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Mr John Molteno
Blacktown City Council
62 Flushcombe Road
Blacktown NSW 2148

5th November 2018

Dear John,

Riverstone Town Centre
Flood Hazard Mapping

INTRODUCTION

Catchment Simulation Solutions (CSS) was engaged by Blacktown City Council to map flood hazard categories for the Riverstone Town Centre area. The goal of the hazard mapping was to provide Blacktown City Council with some guidance on potential flooding constraints for the area which can be used to inform what land uses may be appropriate and what planning controls should be considered to ensure the flood risk is best managed.

The following report summarises the process that was employed to prepare the flood hazard maps. It also discusses how the hazard maps should be interpreted and the potential planning implications.

AVAILABLE DATA

The Riverstone Town Centre is located within the Eastern Creek catchment. Flood behaviour across the Eastern Creek catchment has been defined using a TUFLOW hydraulic model that was developed as part of the "Eastern Creek Hydraulic Assessment" (Catchment Simulation Solutions, 2014) and subsequently refined and updated as part of the "Eastern Creek Development Scenarios Hydraulic Assessment" (Catchment Simulation Solutions, 2016). The floodwater depth and velocity results from this most recent study were used as the basis for preparing the flood hazard maps for the current investigation.

The results of the flood modelling indicate that flooding of the Riverstone Town Centre area can occur as a result of "backwater" flooding from the Hawkesbury River and Eastern Creek (during large floods) as well as local catchment runoff, which tends to dominate during more frequent floods.

A small tributary of Eastern Creek drains through the Riverstone Town Centre area and this tributary is shown in **Figure 1**. Catchment inflows are applied to this tributary in the TUFLOW model along Garfield Road East (between Oxford St and George St). As such, no flood results are available for the portion of the study area located upstream of this location (i.e., Garfield Road East is defined as the

upstream extent of the modelling results and, therefore, the area where flood hazards can be defined).

Flood Hazard

Flood hazard defines the potential impact that flooding will have on development and people across different sections of the floodplain. More specifically, it describes the potential for floodwaters to cause damage to property (i.e., buildings & vehicles) and/or loss of life/injury (*AIDR, 2014*).

Provisional hazard categories were prepared as part of the *'Eastern Creek Hydraulic Assessment' (2014)* based on criteria contained in Appendix L of the *'Floodplain Development Manual' (2005) (FDM)*.

However, since that assessment was completed, more contemporary flood hazard vulnerability curves have been published in the Australian Institute for Disaster Resilience's (AIDR) '*Technical Flood Risk Management Guideline: Flood Hazard' (2014)*. The hazard curves are reproduced in **Plate 1**. As shown in **Plate 1**, the hazard curves assess the potential vulnerability of people (for differing physical abilities), vehicles and structures based upon the depth and velocity of floodwaters at a specific location. Accordingly, this guideline is considered to provide a more detailed understanding of the potential flood hazard, particularly across urban areas, and it was considered valuable to prepare flood hazard mapping in accordance with this guideline.

The resulting flood hazard maps are shown in **Figures 1** to **4** for the design 5% AEP flood, 1%.AEP flood, 0.2% AEP flood and PMF.

Figure 1 shows that during a 5% AEP flood, the hazard categories typically do not exceed H2. This indicates that most of the area would be safe for buildings and people, although small cars may be mobilised in H2 areas.

Figure 2 shows that during a 1% AEP flood, "backwater" flooding from Eastern Creek and the Hawkesbury River start to become more influential. Much of the area adjoining the railway line would be exposed to hazard categories that vary from H3 to H5, indicating that most of this area would be unsafe for people of all mobility levels as well as vehicles. Any buildings located within the H5 area would need to be specifically designed to withstand the forces of floodwaters.

Figure 3 shows that during a 0.2% AEP flood, the area adjoining the railway would be exposed to a H6 category. This indicates that any buildings in this area would likely fail during a 0.2% AEP flood regardless of how well they are designed.

Figure 4 shows that during the PMF, backwater flooding from the Hawkesbury River dominates. Most of the Riverstone Town Centre would be exposed to a H6 hazard category.

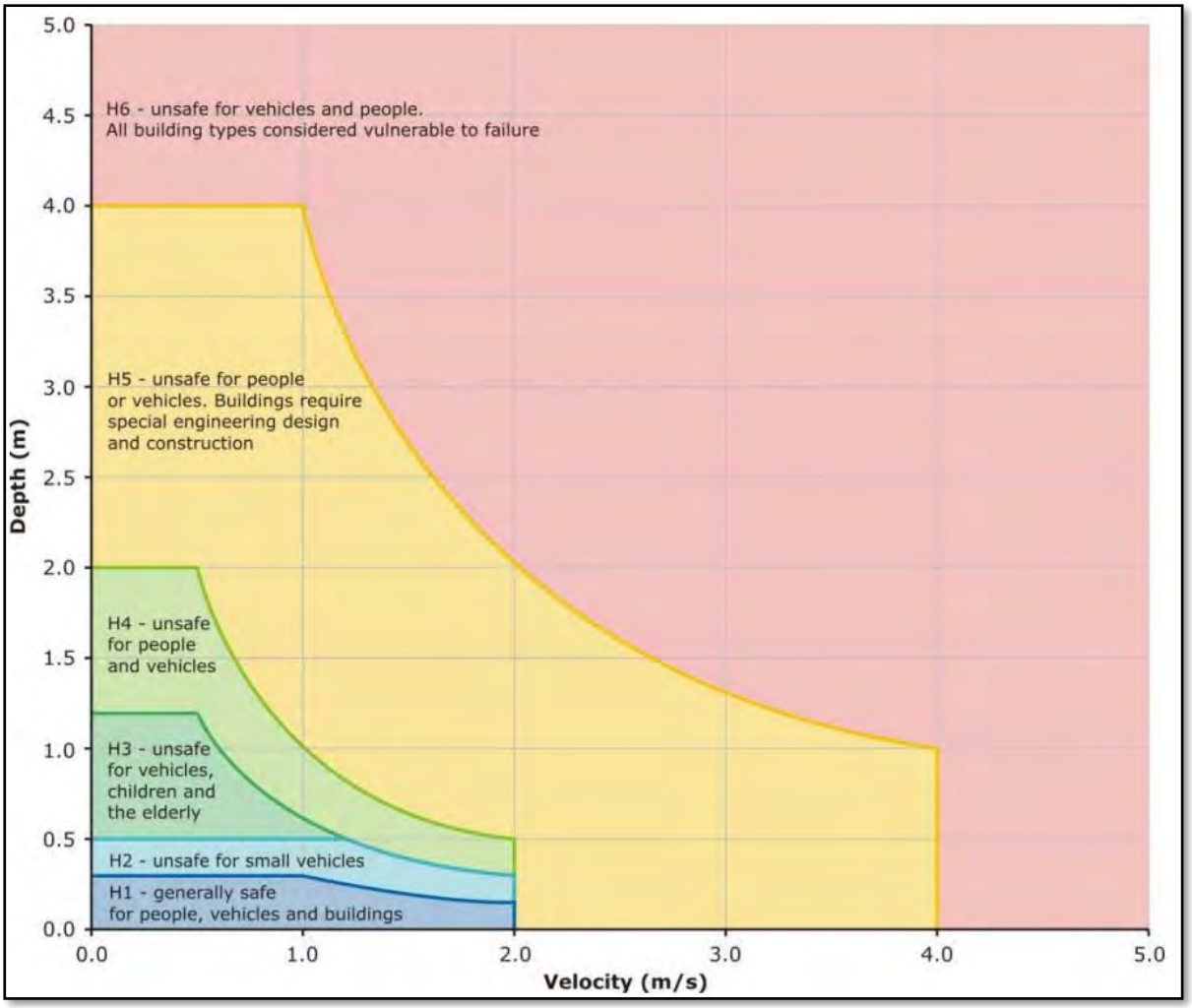


Plate 1 Flood hazard vulnerability curves (Australian Government, 2014)

PLANNING IMPLICATIONS

Although the flood hazard categories are targeted towards defining the impact that floodwaters are likely to have on people and property/vehicles, they can be potentially used to assist in determining what development types and what development controls may be appropriate across different sections of the floodplain to best manage the flood risk.

The flood hazard categories are reproduced in **Table 1**. Also included in Table 1 is a discussion on potential planning implications within each flood hazard zone for different development types. A focus was placed on the 1% AEP hazard as this flood is most commonly used for planning purposes.

It was assumed that all future buildings will need to comply with Council's current minimum flood level requirement (1% AEP flood level + 0.5 metres freeboard). Therefore, the provisional hazard within such buildings will effectively be zero. However, it is important to consider the hazard outside of the buildings in case evacuation is required. In this regard, the planning suggestions included in **Table 1** refer to the hazard external to the building.

Table 1 Adopted Flood Hazard Categories (Australian Government, 2014) and Flood Planning Implications

Hazard Category	Hazard Description	Planning Considerations (based on 1% AEP flood)				
		Sensitive Uses & Facilities	Residential		Commercial & Industrial	Recreation & Non-Urban
			High Density	Low Density		
H1	Generally safe for vehicles, people and buildings. Relatively benign flood conditions. No vulnerability constraints	Suitable	Suitable	Suitable	Suitable	Suitable
H2	Unsafe for small vehicles	Generally suitable	Generally suitable. Although potential for water to spill from roadways and inundate any basement carparks – consider controls to limit potential damage associated with basement inundation (driveway crests to be located above 1% AEP flood level)	Generally suitable. Although consideration to minimum garage/car port level controls could be explored to reduce the potential for mobilisation of vehicles.	Generally suitable	Suitable
H3	Unsafe for vehicles, children and the elderly	Generally not suitable as potential for hazardous conditions for elderly & children	As above	As above	Generally suitable	Suitable

Hazard Category	Hazard Description	Planning Considerations (based on 1% AEP flood)				
		Sensitive Uses & Facilities	Residential		Commercial & Industrial	Recreation & Non-Urban
			High Density	Low Density		
H4	Unsafe for vehicles and people	Not suitable	May be suitable if evidence of a low hazard evacuation route can be provided	May be suitable if evidence of a low hazard evacuation route can be provided	May be suitable if evidence of a low hazard evacuation route can be provided	Suitable
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure	Not suitable	Generally not suitable. If development does occur in these areas, there should a "structural soundness" control to ensure structural stability up to the nominated design flood (typically 1% AEP flood level + 0.5m)	Generally not suitable. If development does occur in these areas, there should a "structural soundness" control to ensure structural stability up to the nominated design flood (typically 1% AEP flood level + 0.5m)	Generally not suitable. If development does occur in these areas, there should a "structural soundness" control to ensure structural stability up to the nominated design flood (typically 1% AEP flood level + 0.5m)	Suitable
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.	Not suitable	Not suitable	Not suitable	Not suitable	Suitable

Critical land uses that will potentially serve important functions during floods (e.g., hospitals), should be located outside of the PMF extent. As shown in **Figure 4**, only very small sections of the Riverstone Town Centre are located outside of the PMF extent.

From a planning perspective, it is generally desirable to incorporate higher density residential areas in close proximity to major transportation links, such as the railway line. At the same time, it is generally undesirable to introduce additional people into high flood risk areas as it potentially increases the burden on emergency services. In this regard, the highest flood hazard during each design flood occurs immediately adjacent to the railway line. In general, urban land uses in this area would be best avoided and opportunities for open space could be explored.

As previously noted, most of the area would be exposed to a H6 hazard category during the PMF, which indicates that most building types would likely fail during a flood of this magnitude. It is rarely practical to cater for the PMF through structural measures. However, the risk during a PMF must still be considered. In general, response measures are the most economical options for addressing the PMF risk (e.g., ensuring evacuation is possible from buildings to a location above the PMF). A review of the terrain in the area indicates that most areas within the town centre grade up and away from the floodplain. Therefore, it should be possible to provide "rising road" evacuation from most areas to a level above the PMF.

In general, the flood hazard categories are depth rather than velocity dominated. Although it would be technically possible to reduce the depth and, therefore, flood hazard through filling, this would serve to reduce flood storage across the area, which may adversely impact on flood behaviour elsewhere. Accordingly, filling is not a recommended means of reducing the flood hazard to more tolerable levels.

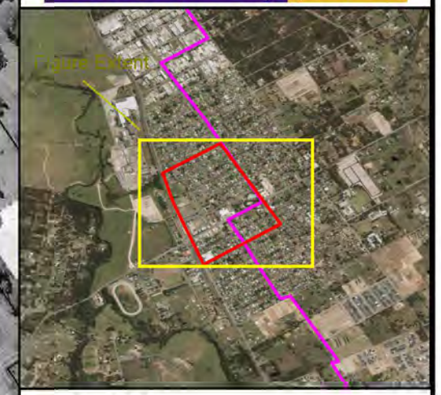
It should be noted that these planning recommendations are by no means exhaustive and focus only on potential flooding constraints based on flood hazard only. The reader is also referred to the *'Australian Disaster Resilience Guideline 7-5: Flood Information to Support Land-use Planning'* (AIDR 2017) which uses a variety of flood outputs (including flood hazard) to help inform land use planning activities.

I trust this provides a suitable summary of the outcomes of the flood hazard mapping that has been prepared for the Riverstone Town Centre and the associated planning implications. However, if you have any questions, please feel free to get in contact with me.

Kind Regards,

David Tetley
Catchment Simulation Solutions

Blacktown City Council



LEGEND

- Study Area
- TUFLOW Model Extents

Hazard Categories

- H1 - generally safe for people, vehicles and buildings
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special design
- H6 - unsafe for people or vehicles. All buildings vulnerable

Notes:

Aerial Photograph Date: 2010

N

W E

S

Scale 1:4,000 (at A3)

0 100 200

(m)

Figure 1: Hazard Categories for the 5% AEP Flood

Prepared By:
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Sydney, NSW 2000

File Name: Figure1 Hazard Categories for 5% AEP Flood.wor

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LEGEND

- Study Area
- TUFLOW Model Extents

Hazard Categories

- H1 - generally safe for people, vehicles and buildings
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special design
- H6 - unsafe for people or vehicles. All buildings vulnerable

Notes:

Aerial Photograph Date: 2010

N

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Scale 1:4,000 (at A3)

0 100 200

(m)

Figure 2: Hazard Categories for the 1% AEP Flood

Prepared By:
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Sydney, NSW 2000

File Name: Figure2 Hazard Categories for 1% AEP Flood.wor

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LEGEND

- Study Area
- TUFLOW Model Extents

Hazard Categories

- H1 - generally safe for people, vehicles and buildings
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special design
- H6 - unsafe for people or vehicles. All buildings vulnerable

Notes:

Aerial Photograph Date: 2010

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W E

S

Scale 1:4,000 (at A3)

0 100 200

(m)

Figure 3: Hazard Categories for the 0.2% AEP Flood

Prepared By:
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File Name: Figure3 Hazard Categories for 0.2% AEP Flood.wor

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LEGEND

- Study Area
- TUFLOW Model Extents

Hazard Categories

- H1 - generally safe for people, vehicles and buildings
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special design
- H6 - unsafe for people or vehicles. All buildings vulnerable

Notes:

Aerial Photograph Date: 2010

N

W E

S

Scale 1:4,000 (at A3)

0 100 200

(m)

Figure 4: Hazard Categories for the PMF

Prepared By:
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File Name: Figure4 Hazard Categories for PMF.wor