles.

- Under such circumstances, evacuation via vehicle may not be possible. SIP is the last resort evacuation option for development in greenfield and infill areas.

Refer to the explanation within point 1 and point 2.

6.2.2 Risks of Shelter in place

Emergency response plans, while crucial for managing and mitigating the impacts of disasters such as floods, are not risk-free. Despite adopting appropriate engineering solutions to make shelter in place a safe response plan, some risks associated with external factors still need to be considered and cannot be ignored:

a) **Power outage:**

To manage power outages due to flooding, it is recommended to:

- Install generators or interruptible power supplies (UPS) to power communication devices, fridges and medical equipment. Ensure that backup systems are properly maintained and tested.
- Use battery powered radios or mobile devices with backup power to receive emergency updates and instructions.
- Report power outages to utility companies and local authorities. Provide information about any immediate dangers or critical needs.
- In the instance of generator failure, it is recommended to install backup batteries connected to essential equipment such as lighting, flood warning systems and communication devices.

b) **Risk to human:** despite shelter in place being a safe refuge for residents during a flood event, it imposes a greater risk on residents attempting to return home. To prevent injuries and possible loss of life it is recommended to:

- Install communication and flood warning systems that receive information from certified sources such as emergency services and the Bureau of Metereology. With current existing technologies to date, mobile phones are a powerful tool. As part of the emergency response plan issued to each resident, it should be made mandatory for residents to install weather warning apps on their phones.
- Install warning devices such as flood sirens and flood water gauges about the site. Flood sirens should be set to activate once flood levels and velocity exceed hazard category H1. Strata management should monitor these warning devices at all time and be responsible for keeping up with the maintenance schedule.

6.2.3 Mitigation Options

To reduce risk to residents during a flood event, the following mitigation techniques are to be implemented:

a) Installation of flood warning sirens.

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b) Installation of water level gauges through the site.
c) Installation of smart TVs with live cast of the Bureau of Meteorology.
d) Maintenance schedules for all warning devices and equipment.
e) Ongoing education and seminars for all residents.
f) Review of emergency response plan on a yearly basis.
g) Maintenance of building structure to ensure longevity.

6.2.4 Actions during flood events

During a flood event the following actions should be taken:

a) Stay Indoors: Remain indoors and avoid traveling unless absolutely necessary. Floodwaters can be dangerous and unpredictable.
b) Avoid Contact with Water: Stay away from floodwater as it may be contaminated with chemicals, sewage, or other hazards.
c) Move to Higher Floors: If water is rising inside the building, move to higher floors or the roof to avoid the risk of drowning or injury. Avoid using elevators during a flood.
d) Notify Authorities: If you are in immediate danger, call emergency services to alert them of your location and situation. Provide clear information about your address and the nature of the emergency.
e) Stay Updated: Keep informed of weather updates and emergency instructions through a battery-powered radio or mobile device.
f) Secure Entry Points: Block or seal doors and windows to prevent water from entering. Use sandbags or other barriers if available.
g) Disconnect Electrical Appliances: If safe to do so, unplug electrical appliances and devices to avoid electrical hazards from potential water exposure.
h) Follow Instructions: Evacuate only if instructed to do so by authorities. Follow official evacuation routes and avoid driving through flooded areas.

6.2.5 Actions after the flood event

a) Wait for Safety: Do not return to your flat until authorities declare it safe. Floodwaters may still be hazardous, and structural damage may not be immediately visible.
b) Inspect for Damage: Once allowed back, carefully inspect your flat for any damage. Avoid touching electrical equipment if it has been submerged or wet.
c) Check Utilities: Have a professional inspect and repair utilities before restoring

power, water, or gas.

d) Avoid Contaminated Water: Be cautious of waterborne diseases and contaminants. Use bottled or boiled water for drinking and cooking if water supplies are compromised.

e) Seek Support: Access community resources, disaster relief organizations, or local authorities for assistance with recovery and rebuilding.

f) Review and Update Plans: Regularly review and update your emergency plan and kit based on lessons learned from the flood.

g) Community Involvement: Participate in local flood preparedness and response initiatives to improve overall resilience.

6.3 Water Entry into the building

All entrances have been set to a level above PMF flood level plus freeboard.

6.4 Evacuation Strategy and Structural Measures

As duty of care to pedestrians and civilians, the following measures have been proposed and adopted in the design:

- Finish floor levels for are set to 500mm above the 1%AEP flood level, allowing for the site to be safe shelter location for pedestrians during a flood event.
- Side set back has been left open with no obstruction to allow for the free flow of overland flow and reduce the nuisance to adjacent properties.
- Open style fencing has been proposed within the zone of the overland flow were necessary.
- All ventilation openings are set well above the flood levels + freeboard where applicable.
- All hazardous materials are stored well above the flood levels + freeboard.
- All electrical cables are set above the flood levels + freeboard where applicable.
- Signage should be located within the site indicating the site is flood prone and warning driver attempting to exit to be careful of flooding during storm events.

Life Threatening Emergency	000	Police, Fire, Ambulance
Bureau of Meteorology (BOM)	1300 659 215 www.bom.gov.au	Weather forecast and flood warnings
State Emergency Services (SES)	132500 www.ses.nsw.gov.au	
Department of	www.environment.nsw.gov.au	

Environment, Water and Natural Resources		
National Relay Service NRS	1300 555 727	For the deaf/hearing/speech impaired
	www.transport.nsw.gov.au	
Poison Information centre	13 11 26	(24 hours)
Red Cross Australia	1800 811 700	
Central Coast Council	02 4306 7900	

Figure 16 - Emergency Response Contact

6.5 If you need to evacuate.

- Pack spare clothes, medication, valuables, personal papers, photos and mementos into sealed plastic bags, to be taken with your emergency kit.
- Lift items onto beds, tables and roof spaces. Don't forget things you have on the floor like computers, televisions and any other electrical items.
- Place sandbags in the toilet bowl and over all laundry/bathroom drain holes. Put all bathplugs in with weight on top. This will prevent sewage back flow.
- Turn off all power, water and gas and take your mobile phone and charger.
- Lock your home and take recommended evacuation routes for your area (please refer to the evacuation plan below).
- Don't drive into any flood waters unless you are sure it is safe.

6.6 If you stay or on your return.

- Stay tuned to local radio for updated advice and help others in your neighborhood.
- Don't allow children to play in or near flood waters.
- Don't go into flood waters and stay away from drains or culverts. Have your gas or electrical appliances which have been in flood waters safety checked.
- Don't eat food which has been in flood waters.
- Boil tap water until supplies have been declared safe.

6.7 Prior to flood storm

Stay informed by listening to the Bureau of Meteorology flood watches and warnings. Bureau of Meteorology website: http://www.bom.gov.au/weather/nsw/ always keep an eye on the weather. Unusually heavy rain is a good indication that flooding may occur.

- Learn your flood-storm risk.

- Prepare your home.
- Prepare your emergency flood-storm kit and plan.

6.8 Emergency Flood Evacuation Kit

- Advise Neighbors and Friends
- Locate your pets.
- Locate your emergency flood storm kit.
- Raise items to a higher level.
    - Rugs
    - Electrical appliance
    - Computers
    - Personal items
    - Light furniture
    - Sound systems.
    - Chemicals
- Secure hazardous items
- Monitor Bureau of Meteorology forecasts and warnings
- Switch off the electricity at the switchboard.
- Turn off gas at the meter.
- Turn of water at the meter
- Cover drains in showers, baths, laundries, etc. with a strong plastic bag filled with earth or sand.
- Shelter in the safest part of the building

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7. Conclusion

1. A detailed investigation into the flooding behavior has been undertaken for the proposed residential flat building development at 310 Terrigal Drive, Terrigal.

2. A detailed 2D hydraulic model was established. This model incorporates the upstream local catchment and has a fine 2D resolution of 1m. Hydrological modelling was undertaken utilizing a traditional hydrological modelling for catchments within the study area. A WBNM hydrologic model has been used to determine design flood estimates applicable to the site.

3. Using the established models, the study has determined the flood behavior for the 20%AEP, 1% AEP, 0.5%AEP, 0.2%AEP, PMF and 1%AEP 2090 climate change storm event. The primary flood characteristics reported for the design events considered include depths, levels, and velocities. The study has also defined the Provisional Flood Hazard and flood function for flood-affected areas. The study was conducted for both pre and post development conditions and compared with results presented in the council's flood assessment. CSEG™ results presented an increase in flood levels. The reason being is that CSEG's flood model adopts a 100% blockage factor for pits and pipes in comparison to council's blockage factor of 50%. Council's model allows for less restriction of flows in oppose to our model allowing for greater depths, velocity and risk readings.

4. The study investigated the impact of the proposed development on the flood levels both upstream and downstream. Mitigation measures were proposed to ensure that the development will have minor to no impacts within the boundary of guidelines on flooding elsewhere in the floodplain and meet the requirements of Council.

5. The flood maps are included in Appendix A. The modelling results indicate that the development can be constructed in its proposed form with negligible impact on the flooding behavior in the close vicinity of the site and elsewhere in the floodplain nor having impact on upstream and downstream properties. Despite witnessing minor depth increases, the dominating risk level for all events remained identical.

6. The proposal meets the requirements of Council's DCP, Council's LEP, and the

NSW government's Section 9.1 Direction Part 4.1 Flooding.

7. The Flood Planning Level has been based on the PMF event and not the 1%AEP + Freeboard. As per CCC's requirements for addressing evacuation up to PMF level, the FPL was proposed at a level greater than PMF to allow for the proposed development to be a safe refuge (i.e Shelter in Place) for all stormwater events up to and including PMF.

8. The proposed development has been designed in a manner not to cause adverse reaction to adjacent and downstream properties while complying with local and state legislations. This was achieved by proposing appropriate flood mitigation measures, such as suspended structures over floodways and open swales.

9. The proposed development has been designed in a manner to act as a safe refuge for residents by complying with the shelter in place requirements during flood events up to and including PMF. This flood risk management has been proposed, due to flood events not exceeding 6 hours in inundation time and due to surrounding roads and intersections being blocked during flood events.

10. A FERP has been included in this report, outlining the preferred method of protection to residents including appropriate flood warning measures.

This report concludes based on the information found within, that the proposed development is considered safe during all flood events and does not exert any danger or risk to people, the environment and neighboring structures nor cause changes to the existing flood behavior. Moreover, the proposed development is designed to act as a safe refuge for all residents by proposing all habitable levels above the PMF flood level, which is the preferred approach for managing risk to life from the SES. Further, considering the amount of surrounding low-density dwellings, the proposed RFB will also act as a safe refuge to those surrounding properties that cannot evacuate in time, reducing the pressure on local emergency respond services.

Yours Faithfully,

CIVIL STORMWATER
ENGINEERING GROUP
.INNOVATE.ENGINEER.TRANSFORM.

Samir C Hakim,

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PRE# - PRE0001864

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Appendix A – TUFLOW Flood Maps

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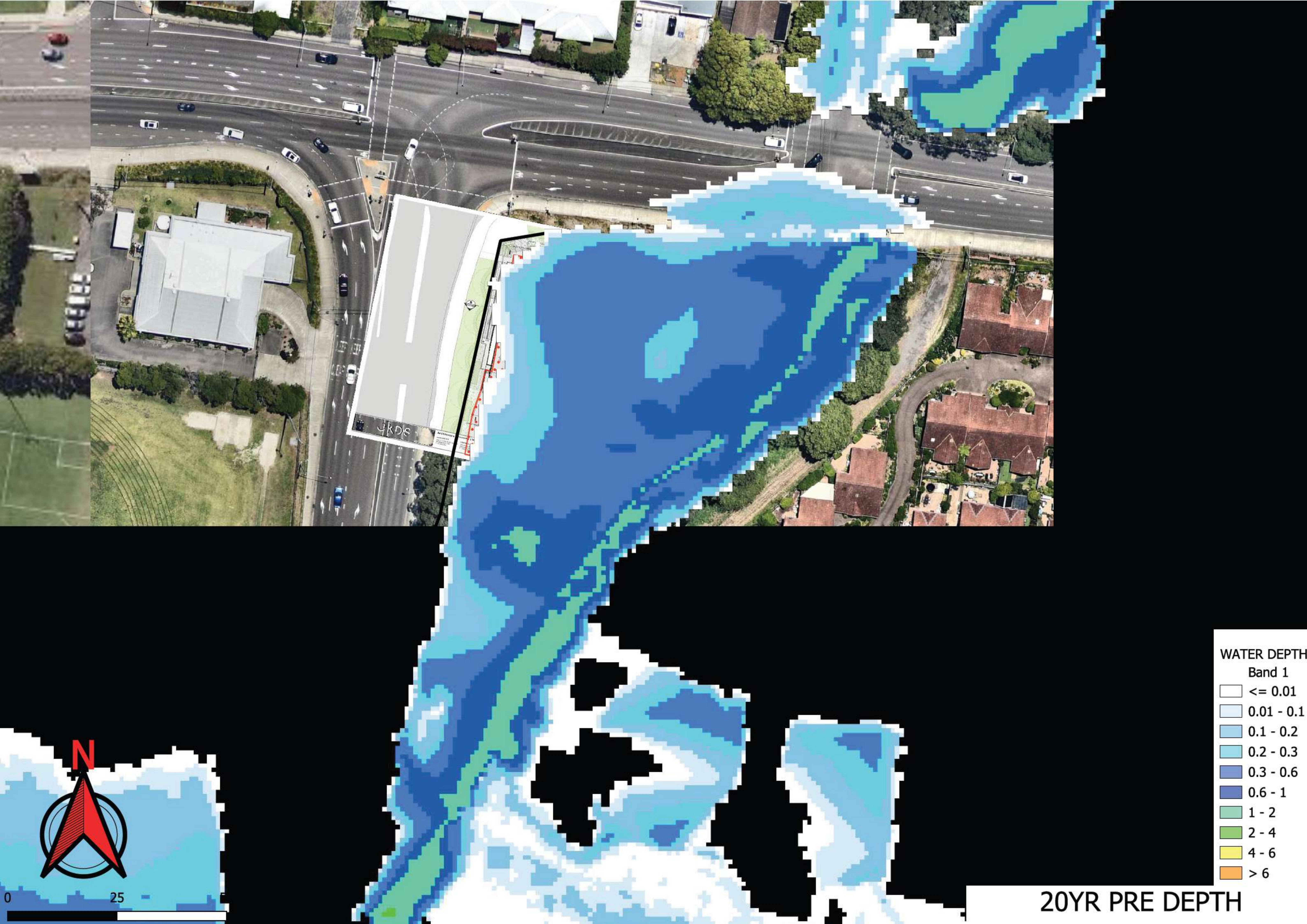
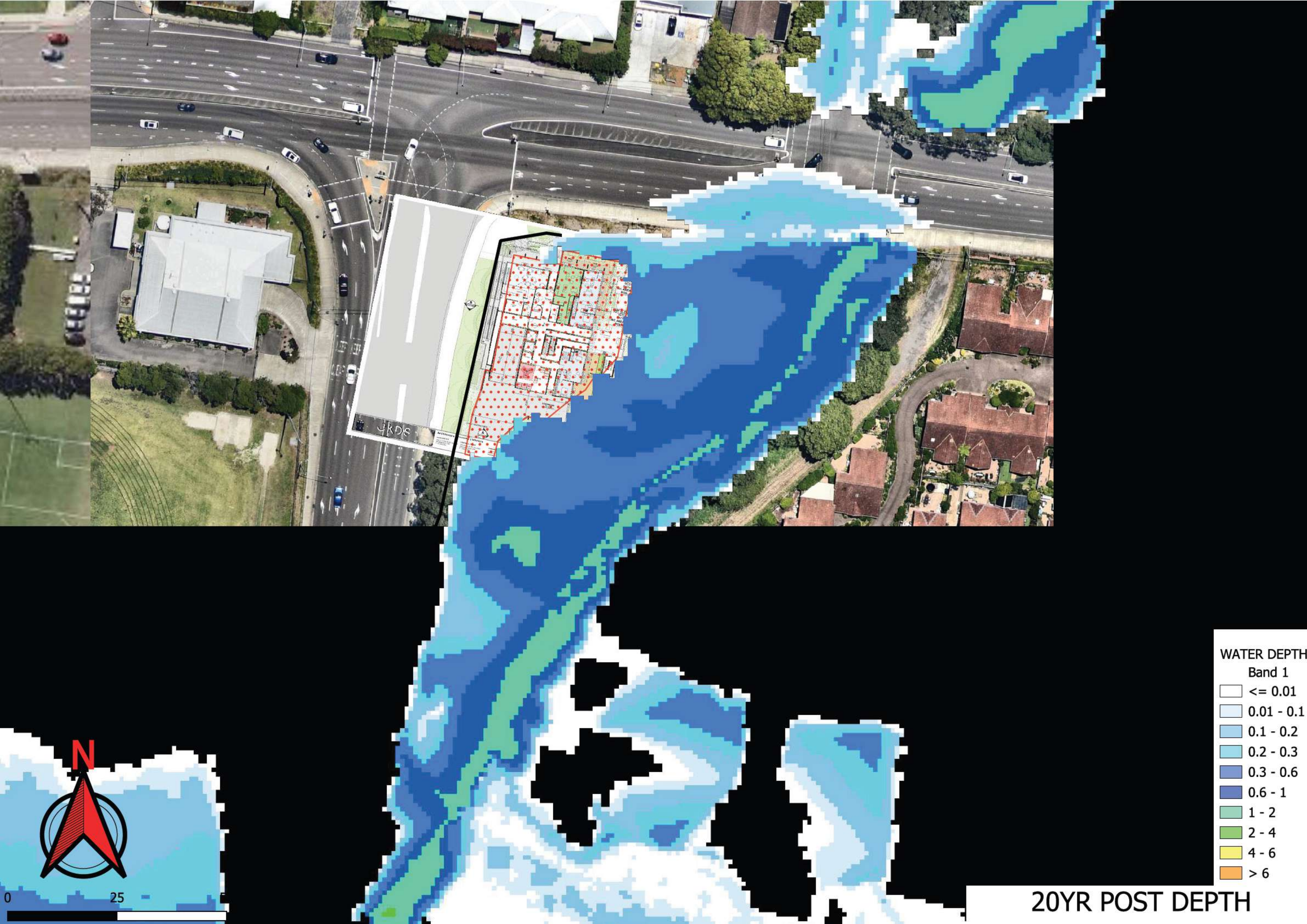

WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
20YR PRE DEPTH



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WATER DEPTH
Band 1
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0.01 - 0.1
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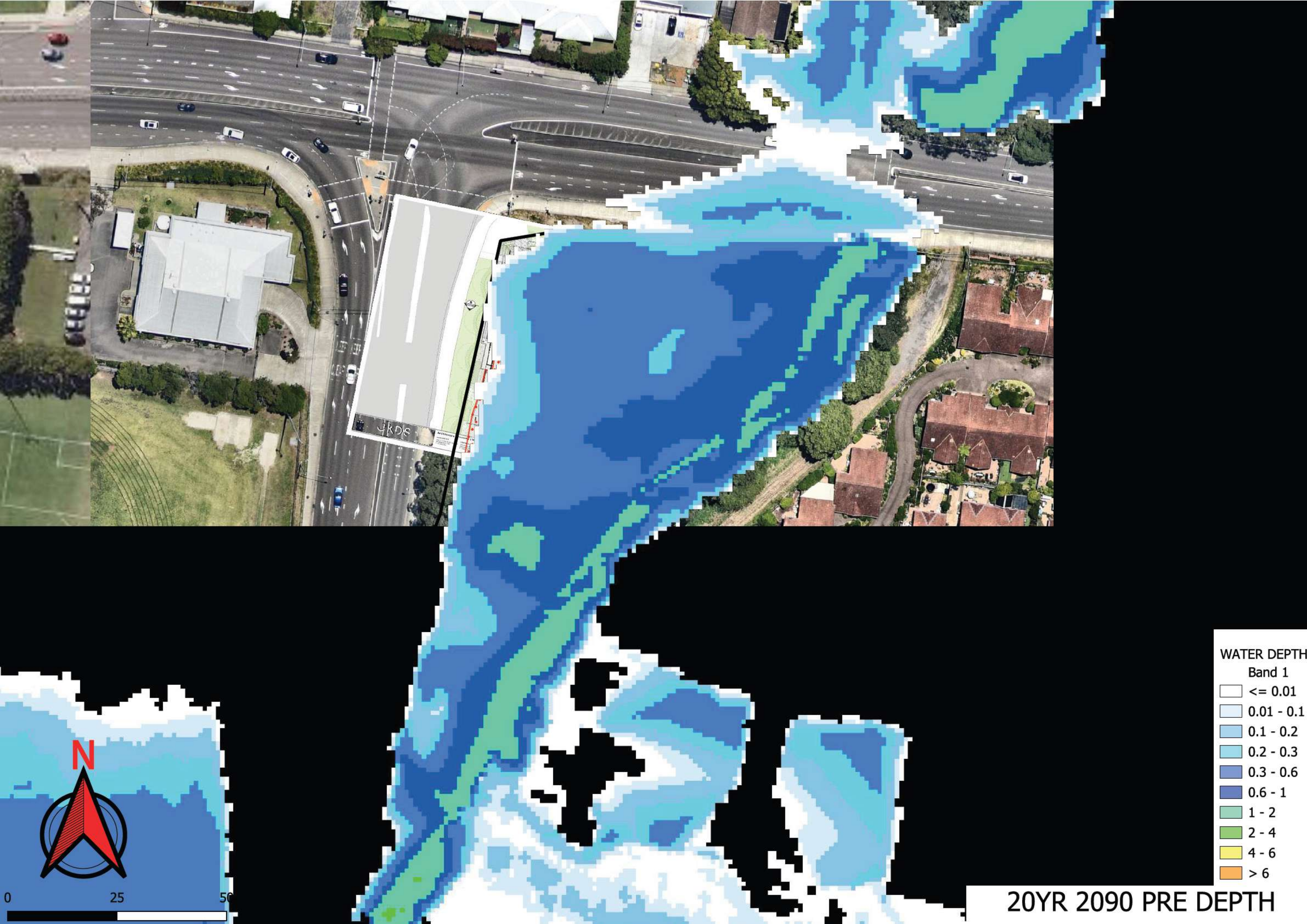
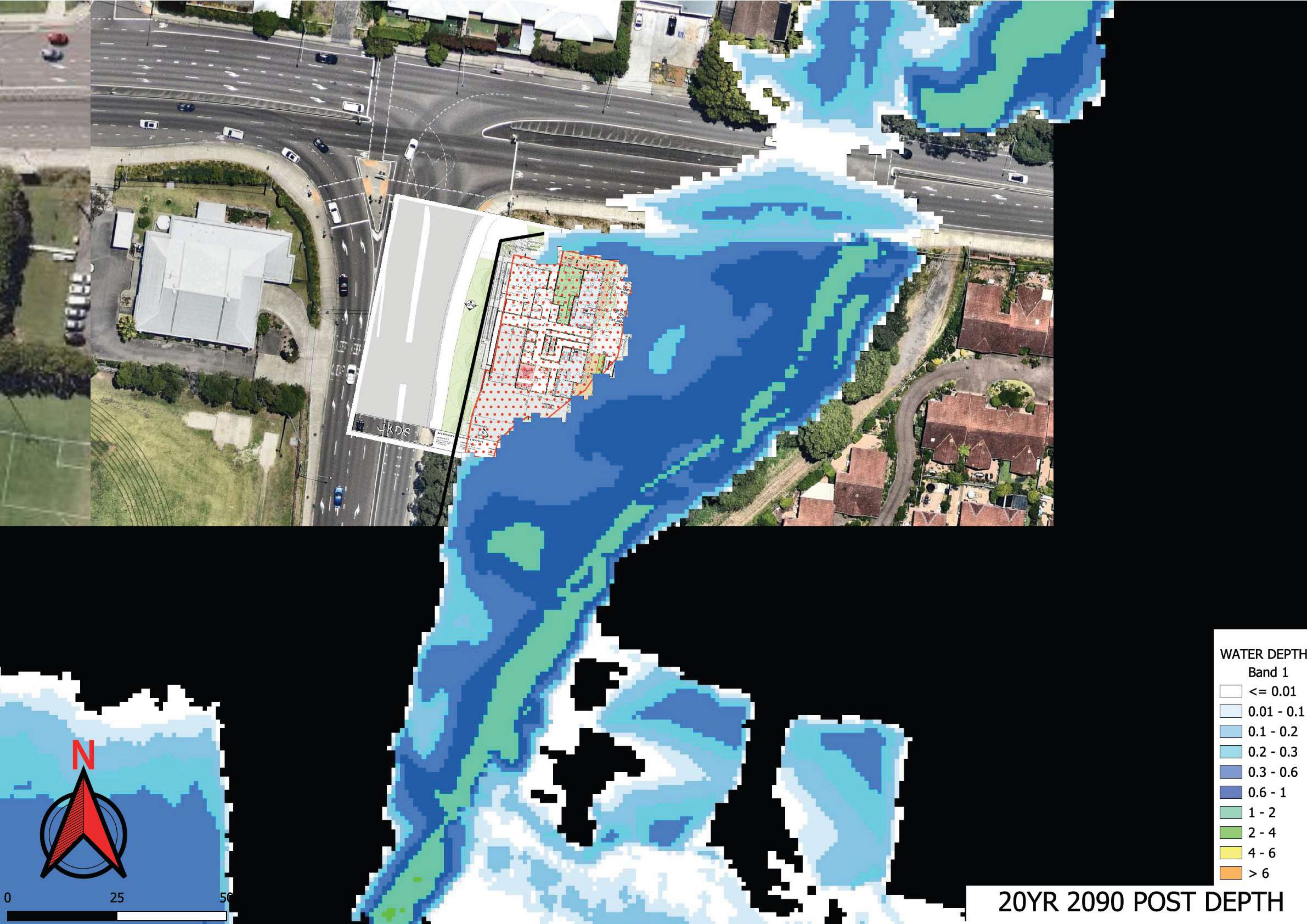
2 - 4
4 - 6
> 6
20YR POST DEPTH



20YR 2090 PRE DEPTH



WATER DEPTH
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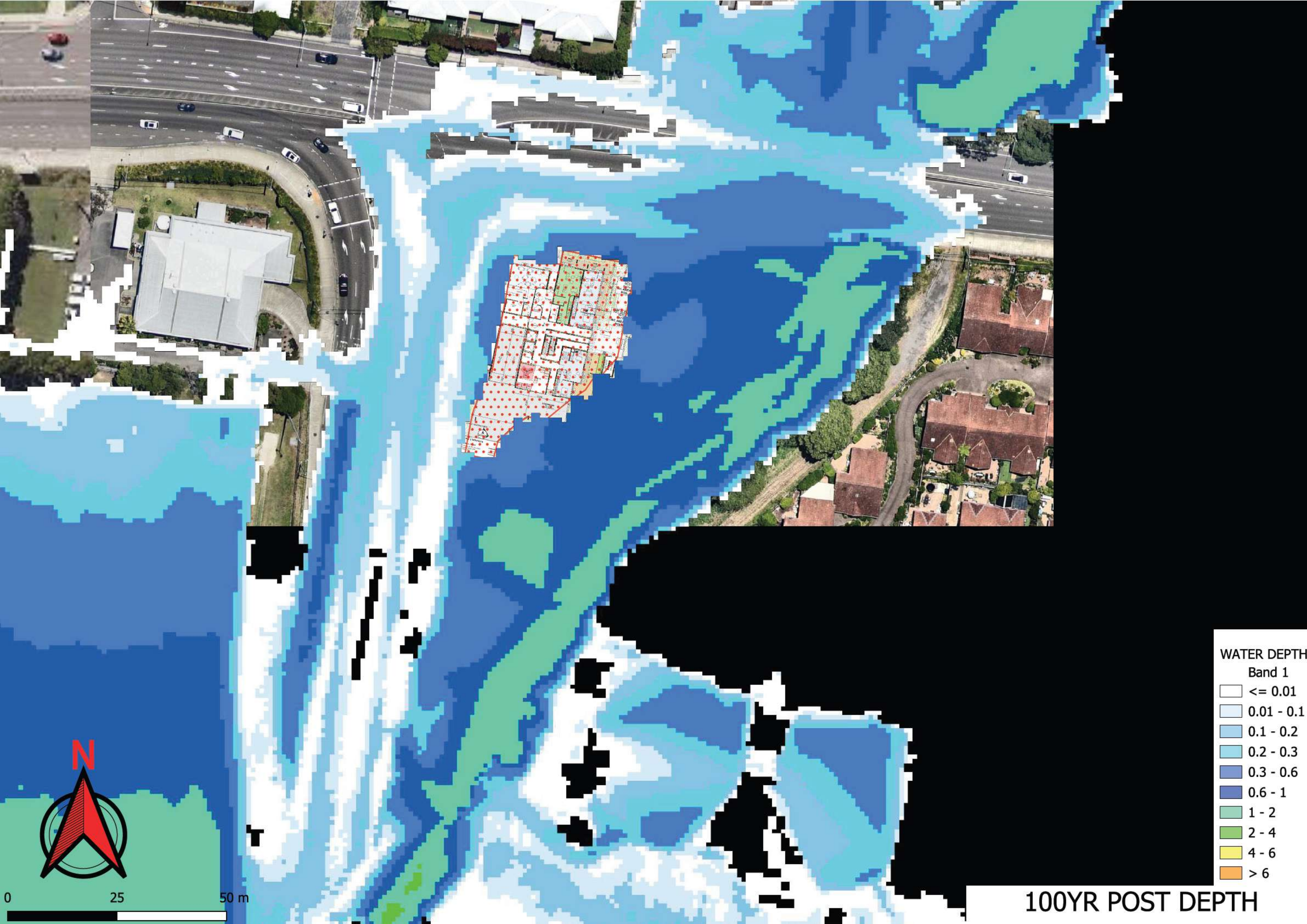
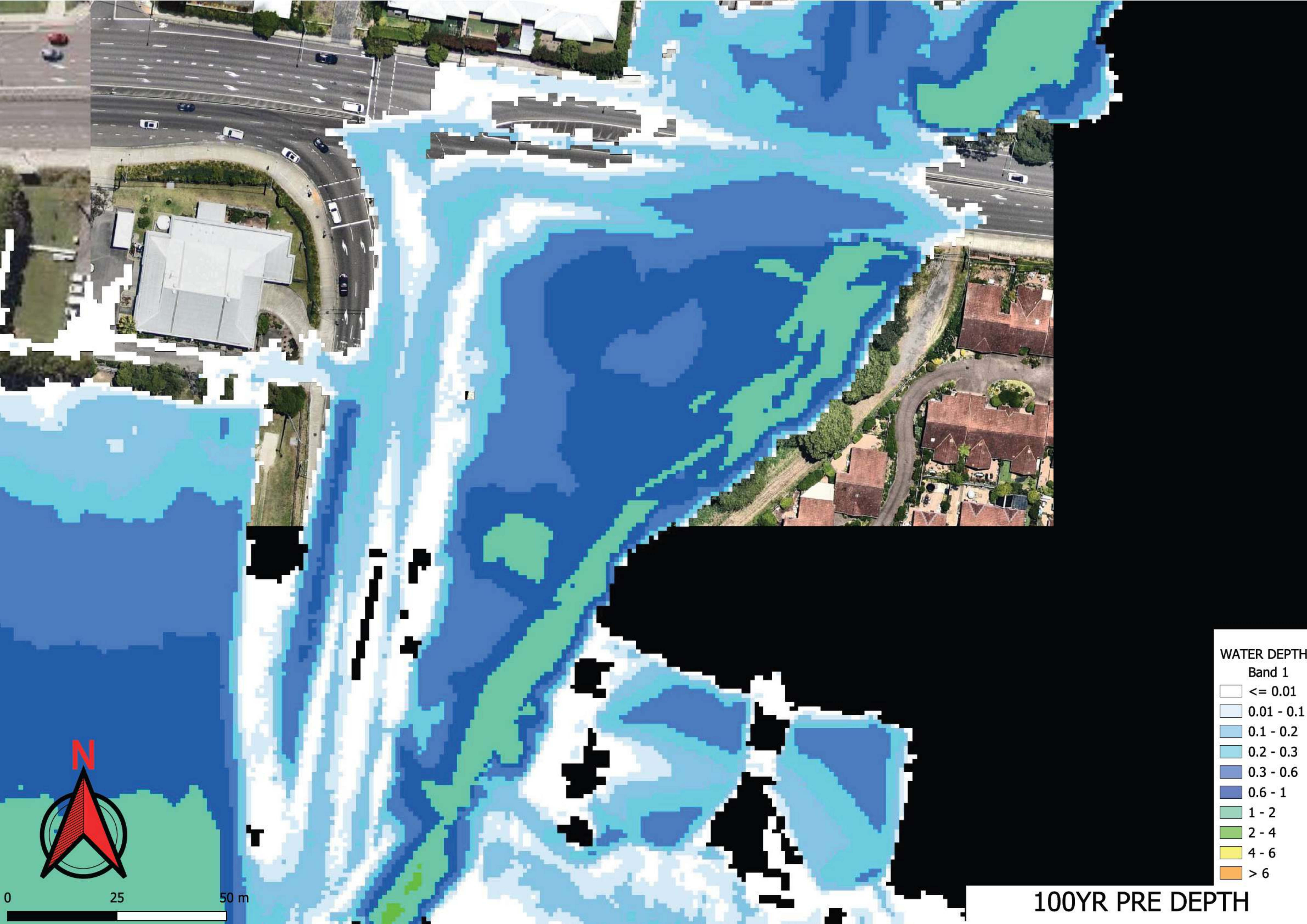
20YR 2090 POST DEPTH



