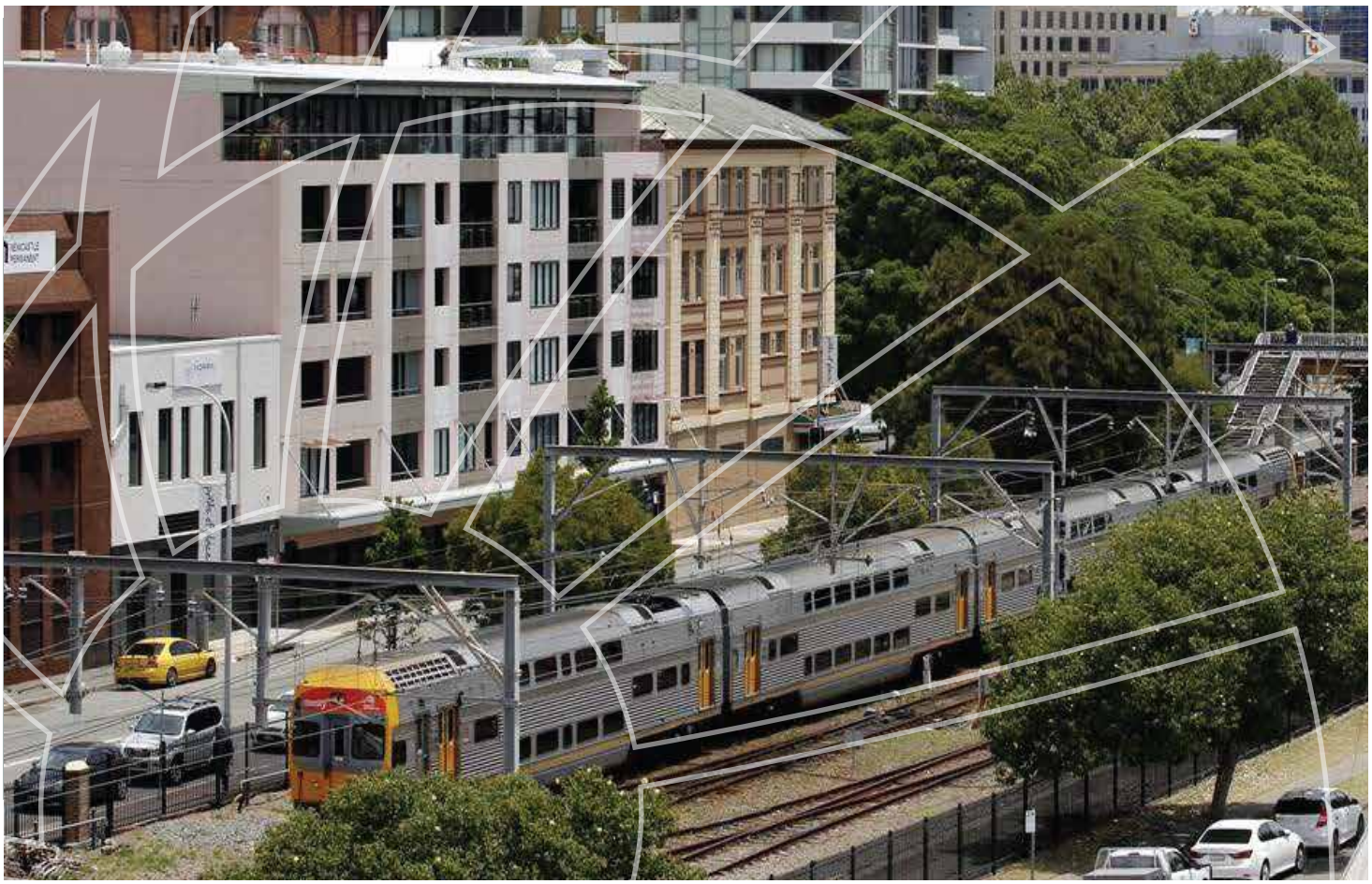
BMT WBM

"Where will our knowledge take you?"



Newcastle Urban Transformation and Transport Program: Rezoning of Surplus Rail Corridor Lands

Flood Risk Assessment

Final Report

March 2017

UrbanGrowth NSW

Newcastle Rail Corridor Rezoning - Flooding

Prepared for:	UrbanGrowth NSW
Prepared by:	BMT WBM Pty Ltd (Member of the BMT group of companies)

Offices

Brisbane
Denver
London
Mackay
Melbourne
Newcastle
Perth
Sydney
Vancouver

Document Control Sheet

BMT WBM Pty Ltd
126 Belford Street
Broadmeadow NSW 2292
Australia
PO Box 266
Broadmeadow NSW 2292

Tel: +61 2 4940 8882
Fax: +61 2 4940 8887

ABN 54 010 830 421

www.bmtwbm.com.au

Document:	R.N20126.002.07.Newcastle_Rail_Corridor_Rezoning.docx
Title:	Newcastle Rail Corridor Rezoning - Flooding
Project Manager:	Darren Lyons
Author:	Darren Lyons
Client:	UrbanGrowth NSW
Client Contact:	Jenny Rudolph (Elton Consulting)
Client Reference:	

Synopsis: **Documentation of preliminary flood risk assessment for proposed rezoning of surplus Newcastle rail corridor lands.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	18/01/16	DJL		DJL	
1	06/02/16	DJL		DJL	
2	31/03/16	DJL		DJL	
3	22/04/16	DJL		DJL	
4	03/06/16	DJL		DJL	
5	01/08/16	DJL		DJL	
6	06/03/17	DJL		DJL	
7	28/03/17	DJL		DJL	

DISTRIBUTION

Destination	Revision							
	0	1	2	3	4	5	6	7
Elton Consulting	1e	1e	1e	1e	1e	1e	1e	1e
BMT WBM File	1e	1e	1e	1e	1e	1e	1e	1e
BMT WBM Library								

Contents

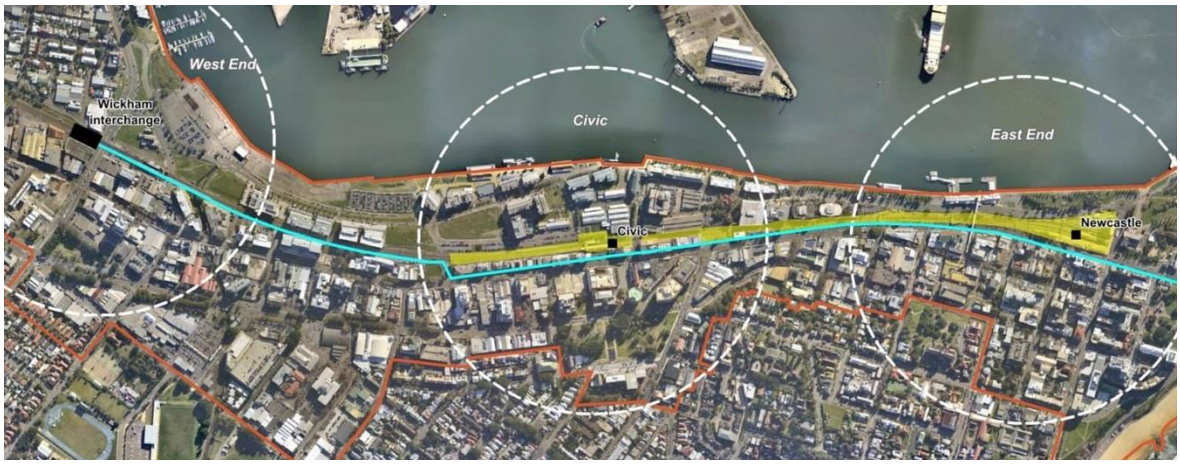
List of Figures

List of Tables

1 Introduction

1.1 General

This report has been prepared to support the amendment to the Newcastle Local Environmental Plan (NLEP) 2012 that applies to the surplus rail corridor land ('rail corridor land') between Worth Place and Watt Street in Newcastle city centre (Figure 1-1).



Source: Hassell

Figure 1-1 Rezoning Study Area

The Newcastle Urban Transformation and Transport Program ('Program') has been established to deliver on NSW Government's more than $500m commitment to revitalise the city centre through: the truncation of the heavy rail line at Wickham and creation of the Wickham Transport Interchange; the provision of a new light rail line from Wickham to the Beach; and the delivery of a package of urban transformation initiatives.

The transformation element of the Program aims to bring people back to the city centre by strengthening connections between the city and the waterfront, creating employment opportunities, providing more public space and amenity, and delivering better transport.

The proposed rezoning of the rail corridor land forms a part of the delivery of urban transformation initiatives, comprising a package of transport, built form and public domain improvements.

1.2 Newcastle Urban Transformation

The Newcastle Urban Renewal Strategy (NURS) sets out the NSW Government's long term approach and vision for the revitalisation of Newcastle city centre to the year 2036.

The NURS identifies three character precincts in Newcastle city centre (West End, Civic and East End), within which significant housing and employment opportunities, together with built form and public domain changes and improvements exist. The NURS describes these precincts as:

- East End: residential, retail, leisure and entertainment
- Civic: the government, business and cultural hub of the city

- West End: the proposed future business district including the western end of Honeysuckle (Cottage Creek)

UrbanGrowth NSW has been directed by NSW Government to deliver on NURS through the Program, in partnership with Transport for NSW (TfNSW), the Hunter Development Corporation (HDC) and the City of Newcastle Council (Council).

1.3 Proposed rezoning

UrbanGrowth NSW seeks to amend the Newcastle Local Environmental Plan 2012 (NLEP) to enable the delivery of the Program and the objectives of NURS planning outcomes.

Vision

Our vision for the Program has been informed by feedback from the community, Council, government agencies and urban renewal experts.

Our vision is an activated city centre and waterfront that attracts people, new enterprises and tourism. Overtime, we see great opportunities to build on the strengths of the city centre to encourage innovative and enterprising industries to survive. In the longer term, we see an opportunity to strengthen Newcastle's position on the regional, national and international stage, with a view to stronger ties with Asia Pacific.

UrbanGrowth NSW, 2015

Program objectives

The Program is underpinned by five objectives which will drive successful urban revitalisation:

- **Bring people back to the city centre.** Reimagining the city centre as an enhanced destination, supported by new employment, educational and housing opportunities and public domain that will attract people
- **Connect the city to its waterfront.** Unite the city centre and the harbour to improve the experience of being in and moving around the city
- **Help grow new jobs in the city centre.** Invest in initiatives that create jobs, with a focus on innovative industries, higher education initiatives to encourage a range of businesses to the city centre
- **Create great places linked to new transport.** Integrate urban transformation with new, efficient transport to activate Hunter and Scott's Streets and return them to thriving main streets
- **Creating economically sustainable public domain and community assets.** Leave a positive legacy for the people of Newcastle. Ensure that new public domain and community facilities can be maintained to a high standard into the future
- **Preserve and enhance heritage and culture.** Respect, maintain and enhance the unique heritage and character of Newcastle city centre through the revitalisation activities.

Urban transformation proposed concept plan

Surplus rail corridor land runs through the East End and Civic city centre precincts as established by NURS.

Based on this vision and the results of extensive stakeholder and community engagement, an overall urban transformation concept plan (the concept plan) has been prepared for the surplus rail corridor (rezoning sites), as well as surrounding areas.

The concept plan considers and integrates with the delivery of light rail. It is also coordinated with the proposed Hunter Street Mall development to create an interactive, synergised and cohesive city centre and foreshore area.

The concept plan (as shown in Figure 1-2) includes five 'key moves', two that relate to the Civic precinct and three of which relate to the East End.

1. **Civic link (Civic)**

This area is the civic heart of Newcastle and includes some of the region's most important civic and cultural assets, including Civic Park, City Hall, Civic Theatre and Newcastle Museum. Current investment in the area includes the law courts development and the, soon to be completed, University of Newcastle NeW Space campus.

The focus of this key move is to leverage best value from new investments by creating new open space and walking and cycling connections that link Newcastle's civic buildings to the waterfront and the light rail system.

- **Civic Green.** Creating a new civic focused public space linking Hunter Street to the Newcastle Museum that will provide direct visual and physical connection from Wheeler Place to the harbour, activate light rail on Hunter Street and meet the needs of the incoming legal and student populations
- **Built form improvements.** Sensibly scaled mixed use development that forms part of the Honeysuckle development.

2. **Darby Plaza (Civic)**

Darby Street is Newcastle's premier 'eat street', offering a mix of shops, cafes, restaurants and night life. At present Darby Street ends at the intersection with Hunter Street, and this key move seeks to create a new node of activity and linkage through to the harbour that complements the delivery of light rail.

- **Darby Plaza.** A new community focused public space including provision of new walking and cycling facilities from Hunter Street to the harbour.
- **Built form improvements.** Zoning of rail corridor land between Merewether Street and Argyle Street to allow for future mixed use development in conjunction with surrounding lands in the longer term.

3. **Hunter Street Revitalisation (East End)**

Hunter Street features some of Newcastle's best heritage buildings and offers a mix of shops, cafes, restaurants and other local business. Hunter Street has experienced decline in recent years, and the opportunity exists to reinstate Hunter Street as the regions premier main street that complements the delivery of light rail.

- **Built form improvements.** Sensibly scaled mixed use development consistent with the adjoining land uses to create an activated street with 'two edges', celebrate heritage and create

new linkages from Hunter Street to the waterfront, provide activation around light rail stops and improve walking and cycling facilities.

4. **Entertainment Precinct (East End)**

This key move aims to create a place where people can come to play, relax and reconnect with the harbour in a new public space stretching from Scott Street to the waterfront incorporating a new connection from Market Street to Queens Wharf. This key move will also assist to activate the area to create an exciting place for the East End.

- **Recreational opportunities.** This precinct will incorporate the adaptive re-use of the signal box and provision of recreation opportunities for all ages and abilities. Public domain will be designed to provide a thoughtful series of character areas and experiences as one traverses its length. The area will also provide opportunities for viewing and interpretation of heritage character that respect the unique qualities of place.

