



Job Number: 200101
Date: 16 June 2022

2A Gregory Place Pty Ltd
c/o Raymond Raad

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 413 631 447
www.grchydro.com.au

Re: 2A Gregory Pl, Harris Park - Flood Report

INTRODUCTION

GRC Hydro Pty Ltd have been engaged to undertake a flood assessment for 2A Gregory Pl, Harris Park (the subject site). The site is affected by flooding due to its proximity to Clay Cliff Creek. Hydrologic and hydraulic models have been established to understand the flood behaviour in a range of flood events, and to assess flood risk at the site. The models have also been used to carry out a flood impact assessment for proposed development of the lot. Lastly, the report presents flood planning controls applicable to the site based on Parramatta Council Development Control Plan (DCP).

SITE DESCRIPTION

The subject site is located within the Clay Cliff Creek catchment. The site location is shown on Figure 01 (figures are located at the rear of the report). The catchment at the site is 285 hectares. Clay Cliff Creek meets Parramatta River 1.2 km downstream of the site. The site is approximately 19,400 m² in size with ground elevations of around 2.3 to 5.5 mAHD. The creek passes through the site, generally adjacent to the site's southern boundary, and consists of a concrete engineered channel.

Based on Council's flood certificate (attached as Appendix 1 at the rear of this report), Parramatta River flooding does not the site in 1% AEP flood event. Based on this information, modelling for the 1% AEP and 5% AEP flood events were carried out for the Clay Cliff Creek catchment only.

The catchment area consists mostly of medium density urban areas with areas of parkland. The catchment has areas of relatively steep grade. The creek extends around 700 m upstream of the site into the Parramatta Central Business District area.

EXISTING FLOOD INFORMATION REVIEW

Flooding Report Letter (HKMA ENGINEERS, 2015)

HKMA Engineers has prepared a letter in support of a Planning Proposal for the site on 21st September in 2015. The letter has responded to the relevant key issues contained within the Section 117 Direction in relating to flooding. In this letter, the appropriate Flood Planning Level (FPL) for the site was advised as the 1% AEP flood level plus 0.5 m freeboard and that also, a detailed Flood Risk Assessment Report was needed. It reported that development on the site will not result in a need for substantially increased requirement

for government spending on flood mitigation measures as the design at ground level did not create any detrimental effects on the flood regime at the site and throughout the associated catchment.

Flood Certificate (Parramatta Council, 2020)

Council has issued a flood certificate for the site. In the certificate, Council has indicated that the site is not in a 'Hatched Grey Area' or 'Grey Area' and the effect of overland flow is subject to detailed investigation. The provided mapping shows a large portion of the site is affected in the 5% AEP flood event, with the remainder within the 1% AEP flood extent. Around half of the site adjacent to the creek is identified as having 1% AEP high hazard flooding. Flood Levels at different events were obtained from the Lower Parramatta River Floodplain Risk Management Study – Flood Study Review (SKM, 2005), as shown in Table 1.

Table 1 Flood Levels Provided by Council

Event	Flood Level (m AHD)		
	'2429' near upstream side of site	'2722' near downstream side of site	Overall level provided by Council
5% AEP	5.18	5.16	5.15
1% AEP	5.60	5.58	5.6
PMF	9.24	9.26	9.3

HYDROLOGICAL MODELLING

A WBNM model was developed to generate catchment flows from applied rainfall using the methodologies outlined in the Australian Rainfall and Runoff guide for flood estimation (ARR2019). The site's catchment and the various subcatchments are shown on Figure 2. The following information was used as inputs in the model:

- Digital Elevation Model (DEM) based on LiDAR sourced from ELVIS, used to delineate the sub-catchments.
- Percentage impervious for each sub-catchment based on visual inspection of aerial imagery.
- Rainfall Initial Losses are as per ARR2019 following its guidelines to use the available Probability Neutral Burst Initial Losses. It ranges from 18.2 mm to 21.8 mm for event durations and probability of interest.
- Rainfall Continuing Losses are as per the ARR2019, multiplied by a factor of 0.4 following its guidelines for urban use, resulting in continuing losses of 0.79 mm/hour
- Temporal Patterns are as per provided in the ARR2019 Datahub for the East Coast – South region. As the catchment area up to the subject site is less than 75 km², the point temporal pattern set was applied.
- Design rainfall are as per the 2016 IFD curves sourced from the Bureau of Meteorology (BOM)

For the PMF event, the same WBNM hydrological model was used but the rainfall data and temporal pattern are derived as per the GSDM method and assuming an initial loss of 1 mm and 0 mm/hour of Continuing Losses.

The WBNM model was run for a range of durations from 20 minutes to 360 minutes for the 5% AEP and 1% AEP events, and from 15 minutes to 180 minutes for the PMF event. Critical duration and critical storm assessment are performed in the hydraulic model and is further detailed in the section below.

TUFLOW MODELLING

TUFLOW is a 2D numerical hydraulic modelling package. This software is widely used and is considered best practice under the NSW Floodplain Risk Management Program. It is used to convert applied flows from the hydrology model to derive flood depths, levels, and velocities. The developed hydraulic model is comprised of the following elements (also see Figure 03 for more details of the elements in the hydraulic model):

- LiDAR data has been used to generate a 2 m model grid. This data has a typical accuracy of ± 0.15 m (1st confidence interval);
- The kerb/gutter and road crests are hydraulic features that have a significant impact on flood behaviour. As such these features have been represented in the model as break lines with invert heights determined by analysis of the LiDAR;
- Buildings can block flood paths and therefore significantly impact flood behaviour. As such, buildings in the vicinity of the subject site were blocked out in the TUFLOW model;
- Manning's 'n' roughness values were applied as follows
 - Roads - 0.02;
 - Dense Vegetation Area - 0.08;
 - Creek channel - 0.05;
 - General Residential Area - 0.04;
- Outside of the channel, stormwater pits and pipes have not been included in the hydraulic model. This is based on a conservative assumption that stormwater pipes are 100% blocked during a flood event.
- The culverts at the creek channel's road crossings were included as 1D elements in the model. Culvert inverts and dimensions were based on site visit and LiDAR elevation data. A photo of the downstream crossing is shown in Image 1 below.
- A fixed tailwater was adopted at the catchment's downstream boundary.



Image 1: Road crossing at Alfred Street

Critical duration and critical storm assessment were undertaken in TUFLOW for the location of the subject site. The critical storm was selected based on the temporal pattern producing the median flood level of its respective storm duration, and the critical duration is selected as the duration producing the highest flood level. The assessment has resulted in a critical duration of 60 minute and critical storm #03 for the 5% AEP event and critical duration of 120 minute and critical storm #02 for the 1% AEP event.

EXISTING FLOOD BEHAVIOUR

The resulting flood depths and levels results for the 5% AEP and 1% AEP is presented in Figure 4 and Figure 5, respectively. Flooding at the site occurs when the Clay Cliff Creek channel capacity is exceeded and water spreads laterally from channel. In large flood events flow can spread across the site with shallow flow on the north side of the site's building.

The peak flow in Clay Cliff Creek adjacent to the property is $20.3 \text{ m}^3/\text{s}$ in the 5% AEP event and $28.8 \text{ m}^3/\text{s}$ in the 1% AEP event. There is minimal flooding at the site in the 5% AEP, with flow outside of the channel limited to the upstream (western) end where depths of around 0.1-0.2 m occur. In the 1% AEP, out-of-bank flow occurs, with flooding over a significant portion of the site, particularly in the north-west corner, where depths of around 0.1-0.4 m occur in the area west of the building.

The modelled levels at Chainage 2429 (refer to Council Flood Certificate) are presented in Table 2 below, in comparison to the Council flood levels. As shown in the table, there is general agreement in the TUFLOW model and Council's results. The 5% AEP peak level is very similar (5.20 versus 5.18) while the 1% AEP is slightly higher (0.13 m) in Council's model results. This indicates the model approach is sound and can be used for the purpose of flood assessment.

Table 2: Comparison of GRC Hydro and Council flood levels

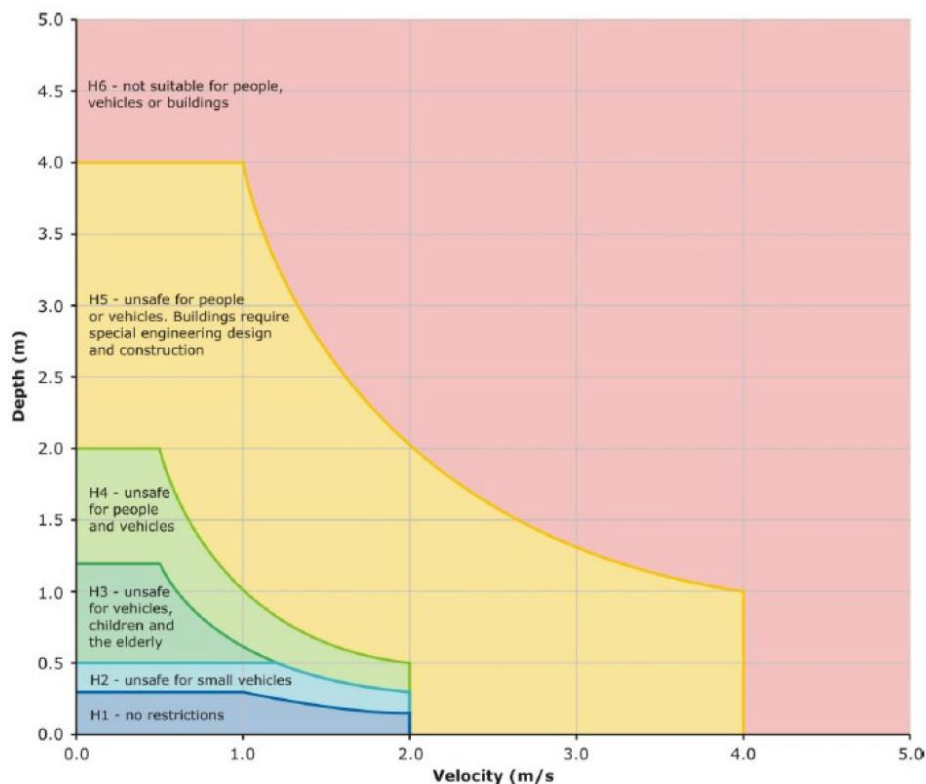
Event	Flood Level (m AHD)	
	GRC Hydro TUFLOW model	Level provided by Council at Chainage 2429
5% AEP	5.20	5.18
1% AEP	5.47	5.60

In terms of flood hazard, the latest floodplain management practices make use of the hazard categories provided by the Australian Emergency Management Institute (2014) with its categories described in Chart 1 and results are presented in Figure 7. The figure shows flooding at the site is H5-H6 in the channel, while flooded areas outside the channel have H1-H2 hazard with small areas of H3.