100YR POST DEPTH


WATER DEPTH
Band 1
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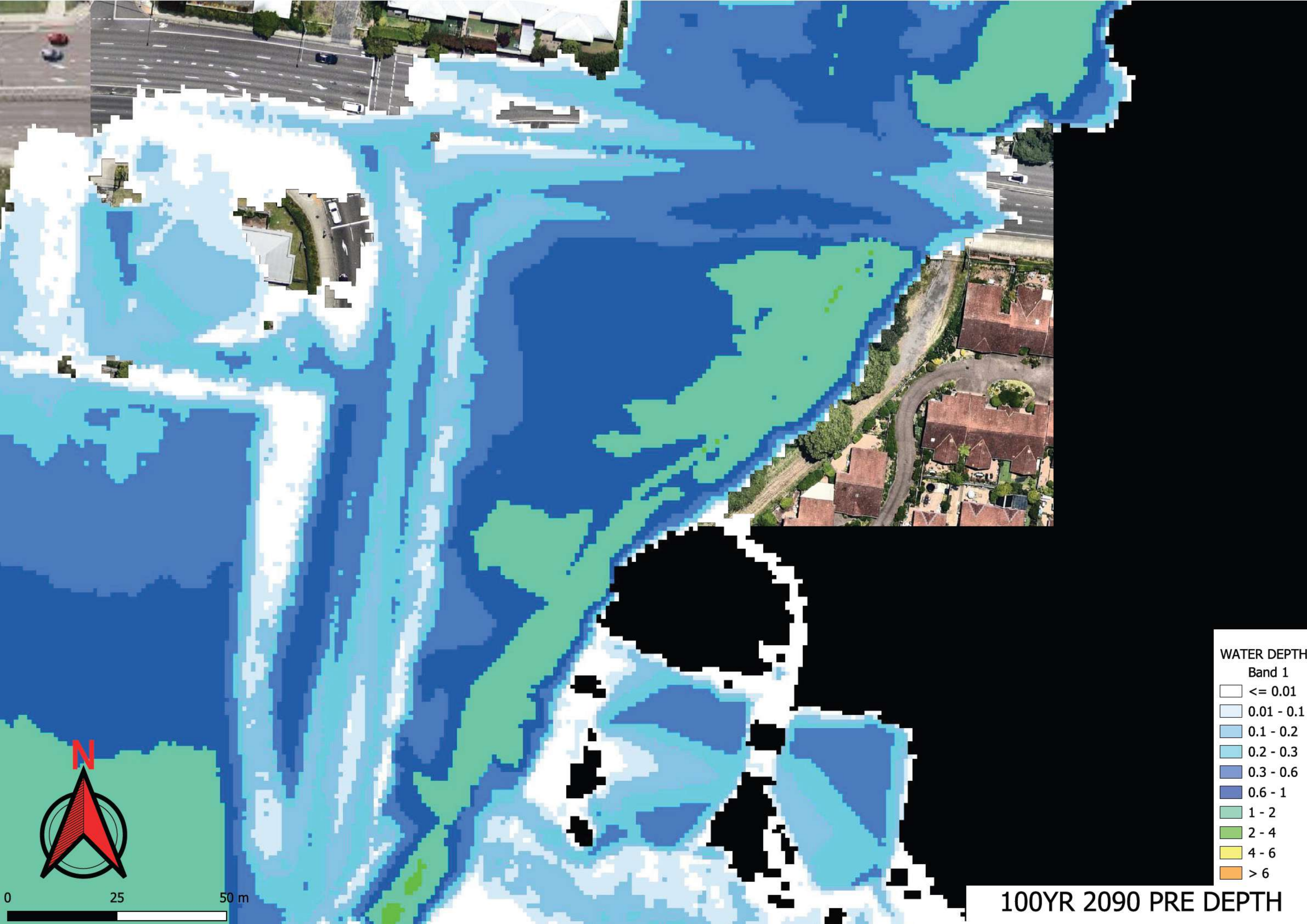
100YR PRE DEPTH


WATER DEPTH
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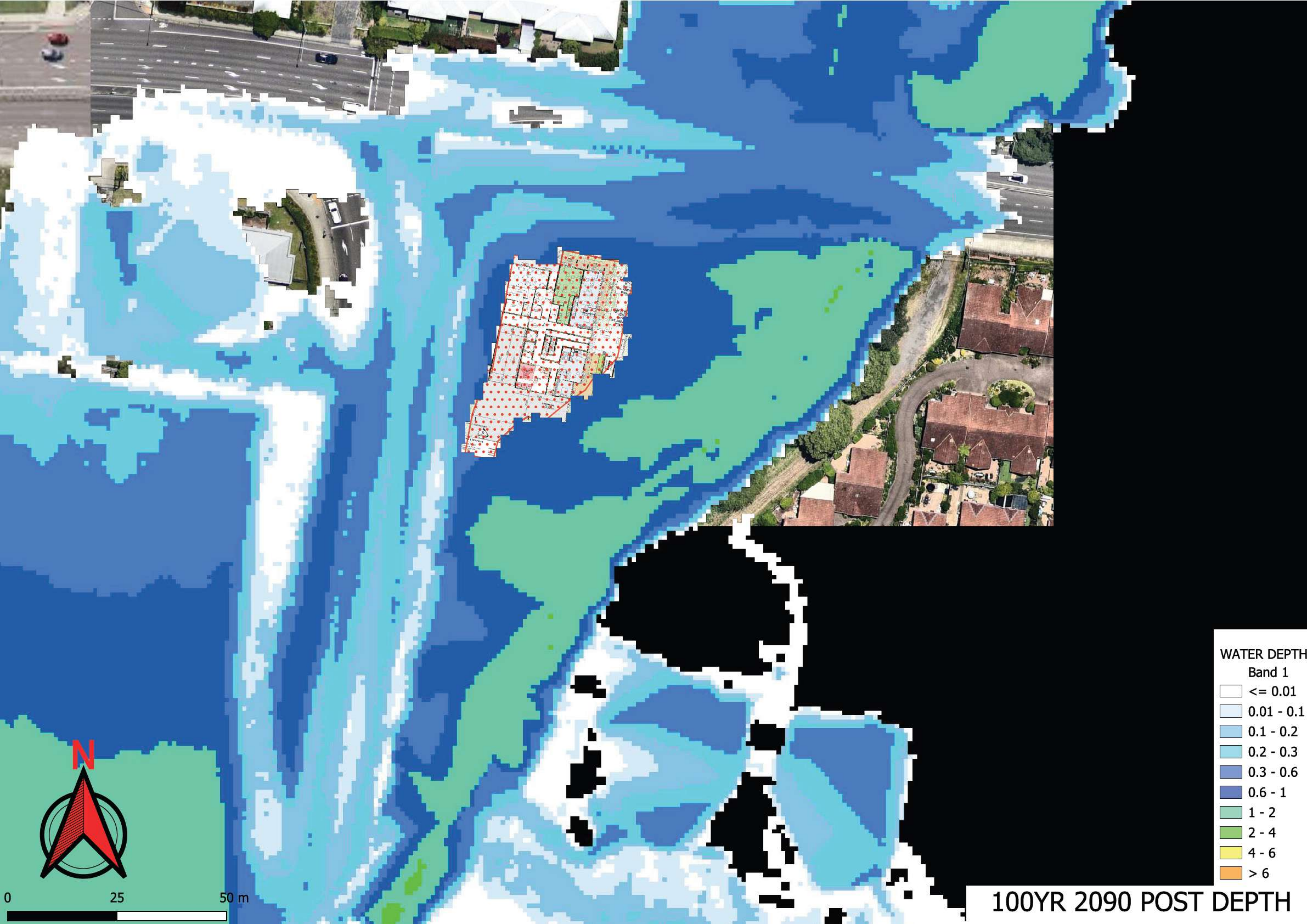
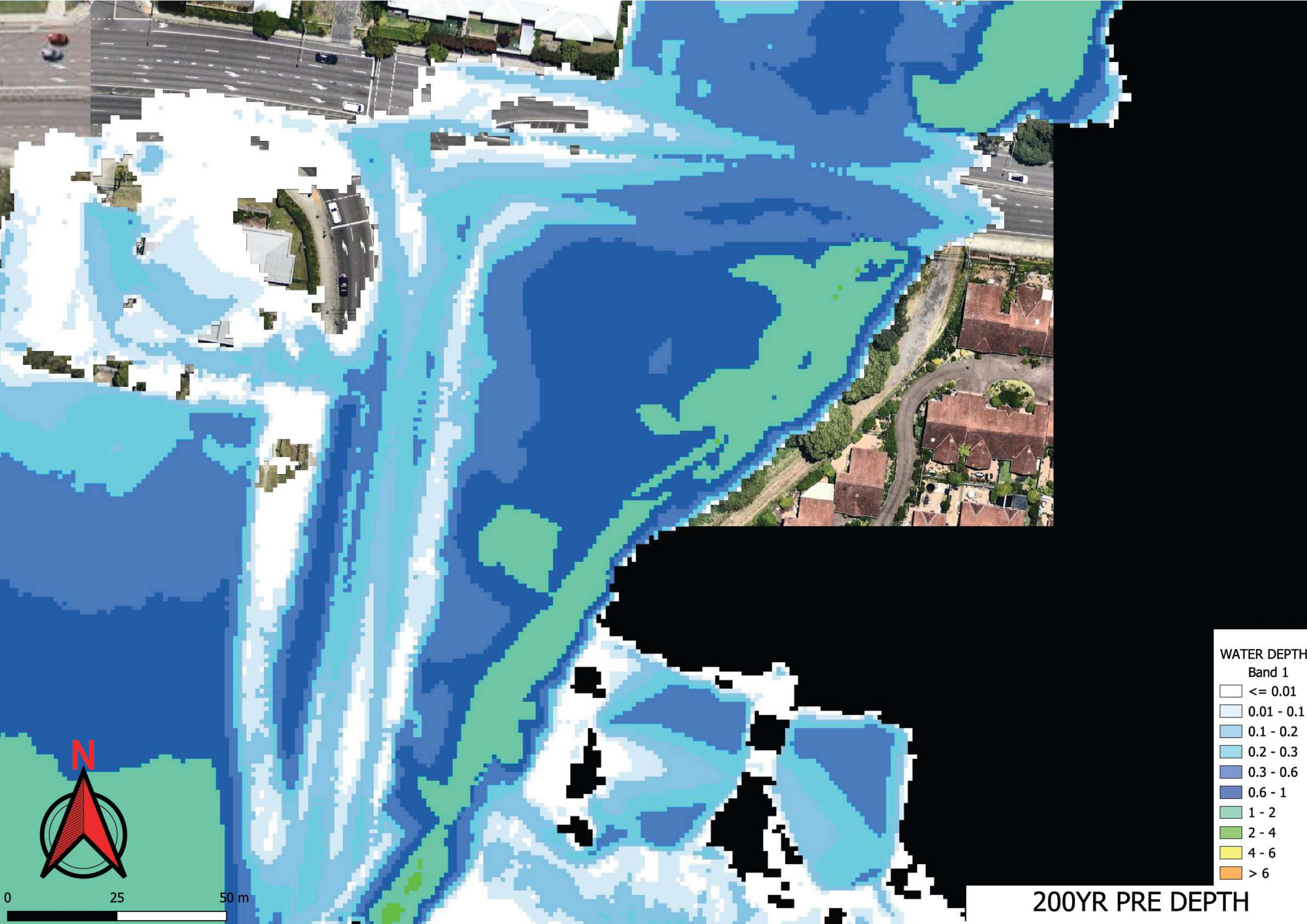
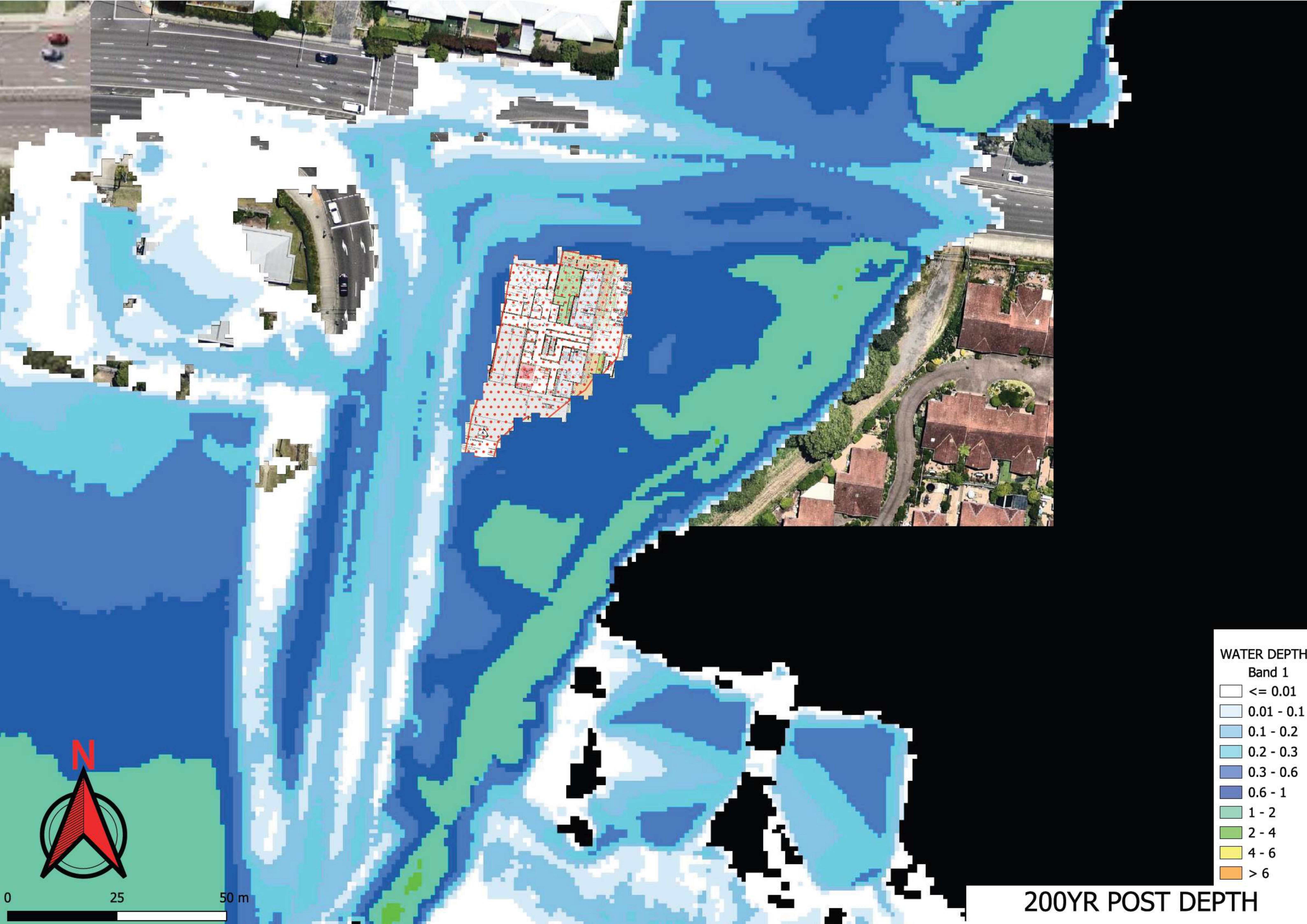
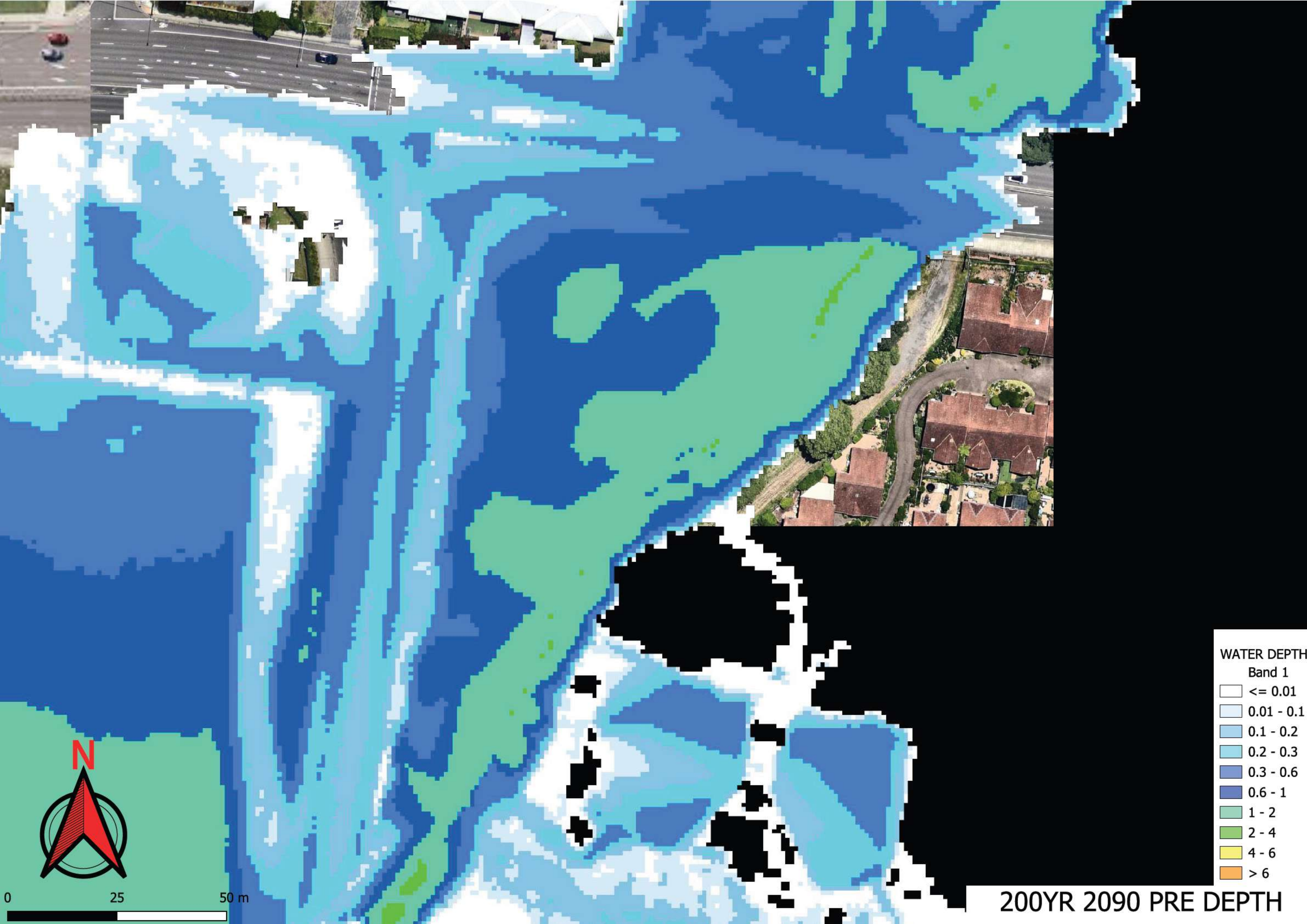
50 m
100YR 2090 PRE DEPTH

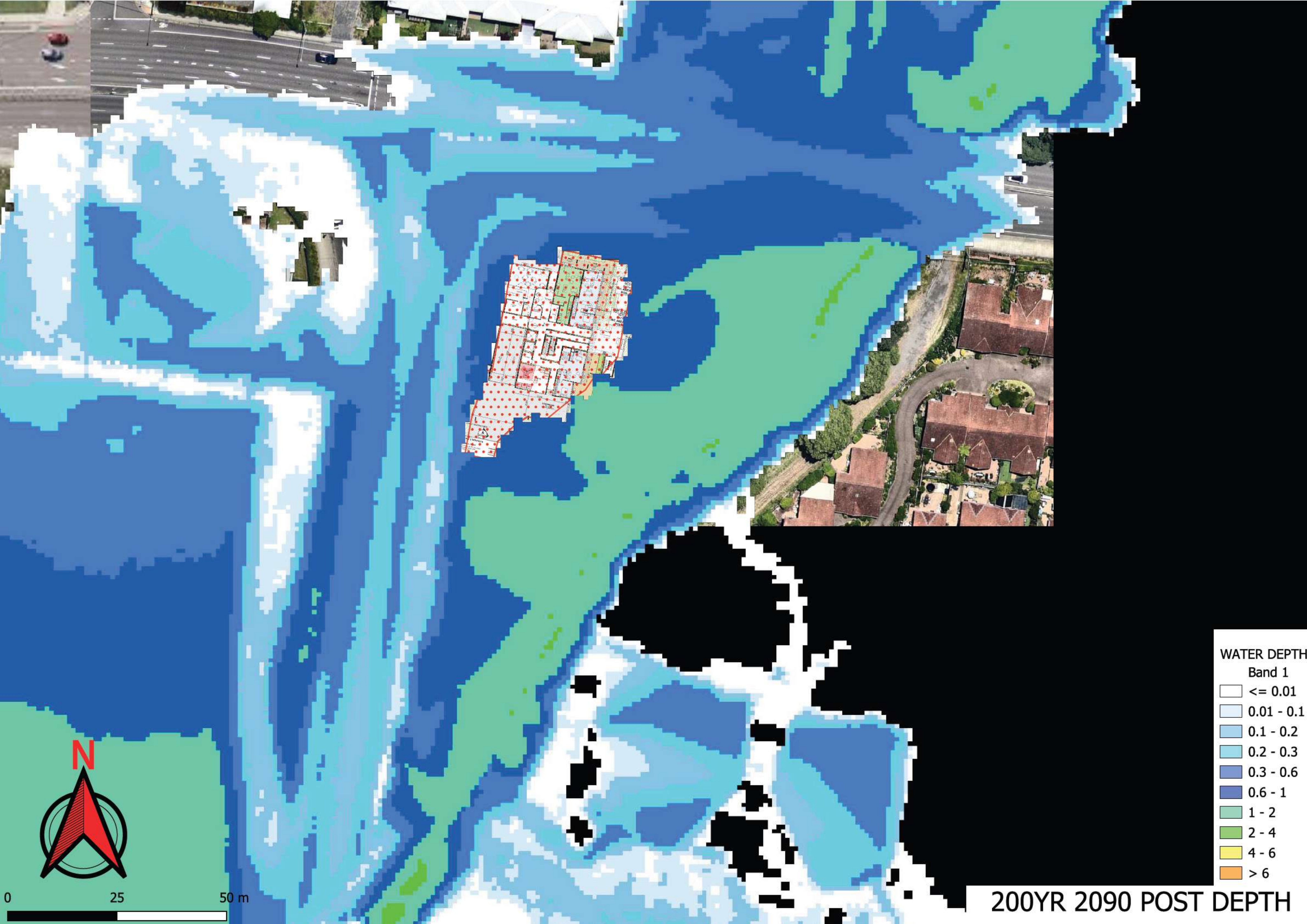

WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
50 m
100YR 2090 POST DEPTH


WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
50 m
200YR PRE DEPTH

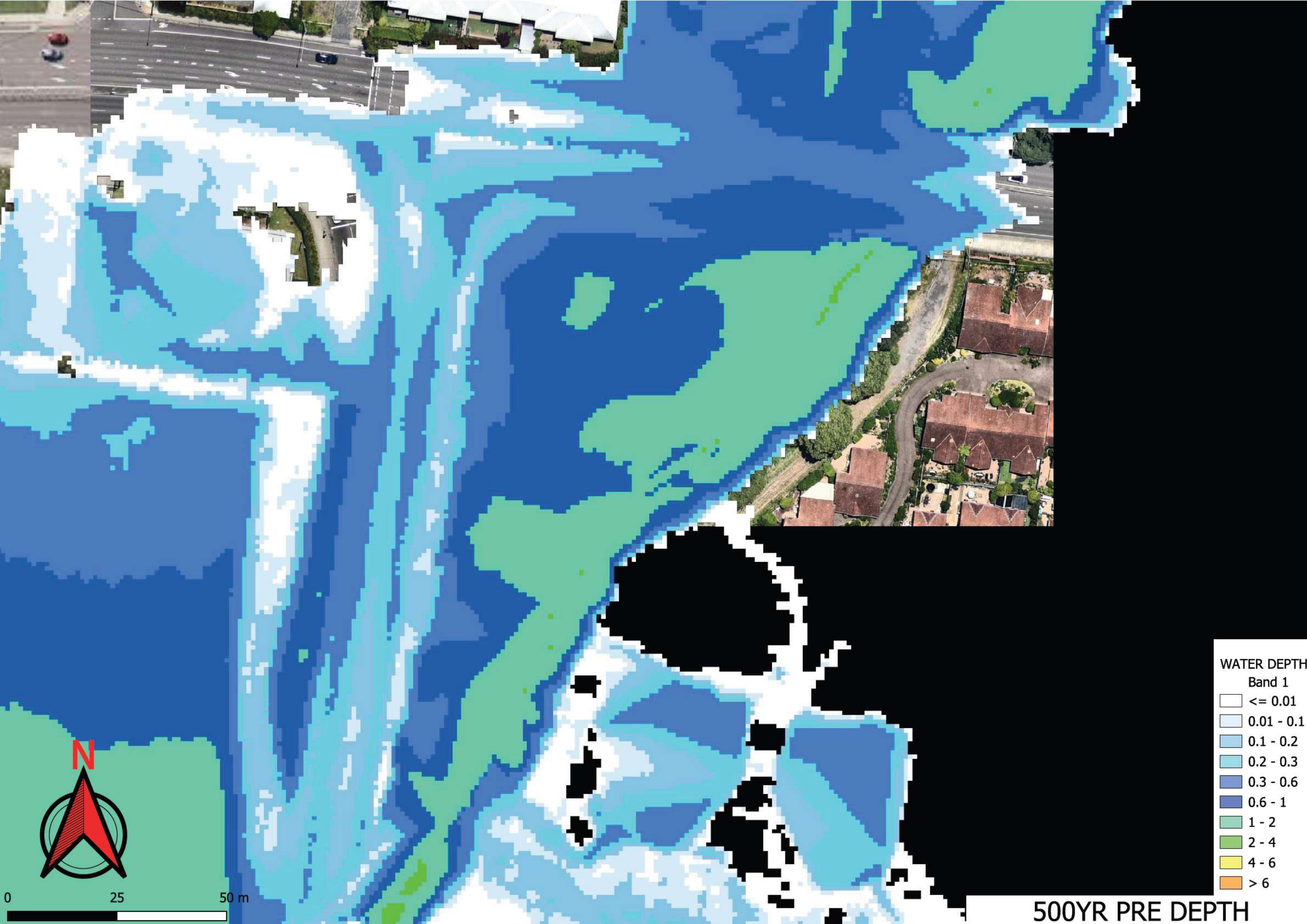


200YR POST DEPTH

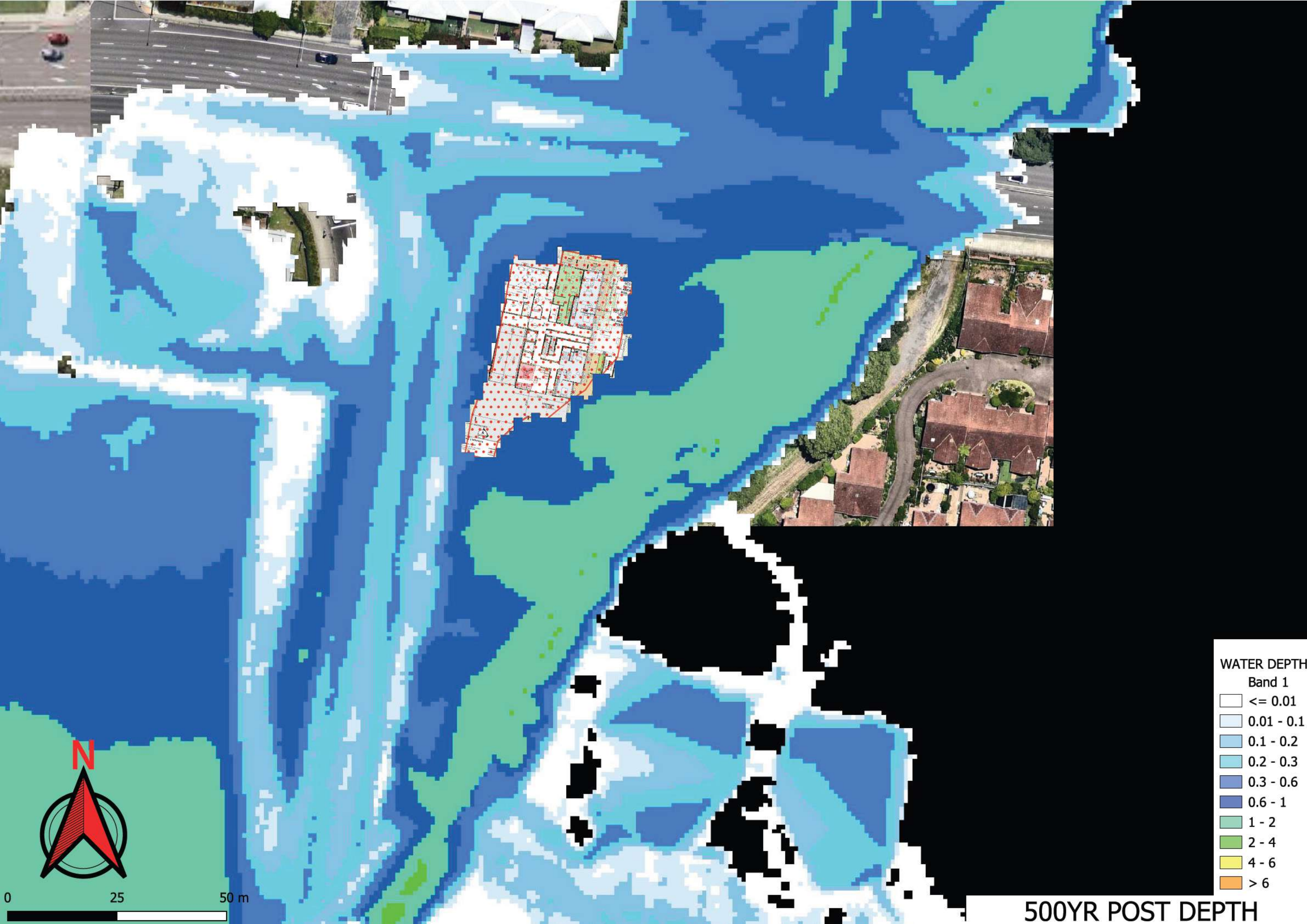

N
0
25
50 m
WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
200YR 2090 PRE DEPTH

