

APPENDIX J

Flood Impact Assessment prepared by Engeny

brazier motti





PREMISE AUSTRALIA PTY LTD

Northshore Commercial Town Centre

Hydraulic Impact Assessment

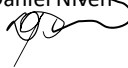
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11 MARCH 2026

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	27/02/2026	Client Issue	Simon Tang	Daniel Niven	Simon Tang	Daniel Niven
1	11/03/2026	Client Issue	Simon Tang	Daniel Niven	Simon Tang	Daniel Niven
Signatures:						

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1. INTRODUCTION

Engeny Australia Pty Ltd (Engeny) has been commissioned by Premise Australia Pty Ltd (Premise) to undertake a Hydraulic Impact Assessment (HIA) to support the proposed development of the commercial town centre at North Shore, Townsville (herein referred to as the Site). The Site is located within the Townsville City Council (TCC) Local Government Area (LGA) and is situated within the Bohle River floodplain. Based on cadastral boundary mapping, the Site is located across Lot 869 on SP248845 and Lot 2506 on SP333142 refer to Figure 1.1. This report outlines the current flooding conditions at the Site and assesses the potential impacts associated with the proposed development.

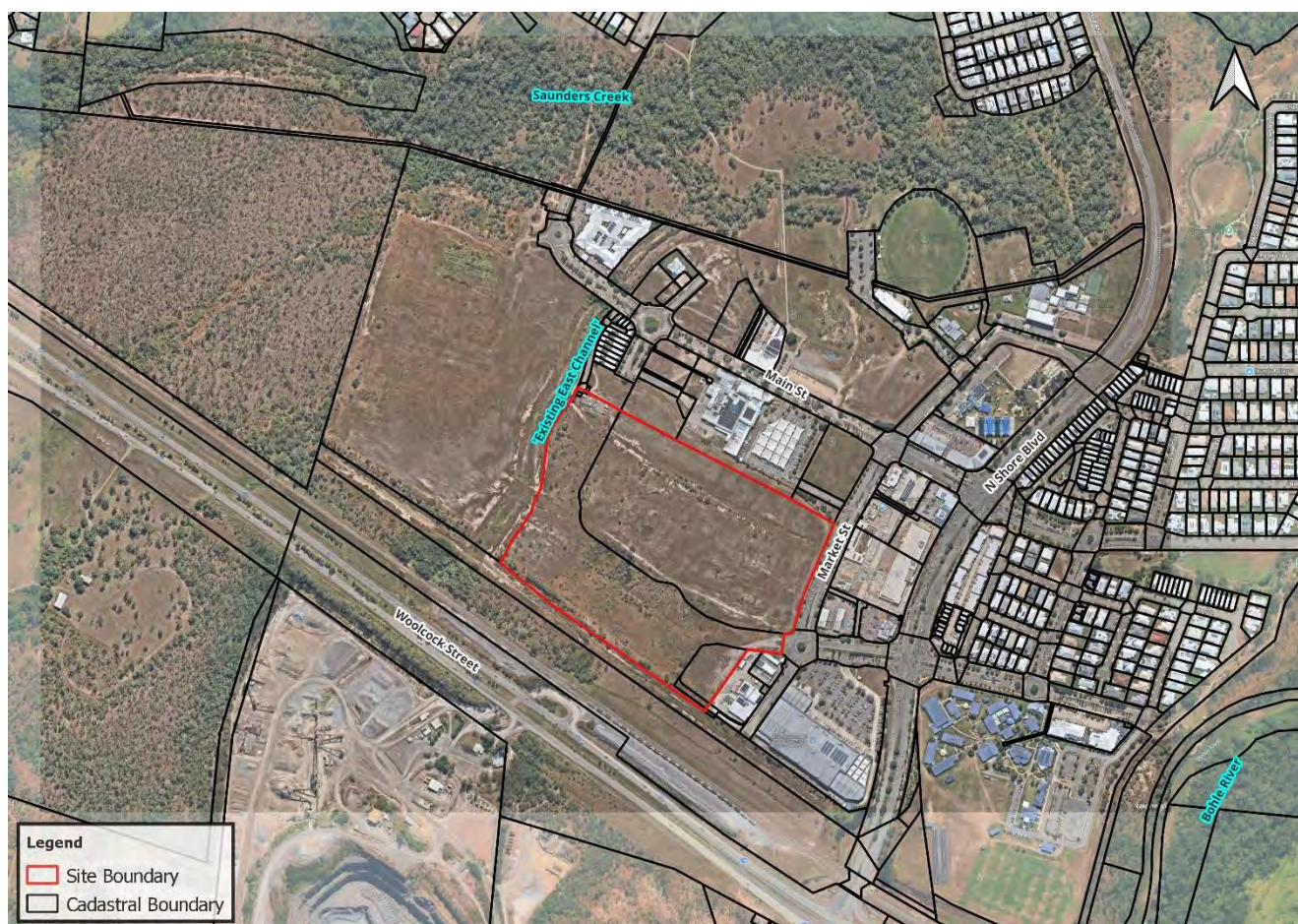


Figure 1.1: Site Locality

1.1 Project Scope

This HIA aims to quantify changes in flooding conditions resulting from the proposed development across Lot 869 on SP248845 and Lot 2506 on SP333142 and to identify any mitigation measures required to ensure compliance with Townsville City Council (TCC) flood planning requirements. The scope of works for this assessment includes the following:

- Review the 2023 Bohle River Flood Study hydrologic and hydraulic models (Water Technology, 2023).
- Simulate the existing flooding conditions for the 50%, 10% and 1% AEP design storm events.
- Update the hydraulic model to represent the proposed developed conditions and simulate for the above design events.
- Assess potential Impacts created by the proposed development.
- Prepare a HIA report outlining methodology, results, and recommendations

1.2 Data Sources and Inputs

In the preparation of this report, information was gathered from the following sources:

- Hydrologic and hydraulic models from the 2023 Bohle River Flood Study (Water Technology, 2023), obtained from TCC.
- Proposed site layout, supplied by the client.
- Latest survey data at the site, supplied by client.
- Aerial Imagery obtained from Nearmap (accessed January 2026).

1.3 Applicable Guidelines and References

The guidelines, standards and codes considered during the assessment were as follows:

- Townsville City Plan, including the Floodplain Management Overlay Code.
- Australian Rainfall and Runoff 2019 (ARR).

Reference documents relevant to this assessment are:

- Bohle River Flood Study Report (Water Technology, 2023).

2. HYDRAULIC MODELLING METHODOLOGY

The 2023 Bohle River Flood Study TUFLOW hydraulic model was reviewed and adapted for use in this assessment. Hydraulic modelling was undertaken using this existing model as the baseline, with simulations prepared for both existing and developed case scenarios. Updates were applied to reflect the proposed Site conditions, and all scenarios were assessed for the 50% AEP, 10% AEP, and 1% AEP design storm events.

2.1 Existing Case Scenario Model

The existing case scenario represents current catchment and floodplain conditions based on the 2023 Bohle River Flood Study TUFLOW model. Hydrologic inflows, land use and hydraulic structures remain consistent with the adopted flood study model.

Topographic information within the site has been updated using survey data provided by the client to reflect the latest surface conditions. The remainder of the model topographical information remains unchanged from the adopted flood study. Figure 2.1 presents the extent of the adopted survey data incorporated within the model and Figure 2.7 presents the updated existing topography conditions with survey information. It is noted that the site conditions at the time of preparing this report is modified due to prior fill associated with the North Shore master plan development.

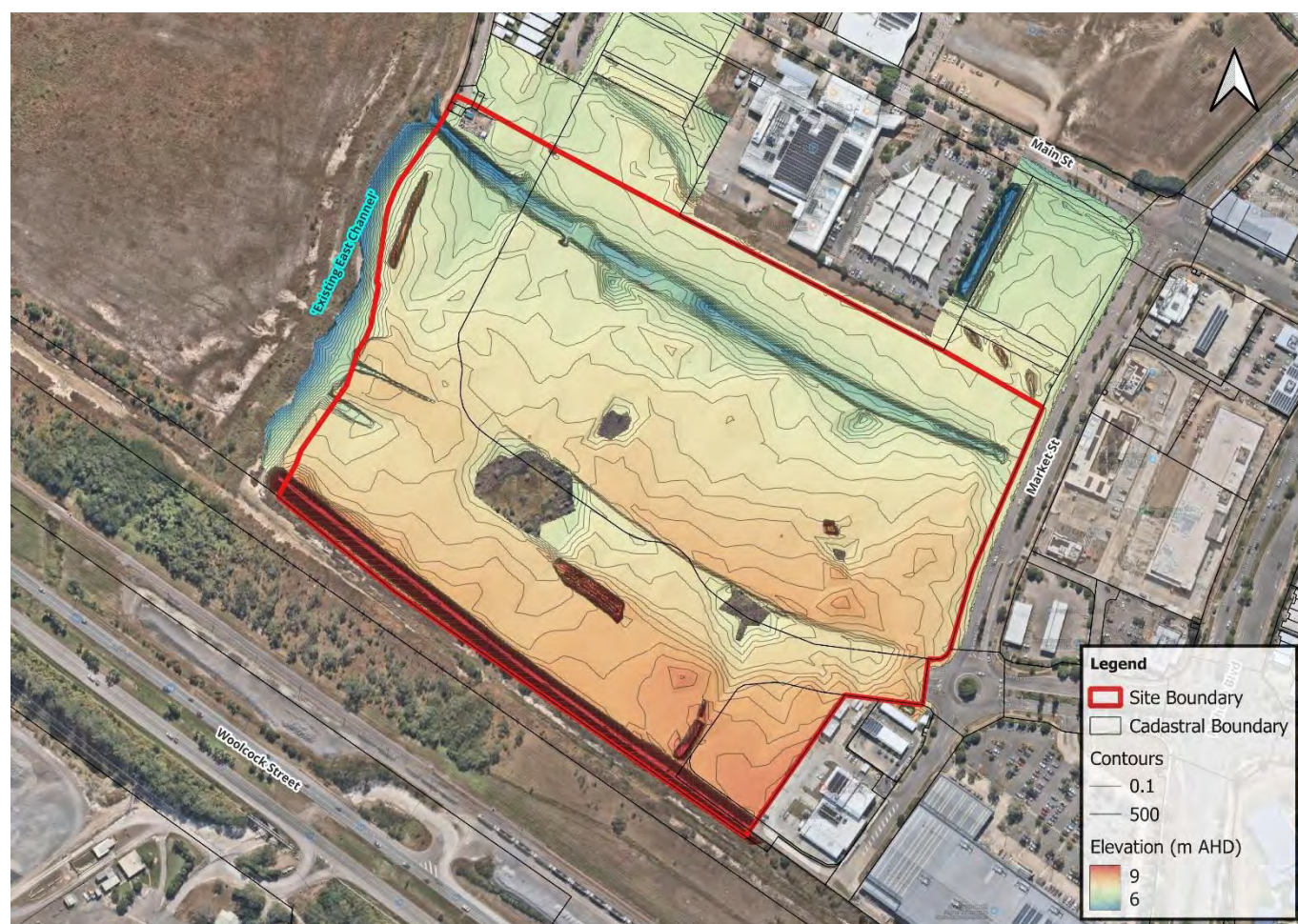


Figure 2.1: Survey Data

Model simulations were undertaken for the 50%, 10%, and 1% AEP design storm events using the durations and temporal patterns adopted in the Bohle River Flood Study. A summary of the modelled durations and associated temporal patterns are provided in Table 2.1.

TABLE 2.1: CRITICAL STORMS MODELLED PER DESIGN EVENT (BOHLE RIVER FLOOD STUDY, 2023)

AEP	Durations	Temporal Pattern Bin
50%	30min TP6, 45min TP7, 60min TP6, 90min TP6, 120min TP7, 180min TP2, 360min TP8, 540min TP6, 1440min TP10	Intermediate (Point)
10%	30min TP6, 45min TP7, 60min TP6, 90min TP6, 120min TP7, 180min TP2, 360min TP8, 540min TP6, 1440min TP10	Intermediate (Point)
1%	30min TP6, 45min TP7, 90min TP1, 120min TP4, 180min TP7, 270min TP10, 360min TP4, 1080min TP1	Rare (Point)

Following simulation in TUFLOW, flood results were post processed to determine the critical duration for each design event by identifying the maximum flood level observed at each location across all simulated storm durations. These critical durations were then adopted for the developed case scenario to reduce simulation time while maintaining a conservative assessment of flood impacts.

The adopted critical durations at the Site are summarised in Table 2.2, with corresponding critical duration maps for all tested events shown in Figure 2.2 to Figure 2.4.