Of note is that these hazard categories are not compatible with the ones used by the DCP which only categorises flood hazard as high or low, notwithstanding, it can be said that the flood hazard categories of H1 to H4 is generally equivalent to “low flood hazard”, whilst categories H5 to H6 is generally equivalent to “high flood hazard”.

Based on the hazard at the site, areas of the site outside of the channel would be classified as Medium Risk Areas in Council’s DCP (see following section), as they are flooded in the 1% AEP with medium and low hazard flooding. The channel itself is a High Risk Area. Small portions of the site are not flooded in a 1% AEP, and would be Low Risk Areas.

Chart 1 - Hazard Categories Description



Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and all vehicles.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

PROPOSED DEVELOPMENT AND FLOOD IMPACT ASSESSMENT

A plan (Date: 08/05/2022) has been provided to GRC Hydro for flood impact assessment. The location of the proposed buildings is shown on Figure 12. The assessment checks whether proposed works may worsen flooding elsewhere. To schematise the development in the hydraulic model, proposed buildings have been blocked out from the model domain. The model assessment then compares the 1% AEP flood level in the existing and proposed case with the difference shown on an impact map.

The flood impact map is shown in Figure 12. The impact map shows there is a small increase in flood level, shown in yellow. These mainly pertain to loss of flood storage and conveyance being inhibited at northwest of site. Impacts appear to be mainly on public land in upstream and downstream. Overall, the flood impact assessment shows a slight increase in flood levels in some areas but no impact on private property and no significant increase in flood risk.

CONCLUSIONS

A flood risk assessment has been carried out for 2A Gregory Place, Harris Park, as part of proposed development at the site. The assessment uses a hydrologic and hydraulic model to map design flood behaviour in the 5% AEP and 1% AEP events. The models show good agreement with Council's results. The site experiences flooding in a large flood event when flow spills out of the Clay Cliff Creek channel. The assessment has identified applicable flood levels and Flood Planning Levels for the development, as well as quantified flood hazard at the site. The models have also been used for a flood impact assessment, which shows that new buildings will cause a slight localised increase in flood levels but that no private property is affected.

Yours Sincerely

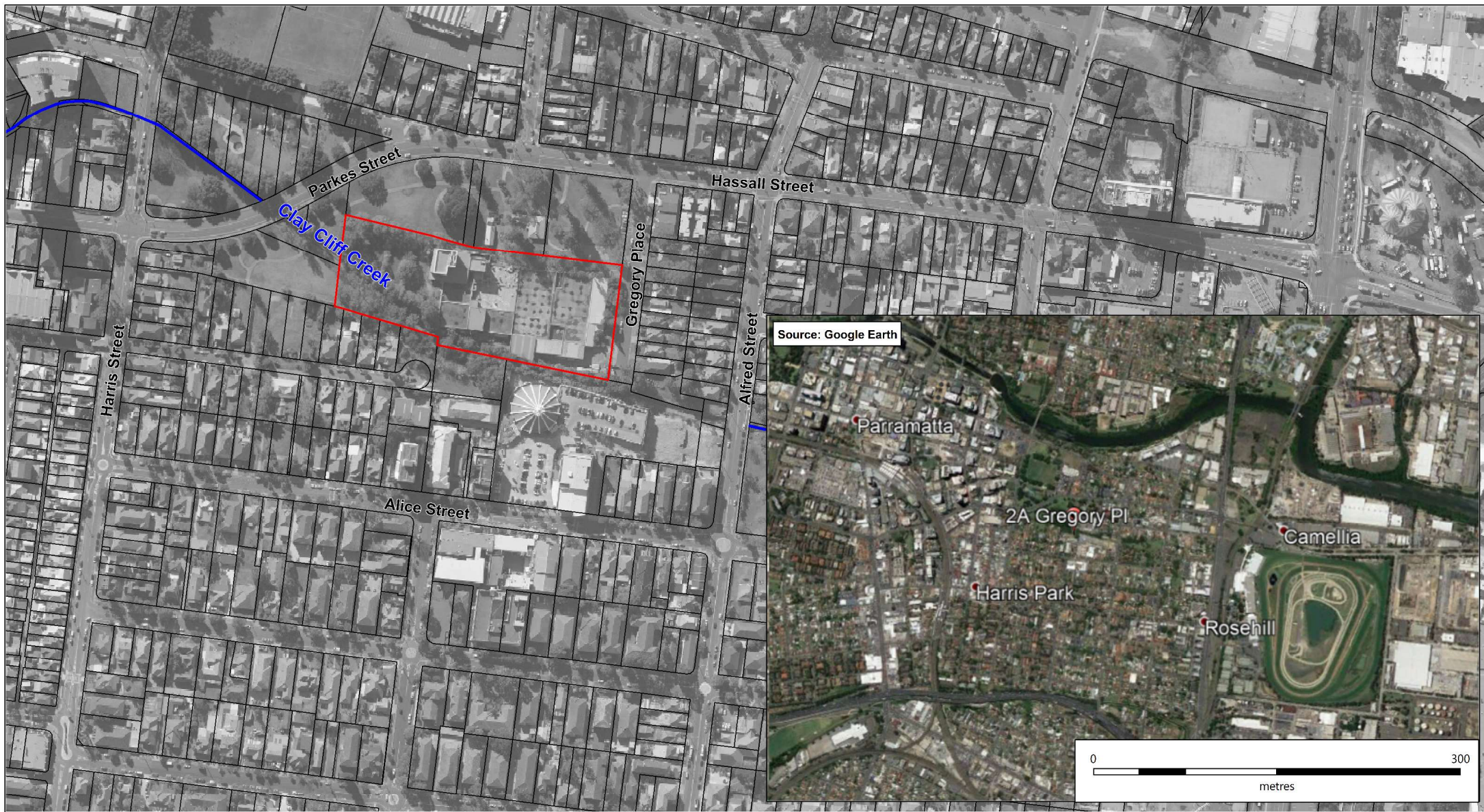
A handwritten signature in blue ink, appearing to read 'SG', enclosed within a light gray rectangular box.

Steve Gray

Director

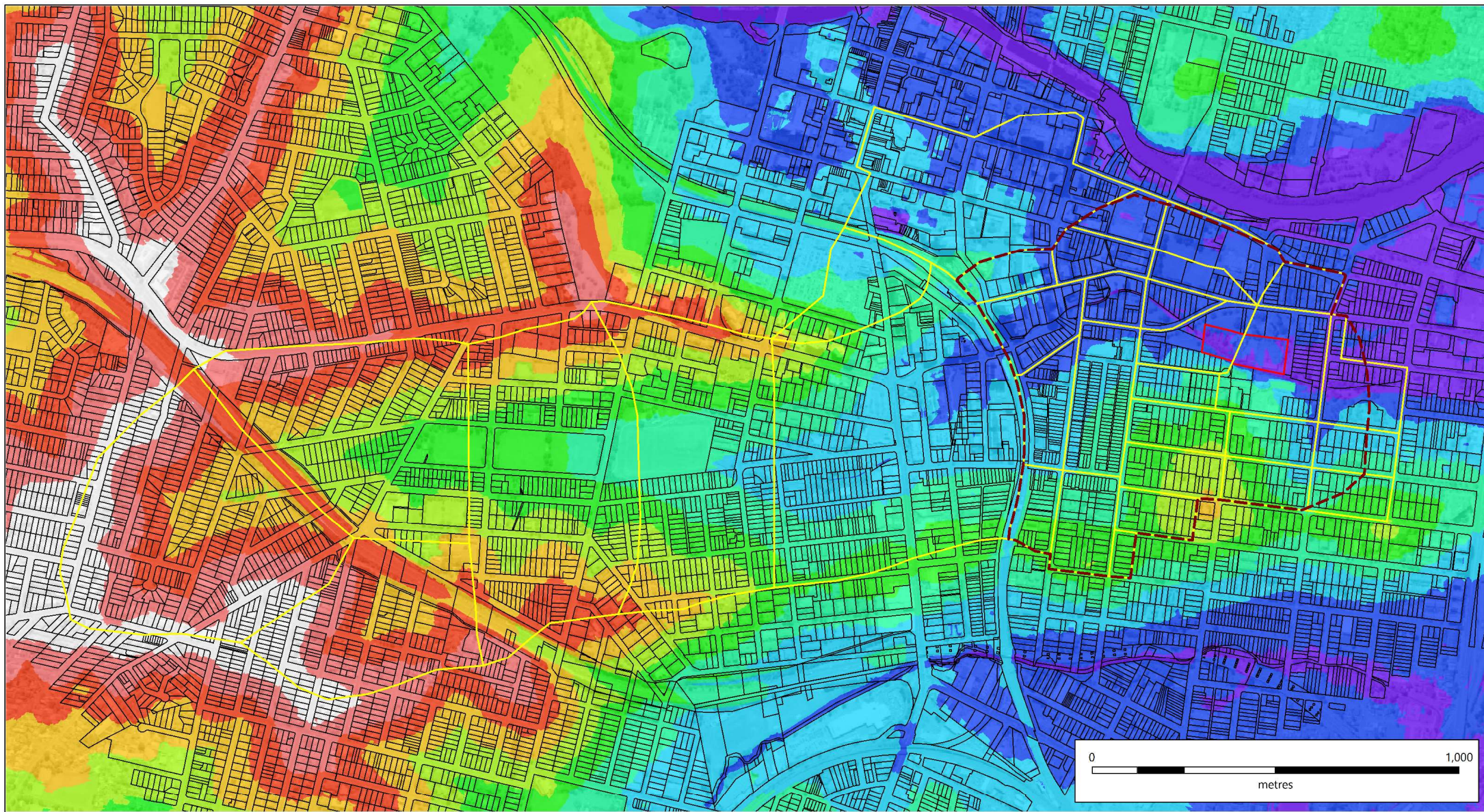
NER 2435438

FIGURES

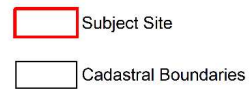
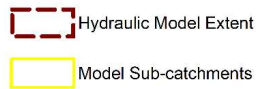