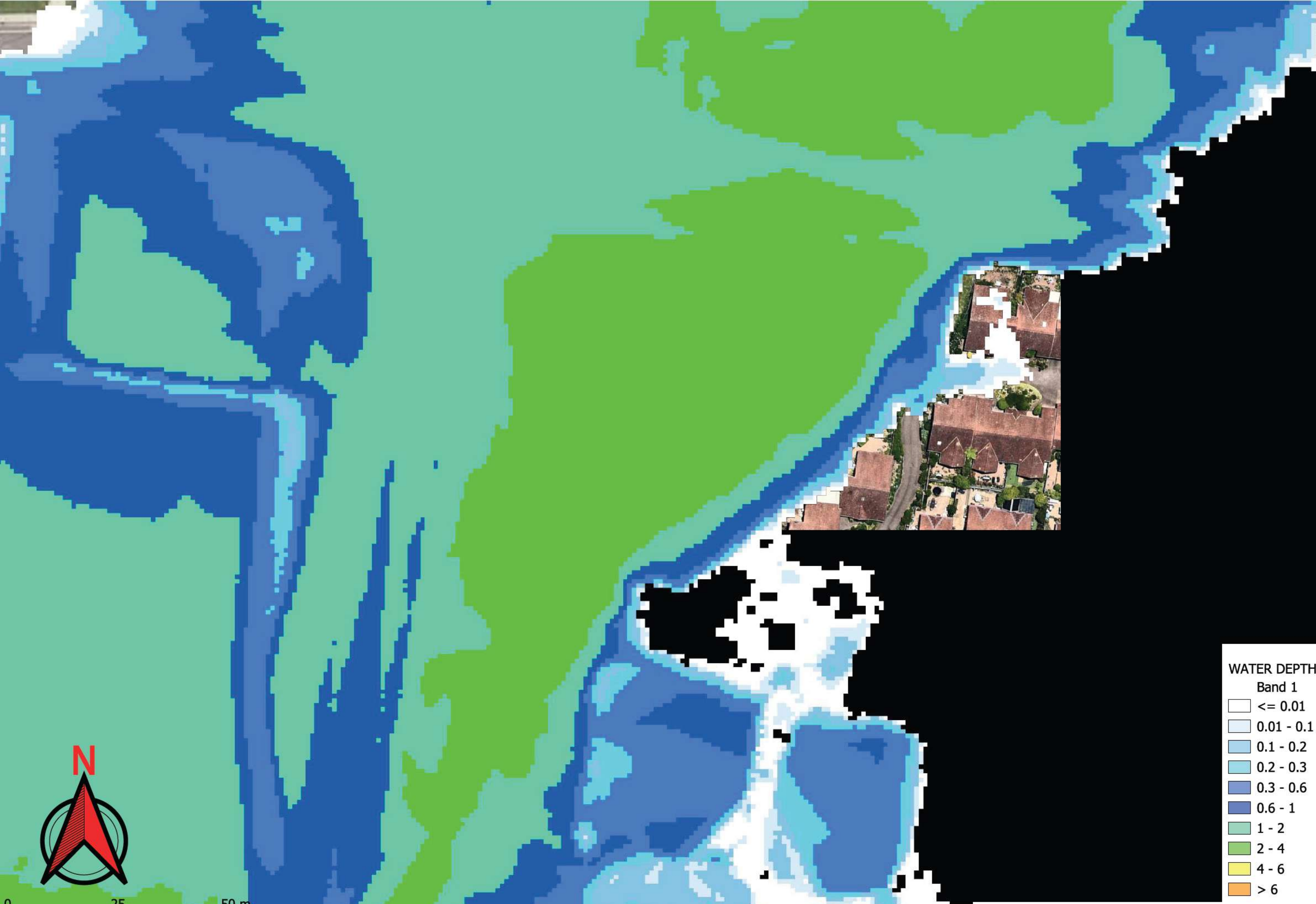


200YR 2090 POST DEPTH

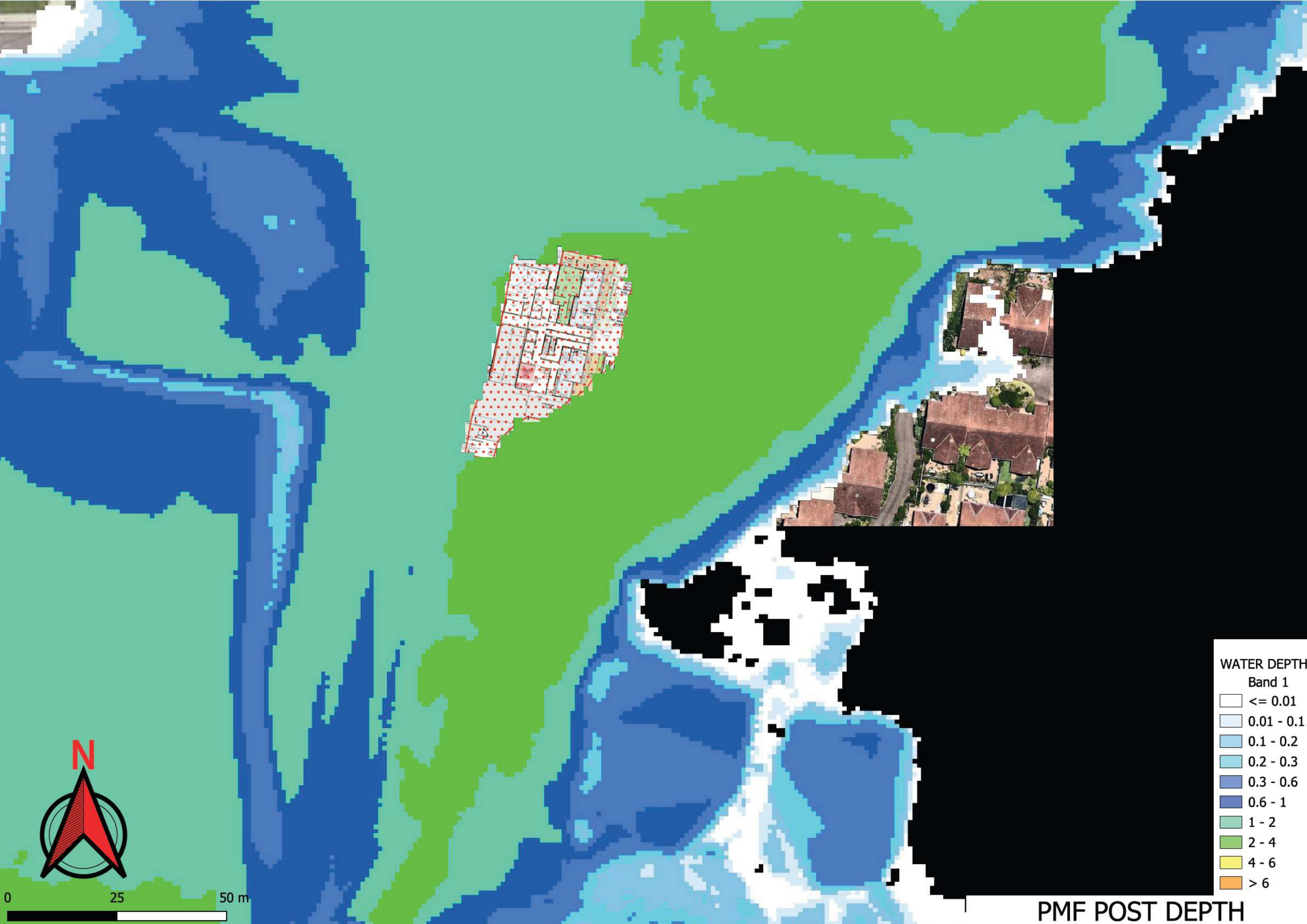


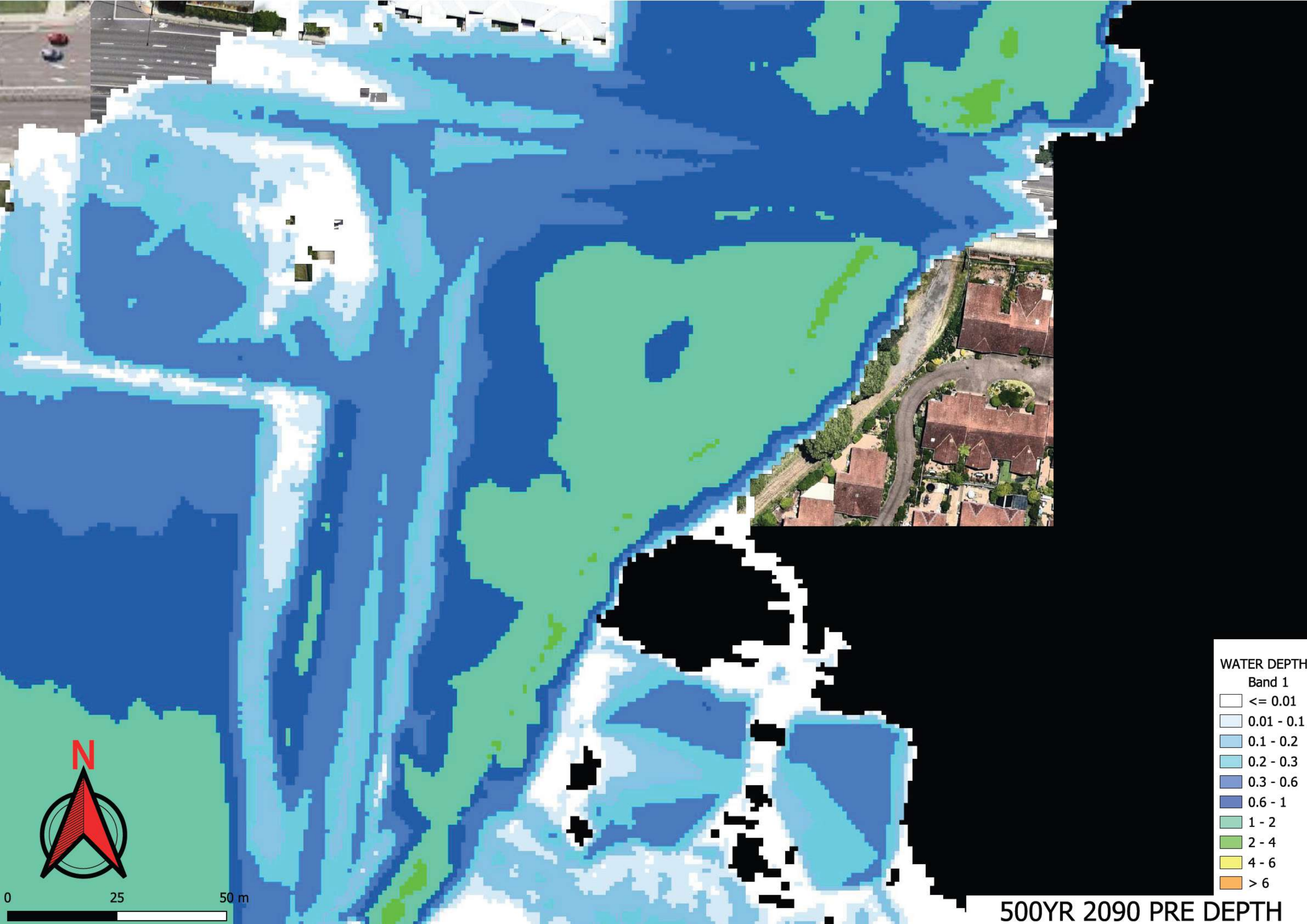
N
0
25
50 m
WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
500YR PRE DEPTH

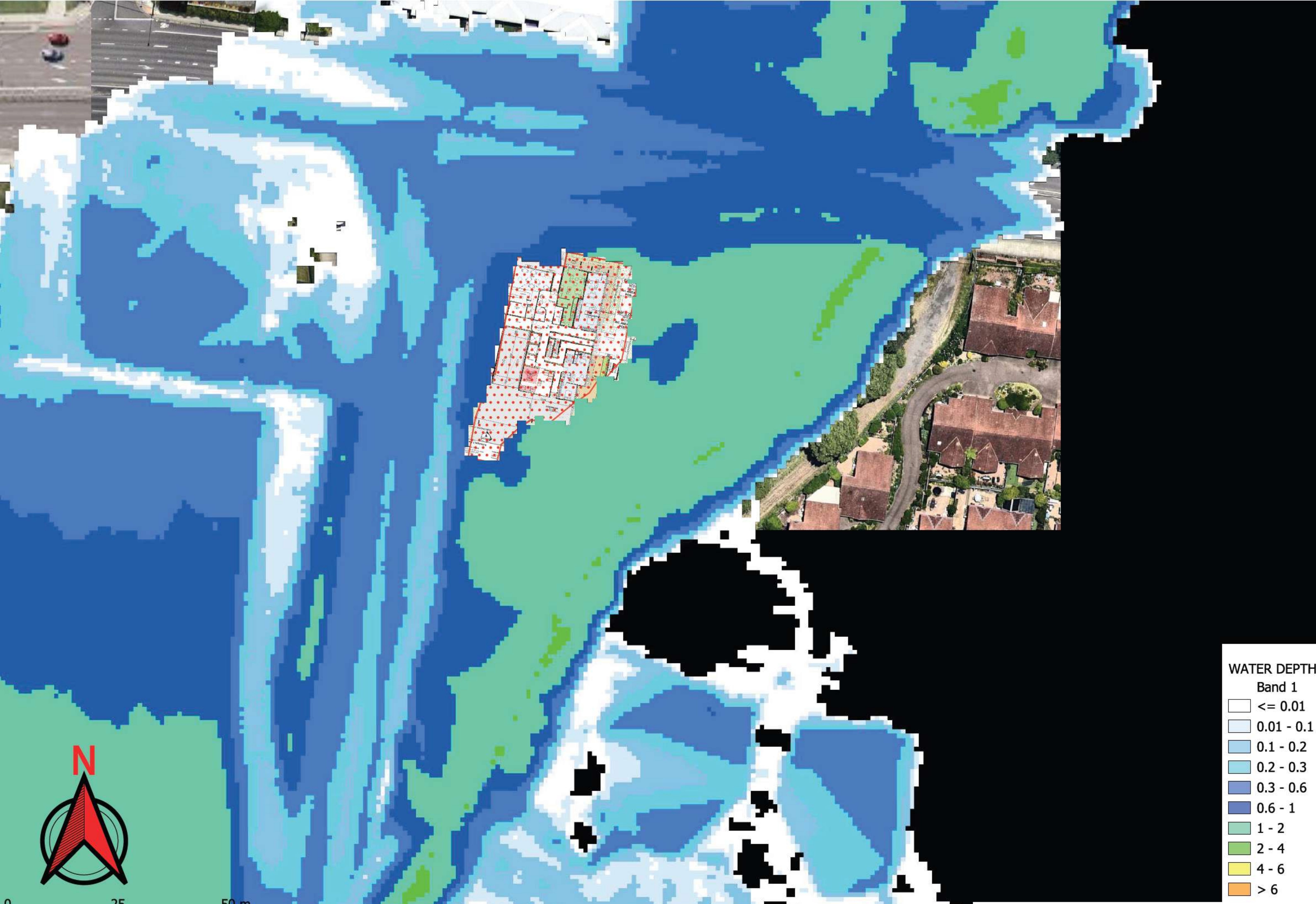

WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
50 m
500YR POST DEPTH



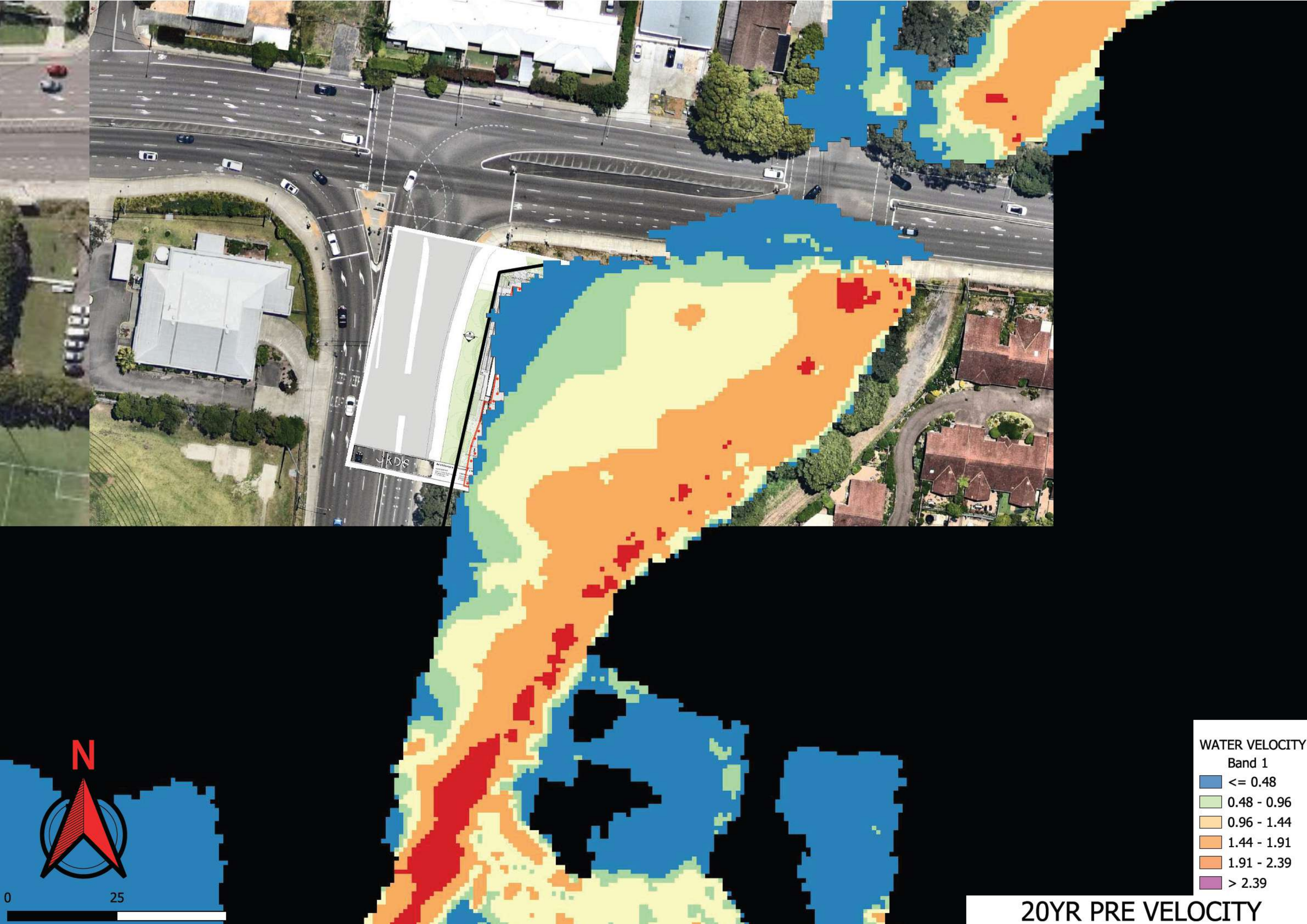
PMF PRE DEPTH

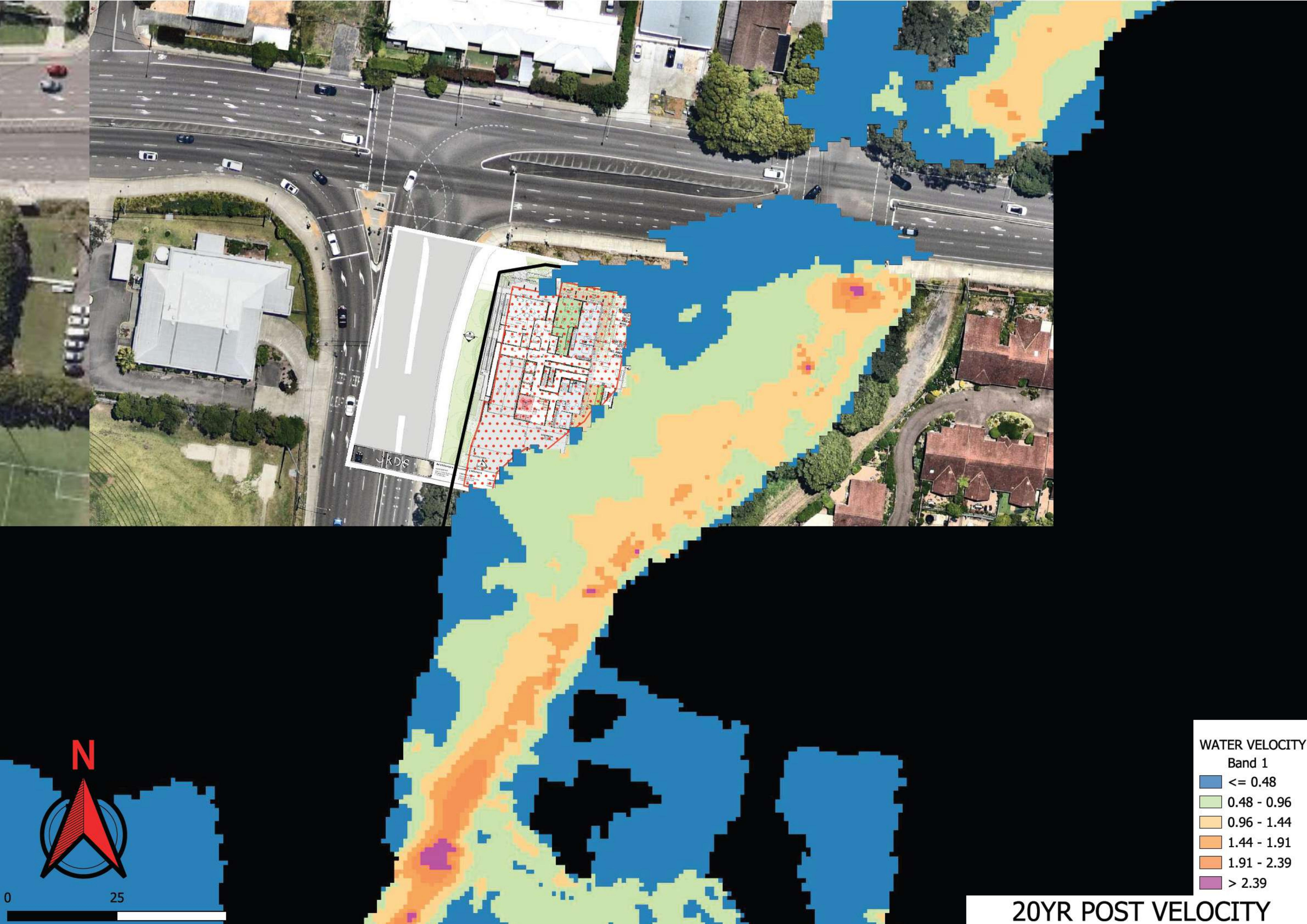

WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
50 m
PMF POST DEPTH

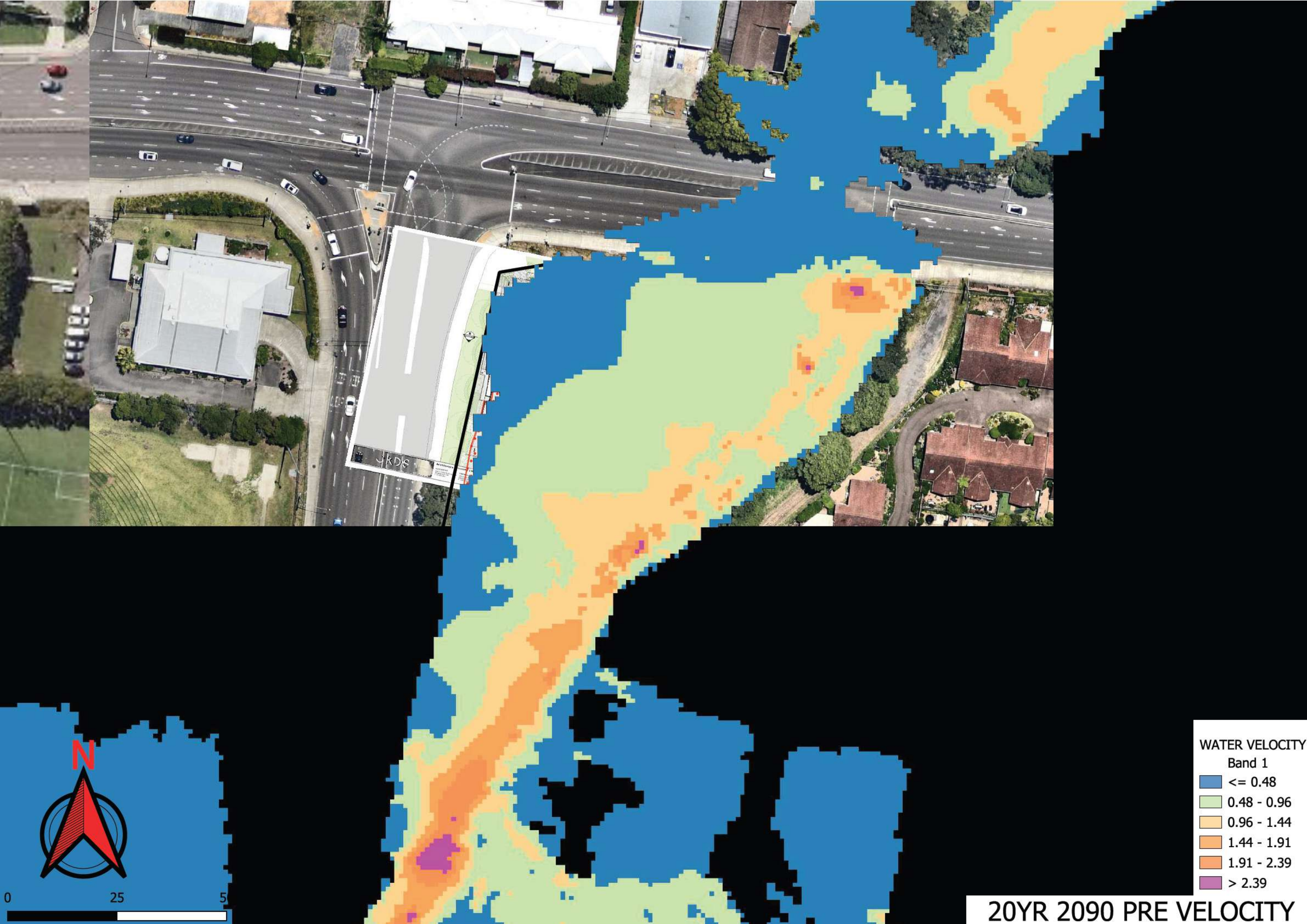

WATER DEPTH
Band 1
<= 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.6
0.6 - 1
1 - 2
2 - 4
4 - 6
> 6
N
0
25
50 m
500YR 2090 PRE DEPTH



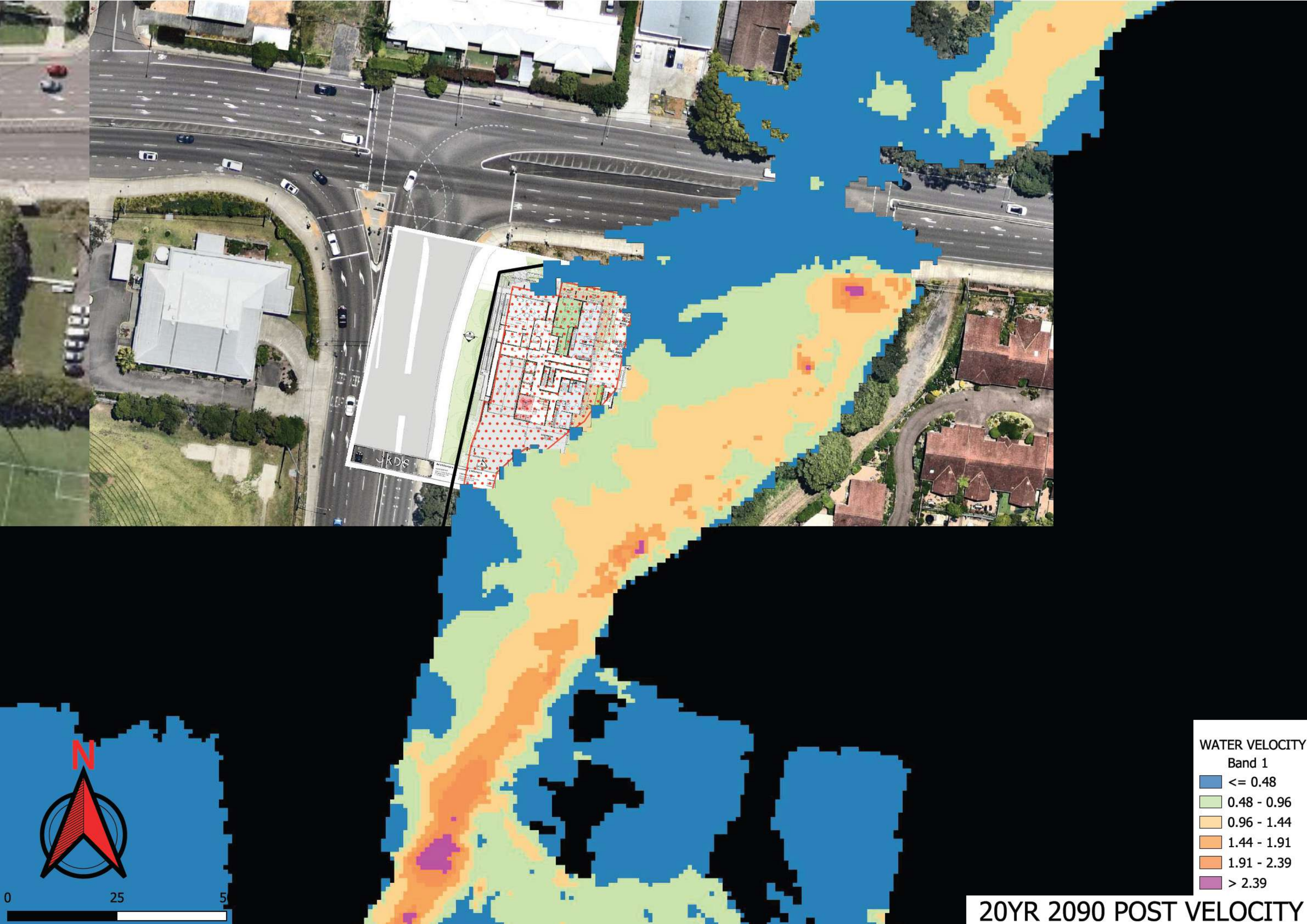
500YR 2090 POST DEPTH


N
0
25
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
20YR PRE VELOCITY

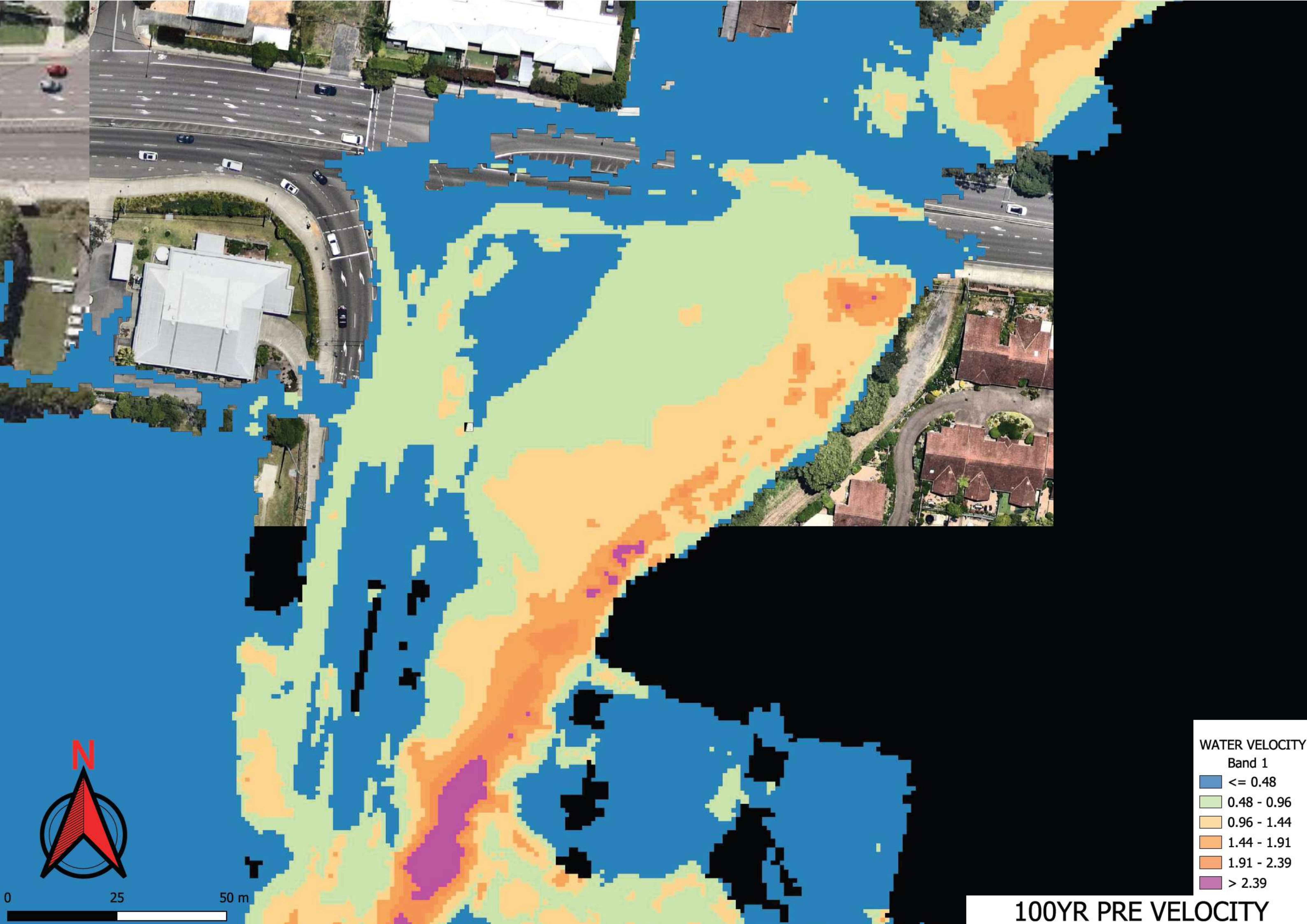

N
0
25
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
20YR POST VELOCITY



20YR 2090 PRE VELOCITY



N
0
25
50
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
20YR 2090 POST VELOCITY


