Regatta Park Kiosk, Emu Plains

Flood Risk Assessment

Prepared for

Breakspear Architects Pty Ltd

23 March 2021

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9439 5170

Document Information

Prepared for	Breakspear Architects Pty Ltd
Proposal Name	Flood Risk Assessment
File Reference	P001
Job Reference	80821190
Date	23 March 2021
Version Number	Rev1

Author(s)

Dr Brett C Phillips	Effective Date 23 March 2021

Approved By

Dr Brett C Phillips	Date Approved 23 March 2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev1	23/3/21	Draft Final Report	BCP	BCP

Table of Contents

1 Background

As described in Councils' Brief:

> *The Regatta Park precinct upgrade is a long-standing community aspiration that is on track for delivery after funding was confirmed last year as a part of the Western Sydney City Deal Liveability fund. Creating a dining precinct in the Regatta Park precinct has been identified in the Our River' Nepean River Masterplan in 2013, in the Regatta Park and Tench Reserve Detailed Planning and Design document in 2016 and more recently in the McGregor Coxall Regatta Park Masterplan in 2019.*
>
> *The 2013 Masterplan and 2016 Detailed Design documentation provided for design development, community engagement and establishing a funding program to support preferred outcomes. Council engaged design consultants McGregor Coxall Landscape Architects to produce a concept design which was endorsed in November 2019.*
>
> *There has been wide recognition within the broader Penrith community that by drawing the Nepean River into the day to day lives of those who live and work in the region, economic cultural and environmental benefits will be returned to the community.*
>
> *The updated preliminary design for the Regatta Park precinct, prepared by McGregor Coxall in 2019, is moving to detail design, showing how Council aspires to transform Regatta Park into a beautiful large green open recreational space that will bring extensive benefits to residents and visitors.*
>
> *The upgrade of the river park plays an important role in realising the ambition to re-embrace the Nepean River as a significant open space asset. The development of a dining precinct is envisaged to increase visitation and utilisation of the Regatta Park precinct and the designs will need to ensure that the structure integrates with the broader river precinct masterplan, the detailed Regatta Park design and specifically to the adjoining riverbank playground.*

As also described in Councils' Brief:

> *Penrith City Council is seeking to engage a suitably qualified innovative design consultancy team to prepare "Design Construction Documentation" for an architecturally unique, high quality, innovative, sustainable structure to support the function as an initial cafe/kiosk with possible expansion for event space, that serves to activate Regatta park, integrate with the new playground and the broader river landscape. The structure will be a crucial feature of the Regatta Park precinct which is bounded by the Great Western Highway, the Nepean River and York Street in Emu Plains.*
>
> *The outcomes envisaged for "Design Construction Documentation" regarding this quotation include:*
>
> - *Detail architectural and structural design documentation for the approved Concept Design*
> - *Project cost estimates and bill of quantities*
> - *Development Assessment Documentation*
> - *Tender Documentation*
> - *Construction Documentation*
> - *Provide ongoing design support throughout the construction phase.*
>
> *All documentation and approvals are required for the complete built form, with allowance for construction to be phased:*
>
> ……
>
> *The Regatta Park precinct has been identified as Flood Planning Land and the dining precinct will be impacted by flood related development controls. Clause 7.2 regarding Flood Planning will be applicable for any development in the Regatta Park precinct.*

As described in the 2020 REF for the River Road Deviation and Masterplan:

REGIONAL AND LOCAL SURFACE WATER FLOWS

The proposal is located within the Nepean River catchment. The Nepean River forms part of the Hawkesbury-Nepean catchment. The Hawkesbury-Nepean catchment covers an area of about 21,400 km^2. This area includes the catchments for Warragamba, the Upper Nepean and the Mangrove Creek dams, which form the main water supply reservoirs for the Sydney metropolitan area.

Surface water flows in the local area include overland flow paths and the existing council stormwater drainage network, both discharging to the Nepean River to the east of the proposal.

FLOODING

The proposal site is located adjacent to the Nepean River. The eastern extent of the proposal site along the river is affected by the 100-year ARI flood, with flood modelling indicating this area becomes entirely inundated (Clouston Associates 2016a). Figure 6.2 shows the 100-year ARI predicted flood level.