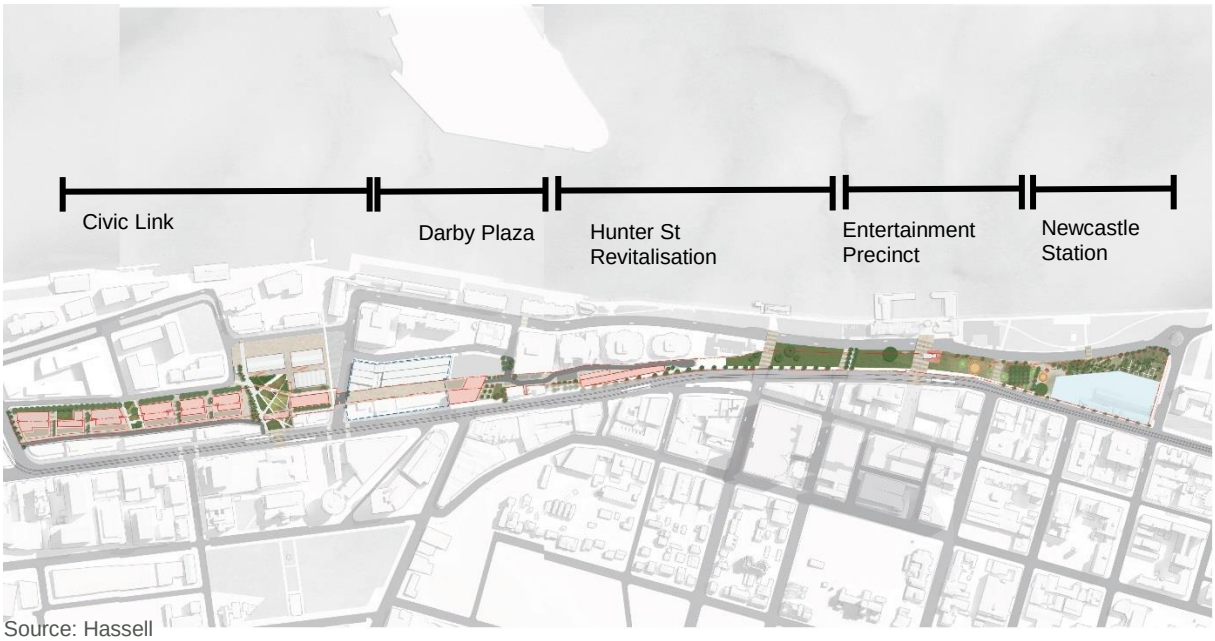
5. **Newcastle Station (East End)**

Newcastle Railway Station is proposed to be re-purposed into a hallmark destination and focal point for the new East End, accommodating enterprises and activities that attract visitors and stimulate the economy.

Refurbishment would fully respect and celebrate the heritage integrity of the Station, and could accommodate a range of different activities including community, retail, leisure and commercial uses.

1.4 Rezoning Concept Plan

The proposed rezoning of the surplus rail corridor lands is the focus of this report. The rezoning area is indicated in Figure 1-2 by a red dotted line, with the plan also indicating the general precinct areas and the indicative built form for the parcels.



Source: Hassell

Figure 1-2 Rezoning Concept Plan

Amendments to the NLEP are required to deliver part of the concept plan. The proposed amendments are on surplus rail corridor land only.

Necessary amendments to the NLEP 2012 include:

- amending the Land Use Zoning Map to introduce B4 Mixed Use, SP3 Tourism and RE1 Public Recreation zones to sites along the corridor
- amending the Height of Building and Floor Space Ratio maps to apply appropriate development standards to selected parcels of land

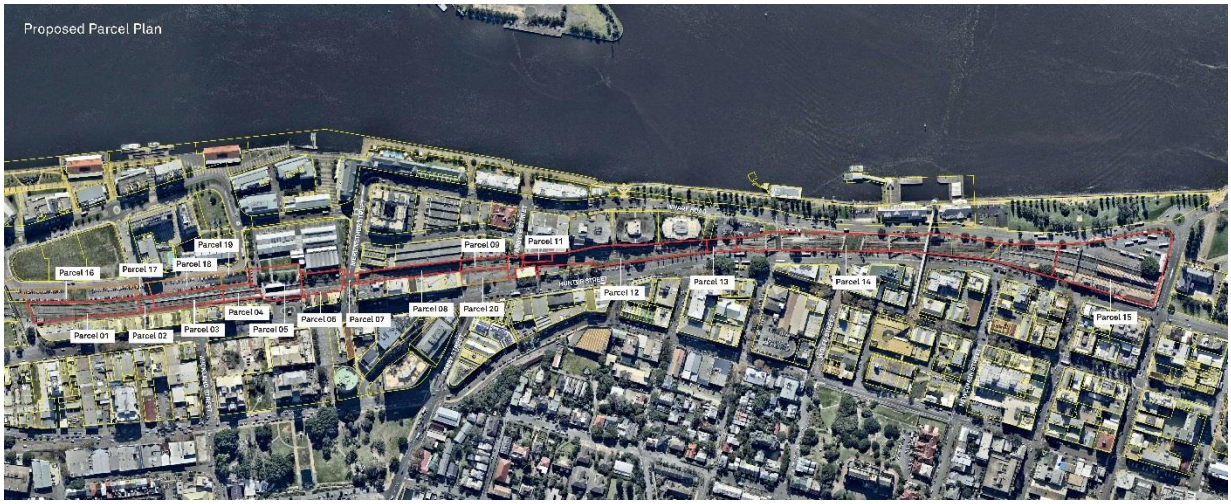
The approach taken to the amendments is to support the NURS planning approach and to remain consistent with surrounding planning controls in terms of zones, floor space ratio (FSR) and height.

The concept plan will also form the basis for updates to the Newcastle City Centre Development Control Plan design controls to guide development and public domain works for rezoning sites.

1.5 Proposed Rezoning

This planning proposal seeks to rezone rail corridor land (rezoning sites) to enable the delivery of the proposed urban uses established in the concept plan.

The location of the land affected by the proposed rezoning is identified in the map in Figure 1-3.



Source: Hassell

Figure 1-3 Rezoning explanatory map – Parcels

The planning proposal concept plan includes public domain, entertainment, mixed use and commercial and residential development.

In general, the proposed rezoning will provide a mix of uses enabling between 400-500 dwellings which will comprise a variety of styles and types, and around 5,000m2 of commercial, restaurant and other entertainment uses, as described in Table 1-1, and excluding any education or associated uses.

Proposed maximum building height and floor space ratio controls respect existing controls that apply to surrounding land.

This report has been based upon the proposed zoning under the Planning Proposal as submitted for Gateway determination, with the inclusion of Parcel 13. It is noted that this parcel has been removed from the current Planning Proposal in accordance with the Gateway determination as issued by the NSW Department of Planning and Environment. Nevertheless, for completeness, this report has considered the potential for some development occurring within this parcel in the future (subject to outcomes of a separate Planning Proposal). The recommendations of this report discuss whether there are any specific implications arising from this additional parcel.

Table 1-1 Sites for Rezoning – Proposed development summary

Previous Parcel Number prior to Gateway	Updated Parcel Number post Gateway	Size	Proposed Zoning	Proposed FSR	Proposed Height
Parcel 01 B4 Mixed Use 3,370m^2	Parcel 01	3,370m^2	B4 Mixed Use	FSR – 3:1	Height - 30m
Parcel 02 B4 Mixed Use 408m^2	Parcel 02	408m^2	B4 Mixed Use	FSR – 3:1	Height - 30m
Parcel 03 B4 Mixed Use 3,146m^2	Parcel 03	1,869m^2	B4 Mixed Use	FSR – 3:1	Height - 30m
	Parcel 04	900m^2	B4 Mixed Use	FSR – 3:1	Height - 24m
Parcel 04 RE1 Public Recreation 2,464m^2	Now parcel 05 (and small corner of old 03 where western boundary of park realigned)	2,839m^2	RE1 Public Recreation	N/A	N/A
Parcel 05 B4 Mixed Use 1,603m^2	Now parcel 06	1,604m^2	B4 Mixed Use	FSR – 3:1	Height – 18m
Parcel 06 B4 Mixed Use 295m^2	Now parcel 07	295m^2	B4 Mixed Use (Road)	FSR – 2.5:1	Height – 30m
Parcel 07 B4 Mixed Use 2,040m^2	Now parcel 08	2,040m^2	B4 Mixed Use	FSR – 2.5:1	Height – 30m
Parcel 08 B4 Mixed Use 988m^2	Now parcel 09	988m^2	B4 Mixed Use	FSR – 4:1	Height – 24m
Parcel 09 B4 Mixed Use	Now parcel 10	467m^2	RE1 Public Recreation	N/A	N/A

Previous Parcel Number prior to Gateway	Updated Parcel Number post Gateway	Size	Proposed Zoning	Proposed FSR	Proposed Height
467m^2					
Parcel 10 SP2 Infrastructure 386m^2	Now parcel 11	386m^2	SP2 Infrastructure	N/A	N/A
Parcel 11 B4 Mixed Use 4,542m^2	Now parcel 12	4,542m^2	B4 Mixed Use	FSR – 1.5:1	Height – 14m
Parcel 12 B4 Mixed Use 1,544m^2	Now parcel 13 (and has been reduced in size)	659m^2	SP2 Infrastructure	N/A	N/A
Parcel 13 RE1 Public Recreation 303m^2	Now parcel 14 (new parcel 14 encompasses part of old parcel 12, and the whole of old parcel 13, 14 and 15)	11,151m^2	RE1 Public Recreation	N/A	N/A
Parcel 14 B4 Mixed Use 2,251m^2					
Parcel 15 RE1 Public Recreation 7,713m^2					
Parcel 16 SP3 Tourist 10,698m^2	Now parcel 15	10,698m^2	SP3 Tourist	FSR – 1.5:1	Height – 10-15m

2 Existing Flood Risk Environment

2.1 Background

2.1.1 Site Location and Flooding Mechanisms

The development area largely occupies the low-lying floodplain area of the Hunter River and Throsby Creek. The Hunter River Estuary is a large riverine estuary system at the downstream end of the extensive Hunter River catchment (size ~ 22,000km^2), which flows into the Tasman Sea through the Port of Newcastle.

The ocean entrance to the Hunter River Estuary is fixed by twin rock breakwaters constructed in the late 19th century. The entrance is approximately 400 metres wide and 16 metres deep, allowing full ocean tides to penetrate into the Harbour. Prior to training of the entrance, it is understood that the Hunter River mouth and lower estuary contained dynamic sediment shoals, which would have been subject to significant and rapid change from periodic floods and coastal processes.

The majority of urban development is concentrated around Newcastle in the lower reaches of the estuary. The main urban catchments at the eastern end of the City drains to Cottage Creek, which has been extensively modified from natural conditions with large sections converted to hydraulically efficient concrete lined trapezoid shaped drains to reduce flooding.

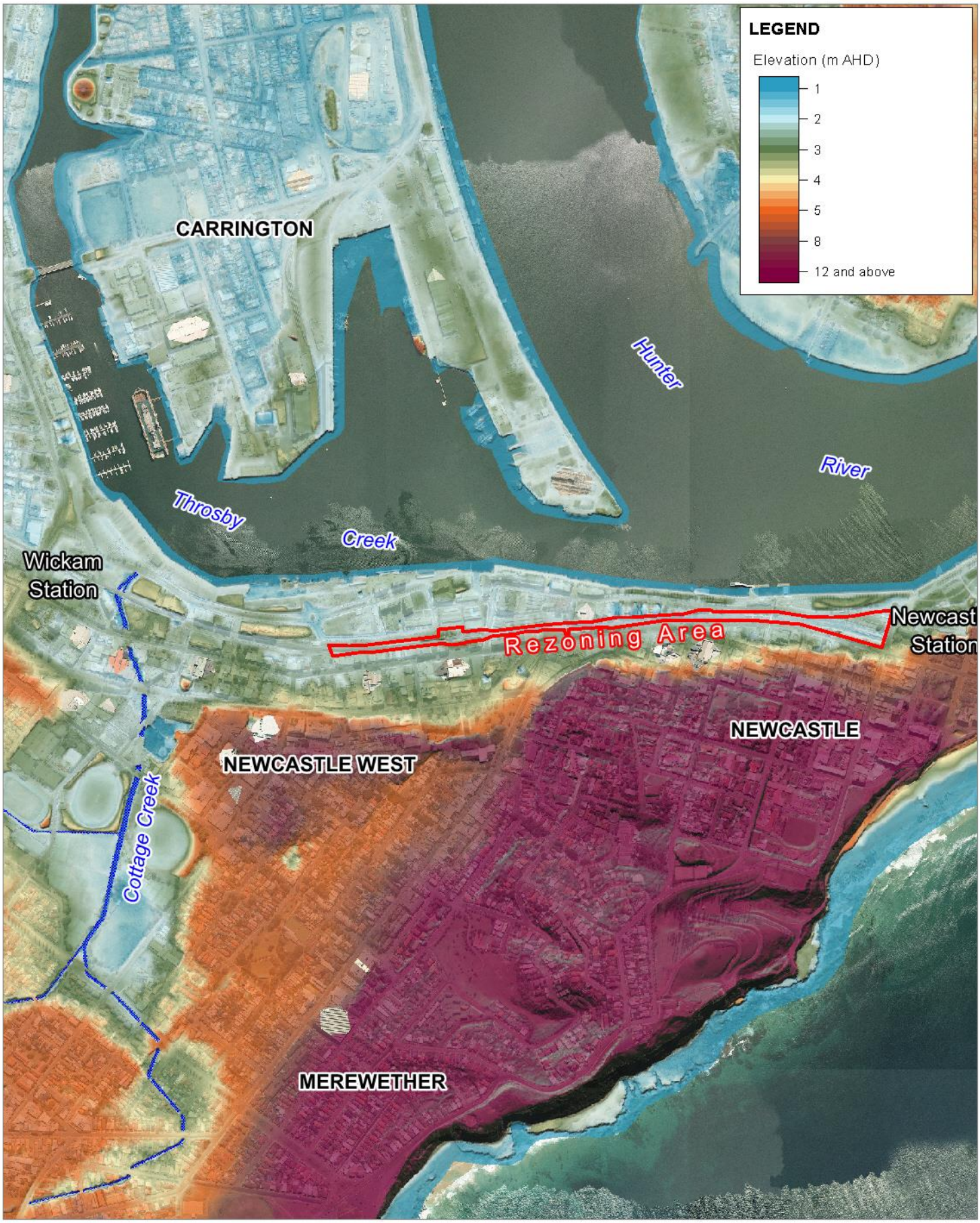
The low-lying nature of the study area is evident in Figure 2-1 showing the local topography. The topography shown is based on a Digital Elevation Model (DEM) derived from LiDAR data (NSW LPI data). The general ground levels around the rail corridor are 2-3m AHD. Some parts of the rail corridor were within cutting with rail line elevations down to around 1.7m AHD.

