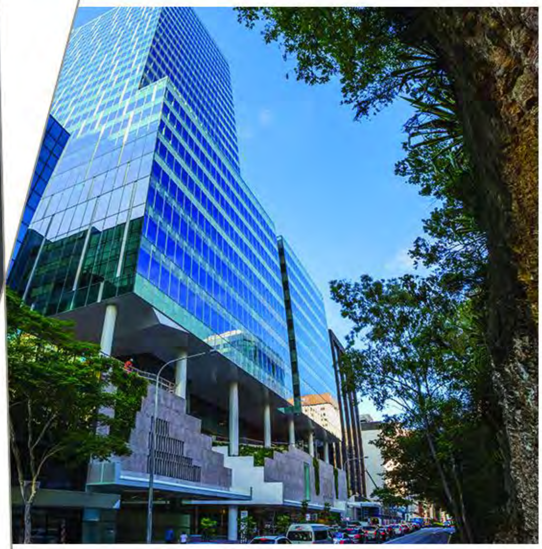
Flood Impact Assessment

23-49 Henry Street, Penrith

59918061



Prepared for
3945 Penrith and 4749 Penrith Pty Ltd

5 March 2018

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1 Background

1.1 Subject Site

The subject site 23-49 High Street, Penrith is located in the Penrith Local Government Area. The site currently contains a multiple single storey buildings, catering to auto maintenance and car wash businesses. The site is bounded by Henry Street to the south, open space Council land to the north and Evan Street to the West and junction of Henry Street and North Street at the eastern boundary of the site, as shown in **Figure 1-1**.

Figure 1-1 Locality Plan

1.2 Objective

The objective of the study is to estimate pre- and post-development flood behaviour in the vicinity of the subject site for a Planning Proposal submission. A preliminary flood assessment for the site reviewing potential flood affectation was prepared on 13 October 2017. This Report is a more detailed assessment based on site-specific flood modelling.

1.3 Council Flood Impact Policy

Penrith City Council DCP 2014 Section C3 – Water Management provides the relevant controls for flood impact assessments.

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) flood event plus 0.5 m freeboard.

Regarding flood impact, the DCP (Section 3.5) requires that any development must not increase the flood hazard or risk to other properties. This includes the impact on any overland flow path. Development should not obstruct overland flow paths and must demonstrate that any overland flow is maintained for the 1% AEP event. However, Council will take a merit based approach when assessing development applications that affect the overland flow.

Filling of floodways or high hazard areas is not permitted and filling of other land at or below the flood planning level is generally not supported. However, Council will also adopt a merits based approach, including consideration of the following criteria:

- Flood levels are not increased by more than 0.1m by the proposed filling;
- Downstream velocities are not increased by more than 10% by the proposed filling;
- Proposed filling does not redistribute flows by more than 15%;
- The potential for cumulative effects of possible filling proposals in that area is minimal;
- There are alternative opportunities for flood storage;
- The development potential of surrounding properties is not adversely affected by the filling proposal;
- The flood liability of buildings on surrounding properties is not increased;
- No local drainage flow/runoff problems are created by the filling; and
- The filling does not occur within the drip line of existing trees.

The DCP has the following further requirements regarding Overland Flow Flooding (Section 2.4):

The following key principles shall also be considered in the overland flow flood study:

- All levels shown shall be to the Australian Height Datum (AHD)
- The development shall not adversely impact on surrounding properties through the diversion, concentration or ponding of overland flows (i.e. the extent, velocity and the depth of overland flow shall remain unchanged);
- The development shall not impede the passage of overland flow to cause a rise (afflux) in the water levels and / or increase velocities of flow on adjoining lands;
- The development shall accommodate the passage of overland flow over the site and, where applicable, shall be designed to withstand damage due to scour, debris and buoyancy forces;
- The development must not be sited where overland flows may result in a hazardous situation for future occupants in terms of depth and velocity of overland flows through the property (i.e. velocity-depth product greater than 0.4 is not acceptable);
- Overland flows shall be directed through common areas and not through private courtyards or on-site detention systems;
- No structures and / or filling are permitted within the overland flow path unless suitable flood mitigation measures approved by Council are to be implemented;
- Any fencing (including boundary fencing) over the extent of the overland flow path must be replaced with open style fencing or similar to allow the free passage of overland flows;
- Design elements such as concrete or paving shall be used to fix critical levels in overland flow paths to minimise interference by future occupiers; and
- Provision of adequate freeboard to finished floor levels.

2 Available Data

2.1 Penrith Detailed Overland Flow Study

The Penrith Detailed Overland Flow Flood Study was completed by Cardno for Penrith City Council in 2015 to define the overland flood behaviour for Penrith CBD catchment. It defined the behaviour of local overland flows and flooding within the catchment which includes the subject site.

The indicative 1% AEP flood extent for the Penrith CBD catchment shown in **Figure 2-1** extracted from Figure 8.3 of the Final Report (Cardno, 2015). The results show that the subject site is partially inundated.

Figure 2-1 1% AEP Flood Extents from the 2015 Penrith Detailed Overland Flow Flood Study

2.2 Ground Topography

A detailed ground survey of the site completed by C & A Surveyors NSW Pty Ltd dated 18/12/2016 (**Appendix A**) was used for this study.

2.3 Proposed Development

Proposed development of the site was modelled for the building footprints of Blocks A, B, C, and D based on the concept architectural design by Australian Consulting Architects dated 03/10/2017 and 08/02/2018 (**Appendix B**). The Proposed development site comprises a mix of commercial\retail and residential apartments.

2.4 Site Inspection

An inspection of the site was conducted in November 2017 to identify local hydraulic constraints relevant for the flood modelling and assessment. Selected photos are presented below and a reference location shown on:

- Photo 1: The subject site from junction of Evan Street and Henry Street.
- Photo 2: Henry Street towards eastern boundary of site.
- Photo 3: The existing open space north of the site.
- Photo 4: The existing shallow area at north-west corner of the site looking from North Street.
- Photo 5: The culvert at The Crescent, north of railway line, stormwater drainage network to North Street.

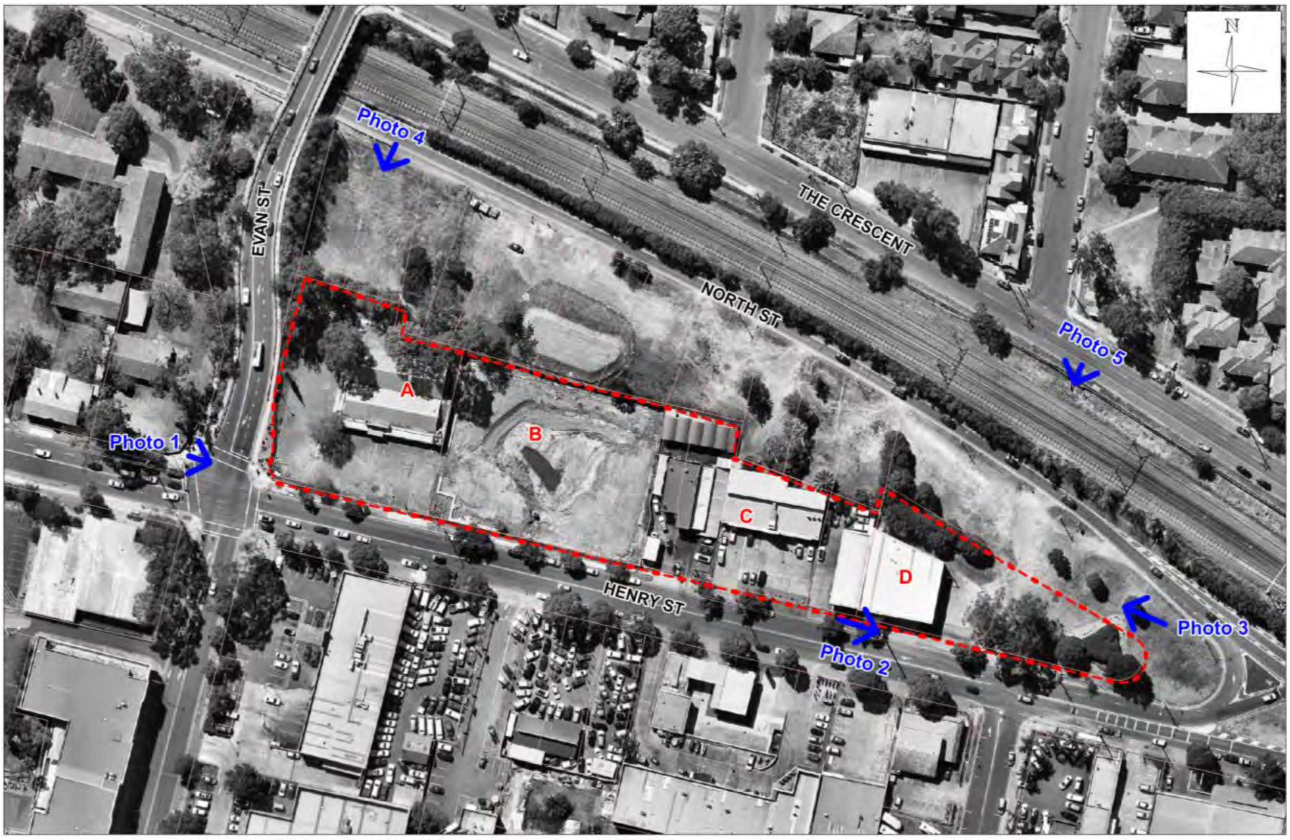


Figure 2-2 Photo Reference Location

Photo 1 - Junction of Evan Street and Henry Street (facing east)

Photo 2 - Henry Street (facing east)

Photo 3 - Junction of Henry Street and North Street (facing west)

Photo 4 - North Street looking towards low point at 47-49 Henry street boundary, east of Evan Street (facing south)

Photo 5 – Drainage culvert under the railway at The Crescent (facing south)

3 Hydrological and Hydraulic Modelling

3.1 Modelling Approach

Flood behaviour at the site was assessed based on site-specific amendments to the current 2015 Study TUFLOW 1D/2D floodplain model. A 1% Annual Exceedance Probability (AEP) event and the Probable Maximum Flood (PMF) event were modelled for the critical durations of 2 hour and 30 minutes respectively.

3.1.1 Model Topography

The site generally grades in westerly direction towards Evan Street. A trapped lowpoint occurs near Evan Street adjacent to the northern boundary of the site. The model terrain grid of 2015 Study model was updated with the detailed ground survey for establishing the pre-development model. A model grid resolution of 2 m x 2 m cells was adopted.

The proposed development layout was modelled with raised building footprints for Blocks A, B, C, and D based on the architectural drawings. Two concepts for the proposed development have different Floor Space Ratios (FSR). The two FSR designs of 3.5:1 and 7.5:1 have the same building footprint on the lower levels, thus the flood modelling is representative of both scenarios. Finished ground levels on the site were adopted based on the available architectural details and interpolated levels from existing ground elevations.