Source: Clouston Associates 2016a

Figure 6.2 Regatta Park 1:100 year flood event modelling (project area shown in red)

A flood risk assessment was required to inform the design of a Kiosk/Cafe at Regatta Park.

2 Flood Risks

The most recent flooding information for Regatta Park is contained in the 2018 Nepean River Flood Study which comprises Volume 1 Main Report and Volume 2 Maps.

The scale of the maps compiled in Volume 2 is such that there is insufficient detail on flooding in Regatta Park to inform the consideration of flood depths, velocities and hazards by Council and other team members.

Upon request, Council supplied copies of the result files and supporting files from the 2018 study to prepare flood maps at the scale of Regatta Park to be prepared. The indicative extent of the proposed kiosk is also mapped for comparison to the mapped flooding.

2.1 2018 Nepean River Flood Study

As described by Advisian, 2018[1]

> *This study culminates several stages in the progressive evolution of a two dimensional numerical flood model of the Nepean River through the Penrith Local Government Area. The initial flood model development commenced in 2005 by revising an earlier version with LiDAR terrain data that had been captured in 2002. The flood model then progressed in stages as more historic data was uncovered, enabling a more detailed and rigorously calibrated model to be developed. The final model awaited the completion of the lakes' terrain landscape and the hydraulic control structures within the Penrith Lakes Scheme. A new LiDAR data set was captured for the Lakes Scheme and the surrounding area in 2016, enabling completion of the study.*
>
> *The flood modelling was undertaken using the RMA-2 hydrodynamic modelling package and covers the floodplain between Glenbrook Creek and Yarramundi Bridge. The calibration was greatly facilitated by a set of vertical air photos taken 3 hours after the peak of the 1978 flood, the largest flood with suitable recorded data (the others being 1986 and 1990). Upstream flow hydrograph and downstream stage discharge boundary condition data was sourced from the one dimensional Hawkesbury-Nepean model that had been developed for Sydney Water's Warragamba Dam studies in the mid 1990s. Eight design flood hydrographs were run through the model, including the 20yr ARI, 50yr ARI, 100yr ARI, 200yr ARI, 500yr ARI, 1000yr ARI, 2000yr ARI and the probable maximum flood.*
>
> *The behaviour of the Nepean River floodplain is somewhat unique amongst the NSW coastal rivers. Typically, flood flows exceed the capacity of the main channel, inundating the floodplain for floods less than a 10yr ARI, and the probable maximum flood is less than two metres higher than the 100yr ARI flood. In contrast the main channel of the Nepean River through Penrith contains flood flows well in excess of a 50yr ARI and the probable maximum flood is five metres higher than the 100yr ARI flood.*
>
> *The 100yr ARI flood, which is generally the basis for flood planning levels, just breaks out across the floodplain at two key locations, Knapsack Creek and Boundary Creek, whereas higher floods breakout along significant lengths of the river bank inundating significantly larger areas.*
>
> *The Knapsack Creek breakout affects the Emu Plains residential area and backs up behind the railway embankment. Insufficient flow enters the area during the 100yr ARI flood to reach equilibrium storage levels, especially between the Great Western Highway and the railway. A slightly higher flood would see flood depths in this area rise dramatically affecting many more properties. Evacuation of the entire residential area along the eastern side would have to commence before the Knapsack Creek breakout occurs.*

[1] Advisian (2018) "Nepean River Flood Study", *Final Report*, 2 Vols, prepared for Penrith City Council, November, 82 pp + Apps

The Boundary Creek breakout discharges into the eastern lakes of the Penrith Lakes Scheme, which progressively fill until Duralia Lake overtops into the main lake of the Scheme. With normal operating levels in the eastern lakes, Duralia Lake does not completely fill during the 100yr ARI flood. The flooding in Cranebrook Village is directly linked to levels in Duralia Lake and is thus susceptible to antecedent levels in the eastern lakes and the total amount of flow from the breakout.

Recommendations are made for managing flood planning levels in these two areas until such time as a Flood Risk Management Study can comprehensively consider the risks and recommend a suitable outcome.

2.2 Flood Depths

The 5% AEP and 1% AEP flood depths in the vicinity of Regatta Park are mapped in **Figures 1** and **5** respectively.