- Clay Cliff Creek
- Subject Site
- Cadastral Boundaries





Ground Levels (m AHD)



TITLE : Hydrologic Model Catchments

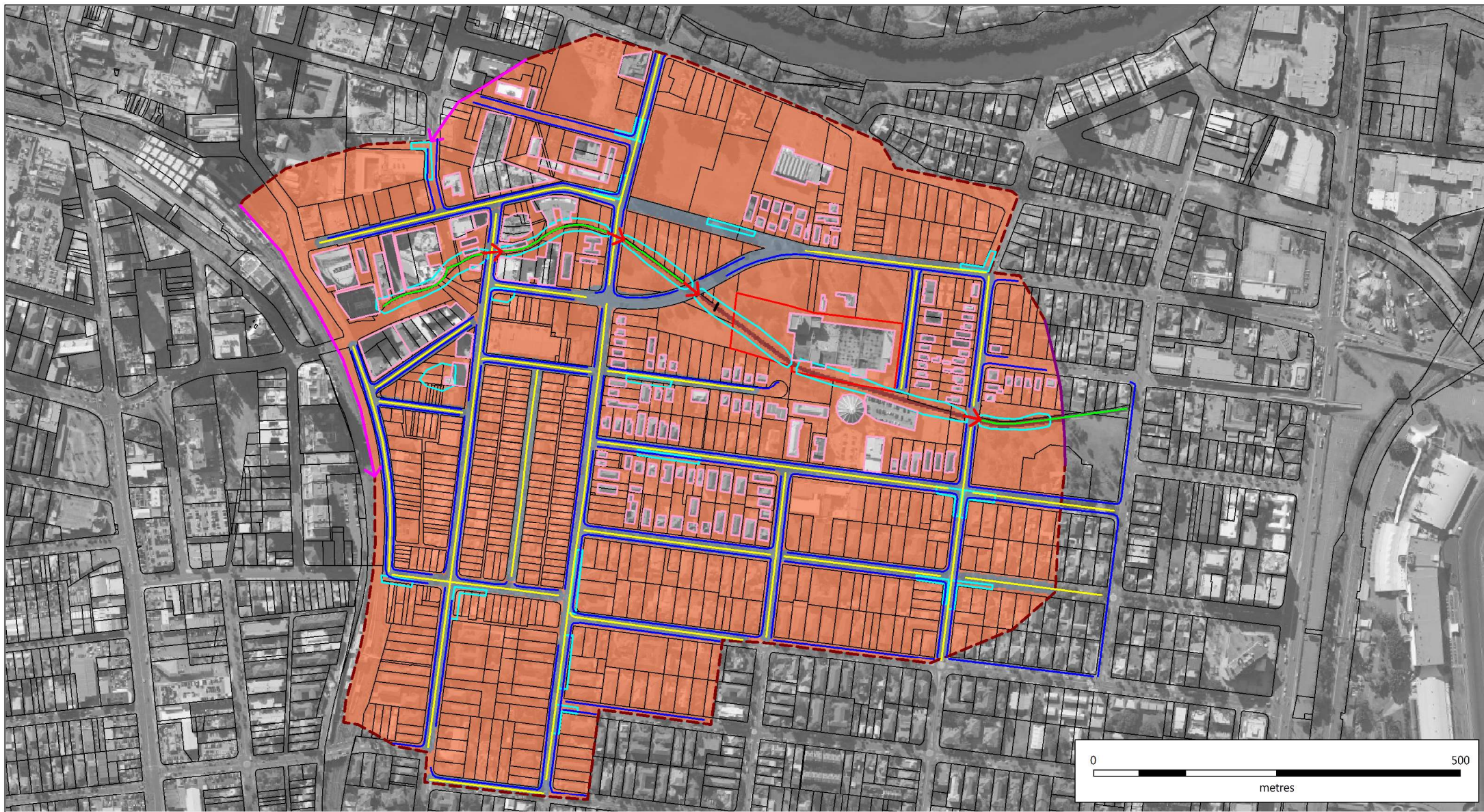
PROJECT: 2A Gregory Place, Harris Park

PROJECT No. 200101

DATE: June 2022

SCALE: 1: 10,000

FIGURE No. 02



Mannings' Values

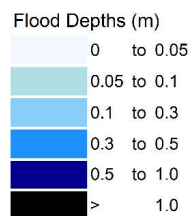
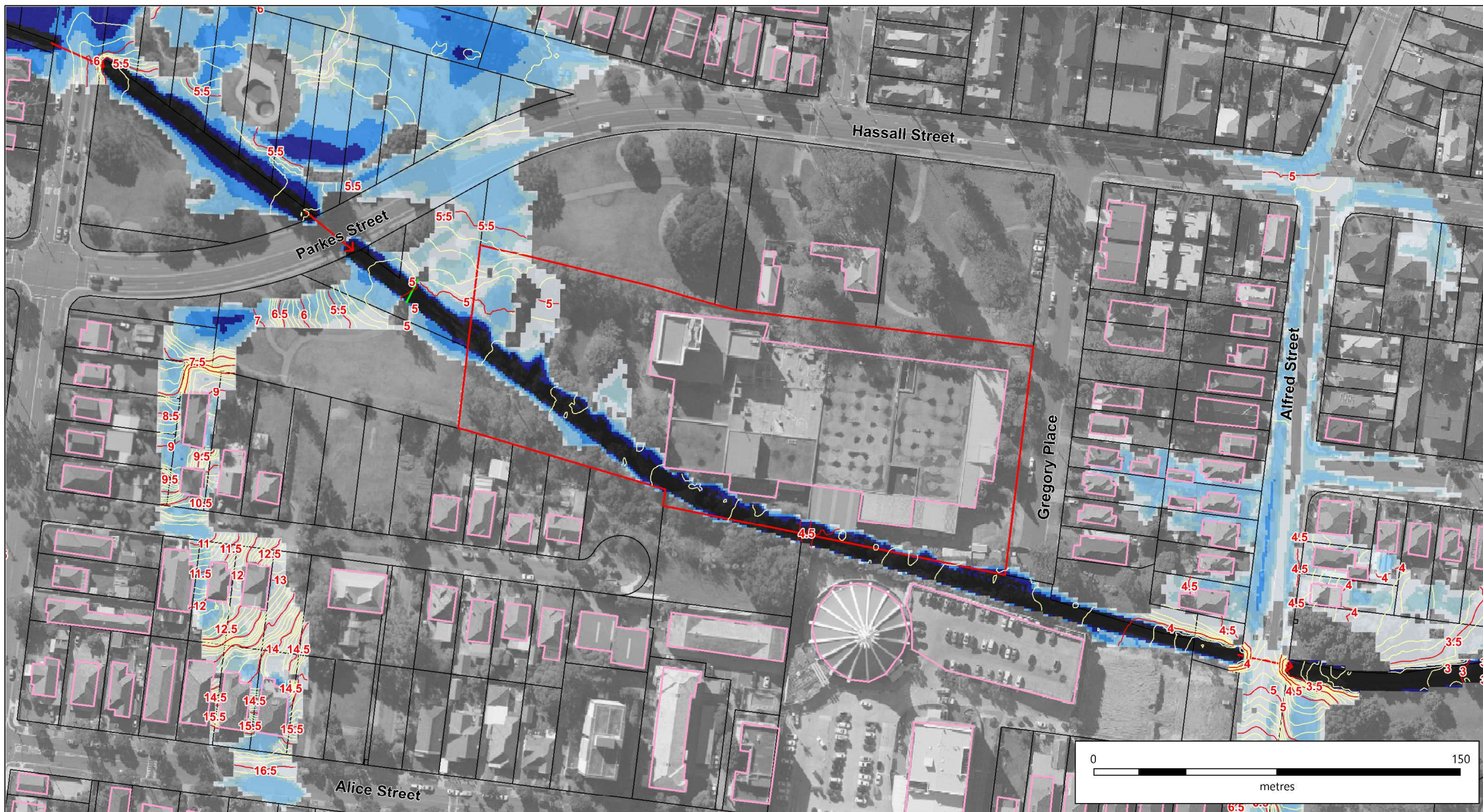
- Light Residential
(Mannings' Value = 0.04)
- Dense Vegetation
(Mannings' Value = 0.08)
- Paved Roads
(Mannings' Value = 0.02)
- Canal
(Mannings' Value = 0.015)