N
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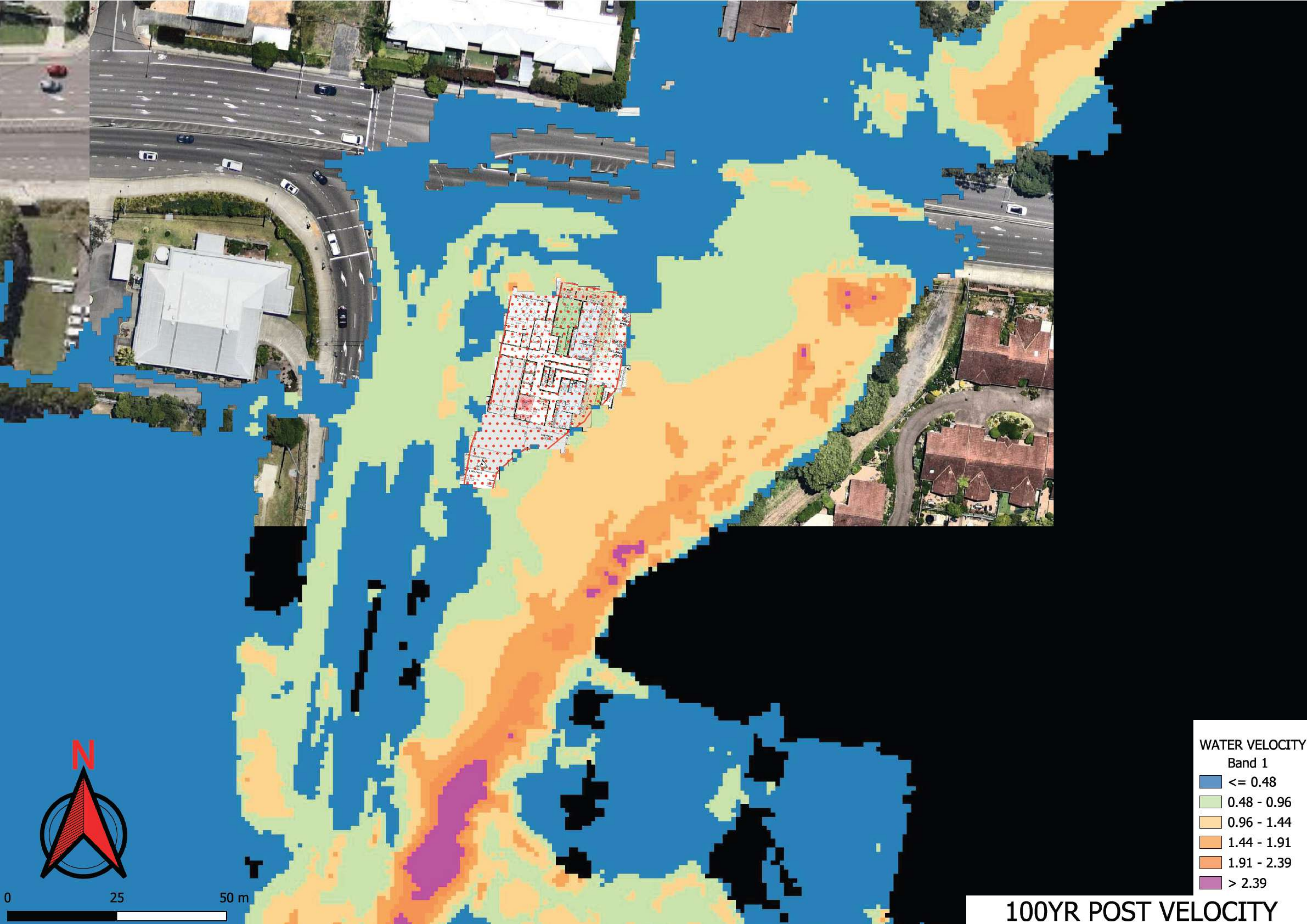
25
50 m
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
100YR PRE VELOCITY


N
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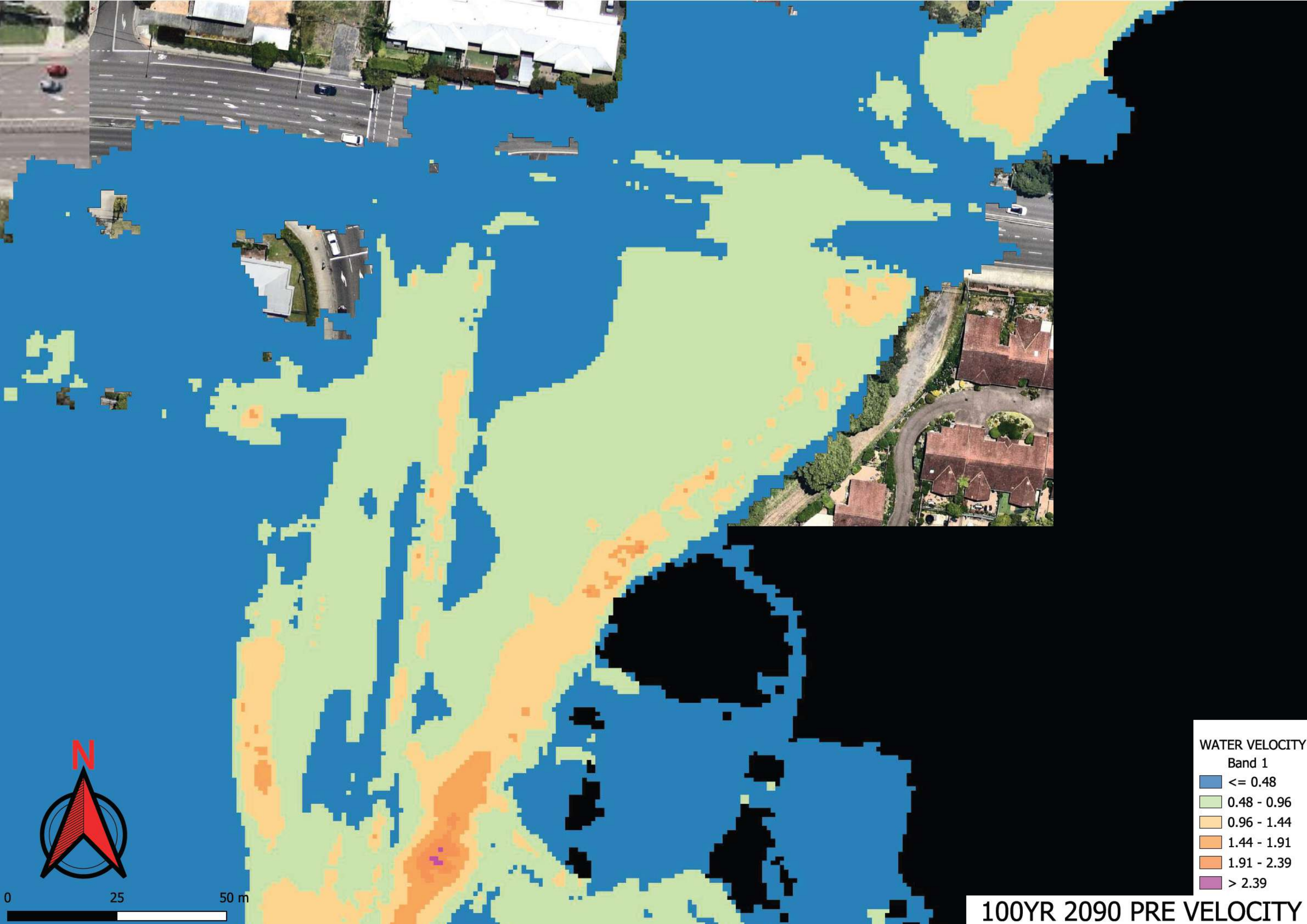
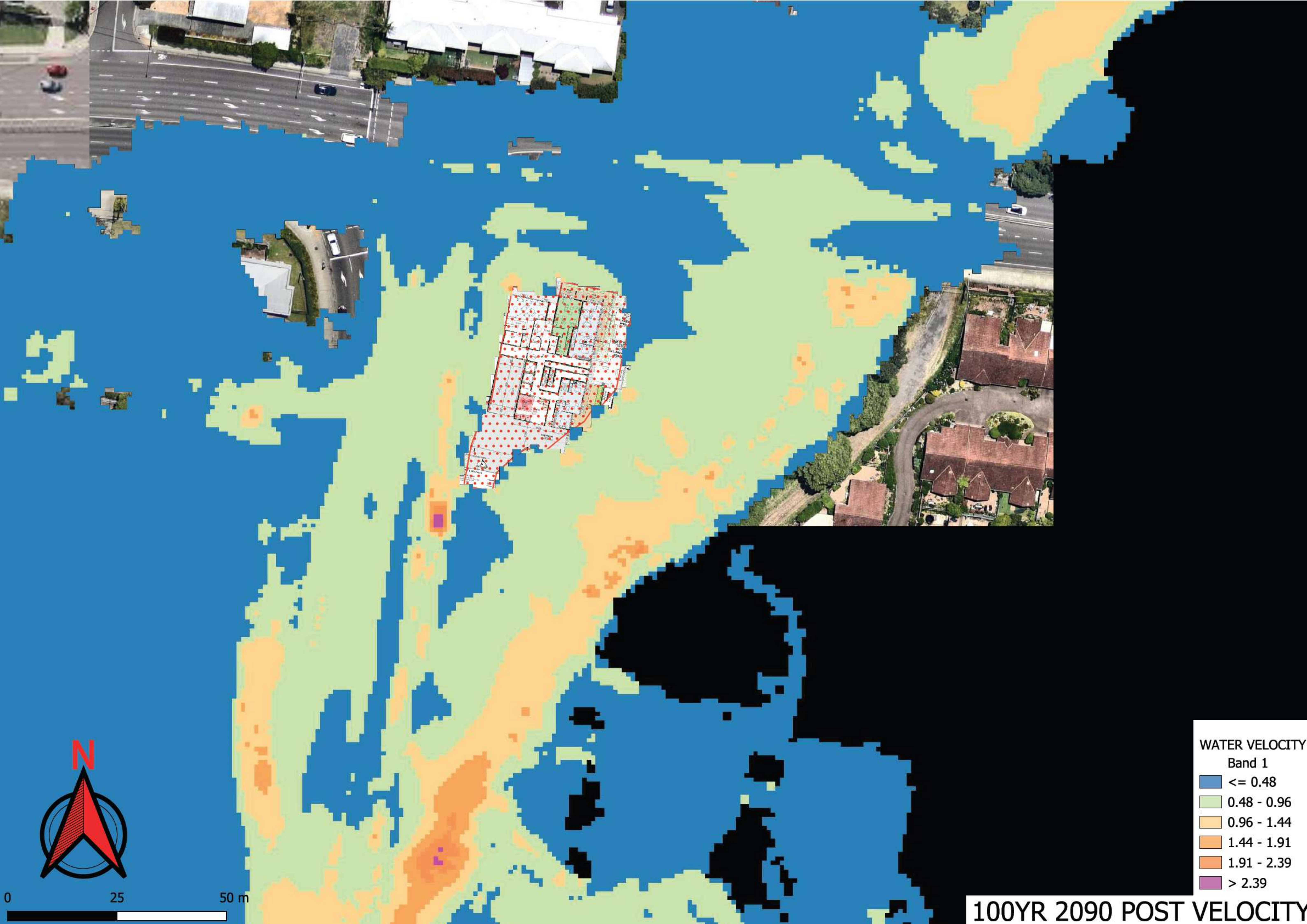
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
100YR POST VELOCITY



100YR 2090 PRE VELOCITY


N
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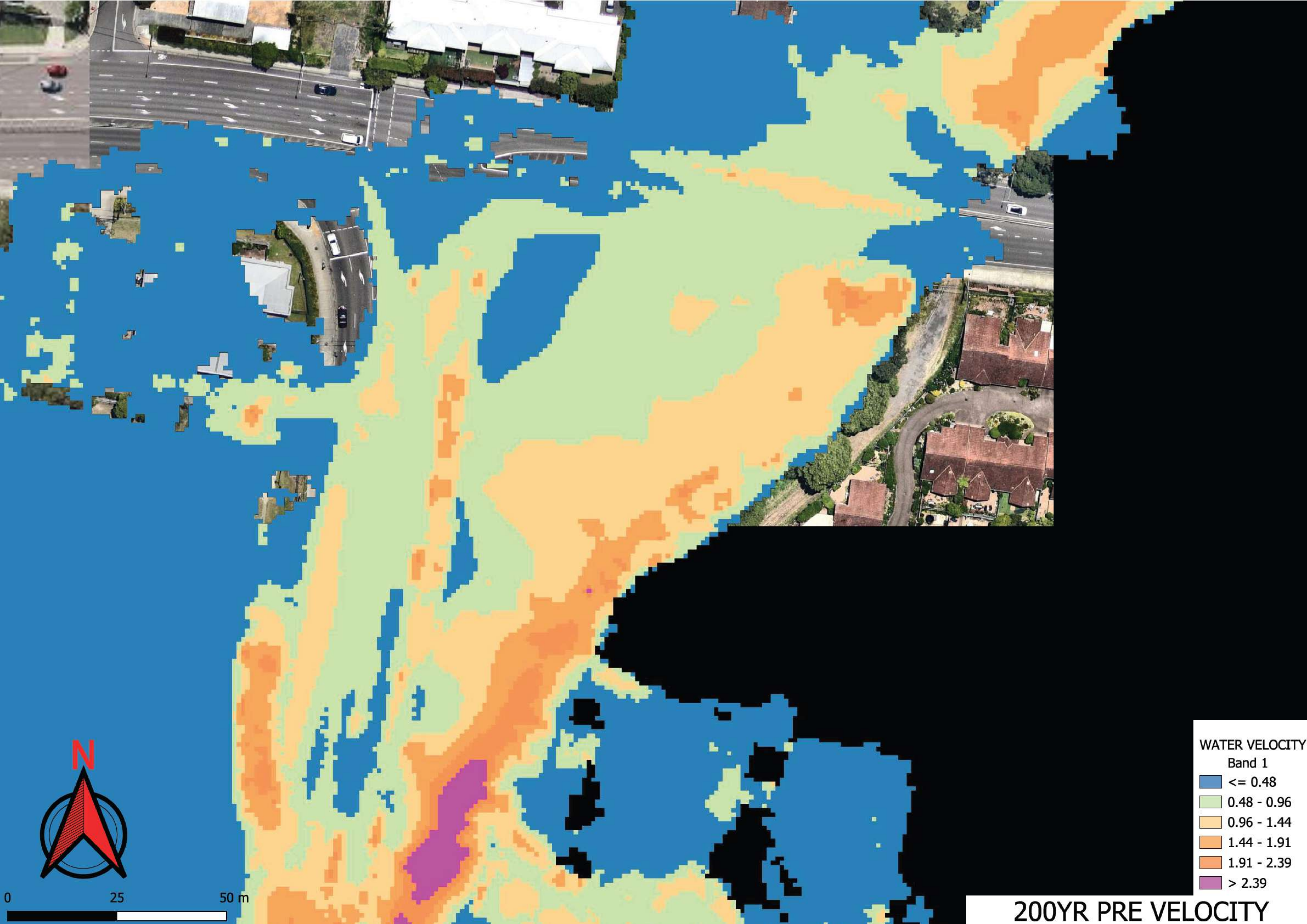
50 m
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
100YR 2090 POST VELOCITY



N
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50 m
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
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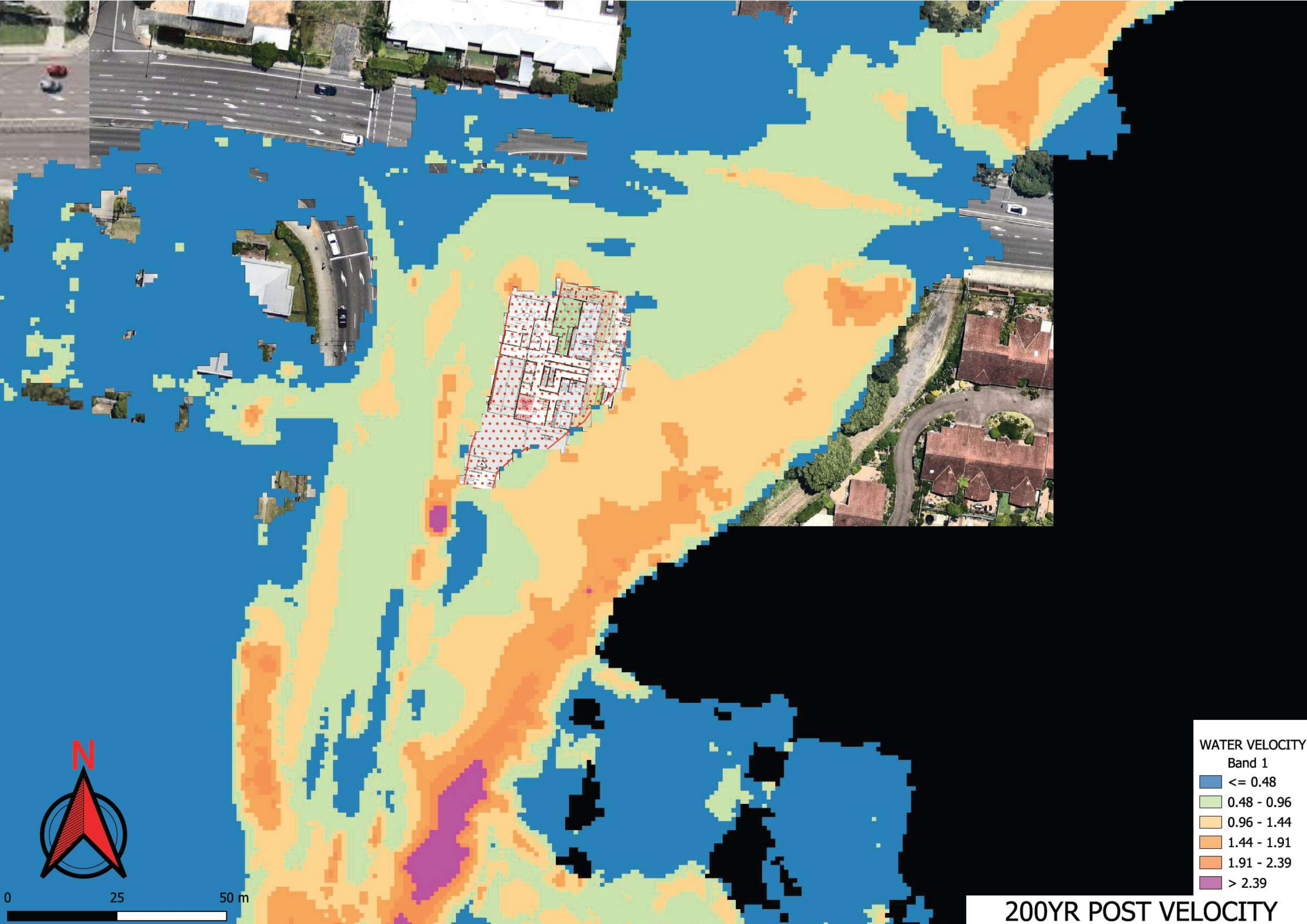
1.44 - 1.91
1.91 - 2.39
> 2.39
200YR PRE VELOCITY



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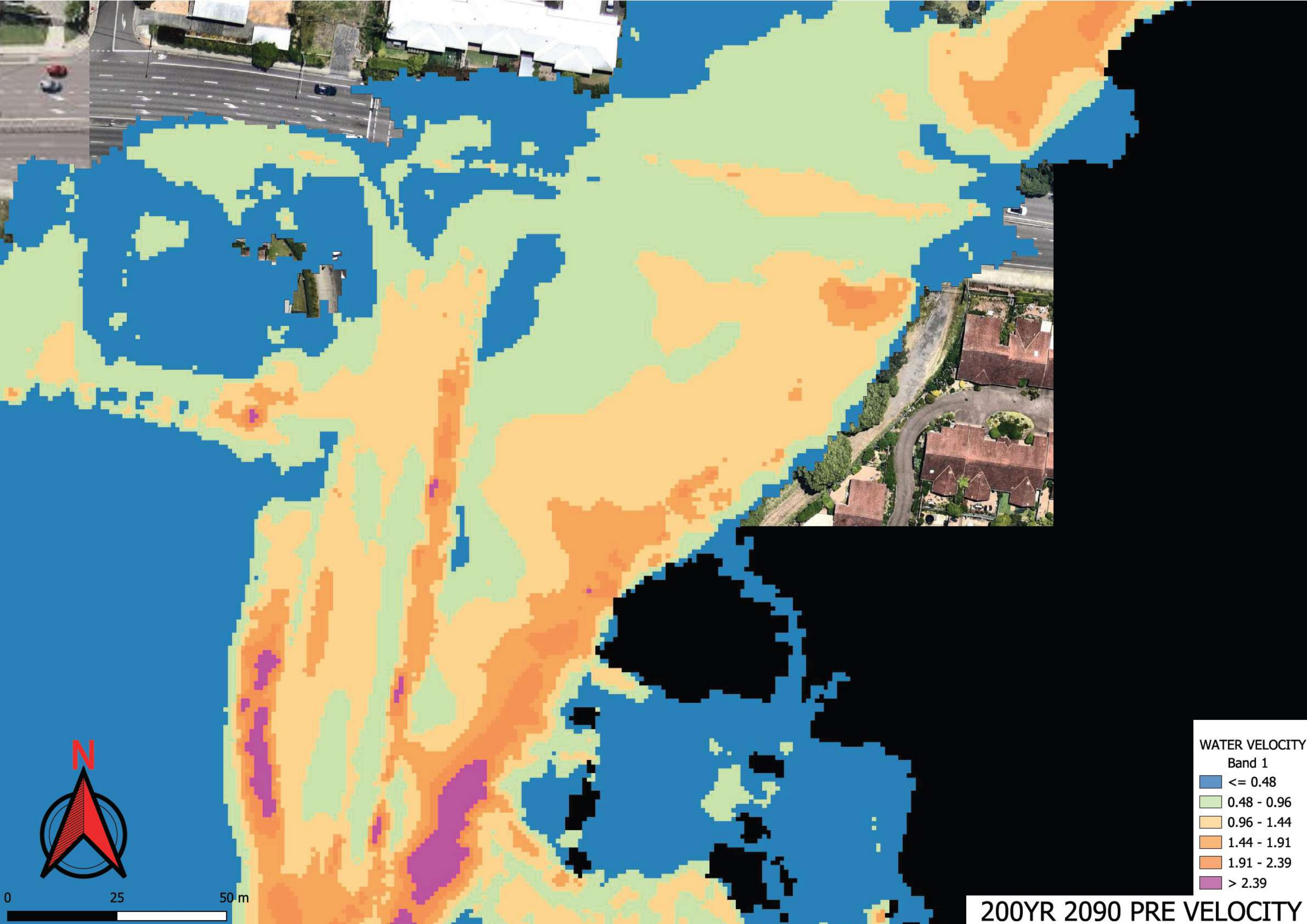

N
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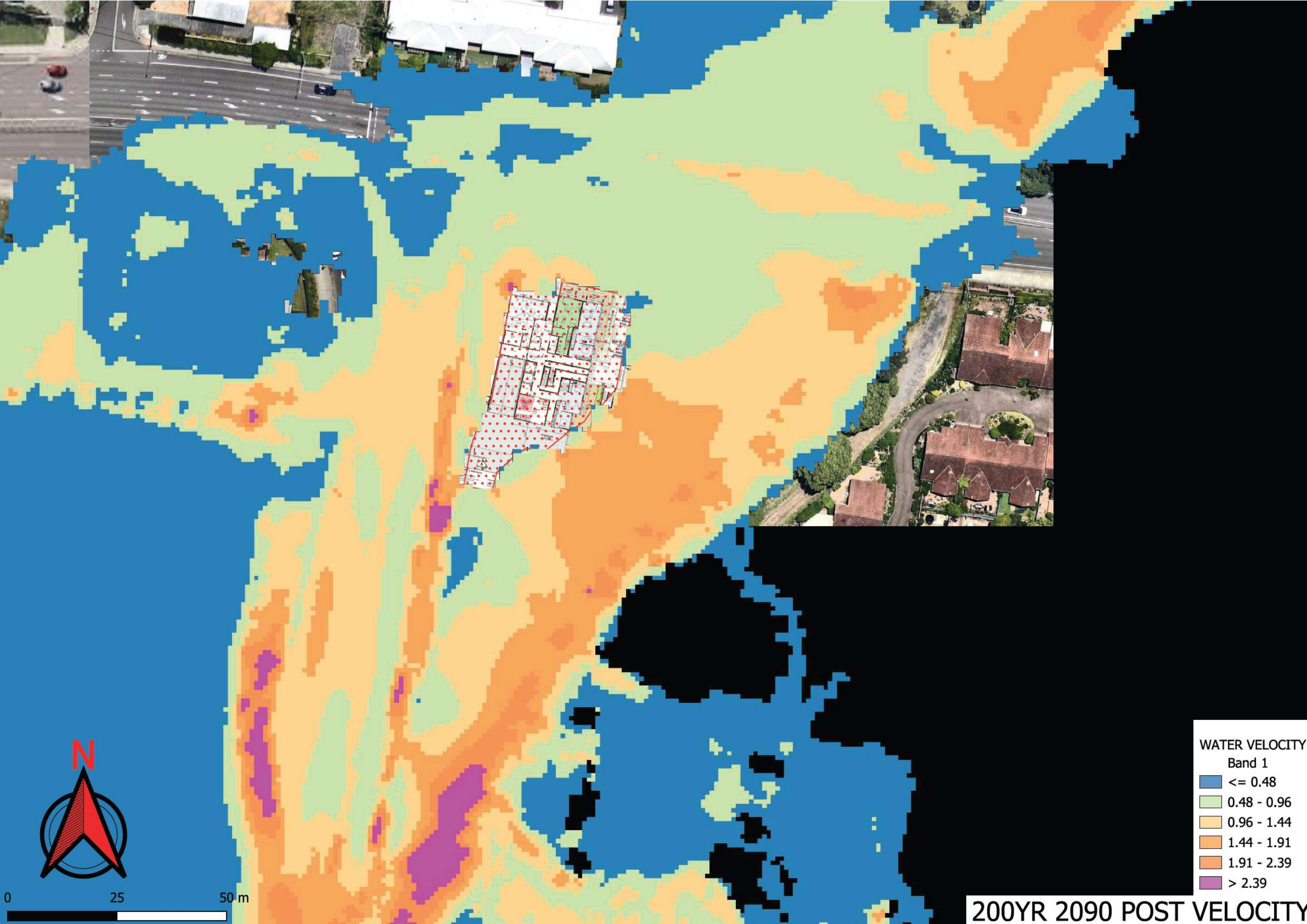
50 m
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
200YR 2090 PRE VELOCITY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50 m
WATER VELOCITY
Band 1
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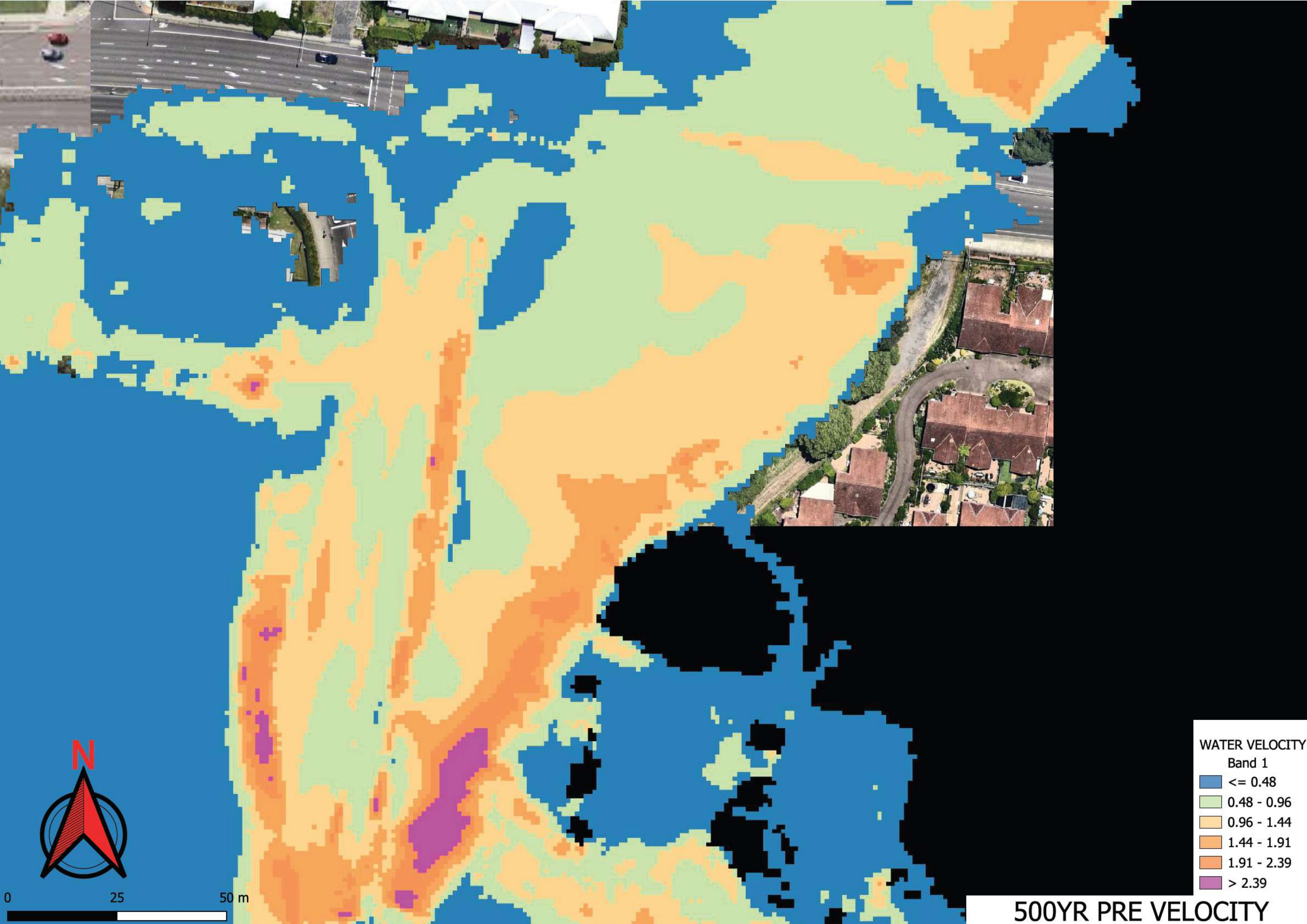
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
200YR 2090 POST VELOCITY


