4 CLIMATE CHANGE CONSIDERATIONS

The NSW Government recently adopted sea level rise planning benchmarks to ensure consistent consideration of sea level rise in coastal areas of NSW. These planning benchmarks are an increase above 1990 mean sea levels of 40cm by 2050 and 90cm by 2100.

To assess the impact these se level rise scenarios on the proposed development, sensitivity tests on the 1% AEP design event have been undertaken incorporating the above potential increases in water level conditions at Newcastle Harbour (model boundary). Separate simulations were undertaken for the 2050 and 2100 planning horizons. The dynamic tidal water level boundary (based on normal tide + 50% AEP storm surge) was raised by the 0.4 and 0.9m respectively to simulate these conditions.

The changes in peak 1% AEP flood level from existing conditions to the 2050 and 2100 planning horizons are shown in Figure 4-1 and Figure 4-2 respectively. Typically the increase in peak flood level local to the development site is less than 0.2m for the 2050 scenario and less than 0.5m for the 2100 scenario.

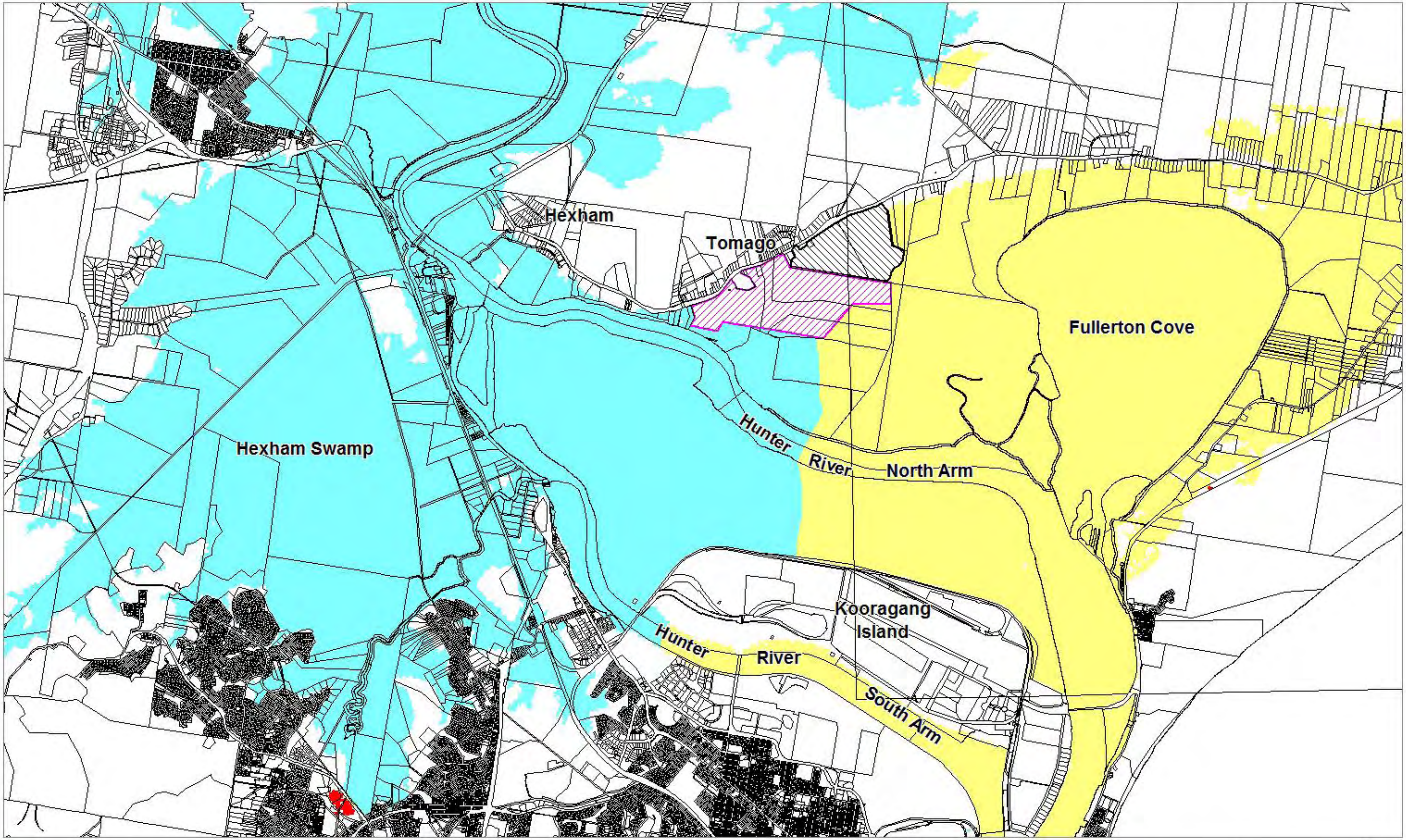
Flood levels for the 1% AEP event incorporating 0.9m SLR to the 2100 condition vary across the proposed development from approximately 3.2m AHD at the upstream (western) boundary to approximately 2.6m AHD at the downstream (eastern) boundary. The proposed finished surface levels across the site (typical building platform) is above 3m AHD and accordingly would provide for flood immunity to the 1% AEP 2100 flood level. At the western boundary of the site corresponding to the 3.2m AHD peak flood level, the fill level in this location is typically above 3.5m AHD.

Specific provisions for climate change beyond 2100 may require further consideration, and may incorporate additional staged filling above proposed levels, or additional freeboard allowances in floor level provisions.

The impact of the proposed development on 1% AEP peak flood levels for the SLR scenarios are presented in Figure 4-3 and Figure 4-4. The magnitude and extent of afflux at the 1% AEP flood level under the SLR scenarios are similar to the afflux pattern under existing conditions.

The greatest changes in peak flood water level and velocity are for the 1% AEP event. Increases in peak water level of up to 0.18m are simulated immediately adjacent to the development footprint. The region of highest afflux is generally contained within the development lot boundary. Peak flood level increases of the order of 0.05 – 0.1m for the 1% AEP are simulated for approximately 3km upstream of the proposed development site. This area is largely occupied by the Kooragang Wetlands in which the 1% AEP flood depths through this region are of the order 2 – 3m.

The extent of the impacts on peak flood levels extends as far as Hexham Swamp, although changes in water level are small (<0.04m). These minor changes in flood level are not expected to have any significant impact on existing development fringing the Swamp. Typically the topography rises relatively steeply from the extremities of the Swamp, such that additional floodplain inundation is negligible for such small increases in peak flood water level.



LEGEND

Increase in Peak Flood Level (m)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0

Adopted Fill Footprint

EXISTING PART 3A APPROVAL 07-0086
& EPBC APPROVAL 2007/3345

Title:

Northbank Enterprise Hub Flood Risk Assessment
Increase in Flood Level - 0.4m Sea Level Rise to 2050

0 1.25 2.5km
Approx. Scale

Figure: 4-1

Rev: A

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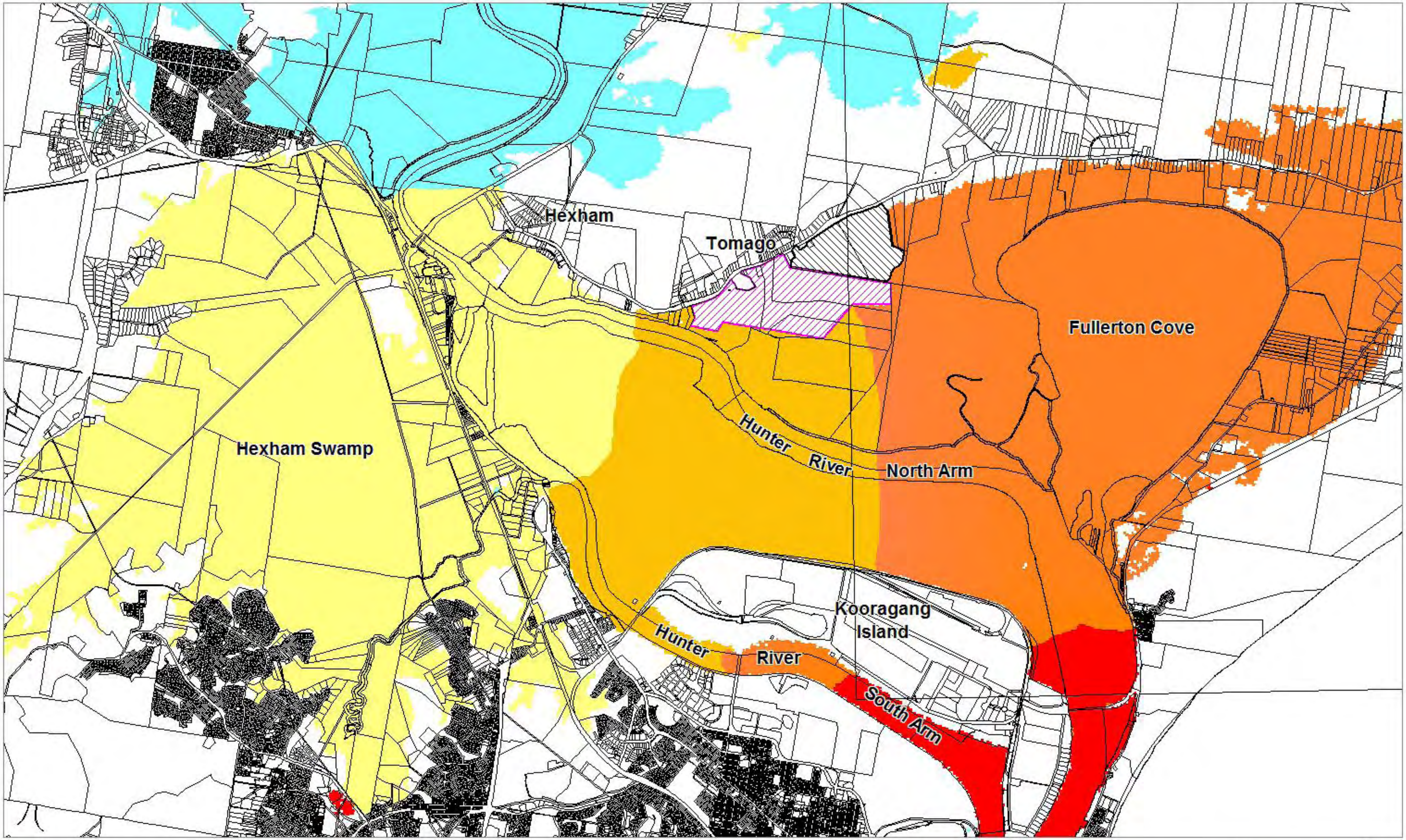


LEGEND

Increase in Peak Flood Level (m)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0

Adopted Fill Footprint

EXISTING PART 3A APPROVAL 07-0086
& EPBC APPROVAL 2007/3345

Title:

Northbank Enterprise Hub Flood Risk Assessment
Increase in Flood Level - 0.9m Sea Level Rise to 2100

Figure: 4-2

Rev: A

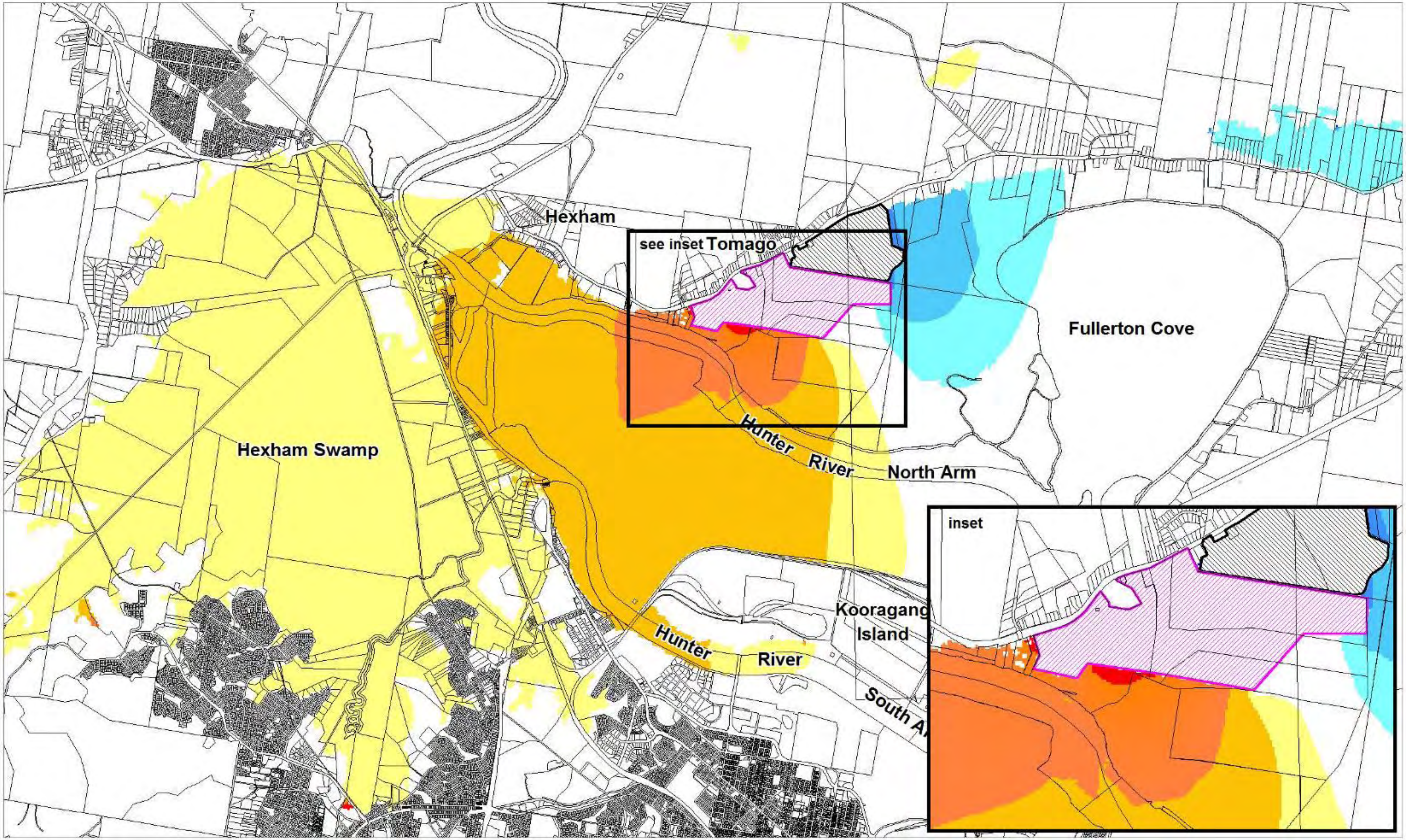
0 1.25 2.5km

Approx. Scale

BMT WBM

www.wbmpl.com.au

Filepath : K:\N1900_Tomago_Northbank_FloodStudy\MI\Workspaces\HAfflux_1%AEP_Final_CC2100.WOR