TABLE 2.2: CRITICAL STORMS ADOPTED AT THE SITE

AEP	Durations	Temporal Pattern Bin
50%	30min TP6, 180min TP2, 1440 TP10	Intermediate (Point)
10%	30min TP6, 90min TP6, 120min TP7	Intermediate (Point)
1%	90min TP1, 360min TP4	Rare (Point)

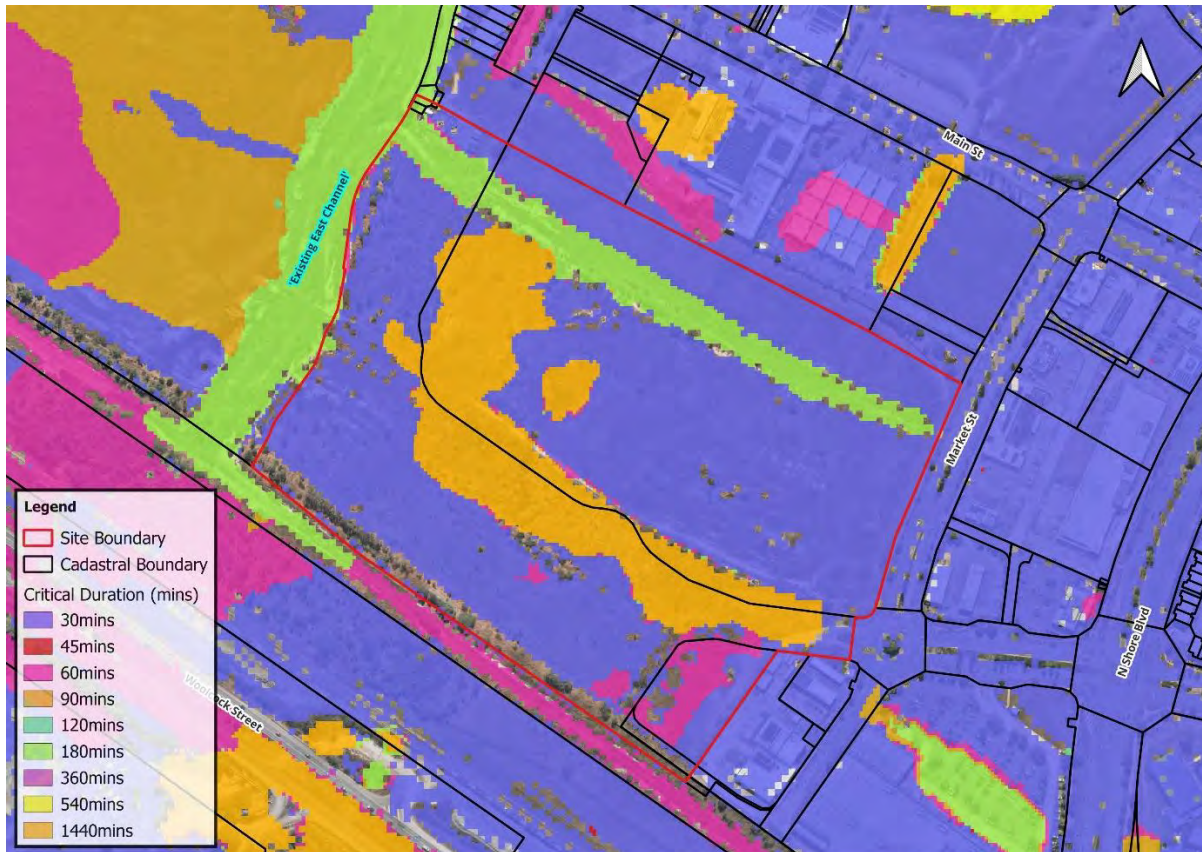


Figure 2.2: 50% AEP – Critical Duration at Site

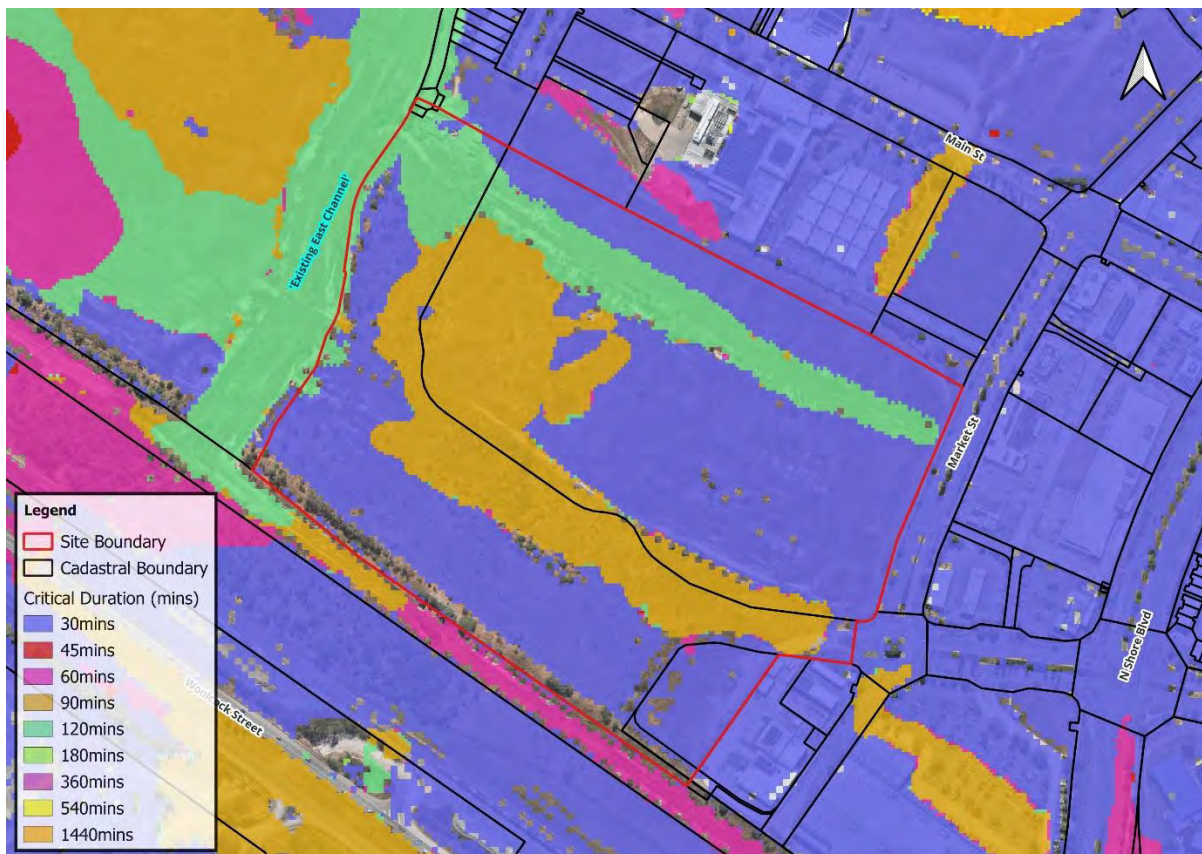


Figure 2.3: 10% AEP – Critical Duration at Site

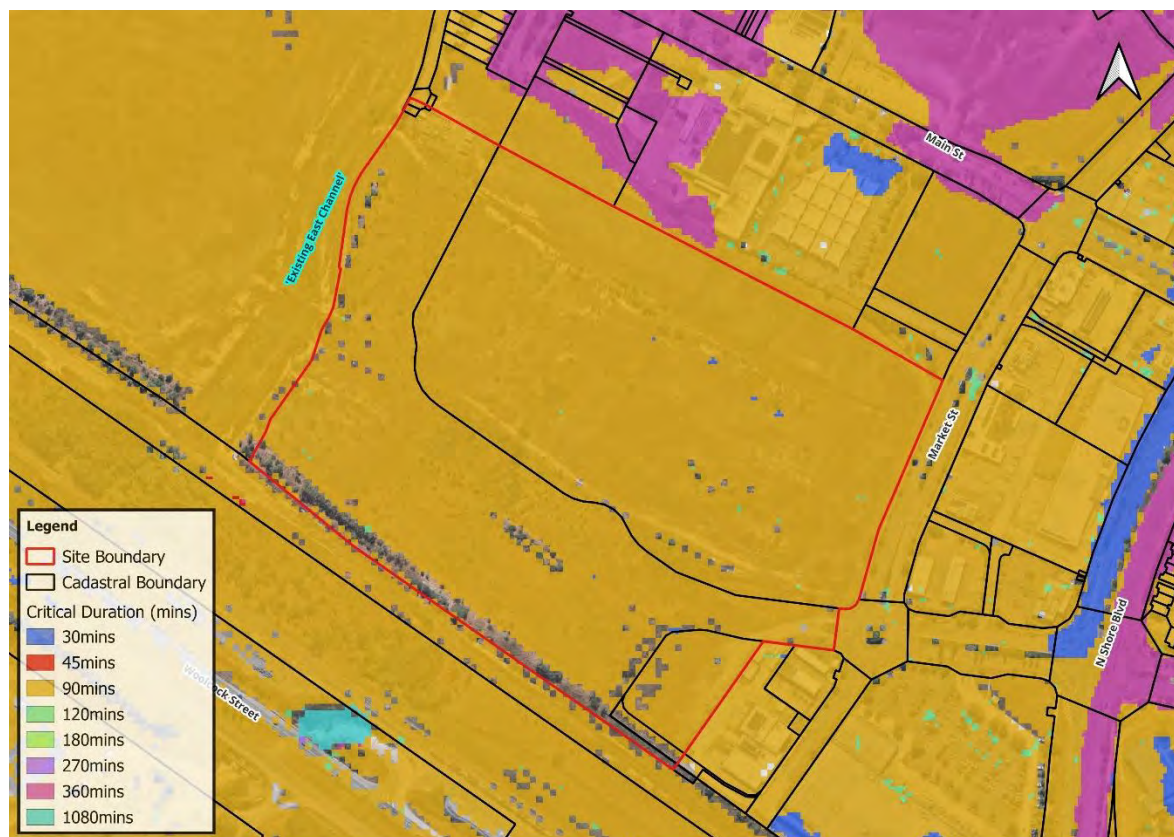


Figure 2.4: 1% AEP – Critical Duration at Site

2.2 Developed Case Scenario Model

The developed case scenario was created by modifying the existing model to reflect the proposed development footprint and associated drainage features. The key updates implemented in the model are summarised below:

2.2.1 Site Filling and Excavation

In the absence of a detailed design surface, the proposed fill was incorporated using TUFLOW's 2D z-shape (2d_zsh) layers to modify the existing topography. The developable area was raised to ensure all finished surface levels are located above the 1% AEP flood level from the existing case scenario, with an additional 300 mm freeboard allowance applied to meet flood immunity requirements. The extent of the raised area was defined based on the proposed lot plan supplied by the client.

The fill surface was graded to generally follow the indicative sub-catchment boundaries provided by the client. Figure 2.5 shows the proposed catchment boundaries for the Site and Figure 2.8 presents the developed topography. The main entry road to the Site was modelled to tie into the existing road network at east of the development and to ramp upward into the filled development area, maintaining connectivity with the existing road.

Excavation works are proposed within the existing channel west of the Site which is located within land owned by the developer of the Site, to increase channel capacity and offset the additional runoff generated by the proposed development. The extent of the proposed excavation work of the Channel is shown in Figure 2.5 and Figure 2.8 presents the developed topography.

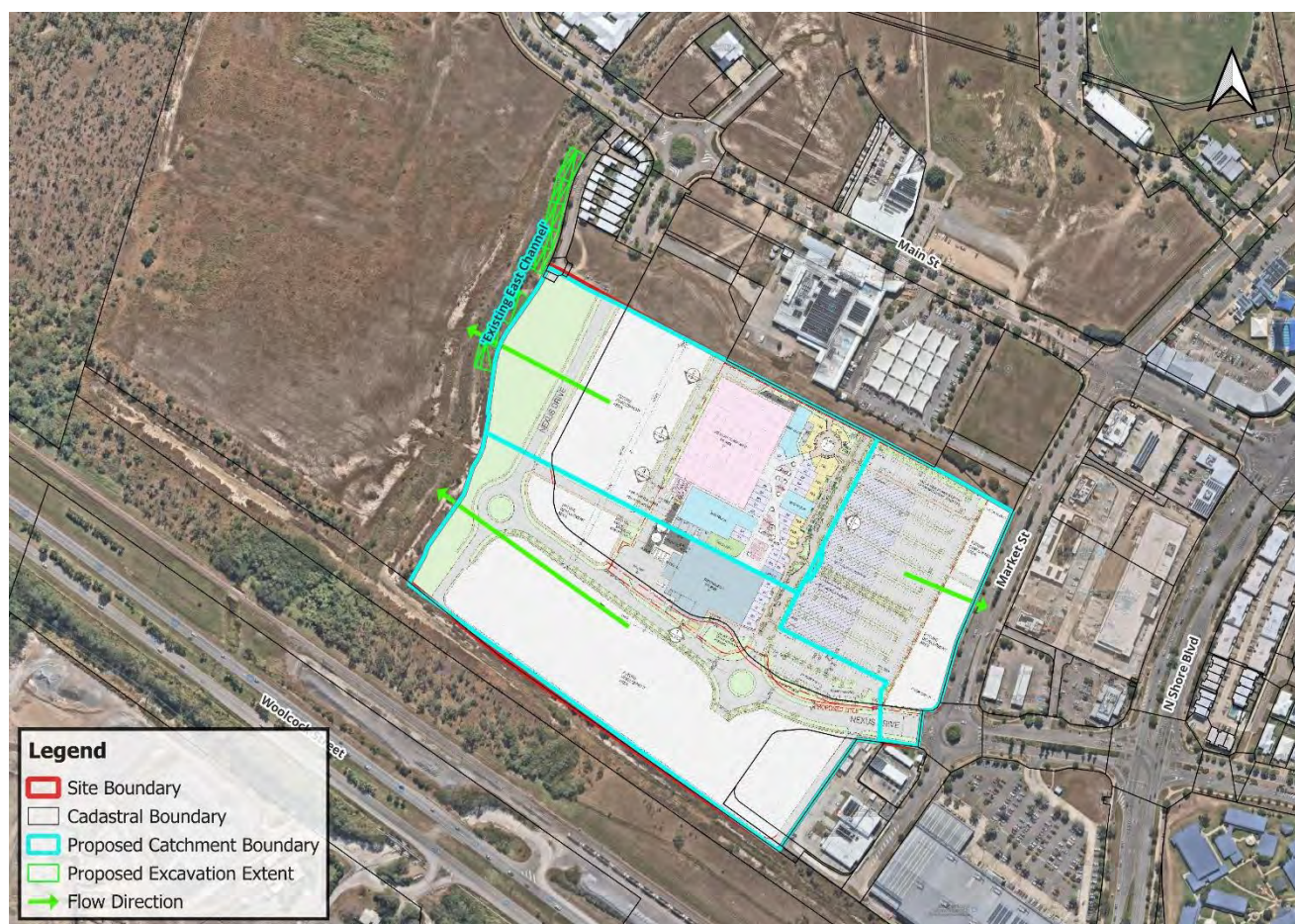


Figure 2.5: Proposed Catchment Boundaries

2.2.2 Site Boundary Terrain Adjustment

Minor terrain adjustments have been incorporated along the development boundary within the hydraulic model to address potential localised flood level increases associated with the artificial fill assumptions incorporated into the flood model. As discussed in section 2.2.1, the site has been modelled at concept fill levels without detailed boundary grading, these conceptual assumptions resulted in abrupt level transitions at the site boundary.

The site boundary adjustments include minor surface refinements to smooth the interface between the proposed site levels and adjoining land, including tie-in to the existing entry road or representation of a shallow surface conveyance to capture local overland inflows, which reflects the future detailed design requirements for all site boundary interfaces. Figure 2.8 presents the modelled topography. These changes are limited within the site boundary and do not represent formal drainage infrastructure or compensatory flood storage.

The detailed boundary treatment (e.g. kerb, surface drain or stormwater connection) will be resolved during detailed civil design, with the intent of maintaining equivalent hydraulic performance and avoiding adverse flood impacts.