N
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50 m
WATER VELOCITY
Band 1
<= 0.48
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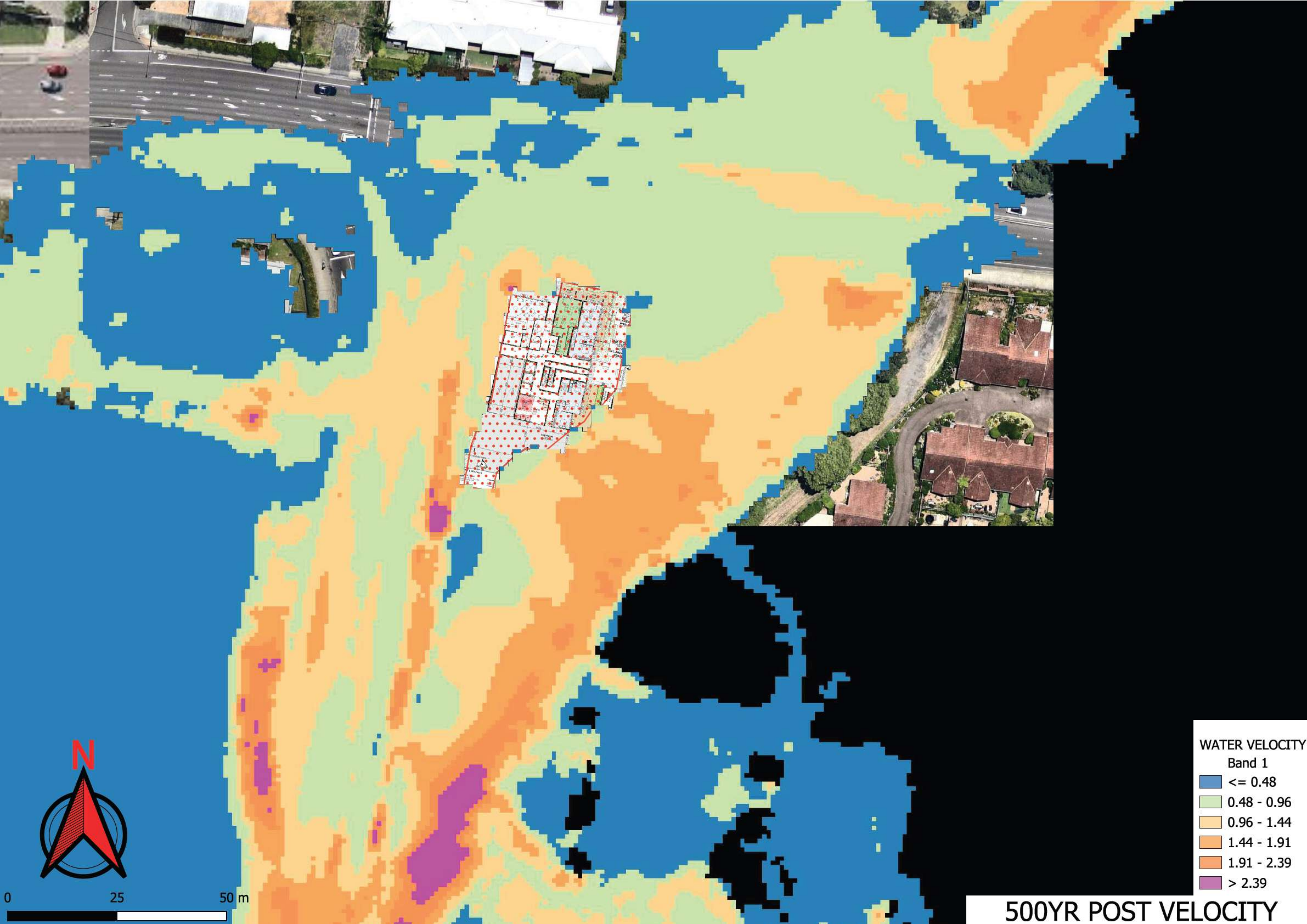
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
500YR PRE VELOCITY


N
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50 m
WATER VELOCITY
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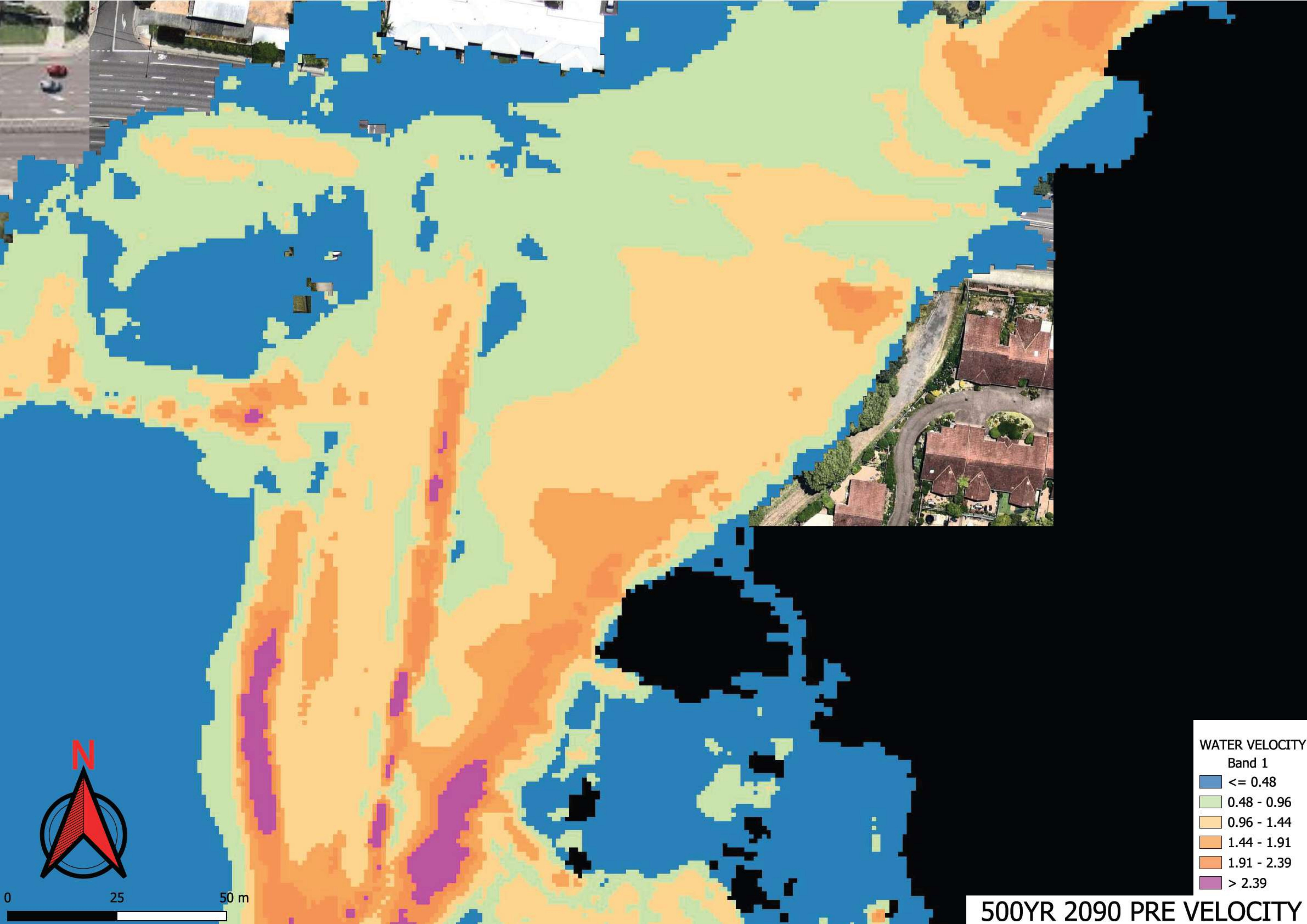
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
500YR POST VELOCITY



N
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50 m
WATER VELOCITY
Band 1
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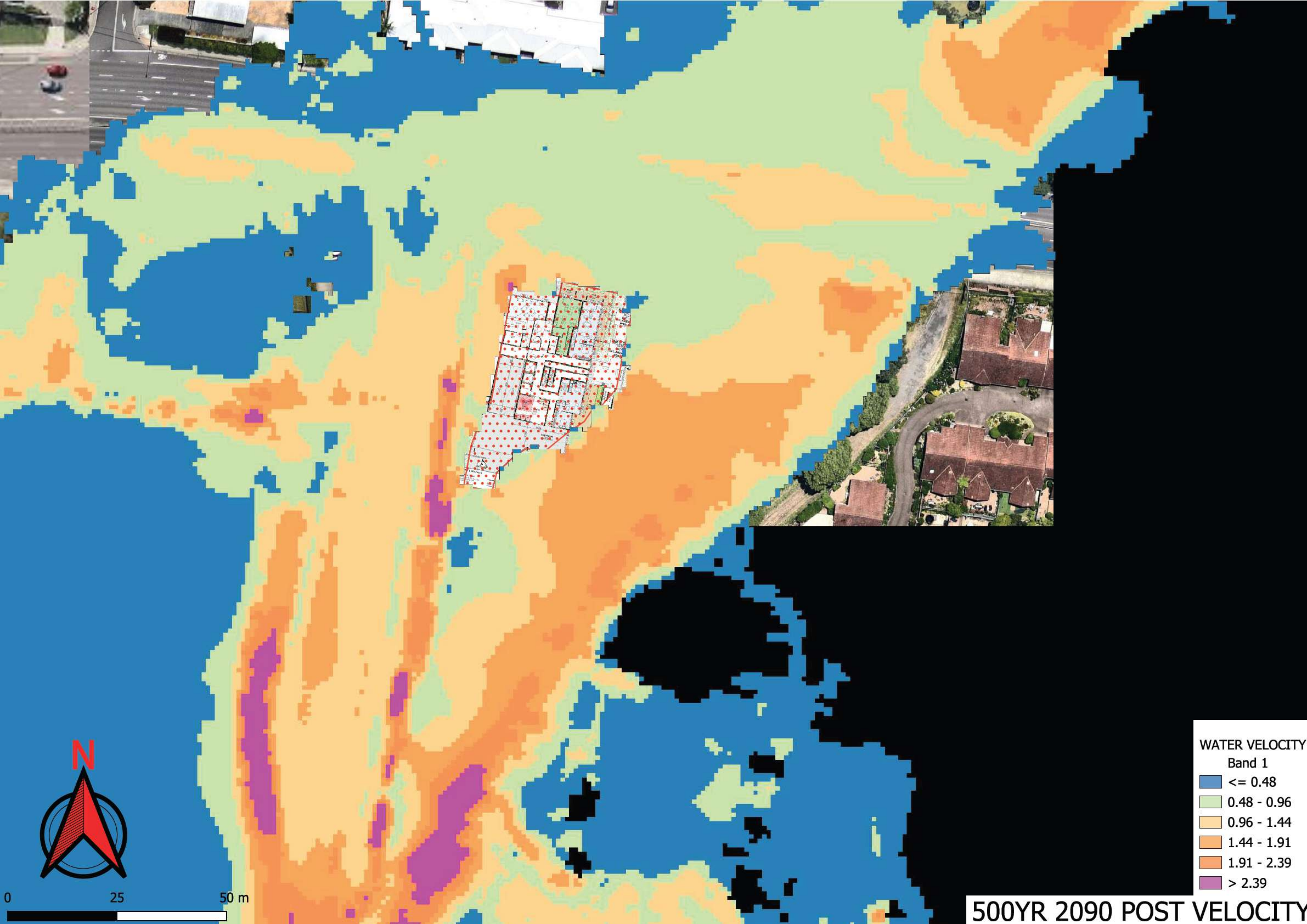
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
500YR 2090 PRE VELOCITY


N
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50 m
WATER VELOCITY
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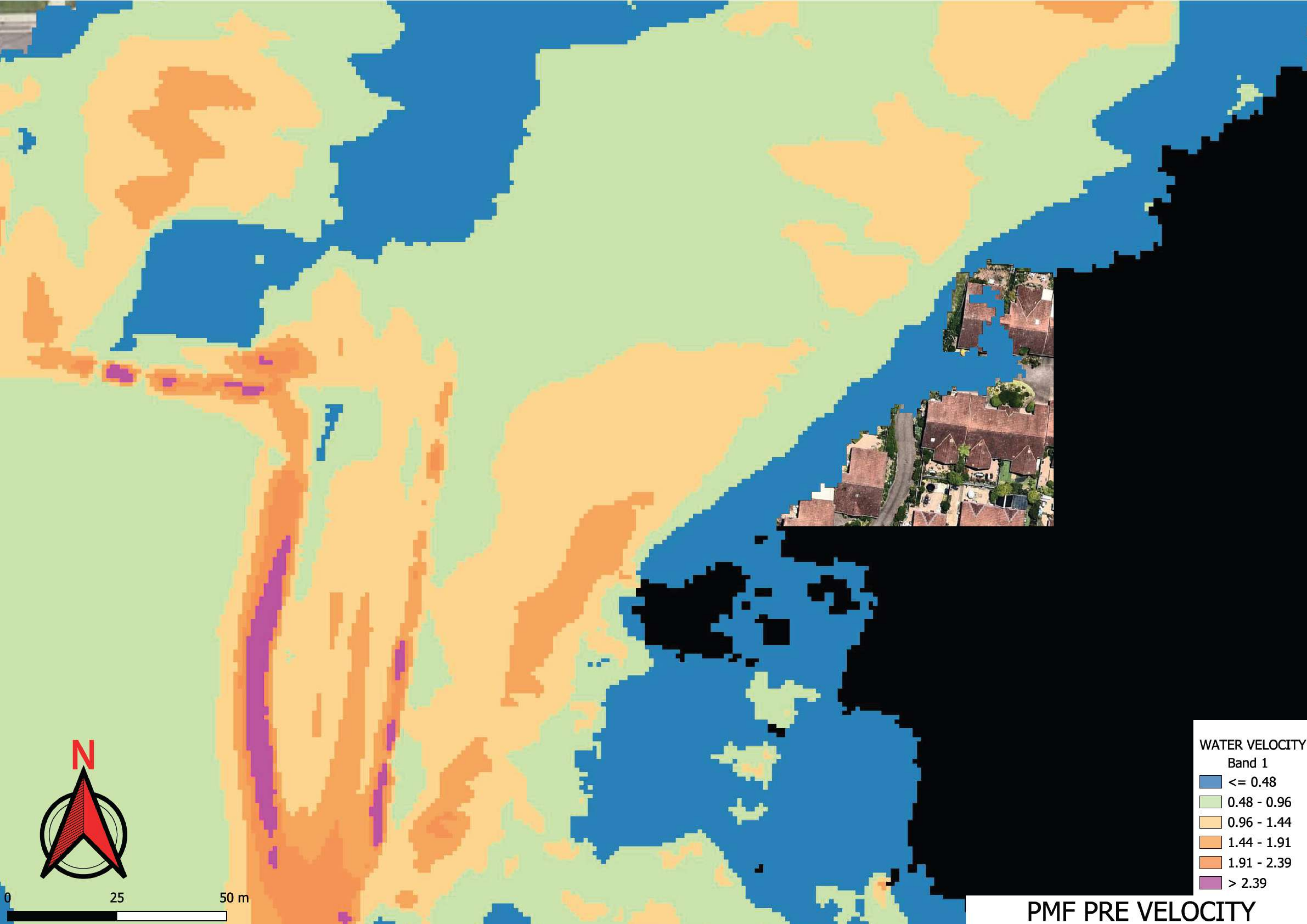
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
500YR 2090 POST VELOCITY


N
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25
50 m
WATER VELOCITY
Band 1
<= 0.48
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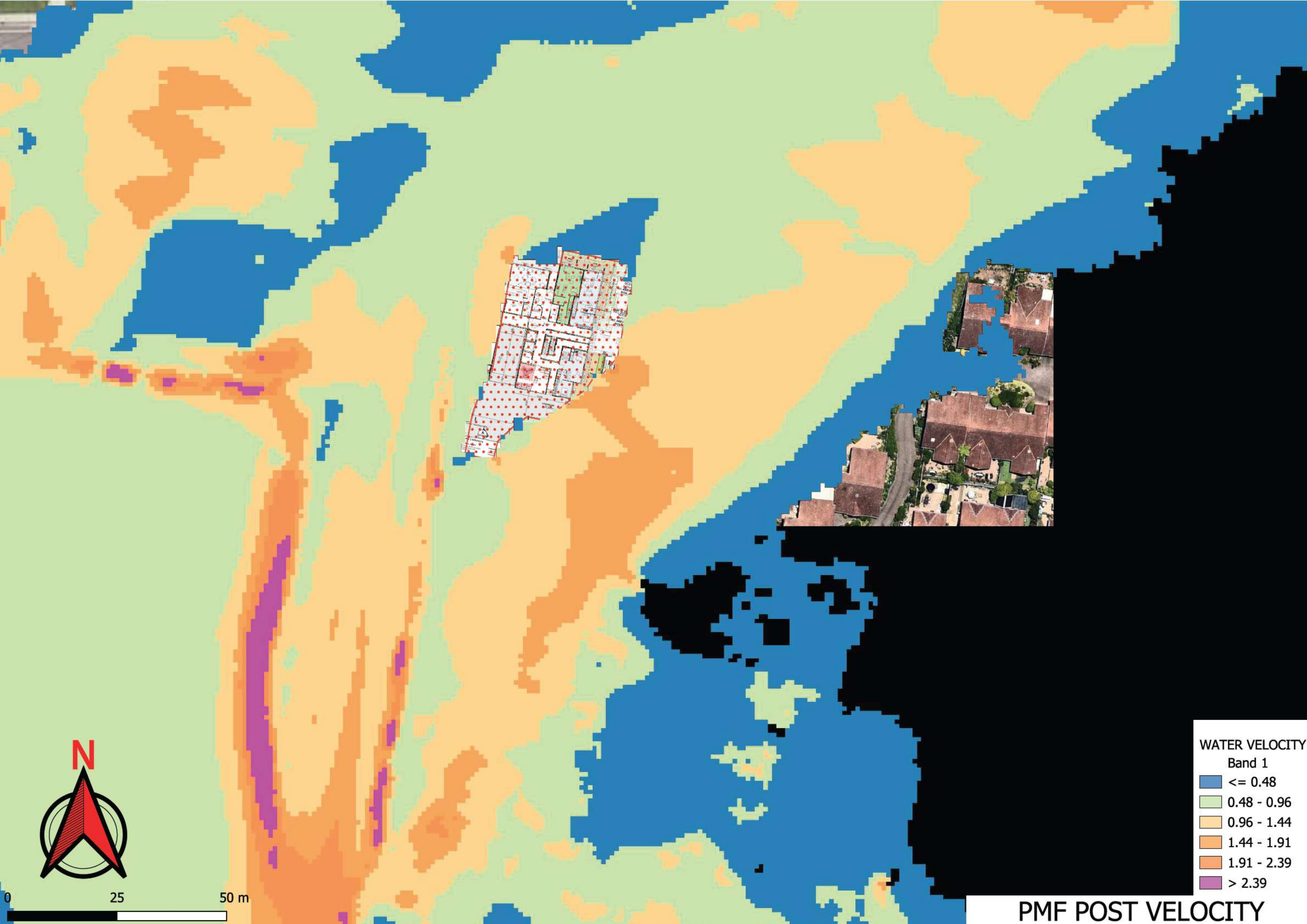
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
PMF PRE VELOCITY



N
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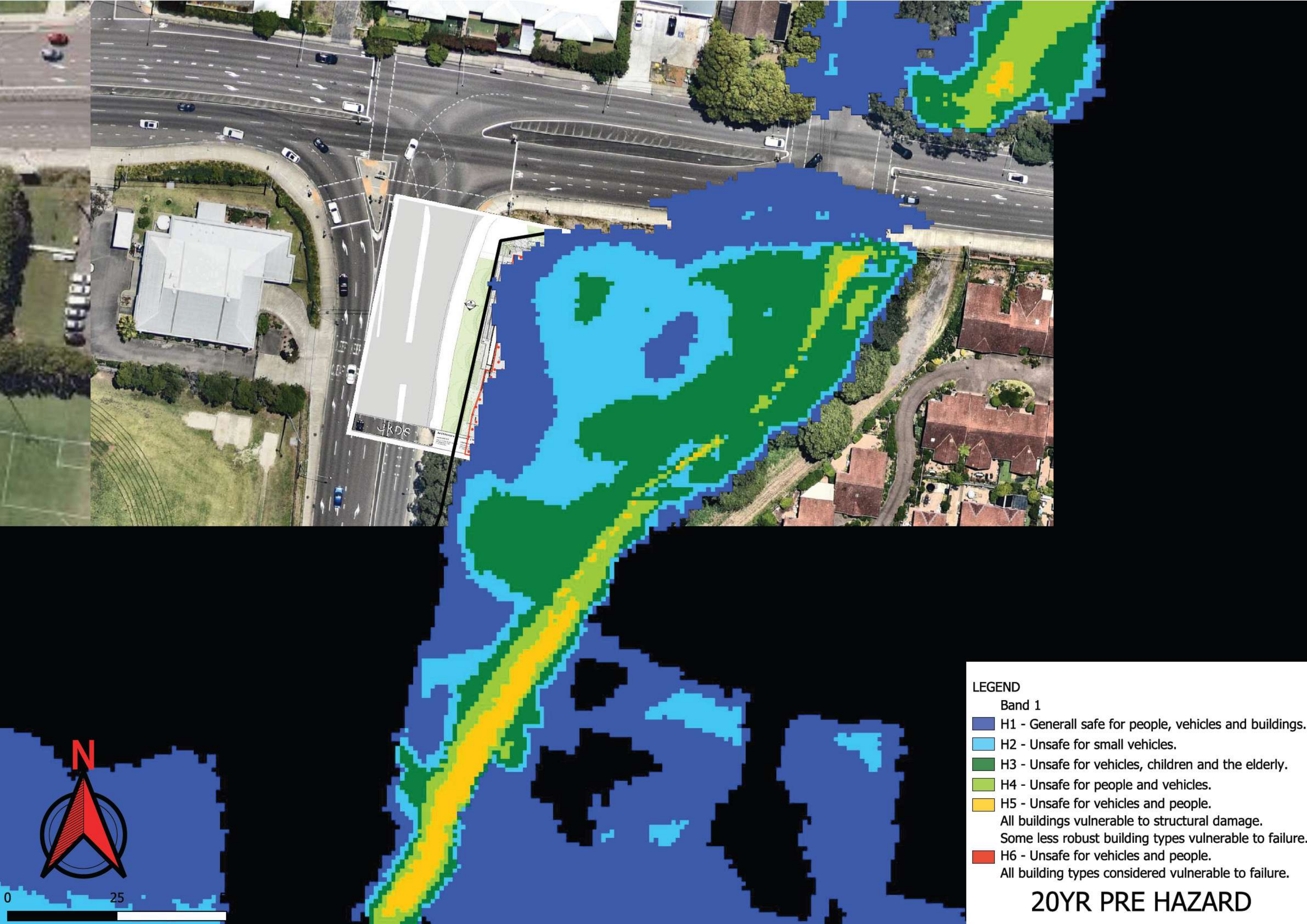
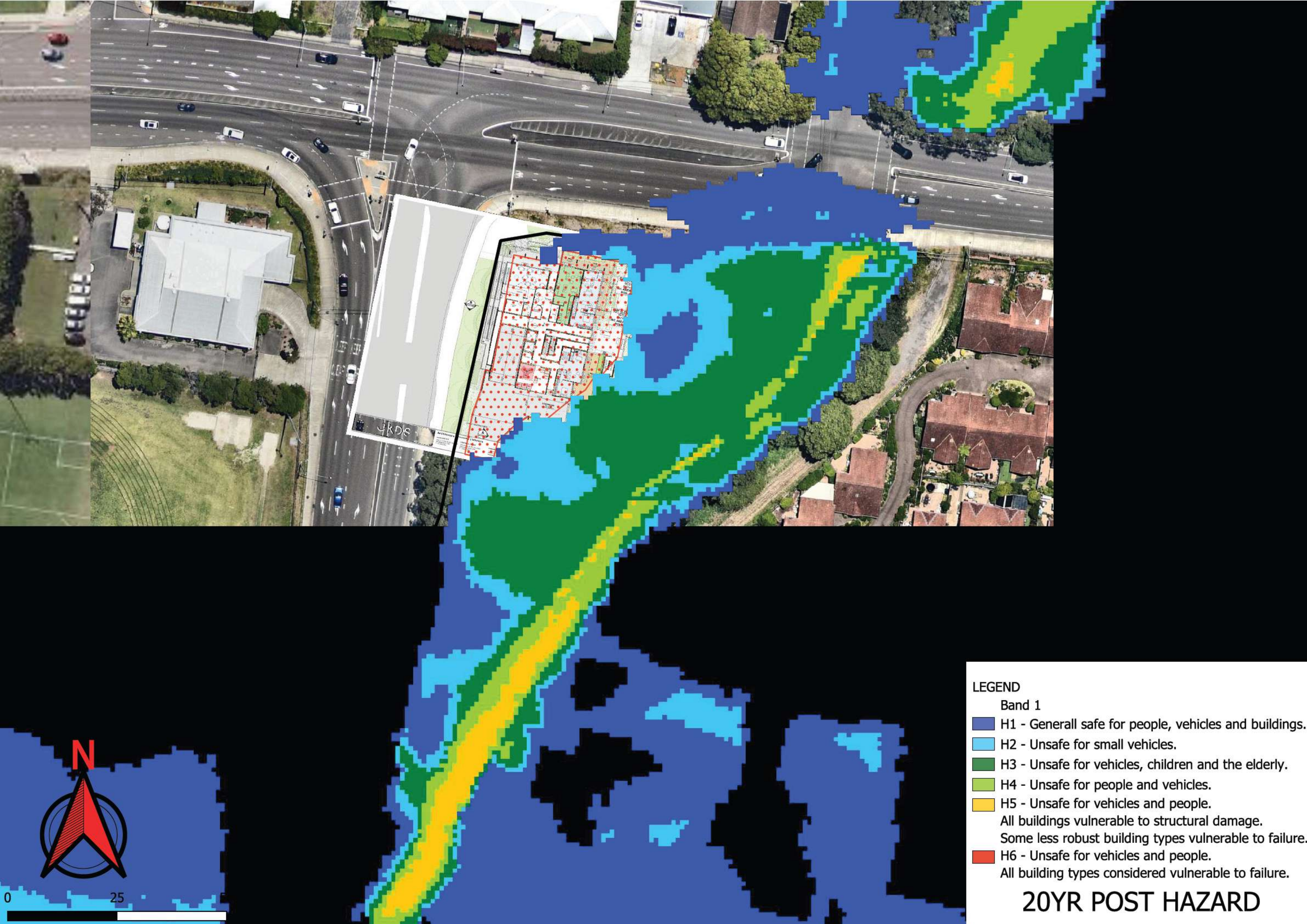
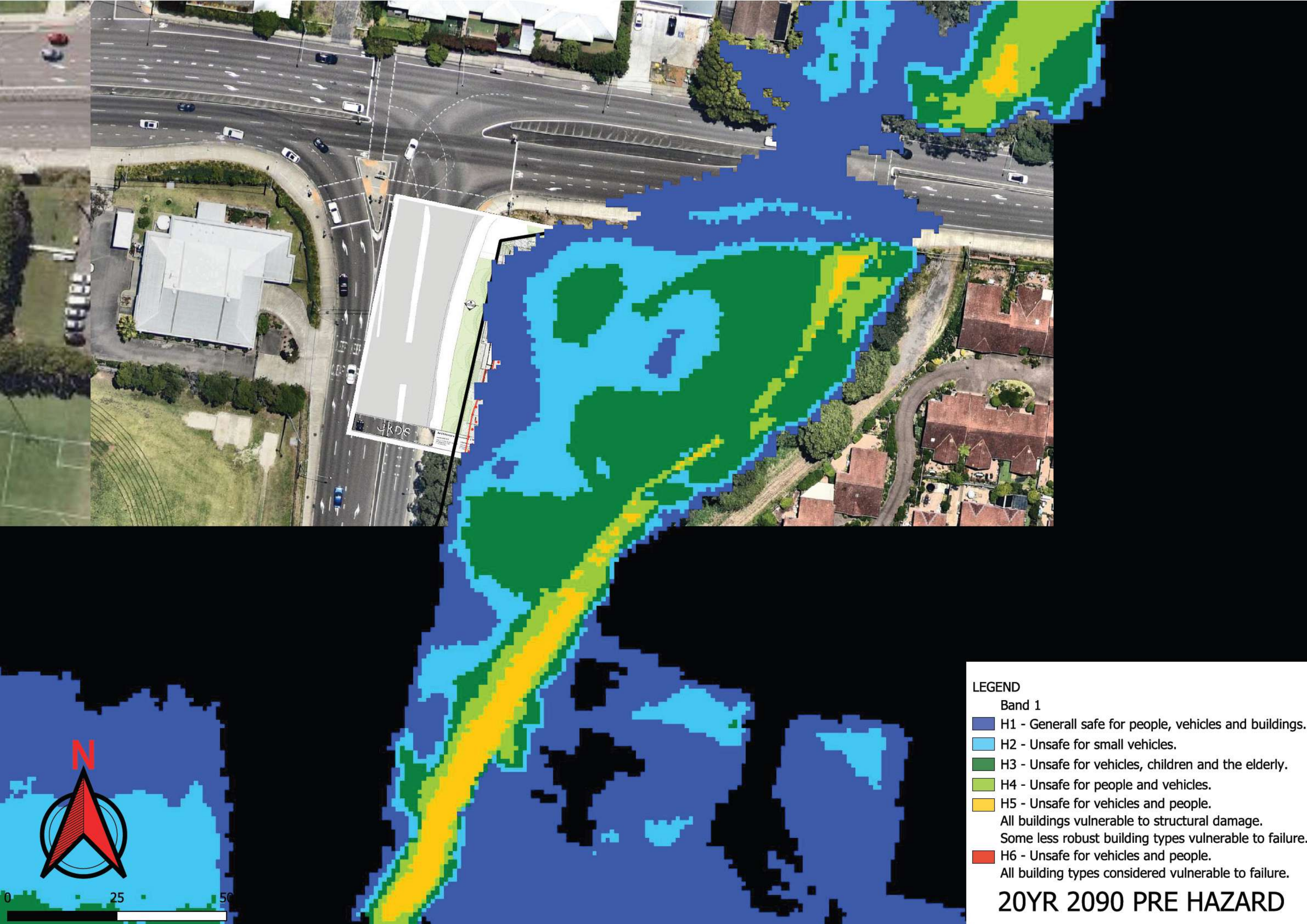
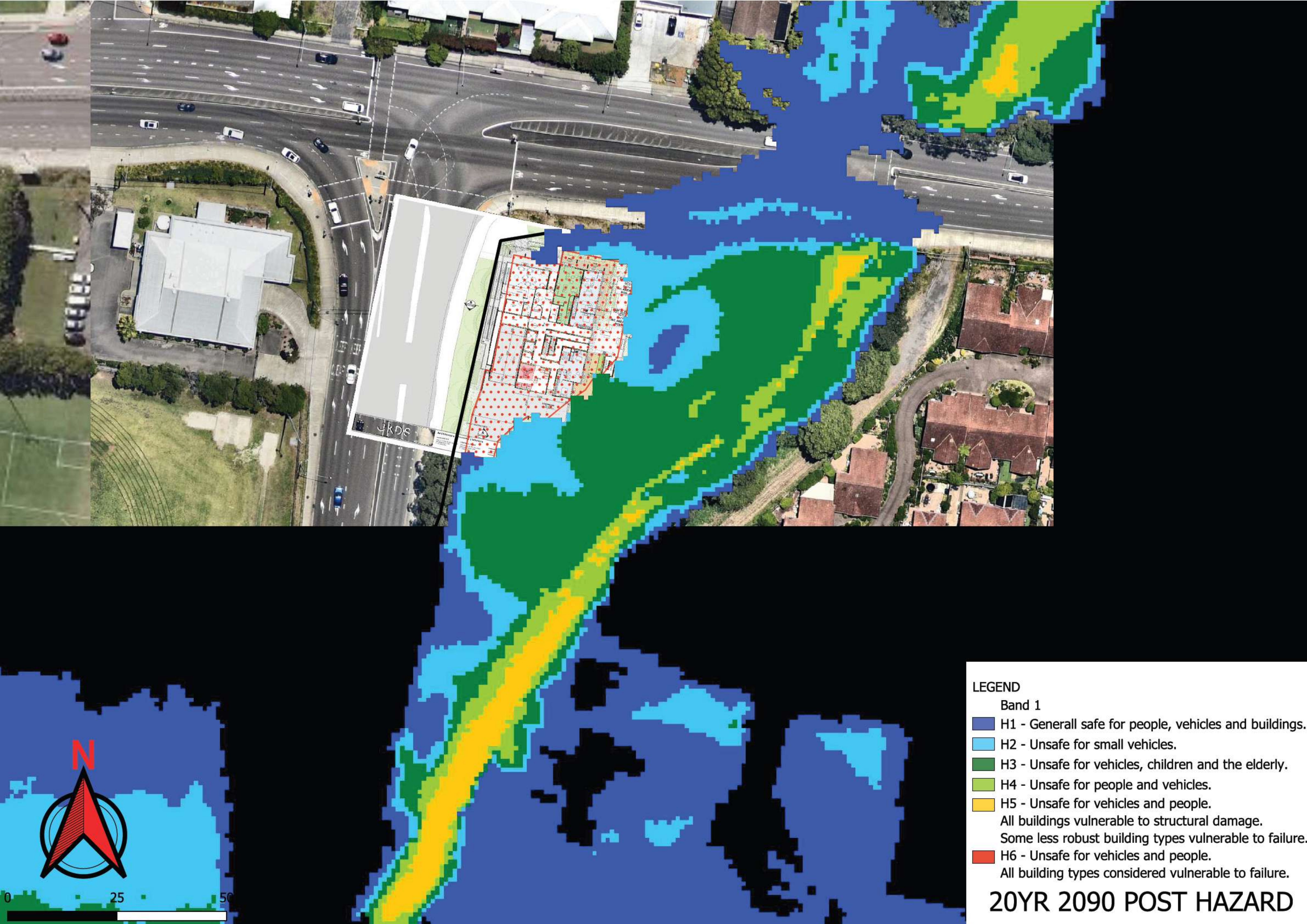
25
50 m
WATER VELOCITY
Band 1
<= 0.48
0.48 - 0.96
0.96 - 1.44
1.44 - 1.91
1.91 - 2.39
> 2.39
PMF POST VELOCITY