LEGEND

Afflux (m)

-0.20 - -0.50	0.02 - 0.05
-0.10 - -0.20	0.05 - 0.10
-0.05 - -0.10	0.10 - 0.20
-0.02 - -0.05	0.20 - 0.50
-0.02 - 0.02	

Adopted Fill Footprint

EXISTING PART 3A APPROVAL 07-0086 & EPBC APPROVAL 2007/3345

Title:

Northbank Enterprise Hub Flood Risk Assessment
Peak Water Level Afflux (Proposed - Existing) 1% 0.4m SLR

Figure: 4-3

Rev: A

0 1.25 2.5km
Approx. Scale

BMT WBM
www.bmtwbm.com.au

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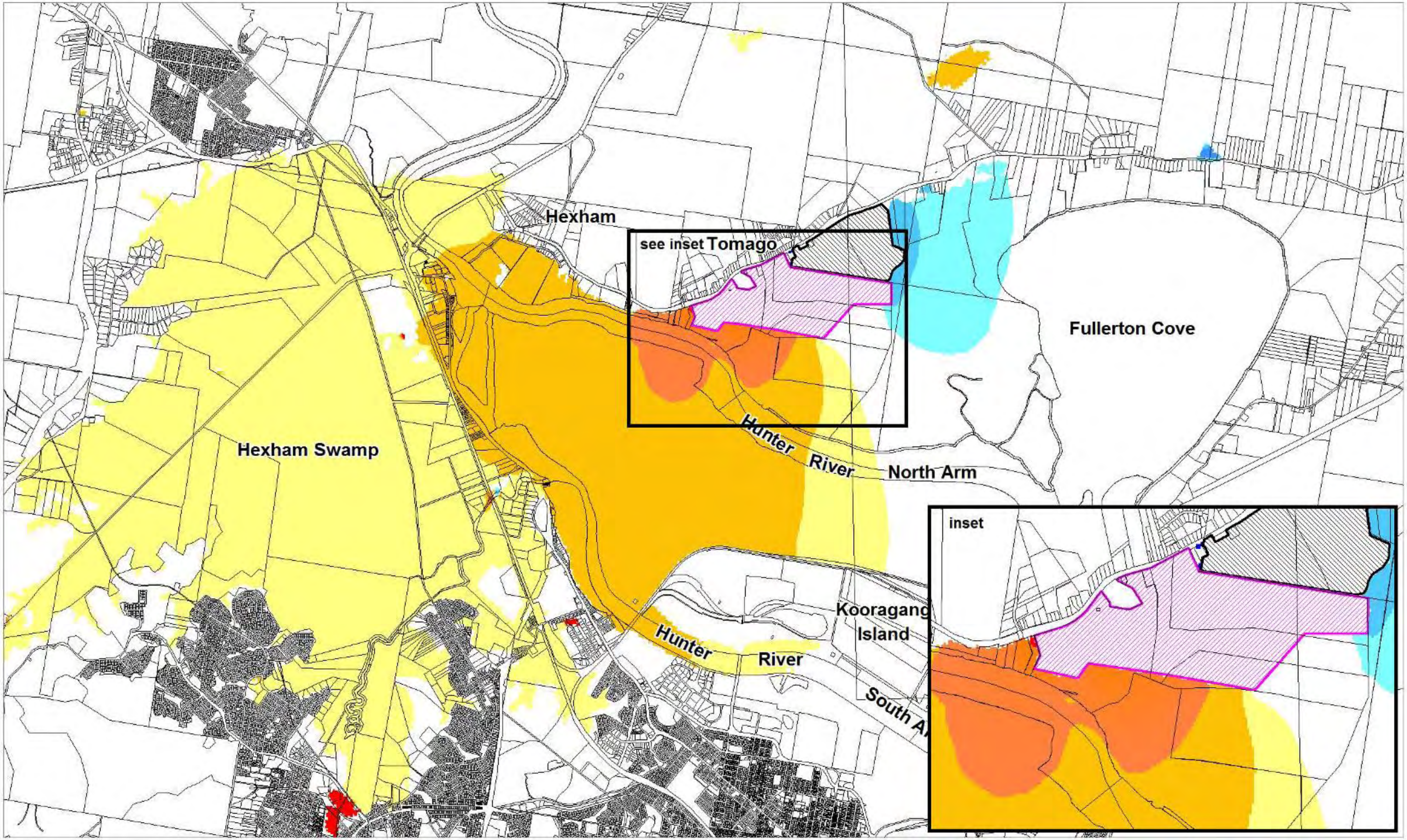


LEGEND

Afflux (m)

-0.20 - -0.50	0.02 - 0.05
-0.10 - -0.20	0.05 - 0.10
-0.05 - -0.10	0.10 - 0.20
-0.02 - -0.05	0.20 - 0.50
-0.02 - 0.02	

Adopted Fill Footprint

EXISTING PART 3A APPROVAL 07-0086 & EPBC APPROVAL 2007/3345

Title:

Northbank Enterprise Hub Flood Risk Assessment
Peak Water Level Afflux (Proposed - Existing) 1% 0.9m SLR

Figure: 4-4

Rev: A

0 1.25 2.5km
Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : K:\N1900_Tomago_Northbank_FloodStudy\MI\Workspaces\HAfflux_1%AEP_Final_CC2100_DoP.WOR

5 CONCLUSIONS

The objective of the study was to undertake a detailed flood impact assessment of the proposed development on Hunter River flood conditions. Central to this was the application of a two-dimensional hydraulic model of the Hunter River floodplain developed as part of the Williams River Flood Study (BMT WBM, 2009) completed for Port Stephens and Dungog Shire Councils. .

Specifically the modelling undertaken for the proposed development aimed to:

- Confirm existing flooding conditions across the site including flood levels, flows and velocities to establish baseline conditions for impact assessment and the flood planning requirements for future site development;
- Assess the potential for development on the site with regards to flooding constraints; and
- Identify the potential flood impacts of the proposed development over a range of design flood magnitudes.

The results of the modelling and flood impact assessment have confirmed:

- Peak 1% AEP flood levels for existing conditions are estimated to vary from 2.8m AHD at the western site boundary to 2.4m AHD at the eastern site boundary;
- The majority of the proposed development would be subject to significant inundation in major flood events with typical 1% AEP flood depths across the site are of the order of 1 – 2m;
- Corresponding peak flow velocities for the 1% AEP event under existing conditions are typically of the order 0.5m/s;
- The southern portion of the proposed development lot is currently classified as “Floodway” for a 1% AEP event corresponding to the location of major overbank flows spilling from the Hunter River North Arm channel to the floodplain;
- Extensive fill is required to achieve the required flood immunity for the site. The proposed fill footprint has been excluded from any nominated floodway area;
- Local increases in peak flood level of up to 0.18m immediately adjacent to the proposed fill area are simulated for the 1% AEP event. Some existing property immediately to the west of the development would be impacted, however given the magnitude and extent of area affected, it is expected some local works (bunding/fill) could be used to effectively manage any adverse impact;
- There is a significant area of the Hunter River floodplain upstream of the development site for which peak flood level increases are predicted, albeit at relatively low levels (<0.05m) for the 1% AEP event. The majority of this floodplain area consists of Kooragang Wetlands and Hexham Swamp with little existing development;
- For the design events less than the 1% AEP, the impact of the proposed development is significantly less, with negligible impacts for the %% AEP event and below.

The proposed development results in some impacts on existing design flood conditions. The most significant of these impacts are generally confined local to the site and in most do not significantly impact on existing development. The further reaching impacts of the development, whilst covering a significant area, are relatively minor in absolute magnitude (i.e. peak flood level increases <0.05m) and is not expected to impact significantly on existing development.

6 REFERENCES

BMT WBM (2009) *Williams River Flood Study,* R.B16030.003.005, Report Prepared for Port Stephens Council, June 2009.

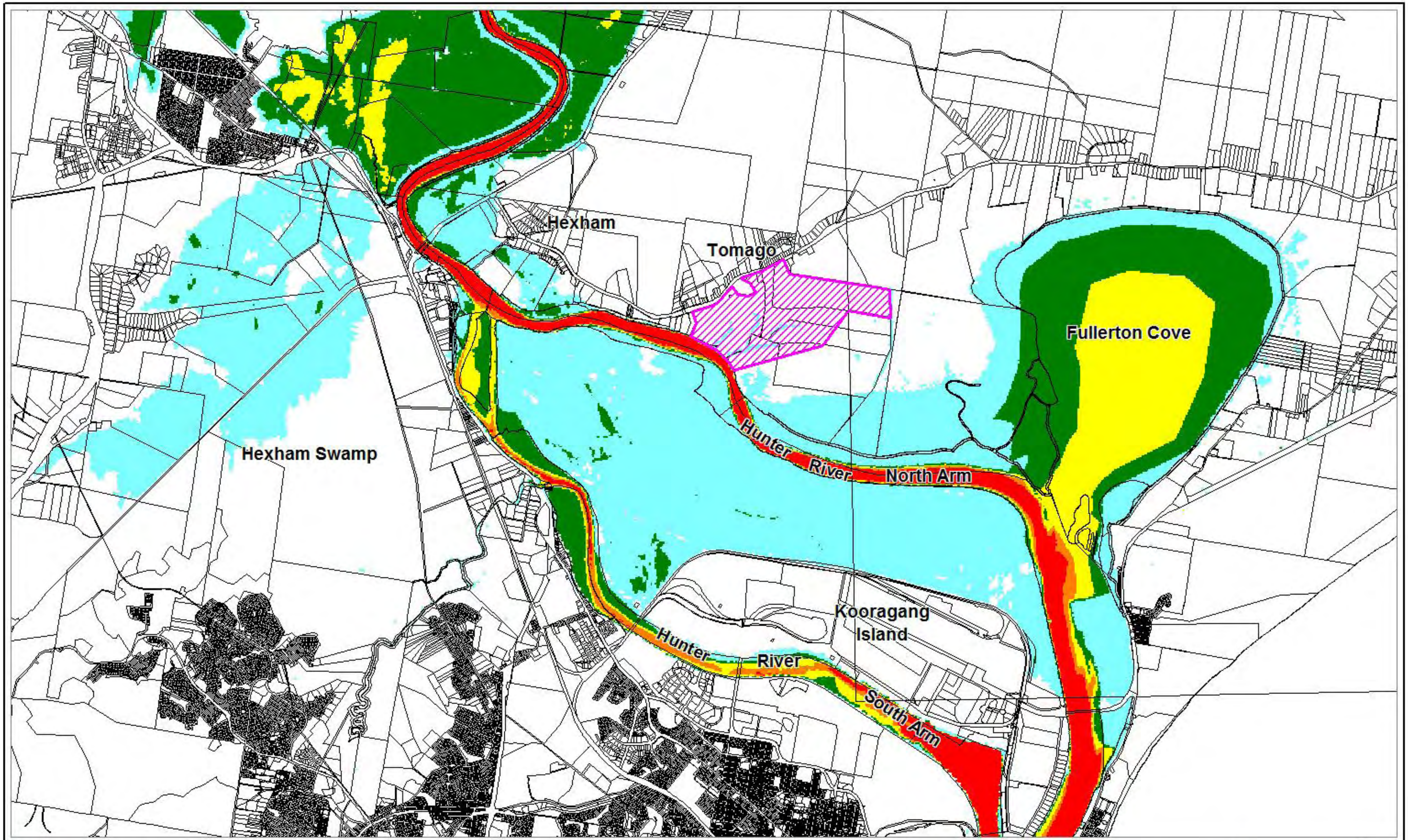
BMT WBM (2012a) *Northbank Enterprise Hub Business and Industrial Park – Stormwater Assessment,* R.N1900.002.05, Report Prepared for ADW Johnson, August 2012.

BMT WBM (2012b) *Northbank Enterprise Hub Business and Industrial Park – Flooding and Drainage Assessment,* R.N1900.003.01, Report Prepared for ADW Johnson, August 2012.

DHI (2008) *Upgrading of Lower Hunter Flood Model at Hexham*, Report Prepared for Newcastle City Council, September 2008.

Public Works Department (1994) *Lower Hunter River Flood Study (Green Rocks to Newcastle)* Report Prepared for Newcastle City Council and Port Stephens Council, August 1994.