2.3 Flood Levels

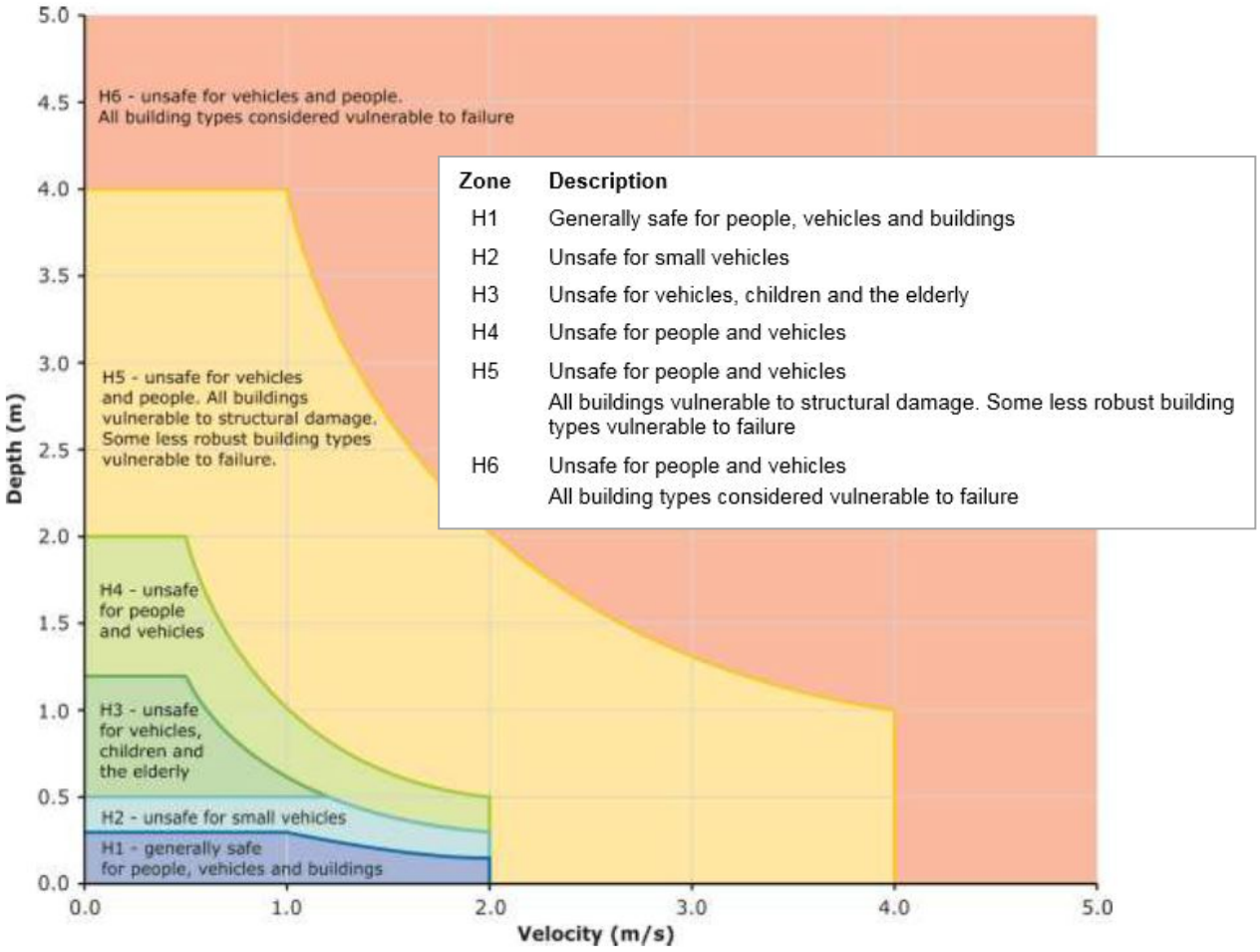
The 5% AEP and 1% AEP flood levels in the vicinity of Regatta Park are mapped in **Figures 2** and **6** respectively.

2.4 Flood Velocities

The 5% AEP and 1% AEP flood levels in the vicinity of Regatta Park are mapped in **Figures 3** and **7** respectively.