Flooding of the study area can occur from three mechanisms (and combinations thereof):

- Oceanic inundation, as a result of high ocean tides, storm surge, wave penetration;
- Local catchment flooding, as a result of intense rainfall within the local catchment of Throsby/Cottage Creek and small local overland flow catchments draining directly to the Hunter River; and
- Hunter River flooding, as a result of major flooding within the broader river system.

The low-lying topography of the study area and the proximity to the major waterways of Hunter River and Throsby Creek provide for significant flood inundation risks. These risks are expected to further increase in the future considering the potential for increases in mean sea level conditions associated with climate change

Risks associated with these forms of flooding in the study area are primarily a legacy of historical floodplain development. There has been extensive development on relatively low-lying foreshore area established before the current awareness and understanding of potential flooding extent and likelihood.



Title:

Local Topography

Figure: 2-1

Rev: A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Local_Topography.WOR

2.1.2 Climate Change Considerations

Climate change is expected to have adverse impacts upon sea levels and rainfall intensities, both of which may have significant influence on flood behaviour at specific locations. The primary impacts of climate change in coastal areas are likely to result from sea level rise, which, coupled with a potential increase in the frequency and severity of storm events, may lead to increased coastal erosion, tidal inundation and flooding.

In 2009 the NSW State Government announced the NSW Sea Level Rise Policy Statement (DECCW, 2009) that adopted sea level rise planning benchmarks to ensure consistent consideration of sea level rise in coastal areas of NSW. These planning benchmarks adopted increases (above 1990 mean sea level) of 40 cm by 2050 and 90 cm by 2100. However, on 8 September 2012 the NSW Government announced its Stage One Coastal Management Reforms which no longer recommend state-wide sea level rise benchmarks for use by local councils. Instead councils have the flexibility to consider local conditions when determining future hazards of potential sea level rise.

Accordingly, it is recommended by the NSW Government that councils should consider information on historical and projected future sea level rise that is widely accepted by scientific opinion. This may include information in the NSW Chief Scientist and Engineer's Report entitled 'Assessment of the Science behind the NSW Government's Sea Level Rise Planning Benchmarks' (2012).

The NSW Chief Scientist and Engineer's Report (2012) acknowledges the evolving nature of climate science, which is expected to provide a clearer picture of the changing sea levels into the future. The report identified that:

- The science behind sea level rise benchmarks from the 2009 NSW Sea level Rise Policy Statement was adequate;
- Historically, sea levels have been rising since the early 1880's;
- There is considerable variability in the projections for future sea level rise; and
- The science behind the future sea level rise projections is continually evolving and improving.

As the majority of the analysis and modelling tasks associated with Councils Flood Study and Floodplain Risk Management Study were completed prior to the announcement of the NSW Government's Coastal Management Reforms in September 2012, the potential impacts of sea level rise have been based on sea level rise projections from the 2009 NSW Sea Level Rise Policy Statement. Nevertheless, the Chief Scientist and Engineer's Report identifies the science behind these sea level rise projections as adequate, and accordingly is expected to provide a reasonable basis for the assessment.

In 2007 the NSW Government released a guideline for practical consideration of climate change in the floodplain management process that advocates consideration of increased design rainfall intensities of up to 30%. Accordingly, this increase in design rainfall intensity will translate into increased flood inundation in the local catchment. Future planning and floodplain management in the catchment will need to take due consideration of this increased flood risk.

2.1.3 Previous Studies

The following collection of studies provides the most comprehensive description and assessment of the natural hydrologic and hydraulic regimes for the Hunter River, Throsby Creek, Cottage Creek and local catchments.

- Lower Hunter River Flood Study (PWD, 1994) - this study included the construction of a one-dimensional hydraulic model (MIKE11 software) and has been used as the basis for subsequent Floodplain Risk Management applications in the Lower Hunter. The developed model was further refined to incorporate a two-dimensional representation of the Hexham Swamp floodplain area (DHI, 2009). The peak design flood conditions derived from these studies form the adopted conditions for riverine flooding in the Lower Hunter Estuary, including the study area.
- Throsby Creek and Cottage Creek Flood Study (WBM, 2006) – the flood study incorporated detailed modelling of the urban catchments of Throsby Creek, Cottage Creek and the Newcastle CBD area , encompassing an area of some 42km^2. The principle objectives of the study were to define the flood behaviour of the catchments through the establishment of appropriate numerical models, producing information on flood flows, velocities, levels and extents for a range of flood event magnitudes. The models incorporate the extensive trunk drainage network throughout the study area. The results of the study have been adopted by Council for flood planning purposes and form the basis for the flood risk assessment and formulation of appropriate floodplain risk management options.
- Newcastle City-wide Floodplain Risk Management Study and Plan (BMT WBM, 2012) - The City-wide Flood Plan has been developed to direct and co-ordinate the future management of flood prone lands across the City of Newcastle. It also aims to educate the community about flood risks across Newcastle, so that they can make more appropriate and informed decisions regarding their individual exposure and responses to flood risks. The City-wide Flood Plan sets out a strategy of short term and long term actions and initiatives that are to be pursued by agencies and the community in order to adequately address the risks posed by flooding.

The Newcastle City-wide Floodplain Risk Management Study provides an extensive mapping compendium that provides a comprehensive description of the flood inundation risks in the study area. The mapping provided incorporates the potential flooding from a number of sources including Hunter River flooding, local flooding in the Throsby/Cottage Creek catchment and tidal inundation including major storm surge events. Mapped scenarios include a range of magnitude events as well as the influence of potential sea level rise on future flooding conditions.

2.2 Existing Inundation Scenarios

Flooding of the study area can occur from three mechanisms (and combinations thereof):

- Oceanic inundation, as a result of high ocean tides, storm surge, wave penetration;
- Local catchment flooding, as a result of intense rainfall within the local catchment of Throsby/Cottage Creek and small overland flow catchments draining directly to the Hunter River; and

- Hunter River flooding, as a result of major flooding within the broader river system.

The following sections outline the existing and future flooding scenarios in the study area under the various flooding mechanisms identified above. These conditions are used as the basis for assessment of potential flood impact in the study area corridor.

2.2.1 Ocean Flooding

Oceanic inundation as a result of elevated tide levels are derived from combinations of the following conditions:

- Barometric pressure set up of the ocean surface due to the low atmospheric pressure of the storm;
- Wind set up due to strong winds during the storm "piling" water upon the coastline;
- Astronomical tide, particularly the Higher High Water Solstice Springs (HHWSS); and
- Wave set up.

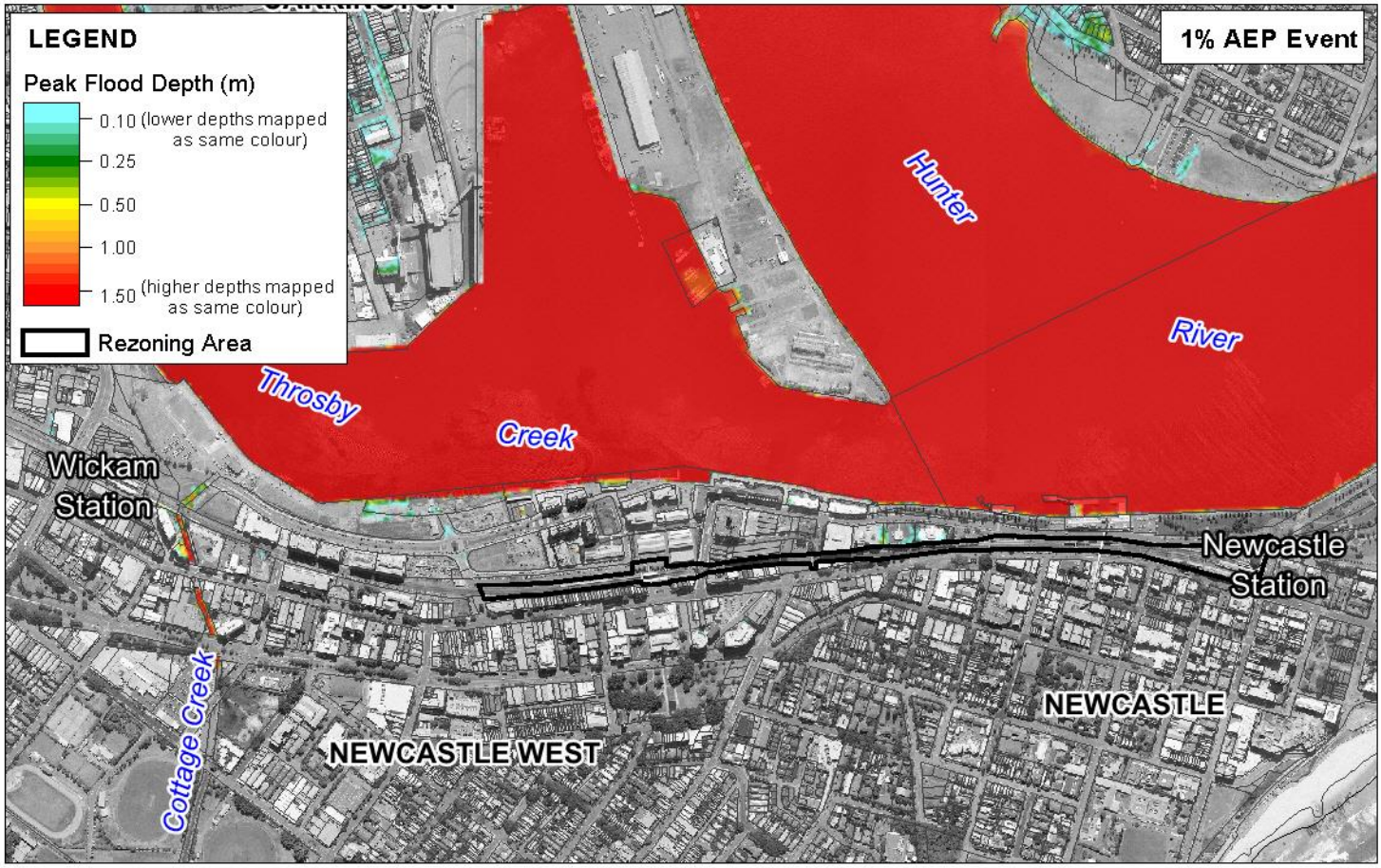
A summary of peak water levels under ocean flooding conditions for key design events is presented in Table 2-1, including the projected influence of sea level rise.

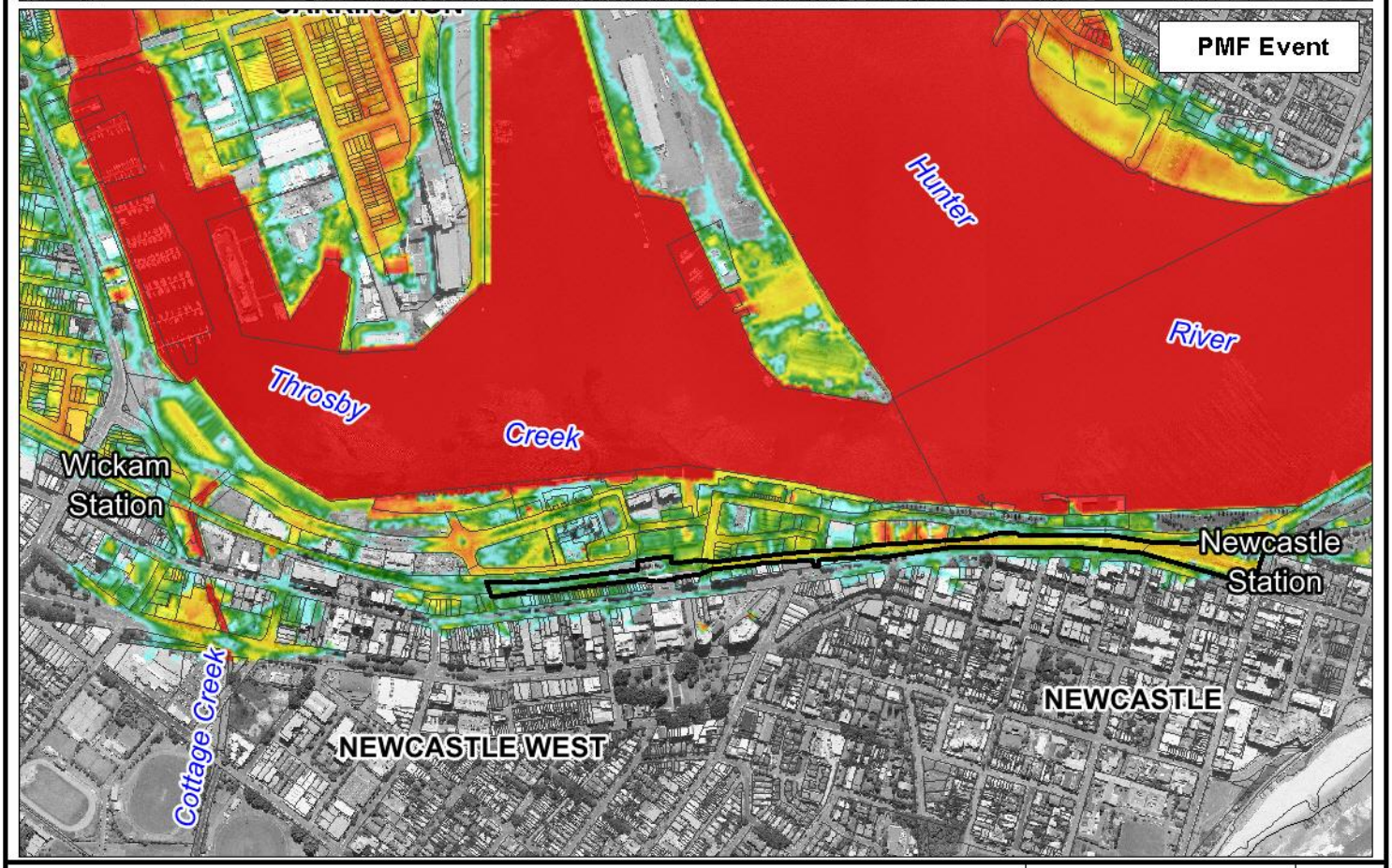
Table 2-1 Design Peak Water Levels (m AHD) - Ocean Flooding

Design Event	Existing Conditions	+0.4m SLR	+0.9m SLR
King Tide	1.0	1.4	1.9
10 % AEP	1.35	1.75	2.25
1% AEP	1.4	1.8	2.3
Extreme (PMF) Event	2.5	2.9	3.4

Given the topography of the study area (refer to Figure 2-1) there is the potential for extensive inundation under ocean flooding scenarios. The relative extents and depths of inundation for the 1% AEP and PMF design ocean events are shown in Figure 2-2. No major inundation of the low-lying foreshore area is expected under existing 1% AEP design ocean flood conditions. For the extreme event (PMF) condition, significant inundation would occur, with some peak flood depths up to the order 0.5 -1.0m.