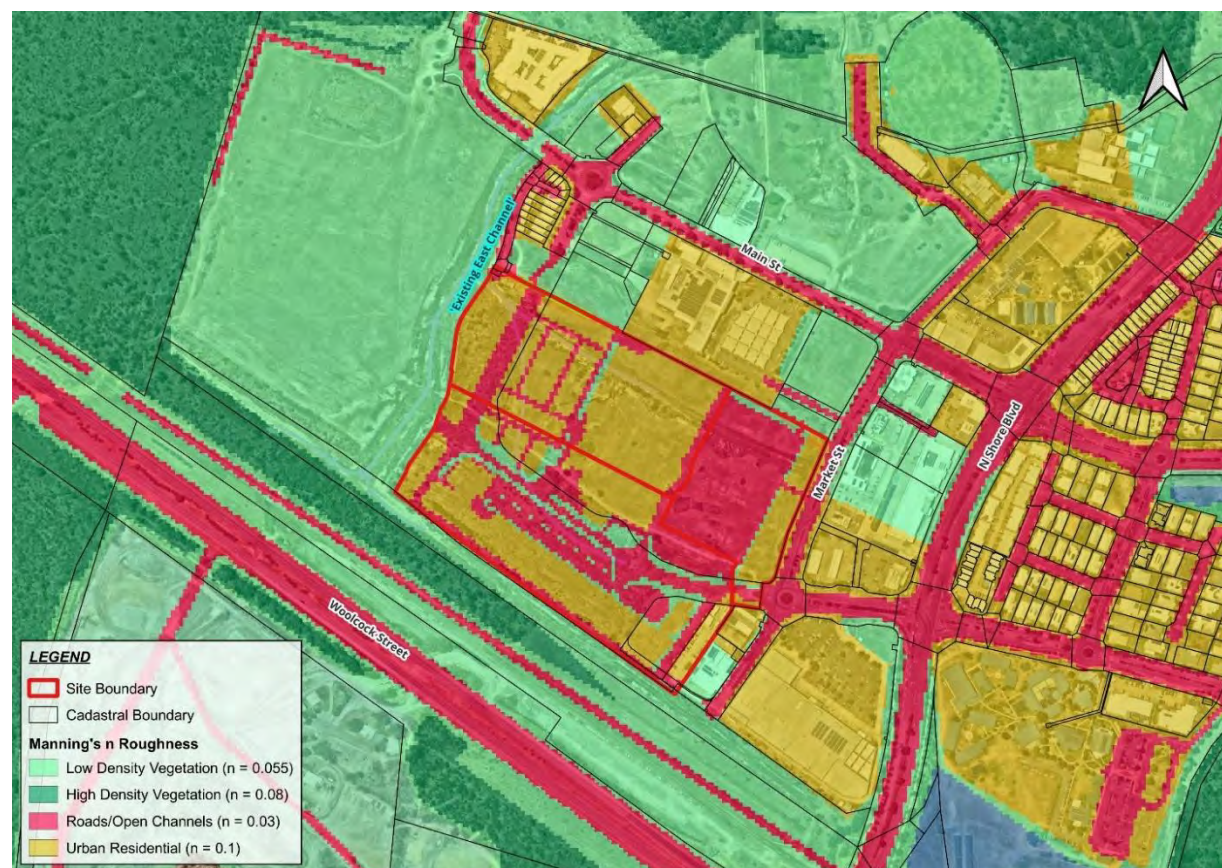
2.2.3 Surface Roughness (Manning's 'n' Values)

Land use within the development footprint was updated in accordance with the proposed lot layout supplied by the client. While the current layout identifies the western boundary of the site as open space, confirmation has been received from the client that this area is intended to be developed as residential lots. The lot layout will be updated accordingly in a future revision.

Surface roughness was applied using Manning's 'n' values consistent with the categories and values adopted in the 2023 Bohle River Flood Study. Adopted manning's values for the Site were tabulated in Table 2.3 and shown in Figure 2.6.

TABLE 2.3: MANNING'S 'N' VALUES

Surface Type	Manning's 'n' values
Low Density Vegetation	0.055
High Density Vegetation	0.08
Roads/ Open Channels	0.03
Urban Residential	0.1


Figure 2.6: Developed Case Surface Roughness

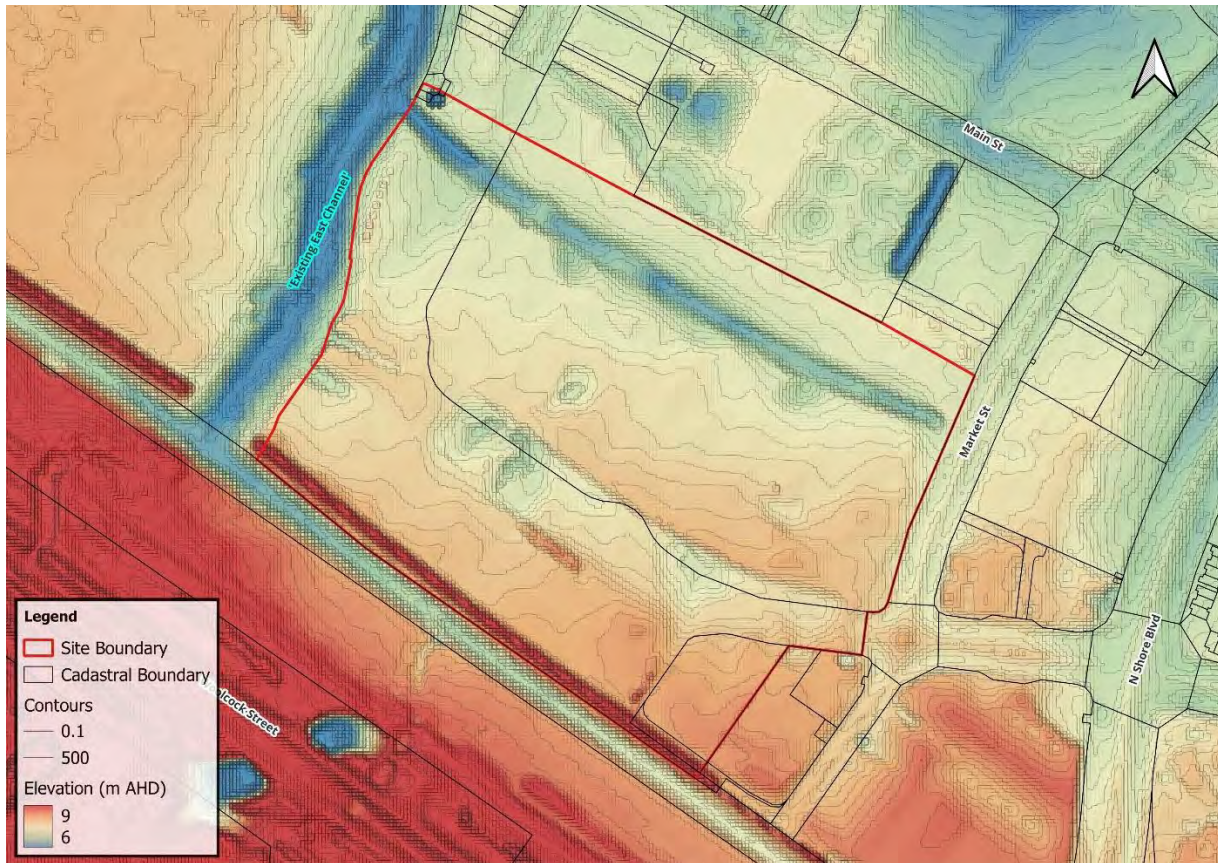


Figure 2.7: Existing Case Topography Condition

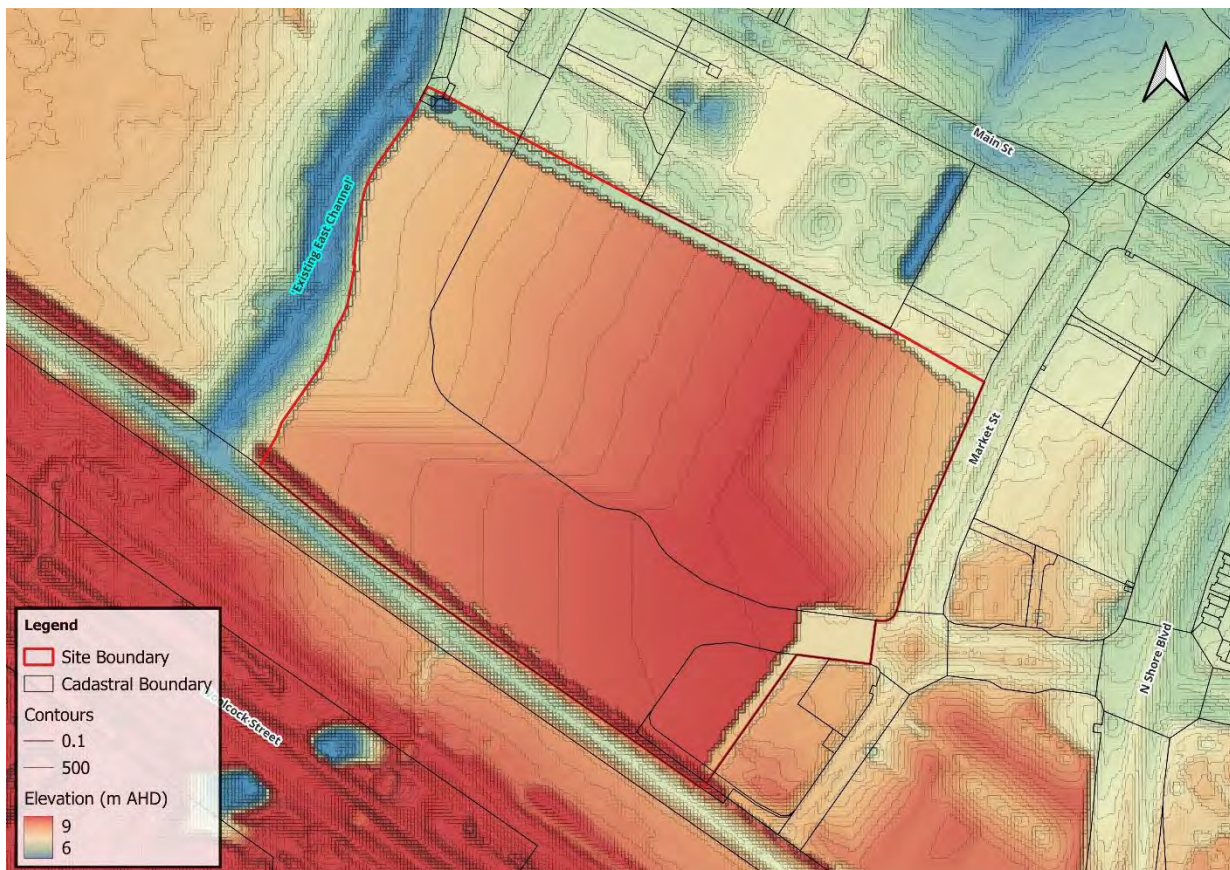


Figure 2.8: Developed Case Topography Condition

3. HYDRAULIC MODEL RESULTS

Hydraulic modelling results for the existing and developed scenarios are summarised in this section. Both scenarios were simulated using the same set of critical durations and temporal patterns identified in Section 2.1, to allow for a consistent comparison of flood behaviour. Flood mapping outputs include peak flood levels, depths and velocities for the 50%, 10%, and 1% AEP events. Results have been processed using the Max-of-Max method to capture the peak values across all durations.

3.1 Existing Case Scenario Results

Flood mappings for the existing case scenario are provided in Appendix B, including flood depth, velocity, and hazard mapping for the relevant AEP events. Figure 3.1 presents the flood depth at the Site for the 1% AEP event under existing conditions.

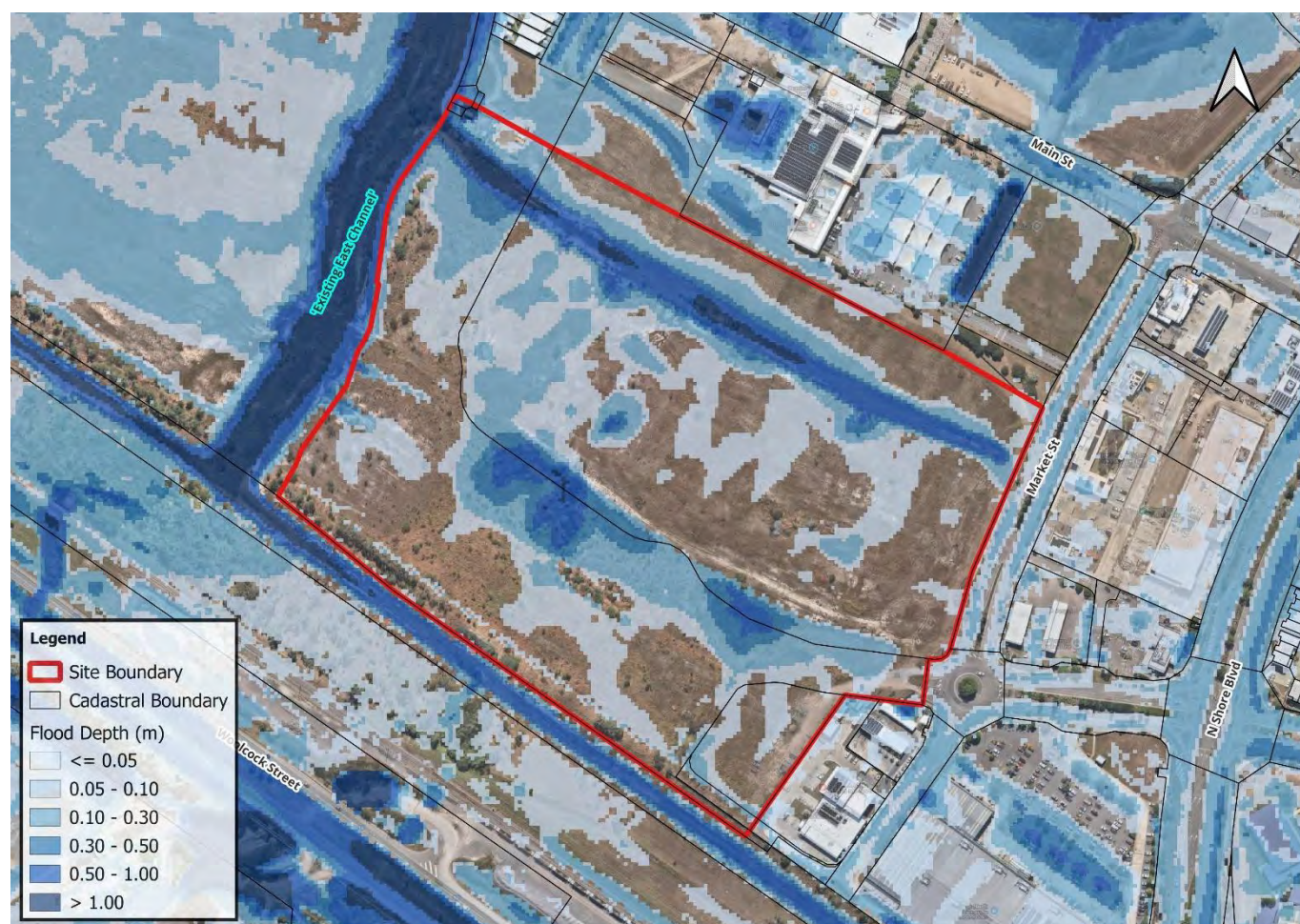


Figure 3.1: Existing Case 1% AEP Flood Depth

As can be seen on this figure, the Site is not subject to regional flooding from Saunders Creek. Minor upstream overland flow is shown to enter the site along the eastern boundary, which is shallow and limited in extent. Flooding within the site is predominantly associated with local runoff, internal drainage channels and topographic depressions. Under existing conditions, local runoff generally travels from east to west, following the site's drainage paths and natural topography.