2.5 Flood Hazards

The ADR Guideline 7-3 Flood Hazard details the six (6) flood hazard vulnerability categories as follows:



The 5% AEP and 1% AEP flood hazard vulnerability categories in the vicinity of Regatta Park are mapped in **Figures 4** and **8** respectively.

2.6 Hydraulic Category

The extents of Flood Storage areas and Floodways in the 1% AEP flood are mapped in **Figure 9**.

2.7 Kiosk and Landscaping

It is noted that the proposed Kiosk and associated earthworks and landscaping:

- Is located partially on ground above the 1% AEP flood level and partially across land which is inundated in a 1% AEP flood;
- It is proposed to construct the Kiosk on fill which will to prevent local backwatering of the 1% AEP flood just west of the Kiosk;
- The Kiosk footprint intersects local zones of H1, H2, H3 and H4 hazards in a 1% AEP flood;
- The Kiosk footprint intersects a local zones of flood storage in a 1% AEP flood.

3 Planning Considerations

3.1 Penrith DCP 2014

Section 3.5 Flood Planning in Section C3 Water Management of the Penrith DCP 2014 sets our planning considerations in relation to developing flood-prone land.

The LEP contains provisions for development on land at or below the flood planning level, defined in the LEP as the level of a 1:100 Average Recurrence Interval (ARI) (1% AEP (100year ARI)) flood event plus 0.5 m freeboard. ……..

The proposed Kiosk floor level of 26.7 m AHD would provide 0.5 m freeboard in a 1% AEP flood.

Alterations to Land at or below the Flood Planning Level/Watercourses

One key issue with the development of land at or below the flood planning level is that some developments have the potential to adversely affect flood behaviour (including flow distributions and velocities). This can result in detrimental increases in the potential flood impacts on other development or properties and/or impacts on the floodplain environment that could cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank/watercourse.

Developments that would partially or fully block floodways or flood storage areas may result in redistribution of flood flows or impacts. The greatest impact comes from filling land at or below the flood planning level in order to raise development above the flood planning level. Therefore, these impacts must be minimised in the location and design of any structures on the land.

Clause 14 appears to be a relevant clause for the proposed development of the Kiosk given that it will be partially constructed on fill.

Minimising Flood Impacts on Property

Flood impacts on property can be reduced not only by appropriate location of development but also by design, layout and structure. This Plan provides controls for appropriate levels for 'habitable rooms' or 'flood proofing' of buildings.

Habitable rooms are defined as a living area such as a lounge room, dining room, rumpus room, kitchen and bedroom and excluding garages.

Flood proofing refers to the combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding to reduce or eliminate flood damages.

The proposed Kiosk has been assessed as new commercial development (Clause 6) while the associated earthworks and landscaping has been assessed as (partial) filling of land at or below the flood planning level (Clause 14) as follows.

6) Industrial/Commercial - New Development

a) Floor levels shall be at least 0.5m above the 1% AEP (100 year ARI) flood or the buildings shall be flood-proofed to a least 0.5m above the 1% AEP (100 year ARI) flood. If floor levels are below the 1% AEP (100 year ARI) flood the matters listed in section 7 i– vii) shall be addressed.

The proposed Kiosk floor level of 26.7 m AHD will provide 0.5 m freeboard in a 1% AEP flood. This requirement is satisfied.

b) Flood safe access and emergency egress shall be provided to all new developments.

The associated internal roads and parking areas west of the kiosk are located at levels higher than the 1% AEP flood level and offer flood safe access and emergency egress in floods up to the 1% AEP flood. This requirement is satisfied.

14) Filling of Land At or Below the Flood Planning Level

a) Council will not grant consent to filling of floodways or high hazard areas.

The proposed kiosk is located partially on ground above the 1% AEP flood level and partially across land which is inundated in a 1% AEP flood. It is located outside the 1% AEP floodway zone (refer Figure 9). The Kiosk footprint intersects local zones of H1, H2, H3 and H4 hazards in a 1% AEP flood.

The filling of otherland at or below the flood planning level will generally not be supported; however, Councilwill adopt a merits based approach. In particular, an application to fill land shall also describe the purpose for which the filling is to be undertaken.

It is proposed to construct the Kiosk partially on fill which will paced on a small backwater flood storage area on the fringe of the 1% AEP flood. This will prevent local backwatering of the 1% AEP flood just west of the Kiosk and will provide flood safe access and emergency egress from the Kiosk in floods up to the 1% AEP flood.