As noted in Table 2-1, ocean flooding conditions are exacerbated with potential sea level rise. The design 1% AEP peak ocean flooding level incorporating 0.9m sea level rise is 2.3m AHD, thereby approaching the severity of inundation under existing extreme event conditions (2.5m AHD). Accordingly, the extent of ocean inundation shown at the bottom of Figure 2-2 is indicative of the typical design flood condition to be considered for the nominal 1% AEP design planning event under future catchment conditions (i.e. beyond 2100).





Title:

Ocean Peak Flood Depths - 1% AEP and PMF Existing Conditions

Figure: 2-2

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Ocean_Existing_Flood_Depths.WOR

2.2.2 Local Catchment Flooding

The design local catchment flooding conditions have been derived in the Throsby Creek and Cottage Creek Flood Study (WBM, 2006). Local catchment flooding is referred to as “Flash Flooding” in the Newcastle City-wide Floodplain Risk Management Study, acknowledging the relatively flashy nature of flooding in local catchments across the CBD area and distinguishing from the mainstream flooding of the Hunter River system.

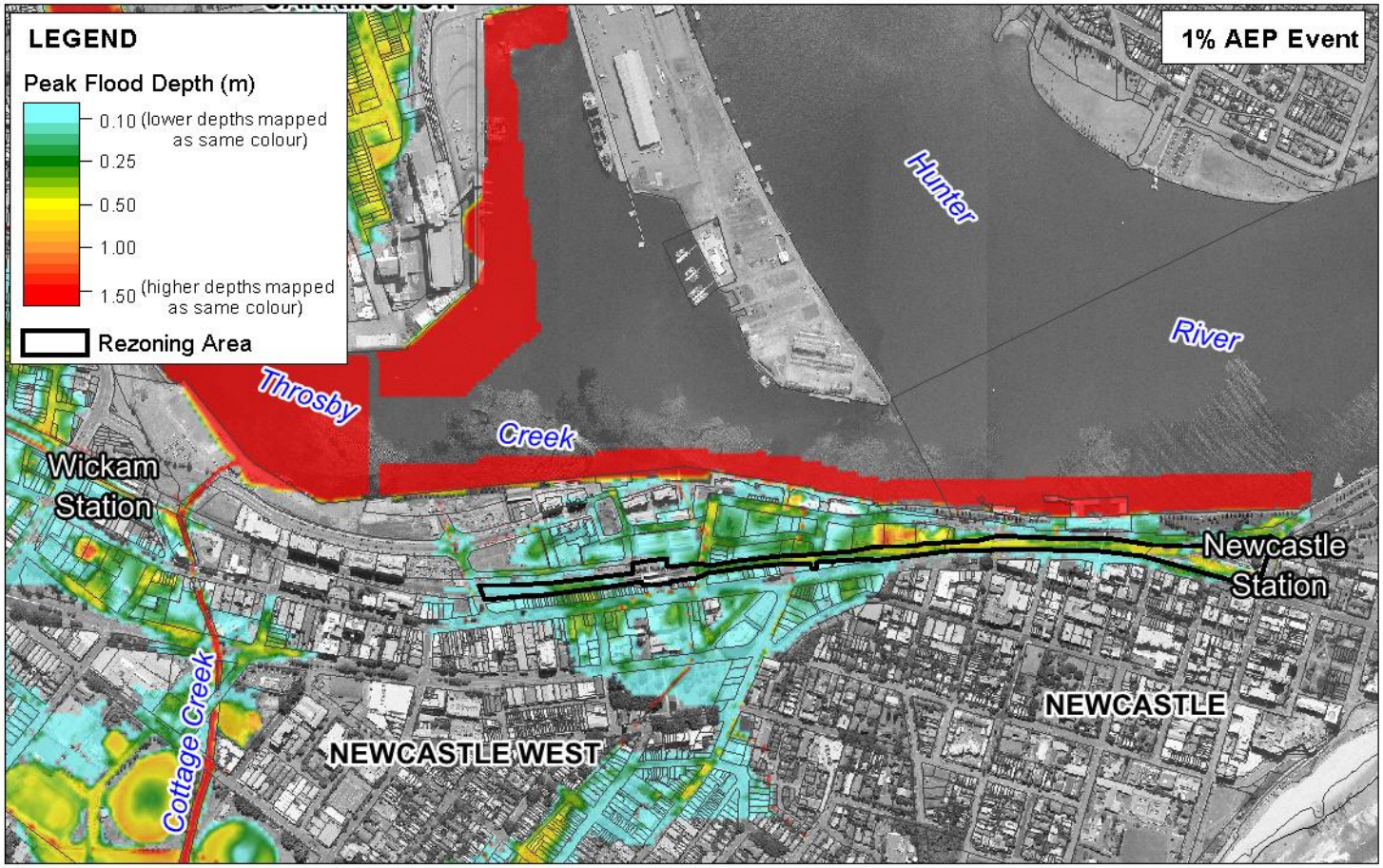
The simulated design flood inundation extents and depths across the study area for the 1% AEP and PMF events under existing conditions is shown in Figure 2-3.

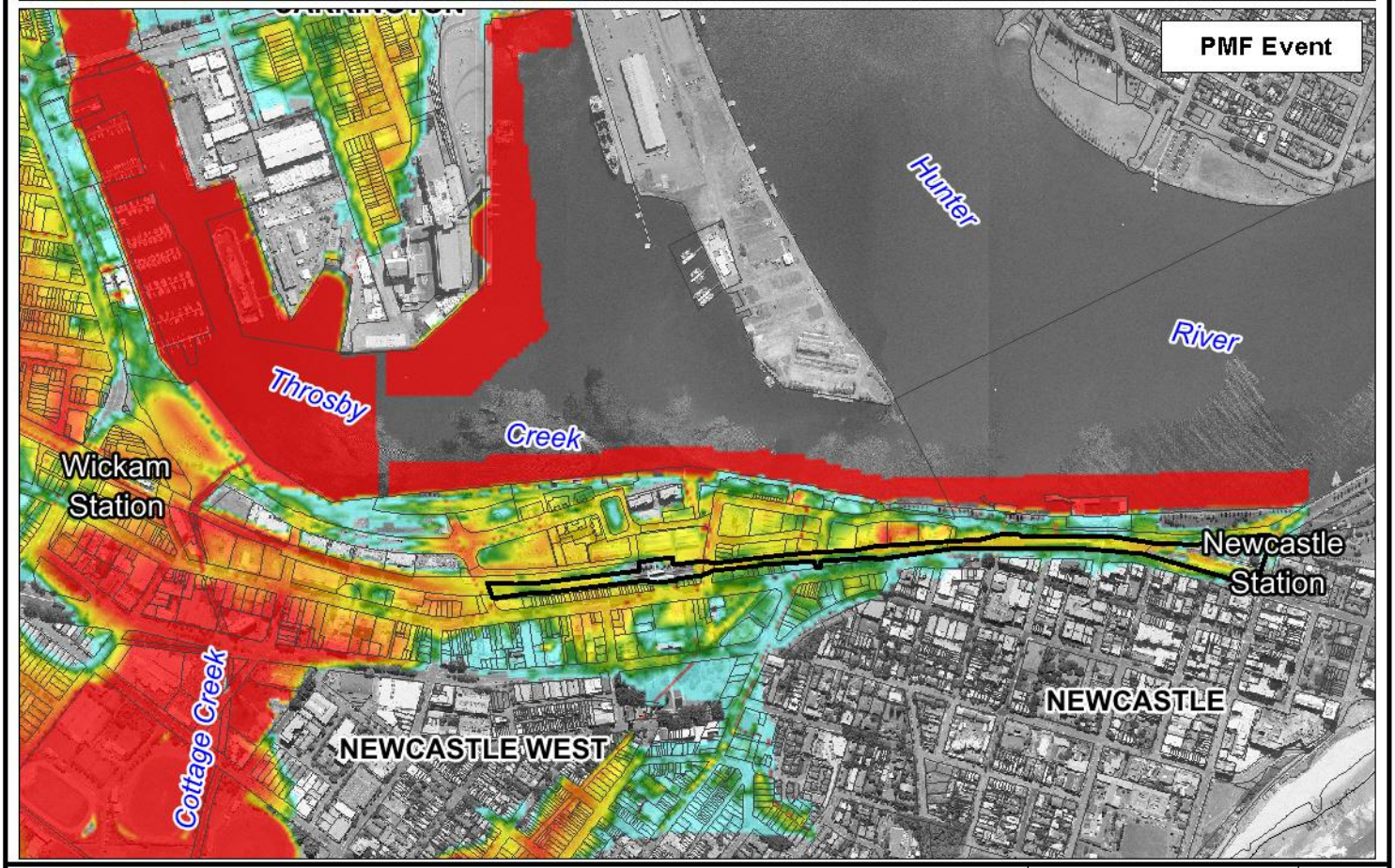
The inundation across the development area at the 1% AEP design flood magnitude is largely characterised by relatively shallow depth of flooding (typically less than 0.3m) with some localised areas of higher depth often corresponding to low points in the local road network. There are some localised areas of higher flood depth shown within the existing rail corridor towards Newcastle Station. These areas also correspond to low points along the rail alignment, typically where the rail alignment is lower than adjacent land (i.e. effectively in shallow cutting). The higher flood depths shown in these areas are largely a function of the coarse model configuration and localised depressions in the underlying topography.

Overland flow regimes in urban environments can be quite complex with interconnecting and varying flowpaths once the design stormwater drainage capacity is exceeded. Road networks often convey a considerable proportion of floodwaters due to the hydraulic efficiency of the road surface compared to developed areas (eg. blocked by fences and buildings), in addition to the underground pipe network draining mainly to open channels. Excluding the main Cottage Creek catchment (i.e. areas west of Worth Place outside the proposed rezoning area) the contributing local catchments are relatively small. Accordingly, there is not a significant overland flooding risk within the project area up to the 1% AEP flood magnitude. This is reflected in the definition of hydraulic category (i.e. floodway/flood storage and flood fringe area) discussed further in Section 2.3.1

Other minor overland flow paths don’t provide a major constraint to redevelopment of the corridor. The exact configuration and location of the local overland flow network through the corridor will ultimately be dependent on the finished land form within the redeveloped corridor. This level of detail on proposed finished surface levels within the corridor is not available at this stage of the flood risk assessment. Accordingly, there may be some local changes in the local overland flow distribution. However, noting the small contributing catchments and therefore relatively small flow magnitudes, it would be expected that effective management of the overland flows be readily accommodated through local drainage and overland flow provisions through the corridor. These would typically be located along existing road network alignments and the proposed open space connections.

At the PMF level there is greater inundation extent with higher depth of floodwaters. The flows generated in the local drainage catchments provide for extensive overtopping of the existing railway embankment. Again reference should be made to Section 2.3.1 in the definition of major floodway flow paths at the PMF level.





Title:

Local Catchment Peak Flood Depths - 1% AEP and PMF Existing Conditions

Figure: 2-3

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Catchment_Existing_Flood_Depths.WOR

2.2.3 Hunter River Flooding

The design Hunter River flooding conditions have been derived in the Lower Hunter River Flood Study (PWD, 1994) with some local refinement in the subsequent model upgrade report (DHI, 2009). The peak design flood level profiles (10% AEP, 1% AEP and PMF events) along the South Arm of the Hunter River between Hexham Bridge and the harbour entrance are shown in Figure 2-4. Included in the figure are key reference locations along the River and the approximate location of the study area (extent of the Carrington suburb boundary between Walsh Point and Throsby Creek).