APPENDIX A: DESIGN FLOOD MAPPING



LEGEND

Depth (m)

- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- > 4.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
10% AEP Peak Flood Depth (Existing Conditions)

Figure: **A-1**

Rev: **A**

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0 1.25 2.5km
Approx. Scale

BMT WBM
www.wbmpl.com.au

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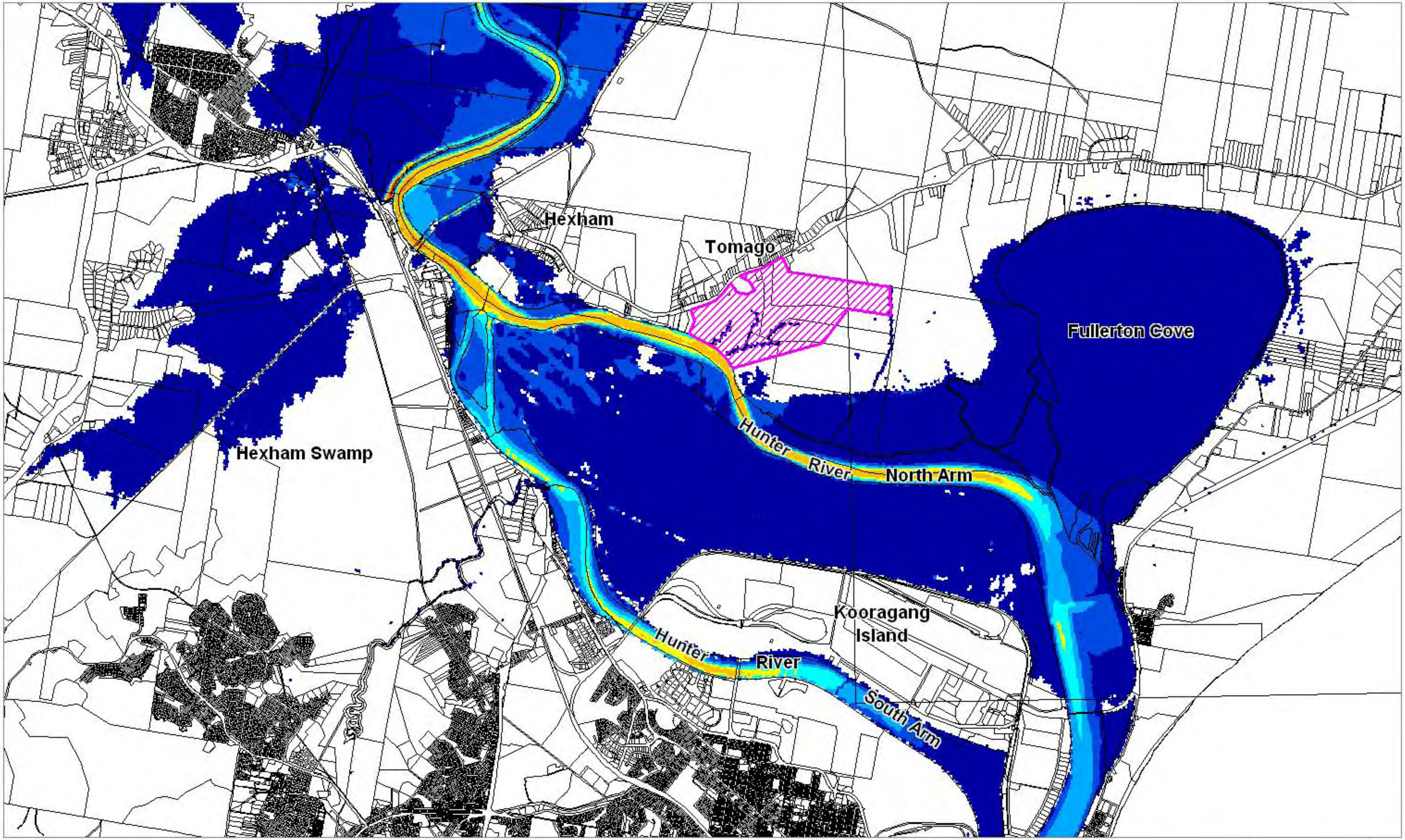

LEGEND

Velocity (m/s)

Velocity (m/s)	Velocity (m/s)
0.0 - 0.2	0.8 - 1.0
0.2 - 0.4	1.0 - 1.5
0.4 - 0.6	1.5 - 2.0
0.6 - 0.8	>2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
10% AEP Peak Flood Velocity (Existing Conditions)

Figure: **A-2**

Rev: **A**

0 1.25 2.5km

Approx. Scale

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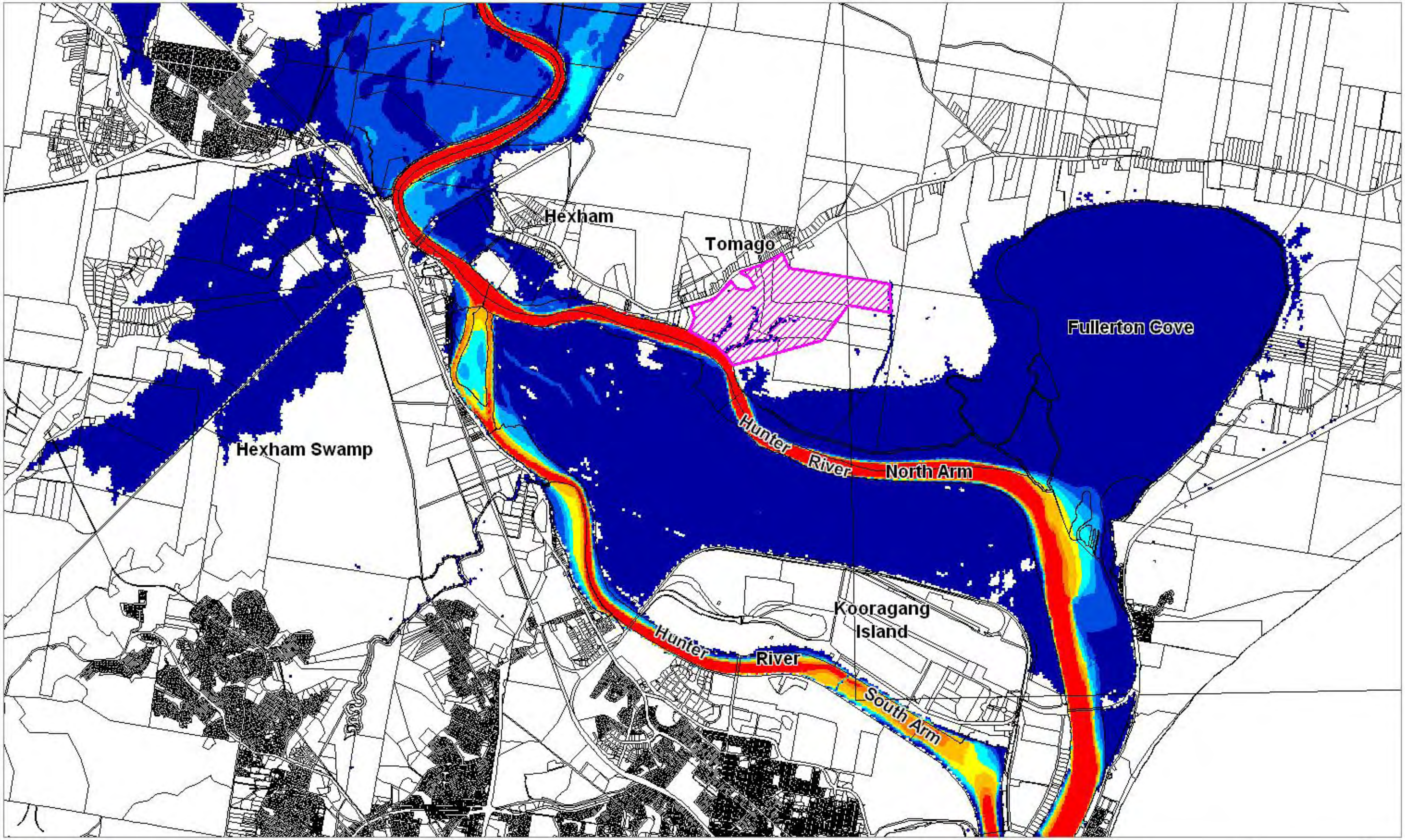

LEGEND

Unit Discharge (m3/s/m)

0.0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1.0
1.0 - 1.5
1.5 - 2.0
>2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
10% AEP Peak Unit Discharge (Existing Conditions)

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0 1.25 2.5km

Approx. Scale

Figure: A-3

Rev: A

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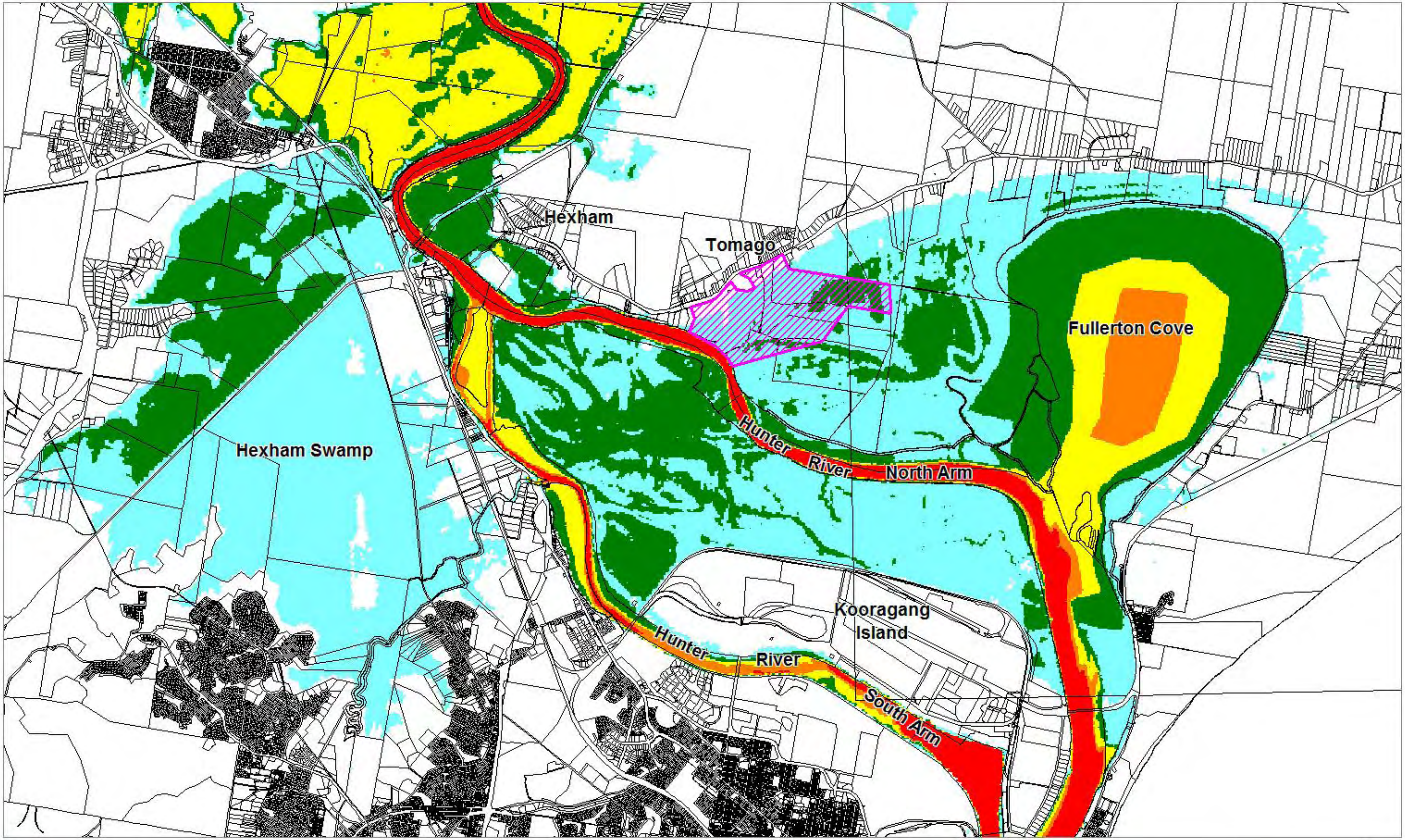

LEGEND

Depth (m)

- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- > 4.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
5% AEP Peak Flood Depth (Existing Conditions)