3.2 Developed Case Scenario Results

Flood mapping outputs for the developed case scenario are provided in Appendix C, including flood depth, velocity, and hazard mapping for the relevant AEP events. Figure 3.2 represents the flood depth at the Site for the 1% AEP event for developed conditions.



Figure 3.2: Developed Case 1% AEP Flood Depth

The proposed filled areas are modelled above the 1% AEP flood levels. Figure 3.2 shows the reporting points located adjacent to the site boundary. The modelled flood levels at each reporting point are summarised in Table X and define the minimum finished surface levels required during detailed design (excluding the adopted 300 mm freeboard) to ensure the development achieves flood immunity.

TABLE 3.1: 1% AEP FLOOD LEVEL AT REPORTING LOCATIONS

ID	Flood Level (m AHD)
RP1	7.40
RP2	7.54
RP3	7.68

In addition, as shown in Figure 2.5 and Figure 2.8, the developed condition revised the internal catchment arrangement, with a portion of the site draining towards the eastern boundary in accordance with the proposed layout.

3.3 Flood Impact Assessment

Flood impact mapping has been prepared to identify any changes in flood levels resulting from the proposed development. Flood level afflux maps for the 50%, 10%, and 1% AEP events are included in Appendix D.

3.3.1 1% AEP Flood Level Afflux

The 1% AEP flood impact mapping (refer to Figure 3.3) shows that:

- Minor flood level increases are predicted at the southwest corner of the site, with a maximum flood level increase of less than 20 mm. These increases are fully contained within the existing drainage channel and the future road corridor. The increase is likely to result from changes in surface characteristics, including increased imperviousness and reduced infiltration resulting from urban development. Given flood level increase of less than 20mm and it's contained within infrastructure corridors, the impact is considered not material.
- Flood level increases of up to approximately 140 mm are predicted along some sections of Market Street. The increase is result from the revised internal catchment configuration and associated changes in surface flow direction described in sections above. The afflux is contained within the road corridor and does not impact any existing private properties. Therefore, the impact is considered acceptable and non material.

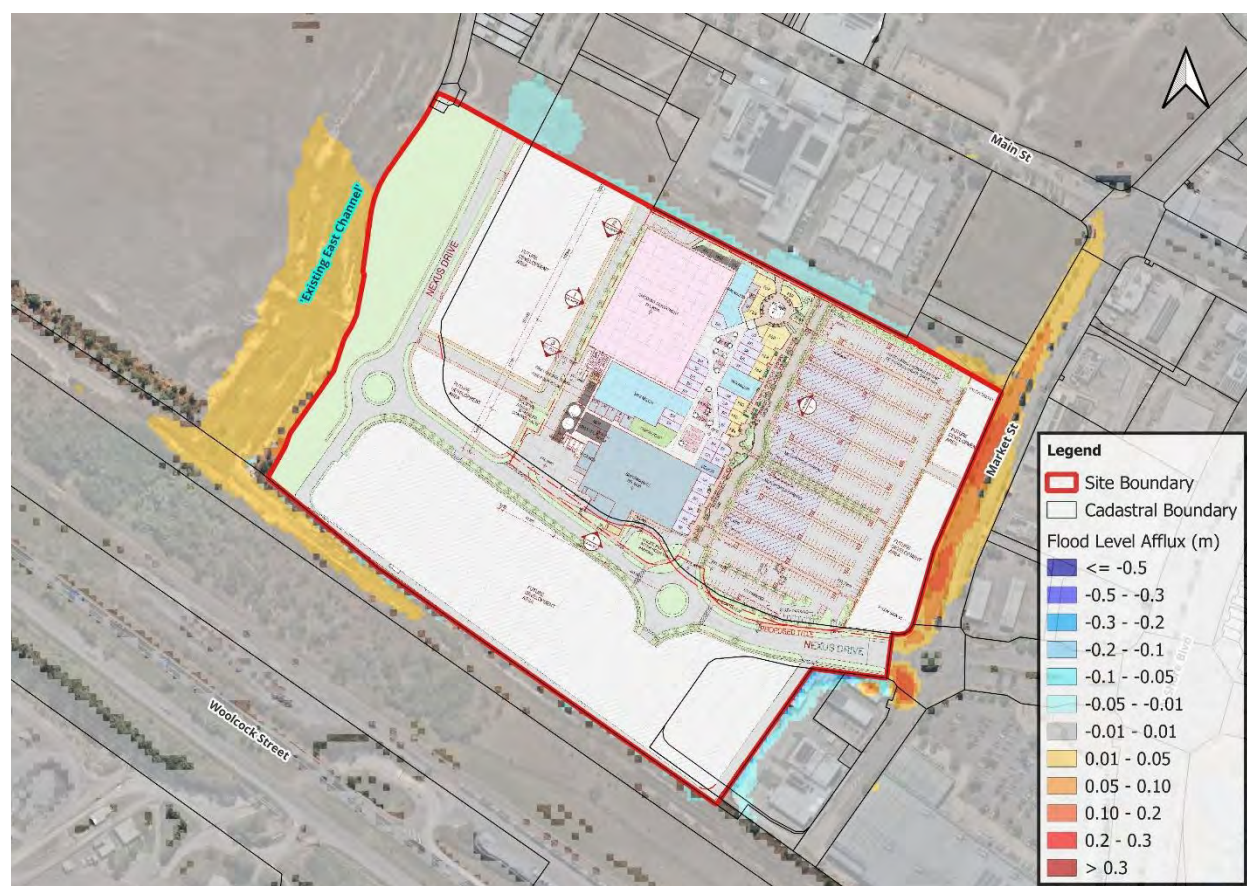


Figure 3.3: 1% AEP Flood Level Afflux

3.3.2 10% AEP Flood Level Afflux

The 10% AEP flood impact mapping (refer to Figure 3.4) indicates similar trends to the 1% AEP event, with maximum flood level increases of less than 90 mm along Market street and less than 15mm within the existing drainage channel and the future road corridor. The impact is considered acceptable and non material.

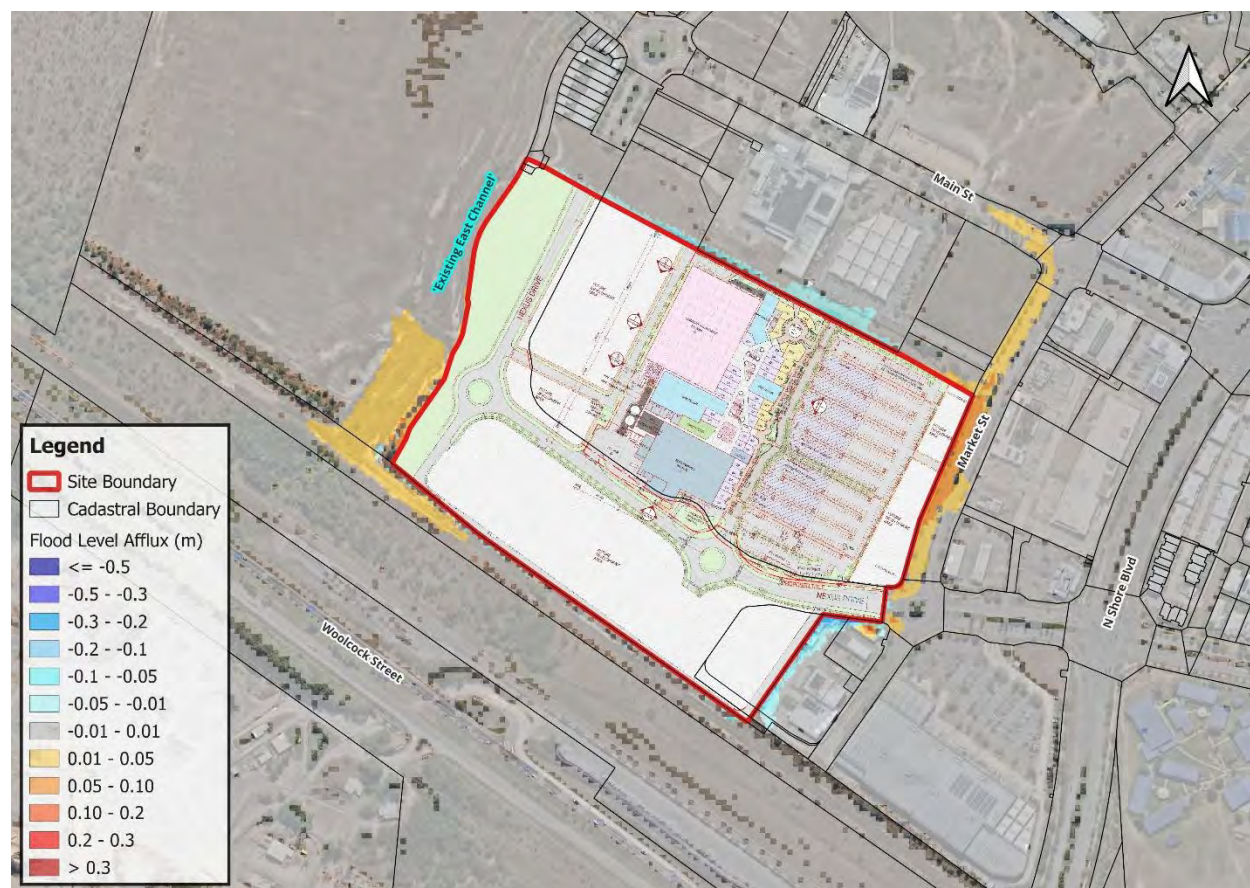


Figure 3.4: 10% AEP Flood Level Afflux

3.3.3 50% AEP Flood Level Afflux

The 50% AEP flood impact mapping (refer to Figure 3.5) indicates similar flood level increases to the 10% AEP event. The extent of flood level increases is generally confined within the road corridor or existing channel. Accordingly, the impacts are considered acceptable and non material.

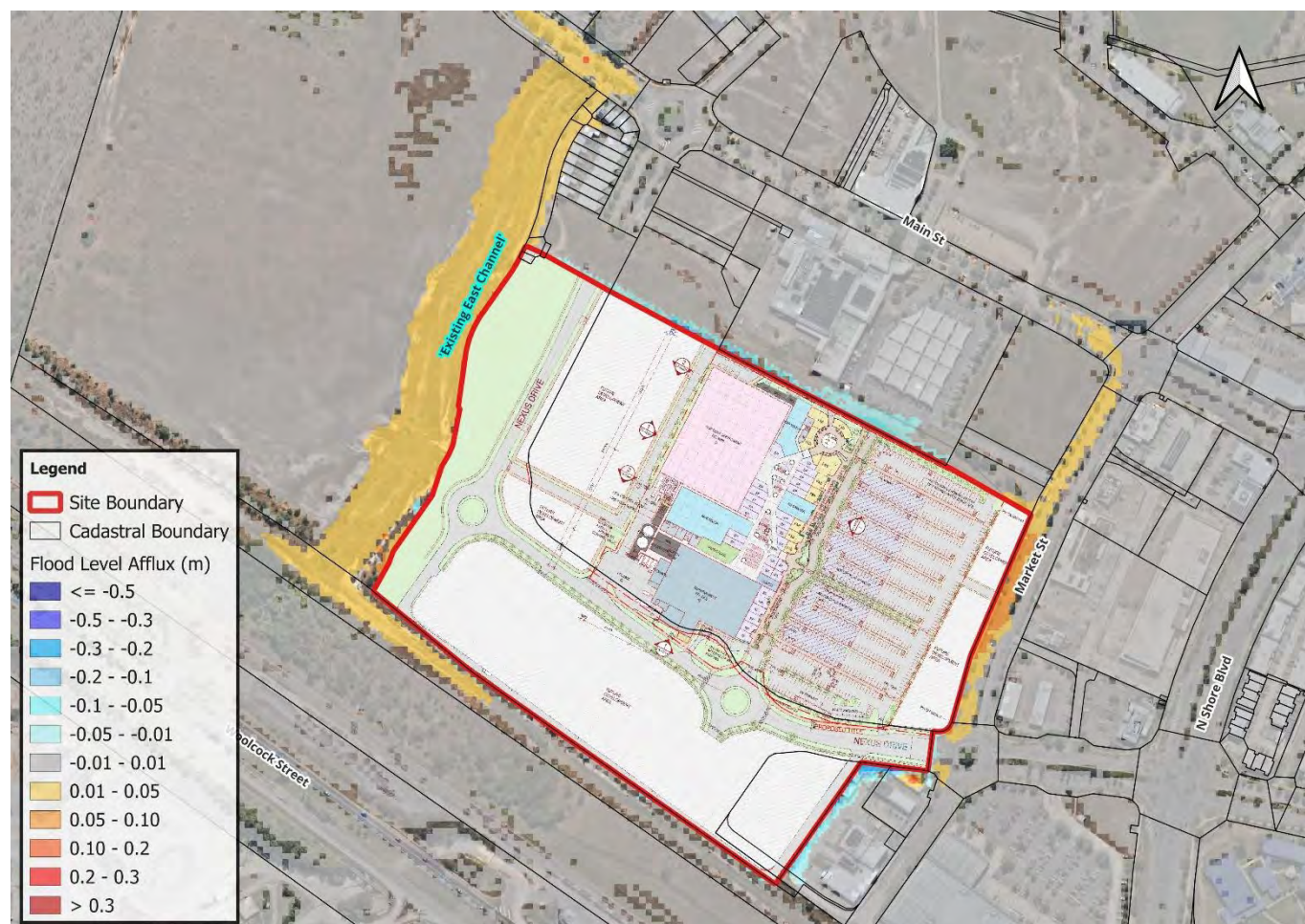


Figure 3.5: 50% AEP Flood Level Afflux

4. CONCLUSION

A hydraulic impact assessment has been undertaken to evaluate the potential flood impacts associated with the proposed development of the commercial town centre at North Shore, Townsville, using the 2023 Bohle River Flood Study hydraulic model with latest survey information at the Site as the base to represent existing flood conditions. The model was then updated to incorporate the proposed development layout and drainage features for assessment of the developed case.

Both existing and developed case scenarios were simulated across a range of design events (50%, 10%, and 1% AEP), with same critical durations and boundary conditions to enable direct comparison.