N
0
25
LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
20YR PRE HAZARD



N
0
25
LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
20YR POST HAZARD


LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
20YR 2090 PRE HAZARD
N
0
25
50


LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
20YR 2090 POST HAZARD
N
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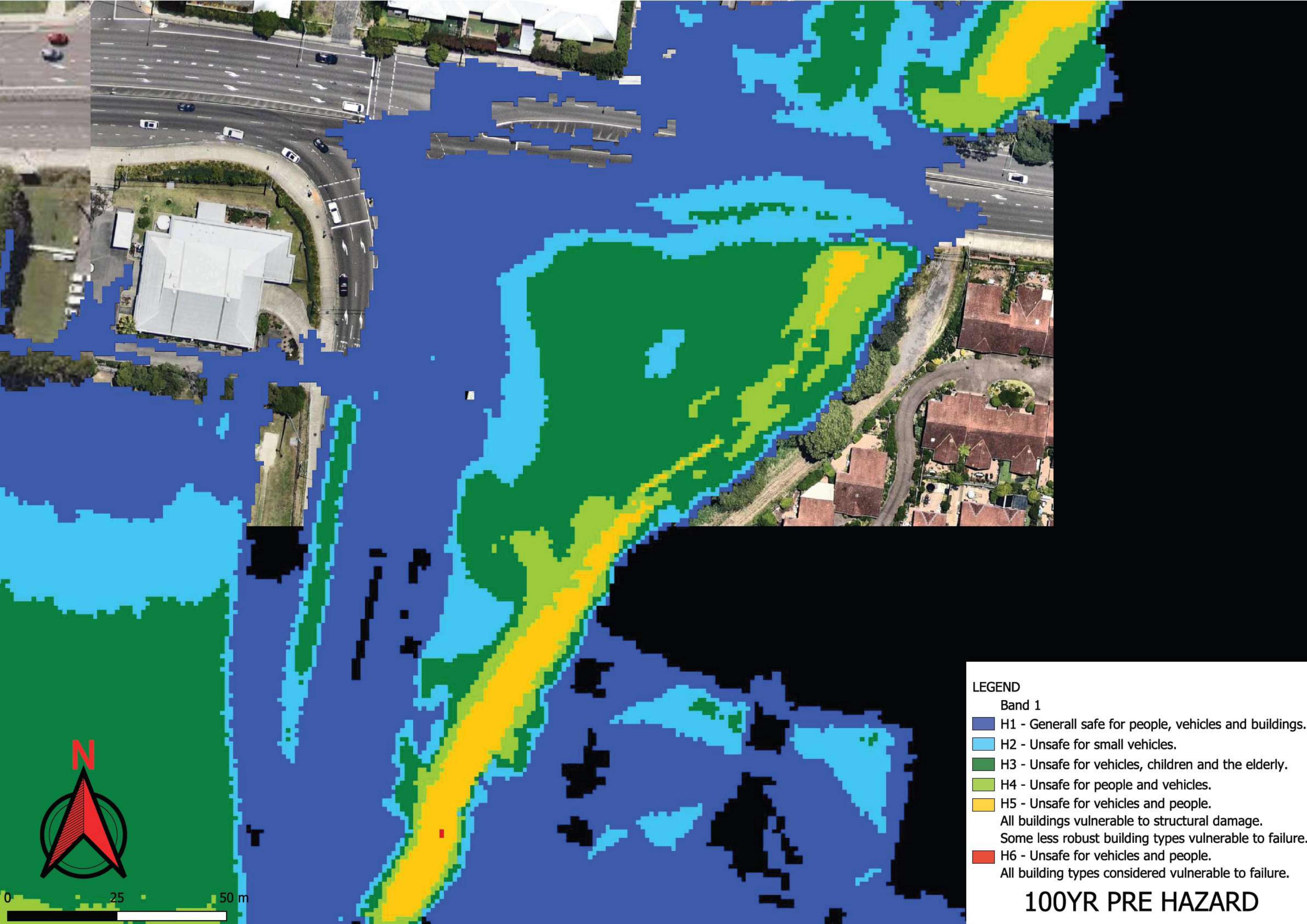
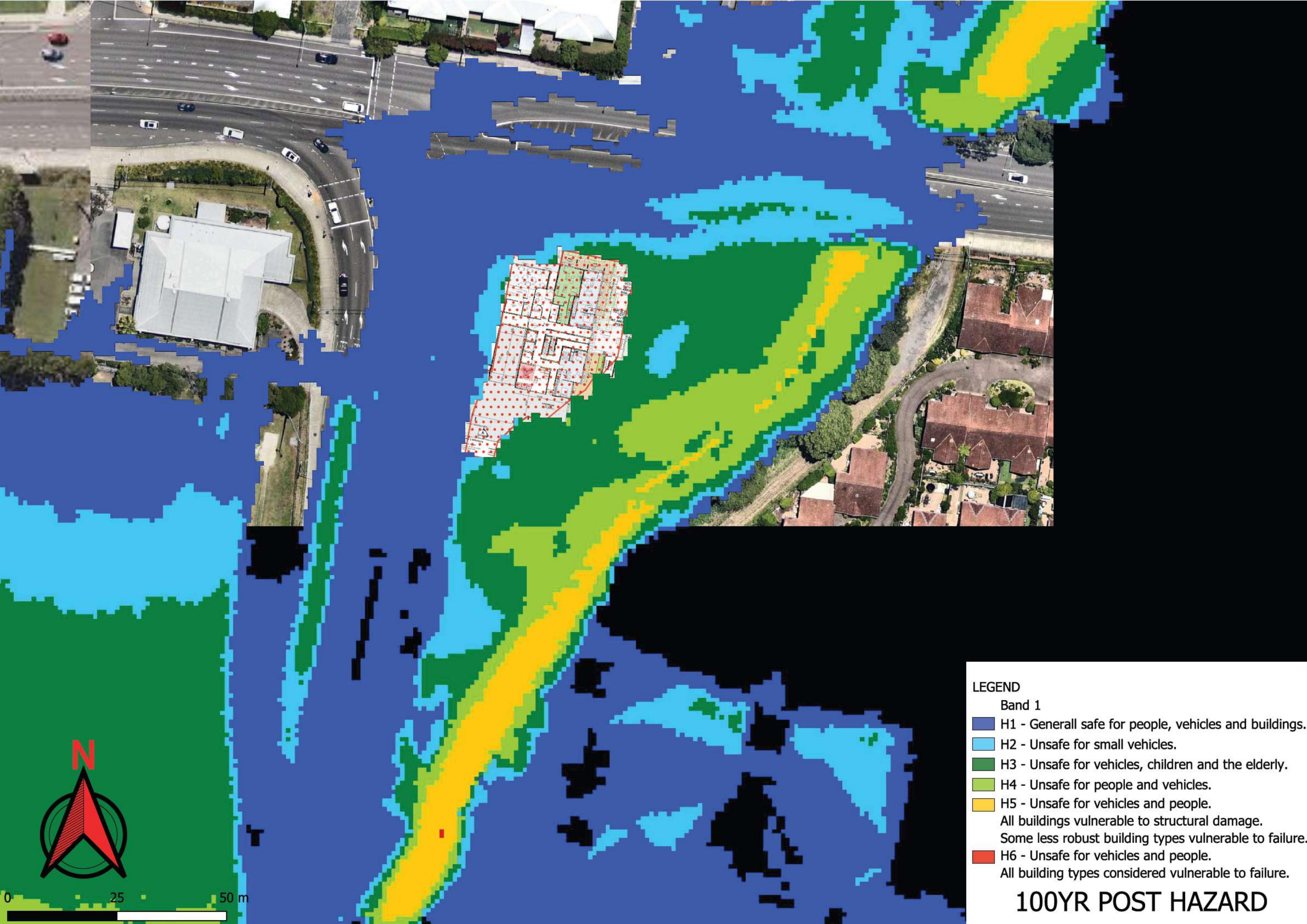
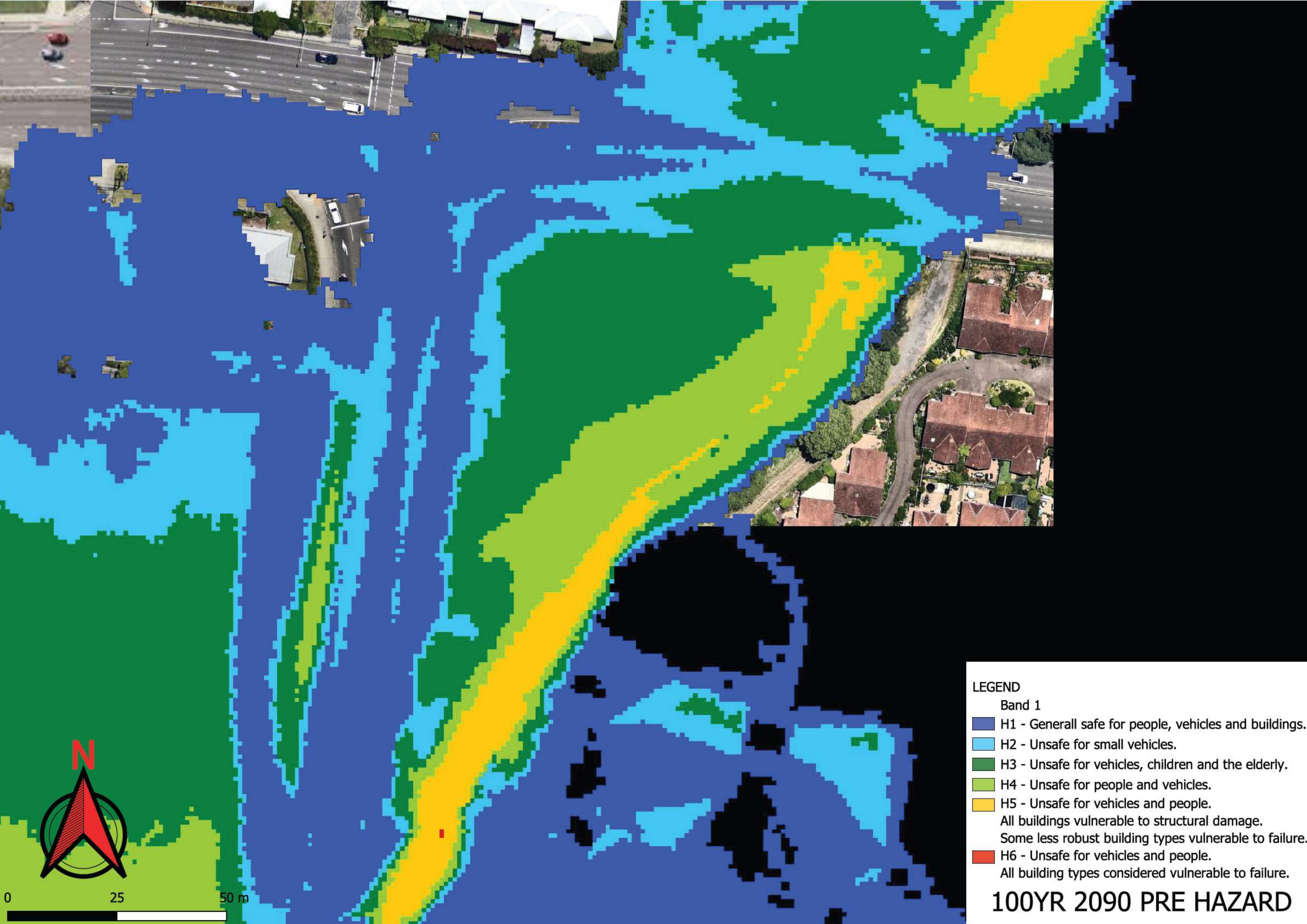
25
50


N
0
25
50 m
LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types consedered vulnerable to failure.
100YR PRE HAZARD


N
0
25
50 m
LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
100YR POST HAZARD


N
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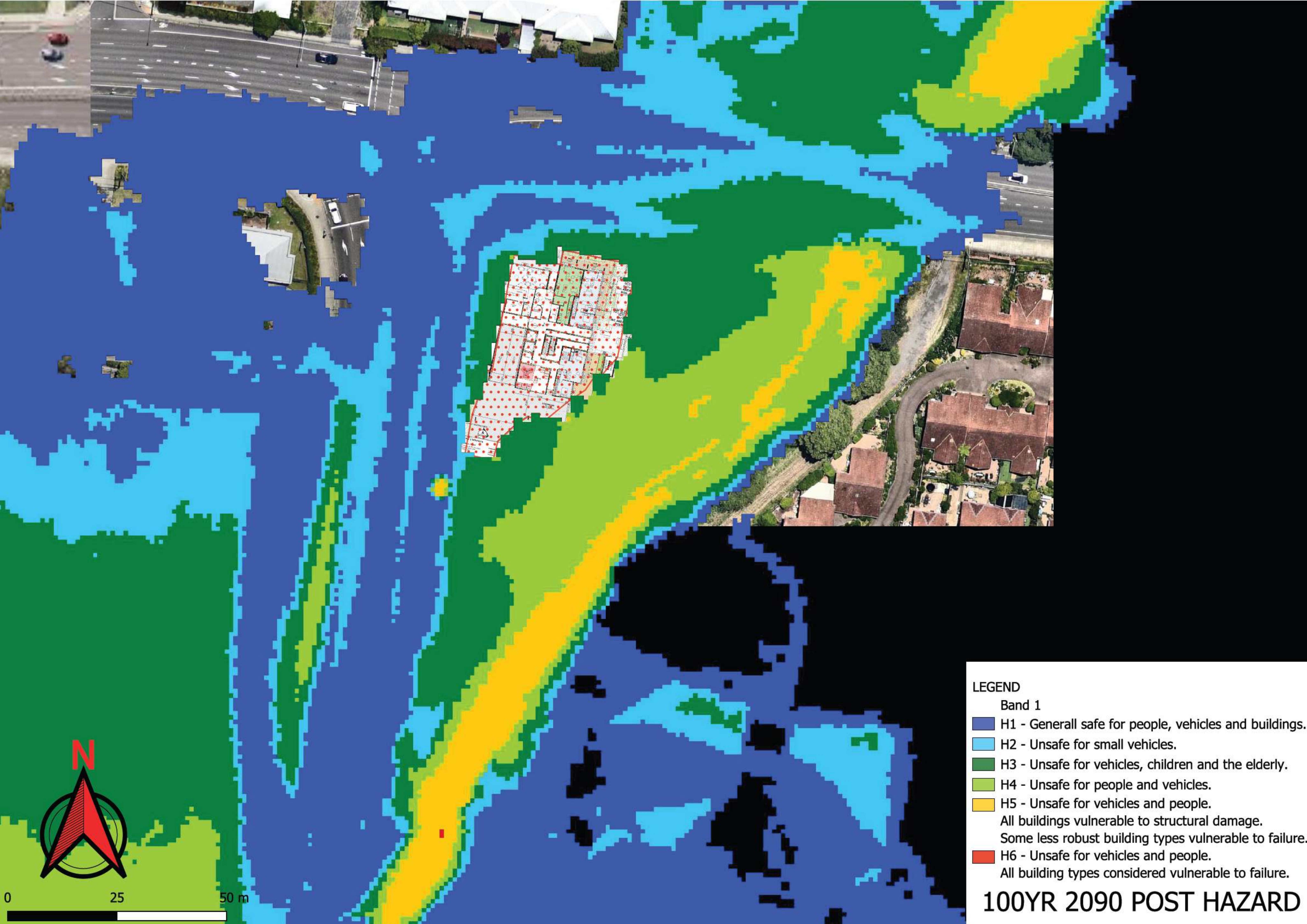
25
50 m
LEGEND
Band 1
H1 - Generall safe for people, vehicles and buildings.
H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
100YR 2090 PRE HAZARD


N
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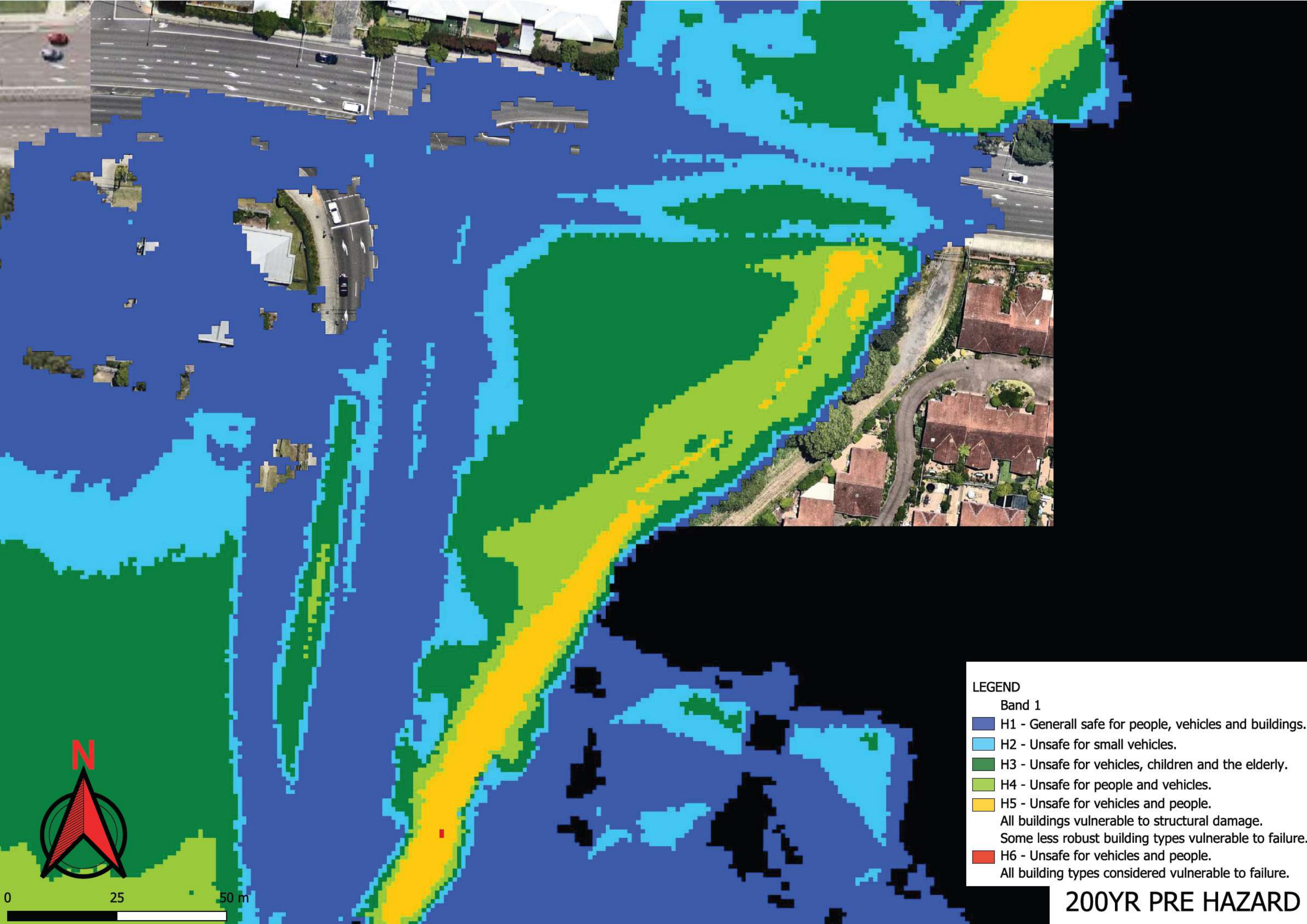
25
50 m
LEGEND
Band 1
H1 - Generall safe for people, vehicles and buildings.
H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
100YR 2090 POST HAZARD


LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types consedered vulnerable to failure.
N
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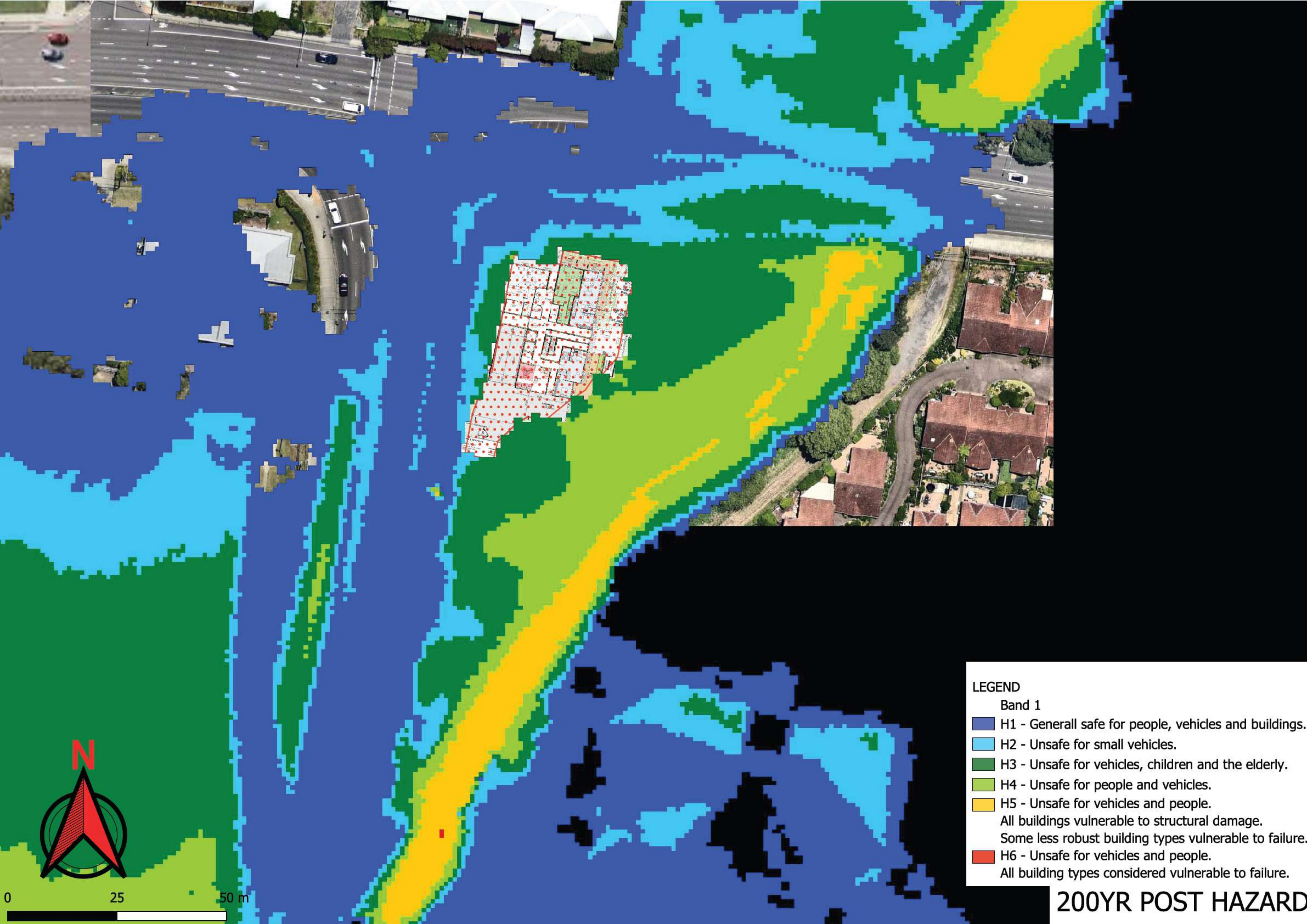
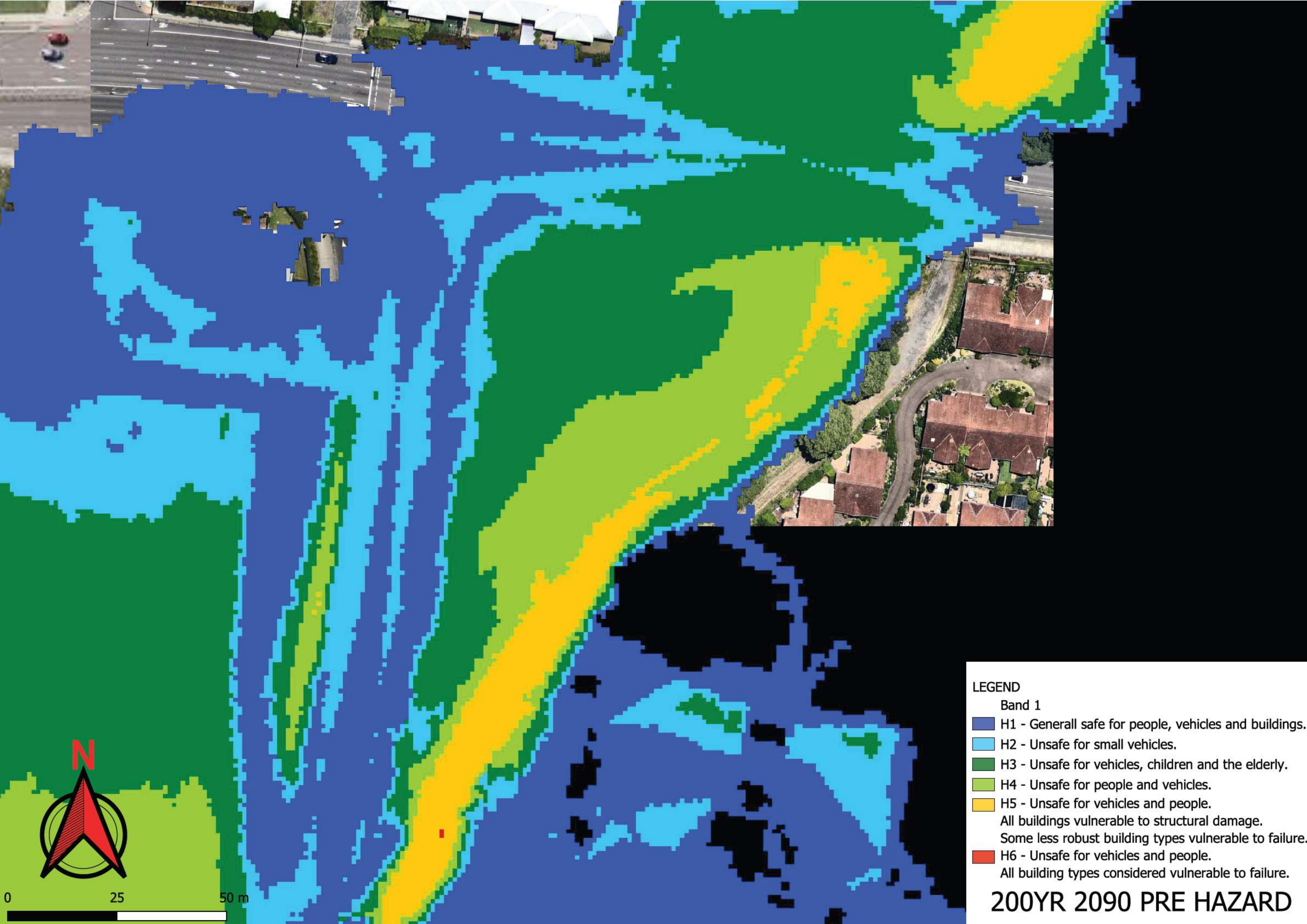
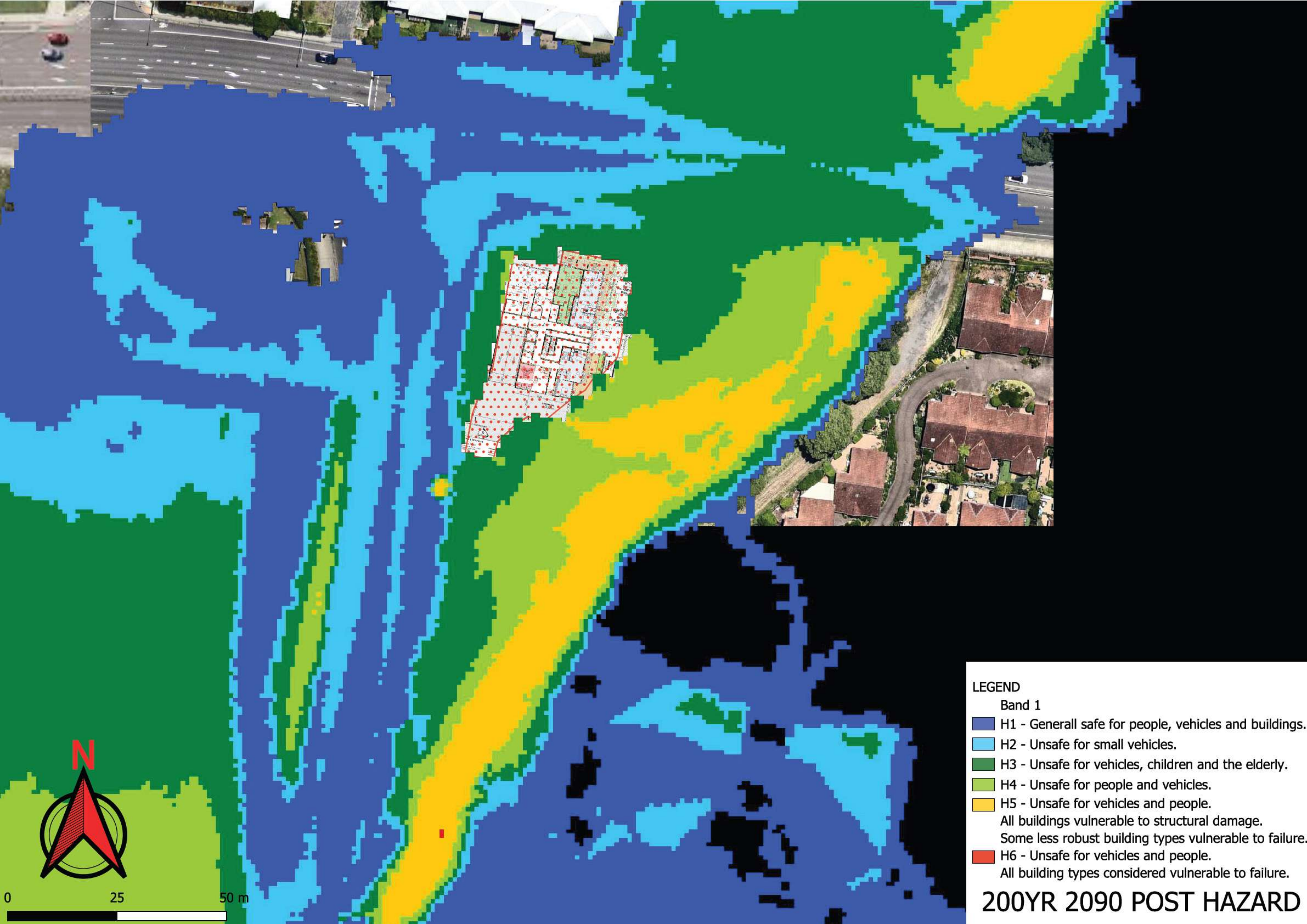
50 m
200YR PRE HAZARD