- Pedestrian Bridge
- Road Crossings
- Road Gutter Lines
- Road Crest Lines
- Creek Lines

- Downstream Boundary
- Upstream Boundary
- Inflow Locations
- Hydraulic Model Extent

- Buildings
- Subject Site
- Cadastral Boundaries





— Major Flood Level Contours
(Spacing = 0.5 m)

— Minor Flood Level Contours
(Spacing = 0.1 m)

→ Road Crossings

— Pedestrian Bridge

□ Buildings

□ Subject Site

□ Cadastral Boundaries

grc
HYDRO

TITLE : 5% AEP Peak Depth and Level - Existing Conditions

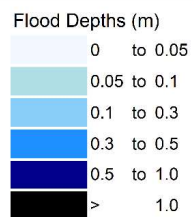
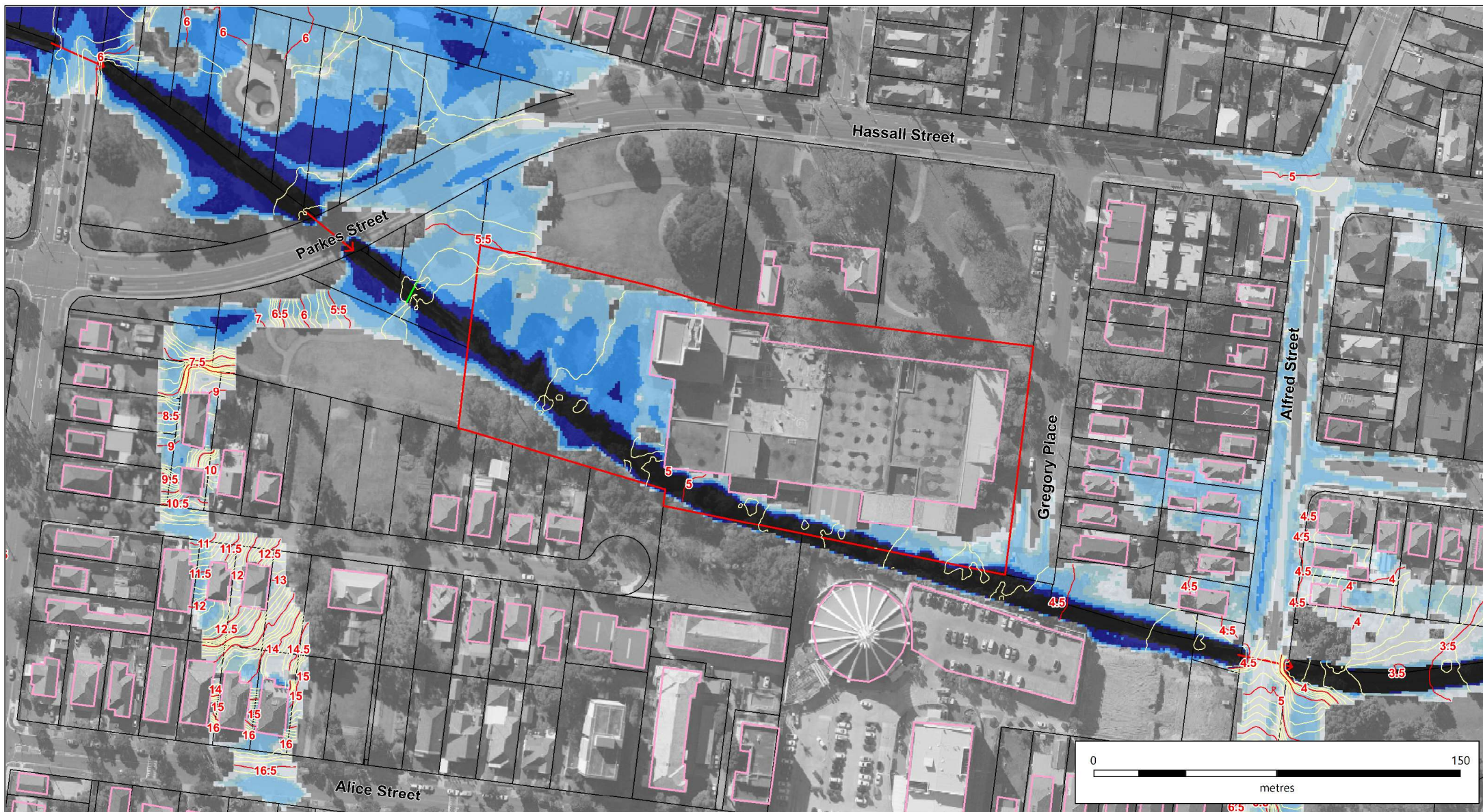
PROJECT: 2A Gregory Place, Harris Park

PROJECT No. 200101

DATE: June 2022

SCALE: 1: 1,500

FIGURE No. 04



— Major Flood Level Contours
(Spacing = 0.5 m)

— Minor Flood Level Contours
(Spacing = 0.1 m)

→ Road Crossings

— Pedestrian Bridge

□ Buildings

□ Subject Site

□ Cadastral Boundaries

grc
HYDRO

TITLE : **1% AEP Peak Depth and Level - Existing Conditions**

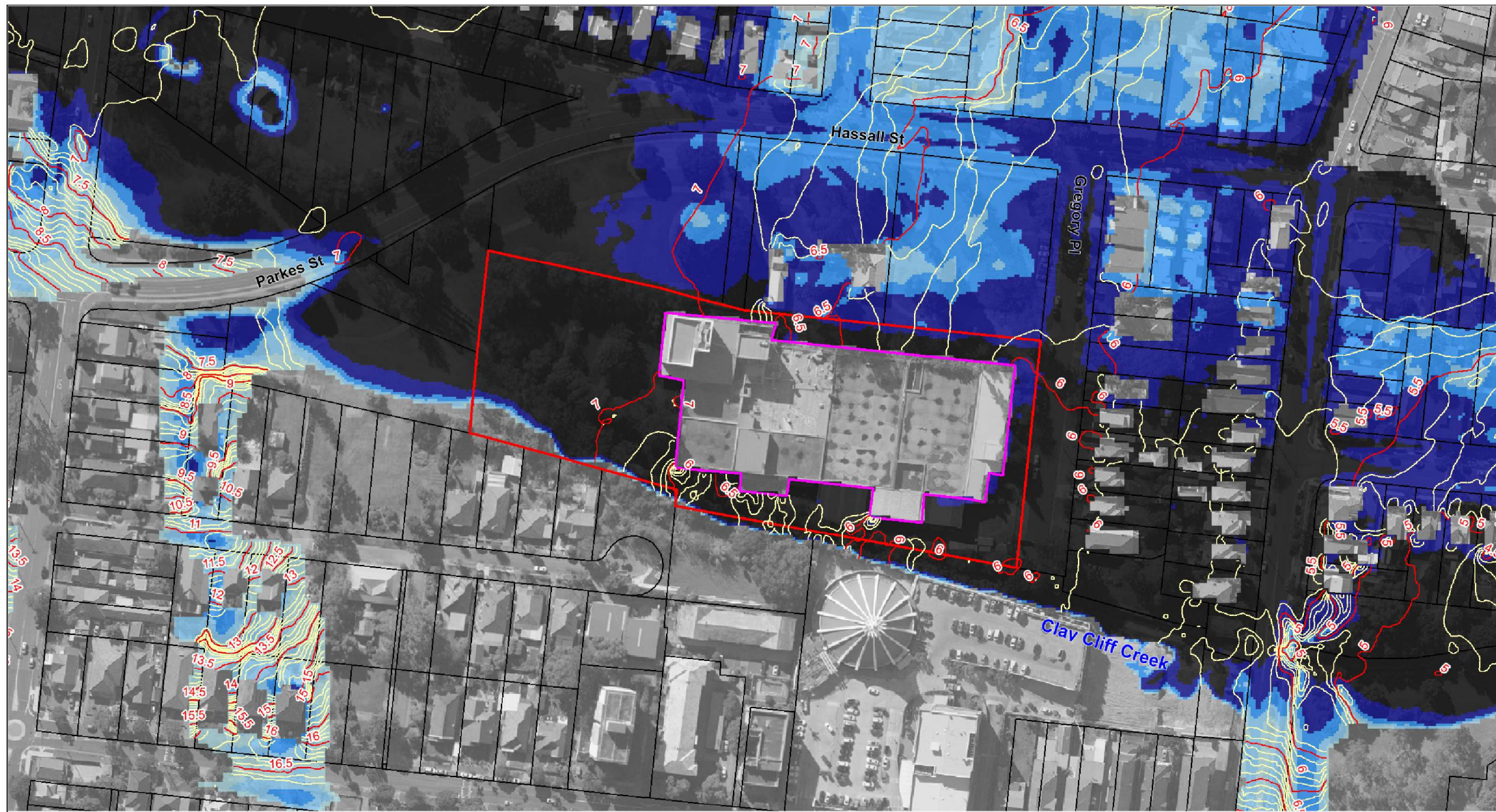
PROJECT: **2A Gregory Place, Harris Park**

PROJECT No. **200101**

DATE: **June 2022**

SCALE: **1: 1,500**

FIGURE No. **05**



Flood Depths (m)

< 0.05	0.3 to 0.5
0.05 to 0.1	0.5 to 1.0
0.1 to 0.3	> 1.0

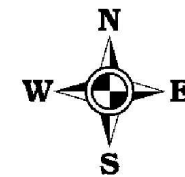
Major Flood Level Contours
(Spacing = 0.5 m)

Minor Flood Level Contours
(Spacing = 0.1 m)