Key outcomes of the assessment are summarised as follows:

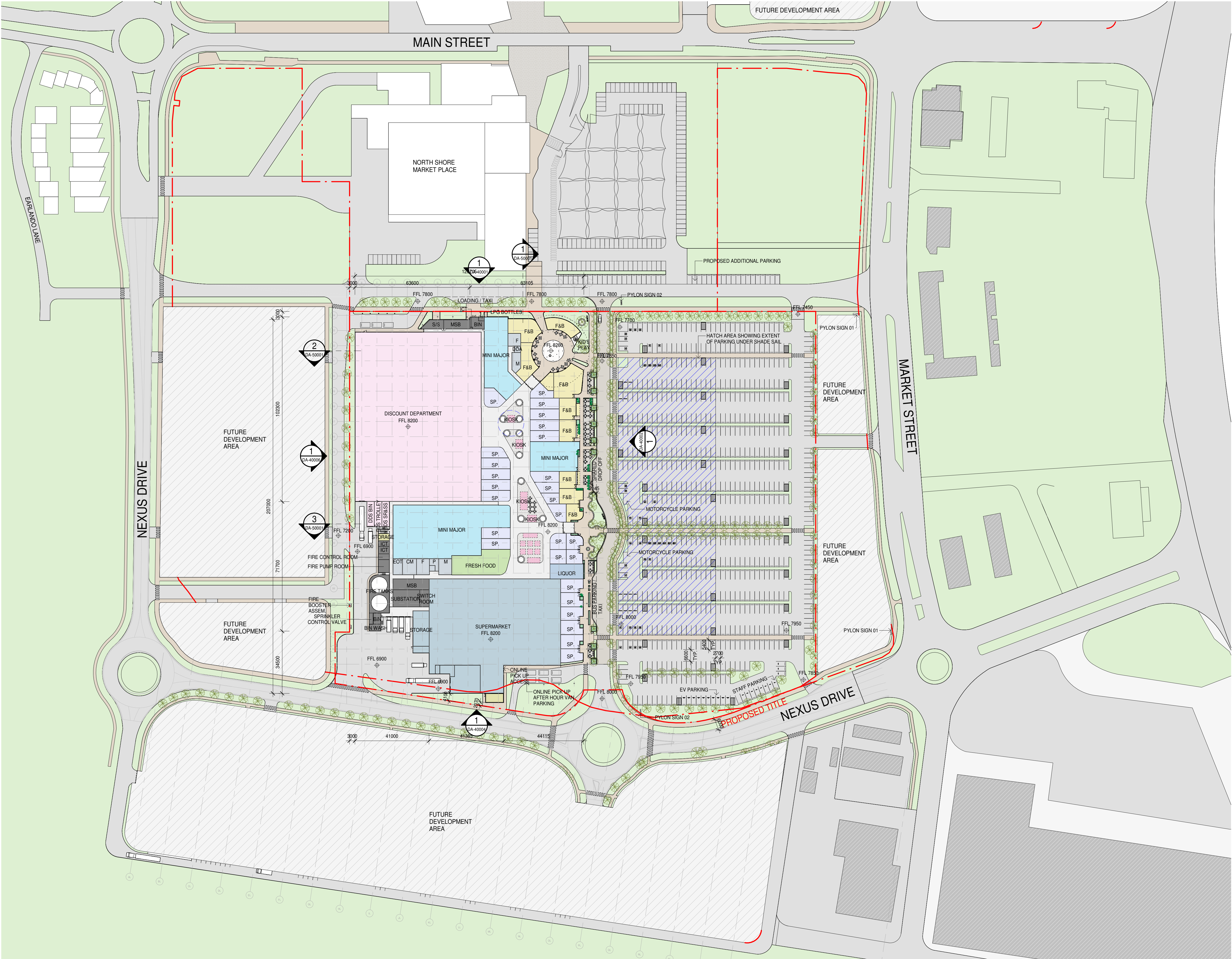
- The developable area of the Site remains flood free in the 1% AEP event, satisfying relevant flood immunity requirements.
- Minor boundary refinements were applied in the hydraulic model to resolve localised artefacts impact from the proposed site fill. The refinements are confined within the site, do not rely on flood storage, and will be formalised during the detailed civil design phase to maintain equivalent hydraulic performance and avoid the minor adverse flood that occur at property interfaces.
- Minor localised flood level increases are predicted at the south-western corner of the site of less than 20mm which are contained within the existing drainage channel and future road corridor in the 1% AEP flood event.
- In the 1% AEP flood event, localised flood level increase of up to approximately 140 mm is predicted along sections of Market Street due to redistribution of surface flows associated with the revised internal catchment configuration. The increase is contained within the road reserve and does not impact existing private properties.

It is anticipated as part of the detailed design the impacts will be refined further, with the finalisation of local channel works necessary for site filling.

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APPENDIX A: PROPOSED SITE PLAN



GFA: 22196m²
SITE COVERAGE: 56498m²

AREA SCHEDULE - GLA	
AREA TYPE	GLA
DISCOUNT DEPARTMENT	6724 m ²
FRESH FOOD	365 m ²
KIOSK	191 m ²
LIQUOR	153 m ²
MINI MAJOR	2666 m ²
SPECIALTY	2338 m ²
SPECIALTY - F&B	1290 m ²
SUPERMARKET	4207 m ²
TOTAL	17954 m ²

PARKING NUMBER	
Description	Count
ACCESSIBLE PARKING	16
ELECTRIC	10
MOTORCYCLE PARKING	10
PARKING WITH PRAMS	12
SENIOR PARKING	10
SHORT TERM PARKING	12
STAFF PARKING	11
STANDARD PARKING	657
TOTAL	738

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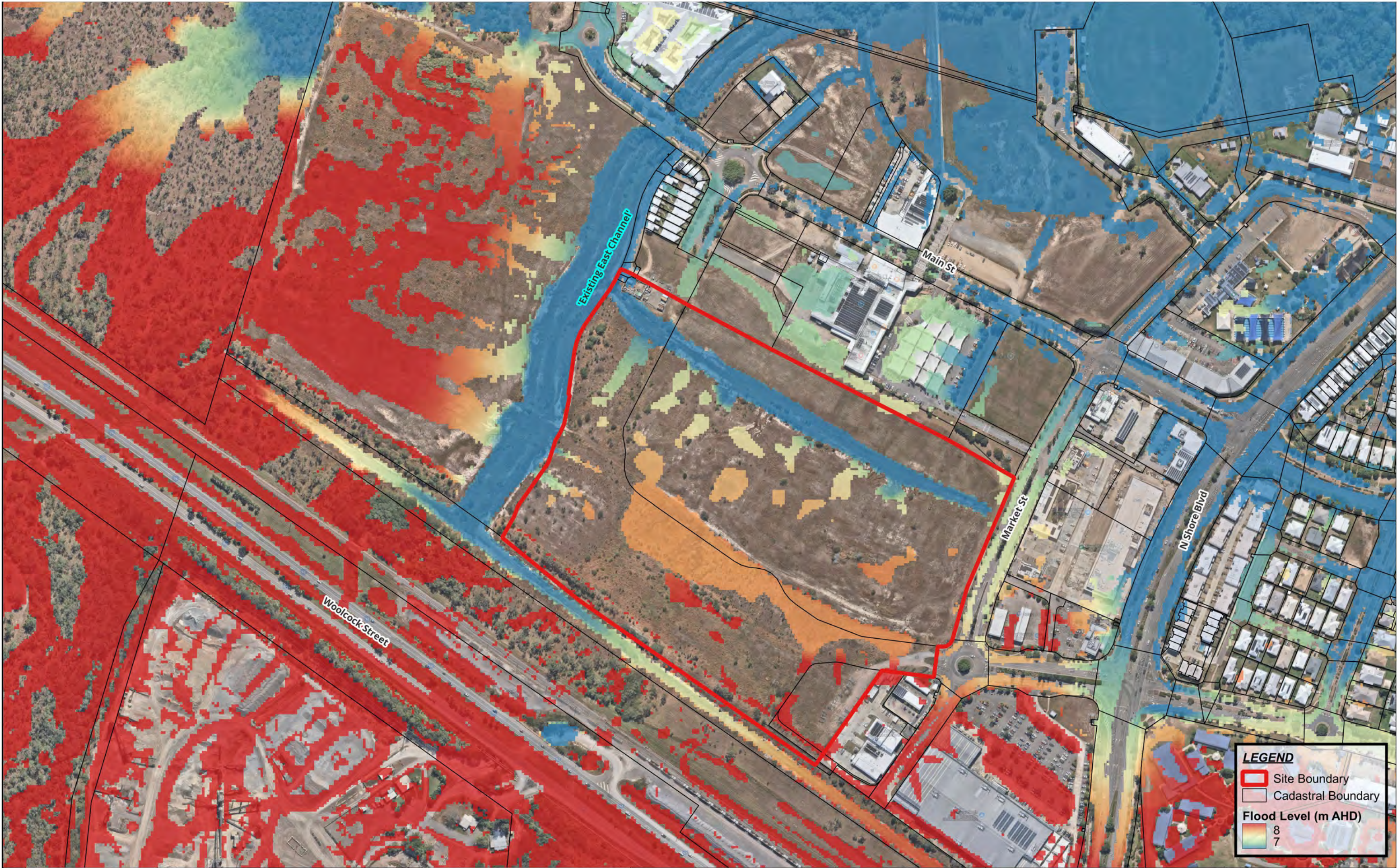
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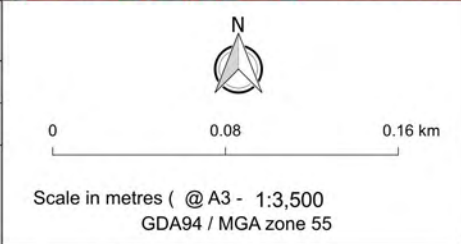
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APPENDIX B: EXISTING CASE FLOOD MAPPING



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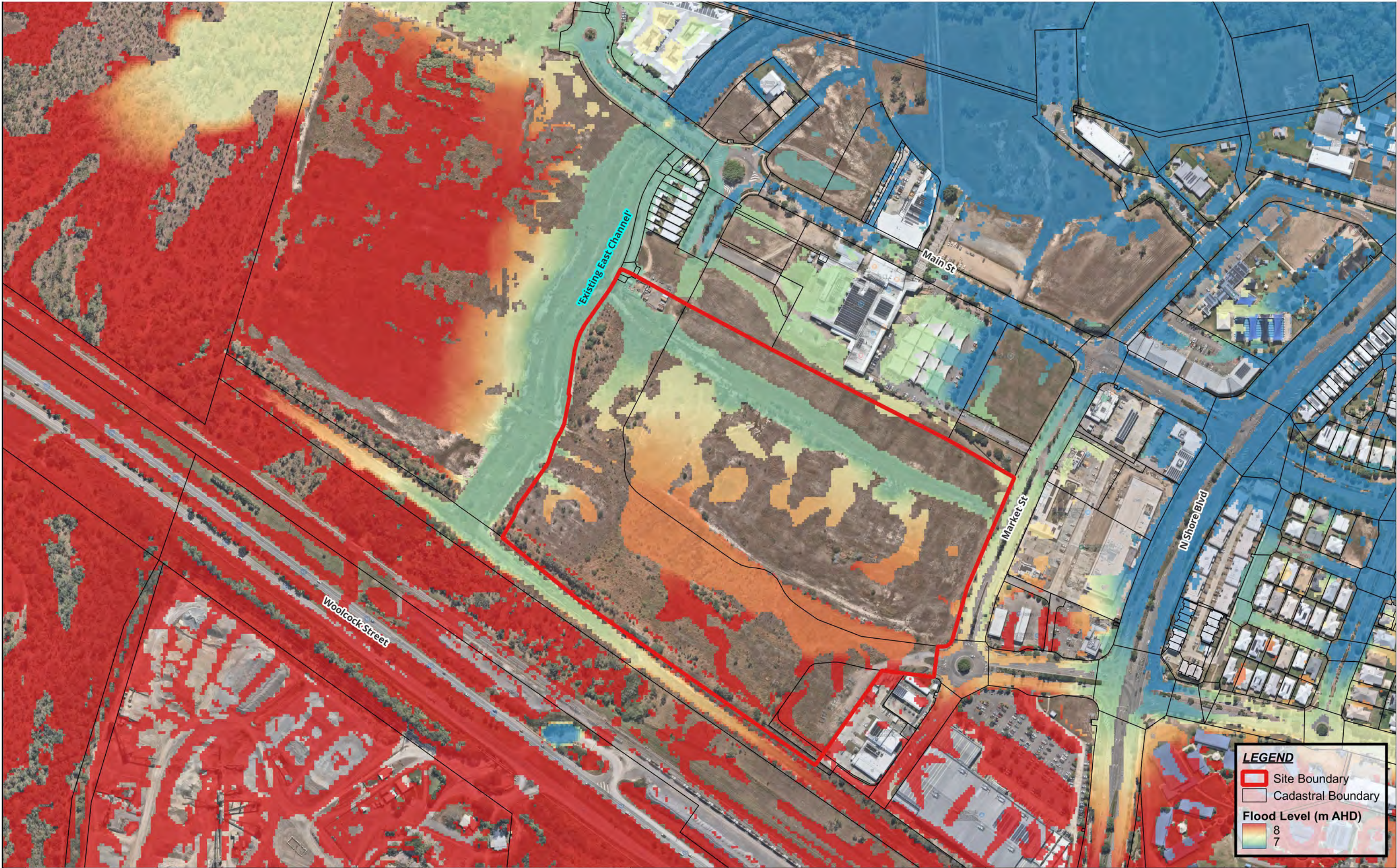
Appendix B.1

Premise
North Shore Commercial Town Centre HIA
Existing Scenario Flood Mapping
50% AEP Flood Height

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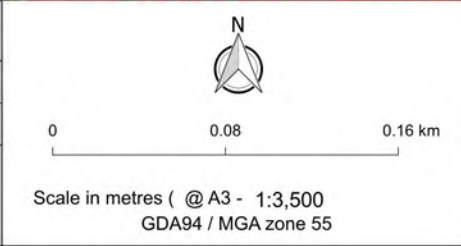
LEGEND

- Site Boundary (Red outline)
- Cadastral Boundary (Pink outline)
- Flood Level (m AHD)
 - 8 (Red)
 - 7 (Blue)