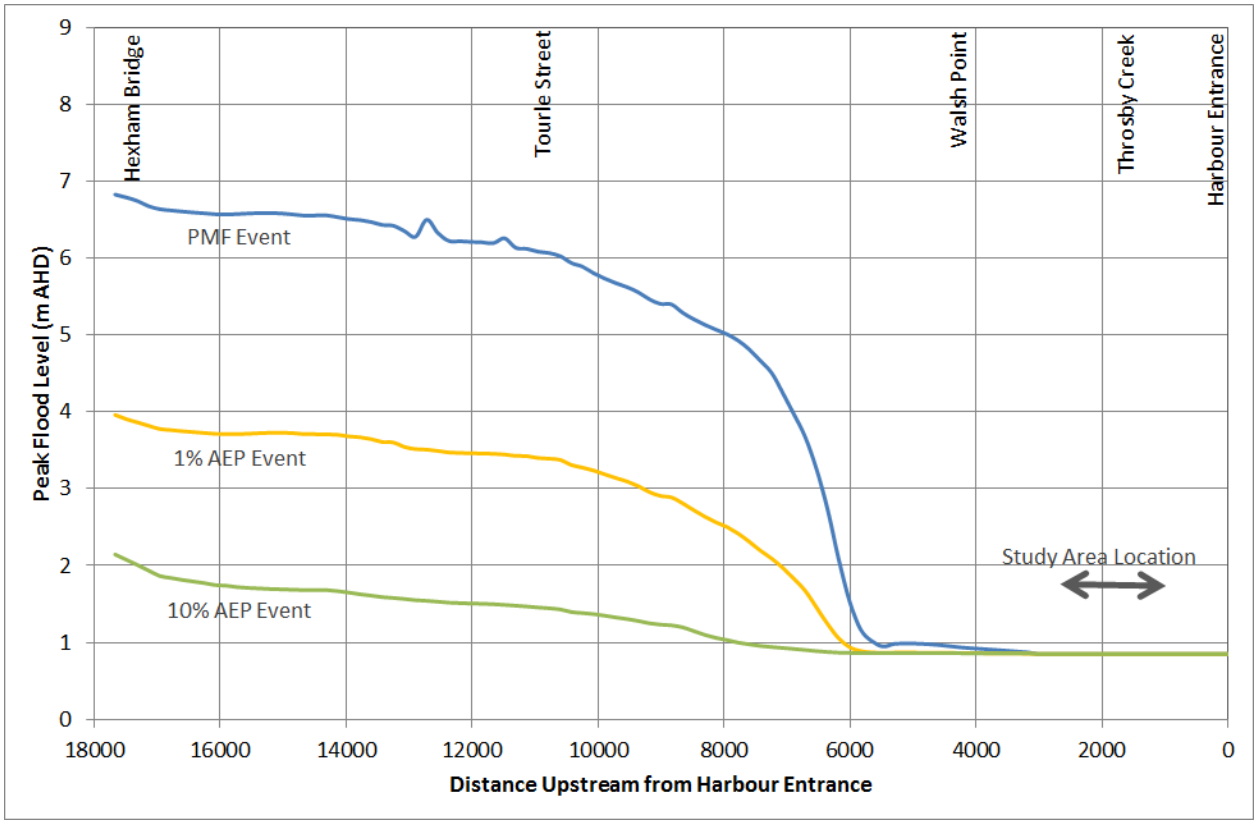


Figure 2-4 Hunter River (South Arm) Design Flood Level Profiles

The study area is largely not directly impacted by major flooding in the Hunter River. As shown in Figure 2-4, all of the events presented have a peak flood level of the order 0.8-0.9m AHD in the reach of the Hunter River adjacent to Throsby Creek. This peak flood level corresponds to the adopted boundary condition at the harbour entrance, approximating a peak spring tide level. A very flat peak flood level gradient is evident through the lower reach of the Hunter River given its large conveyance which has been significantly enlarged through channel widening and dredging works.

2.3 Flood Risk Classifications

The key planning documents with consideration of flood risks in the Newcastle City Council LGA. include:

- Newcastle City Council Flood Policy 2003
- Newcastle Development Control Plan (DCP) 2012 – Section 4.01 Flood Management

- Newcastle City-wide Floodplain Risk Management Study and Plan 2012; and
- NSW Government Floodplain Development Manual (FDM) 2005

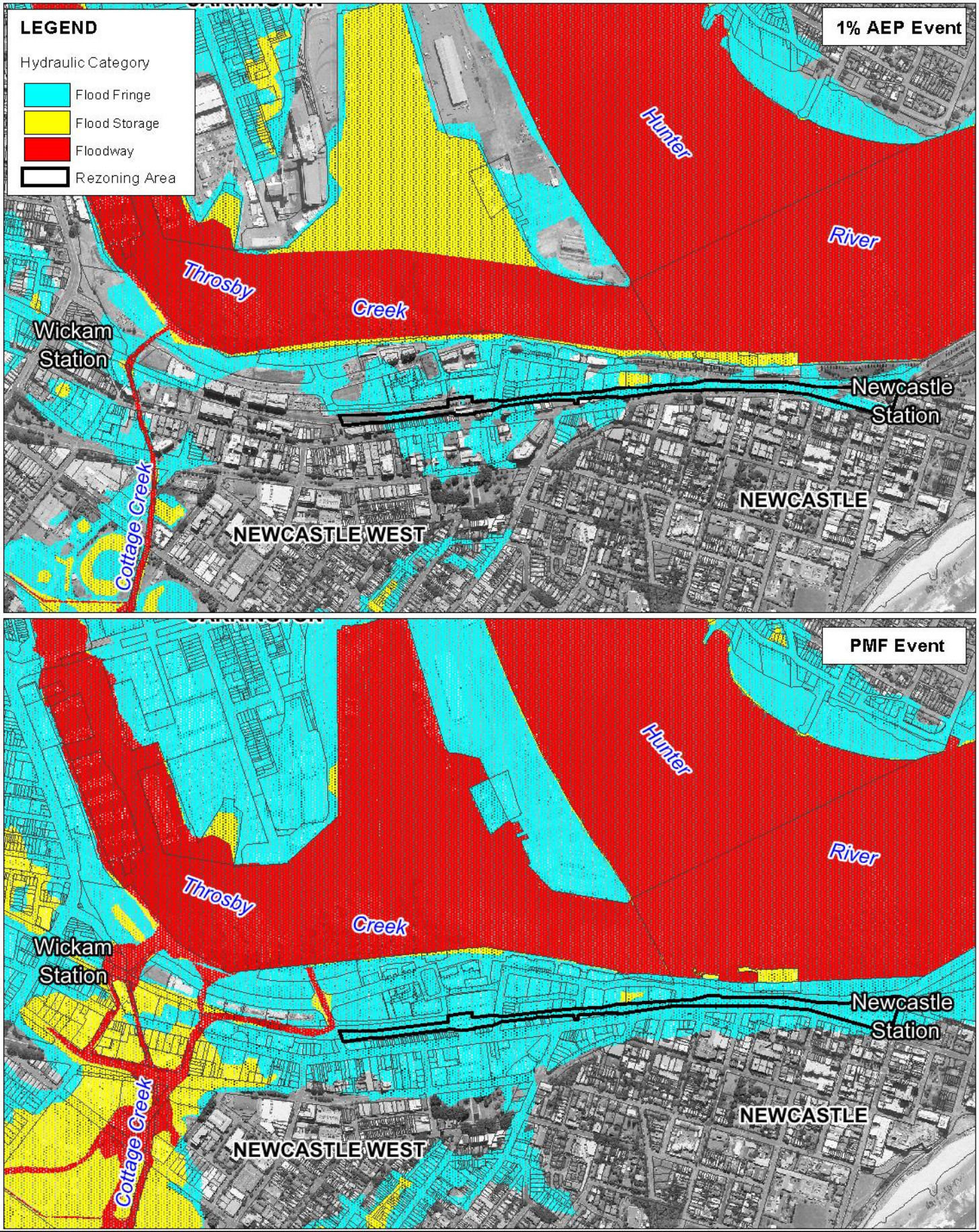
These documents provide information regarding processes to classify the severity of flooding in both quantitative and qualitative terms, and the policies and controls that are applicable to dwellings and developments on flood prone land based on these initial classifications.

2.3.1 Hydraulic Impact Categories

There are no prescriptive methods for determining what parts of the floodplain constitute floodways, flood storages and flood fringes. Descriptions of these terms within the FDM (NSW Government, 2005) are essentially qualitative in nature and emphasis is placed on the need for site specific consideration when determining appropriate methods for hydraulic category classification. The hydraulic categories as defined in the FDM, and the advised general guidelines to assist in the delineation of flooding and flood storage areas, are:

- **Floodway -** Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- **Flood Storage -** Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.
- **Flood Fringe -** Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not significantly affect the flood pattern or flood levels.

The adopted hydraulic impact categories in the Newcastle FRMS are shown in Figure 2-5 and identifies that majority of the site is classed as flood fringe. Flood fringe areas typically don't have major constraints with respect to development type subject to appropriate assessment of potential impacts. Further discussion on flood related development controls applicable to the proposed development site are presented in Section 3.



Title:

Hydraulic Categories - 1% AEP and PMF Existing Conditions

Figure: 2-5

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Hydraulic_Categories.WOR

2.3.2 Property Hazard Categories

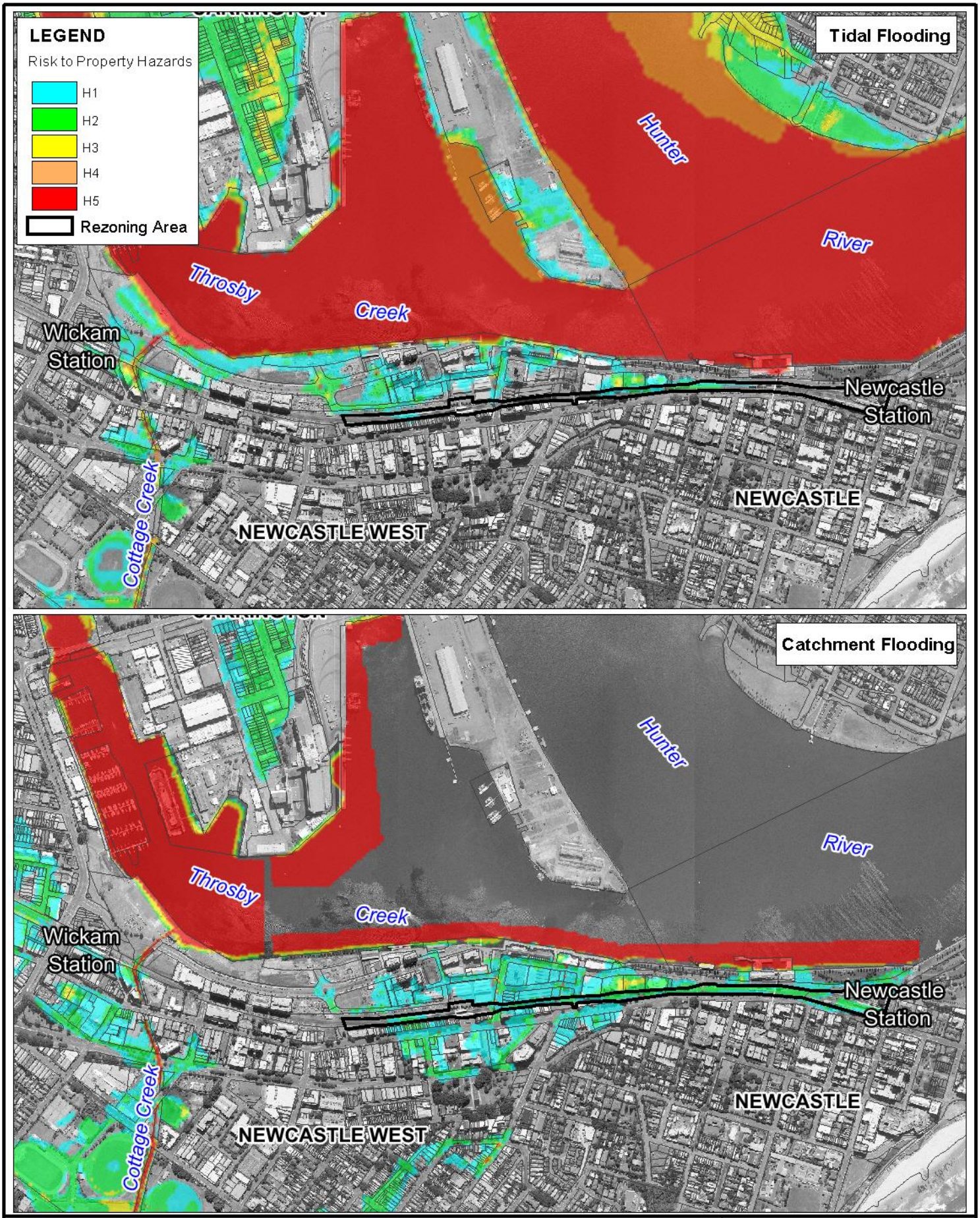
The combination of flood depths and flood velocities can be used to assess the risk to property and life based on the physical flood behaviour. Situations whereby flood depths are shallow, but velocities are high can be just as critical as situations where flood depths are large, but velocities are low. The combination of flood depths and flood velocities (v*d) is defined as the flood hydraulic behaviour. Different values, or thresholds, for flood hydraulic behaviour helps to categorise the risk to people exposed to the flood, either directly as pedestrians, or indirectly inside a vehicle, or inside a building/structure. The hydraulic behaviour also aids in the categorisation of risk to property.

The hydraulic behaviour thresholds are described in Table 2-2, which outline associated technical equations in terms of flow depth and velocity. They are not inherently tied to any particular size or likelihood of flood, but rather, they just describe the stability of a chosen object (e.g. a type of building construction) in water of a particular depth and velocity.

Table 2-2 Definition of Hydraulic Behaviour Thresholds (Newcastle City Council, 2003)

Hydraulic Behaviour Threshold	Velocity-Depth Relationship	Risk to Property
H1	v < 0.5m/s and d < 0.3m	P1 - Parked or moving cars remain stable
H2	v < 2m/s, d < 0.8m and v < (3.2 – 4*d)	P2 - Parked or moving heavy vehicles remain stable
H3	v < 2m/s, d < 2m and v*d < 1	P3 - Suitable for light frame construction
H4	v < 2.5m/s, d < 2.5m and v*d < 2.5	P4 - Suitable for heavy frame construction or structural reinforcement
H5	Remaining areas	P5 - Hydraulically unsuitable for normal building construction

The property hazard classification based on the above definition in the vicinity of the rezoning area is shown in Figure 2-6. The highest property hazard category across the majority of the site is H2. Typically this type of flood condition provides little constraint on the types of construction.