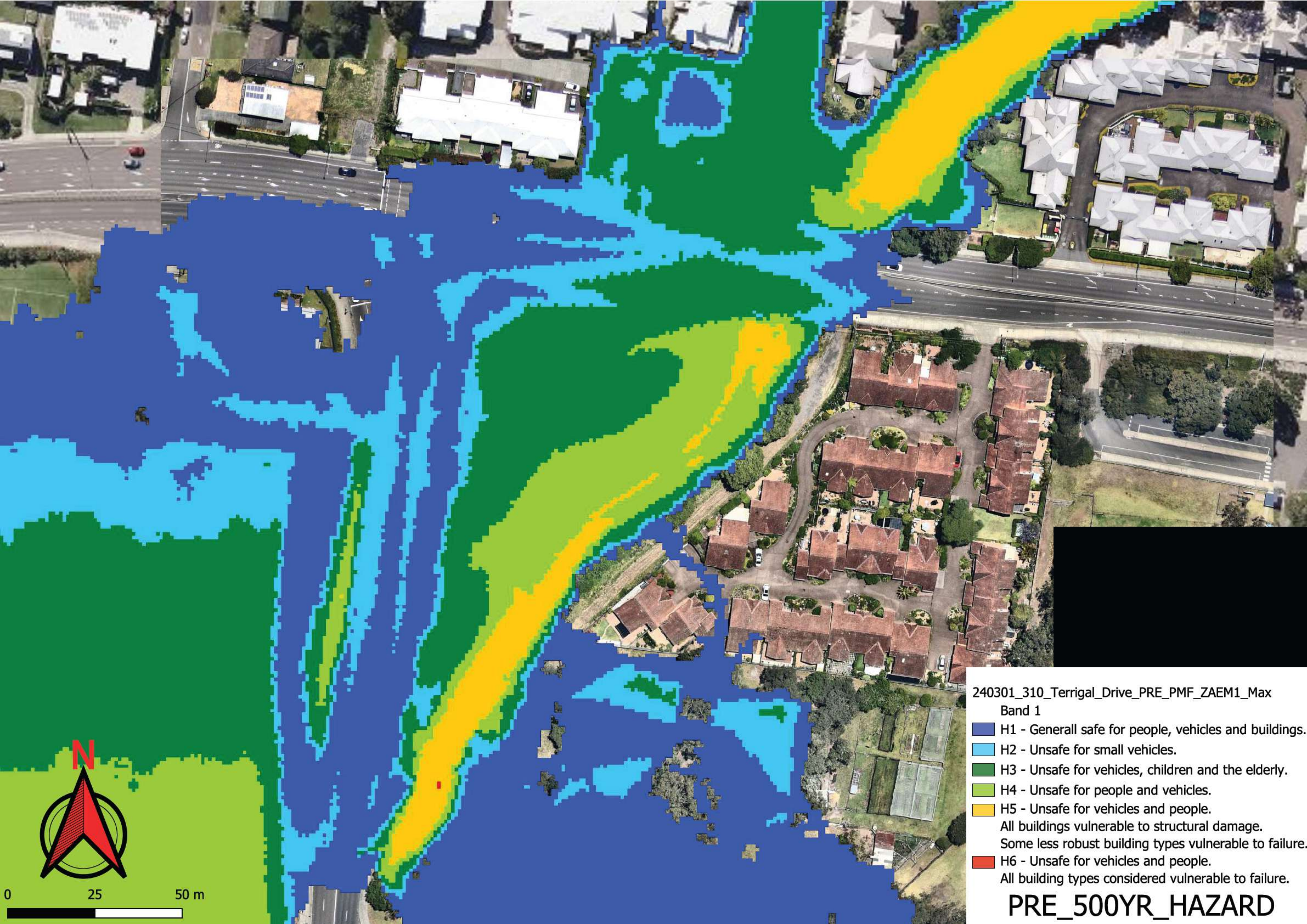


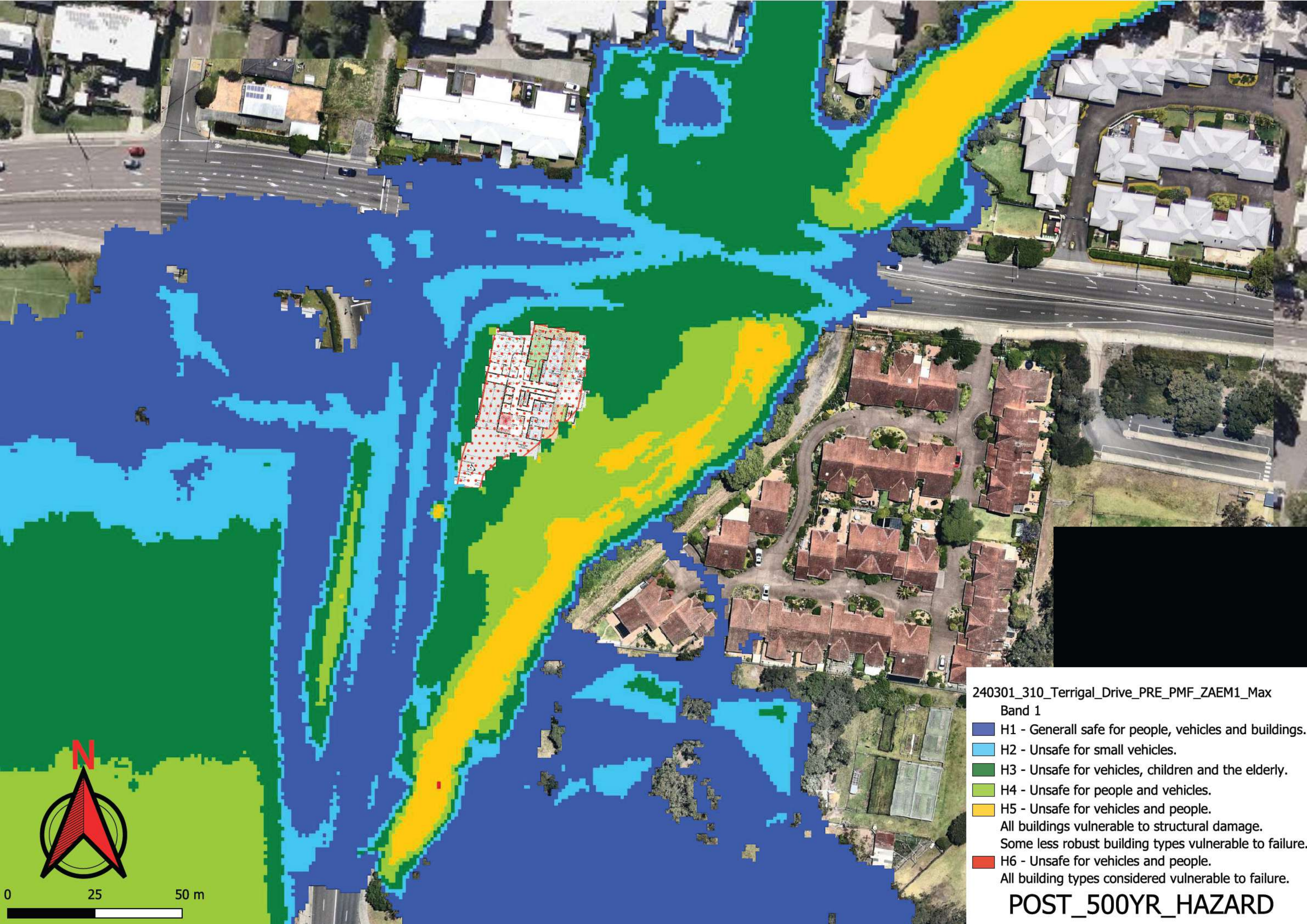
200YR POST HAZARD



N
0
25
50 m
LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
200YR 2090 PRE HAZARD


LEGEND
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
200YR 2090 POST HAZARD
N
0
25
50 m


240301_310_Terrigal_Drive_PRE_PMF_ZAEM1_Max
Band 1
H1 - Generall 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 vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
N
0
25
50 m
PRE_500YR_HAZARD



N
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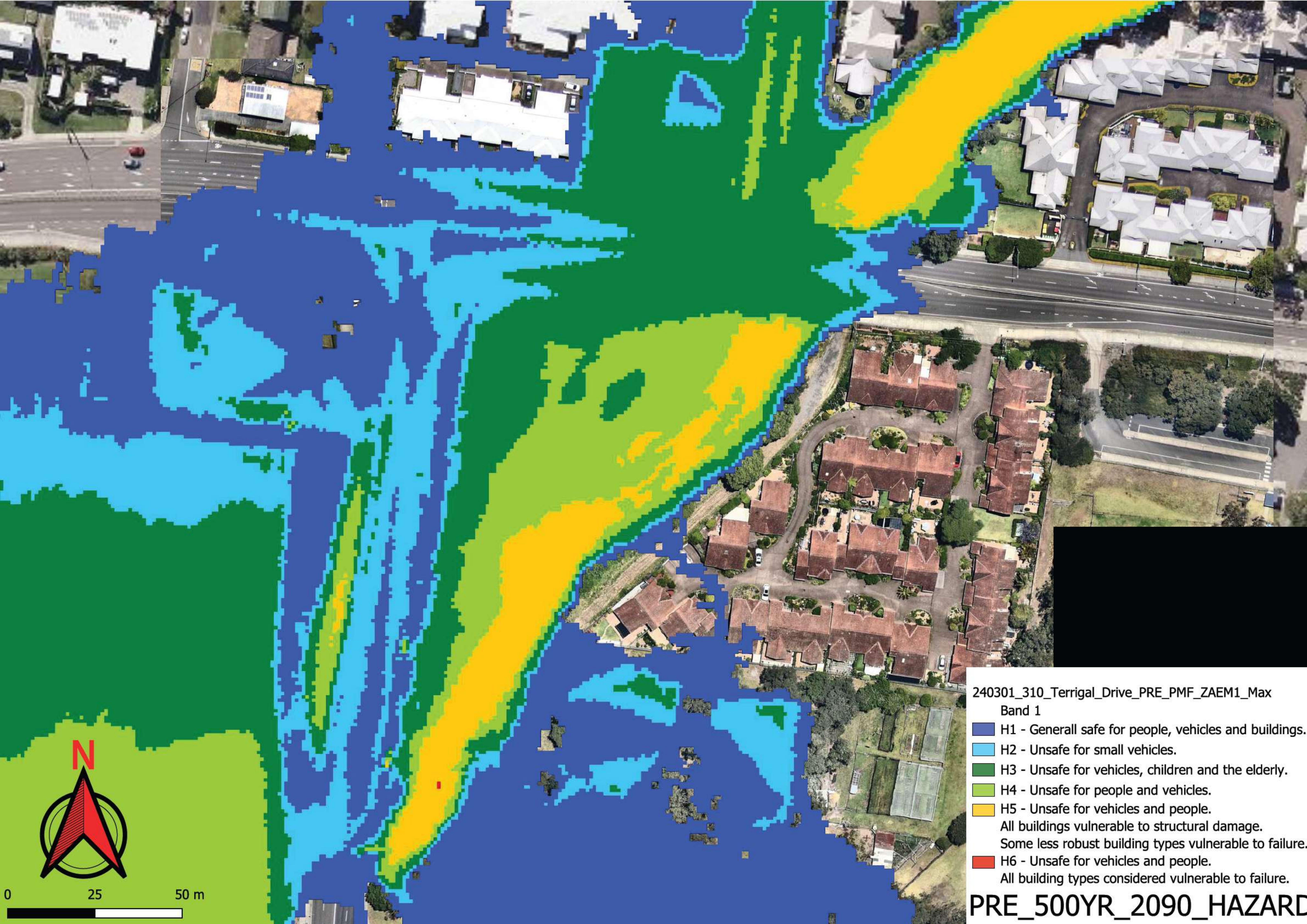
25
50 m
240301_310_Terrigal_Drive_PRE_PMF_ZAEM1_Max
Band 1
H1 - Generall safe for people, vehicles and buildings.
H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
POST_500YR_HAZARD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H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
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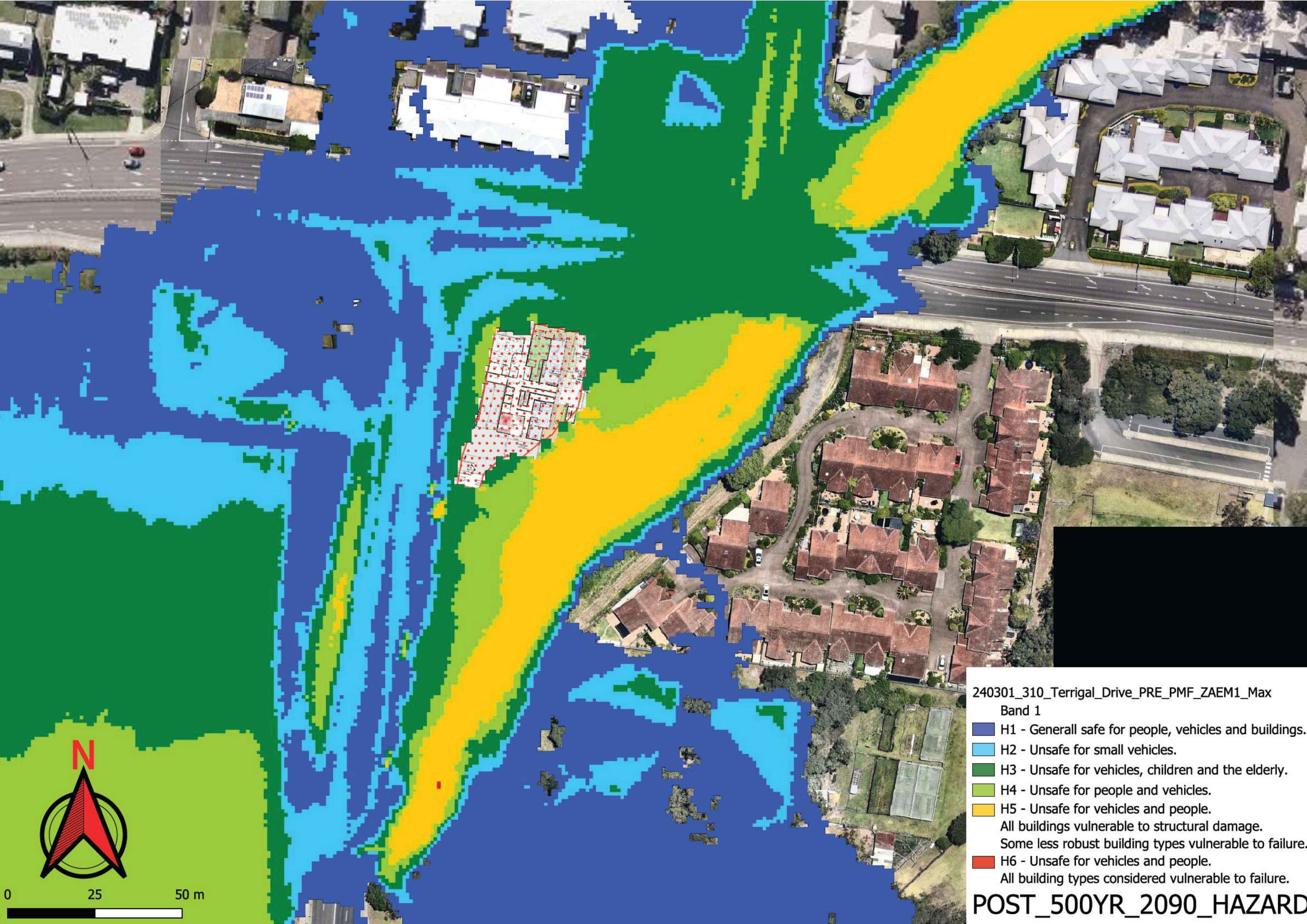
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
PRE_500YR_2090_HAZARD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Band 1
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H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
POST_500YR_2090_HAZARD
N
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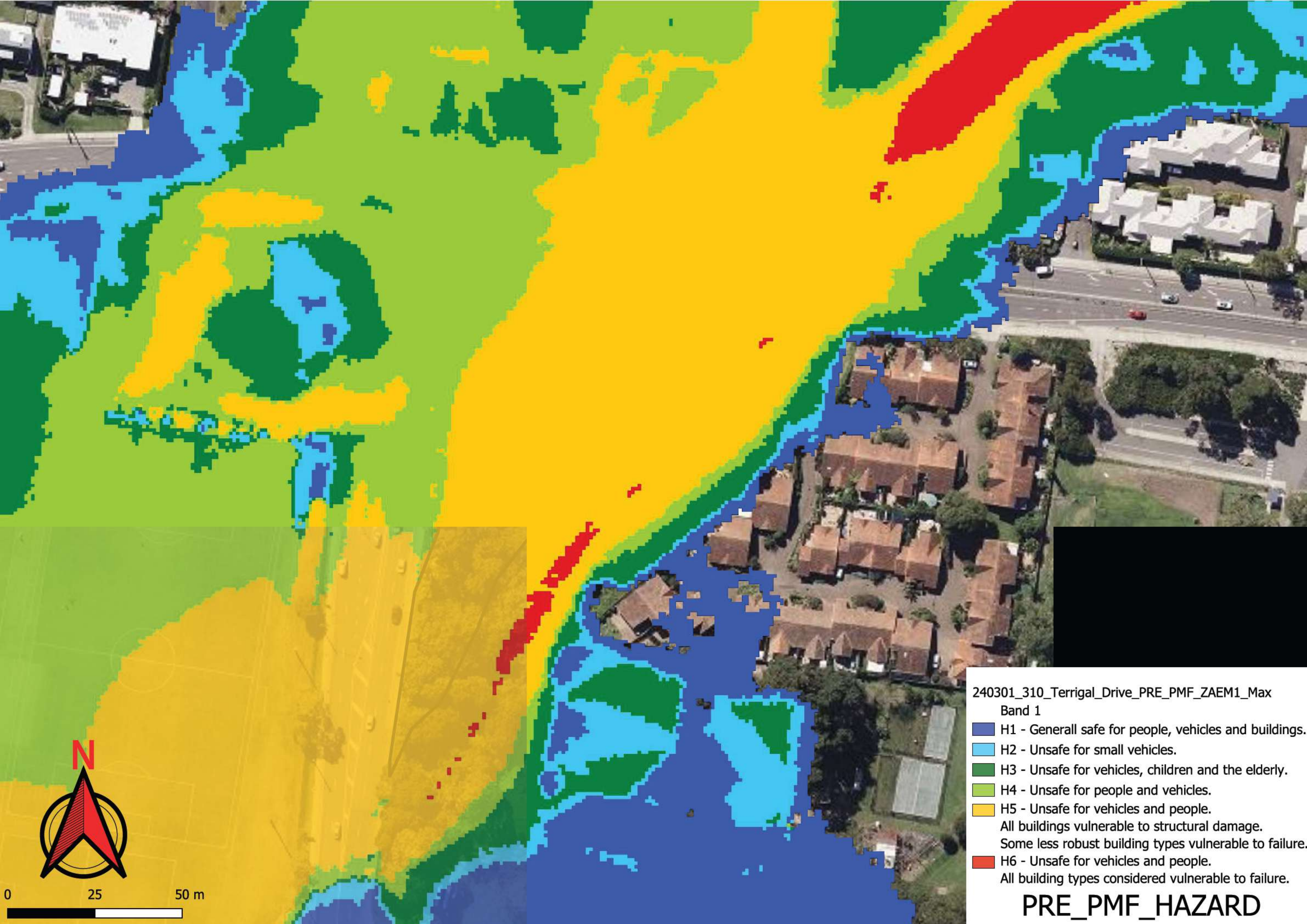
25
50 m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Band 1
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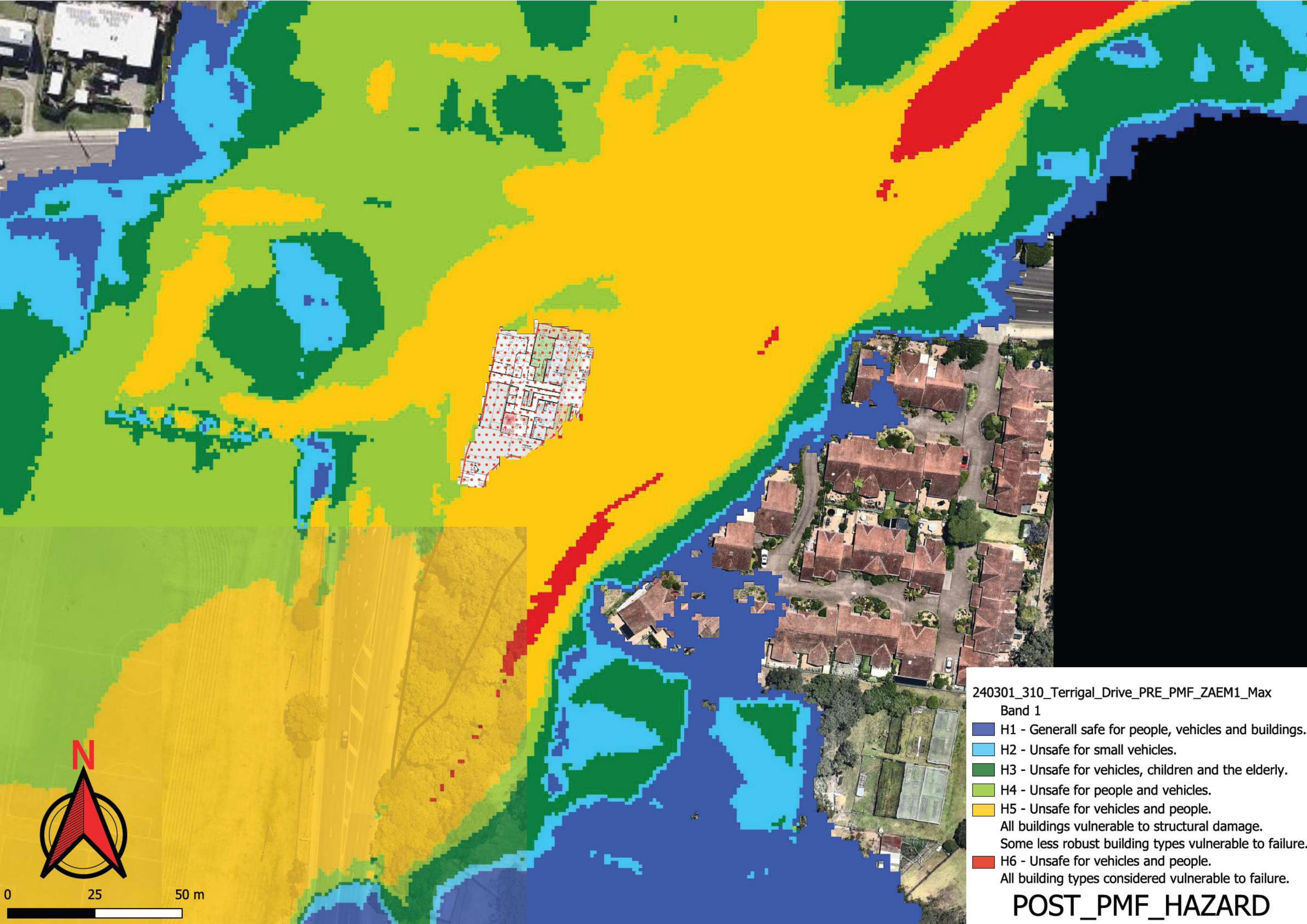
H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
H4 - Unsafe for people and vehicles.
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
N
0
25
50 m
PRE_PMF_HAZARD



240301_310_Terrigal_Drive_PRE_PMF_ZAEM1_Max
Band 1
H1 - Generall safe for people, vehicles and buildings.
H2 - Unsafe for small vehicles.
H3 - Unsafe for vehicles, children and the elderly.
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H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure.
H6 - Unsafe for vehicles and people.
All building types considered vulnerable to failure.
POST_PMF_HAZARD
N
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50 m

N
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25
50 m
PMF_AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
> 0.30
5YR_AFFLUX

5YR_2090_AFFLUX

100YR AFFLUX

100YR_2090_AFFLUX


N
0
25
50 m
PMF_AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
> 0.30
200YR AFFLUX

PMF_AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
> 0.30
N
0
25
50 m
200YR_2090 AFFLUX


PMF_AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
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0.10 - 0.20
0.20 - 0.30
> 0.30
N
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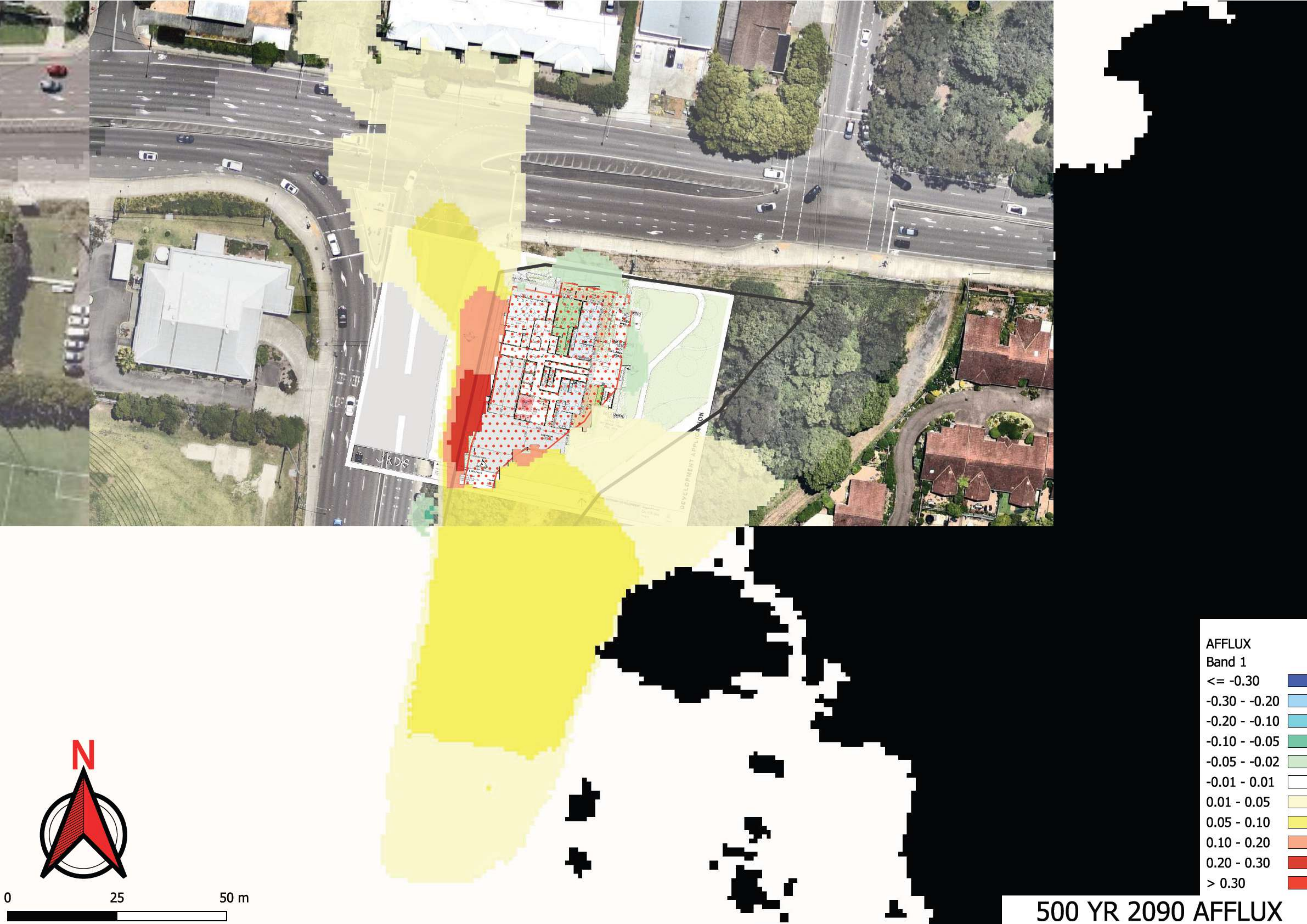
25
50 m
500YR AFFLUX


AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
> 0.30
N
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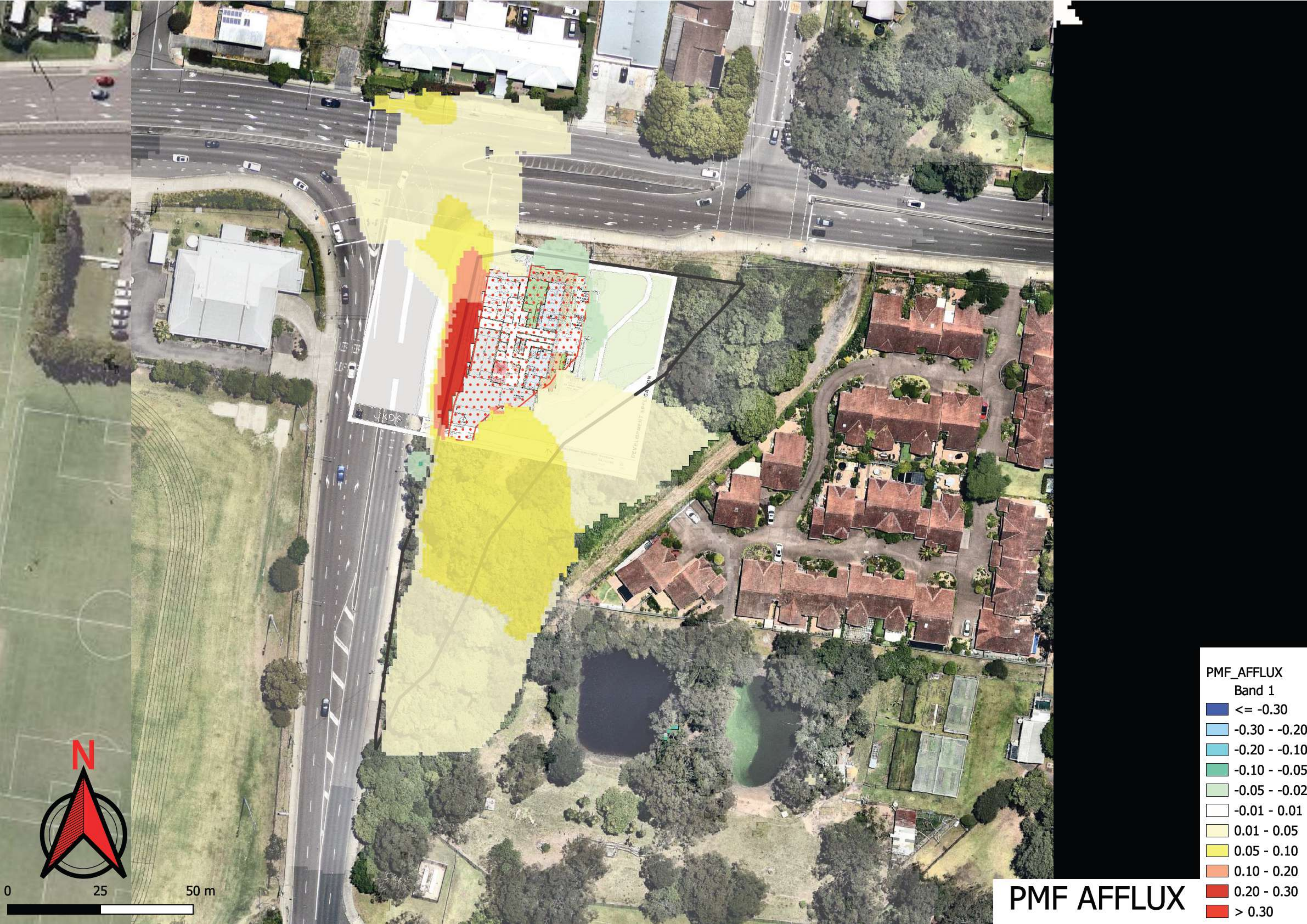
50 m
500 YR 2090 AFFLUX



N
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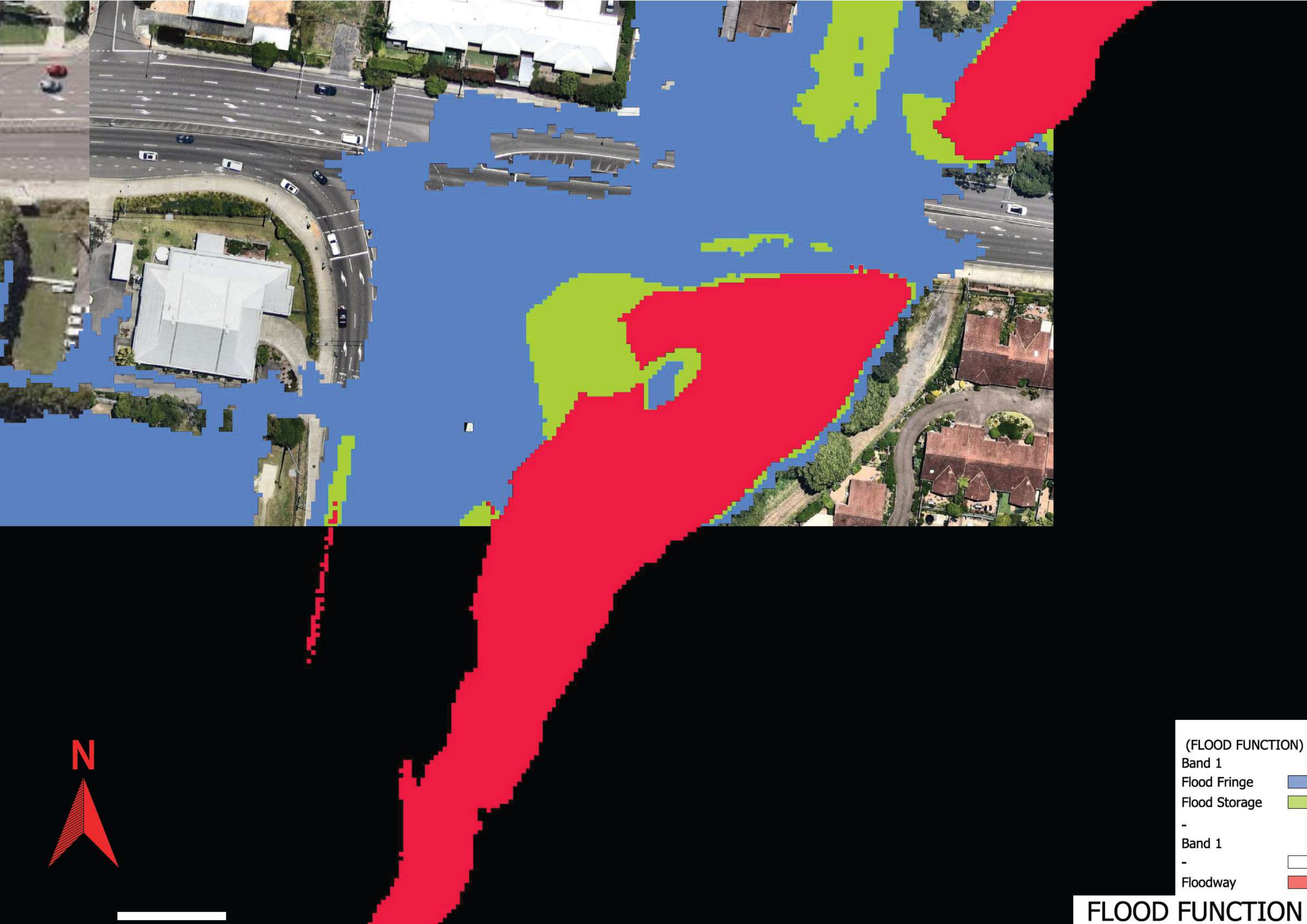
25
50 m
DEVELOPMENT APPLICATION
PMF_AFFLUX
Band 1
<= -0.30
-0.30 - -0.20
-0.20 - -0.10
-0.10 - -0.05
-0.05 - -0.02
-0.01 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
> 0.30

PMF AFFLUX



FLOOD FUNCTION

FLOOD FUNCTION

Appendix B – Flood Mitigation

ABN 95 640 561 584
ACN 640 561 584
Level 2, Suite 2, 10 Mallet Street
Camperdown, NSW, 2050
****
www.cseggroup.com.au
Civil Stormwater Engineering
Group Pty Ltd


DEVELOPMENT APPLICATION
N
0
10
20 m
FLOOD MITIGATION

Appendix C – Structural Letter

ABN 95 640 561 584
ACN 640 561 584
Level 2, Suite 2, 10 Mallet Street
Camperdown, NSW, 2050
****
www.cseggroup.com.au
Civil Stormwater Engineering
Group Pty Ltd

JSBC | CONSULTING

75 Justin St Lilyfield
NSW 2040

P: 02 9743 0220
E: info@jsbcconsulting.com.au

To	Civil Stormwater Engineering Group	**Page**	1 of 1
Project Name/Number	310 Terrigal Drive Terrigal		
From	JSBC Consulting		
File/Ref No.	SL-01	**Date**	04/09/2024

STRUCTURAL LETTER

JSBC Consulting confirms that the structure for the proposed development at 310 Terrigal Drive Terrigal is feasible to be designed to withstand a maximum PMF flood level of RL 5.7m AHD as shown on the flood impact assessment report CSW2024.27.REV.03 prepared by Civil Stormwater Engineering Group.

We note that the lowest basement level as shown on the architectural drawings is at RL -3.2m AHD. The maximum hydrostatic pressure on the lowest basement slab based on the RLs provided is 89kPa. In our professional opinion and based on experience with previous projects with similar conditions, it is feasible to design the structure to withstand the uplift pressures of 89kPa.

For a tanked basement, this could be achieved by using secant piles for the shoring wall with a hydrostatic basement slab with tension piles and/or permanent ground anchors. Details of this construction methodology can be developed at detailed design stages subject to further investigations at Construction Certificate stages.

Alternatively, a cut off shoring wall with a slab on ground with a sump and pump system and underlaying drainage may be feasible subject to further investigation at Construction Certificate Stages. For this option the slab on ground would not be subject to hydrostatic pressures.

Other structural options may also be feasible upon detailed design stages of the project.

This letter does not form a design letter and shall not be construed as relieving any party of their contractual obligations and responsibilities.

Details-

Name: Joe Salhani
Qualifications: BE (Civil) (Hons); DipSe; CPEng, NER, MIEAust

[redacted]

Joe Salhani
Director
For and on behalf of JSBC Consulting

Appendix D – Survey Plan

ABN 95 640 561 584
ACN 640 561 584
Level 2, Suite 2, 10 Mallet Street
Camperdown, NSW, 2050
****
www.cseggroup.com.au
Civil Stormwater Engineering Group Pty Ltd

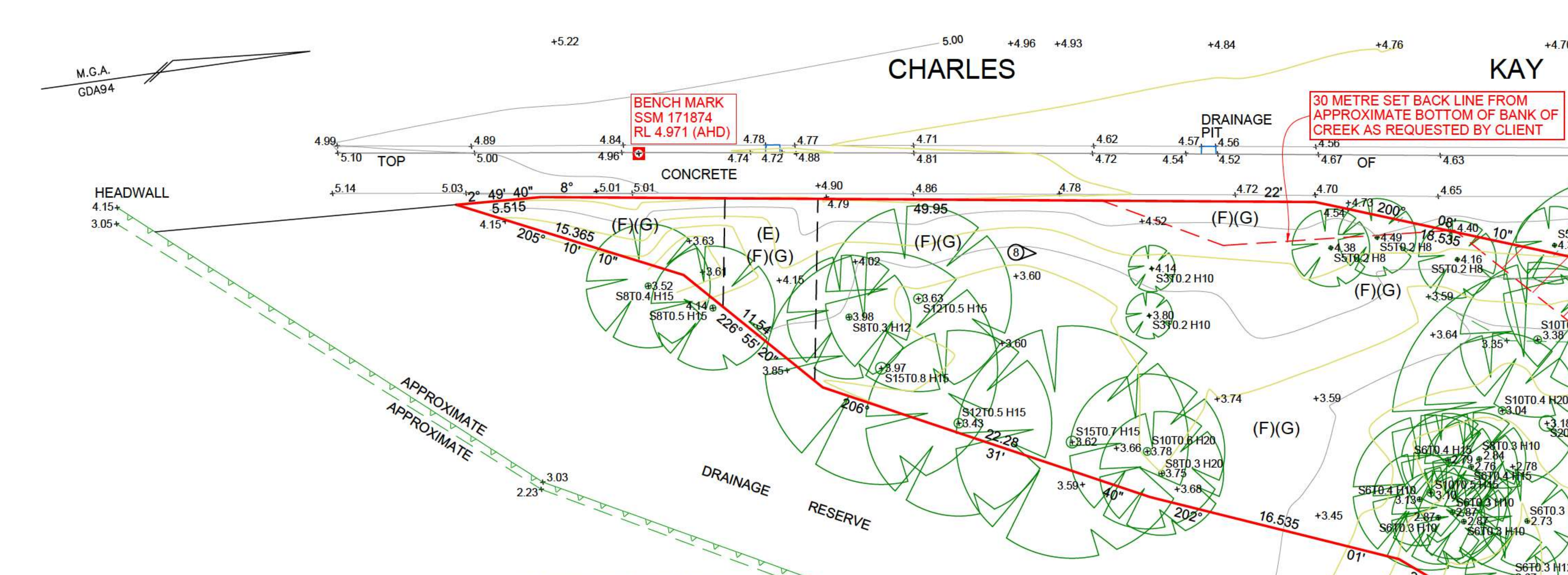
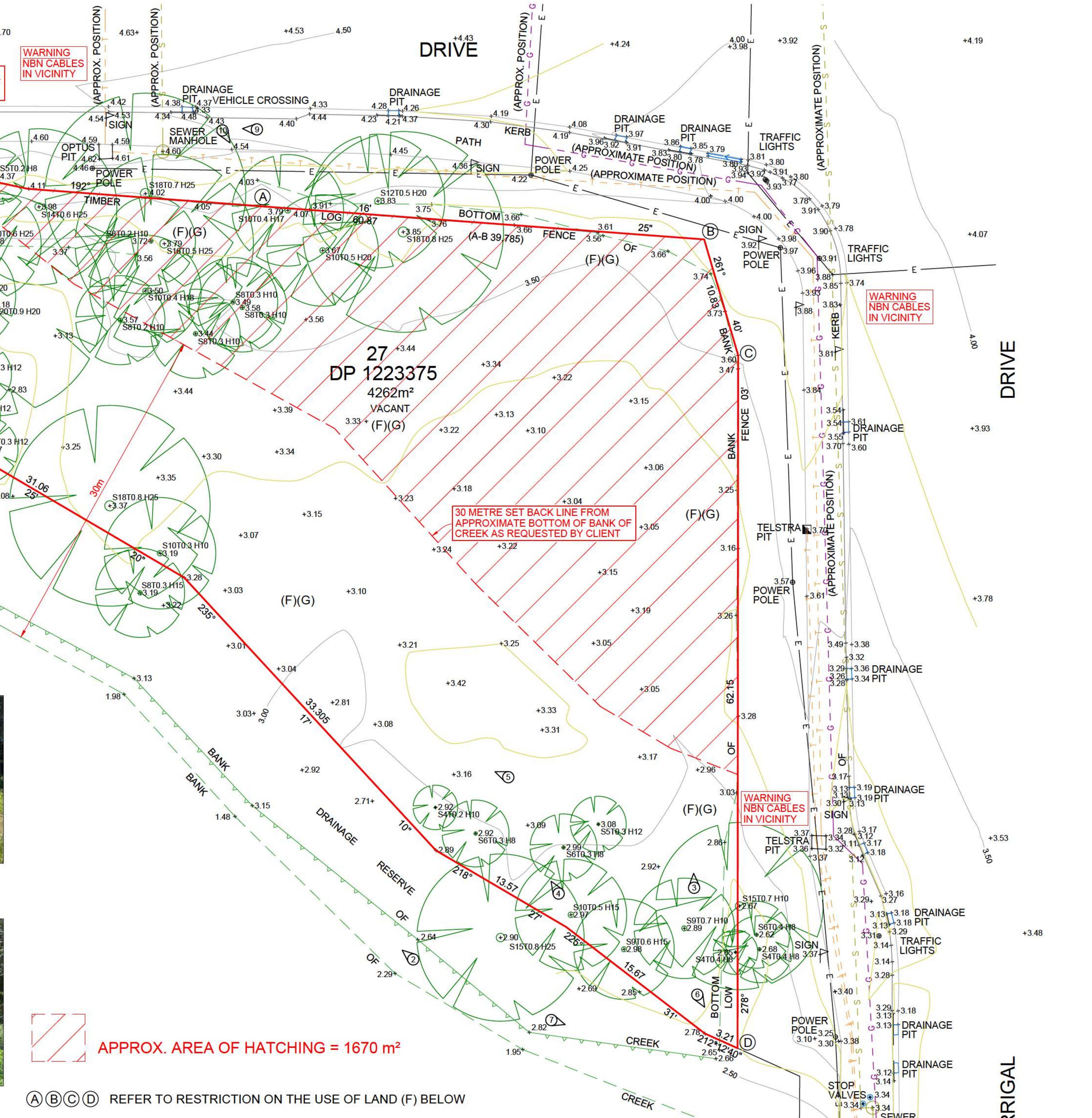




PHOTO 1

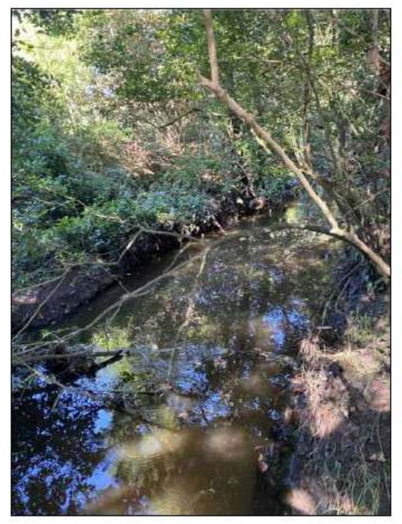


PHOTO 2


PHOTO 3


PHOTO 4


PHOTO 5


PHOTO 6


PHOTO 7


PHOTO 8


PHOTO 9


PHOTO 10

Ⓐ Ⓑ Ⓒ Ⓓ REFER TO RESTRICTION ON THE USE OF LAND (F) BELOW

(E) EASEMENT TO DRAIN WATER 6m WIDE (VIDE DP 1264687)
(F) RESTRICTIONS ON USE OF LAND (VIDE DP 1264687)
(G) EASEMENT FOR NOISE, DUST & VIBRATION AFFECTING THE WHOLE OF THE LAND (VIDE DEALING AQ641042)

PLEASE NOTE:

1. The title boundaries shown hereon were not verified or marked at the time of survey but were determined by a combination of existing title dimensions, occupation (where available) and other evidence. Consequently, these measurements may be out of date due to more recent surrounding surveys or inaccurate by modern surveying standards. This plan should not be used for building in relation to a boundary without further boundary survey.
2. Therefore the boundary lines shown on this plan do not necessarily reflect the true position of the boundaries and further definition of the boundaries should be carried out for design of buildings and structures close to boundaries.

3. This plan has been prepared for LOFTUSLANE CAPITAL PARTNERS from a combination of field survey and existing records for the purpose of showing the physical features of the land to assist in designing future development, and should not be used for any other purpose.
4. Services shown hereon were located where possible by field survey completed on 4-04-2022. Where services are not visible on-site, service alignments have been shown from the relevant asset owners records (Dial-Before-You-Dig) and are therefore approximate only. The location of all services shown hereon must be confirmed with the asset owner prior to commencement of any works on-site.
5. Bannister and Hunter Pty Ltd therefore accepts no liability whatsoever, except to the extent required by consumer protection legislation, for any damage caused to any underground service or any loss or injury suffered if enquiry and verification have not been completed in accordance with this note.
6. This note is an integral part of this plan or data as transmitted. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.
7. The drawing and information shown hereon are the property of Bannister and Hunter Pty Ltd and shall not be copied or reproduced without the written permission of Bannister and Hunter Pty Ltd and shall be used only by the client of Bannister and Hunter Pty Ltd for the purpose for which it was approved.

WARNING
THE COORDINATES WITHIN THIS DRAWING RELATE TO MAP GRID OF AUSTRALIA (MGA) GDA94, REFER TO A REGISTERED LAND SURVEYOR FOR FURTHER CLARIFICATION.
TAKE CAUTION WHEN IMPORTING INFORMATION OBTAINED FROM OTHER SUB-CONSULTANTS OR SOURCES TO ENSURE THAT THE DATA IS ON A MATCHING COORDINATE SYSTEM.

Notes:
1. CONTOUR INTERVAL 0.25m
2. ORIGIN OF COORDINATES & LEVELS SSM 171874 RL 4.971 (AHD) MGA GDA 94
E.353 861.891
N.6 298 768.910 (SCIMS)
3. LOCATION OF UNDERGROUND SERVICES NOT SURVEYED, SURFACE FEATURE ONLY

Legend:
OVERHEAD ELECTRICITY, POWER POLE
GAS
TELECOM, PIT
SEWER, LAMPHOLE
TOP OF BANK
EXISTING SURFACE CONTOUR
PHOTO NUMBER & DIRECTION (SEE SHEET 2 FOR PHOTOS)

TREE SHAPES ARE DIAGRAMMATIC ONLY AND MAY BE IRREGULAR AND LEANING. TREE POSITIONS ADJACENT TO ANY PROPOSED WORKS MUST BE VERIFIED.
S8T0.4 H15
S DENOTES CANOPY SPREAD
T DENOTES TRUNK DIAMETER
H DENOTES TREE HEIGHT

5 2.5 0 5 10 15 20 25
SCALE IN METRES ON ORIGINAL DRAWING AT REDUCTION RATIO 1:250

www.dialbeforeyoudig.com.au DIAL 1100 BEFORE YOU DIG

CAUTION
UNDERGROUND SERVICES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND "DIAL BEFORE YOU DIG" MUST BE CONTACTED PRIOR TO ANY WORKS BEING CONDUCTED ON THIS SITE

DATE	NO.	REVISION DESCRIPTION

SCALE 1:250
BASE DRAWING SIZE A1
SURVEYED BY: RD
DATE OF SURVEY: 4/04/2022
DRAWN BY: CA
DATE: 8/04/2022
CHECKED BY: RKB
DATE: 11/04/2022

Client: LOFTUSLANE CAPITAL PARTNERS

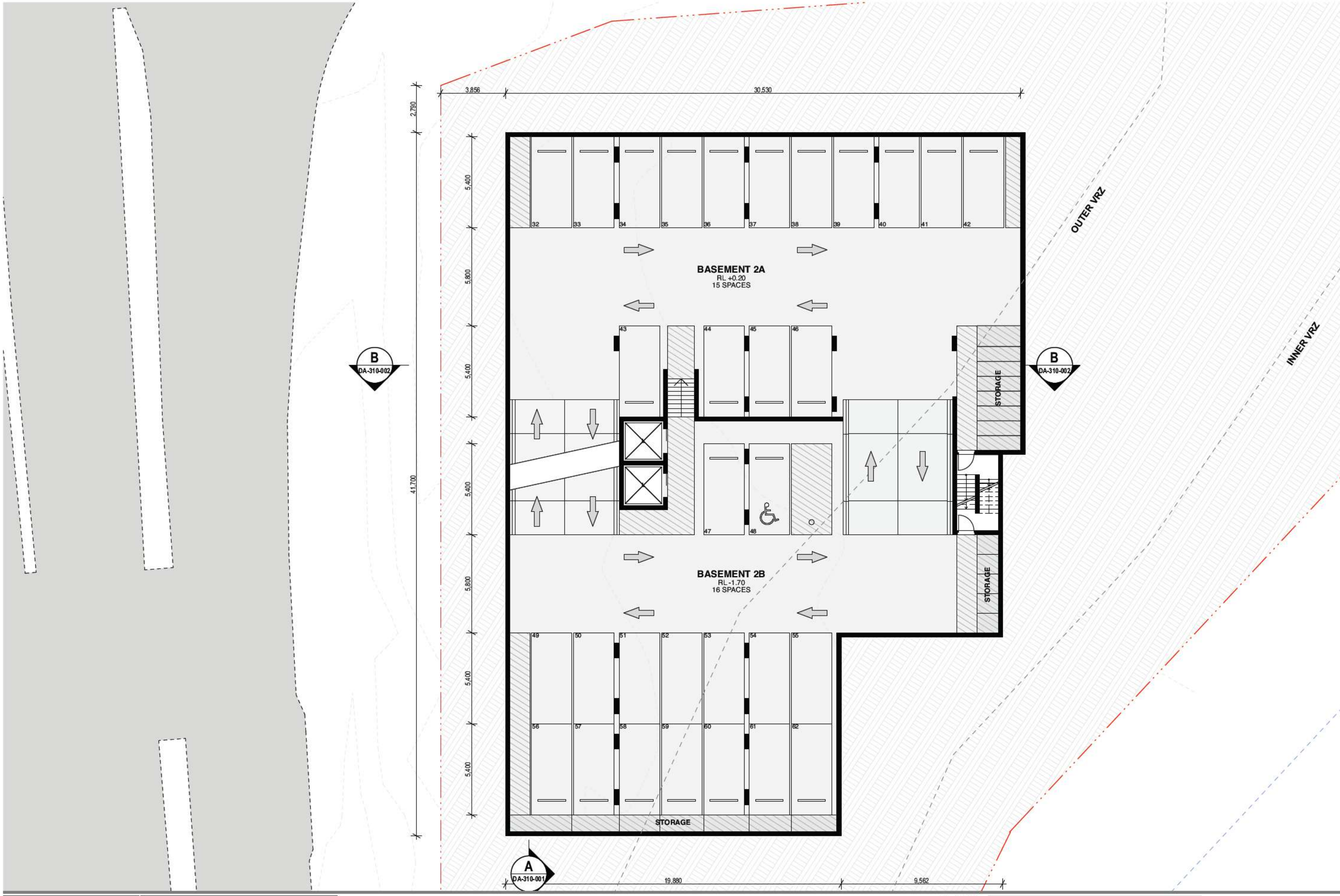
BANNISTER & HUNTER

39 William Street, Gosford, N.S.W. 2250
Phone: (02) 4324 2566
Web: www.bannisterhunter.com.au
Email: admin@bannisterhunter.com.au

Plan of: DETAIL SURVEY OVER LOT 27 DP 1223375 No. 310 TERRIGAL DRIVE TERRIGAL

Ref. No:	58961	Date:	11th April 2022
Ccad Ref:	58961	Datum:	AHD
Acad Ref:	58961-01c	REVISION	-
SHEET No:	1 of 1		

Appendix E – Architectural Plans



DEVELOPMENT APPLICATION

CKDS

Architecture | Planning | Interiors

[redacted]

[redacted]

[redacted]

North Point

TERRIGAL GATEWAY DEVELOPMENT

project #
21150

310 Terrigal Drive,
TERRIGAL, NSW 2260

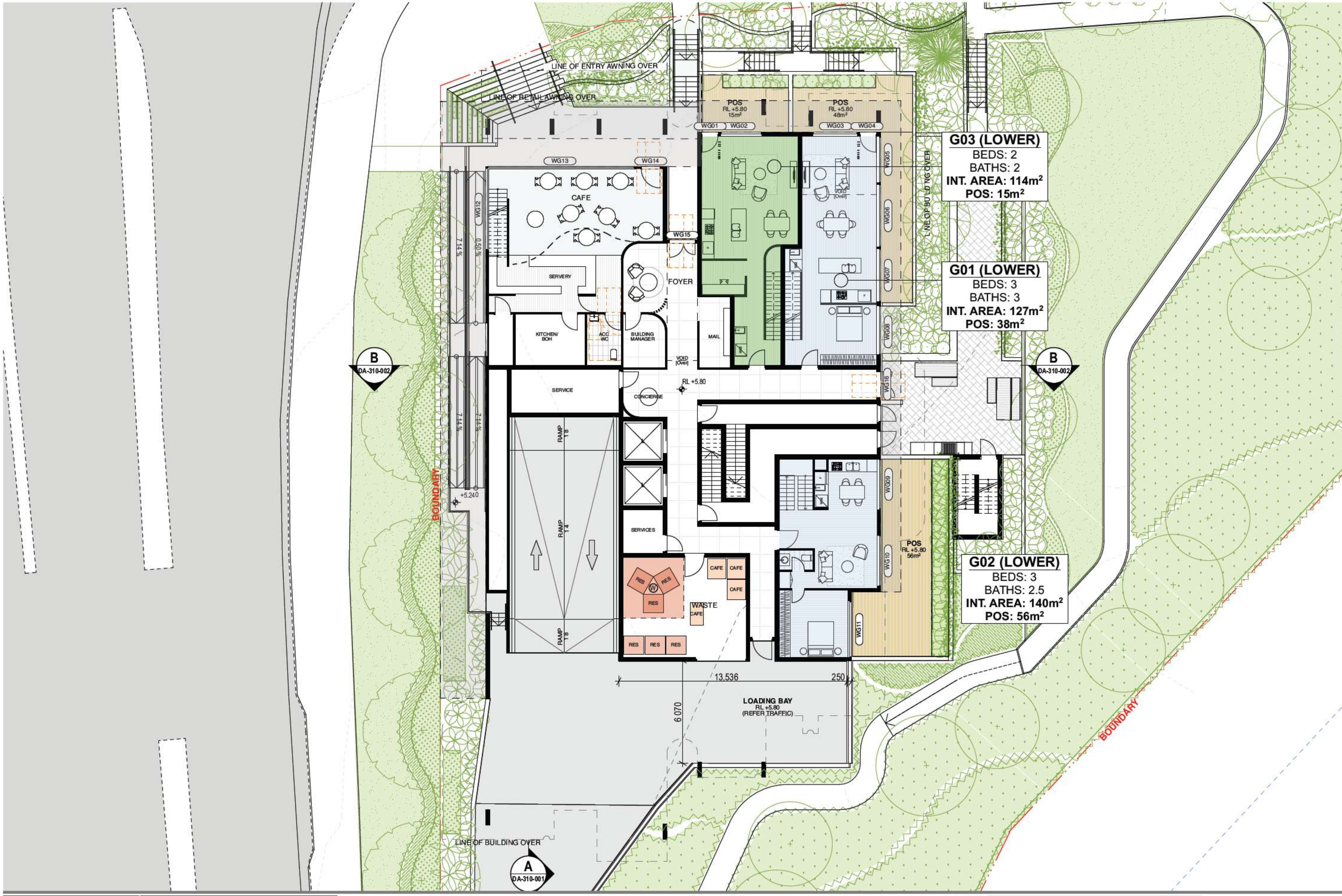
Basement 2

drawing #
DA-110-002

issue
03

1:200 @ A3

22/9/2023



DEVELOPMENT APPLICATION

CKDS

Architecture | Planning | Interiors

[redacted] 3, 23 Watt St (P O Box 958)
Newcastle NSW 2300
P 02 4929 1843

[redacted]
1/28 Adelaide St (P O Box 4400)
East Gosford NSW 2250
P 02 4321 0503

[redacted]

North Point

TERRIGAL GATEWAY DEVELOPMENT
project # 21150
310 Terrigal Drive,
TERRIGAL, NSW 2260

Ground Level
drawing # DA-110-004
issue 03
1:200 @ A3
22/9/2023

CIVIL STORMWATER
ENGINEERING GROUP

. I N N O V A T E . E N G I N E E R . T R A N S F O R M .

admin@cseggroup.com.au – www.cseggroup.com.au – 0491 179 774 – LVL 2, Suite 2, 10 mallet Street, Camperdown, NSW, 2050