Figure: **A-4**

Rev: **A**

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0 1.25 2.5km
Approx. Scale

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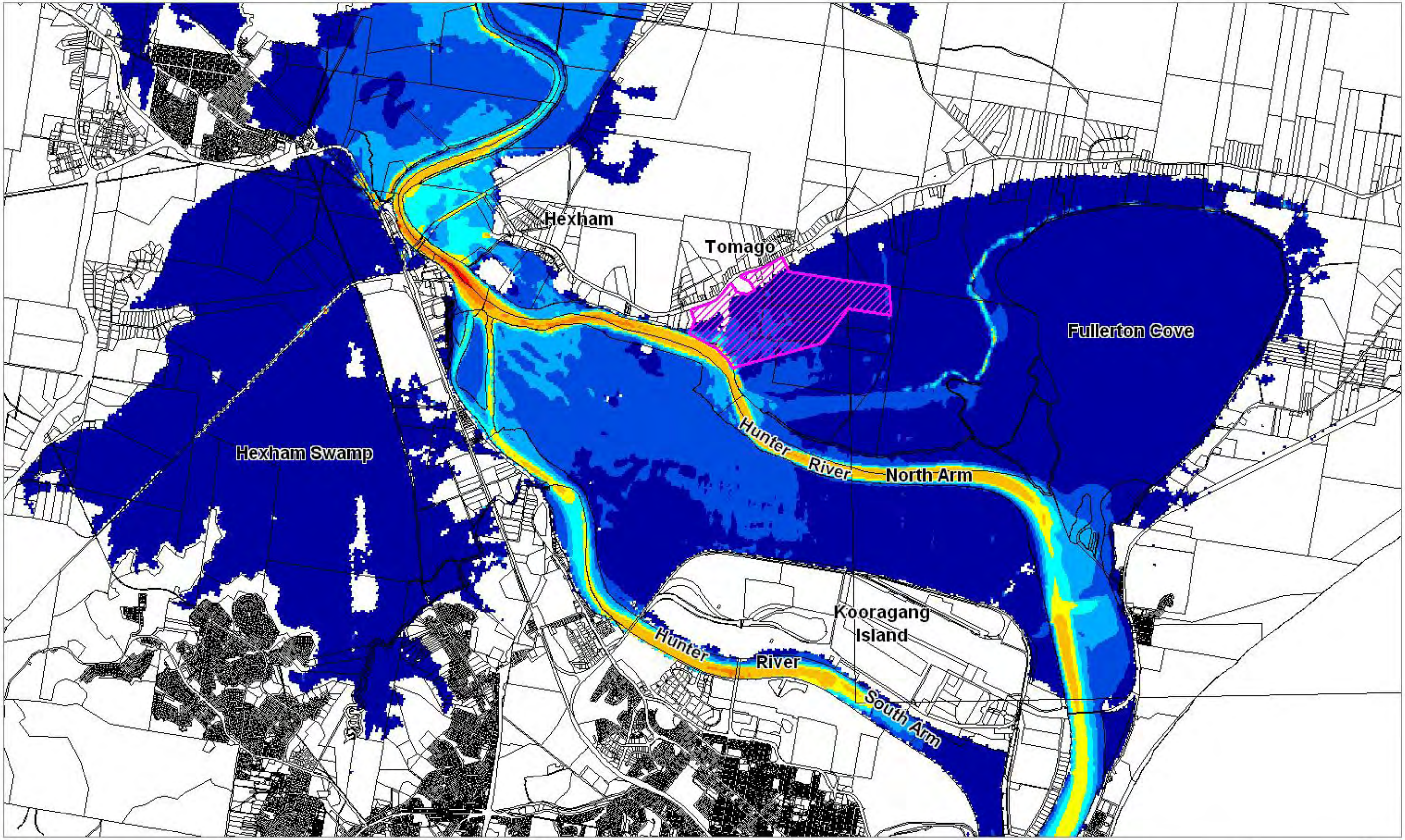

LEGEND

Velocity (m/s)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
5% AEP Peak Flood Velocity (Existing Conditions)

0 1.25 2.5km
Approx. Scale

Figure: **A-5**

Rev: **A**

BMT WBM
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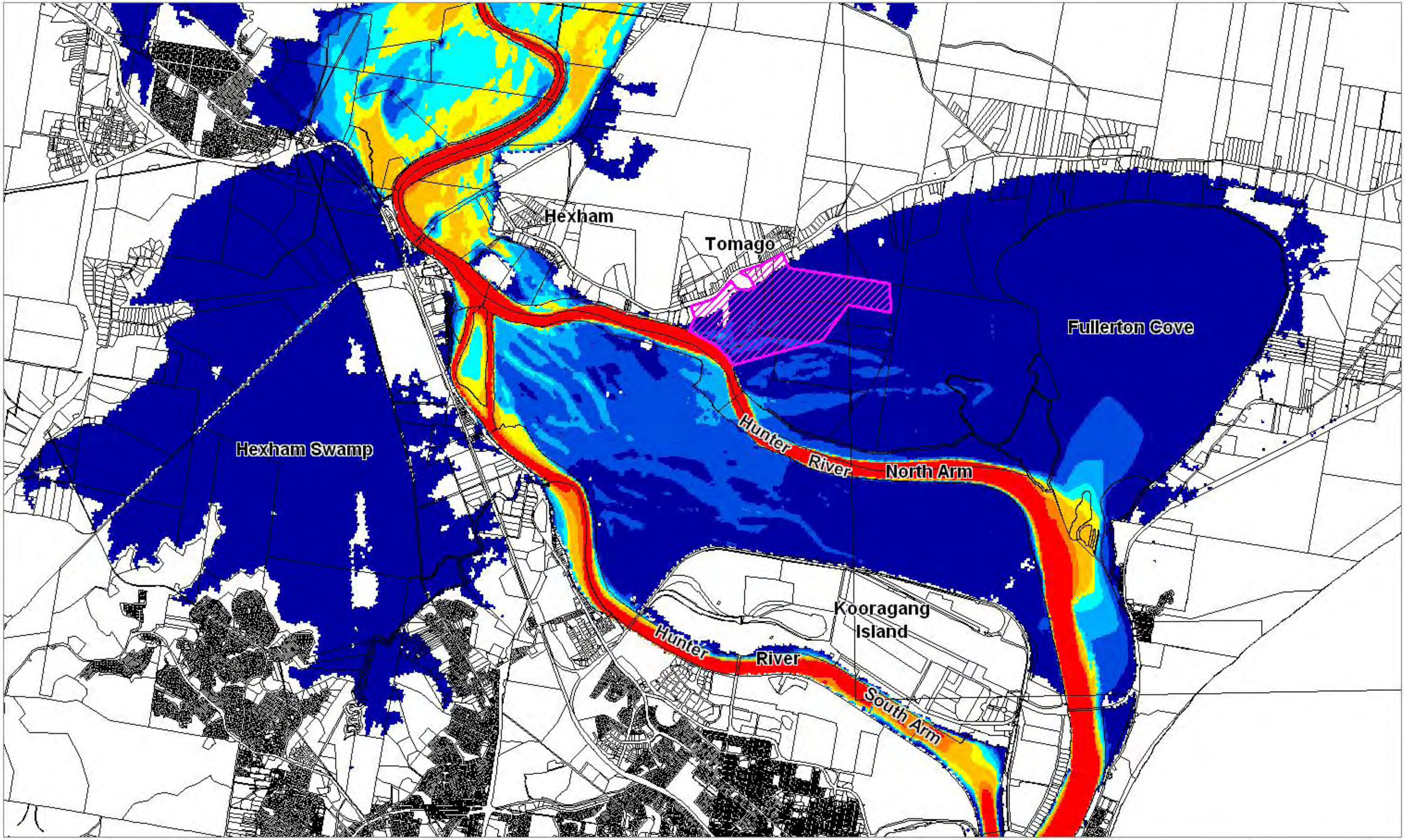

LEGEND

Unit Discharge (m3/s/m)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
5% AEP Peak Unit Discharge (Existing Conditions)

Figure: A-6

Rev: A

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0 1.25 2.5km
Approx. Scale

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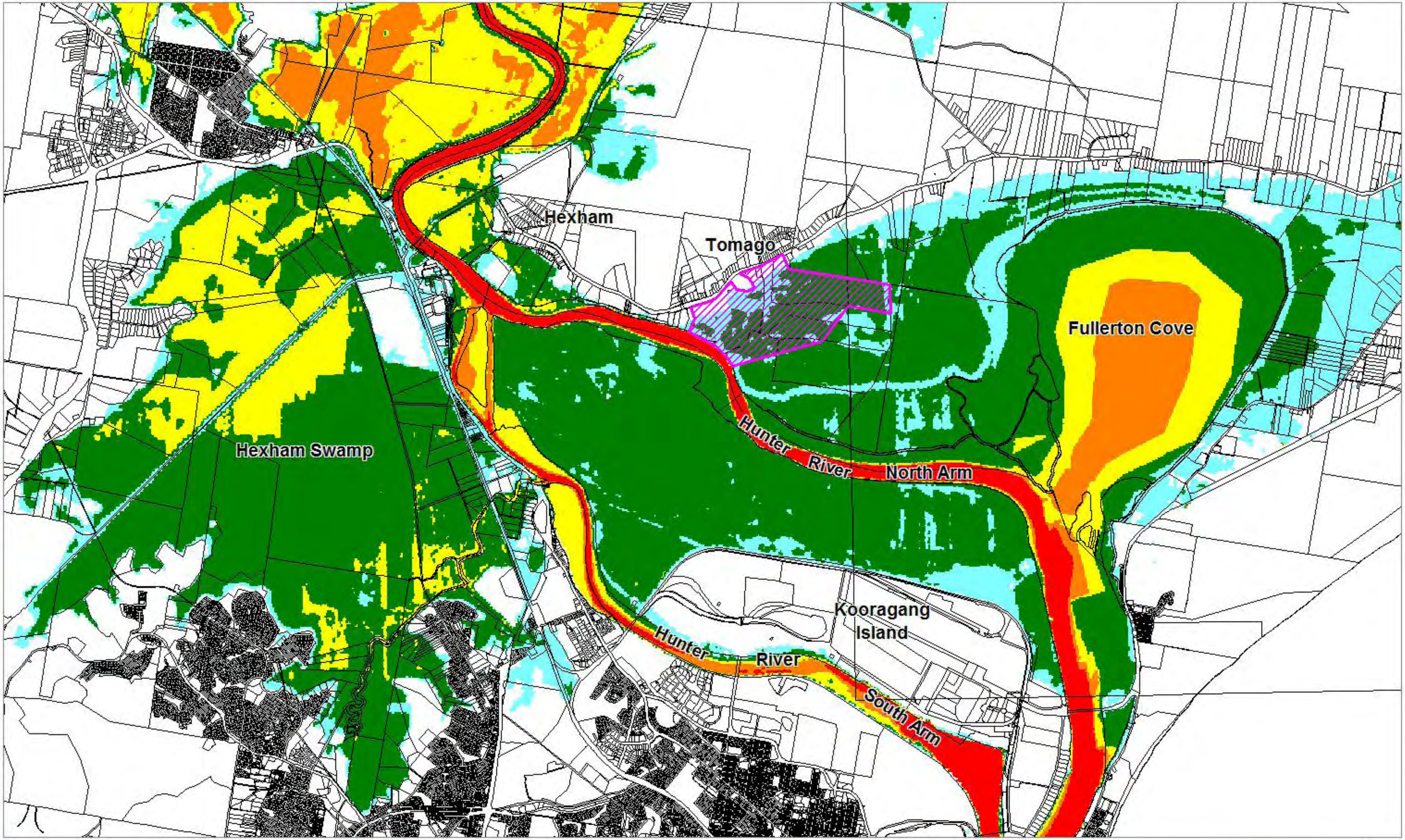

LEGEND

Depth (m)

- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- > 4.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
2% AEP Peak Flood Depth (Existing Conditions)

Figure: **A-7**

Rev: **A**

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0 1.25 2.5km

Approx. Scale

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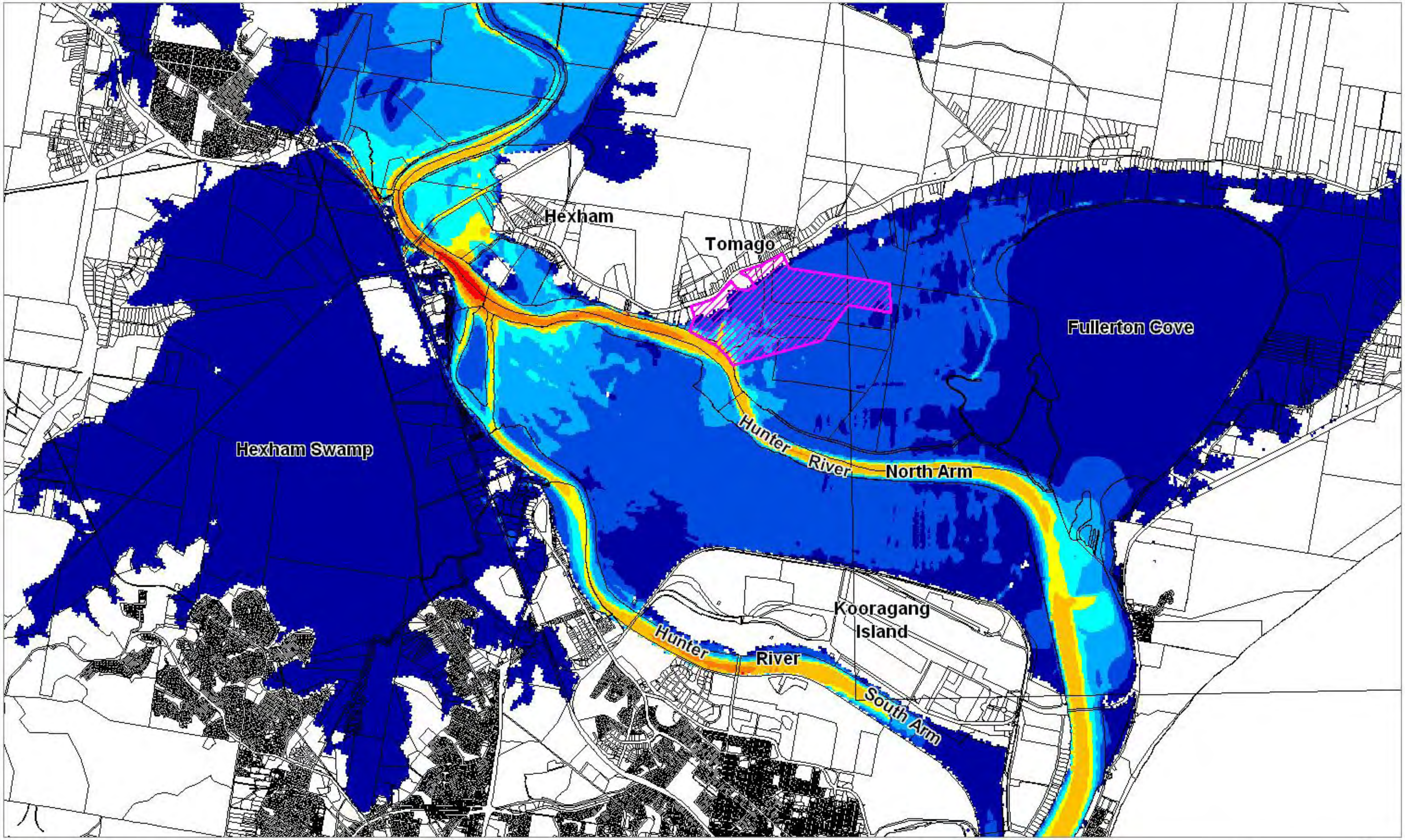