Title:

Property Hazard Categories - 1% AEP Existing Conditions

Figure: 2-6

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Property_Hazard_Categories.WOR

2.3.3 Life Hazard Categories

In addition to hydraulic behaviour, risks to life are influenced by the flooding mechanism (i.e. flash, river or ocean), as well as the availability of an evacuation route. Generally, evacuation can be expected from areas that are under threat from river or ocean flooding. As such, the risks to life in areas affected by river and ocean flooding are considered to be low. Flash flooding, however, can represent a significant risk, as there is generally little time to respond or evacuate. If there is an evacuation route available, which consists of a continuously rising route to flood free land (above the PMF level), then the risks in flash flood situations are reduced.

Risks to life categorisation adopted by Council has been developed taking into account both the availability for evacuation and the hydraulic behaviour, as presented in Table 2-3.

The Risks to Life criteria are determined based on PMF conditions. These extreme flood conditions are adopted as the FDM (2005) is explicit in requiring risks to life to be considered and managed over the full range of flood events (i.e. up to the most extreme conditions, or PMF).

Table 2-3 Risk to Life Hazard Categories (adopted at the PMF level)

<table>
<tr><td colspan="4"></td><td colspan="5">Hydraulic Behaviour Threshold</td></tr>
<tr><td colspan="4"></td><td>H1</td><td>H2</td><td>H3</td><td>H4</td><td>H5</td></tr>
<tr><td rowspan="3">Catchment Response Time</td><td colspan="3">Riverine and Ocean Flooding</td><td colspan="5">L1</td></tr>
<tr><td rowspan="2">Flash</td><td rowspan="2">Escape Route to flood free land</td><td>available</td><td colspan="2">L2</td><td rowspan="2">L4</td><td rowspan="2">L5</td></tr>
<tr><td>not available</td><td colspan="2">L3</td></tr>
</table>

Where:

L1 Riverine flooding where there is sufficient time to remove people from the risk to their lives by means of formal community evacuation plans.

L2 Short duration flash flooding with no warning time in circumstances where there is an obvious escape route to flood free land with enclosing waters during the PMF which are suitable for wading or heavy vehicles i.e. hydraulic threshold does not exceed H2. On site flood refuge not necessary and normal light frame residential building are appropriate.

L3 Short duration flash flooding with no warning time and no obvious escape route to flood free land with enclosing waters during the PMF which are suitable for wading or heavy vehicles i.e. hydraulic threshold does not exceed H2. On site flood refuge not necessary and normal light frame residential buildings and appropriate.

L4 Short duration flash flooding with no warning time and enclosing waters during the PMF not suitable for wading or heavy vehicles i.e. hydraulic threshold exceeds H_2. On site refuge is necessary and if hydraulic threshold exceeds H_3, heavy frame construction or suitable structural reinforcement required.

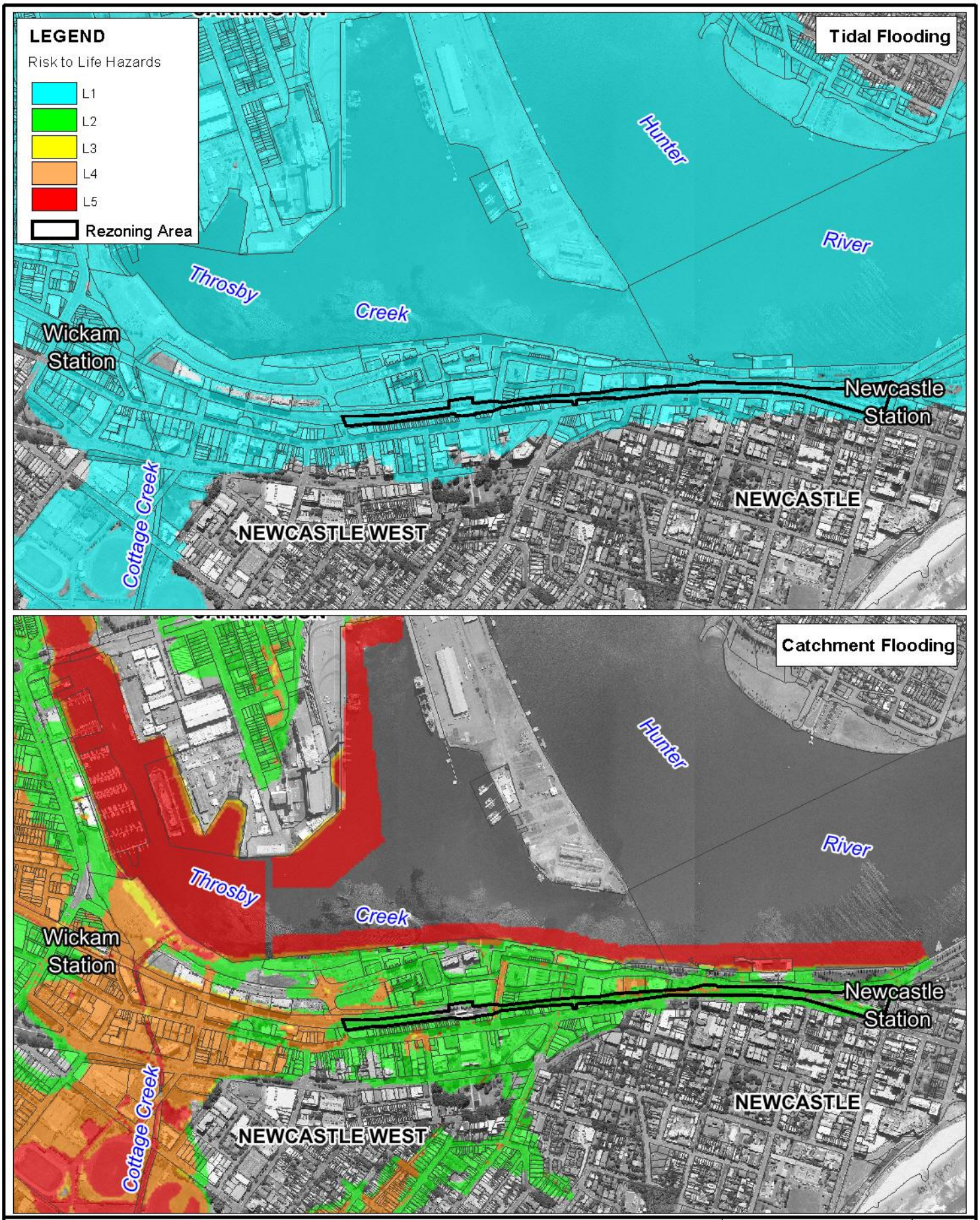
L5 Short duration flash flooding with no warning time and enclosing waters during the PMF have too much energy for normal heavy building construction and therefore it is generally not possible to construct a flood refuge i.e. hydraulic threshold is H_5. The risk to life is considered extreme and the site is unsuitable for habitation, either residential or short stay.

As noted in Table 2-3, the risk to life categorisation for the Hunter River and ocean flooding at the site is the lowest category L1. This is due to the significant warning times afforded to the site for flooding of this nature such that appropriate evacuation plans could be executed.

The local catchment flash flooding scenarios provide the dominant conditions in determining risk to life classification given the short warning times available. As shown on Figure 2-7, the risk to life category across the majority of the rezoning area is L2.

There are some isolated pockets of L4 classification. This L4 area is somewhat limited in extent, however, highlights the potential for rapidly enclosing floodwaters in which wading or driving through floodwaters as a means of evacuation may be difficult. Within the rezoning area, the L4 zones are limited to an existing overland flow path through Merewether Street (limited to the existing road corridor) and small areas of the existing rail corridor that are localised depressions in which the depth of inundation is driving the L4 classification (noting depressions likely to be removed by filling). The areas of existing L4 classification would not be expected to have major constraints on corridor redevelopment.

.



Title:

Life Hazard Categories - 1% AEP Existing Conditions

Figure: 2-7

Rev: A

N

0 250 500m

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath :K:\N20126_Newcastle_Rail_Flood_Advice\MI\Workspaces\Life_Hazard_Categories\WOR

3 Flood Planning Controls

3.1 Review of Regulatory Provisions

3.1.1 State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71)

State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71) aims to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast. SEPP 71 aims for development in the NSW coastal zone to be appropriate and suitably located, in accordance with the principles of the Ecologically Sustainable Development (ESD). The policy provides for: the protection of and improvement to public access compatible with the natural attributes coastal foreshores; and protects and preserves Aboriginal cultural heritage, visual amenities of the coast, the beach environment and amenity, native coastal vegetation, marine environment of New South Wales, and rocky platforms.

The key elements of SEPP 71 with specific reference to flooding and water management constraints for the proposed development include consideration of:

- the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards, and
- the likely impacts of development on the water quality of coastal waterbodies.

Section 3.2 outlines the development constraints and design management with respect to the coastal planning provisions.

3.1.2 The NSW Flood Prone Land Policy and Floodplain Development Manual

The NSW Flood Prone Lands Policy aims to reduce personal and public losses and impacts associated with flooding. The Policy does not attempt to preclude development from the floodplain, but rather, recognises the importance of floodplains for development purposes. The Policy promotes a merit-based approach to floodplain development, wherein all social, economic and ecological consequences are to be considered.

The merit-based approach of the Policy requires a holistic approach by Councils and other consent authorities when prescribing responses and requirements for existing and future development in accordance with the principles of the Floodplain Development Manual (2005). The Manual aims at a fundamental consistency of approach across Councils, and in particular seeks to clarify “the intent … with respect to the determination of Flood Planning Levels and the consideration of rare floods up to the PMF (which) will reduce the potential for inconsistent interpretation by consent authorities”.

The policy is directed towards providing solutions to existing flooding problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. The Policy and recommendations on how to apply the principles of the Policy are defined in the NSW Government’s Floodplain Development Manual (2005).

The NSW Floodplain Development Manual (2005) presents general principles and a process for flood risk management, to enable councils and associated committees to understand flood behaviour, impacts and risks to communities. The Manual has been prepared to assist councils prepare flood risk plans through a staged floodplain risk management process.

The Newcastle City-wide Floodplain Risk Management Study and Plan (City-wide Flood Plan) has been developed to direct and co-ordinate the future management of flood prone lands across the City of Newcastle. Development of the City-wide Flood Plan has been guided by the NSW Government's Floodplain Development Manual (2005).

3.1.3 Newcastle LEP (2012)

Local Environmental Plans (LEP) are prepared in accordance with Part 3 Division 4 of the *Environmental Planning and Assessment Act 1979*. The intent of the LEP is to define the legal framework for land use and development by 'zoning' all land. The LEP incorporates standard planning provisions, clauses, definitions and zones into the one document. It identifies standard zones and zone objectives and specifies permitted and prohibited uses in zones, and identifies compulsory and optional provisions.

The Newcastle LEP (2012) does not contain a standard flood clause. It is understood Council negotiated with the Department of Planning and Environment to have no flood clause in its LEP, and instead rely on the Flood Management provisions of Council's adopted Development Control Plan (2012) (refer to Section 3.1.4). These provisions have been preserved in Council's companion revised Newcastle Development Control Plan, which became effective with the LEP gazettal.

In terms of managing coastal hazards, the LEP contains 'Part 5.5. Development within the Coastal Zone', which is a compulsory clause for all LEPs that apply to land within the coastal zone. Part 5.5 sets objectives and matters for consideration by the consent authority prior to granting consent to development on land wholly or partly within the coastal zone. The objectives include implementing the principles of the NSW Coastal, in particular including the objective to "(iv) recognise and accommodate coastal processes and climate change". In this regard, Part 5.5. states that development consent must not be granted unless the consent authority is satisfied that:

"(d) the proposed development will not:

(i) be significantly affected by coastal hazards, or

(ii) have a significant impact on coastal hazards, or

(iii) increase the risk of coastal hazards in relation to any other land."

3.1.4 Newcastle Development Control Plan (2012)

The Newcastle Development Control Plan 2012 (DCP) provides guidelines to Development Applications for assessment by Council. Section 4.01 of Councils DCP addresses flood management, and applies to all development on flood prone land. The DCP aims to apply elements of the Newcastle Flood Policy in relation to proposed future development and provides

specific guidelines on development within flood prone land. In particular, the DCP provides guidelines on:

- Development within floodways;
- Development within flood storage areas;
- Measures to minimise risks to property (linked to the Flood Planning Level);
- Measures to minimise risks to life (in particular, on site refuge for flash flooding only); and
- Riparian zone management and restoration.

The definition of various flood risk categories referred to on the DCP have been determined across the Newcastle LGA within the adopted City-wide Floodplain Risk Management Study and Plan. As noted, the Plan was developed under the guiding principles for floodplain management as outlined in the Floodplain Development Manual (2005). The DCP provisions in conjunction with Council's adopted flood risk mapping (as presented in Section 3 of this report) define the overarching floodplain risk management constraints for the proposed development.

None of the sections within the DCP provide guidance for managing or minimising risks from coastal hazards, in particular, erosion and recession, and coastal inundation with wave overtopping.

Section 4.01 Flood Management details provisions for managing flooding risks to development. While specific provisions for climate change are not given within this DCP section, the definition of "flooding" recognises the contribution of coastal inundation which is defined as "caused by seawater inundation due to king tides, storm surge, barometric effects, shoreline recession, subsidence, the enhanced greenhouse effect or other causes". The DCP does not directly address coastal inundation or climate change. Instead, for coastal inundation and climate change to be managed through these DCP provisions, they would need to be incorporated when determining the flood planning level.

3.2 Development Constraints

Flooding

Section 2 and 3 outline the expected flood conditions at the site for the key flood planning events and the typical classifications used for flood planning in accordance with Council policies. Provided hereunder is a summary of the key flood related development controls appropriate to the proposed development site.