Buildings Footprint

Subject Site

Cadastral Boundaries



grc
HYDRO

TITLE : **PMF Peak Flood Depths & Levels - Existing Conditions**

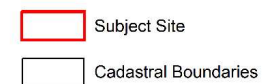
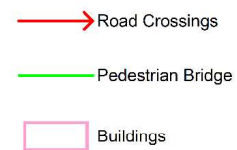
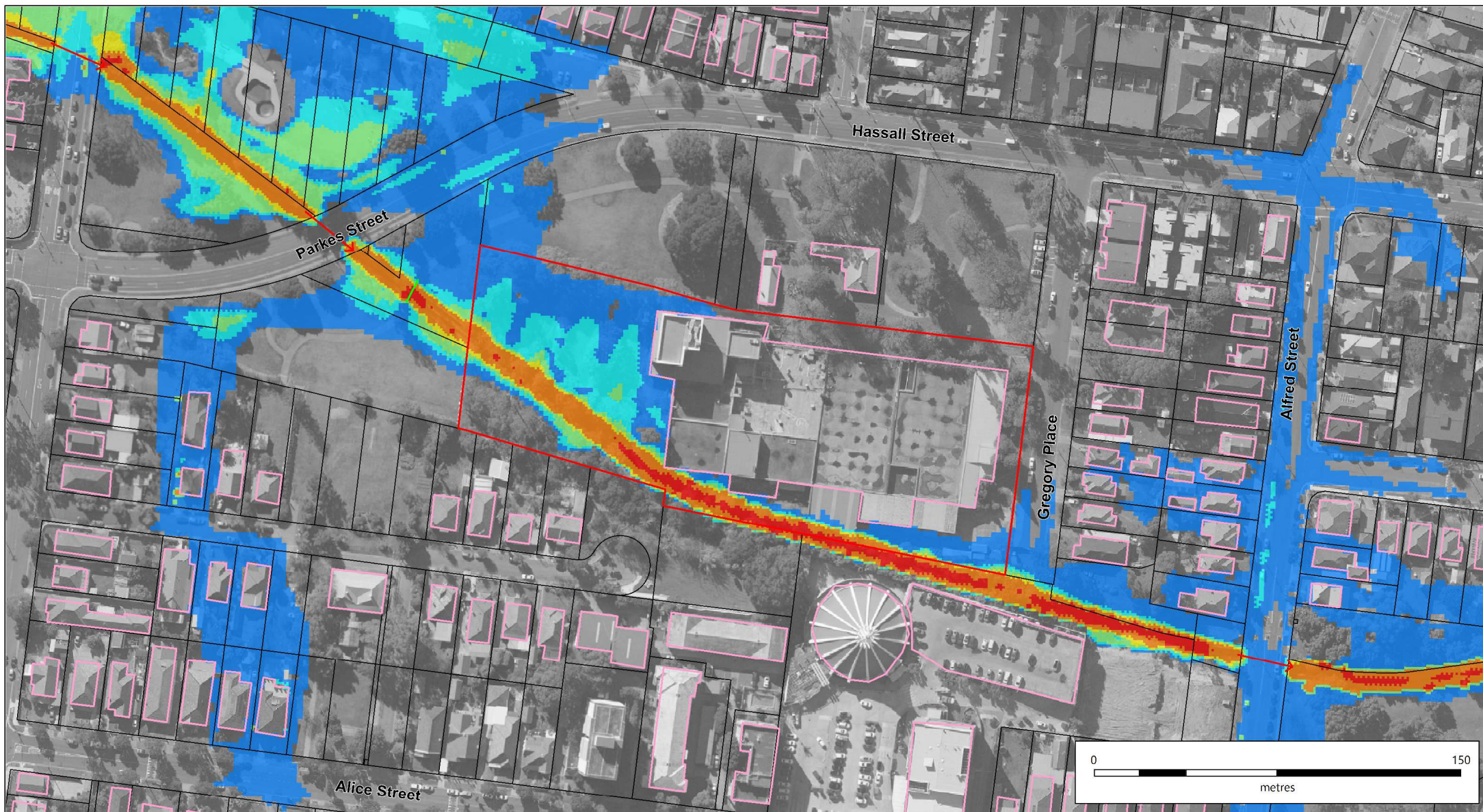
PROJECT: **2A Gregory Place**

PROJECT No. **200101**

DATE: **June 2022**

SCALE: **1: 1500**

FIGURE No. **06**



TITLE : 1% AEP Peak Hazard - Existing Conditions

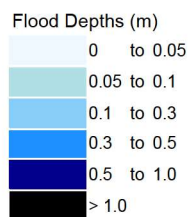
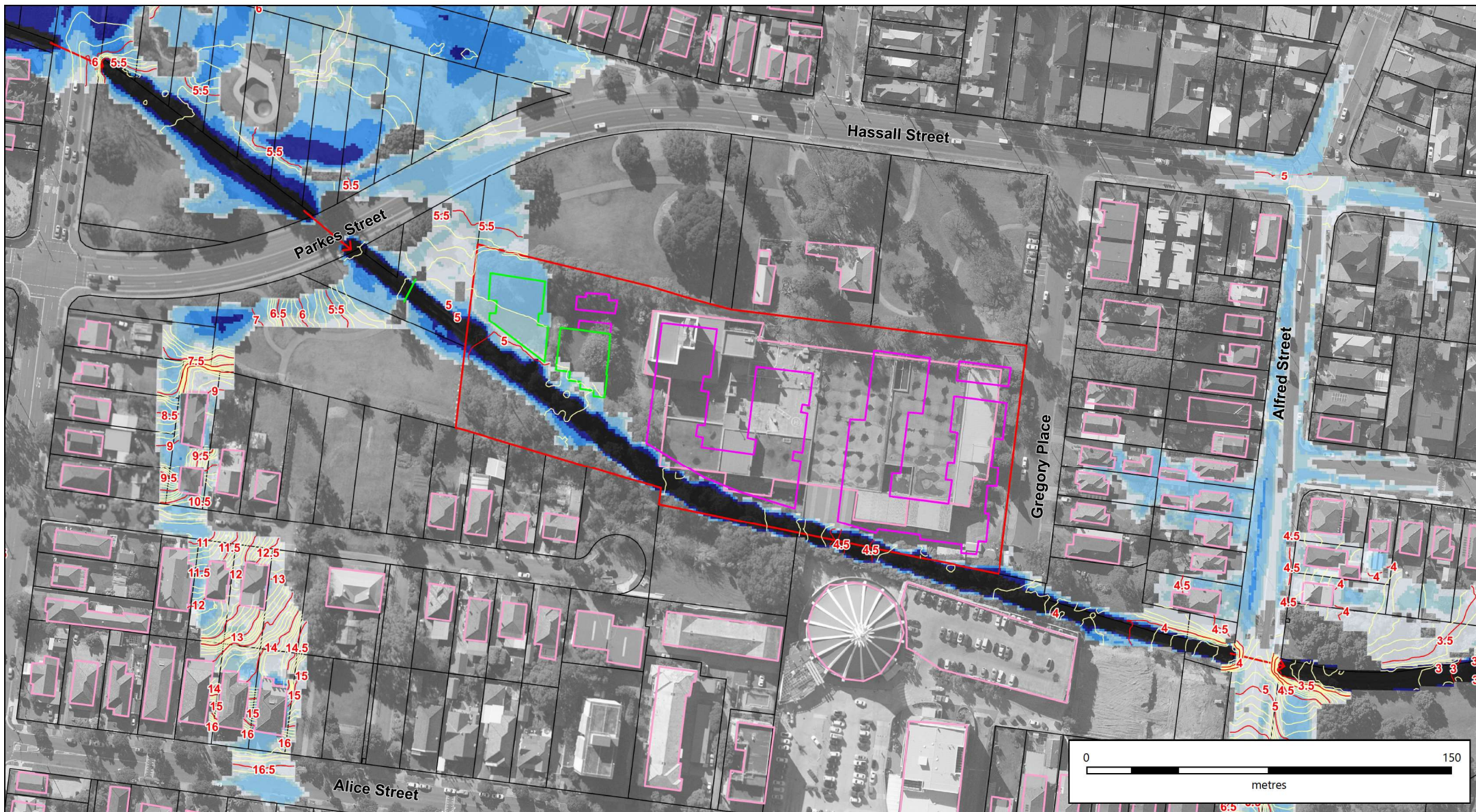
PROJECT: 2A Gregory Place, Harris Park

PROJECT No. 200101

DATE: June 2022

SCALE: 1: 1,500

FIGURE No. 07



- Major Flood Level Contours (Spacing = 0.5 m)
- Minor Flood Level Contours (Spacing = 0.1 m)
- Proposed Buildings on Piers
- Proposed Buildings