LEGEND

Velocity (m/s)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
2% AEP Peak Flood Velocity (Existing Conditions)

Figure: **A-8**

Rev: **A**

0 1.25 2.5km
Approx. Scale

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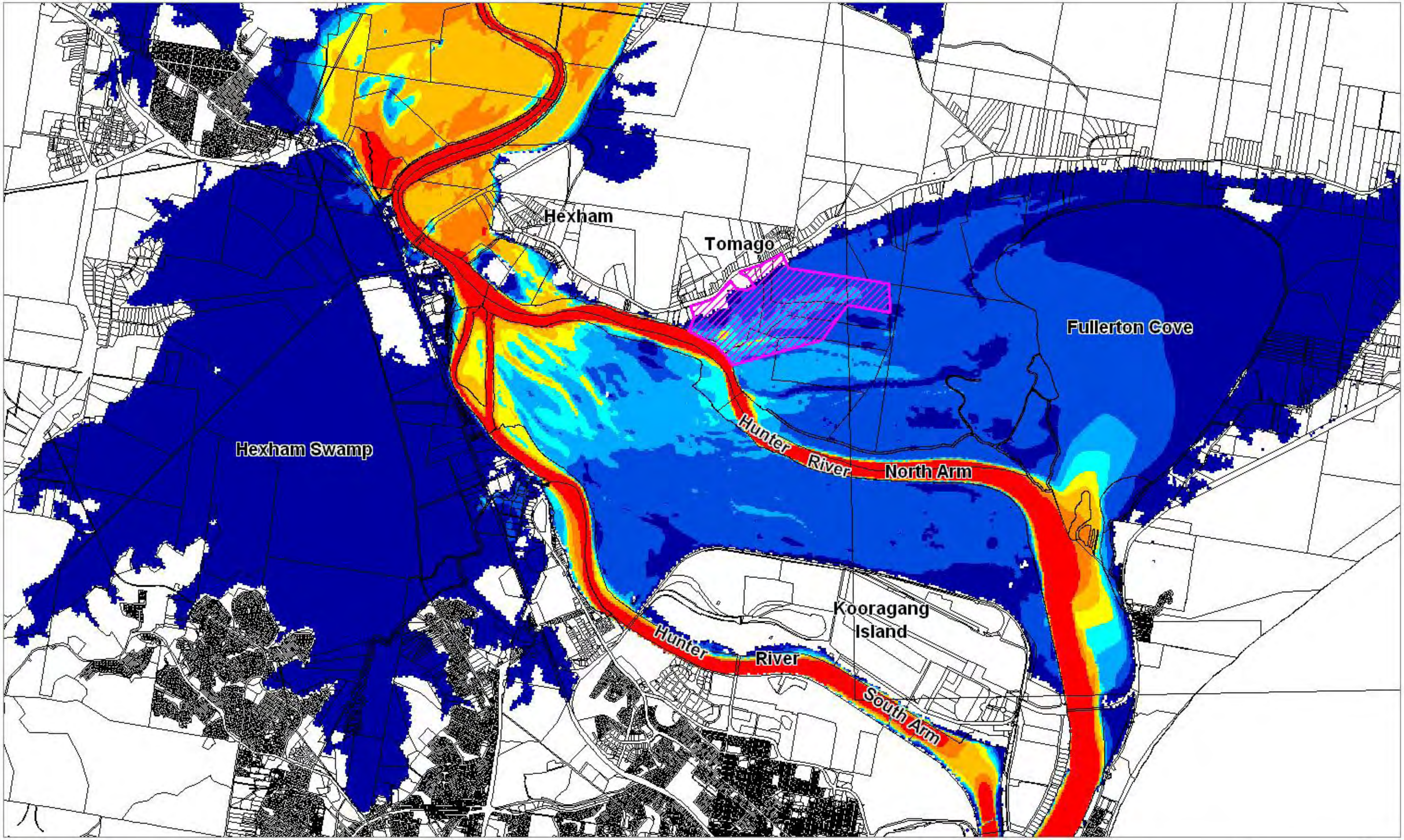

LEGEND

Unit Discharge (m3/s/m)

- 0.0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- >2.0

Development Lot Boundary

Title:

Northbank Enterprise Hub Flood Risk Assessment
2% AEP Peak Unit Discharge (Existing Conditions)

Figure: **A-9**

Rev: **A**

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0 1.25 2.5km
Approx. Scale

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BMT WBM Denver	**14 Inverness Drive East, #B132** **Englewood Denver Colorado 80112 USA** **Tel +1 303 792 9814 Fax +1 303 792 9742** **Email wbmdenver@wbmpl.com.au** **Web www.wbmpl.com.au**
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BMT WBM Melbourne	**Level 5, 99 King Street Melbourne 3000** **PO Box 604 Collins Street West VIC 8007** **Tel +61 3 8620 6100 Fax +61 3 8620 6105** **Email wbmmelbourne@wbmpl.com.au** **Web www.wbmpl.com.au**
BMT WBM Newcastle	**126 Belford Street Broadmeadow 2292** **PO Box 266 Broadmeadow NSW 2292** **Tel +61 2 4940 8882 Fax +61 2 4940 8887** **Email wbmnewcastle@wbmpl.com.au** **Web www.wbmpl.com.au**
BMT WBM Perth	**1 Brodie Hall Drive Technology Park Bentley 6102** **Tel +61 8 9328 2029 Fax +61 8 9486 7588** **Email wbmperth@wbmpl.com.au** **Web www.wbmpl.com.au**
BMT WBM Sydney	**Level 1, 256-258 Norton Street Leichhardt 2040** **PO Box 194 Leichhardt NSW 2040** **Tel +61 2 9713 4836 Fax +61 2 9713 4890** **Email wbmsydney@wbmpl.com.au** **Web www.wbmpl.com.au**
BMT WBM Vancouver	**1190 Melville Street #700 Vancouver** **British Columbia V6E 3W1 Canada** **Tel +1 604 683 5777 Fax +1 604 608 3232** **Email wbmvancouver@wbmpl.com.au** **Web www.wbmpl.com.au**

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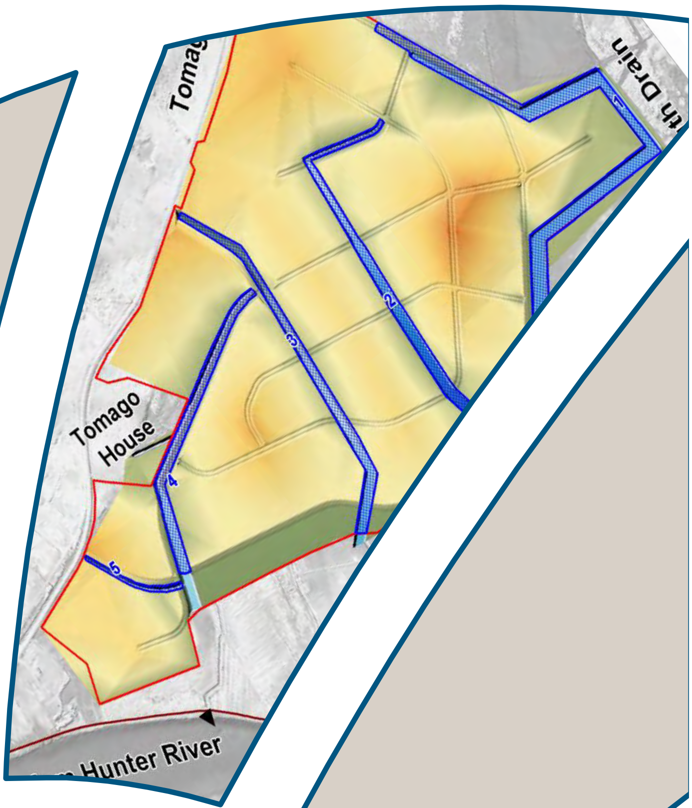
Northbank Enterprise Hub Business and Industrial Park - Flooding and Drainage Assessment

R.N1900.003.01

August 2012



Northbank Enterprise Hub Business and Industrial Park – Flooding and Drainage Assessment

Prepared For:	ADW Johnson
Prepared By:	BMT WBM Pty Ltd (Member of the BMT group of companies)

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Title :	Northbank Enterprise Hub Business and Industrial Park– Flooding and Drainage Assessment
Authors :	
Synopsis :	This report provides an assessment of flooding issues and drainage design for the proposed Northbank Enterprise Hub subdivision major project application.

REVISION/CHECKING HISTORY

REVISION NUMBER	DATE OF ISSUE	CHECKED BY		ISSUED BY	
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1	20 August 2012	DJL		DJL	

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BMT WBM File				
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1 INTRODUCTION

1.1 Purpose of this Report

This report has been commissioned by ADW Johnson for the purposes of identifying potential opportunities/constraints to the proposed Northbank Enterprise Hub Business and Industrial Park development on Tomago Road, Tomago with respect to local flooding and drainage. The report investigates the potential impacts of the proposed development on local flood conditions and specifies the design of a local drainage network that prevents flooding to the proposed development for rainfall events up to the 1 in 100 year design frequency. Separate reports have been prepared by BMT WBM regarding impacts on regional flooding (BMT WBM, 2012a) and stormwater management (BMT WBM, 2012b).

1.2 Outline of Flooding and Drainage Assessment

The aim of the flooding and drainage assessment was to:

- Assess existing site drainage;
- Design open channel drainage corridor system;
- Assess proposed site drainage; and
- Determine impact on offsite local flooding.

A state-of-the-art computational flood model (TUFLOW) was setup and utilised for the flood risk assessment. Direct rainfall modelling within TUFLOW was used to determine the hydrologic (rainfall / runoff) processes required for the study. An iterative design of open channels was used to optimise the area of land available for development within the constraints of water quality and flooding issues.

The flooding and drainage assessment presented in this document details the nature of the proposed development and the analysis undertaken to quantify existing and proposed flooding and drainage issues. The local flooding and drainage assessment herein provides a basis for assessing the Part 3a application in respect to floodplain management principles.

1.3 Site Description

The proposed Northbank Enterprise Hub development area is located on the left bank floodplain of the North Arm of the Hunter River (shown in red on Figure 1-1). A more detailed map of the existing site including ground levels is presented in Figure 3-1. The site is currently zoned for development but is currently used for agriculture and consists of low lying poor quality pasture. A number of minor channels partially drain the site through flapped outfalls into the North Arm of the Hunter River.

The proposed Northbank Enterprise Hub development would involve land raising of approximately 154 hectares for industrial development. Catchments for this assessment include some land that has already been approved (Part 3A Approval 07-0086). The preliminary design ground levels and drainage network for the proposed development (including an area that has already received approval) is presented in Figure 3-2.

The assessment outlined in this report is based on a previous development layout that was modified following completion of the modelling. We understand that the only significant change to the previous layout is associated with a reduction in developable land adjacent to the eastern boundary of the Project Site. Specifically, we understand the small portion of land shown as “area removed from final footprint” in Figure 3-1 is no longer proposed for development as this land (approximately 14.5ha) has been confirmed as part of an area of Endangered Ecological Community (EEC). Therefore, the estimated runoff outlined in this assessment is likely to be higher than would be expected from the reduced development footprint. The development impacts from the modified layout are subsequently expected to be slightly lower than presented in this assessment.