- Flood Planning Level – 2.8m AHD – the flood planning levels for proposed new buildings is expected to be derived from the peak 1% AEP Flood Level from ocean flooding incorporating 0.9m sea level rise allowance and appropriate 0.5m freeboard allowance. This would provide for the minimum occupiable floor levels for proposed developments. Other floor level controls may relate to parking entries/basements etc.
- Flood Classification – the only area classified as floodway in Council's existing mapping (refer to Figure 2-5) in the vicinity of the rezoning area is the extension of the overland flow path along Worth Place. However, there is no floodway area within the proposed rezoning boundary. The

remainder of the rezoning area is largely classified as flood fringe. By definition, blockage or filling of this area will not significantly affect the flood pattern or flood levels. This would be demonstrated by appropriate detailed modelling of design development layouts to support future Development Applications.

- Risk to Life – the high hazard areas within the rezoning area are limited to the existing overland flow path along existing road alignments and localised depressions within the rail corridor (refer to Figure 2-7). It is envisaged that in providing greater connectivity through open space area, there will be the potential to increase the areas of high hazard. Whilst typically not constraining development, given the high flash flood risk, consideration will need to be given to evacuation and emergency response opportunity in these public space areas. It is envisaged this can be achieved through future design phases with opportunity to provide pedestrian access to suitable areas of refuge above the PMF extent and modification of ground levels to remove localised depressions.

For the full suite of development controls, reference should be made to Section 4.01 Flood Management of Councils DCP 2012.

Coastal

Given the proximity of the rezoning area to the Hunter River estuary, the proposal constitutes Development in the Coastal Zone. Provided hereunder is a summary of the key development constraints related to coastal zone management:

- Coastal Processes – the scale and nature of the proposed development is such that it would have insignificant impact on the coastal processes of the broader Hunter River estuary. The works provide for no significant changes to existing overland flow distributions or tidal dynamics of the estuary. The development site is adjacent to the estuarine reaches of Throsby Creek, with the existing shoreline being a hard engineered sea wall. Accordingly there is considered no significant coastal erosion/recession risk to be managed for the development. The site may be impacted upon by coastal flooding, which may be exacerbated by potential climate change influences such as sea level rise. However, existing flood risk policies and appropriate development controls include consideration of the coastal inundation risk.
- Protection of coastal environment – as noted, the development is not expected to have any significant changes in existing flow regimes, however, there is some potential for potential impacts on water quality in the estuary. Again, given the nature and scale of the development, appropriate control of these risks are expected to be effectively managed through development of appropriate stormwater management and erosion/sedimentation control plans for both construction and operational phases of the development. In developing these plans, more detailed consideration of potential pollutant sources will need to be considered including existing contaminated lands and acid sulphate soil areas.

The constraints identified above are expected to be effectively managed through the design phases of the redevelopment through the development of an appropriate flood risk management plan and stormwater/water quality management plan. The local detail of plans will be dependent on the proposed built form environments and accordingly concept plans would be developed through the

design process in future planning stages. At this rezoning planning phase it is considered there are no major constraints on the proposed future development from a flooding/stormwater perspective.

4 Consistency with Flood Prone Land Direction

Parts of the land to which the planning proposal applies are affected by flooding. By seeking to change the land use zoning in a Flood Planning Area, and thereby increasing the potential for an increase in flood risk exposure on the land, the proposal needs to demonstrate consistency with Section 117 Direction 4.3 Flood Prone Land.

The consistency with the flood planning direction is demonstrated through the preparation of the planning proposal being in accordance with the relevant Newcastle City-wide Floodplain Risk Management Plan, developed on the principles of the NSW Governments Flood Policy and the NSW Floodplain Development Manual. The planning proposal has considered relevant flood planning cotrols (Section 4.01 Newcastle Development Control Plan 2012) developed as a direct result of the City-wide FRMP.

Any risks associated with higher density development will be effectively dealt with through flood planning development controls at the DA stage. No development in the rezoned areas will be permitted without consent. Accordingly, application of development control policies through the development approval process would provide for appropriate flood planning conditions such as:

- New development which occurs will be developed in such a way as to effectively avoid, minimise, or mitigate the flood risk according to the individual circumstances of each site.
- Physical impacts, brought about by increases to building footprints or the presence of walls and fences which might interfere with overland flows will be effectively dealt with by Council's flood planning controls.
- The requirement for a flood evacuation strategy or a site emergency response flood plan will ensure that no additional risk to life or property occurs in these areas as a result of increased population density.

4.1 Summary of Response to S.117 Direction 4.3 Flood Prone Land

Objectives

(1) The objectives of this direction are:

(a) to ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005, and

(b) to ensure that the provisions of an LEP on flood prone land is commensurate with flood hazard and includes consideration of the potential flood impacts both on and off the subject land.

Where this direction applies

(2) This direction applies to all relevant planning authorities that are responsible for flood prone land within their LGA.

- The direction applies. City of Newcastle is responsible for flood prone land.

When this direction applies

(3) This direction applies when a relevant planning authority prepares a planning proposal that creates, removes or alters a zone or a provision that affects flood prone land.

- The direction applies. The Planning Proposal seeks to alter a zone that affects flood prone land.

What a relevant planning authority must do if this direction applies

(4) A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas).

- Consistent. The Newcastle LEP (2012) does not contain a standard flood clause. It is understood Council negotiated to have no flood clause in its LEP, and instead rely on the Flood Management provisions of Council's adopted Development Control Plan (2012) These provisions are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005. The Planning Proposal will not alter flood prone land provisions within the DCP2012.

(5) A planning proposal must not rezone land within the flood planning areas from Special Use, Special Purpose, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial, Special Use or Special Purpose Zone.

- Inconsistent. The Planning Proposal intends to rezone land from SP2 Infrastructure to B4 Mixed Use. However, the area is generally classified as low risk precinct such that application of appropriate development controls is expected to provide effective flood risk management to enable change in land use without increase in overall flood risk.

(6) A planning proposal must not contain provisions that apply to the flood planning areas which:

(a) permit development in floodway areas,

- Consistent. No parts of the subject lands are located within a floodway area. Further, the planning proposal does not include provisions that permit development to be carried out without development consent. Existing development controls controls will effectively restrict new residential or commercial development from occurring within floodway zones which would be incompatable with the flood hazard.

(b) permit development that will result in significant flood impacts to other properties,

- Consistent. The planning proposal does not include provisions that permit development to be carried out without development consent. Existing development controls require consideration of potential adverse flood impact in the development assessment process.

(c) permit a significant increase in the development of that land,

- Inconsistent. The rezoning of parcels to B4 Mixed Use provides the opportunity for increased development from the existing rail corridor. However, the area is generally classified as low risk precinct such that application of appropriate development controls is

expected to provide effective flood risk management to enable proposed development yields to be realised without increase in overall flood risk.

(d) are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services, or

- Consistent. Future redevelopment consistent with the new zoning will be required to satisfy objectives of Councils flood policy objective to reduce the risks and costs of flooding to existing areas.

(e) permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads or exempt development.

- Consistent. The planning proposal does not include provisions that permit development to be carried out without development consent.

(7) A planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).

- Consistent. The Planning Proposal will not impose flood related development controls above the residential flood planning level for residential development on land.

(8) For the purposes of a planning proposal, a relevant planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas) unless a relevant planning authority provides adequate justification for the proposed departure from that Manual to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).

- Consistent. The flood planning levels adopted by Council are based on the City-wide Floodplain Risk Management Study and Plan (2012) which has been prepared in accordance with the Floodplain Development Manual 2005.`

Consistency

(9) A planning proposal may be inconsistent with this direction only if the relevant planning authority can satisfy the Director-General (or an officer of the Department nominated by the Director- General) that:

(a) the planning proposal is in accordance with a floodplain risk management plan prepared in accordance with the principles and guidelines of the Floodplain Development Manual 2005, or

- Applicable. The rezoning proposal has considered provisions and is consistent with Newcastle City-wide Floodplain Risk Management Plan developed under the guiding principles for floodplain management as outlined in the Floodplain Development Manual (2005).

(b) the provisions of the planning proposal that are inconsistent are of minor significance.

- Not applicable

5 References

BMT WBM (2012) *Newcastle City-wide Floodplain Risk Management Study and Plan*

Newcastle City Council (2003) *Newcastle Flood Policy*

Newcastle City Council (2004) *Newcastle Stormwater Management Plan*

NSW Government (2005) *Floodplain Development Manual*

Newcastle City Council (2012) *Newcastle Development Control Plan – Section 4.01 Flood Management*

WBM, 2006. *Throsby Creek and Cottage Creek Flood Study*. Prepared for City of Newcastle.

Appendix A Newcastle DCP Section 4.01 Flood Management

4.01 Flood Management

Amendment history

Version Number	Date Adopted by Council	Commencement Date	Amendment Details
1	15/11/2011	15/06/2012	New

Savings provisions

Any development application lodged but not determined prior to this section coming into effect will be determined as though the provisions of this section did not apply.

Land to which this section applies

This section applies to all development on flood prone (= flood liable) land in the Newcastle Local Government Area, as defined by Council's Flood Policy - (adopted 2004) and *The NSW Government Floodplain Development Manual – the management of flood liable land (2005)*, being "land susceptible to flooding by the PMF event" *.

A flood information application form can be obtained from Council's website: (www.newcastle.nsw.gov.au) or Council's Customer Enquiry Centre, City Administration Centre, 282 King Street Newcastle NSW 2300.

Development (type/s) to which this section applies

All of these provisions apply to all development on flood prone land with the exception of minor additions to existing buildings.

Minor additions (refer to definitions) are allowable without further reference to the provisions of this section, provided that the flood risk is not unreasonably increased.

Applicable environmental planning instruments

The provisions of the Newcastle Local Environmental Plan 2012 also applies to development applications to which this section applies.

In the event of any inconsistency between this section and the above environmental planning instrument, the environmental planning instrument will prevail to the extent of the inconsistency.

Note 1: Additional environmental planning instruments may also apply in addition to those listed above.

Note 2: Section 74E (3) of the *Environmental Planning and Assessment Act 1979* enables an environmental planning instrument to exclude or modify the application of this DCP in whole or part.

* Supplementary note (not required for application of this DCP): This definition remains unchanged to that defined by the previous Element 4.3 Flood Management Newcastle DCP 2005.

Associated technical manual/s

- *The NSW Government Floodplain Development Manual – the management of flood liable land (2005)*. This Manual is available from the NSW Government website at the time of writing (www.environment.nsw.gov.au) or a copy may be viewed at Council's Customer Enquiry Centre.

Additional information

More information about floodplain risk management in the Newcastle Local Government Area can be found at Council's website. Copies of various flood studies and reports are also available for viewing at Council's Customer Enquiry Centre.

Definitions

A word or expression used in this development control plan has the same meaning as it has in Newcastle Local Environmental Plan 2012, unless it is otherwise defined in this development control plan.

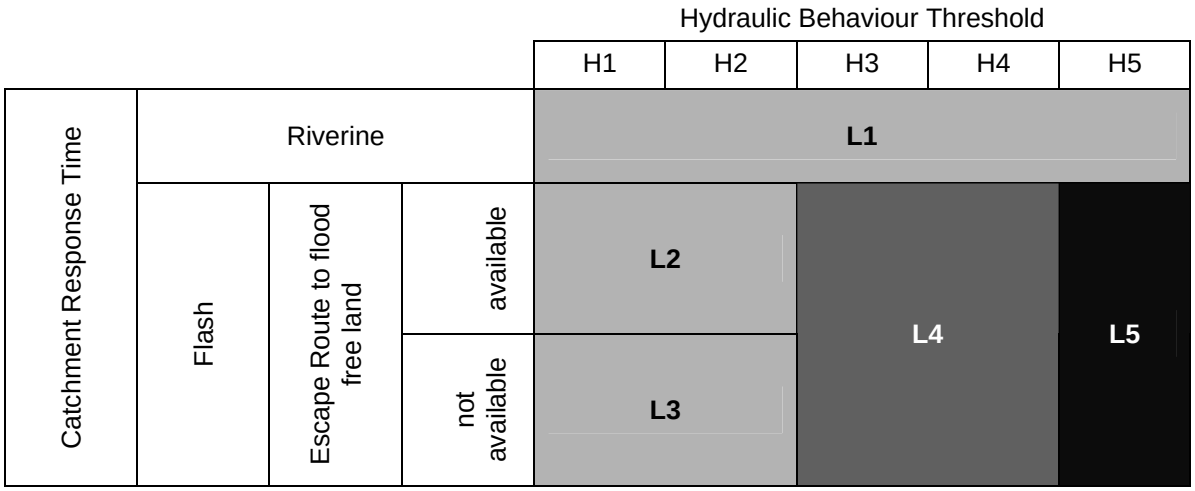
Other words and expressions referred to within this section are defined within Part 9.00 – Glossary and include:

- **Annual exceedance probability (AEP)** – is the probability that a flood of a given or larger magnitude will occur within a period of one year. Its reciprocal is equivalent to average recurrence interval.
- **Average recurrence interval (ARI)** – the average period between the recurrence of a storm event of at least a given rainfall intensity. The ARI represents a statistical probability. For example, a 10 year ARI indicates an average of 10 events over 100 years. The ARI is not the period between actual events.
- **Basement garage** – is a garage normally used for the parking of vehicles with the floor constructed below the street level.
- **Flood fringe areas** - the remaining area of the floodplain not included in flood storage areas and floodways. Flood fringe areas can usually be developed without reference to how that development will affect the flood behaviour either upstream or downstream.
- **Flood information certificate** - is a certificate issued by Council that provides information about the likelihood, extent or other characteristics of flooding known to affect a specified parcel of land.
- **Flooding** - is relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river estuary, lake or dam, and/or local overland flooding associated with major drainage, and/or coastal inundation resulting from super-elevated sea levels and/or waves , excluding tsunami. Accordingly, flooding may occur due to a variety of reasons, either separately or in combination including:
  - river flooding - caused by a river or stream overtopping its banks onto the surrounding floodplain
  - urban flooding - caused by urban stormwater flows during an intense rainfall event, such as surface flows, surcharge from piped drainage systems or overflow from man-made stormwater channels.
  - coastal inundation - caused by sea water inundation due to king tides, storm surge, barometric effects, shoreline recession, subsidence, the enhanced greenhouse effect or other causes.