- Road Crossings
- Pedestrian Bridge
- Buildings

- Subject Site
- Cadastral Boundaries



TITLE : **5% AEP Peak Depth and Level - Proposed Conditions**

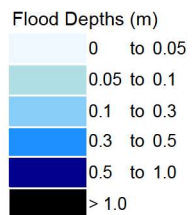
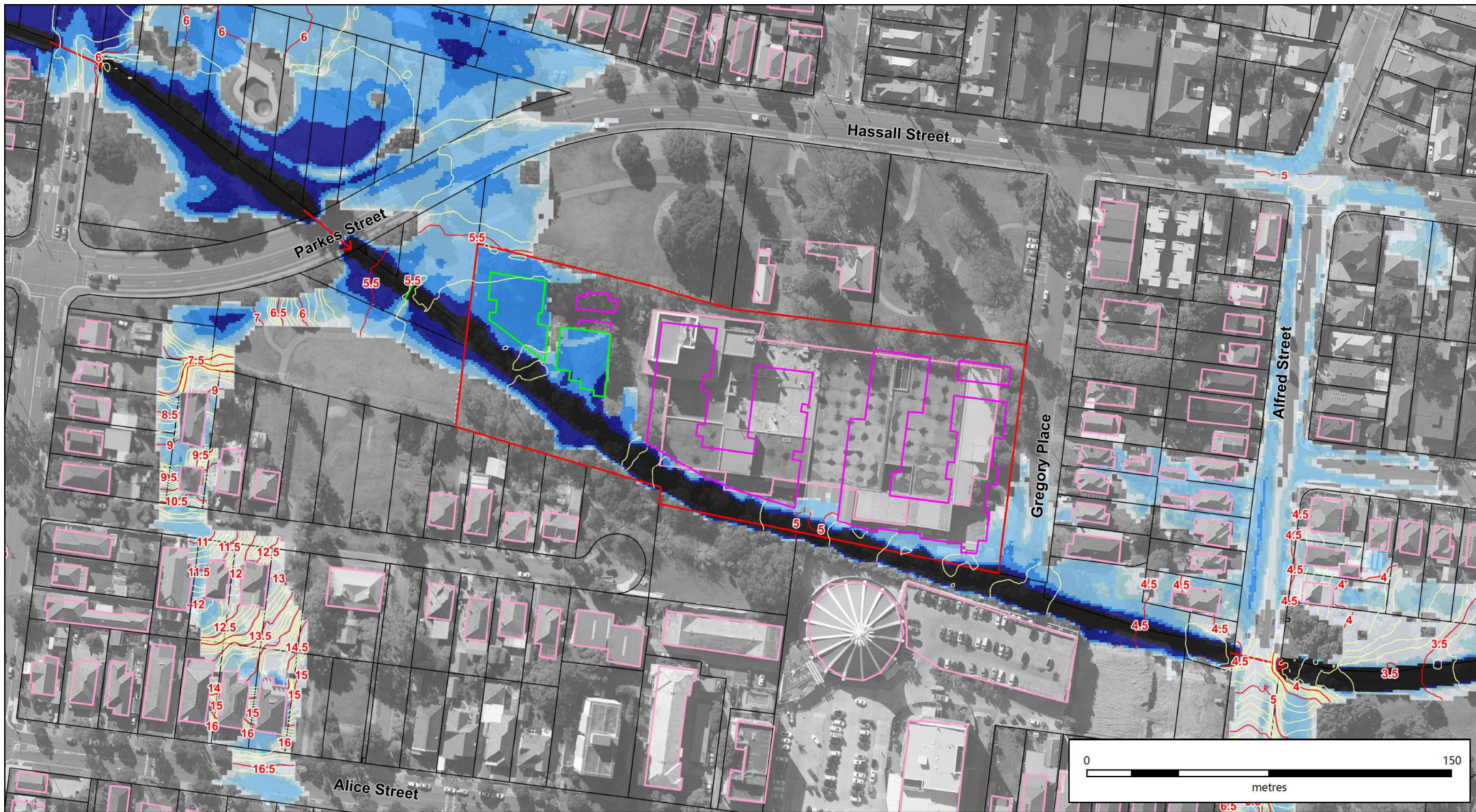
PROJECT: **2A Gregory Place, Harris Park**

PROJECT No. **200101**

DATE: **June 2022**

SCALE: **1: 1,500**

FIGURE No. **08**



- Major Flood Level Contours (Spacing = 0.5 m)
- Minor Flood Level Contours (Spacing = 0.1 m)
- Proposed Buildings on Piers
- Proposed Buildings

- Road Crossings
- Pedestrian Bridge
- Buildings

- Subject Site
- Cadastral Boundaries



TITLE : 1% AEP Peak Depth and Level - Proposed Conditions

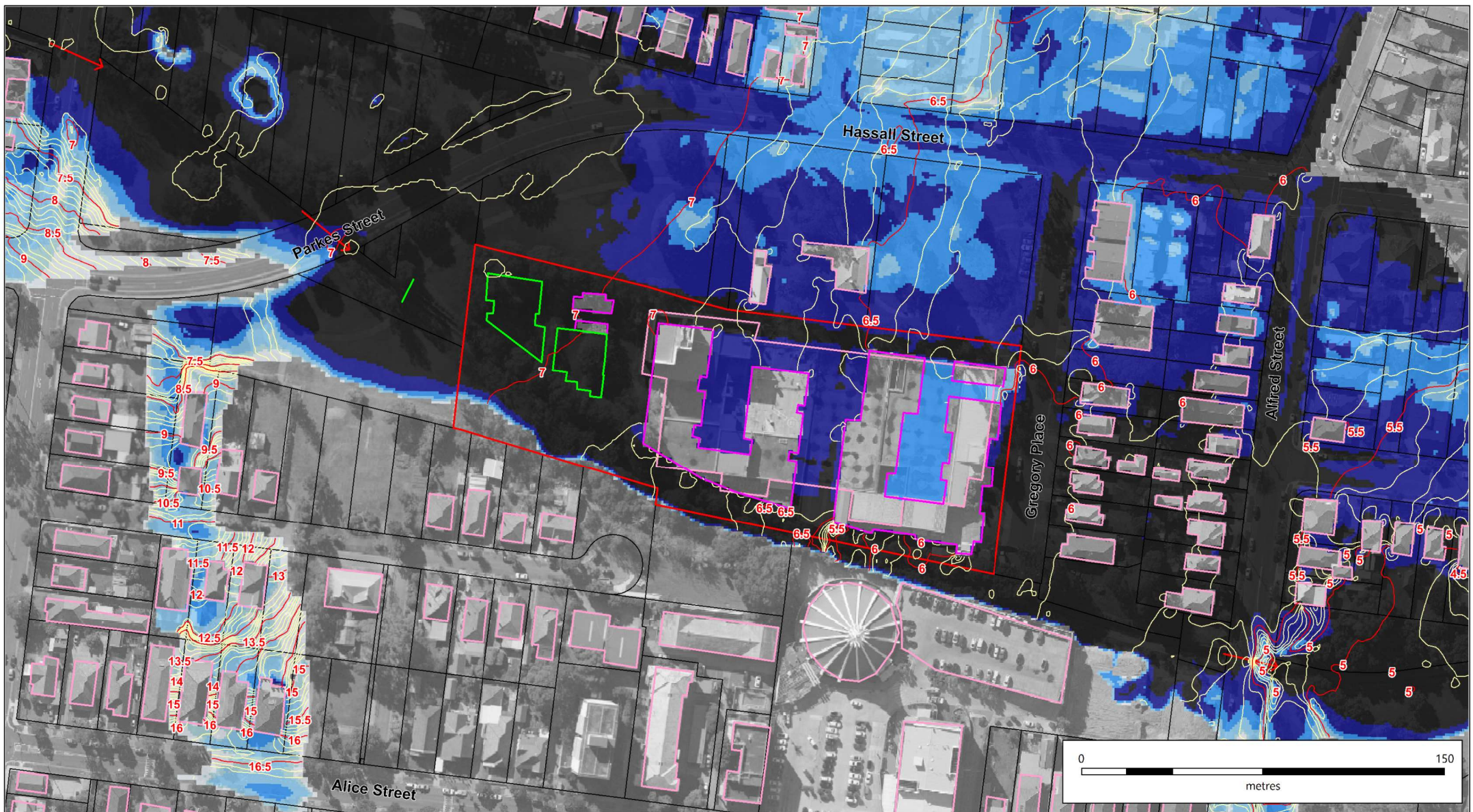
PROJECT: 2A Gregory Place, Harris Park

PROJECT No. 200101

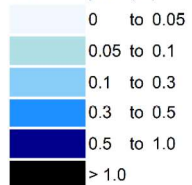
DATE: June 2022

SCALE: 1: 1,500

FIGURE No. 09



Flood Depths (m)



Major Flood Level Contours
(Spacing = 0.5 m)

Minor Flood Level Contours
(Spacing = 0.1 m)