Council may consider such anapplication when the following criteria are met:

i) Flood levels are not increased by more than 0.1m by the proposed filling;

The proposed development is located partially on ground above the 1% AEP flood level and partially across land which is inundated in a 1% AEP flood on the fringe of the 1% AEP flood. The impact on the 1% AEP flood is expected to be a minor loss of flood storage which would have negligible impact on 1% AEP flood levels.

ii) Downstream velocities are not increased by more than 10% by the proposed filling;

The proposed development is located on the fringe of the 1% AEP flood. The impact on the 1% AEP flood is expected to be a minor loss of flood storage which would have negligible impact on flood velocities.

iii) Proposed filling does not redistribute flows by more than 15%;

The proposed development is located on the fringe of the 1% AEP flood. The impact on the 1% AEP flood is expected to be a minor loss of flood storage which would have negligible impact on flood flows in the vicinity of the park.

iv) The potential for cumulative effects of possible filling proposals in that area is minimal;

The proposed earthworks in the vicinity of the kiosk will lead to a minor loss of flood storage. It is our understanding that this represents the proposed extent of filling in areas at or below the 1% AEP flood level.

v) There are alternative opportunities for flood storage;

The minor loss of flood storage would be accommodated by a very small increase of the flood level in this reach of the river.

vi) The development potential of surrounding properties is not adversely affected bythe filling

proposal;

The proposed local and minor filling will not adversely impact the development potential of surrounding properties because the development is located centrally within a park.

vii) The flood liability of buildings on surrounding properties is not increased;

The flood liability of buildings on surrounding properties is not increased because the proposed local and minor filling is located centrally within a park.

viii) No local drainage flow/runoff problems are created by the filling; and

The proposed earthworks will prevent local backwatering of the 1% AEP flood just west of the Kiosk which in turn will require drainage measures to convey to the river any runoff which flowed to this local swale prior to the proposed development.

ix) The filling does not occur within the drip line of existing trees.

c) The above criteria can only be addressed and satisfied by the submission of a detailed flood study report by an appropriate consulting engineer. The flood study report would involve both hydrologic and hydraulic analysis of the watercourse and the effects of the proposed filling on flood levels, flow velocities and distribution of flows as listed in i) to iii)above. In addition, the report needs to address items iv) to ix) listed above. Any filling ofland also needs to be in accordance with the other provisions in this Plan.

PENRITH CITY COUNCIL

Regatta Park

Current Condition
5% AEP Depth

Legend

5% AEP depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50
- Cadastre

FIGURE 01

1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
5% AEP Water Level

Legend

Nepean RMA_ WMP 20yr-LEVEL
Flood Extent
Cadastre

FIGURE 02

1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
5% AEP Velocity

Legend

Nepean RMA_ WMP 20yr-VELOCITY

0.00 to 0.50	
0.50 to 1.00	
1.00 to 1.50	
1.50 to 2.00	
2.00 to 3.00	
> 3.00	
Cadastre	

FIGURE 03

1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
5% AEP Hazard

Legend

Cadastre

FIGURE 04

1:2,500 **Scale at A3**

0 20 40 60 80 100 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
1% AEP Depth