The modelled pre- and post-development terrain is shown in **Figures 3-1** and **3-2** respectively.

3.1.2 Hydrology

An XP-RAFTS hydrologic model of the entire catchment was established for the 2015 Study to estimate input flows for areas upstream of the 2D domain extent which used the ‘Direct Rainfall’ method (also known as ‘rainfall on the grid’) hydrologic modelling.

3.1.3 1D Hydraulics

The stormwater pit and pipe network was modelled as 1D elements in the TUFLOW model per the 2015 Study. The existing trunk drainage 1.5m x 1.2m RCBC has been retained in its current location under proposed Block A.

3.1.4 Boundary Conditions

Boundary conditions were adopted based on the 2015 Study model.

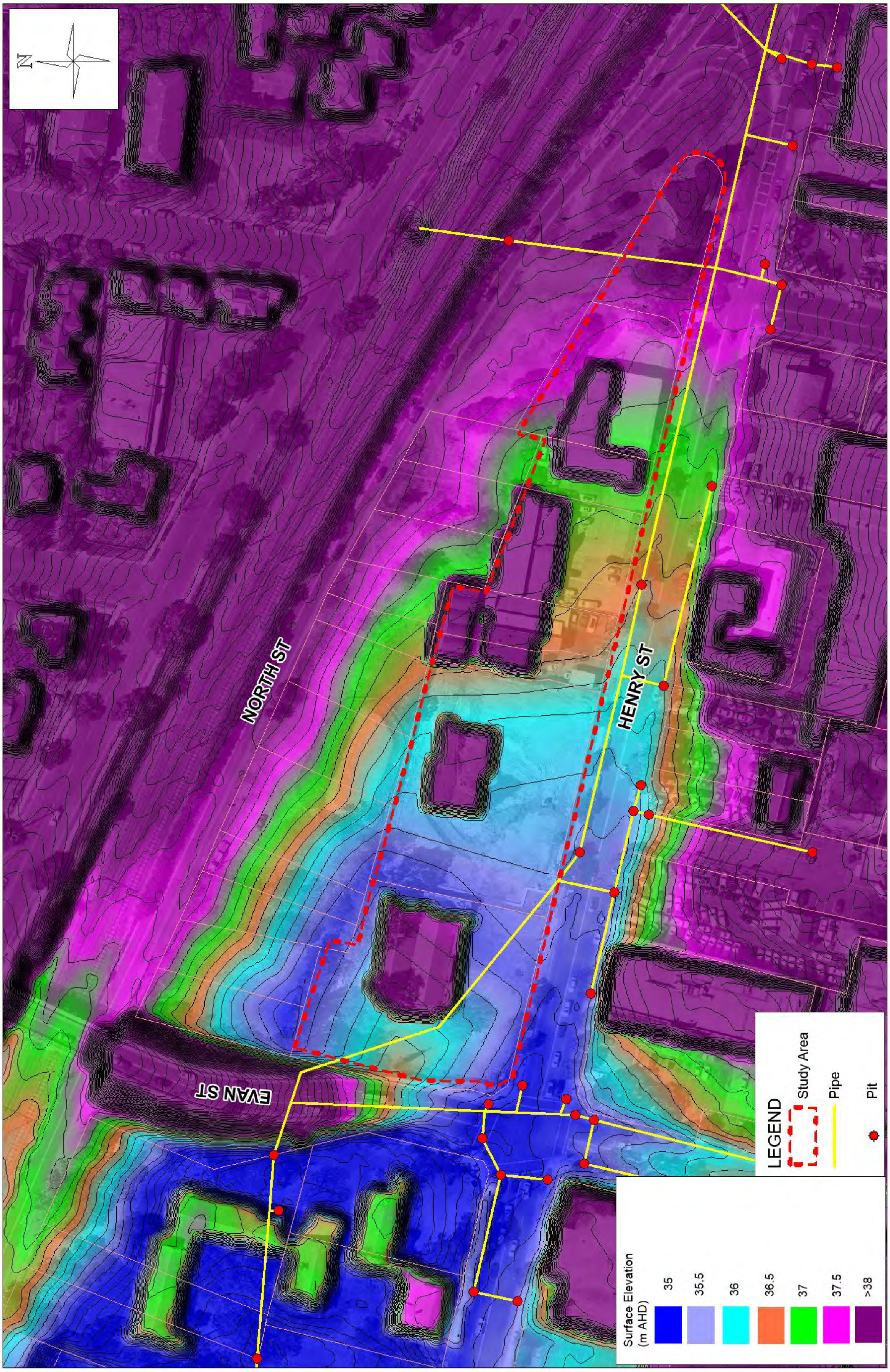


Figure 3-1 **Modelled DTM – Pre-Development**

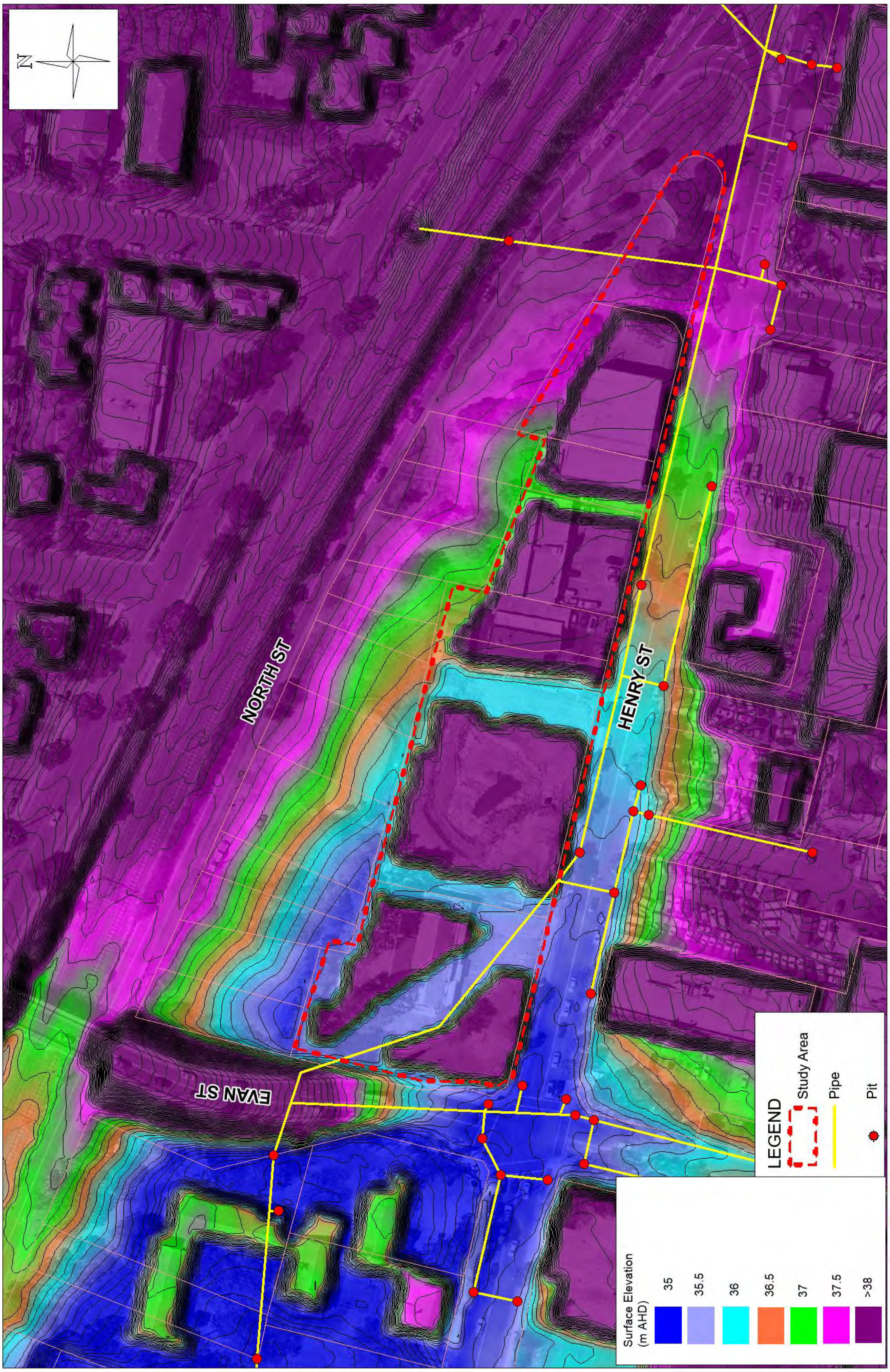


Figure 3-2 Modelled DTM – Post-Development

4 Results

4.1 Flood Behaviour under Pre-Development Scenario

Flood model results for the pre-development scenario for the 1% AEP and PMF event are mapped in the figures listed in **Table 1-1** (figures in **Appendix C**).

Generally in a 1% AEP event, flow is conveyed along Henry Street from east of the site to the intersection with Evan Street. Runoff from the site and the open-space to the north is primarily conveyed to the low-point near the site's north-western boundary. Site runoff flows to Henry Street at a number of locations. High provisional flood hazard conditions are estimated at some locations on Henry Street in a 1% AEP event.

Table 1-1 Figures of Modelled Results – Pre-development

Figure	Modelled Result – Pre-development
Figure C1	Peak 1% AEP Water Level
Figure C2	Peak PMF AEP Water Level
Figure C3	Peak 1% AEP Depth
Figure C4	Peak PMF AEP Depth
Figure C5	Peak 1% AEP Velocity
Figure C6	Peak PMF AEP Velocity
Figure C7	Peak 1% AEP Provisional Hazard
Figure C8	Peak PMF AEP Provisional Hazard

4.2 Flood Behaviour under Post-Development Conditions

Flood model results for the post-development scenario for the 1% AEP and PMF event are mapped in the figures listed in **Table 1-2** (figures in **Appendix C**).

Table 1-2 Figures of Modelled Results – Post-development

Figure	Modelled Result – Post-development
Figure C9	Peak 1% AEP Water Level
Figure C10	Peak PMF AEP Water Level
Figure C11	Peak 1% AEP Depth
Figure C12	Peak PMF AEP Depth
Figure C13	Peak 1% AEP Velocity
Figure C14	Peak PMF AEP Velocity
Figure C15	Peak 1% AEP Provisional Hazard
Figure C16	Peak PMF AEP Provisional Hazard

5 Flood Impact Assessment

5.1 Impact Assessment

The flood modelling is based on a preliminary design terrain and building layout for the planning proposal which would be further defined for the Development Application.

Changes to peak water levels are modelled post-development due to the altered building footprints and ground topography. **Figure C17** (in **Appendix C**) shows the mapped changes to peak water levels post-development compared to pre-development for a 1% AEP event. **Figure C18** shows the peak water level difference in a 1% AEP event for a FSR of 7.5:1 which is unchanged compared to a FSR of 3.5:1 as the building footprint is not altered.