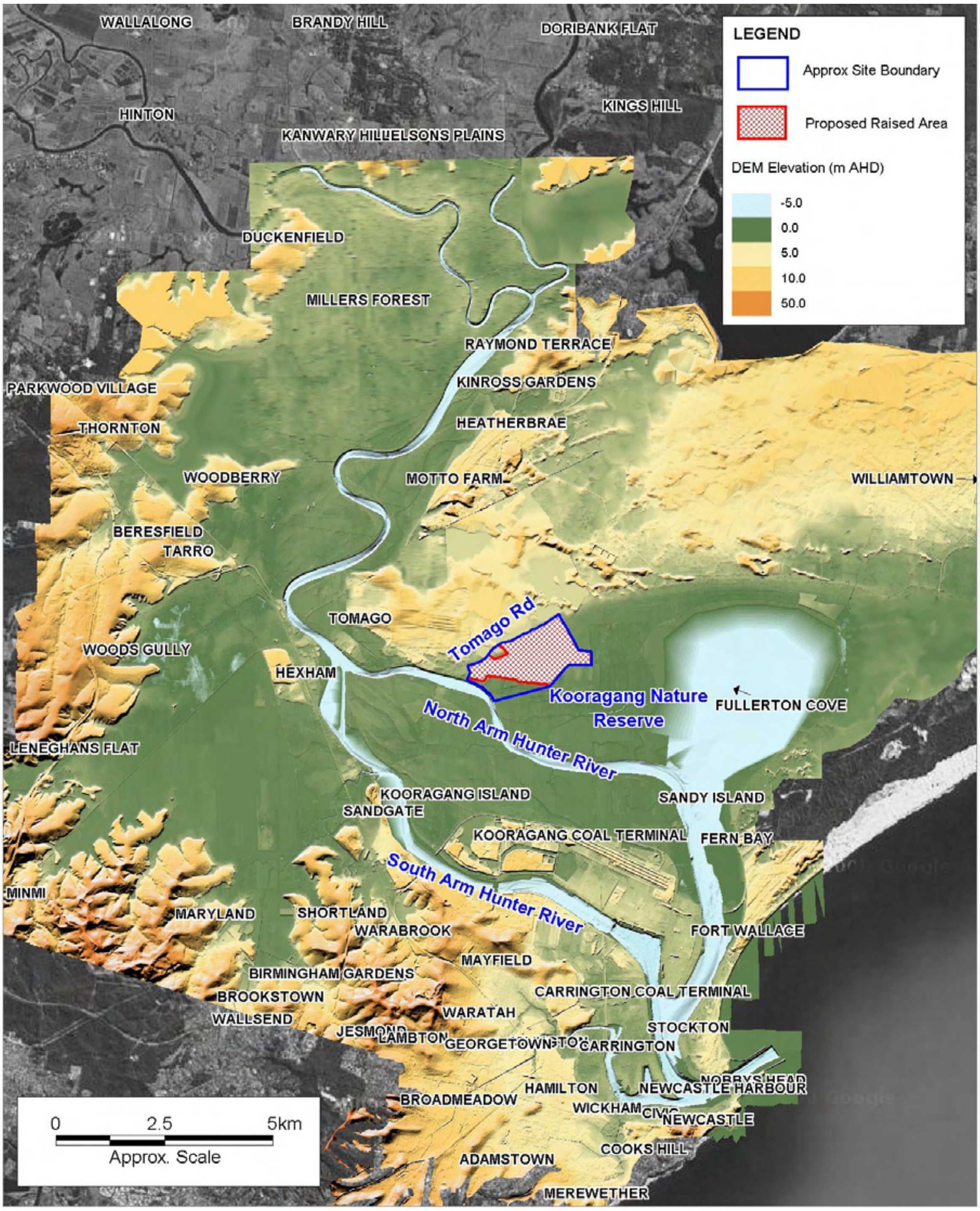

Figure 1-1 Site Locality

2 MODEL SETUP

A TUFLOW 2D flood model of the site and surrounding catchment was setup to evaluate flood behaviour of the proposed Northbank Tomago development. A pre (existing case) and post development model topography has been developed for the study. In order to optimise the drainage design of the proposed development, the open channels were represented using 1D sections carved through the 2D model and linked along the banks of the channels. A 5m model grid (which allows for the topography to be defined at a 2.5 m resolution) was selected for the study based on a trade-off between model resolution, model run time and result size.

3 MODEL TOPOGRAPHY

The base case model uses a digital elevation model (DEM) of the existing topography based on LiDAR data collected in 2007. A map of ground elevations is presented in Figure 3-1.

The post-development model uses a proposed site DEM provided by ADW Johnson. The DEM includes an area that has already been approved for development (Part 3A Approval 07-0086) but will contribute to site run-off to the proposed drainage network. The site was designed with minimum levels above 2.5 mAHD so as to minimise flood risk from high Hunter River flows that spill on to the site during regional scale flood events (BMT WBM, 2012a). The site is graded for drainage at approximately 1% into five drainage channels as shown in Figure 3-2

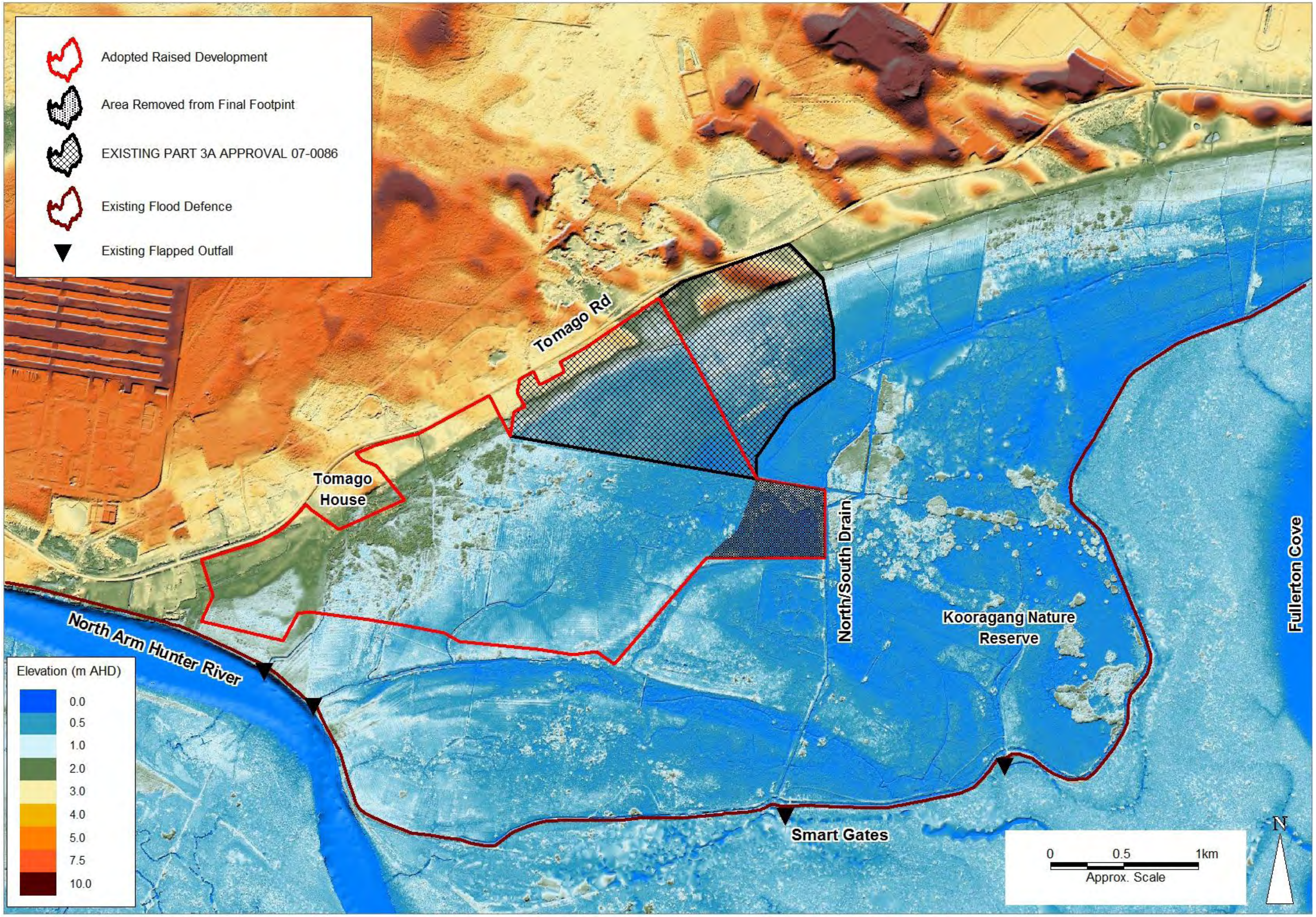

Figure 3-1 Existing Ground Elevations (LiDAR Data)

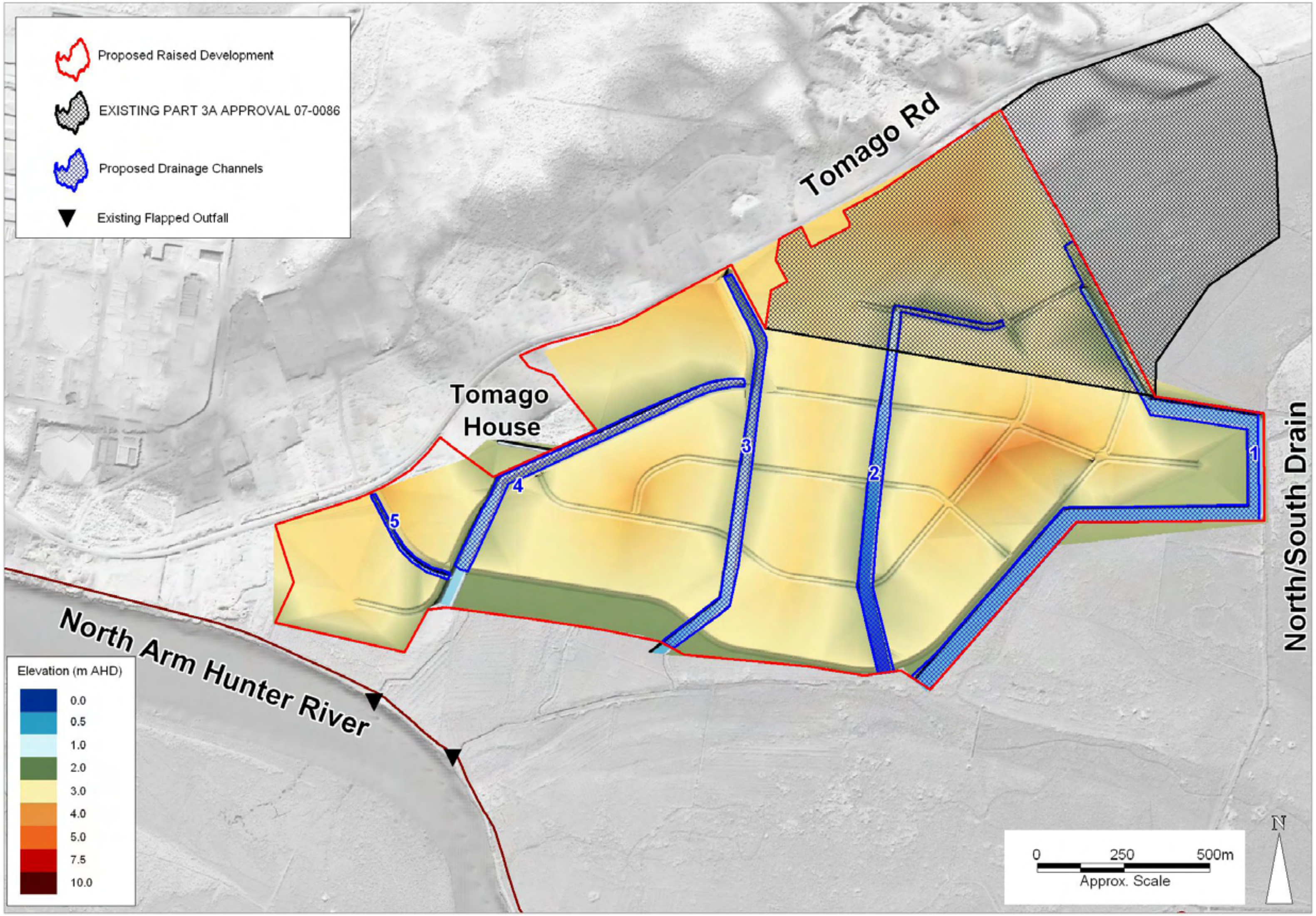

Figure 3-2 DEM and Layout of Proposed Development

4 MODEL HYDROLOGY

Due to the flat topography of the catchment and relative small size of the study area, direct rainfall was used to define the model hydrology. Direct rainfall modelling has been available in TUFLOW since 2007 and means that sub-catchment do not have to be pre-defined. However, use of direct rainfall hydrology results in significantly longer model run times.

To minimise flood risk to the development, the drainage system was designed to be able to cope with flows up to the 1 in 100 year average recurrence interval (ARI) which is approximately equivalent to the 1% annual exceedance probability (AEP) event. For design events, rainfall depths are most commonly determined by the estimation of intensity-frequency-duration (IFD) design rainfall curves for the catchment. Standard procedures for derivation of these curves are defined in AR&R (1987). Similarly AR&R (1987) defines standard temporal patterns for use in design flood estimation. Cumulative rainfall totals for five different duration events for the 1 in 100 year ARI event are presented in Figure 4-1.

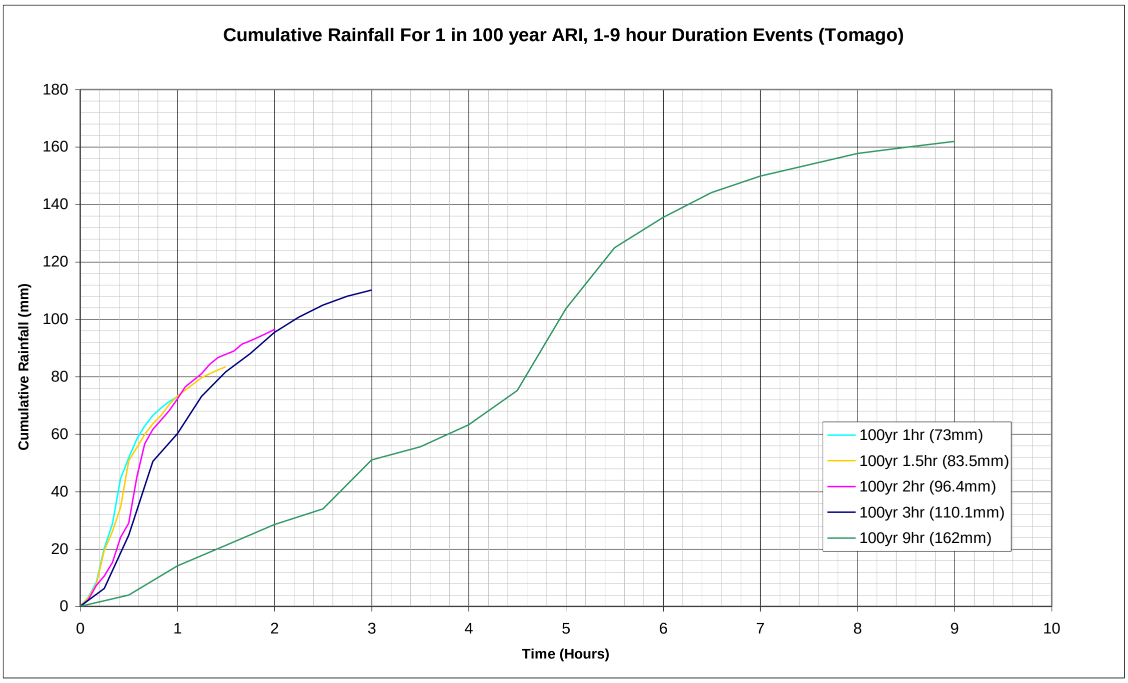

Figure 4-1 Cumulative Rainfall Totals for 1 – 9 Hour Duration, 1 in 100 Year Rain Events

Given that the 2 hour event contains the longest period of high intensity rainfall it was selected for the key design event. Both the 1 and 9 hour duration events were also simulated and predicted lower flood levels than were simulated for the 2 hour event, as is typical for a catchment/development of this size.