Legend

Nepean RMA_ WMP 100yr-DEPTH

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50
- Cadastre

FIGURE 05

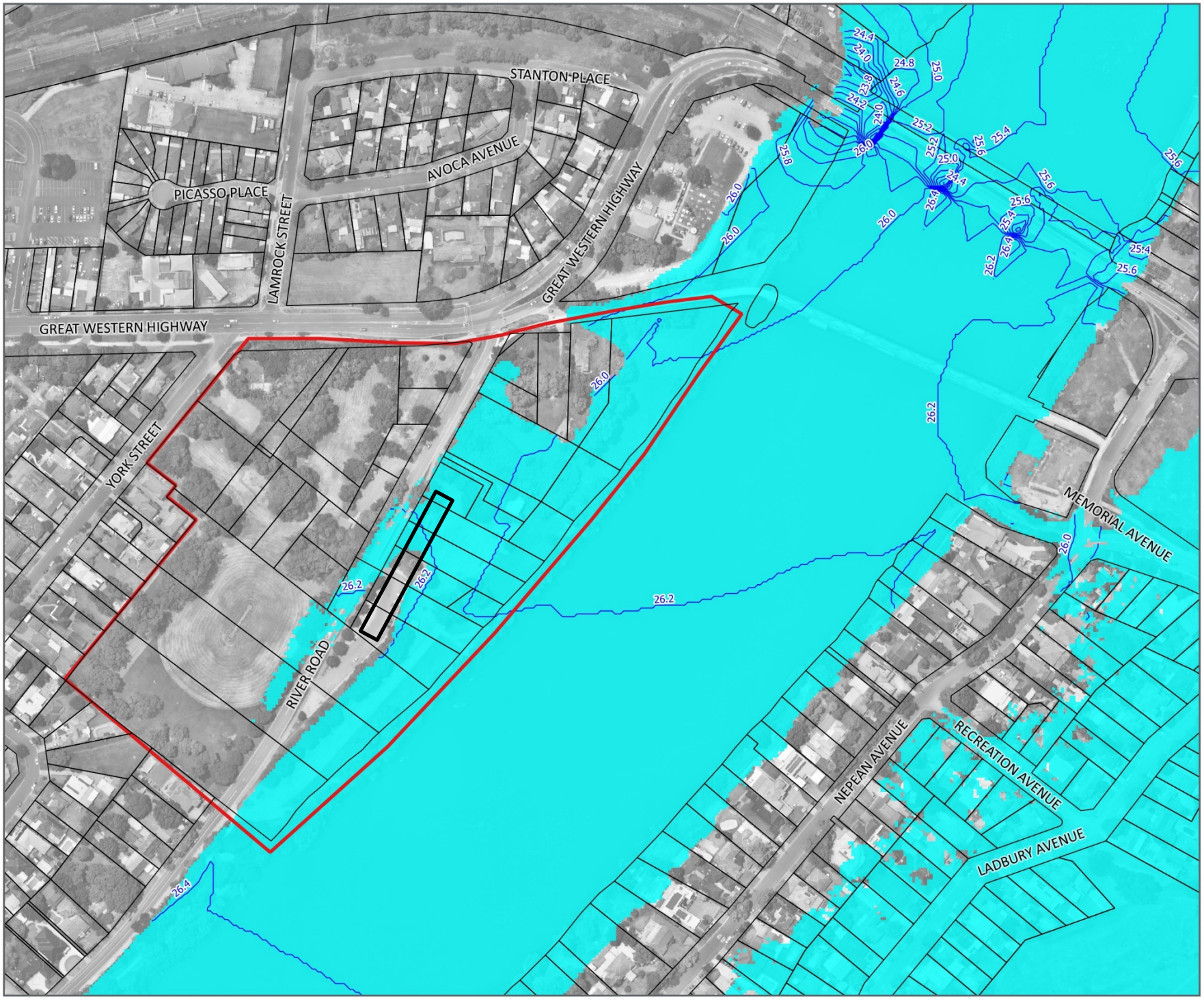
1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz



PENRITH CITY COUNCIL

Regatta Park

Current Condition
1% AEP Water Level

Legend

Nepean RMA_ WMP 100yr-LEVEL
Flood Extent
Cadastre

FIGURE 06

1:2,500 Scale at A3

0 20 40 60 80 100 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
1% AEP Velocity

Legend

Nepean RMA_ WMP 100yr-VELOCITY

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00
- Cadastre

FIGURE 07

1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
1% AEP Hazard

Hazard Classification

- H1
- H2
- H3
- H4
- H5
- H6

FIGURE 08

1:2,500 Scale at A3

0 20 40 60 80 100 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

PENRITH CITY COUNCIL

Regatta Park

Current Condition
1% AEP Hydraulic Categories

Legend

- Flood Storage
- Floodway

FIGURE 09

1:2,500 Scale at A3

0 20 40 60 80 100 m

N

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-2-12| Project: 80821190
Coordinate System: MGA Zone 56
Map: Regatta Park Figures.qgz

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

Global Head Office

Level 11, North Tower
Green Square
515 St Paul's Terrace
Locked Bag 4006
Fortitude Valley Qld 4006

Phone +61 7 3369 9822
Fax +61 7 3369 9722

cardno@cardno.com
www.cardno.com