The model estimates areas of increase and decrease on the open-space properties to the north of the site and similarly on Henry Street for the post-development scenario in a 1% AEP event. An increase of up to 0.12m is estimated in the trapped low-point at the north-west boundary of the site. Runoff ponds at this location up to a maximum depth of 0.7m.

Generally, Henry Street is inundated by flood depths above 0.1m along the site frontage in pre-development conditions for the 1% AEP event. A maximum increase on Henry Street post-development of up to 0.12m is modelled at one location between Block C and Block D. An increase of up to 0.05m is estimated at the boundary of 52 Henry Street, noting this building has a solid wall at the street frontage. At the boundary of 30 Henry Street, an increase of up to 0.04m is estimated. The provisional hazard on Henry Street does not change significantly from the pre-development modelled results which some high hazard areas.

5.2 Mitigation Options

The estimated impacts to peak flood levels post-development in a 1% AEP event are modest and if needed could be mitigated by implementation of changes to the building, landscape and/or post-development ground levels. This would be assessed during the design development for a Development Application.

Mitigation options could include one or a combination of the options shown in **Figure 5-1**:

- Storage basin at the south-east corner of the site;
- Flowpaths along the northern edge and on access roads between buildings to control / divert overland flows;
- Rooftop storage; and/or
- Shallow storage between the ground level and the ground floor of Building A.

The primary aim would be to mitigate potential adverse impacts to any properties fronting Henry Street.

5.3 DCP Controls

Penrith City Council DCP 2014 Section C3 – Water Management provides the relevant controls for flood impact assessments. 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% AEP (1:100 Average Recurrence Interval (ARI)) flood event plus 0.5 m freeboard.

Council's DCP lists requirements, such as finished floor levels, basement entries, construction materials, services, evacuation, and safety that can be reviewed at the development application stage when the proposed works are further defined.

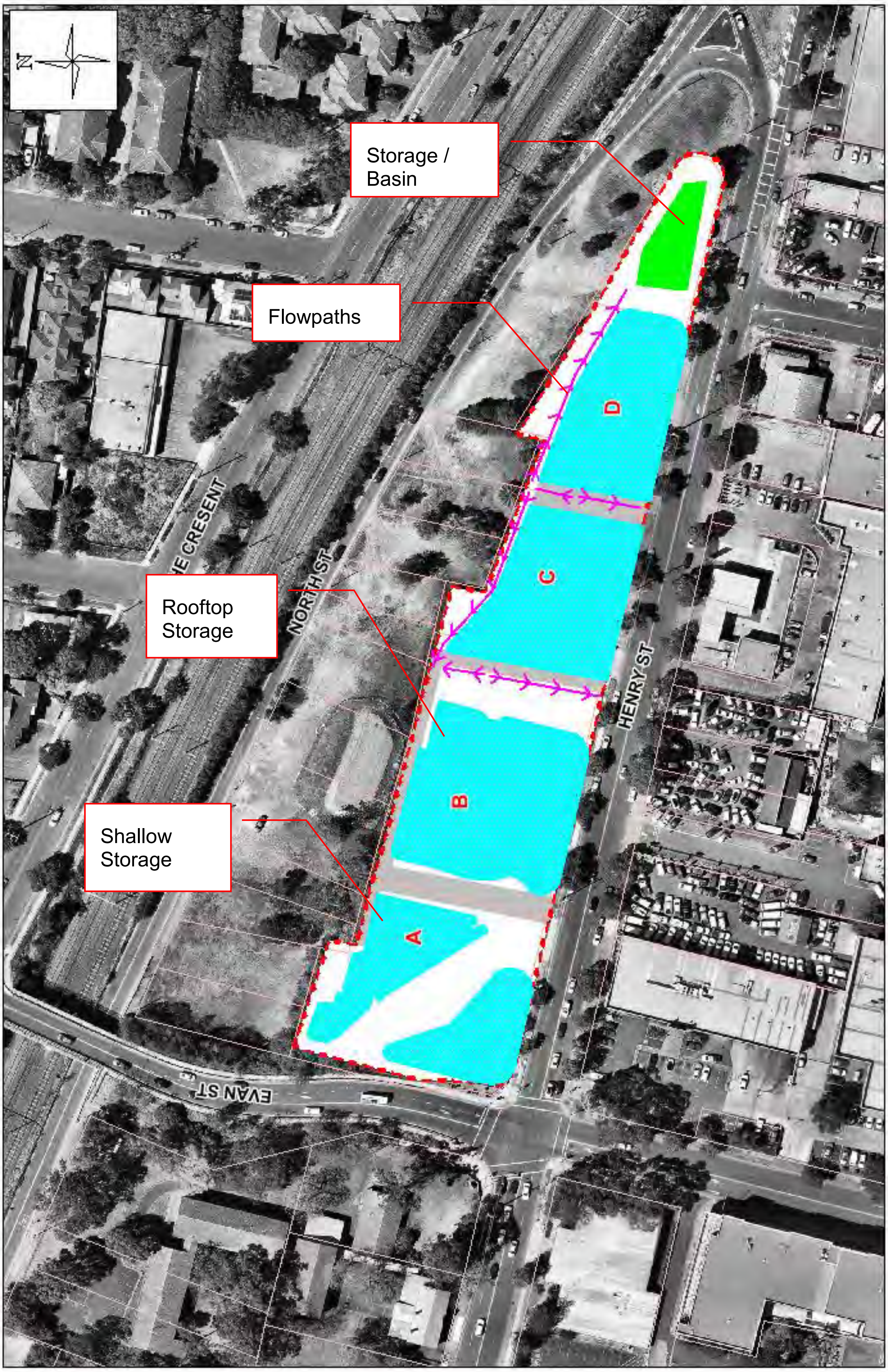


Figure 5-1 Potential Mitigation Options

6 References

Penrith City Council (2014). *Penrith Development Control Plan 2014.*

Cardno (2015). *Penrith Detailed Overland Flow Flood Study.*

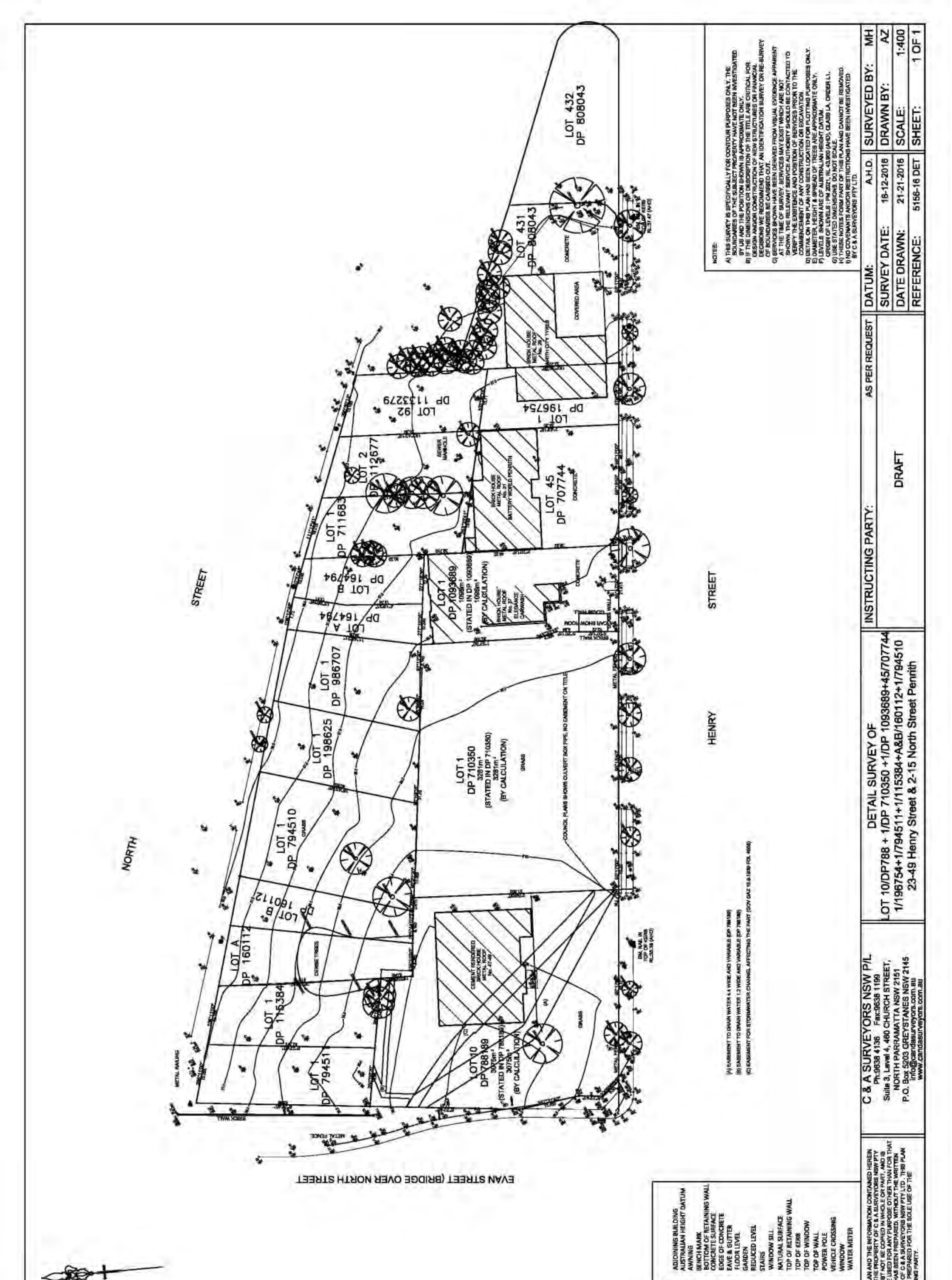
Department of Infrastructure, Planning and Natural Resources (2005). *Floodplain Development Manual.*

23-49 Henry Street, Penrith

APPENDIX

A

GROUND SURVEY



Ground Survey by C & A Surveyors NSW P/L

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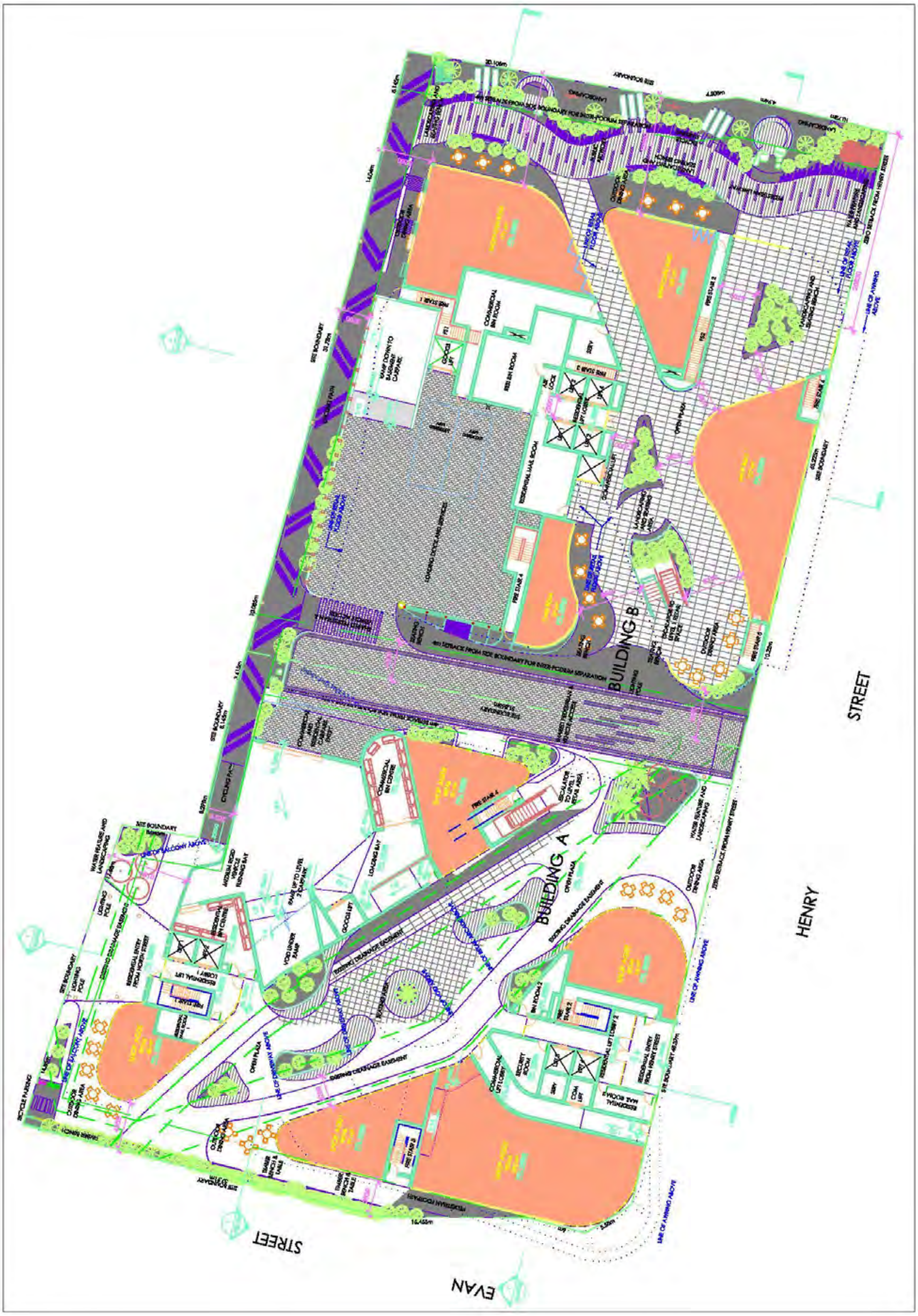
APPENDIX B

PROPOSED DEVELOPMENT PLAN

Proposed Design by Australian Consulting Architects



Proposed Design by Australian Consulting Architects

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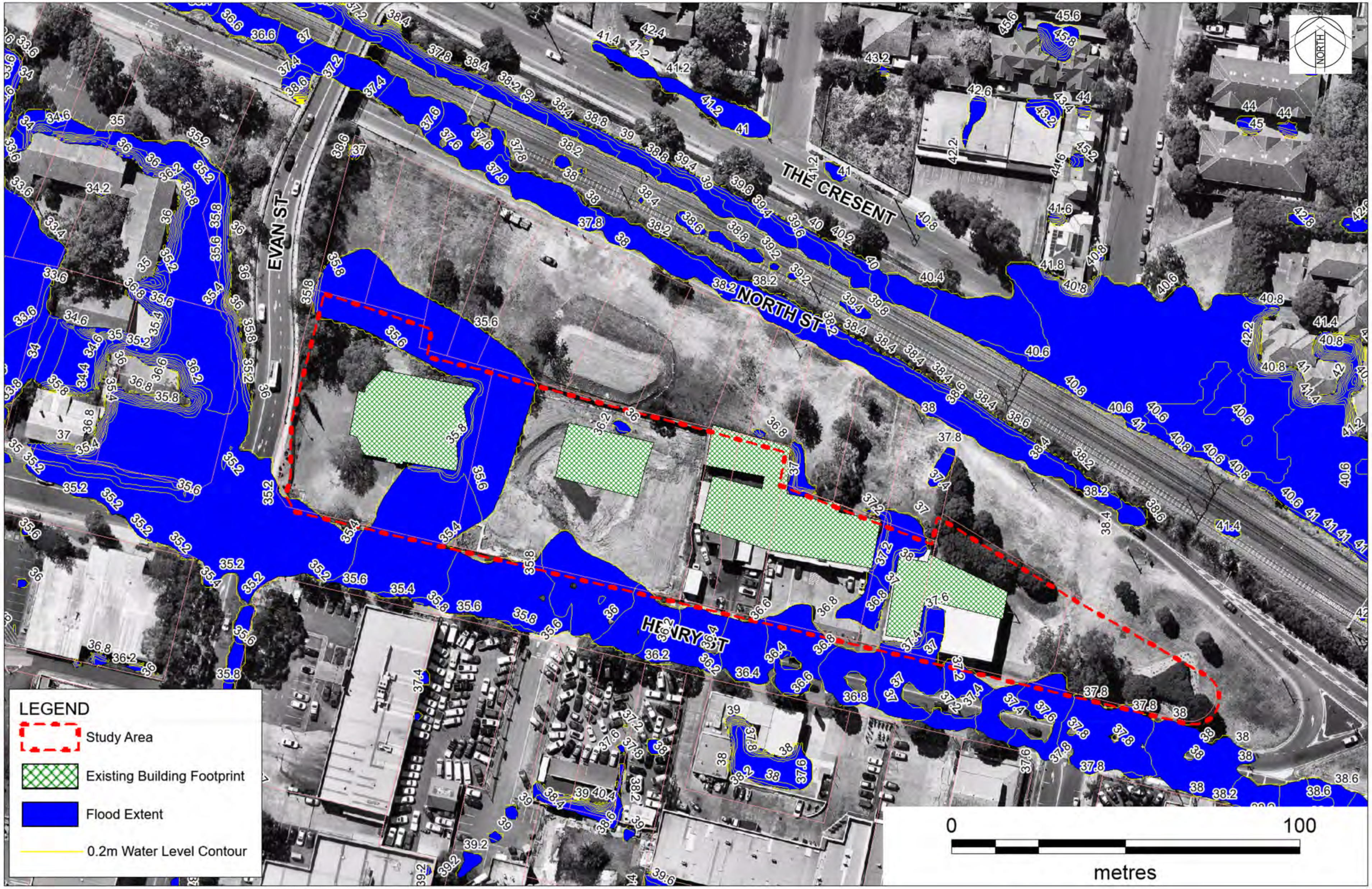
APPENDIX

C

FIGURES



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Note

Results shown for depth greater than 0.10 m

Figure C1 - 1% AEP Peak Water Level Pre - Development

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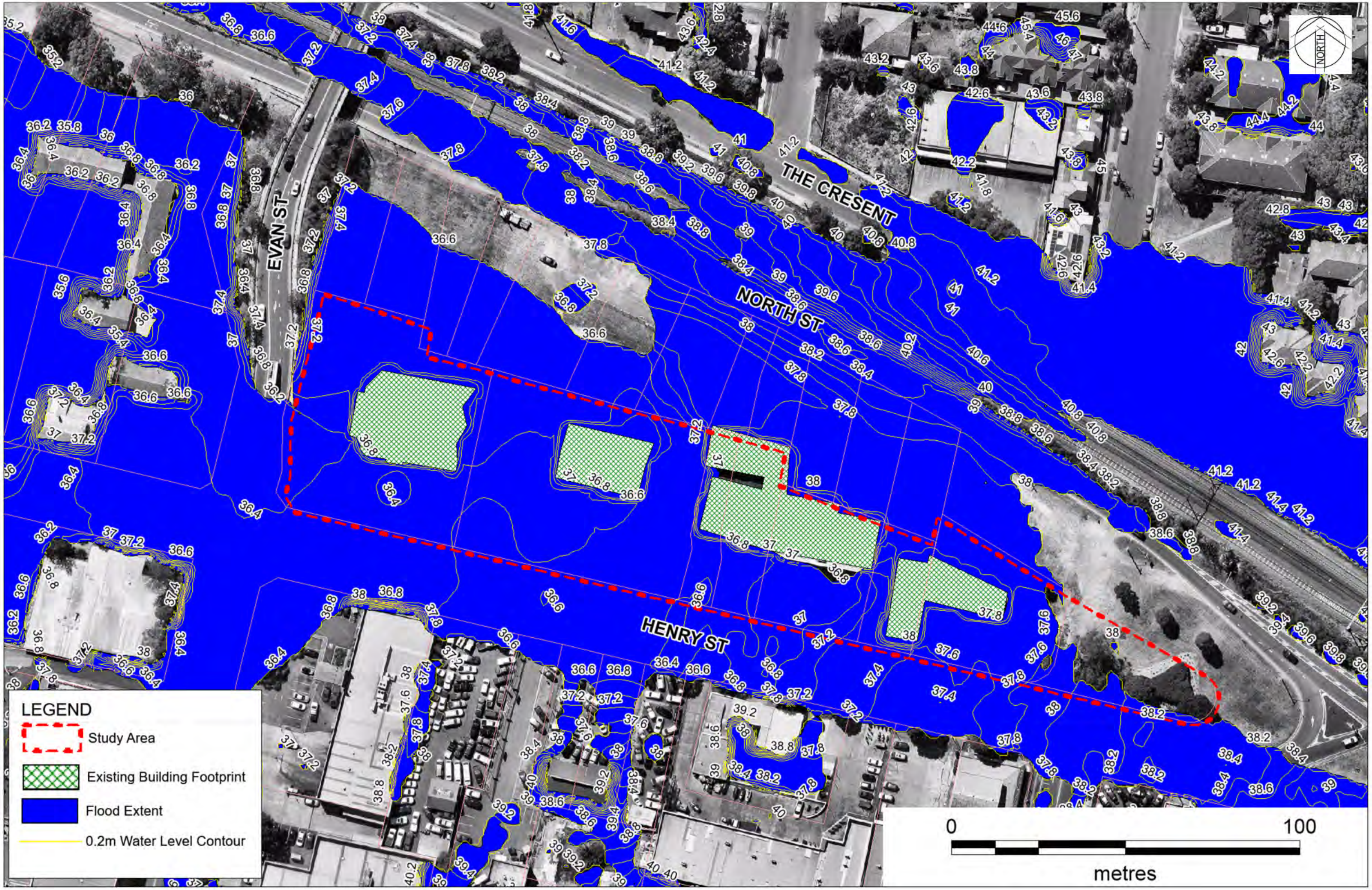

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Note

Results shown for depth greater than 0.10 m

Figure C2 - PMF Peak Water Level Pre - Development

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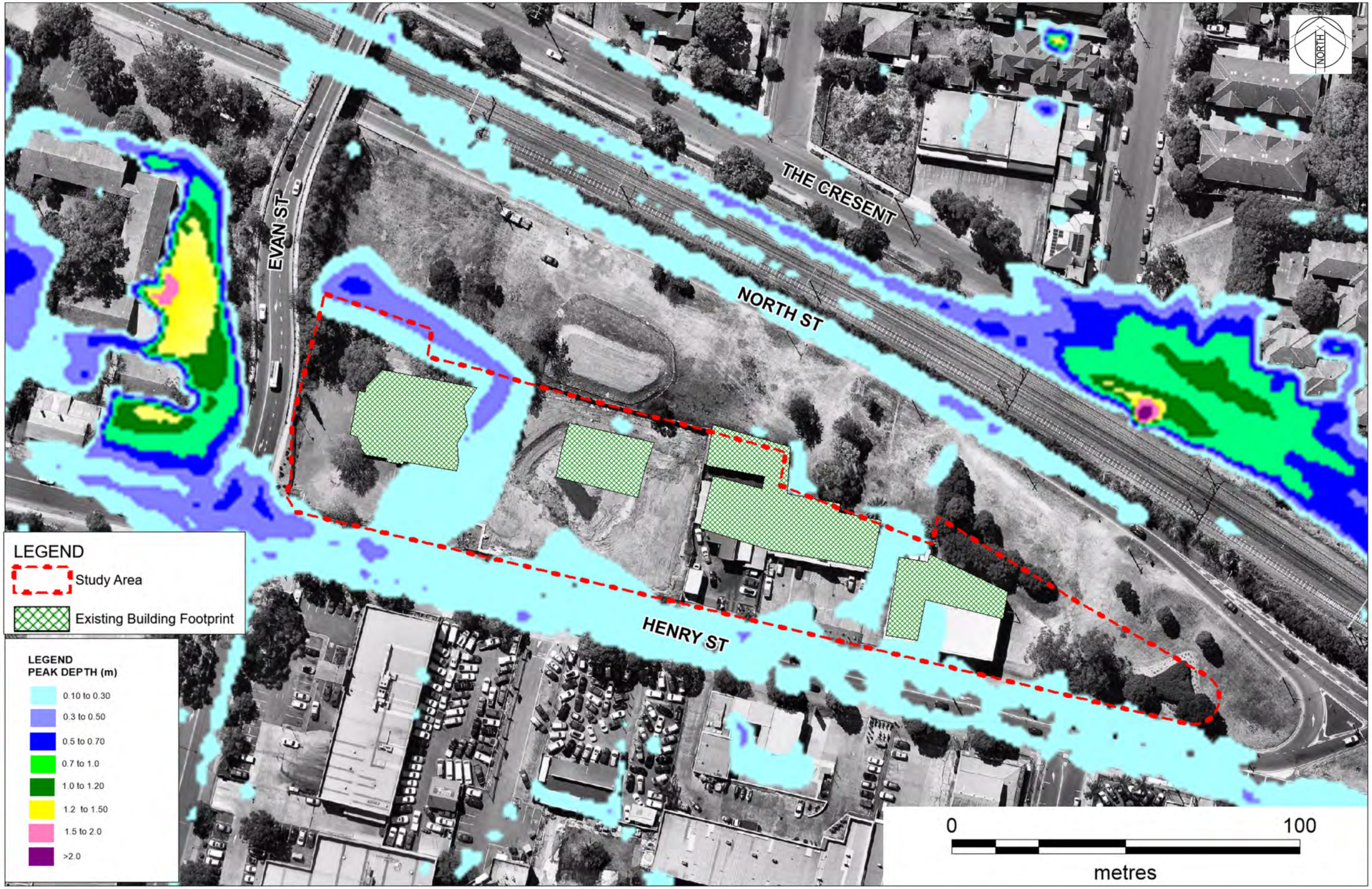

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Figure C3 - 1% AEP Peak Depth
Pre - Development

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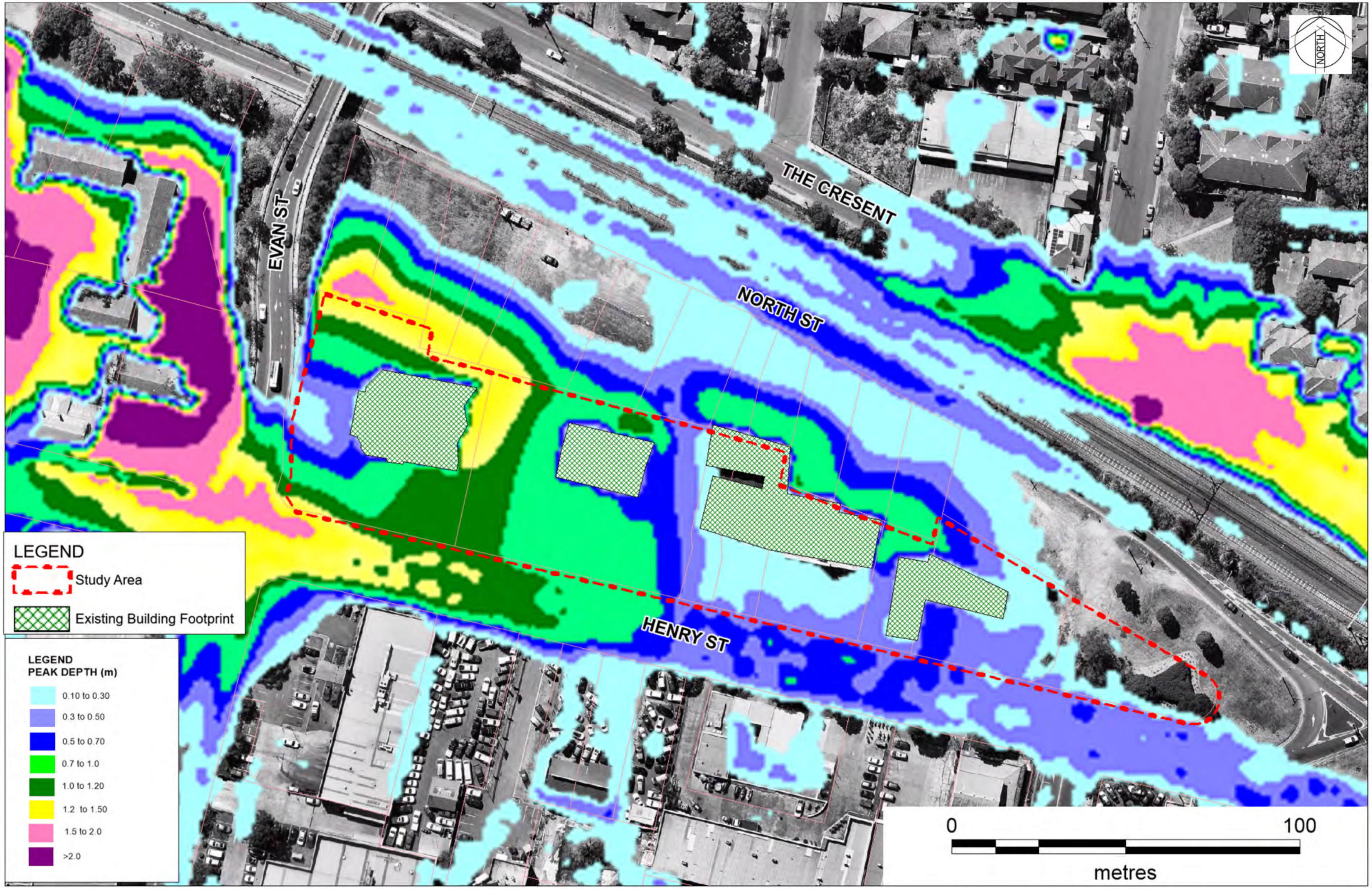

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Figure C4 - PMF Peak Depth
Pre - Development

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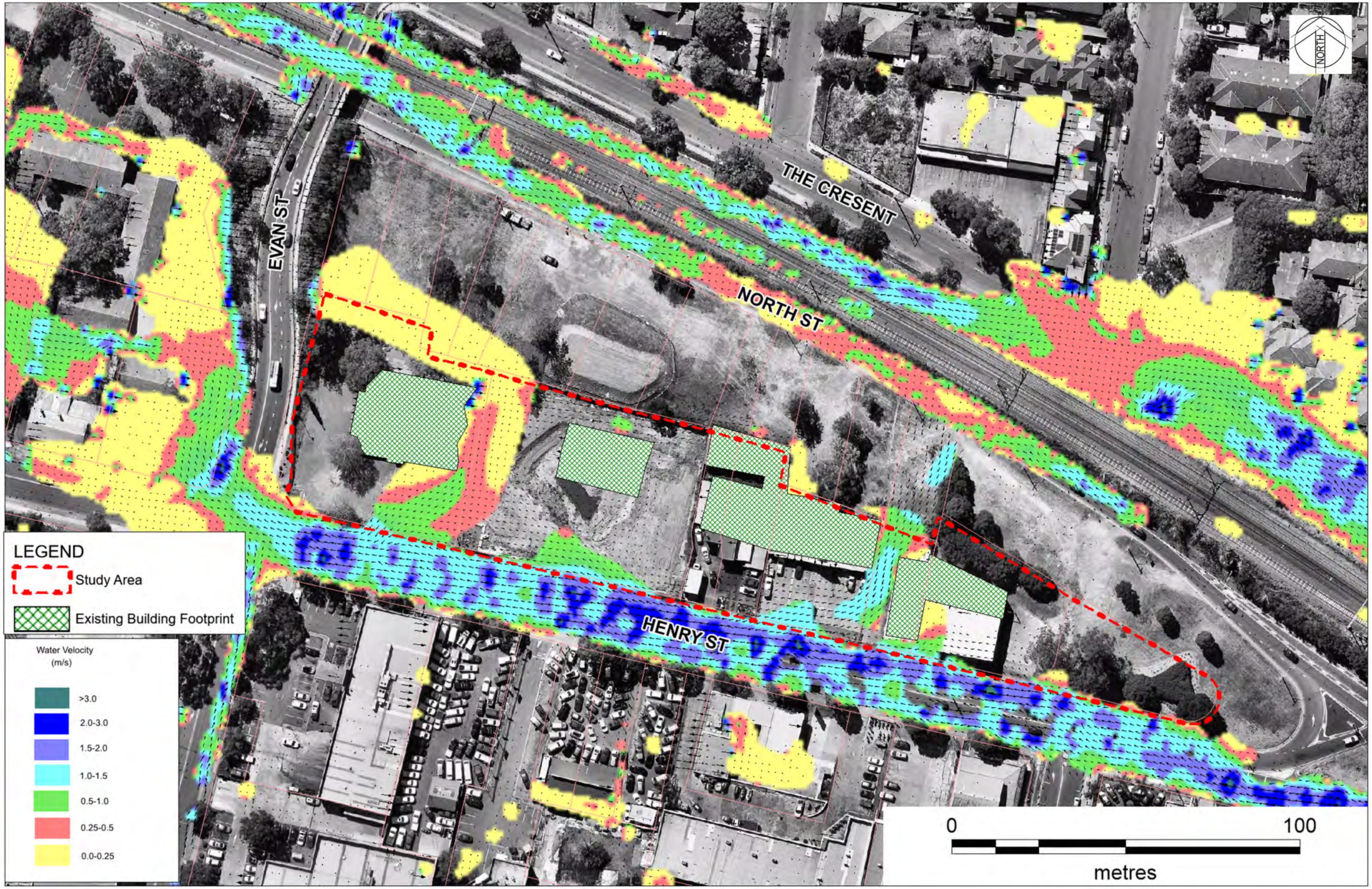

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Figure C5 - 1% AEP Peak Velocity
Pre - Development

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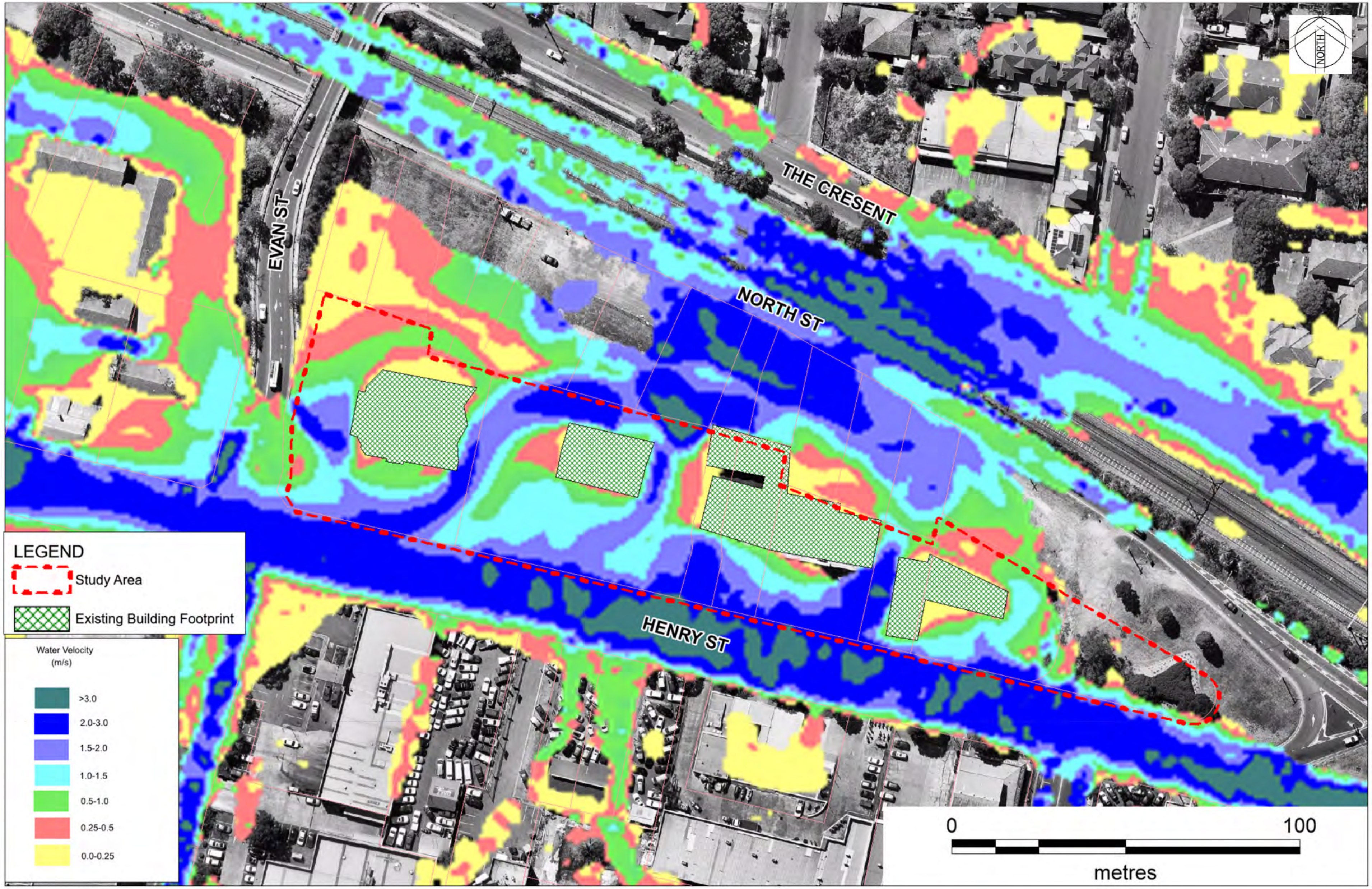

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Figure C6 - PMF Peak Velocity Pre - Development

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Results shown for depth greater than 0.10 m

Figure C7 - 1% AEP Provisional Hazard
Pre - Development

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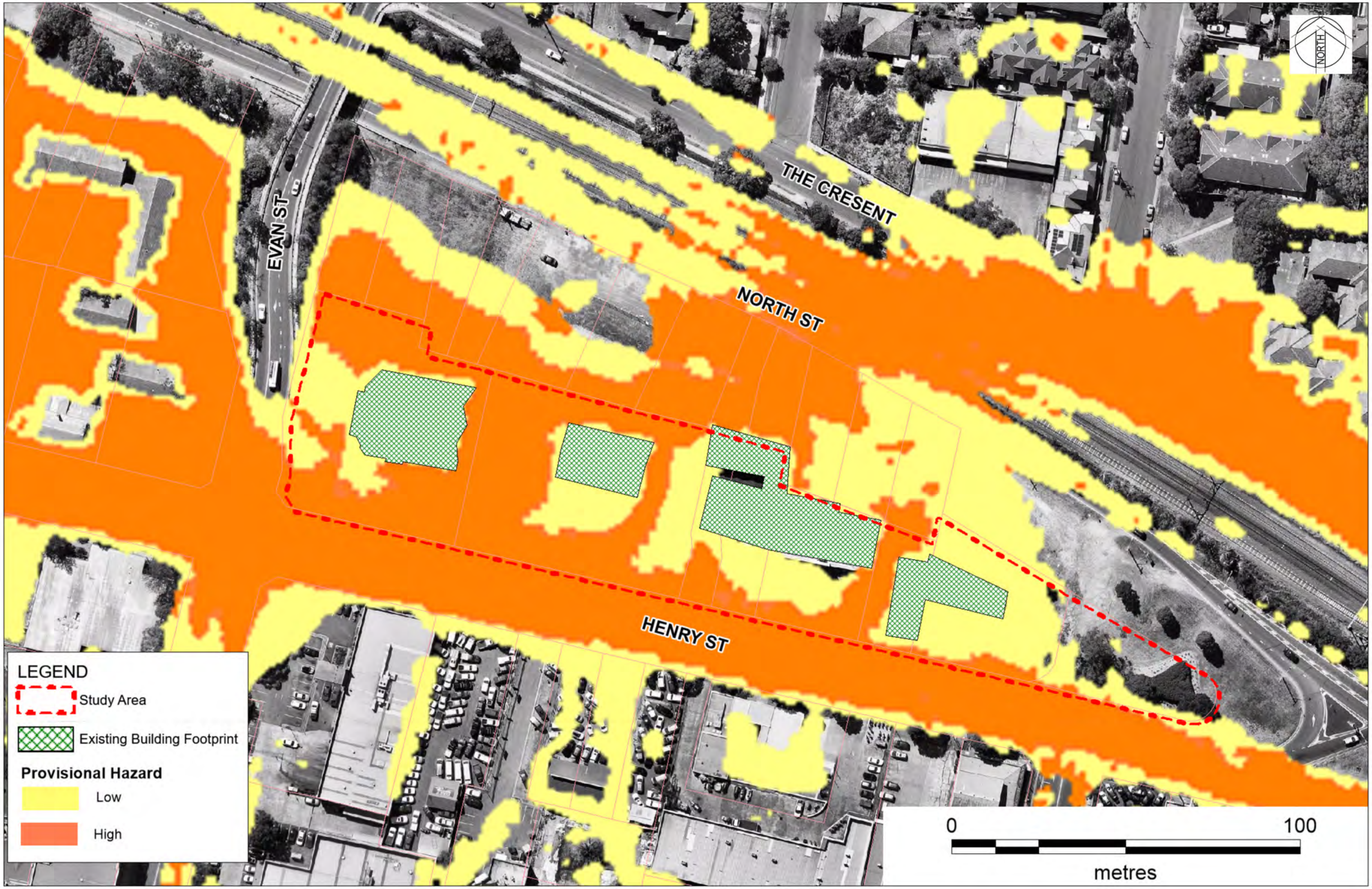

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Figure C8 - PMF Provisional Hazard
Pre - Development

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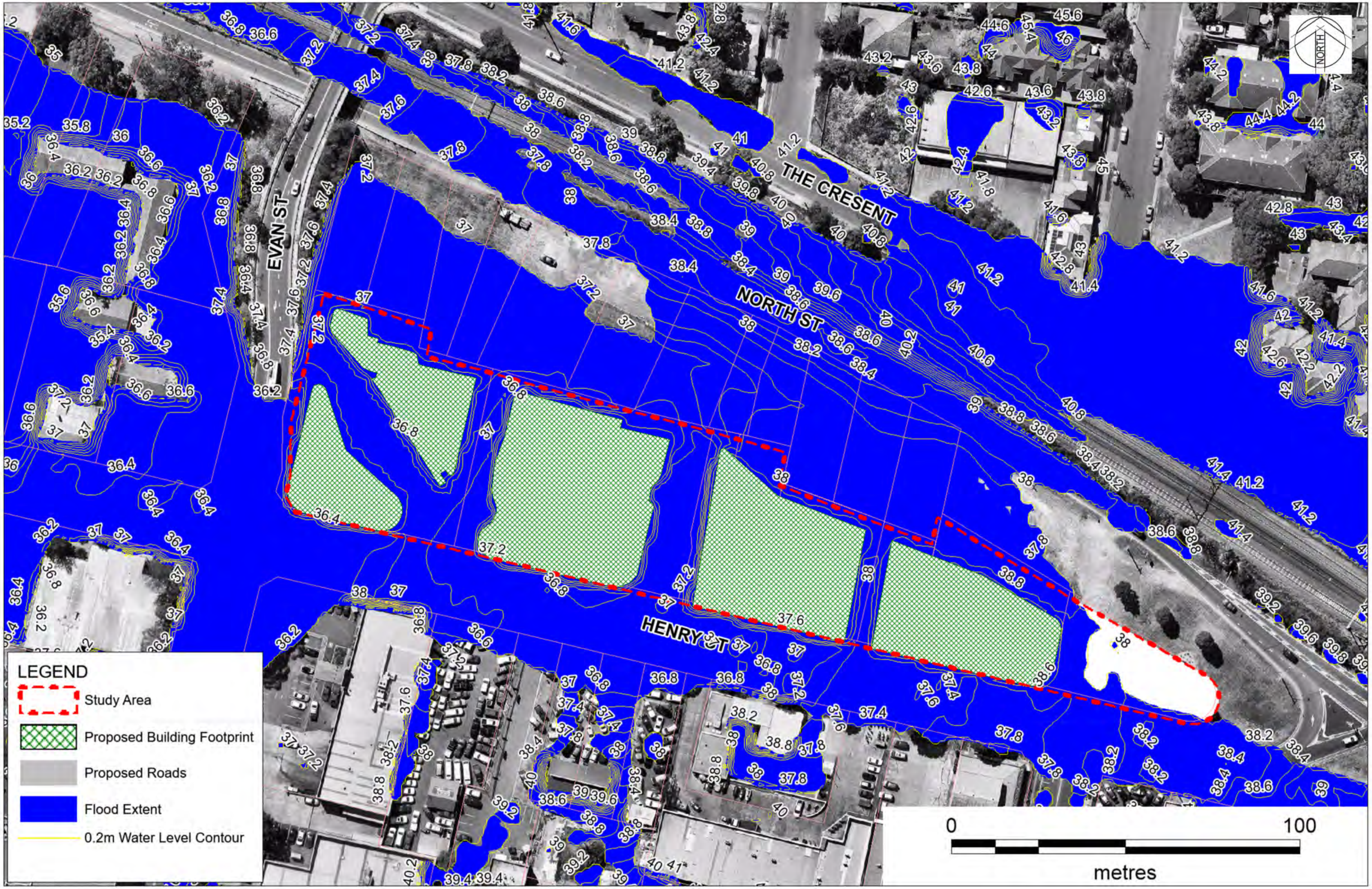