An initial and continuing loss model is incorporated into the direct rainfall approach utilised for this study. The initial loss is the depth (millimetres) of rainfall that is prevented from becoming runoff in the initial stages of the flood-producing rainfall event. It is a function of the ground cover and initial "wetness" of a catchment (i.e. the wetter the catchment prior to flood-producing rainfall event, the lower the initial loss). The continuing loss rate (millimetres per hour) is the rainfall that is continually (i.e. throughout the event) prevented from becoming runoff and is typically high in sandy soils.

Conservative loss rates were applied to both the pervious (ie natural) and impervious (developed) surfaces as presented in Table 4-1.

Table 4-1 Adopted Rainfall Loss Rates

Rainfall Loss Type	Value
Initial Loss – Pervious	10 mm
Initial Loss – Impervious	0 mm
Continuing Loss – Pervious	2.5 mm/hr
Continuing Loss – Impervious	0 mm/hr

5 EXISTING SITE DRAINAGE / FLOODING ASSESSMENT

Due to the flatness of the site, there is limited scope for runoff during storms. During the 1 in 100 year rain event water ponds across much of the site to depths of up to 0.5 m, as presented in Figure 5-1. The flat, narrow drainage channels are of limited capacity and slowly drain the site through flapped outfalls into the North Arm of the Hunter River. The higher ground to the north of Tomago Road is also relatively flat, resulting in no significant upstream flow inputs to the site.

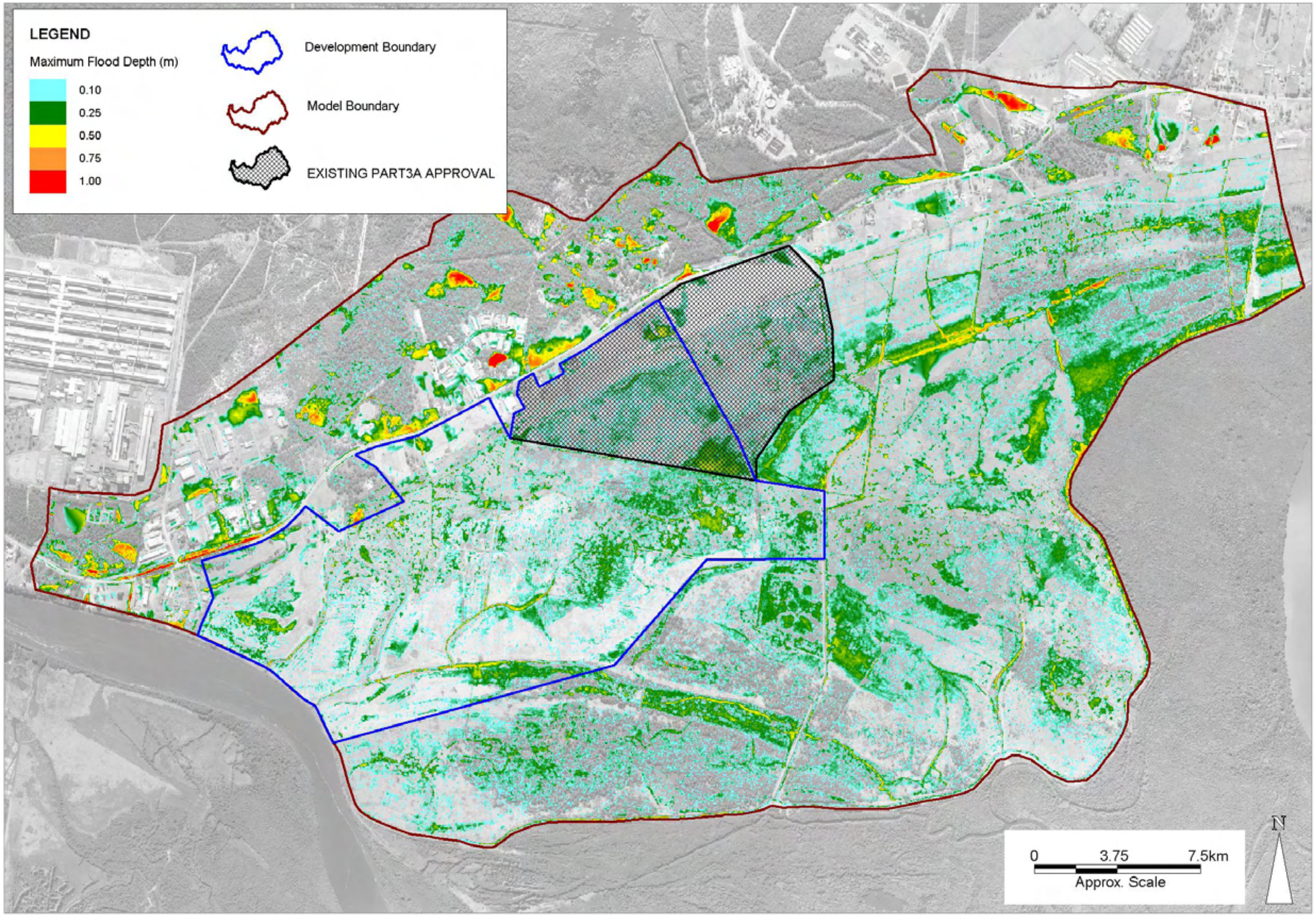

Figure 5-1 Existing Conditions - 1 in 100 Year Flood Depths

6 OPEN CHANNEL DRAINAGE SYSTEM DESIGN

The design of the drainage system is heavily influenced by the requirements for the lateral water quality treatment system that is currently proposed. The water quality study indicated that a 10 m wide bench/ledge for the installation of 1m deep bio-remediation units is suitable for the proposed development. Details of the cross-sections required for water quality treatment are presented in BMT WBM (2012b).

Due to the size of the site, low level of the existing land and proposed development, a flat channel gradient was assumed. The lack of channel gradient results in a requirement for a large channel cross-section, to allow for significant storage within the channel to store runoff during periods of intense rainfall.

Batter slopes of 1 in 4 have also been assumed based on geotechnical stability issues as well as access, safety and maintenance considerations. Small reductions in cross-section width may be possible if steeper batter slopes are adopted. However, steeper batter slopes would reduce both channel conveyance and storage and would therefore need to be checked to see if would cause increased flood levels.

For the purposes of hydraulic assessment three cross-sections have been schematised as shown in Figure 6-2 to Figure 6-4 and described in Table 6-1. The channel schematisation represents the hydraulic properties of the channel that are representative of there operation under flood conditions. The schematisation is designed to predict conservative estimates of flood levels within the channels.

Optimisation of the open channel drainage system involved selecting the optimal location of transition between Section A and Section B so that peak water levels for the 1 in 100 year flood event were below 2.5 mAHD. Based on this optimisation process the location of the various Sections within the proposed development is shown in Figure 6-1.

A preliminary design of culverts has also been undertaken to check whether culverts are suitable for road crossings or if clear span crossings would be required. The preliminary assessment used five, 2.4 m wide x 0.6 m high x 20 m long at each Section A crossing and two, 2.4 m wide x 1.8 m high x 20 m long at each Section B crossing. Due to the flat channel beds and resulting low channel velocity, typical afflux at each culvert was less than 5cm and resulted in only minimal increases (typically less than a 2-5 cm's) in peak channel flood levels.

Table 6-1 Description of Cross-Sections used in Open Channel Drainage Design

Section	Comments
A (Figure 6-2)	• Treatment bench/units on the left and right banks draining into a 375 mm pipe. • Total section width is 28 m. • Section dimensions are dictated by water quality requirements.
B (Figure 6-3)	• Treatment bench/units on the left and right banks with a 5 m wide drainage section. • Total section width is 41 m. • 5 m wide (high flow / storage) drainage section required to reduce flood impact.
C (Figure 6-4)	• Treatment bench/unit on the right bank only with a 5 m wide drainage section. • Total section width is approximately 31 m (depends on offsite ground level). • Designed for draining the eastern / southern site boundary. • 2 mAHD left bank to provide sufficient in-channel conveyance / storage. • Defined with batter slopes on the right bank at 1:2 to minimise the width of the cross-section. However, if batter slopes of 1:4 are required for stability, then both the hydraulic conveyance and storage capacity of the section will increase, resulting in reduced channel flood levels. Typical offsite / tie-in ground levels are 0.5 mAHD. • The 2 mAHD bank level is recommended to prevent flood waters impacting on the Ramsar salt marsh site and also to reduce the likelihood of failure, should the bank be overtopped

Figure 6-1 Optimised Location of Channel Sections

BMT WBM

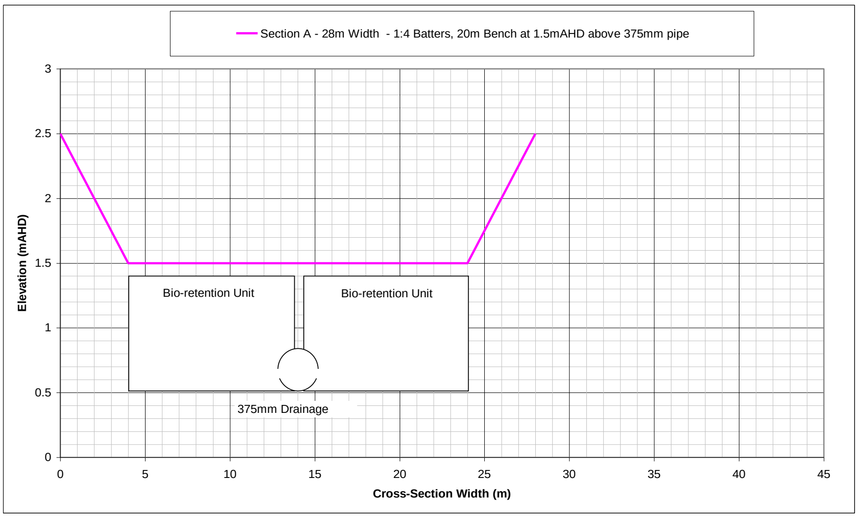

Figure 6-2 Section A Cross-Section Schematic

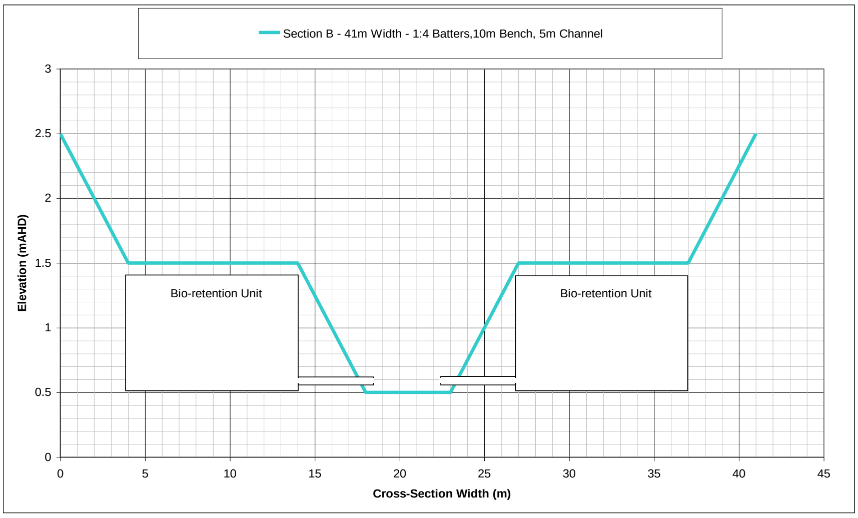

Figure 6-3 Section B Cross-Section Schematic

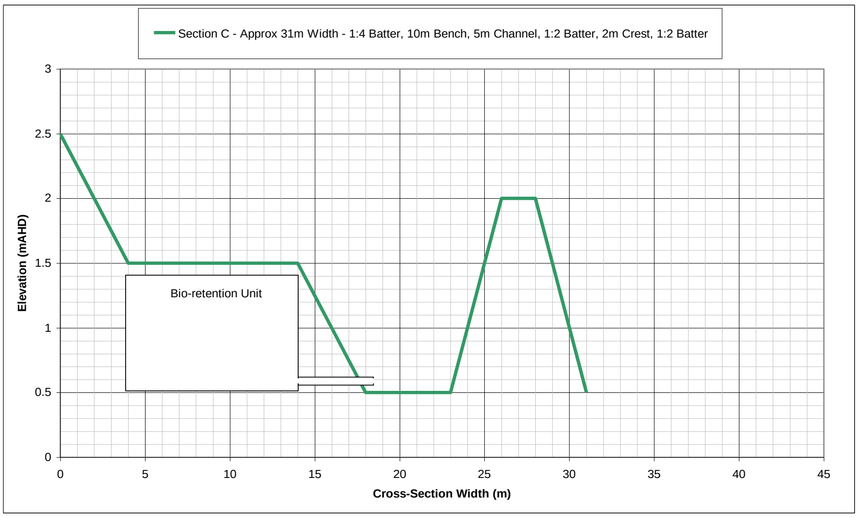

Figure 6-4 Section C Cross-Section Schematic

7 PROPOSED SITE DRAINAGE / FLOODING ASSESSMENT

The proposed Northbank development has been designed to be able to drain the 1 in 100 year flood event such that peak water levels are below the minimum site level of 2.5 mAHD. It is assumed that the adoption of appropriate site gradings will be able to adequately convey rainfall into the five proposed drainage channels. During the open channel drainage design process (described in Section 6) the linked 1d-2d TUFLOW hydraulic model was used to ensure peak flood levels in the channels were below 2.5 mAHD. The model was also used to determine the post development offsite flood depths and impact (increase in flood levels above the existing case).