- **Flood liable land** - is synonymous with flood prone land (ie) land susceptible to flooding by the PMF event on the basis of flood information held by Council. Note that the term flood liable land covers the whole floodplain, not just that part below the FPL (see flood planning area).
- **Floodplain** - an area of land along the course of a river that is subject to periodic inundation due to the river overtopping its bank. It is commonly delineated by the area that would be flooded by an event with a given average recurrence interval.
- **Flood planning area** - the area of land below the FPL. Note that development controls that mainly relate to risk to property apply to the flood planning area, but other development controls mainly relating to risk to life and floodways and flood storages may apply to the remainder of flood liable (prone) land.
- **Flood planning level (FPL)** - is the level of the planning flood plus an additional freeboard as advocated in the NSW Floodplain Development Manual. For purposes of this element, the planning flood is the 1% Annual Exceedance Probability flood, and the freeboard is generally 500mm.
- **Flood prone land** - is land that, on the basis of flood information held by Council, is estimated to be inundated by the probable maximum flood.
- **Flood refuge** - is an area free of flooding. It can be either higher ground or it could be in the form of an area of the building, either constructed specifically for the purpose or as an intrinsic part of the building.
- **Flood storage area** - is an area where flood water accumulates and the displacement of that floodwater will cause a significant redistribution of floodwaters, or a significant increase in flood levels, or a significant increase in flood frequency. Flood storage areas are often aligned with floodplains and usually characterised by deep and slow moving floodwater.
- **Floodway** - those areas of the floodplain where a significant discharge of water flows during floods; often aligned with obvious naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow or increase in flood levels, which may in turn adversely affect other areas.
- **Freeboard** - is a margin applied to the estimation of flood levels to compensate for factors such as wave action, localised hydraulic behaviour, climatic change and modelling confidence.
- **Hydraulic behaviour threshold** - is a set of circumstances (that may or may not be present at some locations at some time in any particular sized flood) that constitutes a particular level of hydraulic impact, as specified below:

H_1	hydraulically suitable for parked or moving cars V < 0.5m/sec and d < 0.3m
H_2	hydraulically suitable for parked or moving heavy vehicles and wading by able-bodied adults V < 2m/sec, d< 0.8m and v < 3.2 – 4*d
H_3	hydraulically suitable for light construction *(eg. timber frame and brick veneer)* v < 2m/sec, d < 2m, v*d < 1
H_4	hydraulically suitable for heavy construction *(eg. steel frame and reinforced concrete)* v < 2.5m/sec, d < 2.5m and v*d < 2.5
H_5	generally unsuitable

Life hazard - is the 'risk to life hazard category' as a combination of hydraulic hazard category, warning time and escape path availability, applied to all floods, up to and including the PMF (as required by the NSW Government Floodplain Development Manual for the management of personal safety). For simplicity, the Life Hazard categories set out below are only assessed at the PMF in the application of this DCP section, on the assumption that once the PMF is managed for personal safety, all other lesser floods will also be managed. The life hazards "L1" to "L5" are defined below*:



L1	Riverine flooding where there is sufficient time to remove people from the risk to their lives by means of formal community evacuation plans. Not relevant to flash flooding scenarios such as the Wallsend Catchment.
L2	Short duration flash flooding with no warning time in circumstances where there is an obvious escape route to flood free land with enclosing waters during the PMF which are suitable for wading or heavy vehicles ie. hydraulic threshold does not exceed H2. On site flood refuge not necessary and normal light frame residential building are appropriate.
L3	Short duration flash flooding with no warning time and no obvious escape route to flood free land with enclosing waters during the PMF which are suitable for wading or heavy vehicles ie. hydraulic threshold does not exceed H2. On site flood refuge not necessary and normal light frame residential buildings and appropriate.
L4	Short duration flash flooding with no warning time and enclosing waters during the PMF not suitable for wading or heavy vehicles ie. hydraulic threshold exceeds H2. On site refuge is necessary and if hydraulic threshold exceeds H3, heavy frame construction or suitable structural reinforcement required.
L5	Short duration flash flooding with no warning time and enclosing waters during the PMF have too much energy for normal heavy building construction and therefore it is generally not possible to construct a flood refuge ie. hydraulic threshold is H5. The risk to life is considered extreme and the site is unsuitable for habitation, either residential or short stay.

*Supplementary note (not required for application of this DCP): This definition remains unchanged to that defined by the previous Element 4.3 Flood Management Newcastle DCP 2005.

- **Minor additions** - (for the purpose of section 4.01 Flood Management) are additions that fall below the following limits:

Existing building area	Minor addition limit
< 250m^2	50m^2
250m^2 – 750m^2	20% of the existing building area
>750m^2	150m^2

- **Occupiable rooms** – rooms of buildings where people may be present in the normal use of the building.
- **Planning flood** - is the flood event from which the flood planning level is derived. It is expressed in terms of the probability of the event being exceeded, usually within any given year (see annual exceedance probability).
- **Probable maximum flood (PMF)** - is the largest flood that could conceivably occur at a particular location.
- **Probable maximum flood level** - the flood level calculated to be the maximum which is likely to occur.
- **Property hazard** - is the 'risk to property hazard category' as a combination of hydraulic behaviour threshold and its effect on property. The risk to property hazards are based on the peak hydraulic behaviour thresholds *(H_1-H_5)* determined for the 1 in 100 annual chance flood. Five risks to property hazard categories (P1-P5) are defined as P1-P5 correlate directly with H1-H5 as follows*:

P_1	Parked or moving cars remain stable ie. equivalent to areas of H_1 at the Flood Planning Event.
P_2	Parked or moving heavy vehicles remain stable ie. equivalent to areas of H_2 at the Flood Planning Event.
P_3	Suitable for light construction *(eg. timber frame, masonry and brick veneer)* ie. equivalent to areas of H_3 at the Flood Planning Event.
P_4	Suitable for heavy construction *(eg. steel frame, reinforced concrete)* ie. equivalent to areas of H_4 at the Flood Planning Event.
P_5	Hydraulically unsuitable for normal building construction is equivalent to areas of H_5 at the Flood Planning Event.

The distribution of P_1-P_5 is identical to the related H_1-H_5 *(at the Flood Planning Event).*

- **Tsunami** - a series of ocean waves with very long wavelengths (typically hundreds of kilometres) caused by large-scale disturbances of the ocean, such as:
  - earthquakes
  - landslide
  - volcanic eruptions
  - explosions
  - meteorites.

*Supplementary note (not required for application of this DCP): This definition remains unchanged to that defined by the previous Element 4.3 Flood Management Newcastle DCP 2005.

Aims of this section

1 To guide the development of floodprone land, applying balanced strategies to economically, socially and environmentally manage risk to life and property.

2. To set aside appropriate areas to convey and/or store flood waters.

3. To ensure development, when considered both individually and as an instance of cumulative development trends, will not cause unreasonable adverse flooding impacts in other locations.

4. To implement the principles of *The NSW Government Floodplain Development Manual (2005)* to new development as applicable.

Notes: Tsunami and very minor nuisance flooding (such as the trapping of surface runoff in a road shoulder or against a building) are specifically excluded from the application of the DCP.

The life risk hazard category "L1" assumes people will respond to warnings and safely evacuate to the safety flood free high ground. Additional requirements may be necessary to manage personal safety in riverine flooding if there is evidence that a lack of response is likely, and this may lead to life threatening situations.

4.01.01 Floodways

Objectives

1. Retain floodways in a condition capable for the conveyance of essential flood flow.

Controls

1. No building or structure erected and no land filled by way of the deposition of any material within any area identified as a floodway except for minor alterations to ground levels which do not significantly alter the fundamental flow patterns for:

   (a) roads

   (b) parking

   (c) below ground structures

   (d) landscaping.

2. Where dividing fences across floodways are unavoidable, they are constructed only of open type fencing that does not restrict the flow of flood waters and are resistant to blockage. New development shall be designed to avoid fences in floodways.

Note: Floodways are shown on a flood information certificate obtainable on application from Council. In general, development other than low level driveways and parking areas is not practicable in floodways. Floodways are not necessarily indicative of high hazard flow, although the two will generally coincide. It is necessary to separately investigate hazard in order to determine if parking areas and the like are suitable within floodways.

4.01.02 Flood storage areas

Objectives

1. Protect flood storage areas to provide storage of floodwaters to ensure that other areas are not significantly worse off due to development of the site.

Controls

1. Not more than 20% of the area of any development site in a flood storage area is filled. The remaining 80% is generally developed allowing for underfloor storage of floodwater by the use of suspended floor techniques such as pier and beam construction.

2. Where it is proposed to fill development sites, the fill does not impede the flow of ordinary drainage from neighbouring properties, including overland flow.

Note: Flood storage areas are identified on the flood information certificate.

4.01.03 Management of risk to property

Objectives

1. Manage risks to property up to an acceptable level of risk (the flood planning level).

Controls

1. Floor levels of all occupiable rooms of all buildings are not set lower than the FPL.

2. Garage floor levels are no lower than the 1% Annual Exceedance Probability Event. However, it is recognised that in some circumstances this may be impractical due to vehicular access constraints. In these cases, garage floor levels are as high as practicable.

3. Basement garages may be acceptable where all potential water entry points are at or above the probable maximum flood (PMF), excepting that vehicular entry points can be at the FPL. In these cases, explicit points of refuge are accessible from the carpark in accordance with the provisions for risk to life set out below.

4. Electrical fixtures such as power points, light fittings and switches are sited above the FPL unless they are on a separate circuit (with earth leakage protection) to the rest of the building.

5. Where parts of the building are proposed below the flood planning level, they are constructed of water-resistant materials.

6. Areas where cars, vans and trailers are parked, displayed or stored are not located in areas subject to property hazard of P2 or higher. Containers, bins, hoppers and other large floatable objects also are not stored in these areas. Heavy vehicle parking areas are not located in areas subject to property hazard P3 or higher.

7. Timber framed, light steel construction, cavity brickwork and other conventional domestic building materials are generally not suitable forms of construction where the property hazard is P4 or higher. Where property hazard is P4, the structure is certified by a practising structural engineer to withstand the hydraulic loads (including debris) induced by the flood waters.

8. Property hazards of P5 are generally unsuitable for any type of building construction and building is discouraged from these areas. Where building is necessary, the structure is certified by a practising structural engineer to withstand the hydraulic loads (including debris) induced by the flood waters.

Note: This provision limits the risk of inundation relative to the flood planning level (FPL). The FPL is the water surface level of the relevant 'planning flood' plus a freeboard. Compliance with the flood planning level does not guarantee that flooding will not affect work carried out in accordance with Risk to Property Development Controls: In most cases, the flood planning levels and the property hazards are given on the flood information certificate for the relevant property. The "planning flood" for all development in all areas of Newcastle is the 1% Annual Exceedance Probability event.

4.01.04 Management of potential risk to life

Objectives

1. Only permit new development or redevelopment where the full potential risk to life from flooding can be managed for all floods up to and including the PMF.

Controls

Risk to life category L5

1. Risk to life hazards of L5 are generally unsuitable for any type of building construction and building is discouraged from these areas. Reliable safe escape to high ground is likely not possible and normal building construction would likely suffer structural failure from the force of floodwaters, so that any people seeking refuge in the building would likely perish. Where building is necessary, the structure is certified by a practising structural engineer to withstand the hydraulic loads (including debris) induced by the flood waters.

Islands

2. The formation of islands in the floodplain during a flood is a potentially dangerous situation, especially when floods larger than the FPL totally inundate the island for an extended period. Development of such land is considered with great care.

On-site refuge

3. On-site refuge is to be provided for all development where the life hazard category is L4 unless the proposed development is less than 40m from the perimeter of the PMF extent and the higher ground is accessible.

> Note: Refuge can be in the form of on-site refuge or convenient access to flood free ground. In general, it is not acceptable to rely on refuge provided by or on other development sites. In all cases where on site refuge is provided, it is to be both intrinsically accessible to all people on the site and an integrated part of the development (eg a second storey with stair access). The route to the refuge is to be fail safe, plainly evident and self-directing. In most cases, life hazard categories are nominated on the flood information certificate for the relevant property.

Standards for on-site refuge

4. Where on-site refuge is required for a development, it should comply with the following minimum standards:

   (a) The minimum on-site refuge level is the level of the PMF. On-site refuges are designed to cater for the number of people reasonably expected on the development site and are provided with emergency lighting.

   (b) On-site refuges are of a construction type able to withstand the effects of flooding. Design certification by a practising structural engineer that the building is able to withstand the hydraulic loading due to flooding (at the PMF).

> Note: In most cases, the potential risk to life hazards categories are given on the flood information certificate for the relevant property.

This page is intentionally blank.

BMT WBM Bangalow
6/20 Byron Street, Bangalow 2479
Tel +61 2 6687 0466 Fax +61 2 66870422
Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Brisbane
Level 8, 200 Creek Street, Brisbane 4000
PO Box 203, Spring Hill QLD 4004
Tel +61 7 3831 6744 Fax +61 7 3832 3627
Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Denver
8200 S. Akron Street, #B120
Centennial, Denver Colorado 80112 USA
Tel +1 303 792 9814 Fax +1 303 792 9742
Email denver@bmtwbm.com
Web www.bmtwbm.com

BMT WBM London
International House, 1st Floor
St Katharine's Way, London E1W 1AY
Email london@bmtwbm.co.uk
Web www.bmtwbm.com

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 mackay@bmtwbm.com.au
Web www.bmtwbm.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 melbourne@bmtwbm.com.au
Web www.bmtwbm.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 newcastle@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Perth
Suite 6, 29 Hood Street, Subiaco 6008
Tel +61 8 9328 2029 Fax +61 8 9486 7588
Email perth@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Sydney
Level 1, 256-258 Norton Street, Leichhardt 2040
PO Box 194, Leichhardt NSW 2040
Tel +61 2 8987 2900 Fax +61 2 8987 2999
Email sydney@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Vancouver
Suite 401, 611 Alexander Street
Vancouver British Columbia V6A 1E1 Canada
Tel +1 604 683 5777 Fax +1 604 608 3232
Email vancouver@bmtwbm.com
Web www.bmtwbm.com