R	DETAILS	DATE
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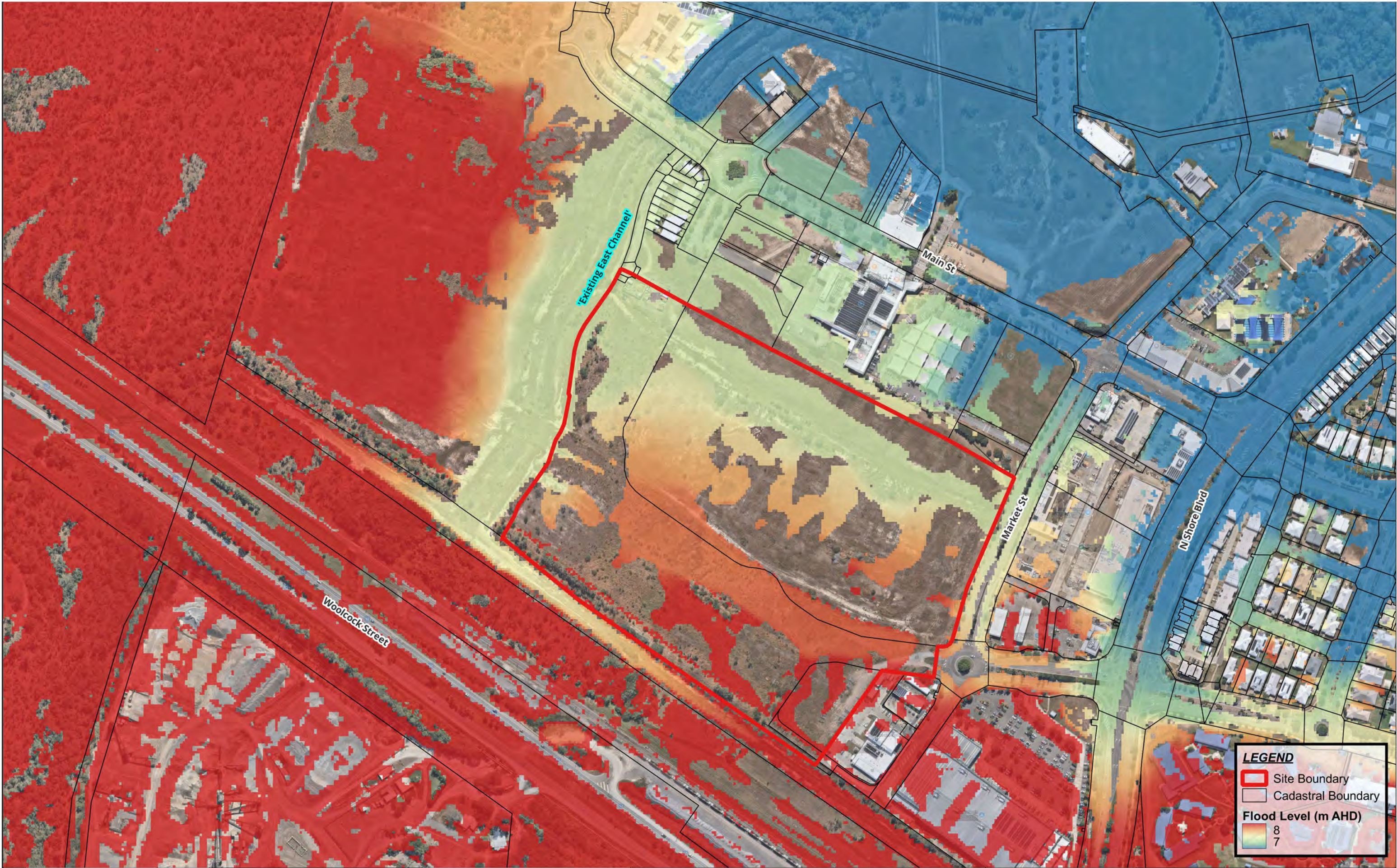
Appendix B.2

Premise
North Shore Commercial Town Centre HIA
Existing Scenario Flood Mapping
10% AEP Flood Height

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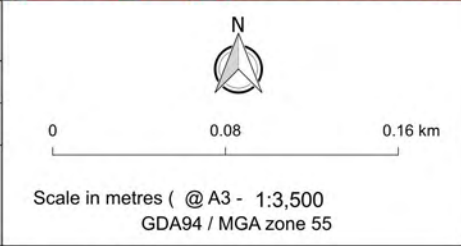
LEGEND

- Site Boundary (Red outline)
- Cadastral Boundary (Pink outline)
- Flood Level (m AHD)
 - 8 (Red)
 - 7 (Blue)



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Appendix B.3

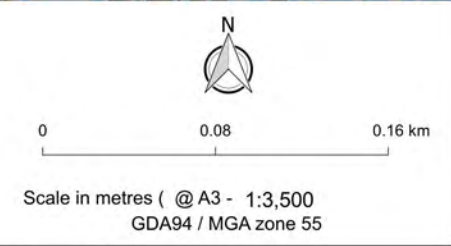
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Existing Scenario Flood Mapping
1% AEP Flood Height

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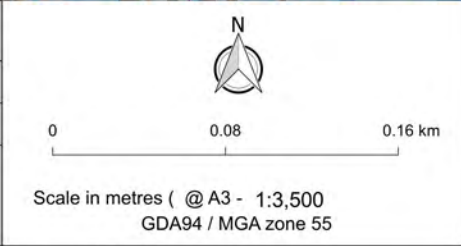
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Existing Scenario Flood Mapping
50% AEP Flood Depth

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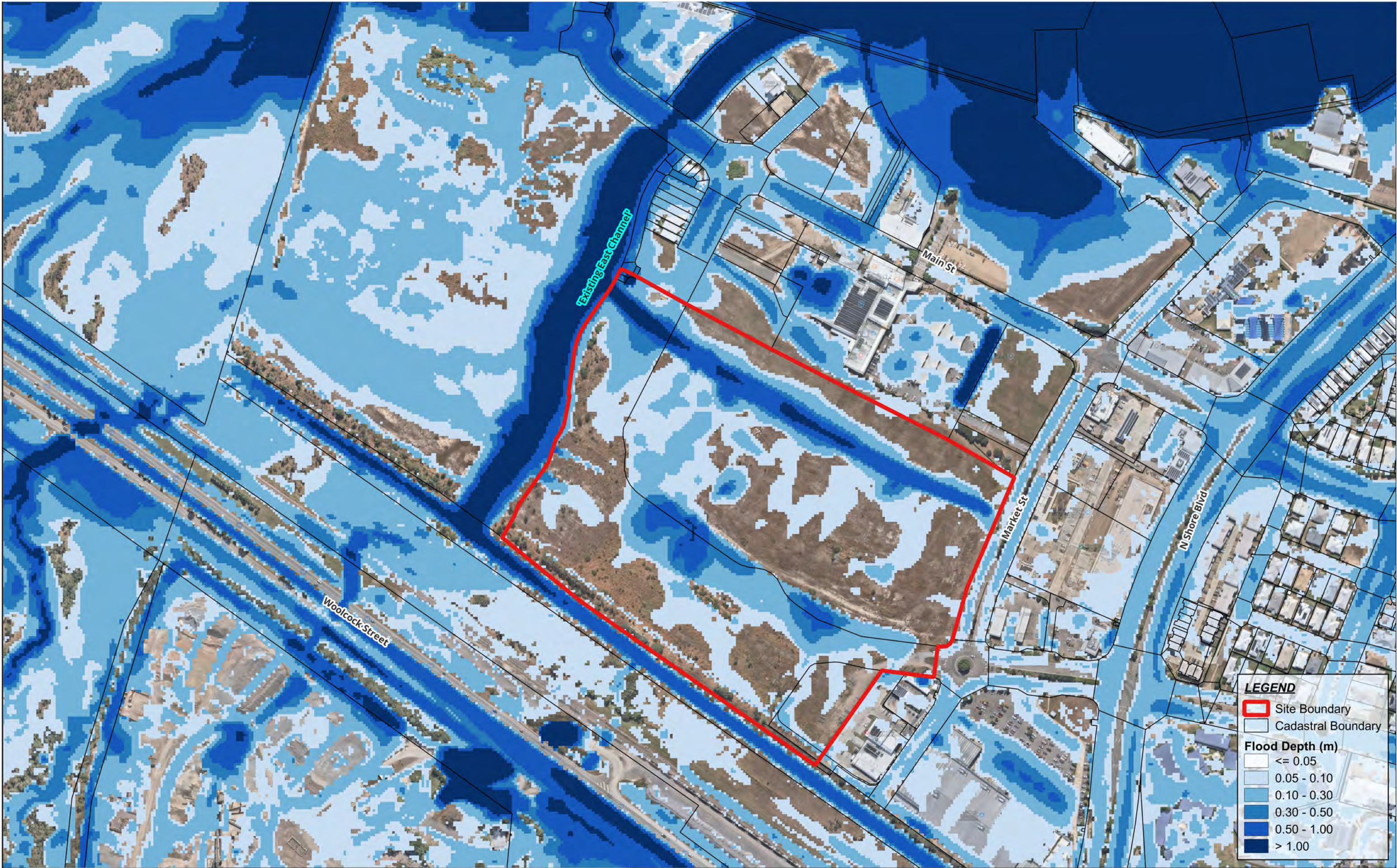


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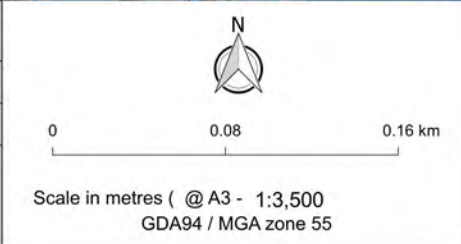


Appendix B.5
Premise North Shore Commercial Town Centre HIA Existing Scenario Flood Mapping 10% AEP Flood Depth
Dwg Ref:



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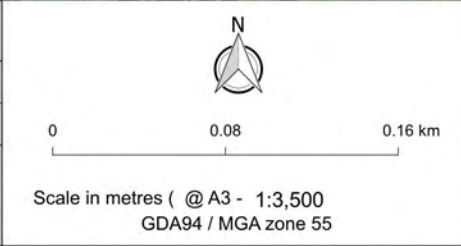


Appendix B.6
Premise North Shore Commercial Town Centre HIA Existing Scenario Flood Mapping 1% AEP Flood Depth
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Appendix B.7

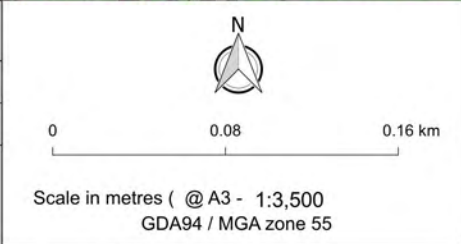
Premise
North Shore Commercial Town Centre HIA
Existing Scenario Flood Mapping
50% AEP Flood Velocity

Dwg Ref:



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Appendix B.8

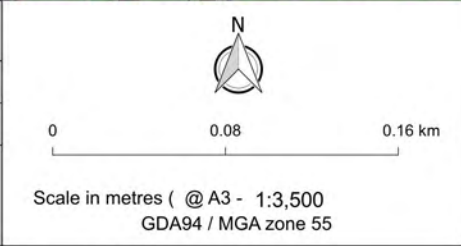
Premise
North Shore Commercial Town Centre HIA
Existing Scenario Flood Mapping
10% AEP Flood Velocity

Dwg Ref:



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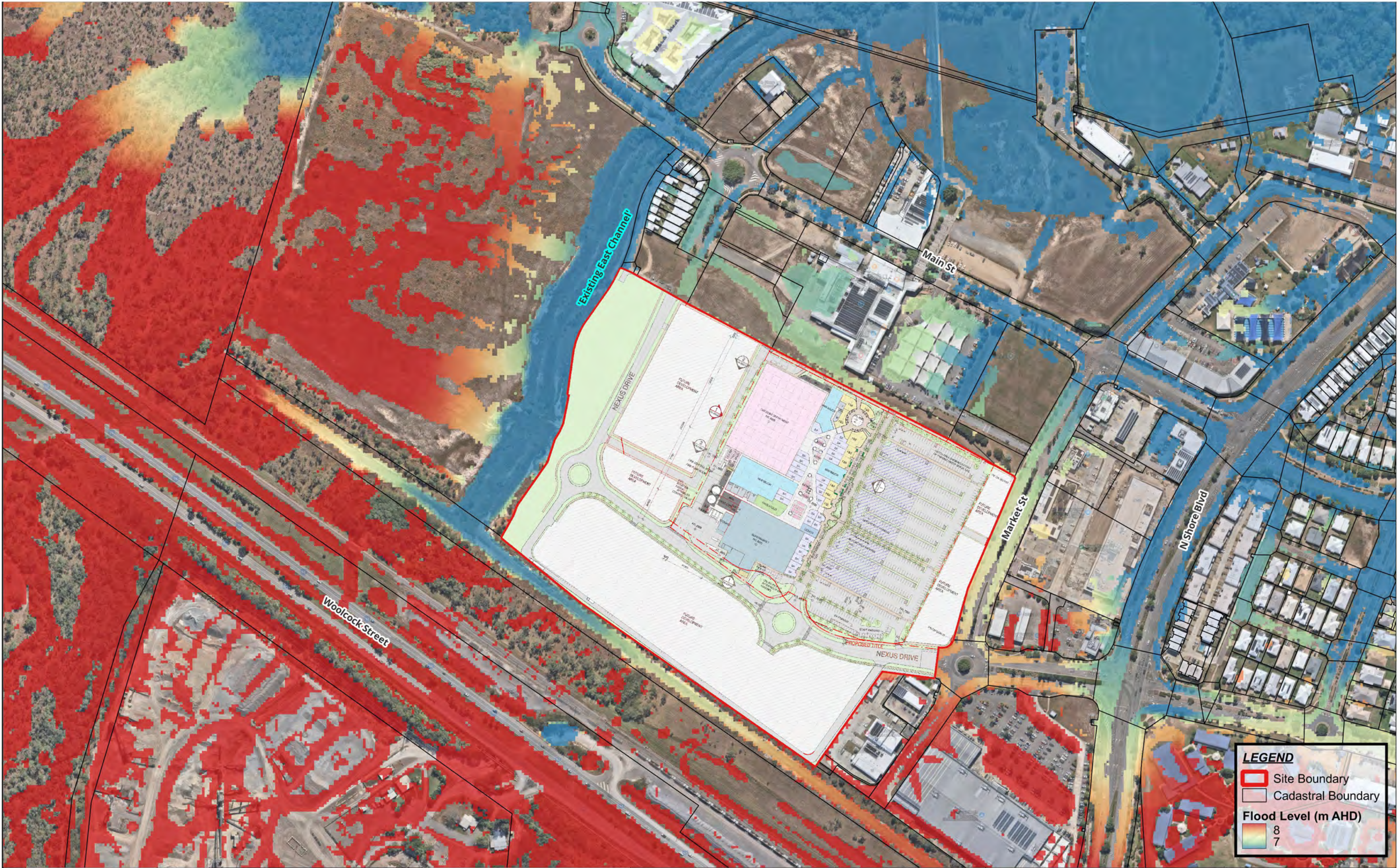


Appendix B.9

Premise
North Shore Commercial Town Centre HIA
Existing Scenario Flood Mapping
1% AEP Flood Velocity