Results are presented for a scenario that uses a partial bund around the perimeter of the site which allows some water to flow from the site in small quantities at the existing discharge points onto Kooragang Nature Reserve during the 1 in 100 year rain event (see Figure 7-1). A second scenario was investigated that used a complete bund (crest level 1.5mAHD) that prevented any local drainage spilling offsite, however, it was found to increase regional flooding to an unacceptable degree.

The partial flood bund is a 700m long flood defence bund with 1.20 mAHD crest level that ties into the flood bund that is part of the Section C drainage channel, that surrounds the eastern and southern site boundary (as shown in Figure 6-1). The use of the partial flood bund is consistent with the requirement to exclude development from the 1 in 100 year floodway extent (as defined in BMT WBM, 2012a).

Flood depths surrounding the proposed development are presented in Figure 7-1. Increases to 1 in 100 year flood levels, post-development are shown in Figure 7-2. The model predicts that if a partial bund is used, large areas of land to the east of the North-South drain will increase by approximately 10cm.

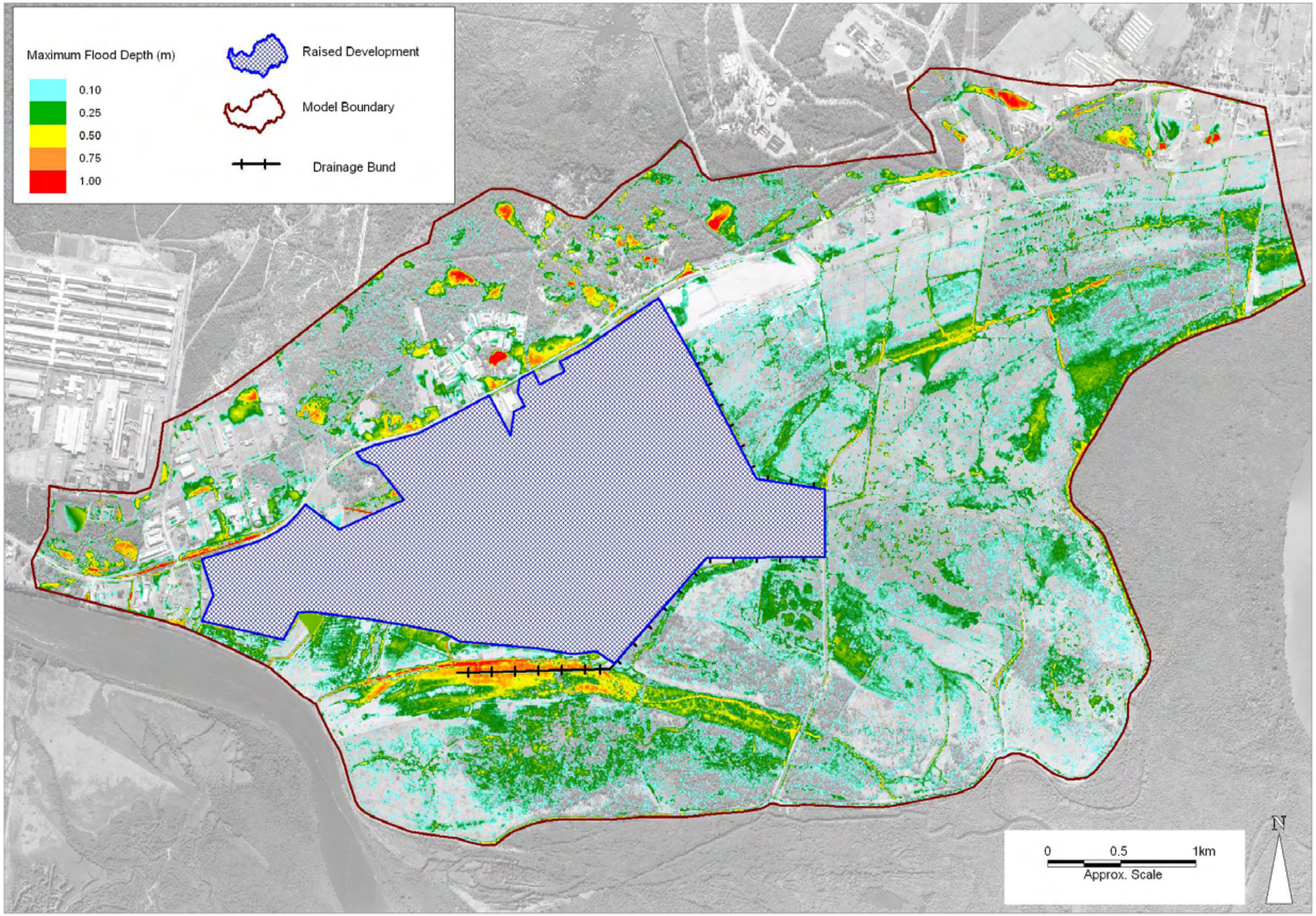

Figure 7-1 Post Development Scenario (Partial Flood Bund) - 1 in 100 Year Flood Depths

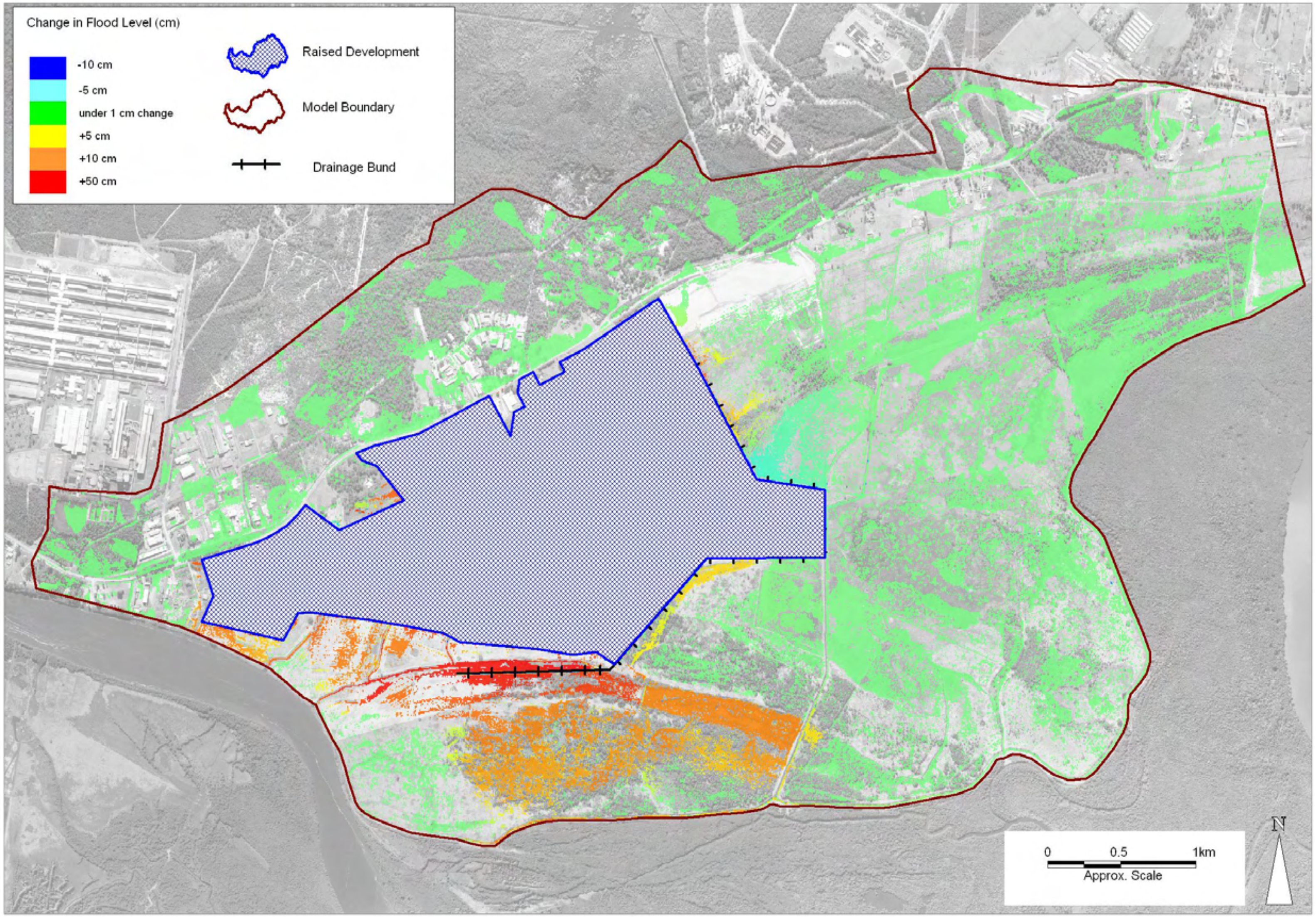

Figure 7-2 Post Development Scenario (Partial Flood Bund) - 1 in 100 Year Flood Impact

8 DISCUSSION & CONCLUSIONS

A direct rainfall, TUFLOW linked 1d-2d flood model was developed and used to investigate local flooding and drainage design issues for the proposed Northbank Enterprise Hub subdivision in Tomago. The model shows that because the existing site is very flat, during the 1 in 100 year rain event rain ponds in local depressions across much of the site to depth of up to 0.5m, while a series of small, flat drainage channels slowly convey water into the Hunter River through flapped outfalls.

The proposed Northbank Enterprise Hub subdivision involves raising some 154 hectares of land above 2.5 mAHD with site grading of approx 1% draining into five drains. The adoption of in-channel water quality treatment measures (described in BMT WBM, 2010a) strongly influenced the drainage design by dictating minimum cross-section dimensions. Design of the drainage channel network involved optimising the area of available land for development while keeping peak water levels predicted in the 1 in 100 year rain event below 2.5 mAHD. The optimised drainage design is presented in Section 6.

The developed scenario was modelled to determine the impact of the development on offsite flooding. The scenario uses a partial flood bund and allows some water to spill offsite onto Kooragang Nature Reserve increasing water depth by approximately 10 cm to an area of land west of the existing North-South drain in peak events.

It should be noted that this assessment has been undertaken at a broad concept level and a number of minor drainage issues may need to be resolved during the detailed design phase.

9 REFERENCES

BMT WBM (2012a) *Northbank Enterprise Hub Business and Industrial Park – Regional Flooding Assessment,* R.N1900.001.003, Report Prepared for ADW Johnson, August 2012.

BMT WBM (2012b) *Northbank Enterprise Hub Business and Industrial Park – Stormwater Assessment,* R.N1900.002.005, Report Prepared for ADW Johnson, August 2012.

Institution of Engineers, Australia (1987) *Australian Rainfall and Runoff: A Guide to Flood Estimation* , Vol. 1, Editor-in-chief D.H. Pilgrim, Revised Edition 1987 (Reprinted edition 1998), Barton, ACT.

BMT WBM Brisbane	Level 11, 490 Upper Edward Street Brisbane 4000 PO Box 203 Spring Hill QLD 4004 Tel +61 7 3831 6744 Fax +61 7 3832 3627 Email wbm@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Denver	14 Inverness Drive East, #B132 Englewood Denver Colorado 80112 USA Tel +1 303 792 9814 Fax +1 303 792 9742 Email wbmdenver@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Mackay	Suite 1, 138 Wood Street Mackay 4740 PO Box 4447 Mackay QLD 4740 Tel +61 7 4953 5144 Fax +61 7 4953 5132 Email wbmmackay@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Melbourne	Level 5, 99 King Street Melbourne 3000 PO Box 604 Collins Street West VIC 8007 Tel +61 3 8620 6100 Fax +61 3 8620 6105 Email wbmmelbourne@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Newcastle	126 Belford Street Broadmeadow 2292 PO Box 266 Broadmeadow NSW 2292 Tel +61 2 4940 8882 Fax +61 2 4940 8887 Email wbmnewcastle@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Perth	1 Brodie Hall Drive Technology Park Bentley 6102 Tel +61 8 9328 2029 Fax +61 8 9486 7588 Email wbmperth@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Sydney	Level 1, 256-258 Norton Street Leichhardt 2040 PO Box 194 Leichhardt NSW 2040 Tel +61 2 9713 4836 Fax +61 2 9713 4890 Email wbmsydney@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Vancouver	1190 Melville Street #700 Vancouver British Columbia V6E 3W1 Canada Tel +1 604 683 5777 Fax +1 604 608 3232 Email wbmvancouver@wbmpl.com.au Web www.wbmpl.com.au