Proposed Buildings on Piers

Proposed Buildings

Road Crossings

Pedestrian Bridge

Buildings

Subject Site

Cadastral Boundaries

grc
HYDRO

TITLE : **PMF Peak Depth and Level -
Proposed Conditions**

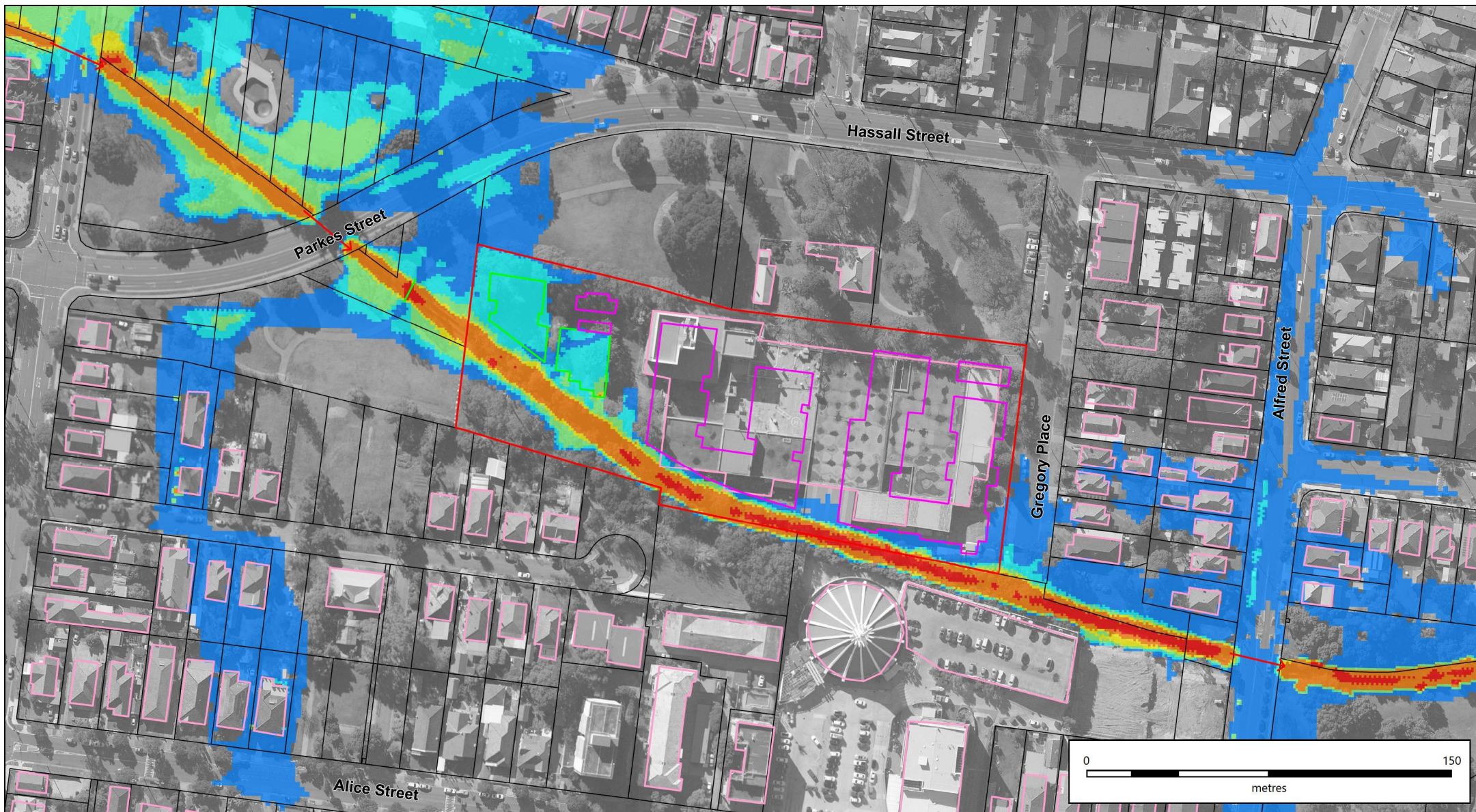
PROJECT: **2A Gregory Place, Harris Park**

PROJECT No. **200101**

DATE: **June 2022**

SCALE: **1: 1,500**

FIGURE No. **10**



Hazard




 Road Crossings

 Pedestrian Bridge

 Buildings

 Proposed Buildings on Piers

 Proposed Buildings

 Subject Site

 Cadastral Boundaries



TITLE : **1% AEP Peak Hazard - Proposed Conditions**

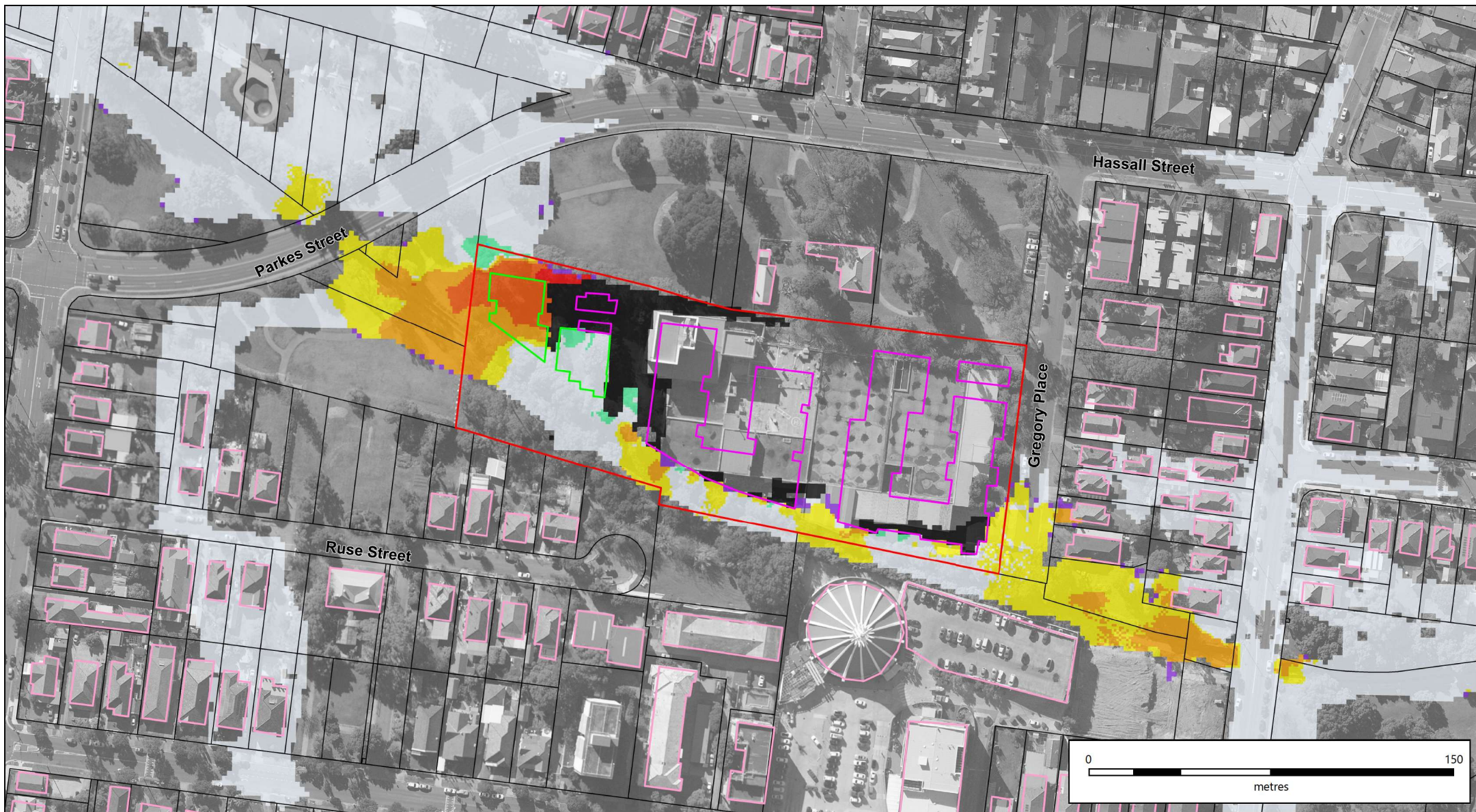
PROJECT: **2A Gregory Place, Harris Park**

PROJECT No. **200101**

DATE: **June 2022**

SCALE: **1: 1,500**

FIGURE No. **11**



Change in Levels (m)



 Proposed Buildings on Piers

 Proposed Buildings

 Buildings

 Subject Site

 Cadastral Boundaries



TITLE : 1% AEP Flood Level Impacts

PROJECT: 2A Gregory Place, Harris Park

PROJECT No. 200101

DATE: June 2022

SCALE: 1: 1,500

FIGURE No. 12

APPENDIX 1

Council Flood Certificate



Our Reference: FL/133/2020
Contact: Peter Sirianni
Telephone: 02 9806 8250
Fax: 02 9806 5906

Raymond Raad
2A Gregory Place
HARRIS PARK NSW 2150

23 September 2020

FLOOD ENQUIRY APPLICATION

Property Details

Address	2A Gregory Place, HARRIS PARK NSW 2150
<i>This form applies for up to three adjoining sites relating to the same development. A separate Flood Enquiry form and fee will be required for more than 3 or separate lots.</i>	

Delivery Preference

raymond@raad.com.au

Reason for Enquiry

Flood drainage Investigation Emailed

Property Type

**** GST not applicable from 1 July 2013****

Flooding Application - Development Duplex	\$300.50
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Disclaimer: Flood levels and flood extent lines are based on current information held by Council. Council does not accept responsibility for the accuracy of this information. Any pipe sizes and location of pits and pipe lines should be confirmed by site investigation.

The flood levels shown on the back of this form are only an approximate guide and have been derived using the current computer simulated model.

The information provided in this document is presented in good faith to assist the public in understanding Council's drainage requirements that apply within the Parramatta Local Government Area. It is the responsibility of each individual using this information to undertake their own checks and confirm this information prior to its use.

City of Parramatta Council, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement, or advice referred to above.

Refer to back of this form for level information issued



Flood Enquiry Information Issued - 23 September 2020

Mainstream Flooding

Is this property affected by mainstream flooding? 2A Gregory Place, HARRIS PARK		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Flood Levels	Closest Cross Sections: (Please refer to Flood Study): Refer to Flood Map	
5% AEP	RL 5.15 m AHD	Comments: See Note on Flood/Hazard Map
1% AEP	RL 5.6 m AHD	
PMF	RL 9.3 m AHD	
<input checked="" type="checkbox"/> Refer to flood maps provided for detailed flood levels.		
Flood information is obtained from the following flood study report: Lower Parramatta River Floodplain Risk Management Study – Flood Study Review, 2005 (SKM)		

Note: Flood inundation can be verified by detail survey to AHD undertaken by a Registered Surveyor.

Local Flooding

Is the property located within a Hatched Grey Area? <i>Properties located within a Hatched Grey Area are subjected to flooding from the local catchment.</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is the property located within a Grey Area? <i>Properties located within a Grey Area are subjected to additional site drainage controls to manage flooding in the local catchment.</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is the property likely to be affected by overland stormwater run-off from the local catchment? Note: No site inspection conducted for this assessment. Based solely on the information supplied for this flood enquiry application.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Subject to Detailed Investigation
Note: You are required to contact Council's Development Service Engineer for any details and requirements relating to development that is affected by local flooding.	

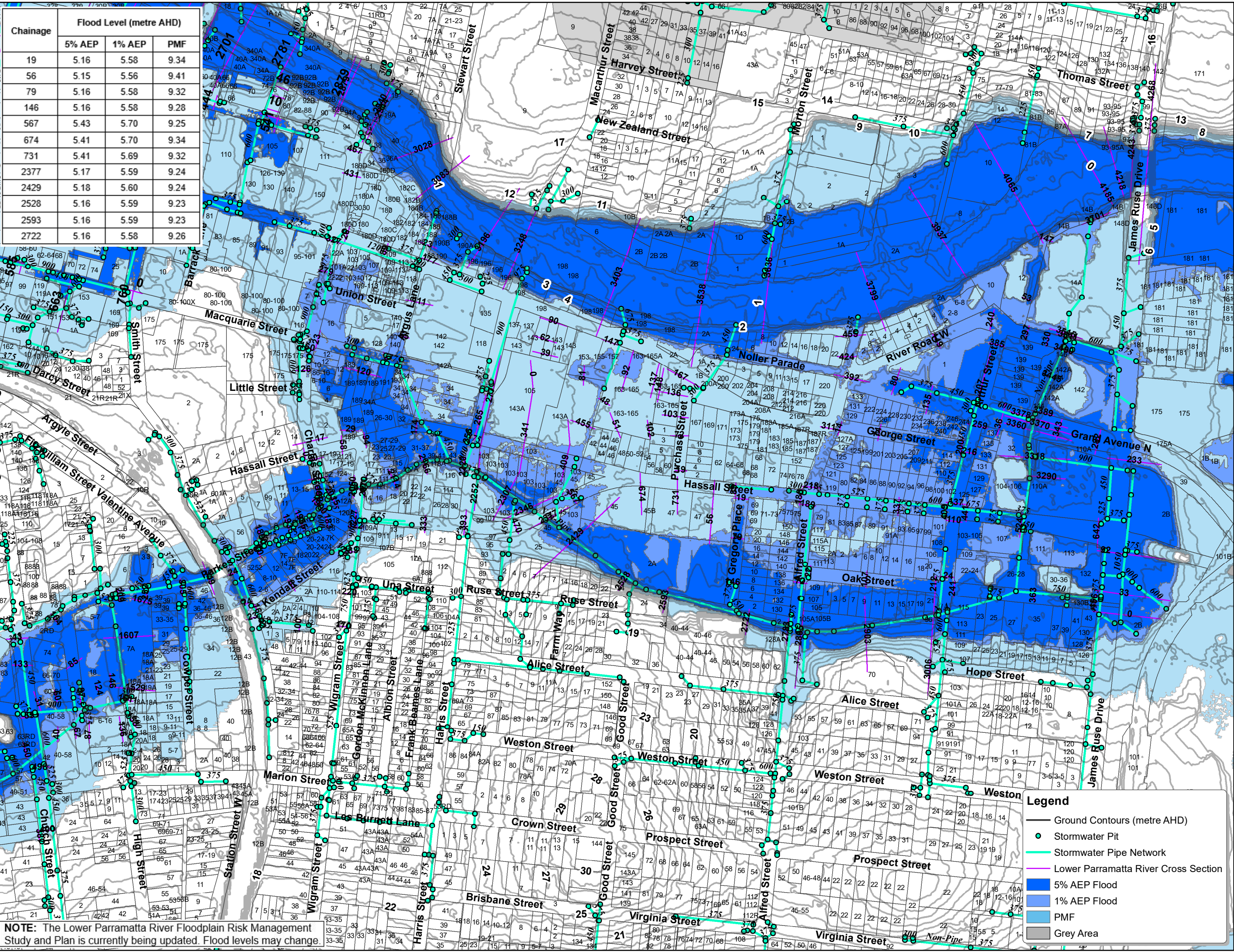
Additional Recommended Actions

<input checked="" type="checkbox"/>	The Applicant needs to discuss the proposal to re-develop this site with Council's Town Planner and Development Services Engineer.
<input checked="" type="checkbox"/>	The Applicant needs to contact Council's Town Planner and organise a pre-lodgement meeting to discuss any proposal to redevelop this property.
<input checked="" type="checkbox"/>	The Applicant needs to refer to Council's Local Floodplain Risk Management policy for details relating to developing a land affected by flooding.

Definitions: (As per NSW Floodplain Development Manual dated April 2005)

- AHD** – a common national surface level datum approximately corresponding to mean sea level.
- ARI** – the long term average number of years between the occurrences of a flood as big as or larger than, the selected event.
- PMF** – is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
- AEP** – Annual Exceedance Probability is the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage.

Chainage	Flood Level (metre AHD)		
	5% AEP	1% AEP	PMF
19	5.16	5.58	9.34
56	5.15	5.56	9.41
79	5.16	5.58	9.32
146	5.16	5.58	9.28
567	5.43	5.70	9.25
674	5.41	5.70	9.34
731	5.41	5.69	9.32
2377	5.17	5.59	9.24
2429	5.18	5.60	9.24
2528	5.16	5.59	9.23
2593	5.16	5.59	9.23
2722	5.16	5.58	9.26



NOTE: The Lower Parramatta River Floodplain Risk Management Study and Plan is currently being updated. Flood levels may change.

- Legend**
- Ground Contours (metre AHD)
 - Stormwater Pit
 - Stormwater Pipe Network
 - Lower Parramatta River Cross Section
 - 5% AEP Flood
 - 1% AEP Flood
 - PMF
 - Grey Area

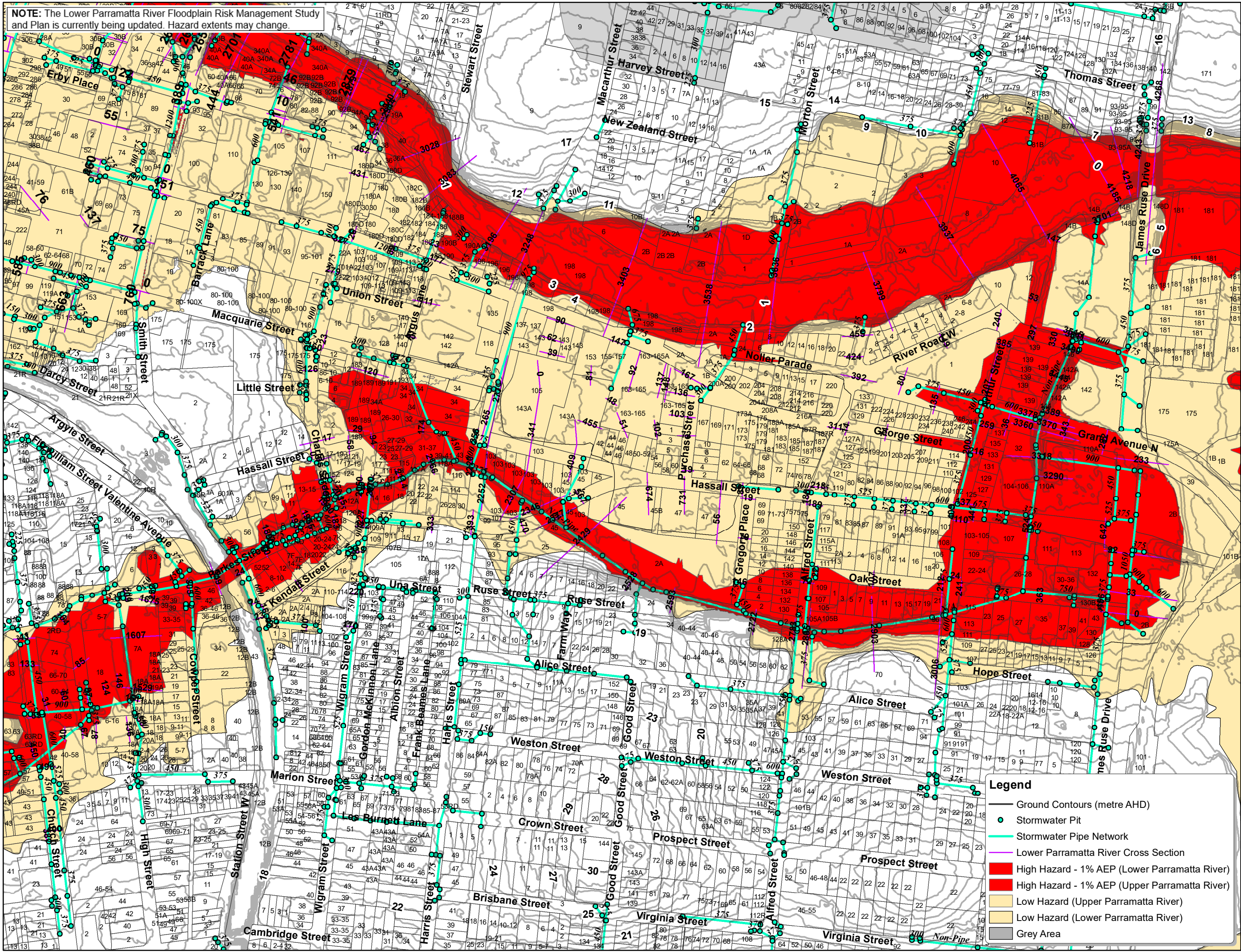
City of Parramatta Council Flood Map

DISCLAIMER: Flood levels and flood extent lines are based on current information held by Council. Council does not accept responsibility for the accuracy of this information. Any pipe sizes and location of pits and pipe lines should be confirmed by site investigation. The flood levels provided are only an approximate guide and have been derived using the current computer simulated model. The information provided on this document is presented in good faith. It is the responsibility of each individual using this information to undertake their own checks and confirm this information prior to its use. City of Parramatta Council, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement, or advice referred to above.



Printed
23/09/2020

NOTE: The Lower Parramatta River Floodplain Risk Management Study and Plan is currently being updated. Hazard extents may change.



1:5,000

City of Parramatta Council Flood Hazard Map

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