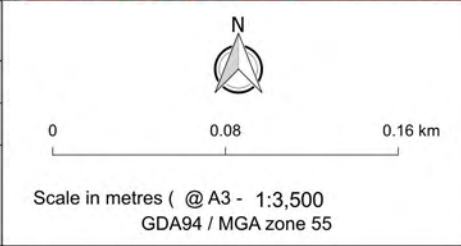
Dwg Ref:

APPENDIX C: DEVELOPED CASE FLOOD MAPPING



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Appendix C.1

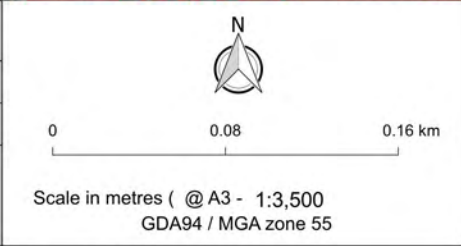
Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
50% AEP Flood Height

Dwg Ref:



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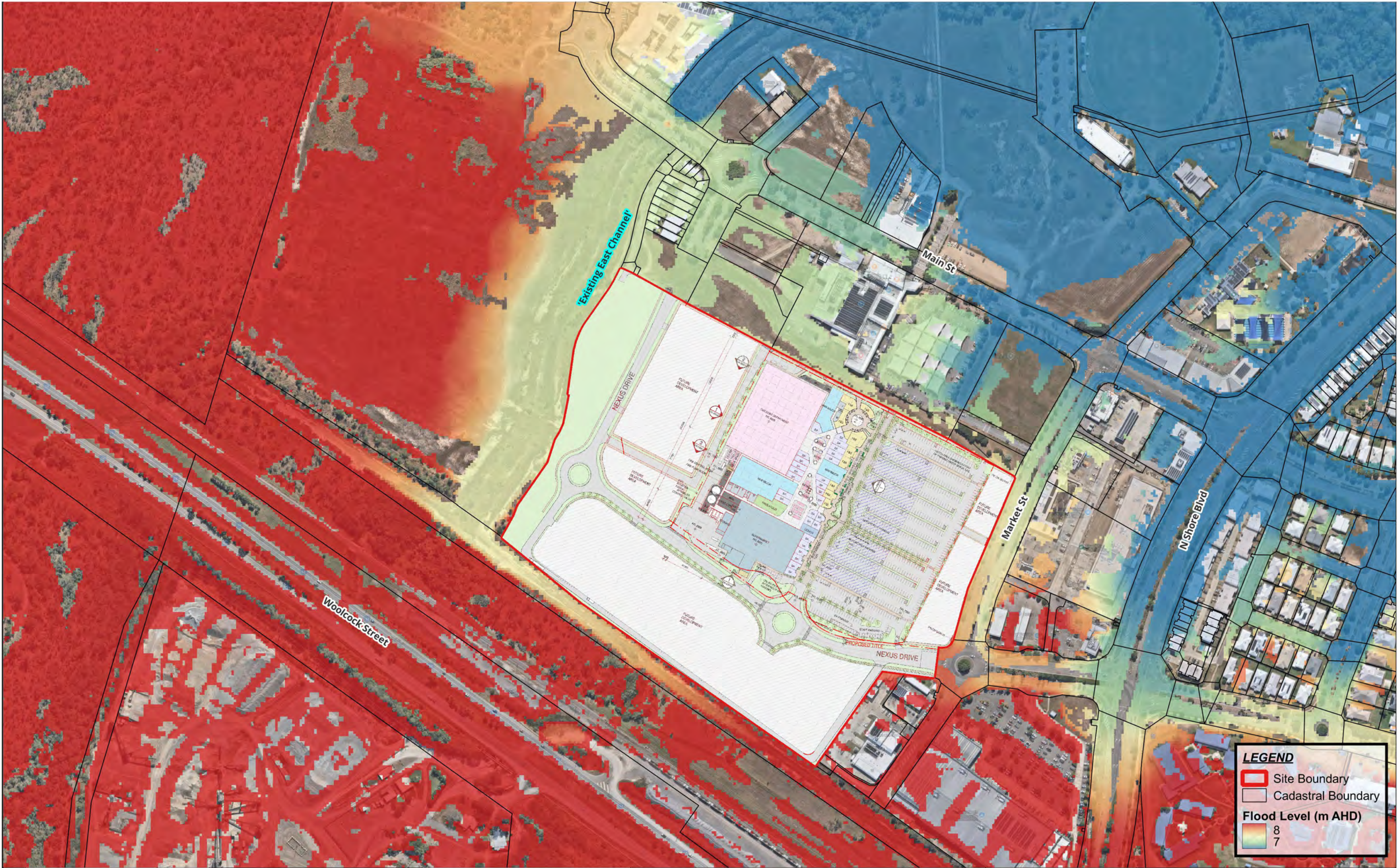
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Appendix C.2

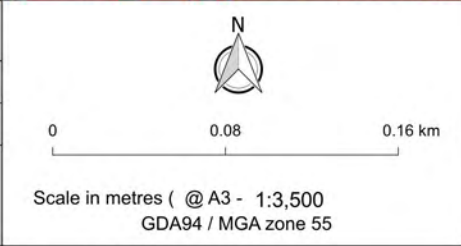
Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
10% AEP Flood Height

Dwg Ref:



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Appendix C.3
Premise North Shore Commercial Town Centre HIA Developed Scenario Flood Mapping 1% AEP Flood Height
Dwg Ref.

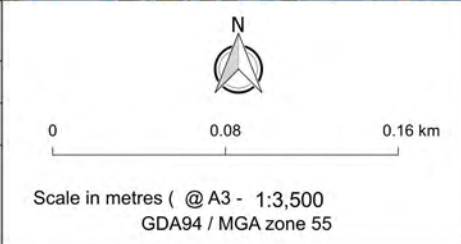
LEGEND

- Site Boundary
- Cadastral Boundary
- Flood Level (m AHD)
 - 8
 - 7



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Appendix C.4

Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
50% AEP Flood Depth

Dwg Ref:



LEGEND

Site Boundary
Cadastral Boundary

Flood Depth (m)

- <= 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

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0 0.08 0.16 km

Scale in metres (@ A3 - 1:3,500
GDA94 / MGA zone 55

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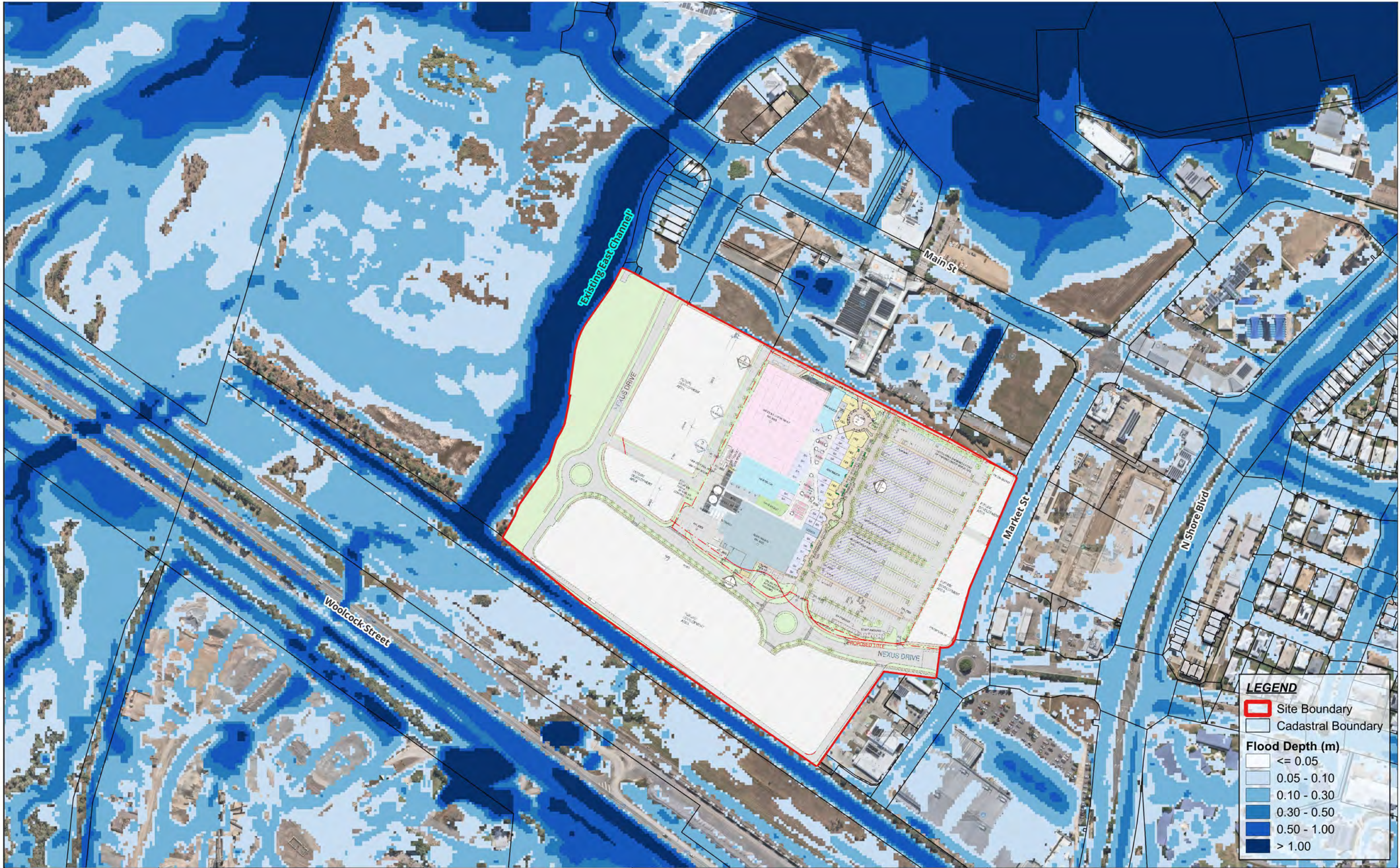
DATA SOURCE
QLD Government Open Data Source



Appendix C.5

Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
10% AEP Flood Depth

Dwg Ref:



LEGEND

Site Boundary

Cadastral Boundary

Flood Depth (m)

<= 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 1.00

> 1.00

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1	Final Issue	05-03-2026

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0 0.08 0.16 km

Scale in metres (@ A3 - 1:3,500
GDA94 / MGA zone 55

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ENGENY

Premise

Appendix C.6

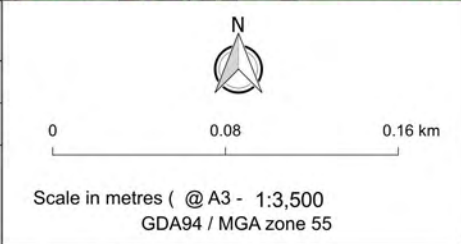
Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
1% AEP Flood Depth

Dwg Ref:



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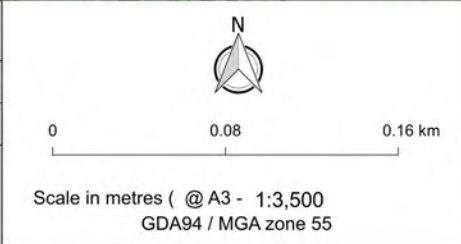


Appendix C.7
Premise North Shore Commercial Town Centre HIA Developed Scenario Flood Mapping 50% AEP Flood Velocity
Dwg Ref:



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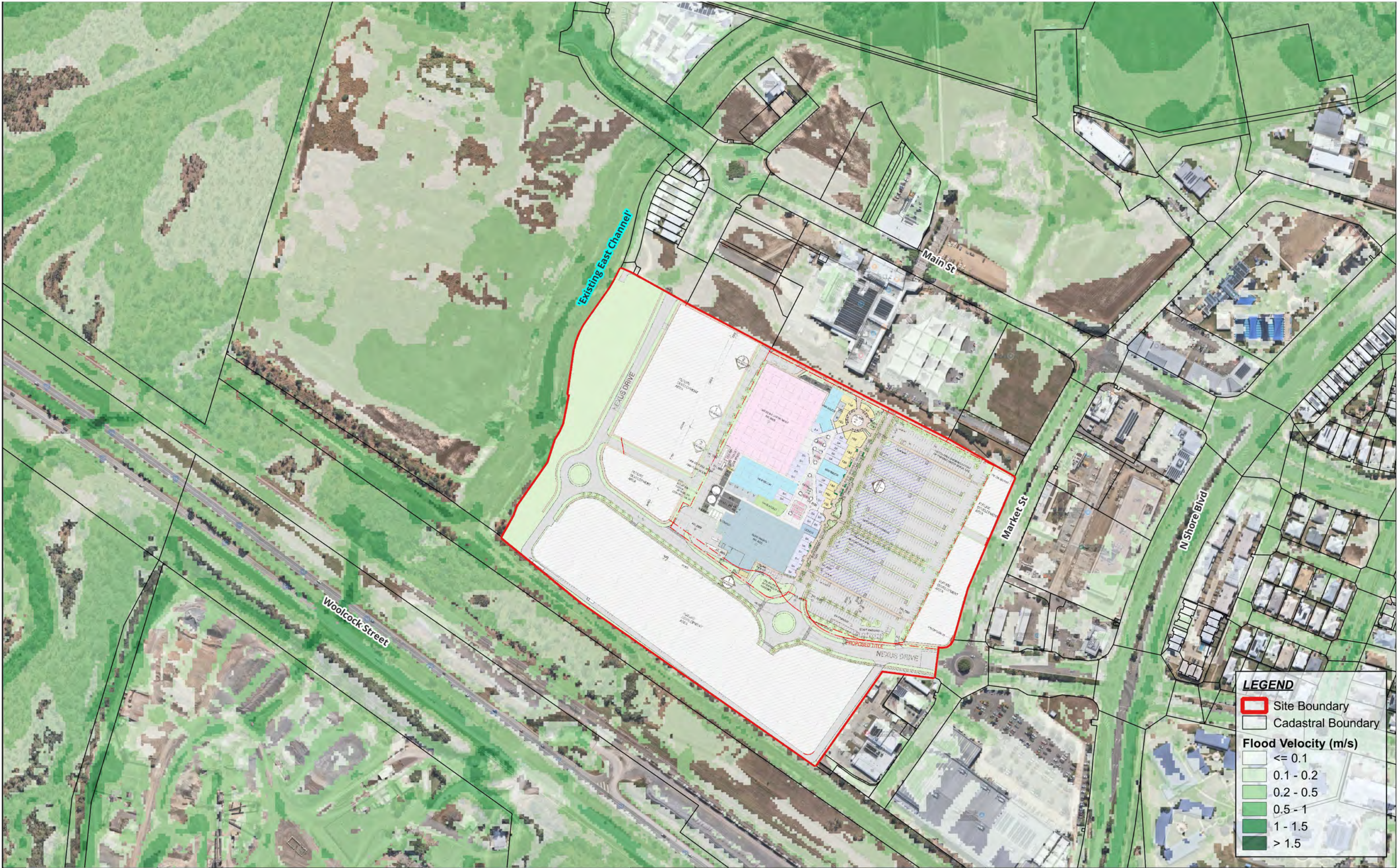
DATA SOURCE
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Appendix C.8