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Note
Results shown for depth greater than 0.10 m

Figure C9 - 1% AEP Water Level Post - Development

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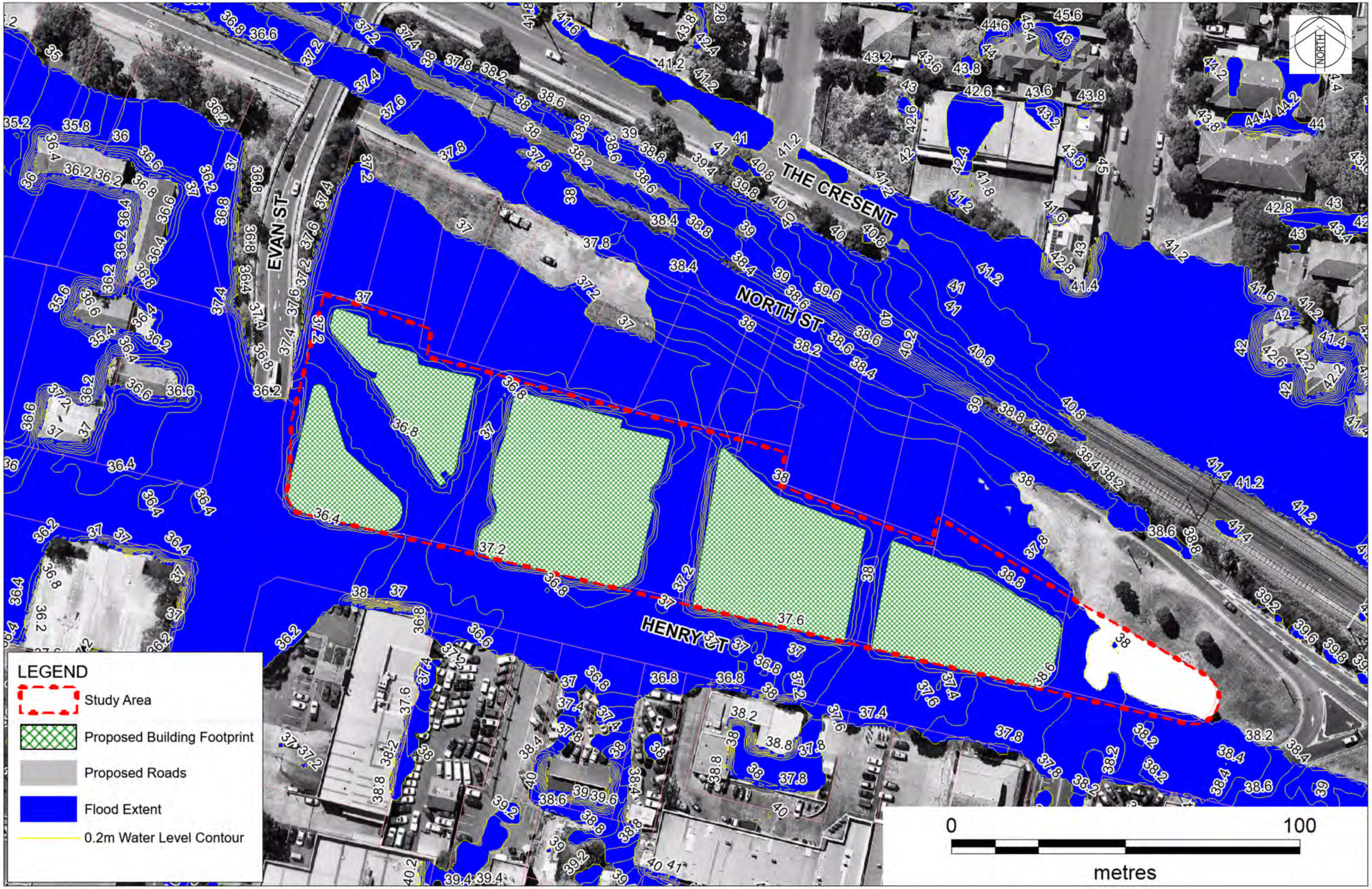

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Figure C10 - PMF Peak Water Level Post - Development

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Figure C11 - 1% AEP Depth Post - Development

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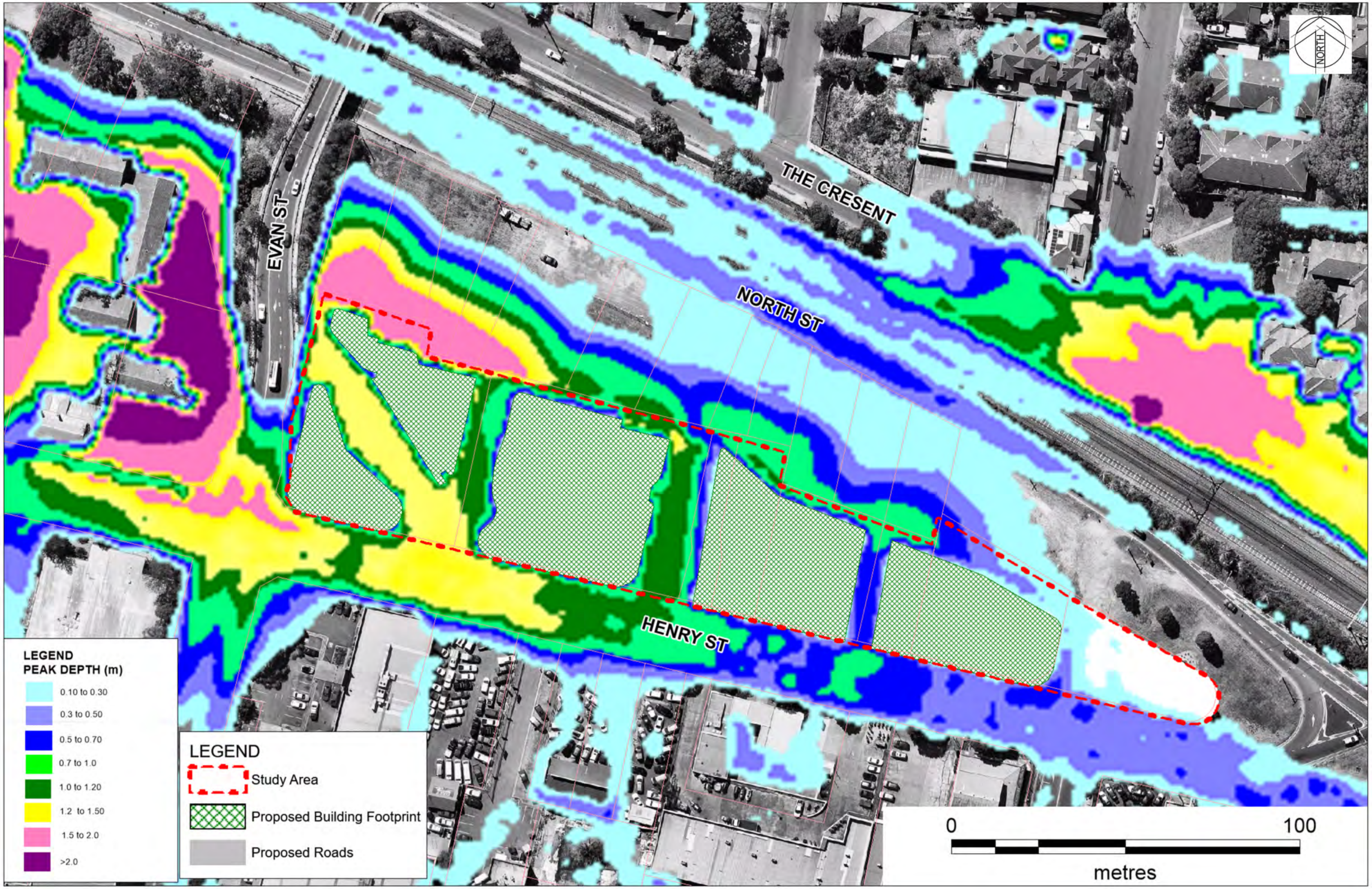

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Figure C12 - PMF Peak Depth Post - Development

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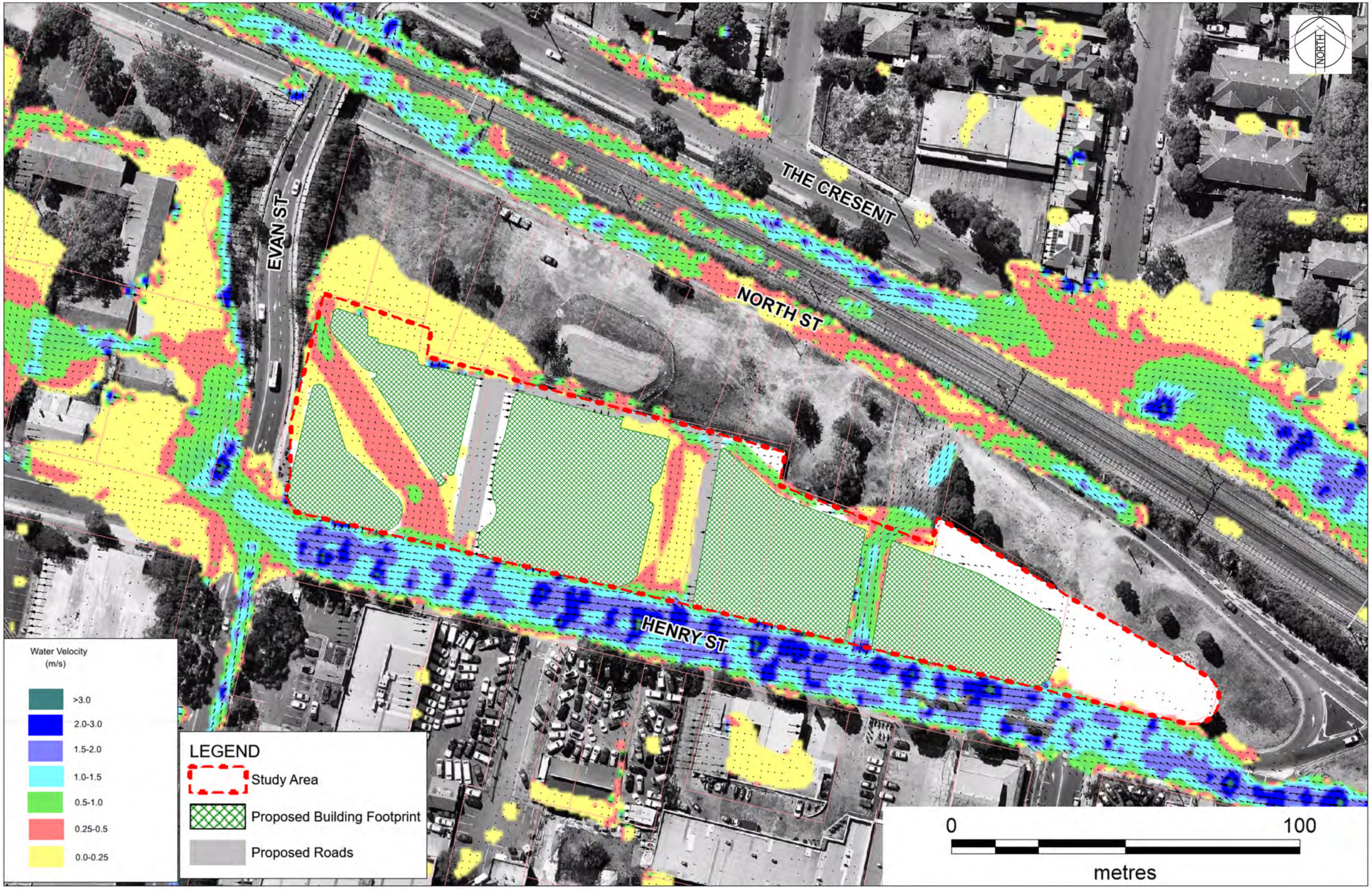

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Note

Results shown for depth greater than 0.10 m

Figure C13 - 1% AEP Peak Velocity Post - Development

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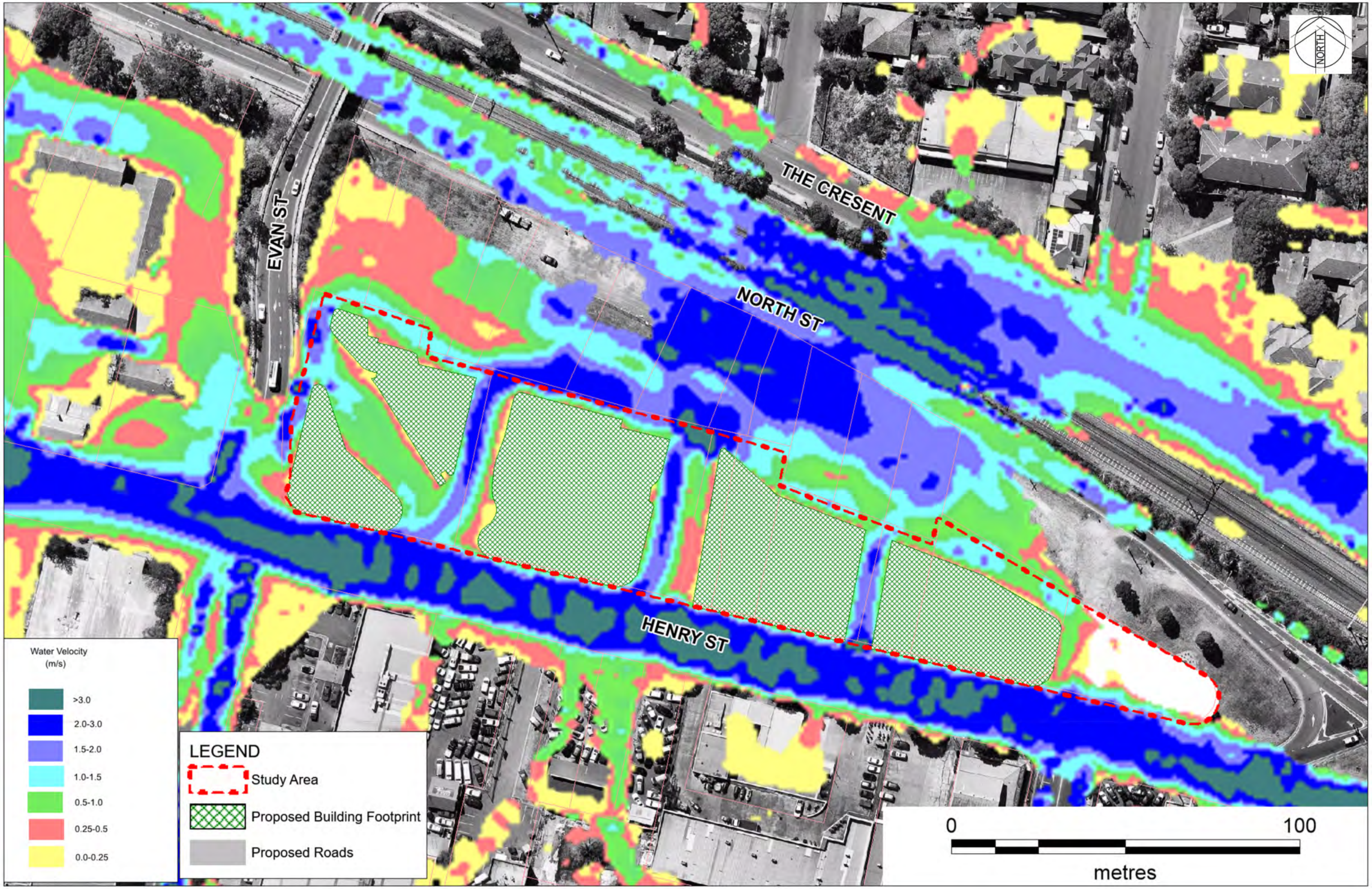

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Figure C14 - PMF Peak Velocity Post - Development

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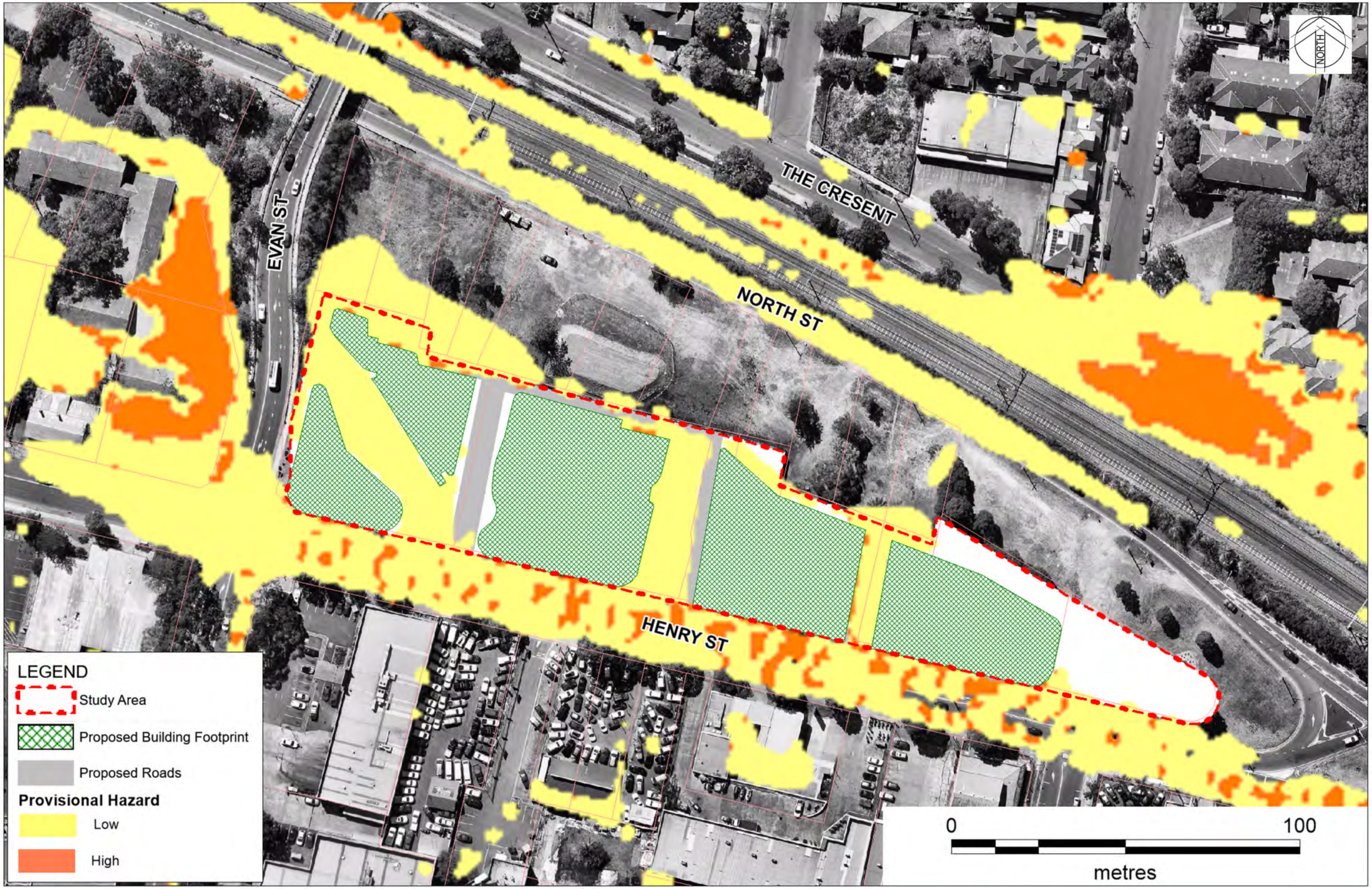

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Figure C15 - 1% AEP Provisional Hazard Post - Development

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Figure C16 - PMF Provisional Hazard Post - Development

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Results shown for depth greater than 0.10 m

Figure C17 - 1% AEP Peak Water Level Difference Post- (FSR 3.5) Minus Pre-Development

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Figure C18 - 1% AEP Peak Water Level Difference Post- (FSR 7.5) Minus Pre-Development

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