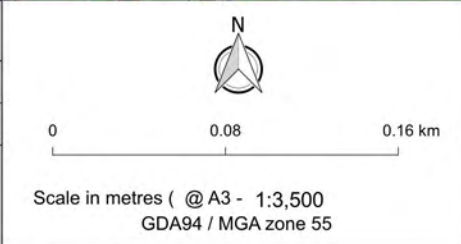
Premise
North Shore Commercial Town Centre HIA
Developed Scenario Flood Mapping
10% AEP Flood Velocity

Dwg Ref:



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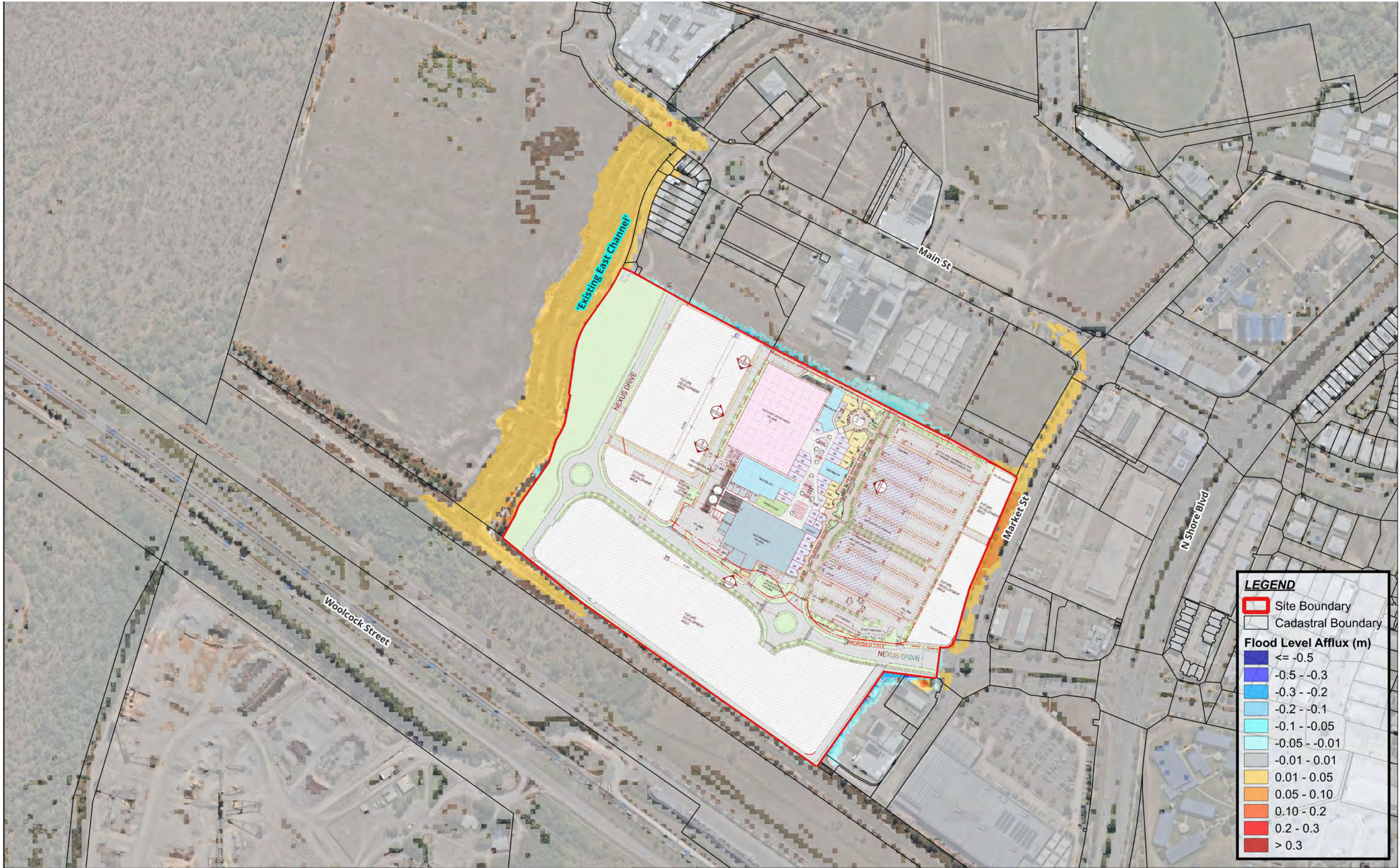
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Appendix C.9
Premise North Shore Commercial Town Centre HIA Developed Scenario Flood Mapping 1% AEP Flood Velocity
Dwg Ref:

APPENDIX D: FLOOD IMPACT MAPPING



LEGEND

Site Boundary

Cadastral Boundary

Flood Level Afflux (m)

<= -0.5

-0.5 - -0.3

-0.3 - -0.2

-0.2 - -0.1

-0.1 - -0.05

-0.05 - -0.01

-0.01 - 0.01

0.01 - 0.05

0.05 - 0.10

0.10 - 0.2

0.2 - 0.3

> 0.3

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	NOTES:					

00.080.16 km

Scale in metres (@ A3 - 1:3,500
GDA94 / MGA zone 55

DISCLAIMER

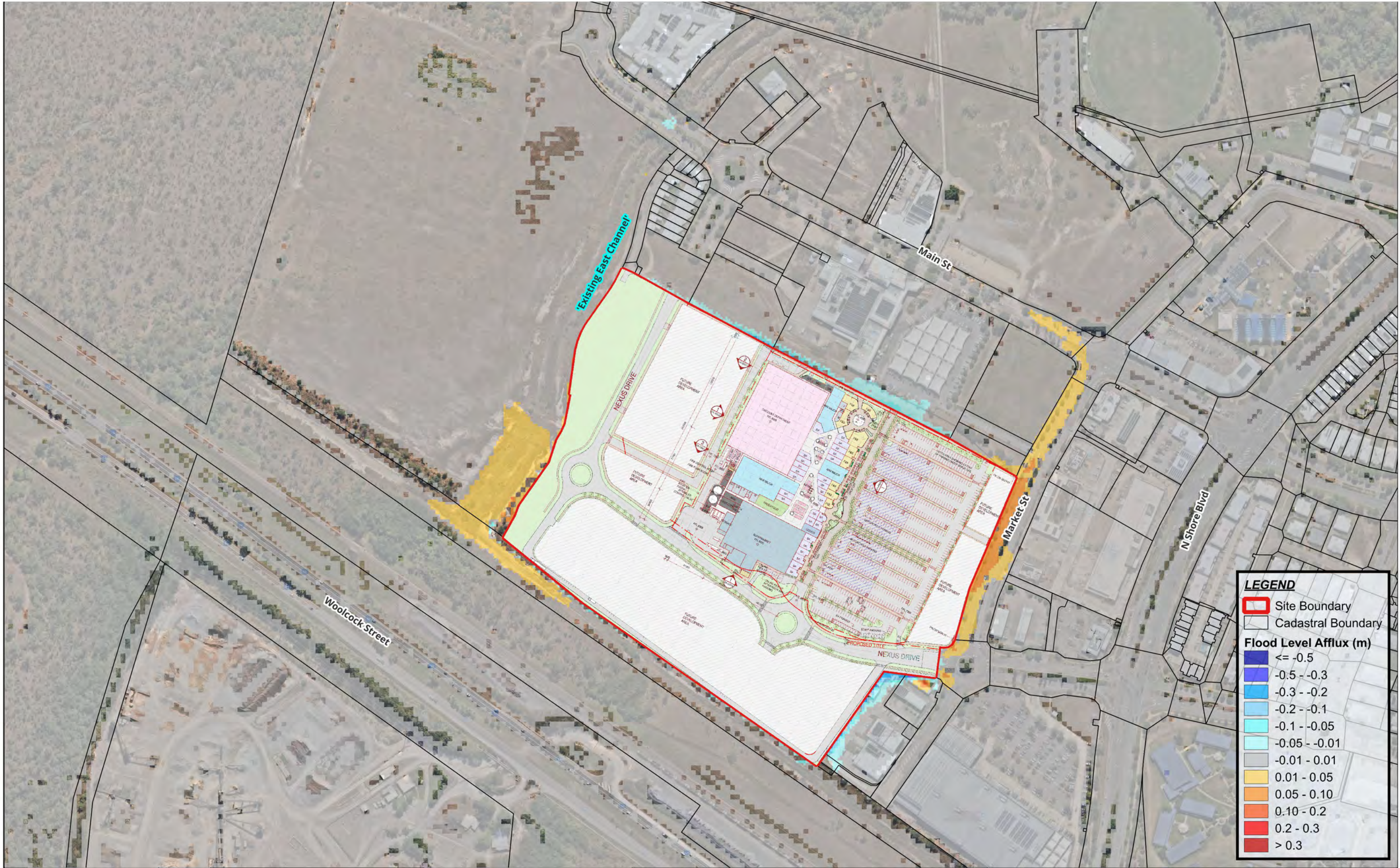
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Appendix D.1

Premise
North Shore Commercial Town Centre HIA
Flood Impact Mapping
50% AEP Flood Level Difference

Dwg Ref:



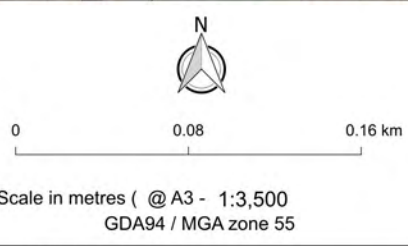
LEGEND

Site Boundary
Cadastral Boundary

Flood Level Afflux (m)

Dark Blue	<= -0.5
Blue	-0.5 - -0.3
Light Blue	-0.3 - -0.2
Very Light Blue	-0.2 - -0.1
Cyan	-0.1 - -0.05
Light Cyan	-0.05 - -0.01
White	-0.01 - 0.01
Yellow	0.01 - 0.05
Orange	0.05 - 0.10
Red-Orange	0.10 - 0.2
Red	0.2 - 0.3
Dark Red	> 0.3

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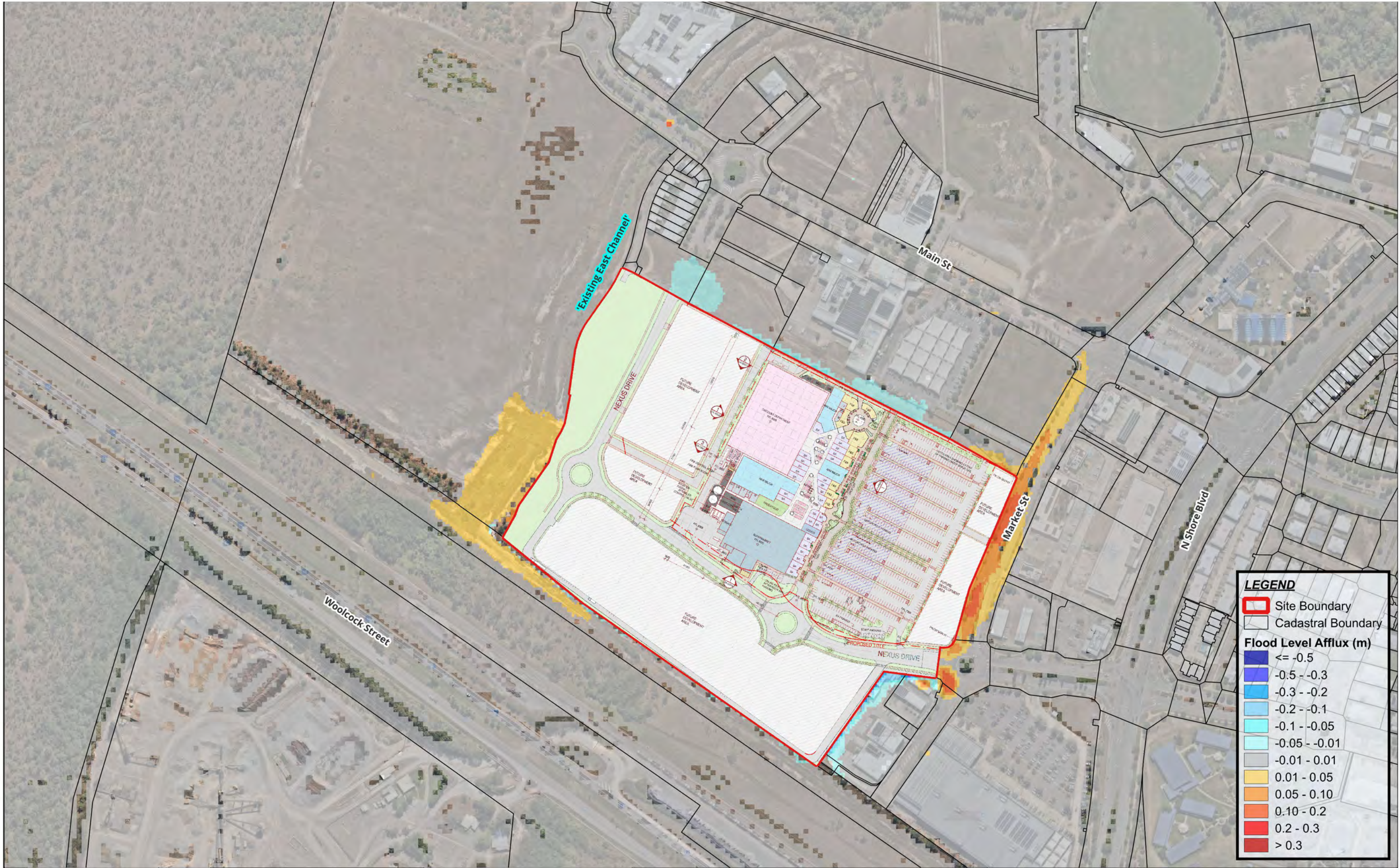
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Appendix D.2

Premise
North Shore Commercial Town Centre HIA
Flood Impact Mapping
10% AEP Flood Level Difference

Dwg Ref:



LEGEND

Site Boundary

Cadastral Boundary

Flood Level Afflux (m)

	<= -0.5
	-0.5 - -0.3
	-0.3 - -0.2
	-0.2 - -0.1
	-0.1 - -0.05
	-0.05 - -0.01
	-0.01 - 0.01
	0.01 - 0.05
	0.05 - 0.10
	0.10 - 0.2
	0.2 - 0.3
	> 0.3

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008
0.16 km

Scale in metres (@ A3 - 1:3,500
GDA94 / MGA zone 55

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Appendix D.3

Premise
North Shore Commercial Town Centre HIA
Flood Impact Mapping
1% AEP Flood Level Difference

Dwg Ref: