

Our Ref: DJL: L.T2681.004.docx

29 April 2026

Waterfall Estate Pty Ltd
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ARMIDALE NSW 2350c/o Alistair Palmer
Transcend Property
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Dear Alistair

RE: FLOOD RISK ASSESSMENT FOR PROPOSED RESIDENTIAL SUBDIVISION WATERFALL WAY, ARMIDALE NSW**Background**

Torrent Consulting was engaged to provide flood advice with respect to the proposed residential subdivision at Waterfall Way Armidale NSW (the Site). The property was rezoned in 2009 from rural to R2 residential subdivision and a Development Application (DA) was approved for the first stage of the masterplan.

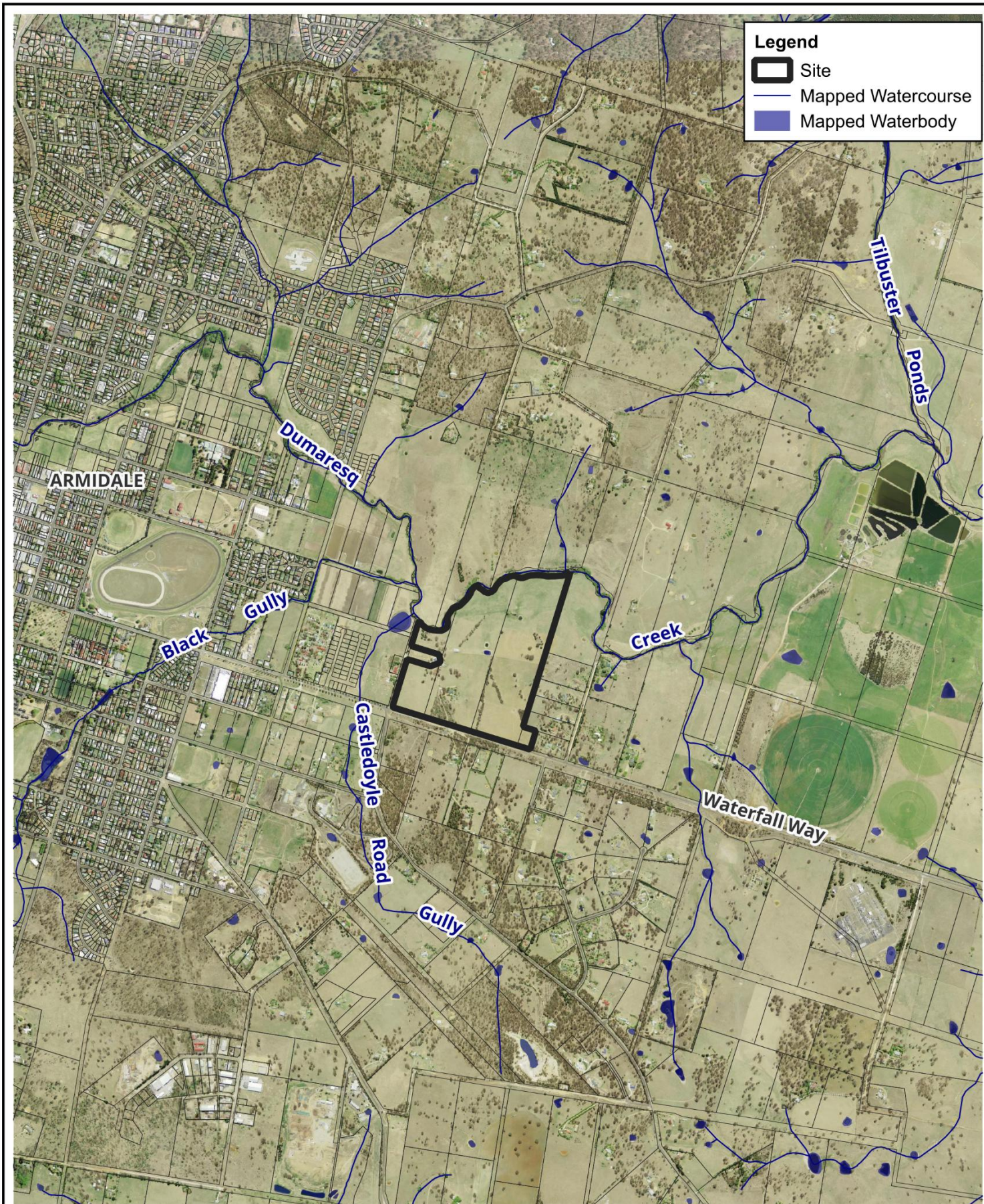
The Site is located on the floodplain of Dumaresq Creek on the eastern outskirts of the city of Armidale as shown in Figure 1. The existing Site land use is rural agriculture. The main alignment of Dumaresq Creek forms the southern boundary of the Site. There are number of unnamed watercourses in the Site vicinity being minor tributaries of Dumaresq Creek. Tilbuster Ponds is the only other significant watercourse in the locality with its confluence with Dumaresq Creek located approximately 3km downstream of the Site.

A Scoping Proposal / Planning Proposal has been lodged with Armidale Regional Council (Council) for higher density to R1 and residential (and commercial) subdivision layout. A flood assessment is required to address the planning requirements including the provisions under *Planning Circular PS 24-001 Update on addressing flood risk in planning decisions*. Accordingly, this assessment provides for a detailed review of design flood conditions and planning constraints for the Site to consider the compatibility of the proposed development to support the planning proposal.

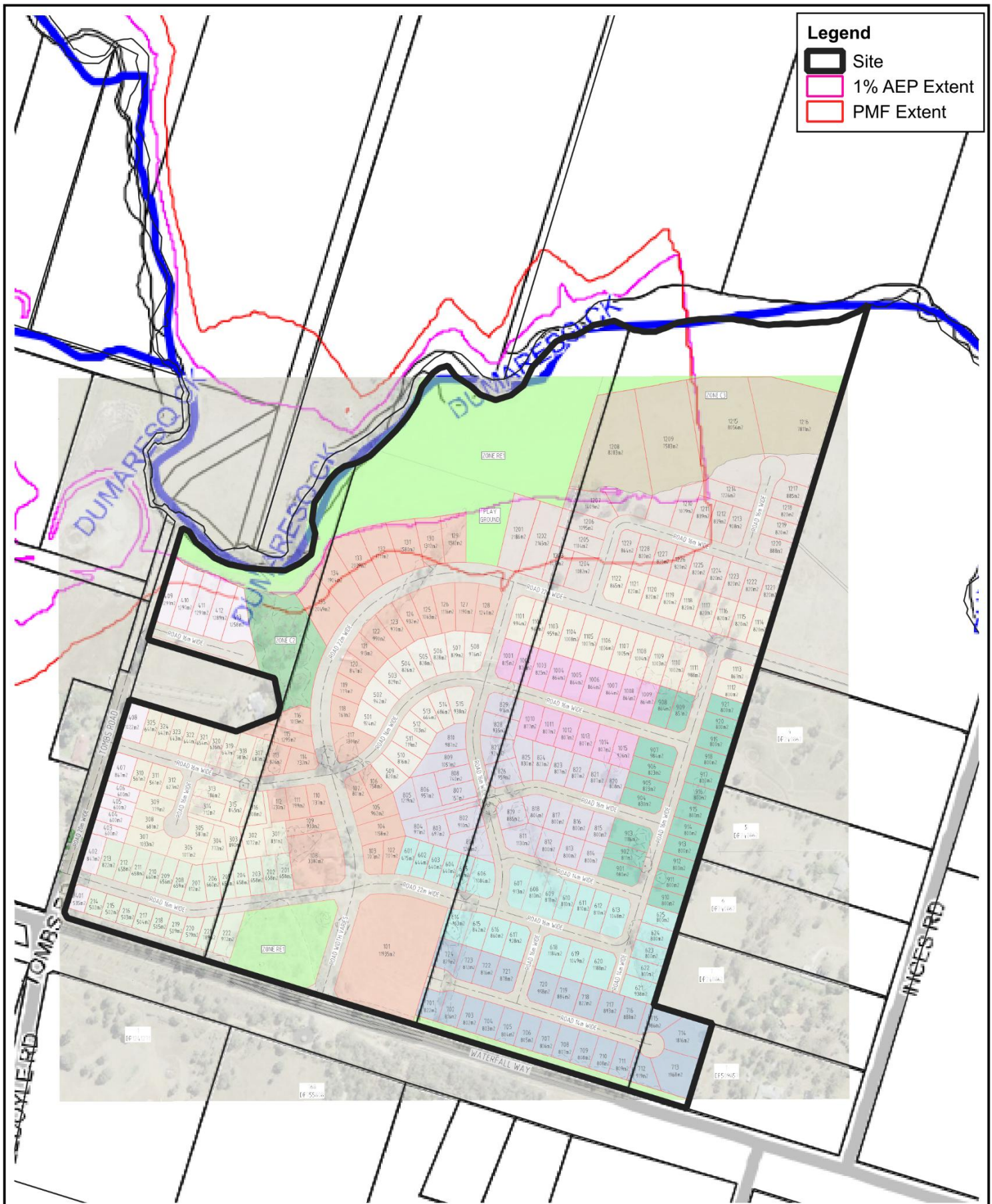
Existing Flood Data

Existing Council flood mapping from the *Armidale Flood Study Review and Update* (BMT WBM, 2014) indicate that parts of the Site are within the 1% Annual Exceedance Probability (AEP) flood extents, within increased inundation across the Site up to the Probable Maximum Flood (PMF) level. The mapped flood extents within the Site are shown in Figure 2 overlaid on the concept development layout. The corresponding Council flood extent mapping and BMT WBM (2014) flood mapping is included in Appendix A for reference.

The downstream extent of the existing flood mapping is within the Site boundary, with no established design flood condition in the north-eastern corner of the Site. Proposed lots in the northern part of Site adjacent to Dumaresq Creek are within the current mapped 1% AEP extent and corresponding Flood Planning Area (FPA) and accordingly subject to local flood development controls.



Title: Site Locality		0 0.6 1.2 km approx. scale	
Figure:	1	Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.	
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0 100 200 m
approx. scale



The BMT WBM (2014) flood mapping as included in Appendix A is derived from one-dimensional (1D) hydraulic modelling using HEC-RAS software. BMT WBM (2014) noted that Council commissioned BMT WBM to develop a 2D hydraulic model of Dumaresq Creek through the city centre of Armidale. The developed 2D model using the TUFLOW software was provided by Council for information in the current assessment. The 2D model results provide for different flood extents to the Council flood planning information shown in Figure 2, with the mapped 2D flood extent providing a lesser encroachment into the proposed development area. In undertaking the current assessment, it is assumed that 2D model results provides a better representation of the local floodplain design flood condition and accordingly is considered for the basis of the assessment.

The existing Council model does not extend across the full Site and accordingly, a separate model has been developed for the current assessment to derive design flood conditions.

Model Development

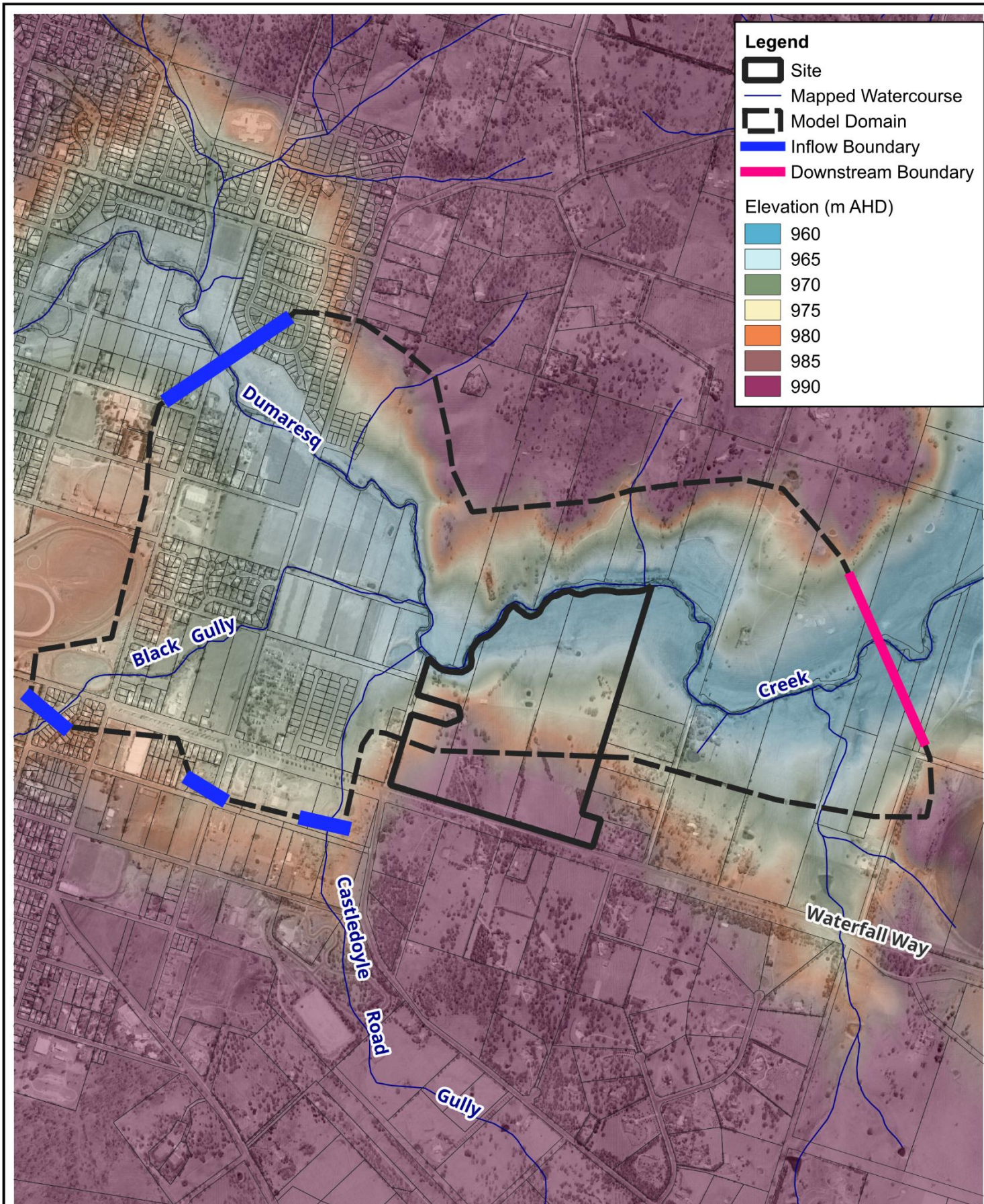
In order to facilitate an appropriate flood risk assessment, a TUFLOW software flood model has been developed to establish design flood conditions across the full Site. The objective of the model development is to replicate Council's existing flood mapping in the Site locality whilst extending the derived flood conditions to cover the full Site area.

The developed model configuration is shown in Figure 3. A summary of the key elements of the model configuration is provided below:

- **Model Extent and Resolution** – The model extents cover a local reach of the Dumaresq Creek floodplain extending from approximately 1.5km upstream of the Site to approximately 1km downstream. The upstream boundary corresponds to a natural floodplain constriction on Dumaresq Creek being a suitable location for inflow definition. The downstream boundary is extended to a sufficient distance to ensure adopted boundary conditions do not influence simulated flood conditions at the Site.
A model grid resolution of 5m was adopted. This resolution is appropriate to model the mainstream flooding along the Dumaresq Creek waterway and interaction with overbank flow in the floodplain.
- **Model Topography** - The ability of the model to provide an accurate representation of the flow distribution on the floodplain ultimately depends upon the quality of the underlying topographic model. The topography is based on NSW Government Spatial Services LiDAR data acquired in 2015 and is provided as a 2 m grid resolution Digital Elevation Model (DEM).

The Site elevations range from around 1000m AHD at the high ground along Waterfall Way to around 960m AHD in the floodplain adjacent to Dumaresq Creek. The topography is representative of the mapped flood inundation extents showing a narrow floodplain width and inundation area on the Site at the western boundary. Moving east through the Site and downstream along Dumaresq Creek broader inundation occurs as the floodplain area widens through the Site.

- **Design Inflows** – The model inflows are dominated by Dumaresq Creek with the adopted minor tributary inflows provided to incorporate some local inflow interaction just upstream of the Site. The peak design flows utilise design inflow hydrographs from Council's existing flood study. The peak design inflows include:
 - Dumaresq Creek – 1% AEP event: 396m³/s, PMF event: 2,934m³/s
 - Combined Tributaries – 1% AEP event: 58m³/s, PMF event: 229m³/s



Title:
TUFLOW Model Configuration

0 400 800 m
approx. scale

Figure: **3** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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- Downstream Boundary – The downstream model boundary represents a free outflow condition using a model derived stage-discharge relationship based on the topographical cross section at the boundary and a nominal hydraulic slope.
- Hydraulic Roughness – The TUFLOW model enables the assignment of different hydraulic roughness zones. The land use in the model domain largely represents the waterway (including riparian corridor) and cleared floodplain. The adopted Manning's 'n' coefficients for hydraulic roughness are 0.04 for the general cleared floodplain and 0.05 for the riparian corridor being consistent with the existing Council flood study.

Design Flood Results

The developed model has been simulated for the 1% AEP and PMF design condition. The model output includes the peak flood inundation extents and levels, peak flood depth, velocity, and flood hazard distributions.

The simulated flood extents provide a reasonable match to Councils existing mapping. It is noted the simulated levels are slightly higher than the Council study results throughout the Site. This is a function of the underlying model topography which shows some discrepancy between the two models. The Council model data set is understood to be based on photogrammetry acquired for the study, with the current assessment utilising the LiDAR data acquired in 2015. A review of these datasets shows that floodplain ground levels are generally higher (up to 0.3m) in the LiDAR which translated to higher peak flood levels. The Council study survey data does not cover the full Site in the current assessment, and accordingly, the LiDAR data is required to cover the full extent of the model domain.

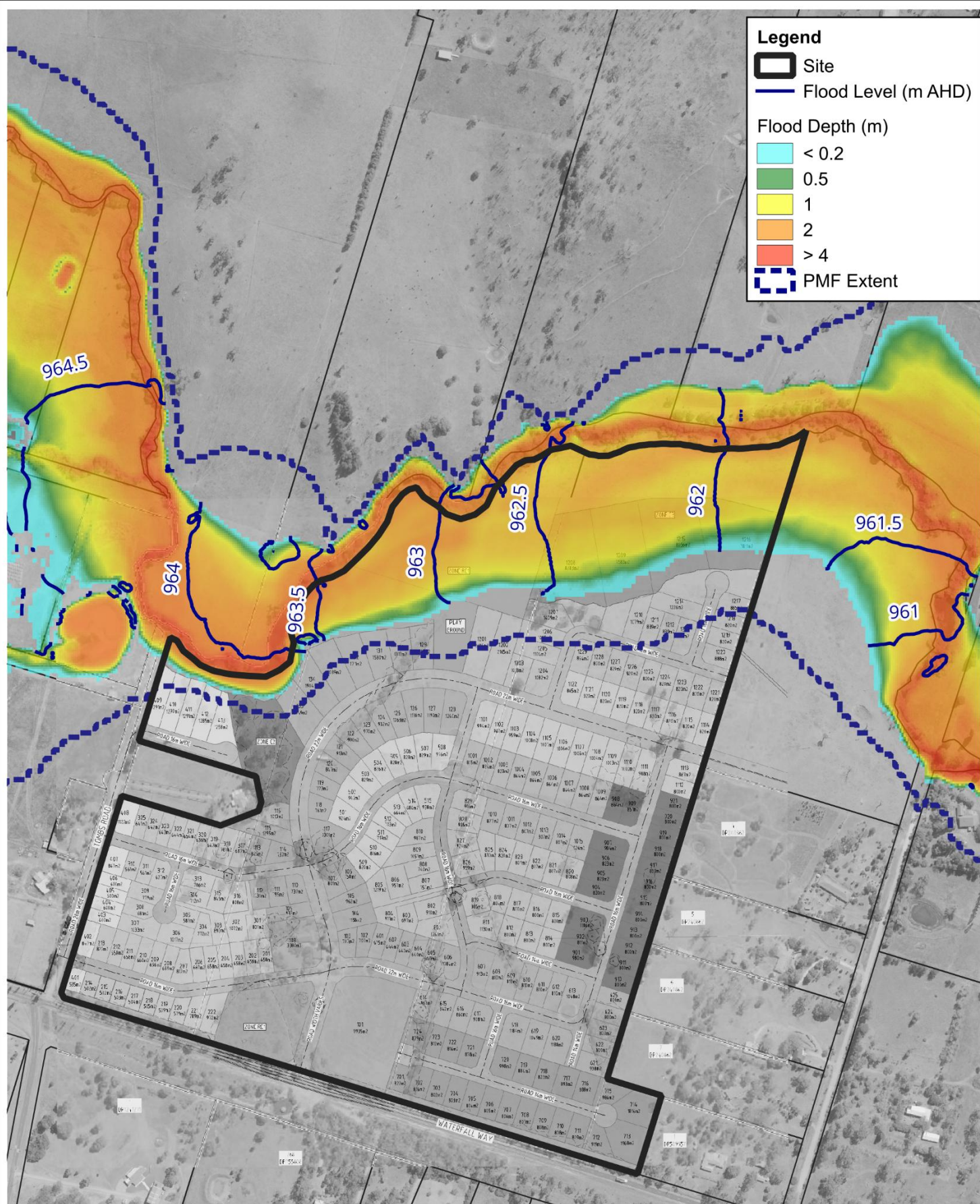
It is not evident which survey data set is more representative of existing ground levels. The higher flood levels mapped in the current assessment may be considered conservative in relation to adopted Council flood planning levels. Notwithstanding, the mapped flood results provide similar representation of the broader flood risk profile for to support the flood planning proposal assessment.

The simulated peak 1% AEP flood depths and inundation extents in the vicinity of the Site are shown in Figure 4 with an overlay of the proposed development layout. The corresponding PMF flood extent is shown for reference. The simulated peak PMF flood depths and inundation extents are shown in detail in Figure 5.

There is a reasonable flood water level gradient across the Site with 1% AEP flood levels varying from ~964.1m AHD at the western (upstream) boundary to ~961.8m AHD at the eastern (downstream) boundary. Similarly, the PMF levels vary from ~968.4m AHD to 964.8m AHD.

Whilst there is broader floodplain inundation in the northern part of the Site towards the Dumaresq Creek alignment, the majority of the proposed development area is outside of the 1% AEP flood extent. There is some partial inundation of some of the lots in the north-western portion of the proposed development fronting the Dumaresq Creek floodplain.

Given the relative steepness of the topography at the edge of the floodplain, there is a limited change in inundation extents between 1% AEP and PMF design flood magnitudes. All of the lots in the proposed lot layout have flood free area above the PMF extent. Accordingly, it can be considered there is no significant change in the overall flood risk profile for the proposed development area for intermediate events between the 1% AEP and PMF events. This may include consideration of climate change for which the 0.5% AEP and 0.2 AEP events are often considered as proxy events depending on the future planning horizon considered.



Title:
Simulated 1% AEP Peak Flood Conditions

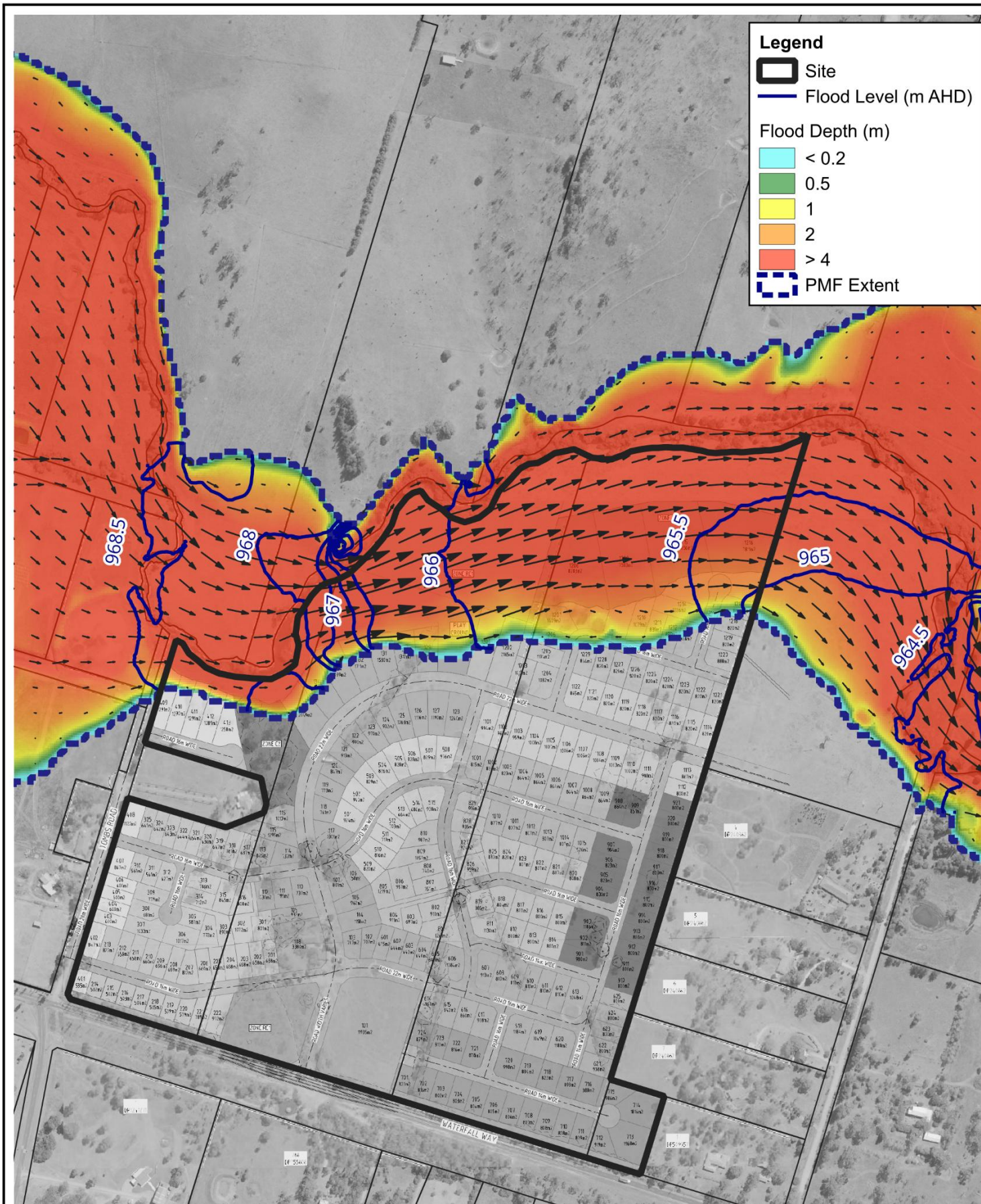
0 100 200 m
approx. scale

Figure: **4** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:
Simulated PMF Peak Flood Conditions

0 100 200 m
approx. scale

Figure: **5** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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The flood hazards have been determined in accordance with Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). The hazard classes relate directly to the potential risk posed to people, vehicles, and buildings, as presented in Figure 6.

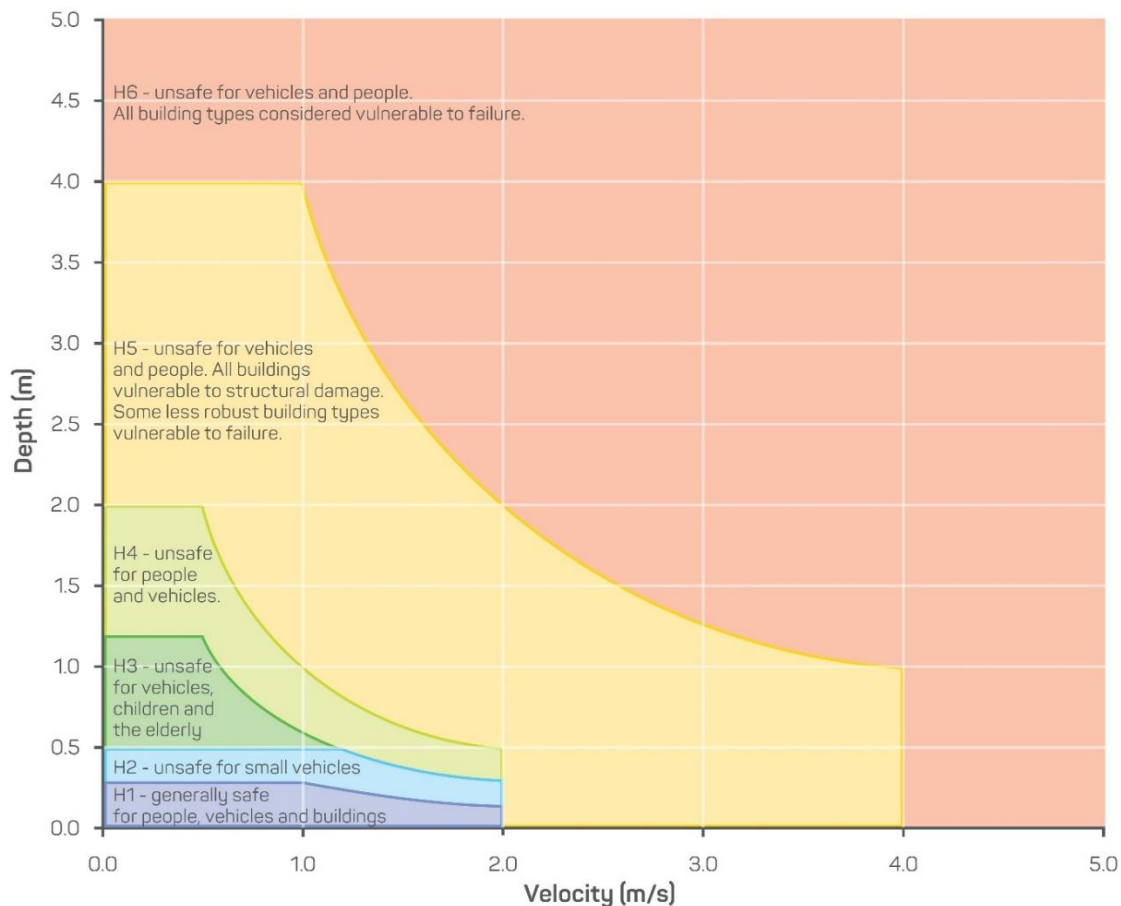
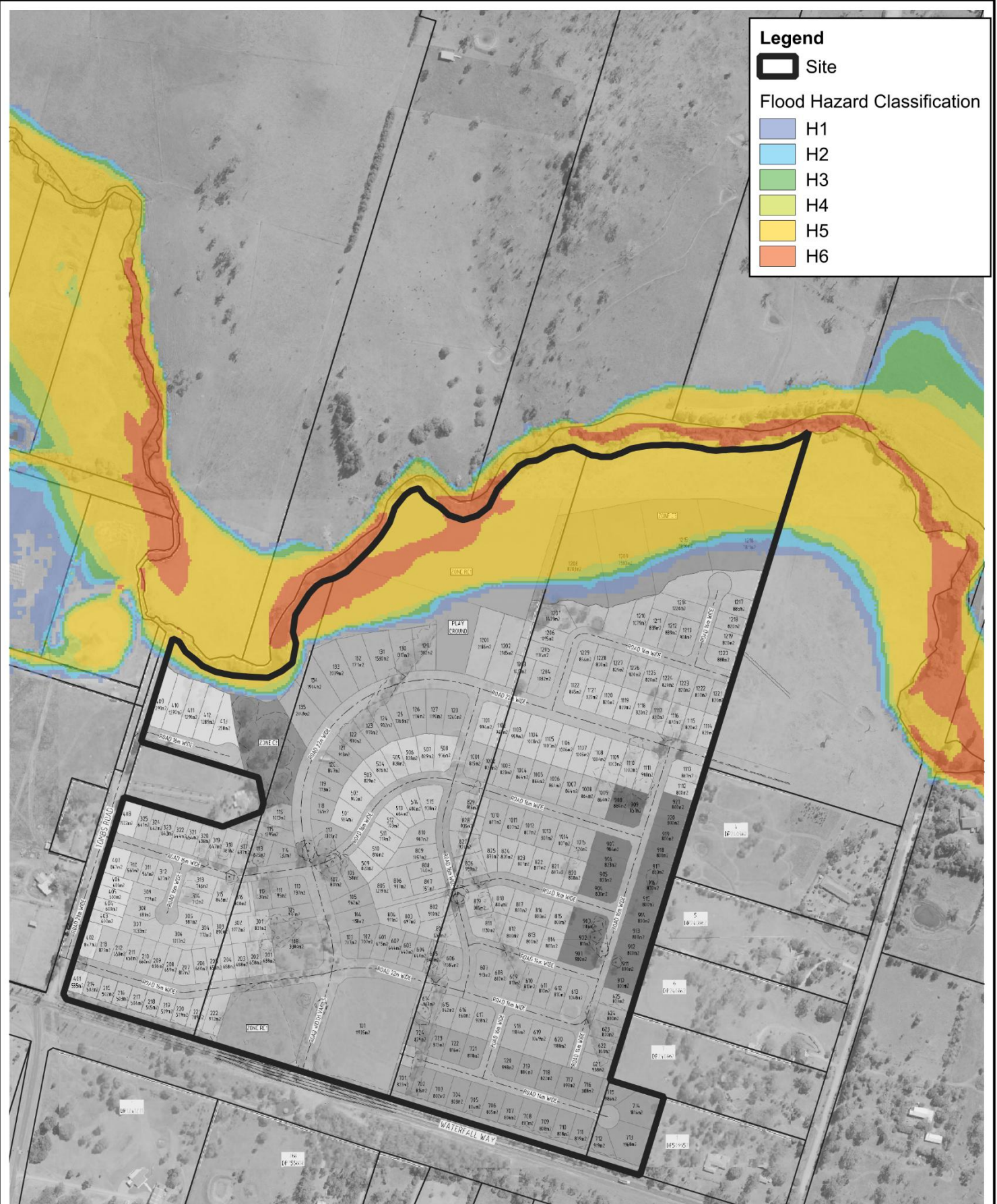


Figure 6 - General Flood Hazard Vulnerability Curves (AIDR, 2017)

The existing 1% AEP and PMF flood hazard distribution is shown in Figure 7 and Figure 8 respectively. The majority of the mainstream flood extents along Dumaresq Creek represent high hazard classes H5 – H6. The limited inundation area within the some of the lots has variable hazard linked to the flood depth, with up to H6 hazard at the PMF level.

All of the lots potentially affected by flooding have flood free area above the PMF level and/or frontage to access roads flood free at the PMF. Accordingly, each of the lots within the proposed layout can be considered to have flood egress route at the PMF.

Flood access to Armidale is westwards along Waterfall Way from the Site. The principal catchment traversed along this route is Black Gully as shown in Figure 1. Castledoyle Road gully is another minor tributary catchment, however, the Black Gully catchment is significantly larger and represents the principal watercourse that may provide for extended period of isolation of the Site from Armidale. The simulated flood level in Black Gully at the upstream side of Waterfall Way is shown in Figure 9 for the 1% AEP, 0.5% AEP, 0.2% AEP and PMF events (based on Council flood study 9-hour durations). The approximate road level of Waterfall Way at the Black Gully crossing is for reference at ~976.6m AHD.



Title:
1% AEP Flood Hazard Classification

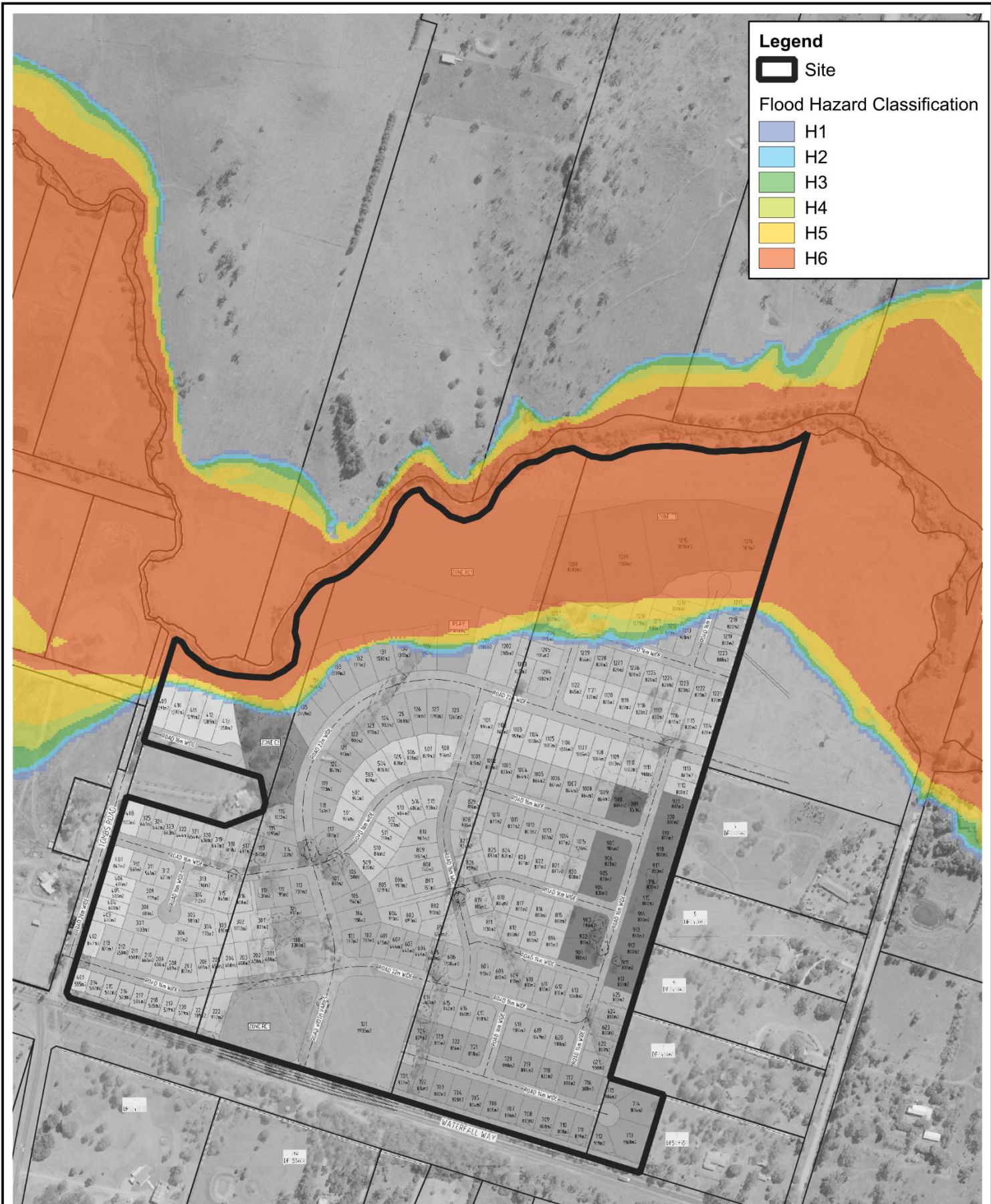
0 100 200 m
approx. scale

Figure: **7** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:
PMF Flood Hazard Classification

0 100 200 m
approx. scale

Figure: **8** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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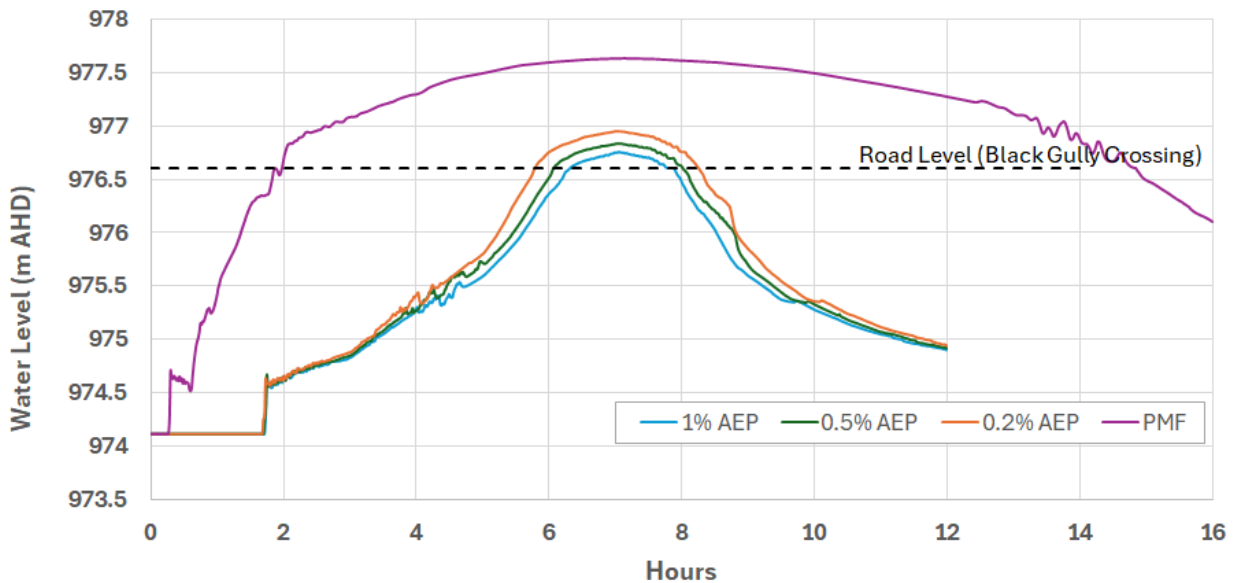


Figure 9 – Flood Level and Duration of Overtopping of Waterfall Way at Black Gully

The simulated flood conditions provided for minor overtopping of Waterfall Way for the 1% AEP 9-hour event with simulated depths over the road carriageway of around 0.2m. In combination with the flow velocity this provides for only H1 hazard classification, such that the road would remain trafficable. This is similarly the case for up to the 0.2% AEP event albeit with slightly higher depths over the road but remaining in the H1-H2 category. The corresponding duration of overtopping is a relatively short period of ~2hours. Accordingly, it is expected the Site has reasonable flood access to Armidale for these events. An extended period of isolation may be anticipated at the PMF level.

Flood Planning Requirements

NSW Planning has prepared a Special Flood Considerations Clause as an optional clause to include in LEPs in order to better protect and manage new development in areas that could be at risk during floods. The Special Flood Considerations clause has not been adopted in the Armidale Regional LEP 2012. Notwithstanding, the flood risk assessment for the planning proposal has considered potential flood risk to future occupation of the floodplain for all events up to and including the PMF event magnitude.

Planning authorities are required to assess planning proposals in accordance with Section 9.1 Ministerial Direction - 4.1 Flooding - for planning proposals that create, remove or alter a zone or a provision that affects flood prone land.

Ministerial Direction 4.1 (the Direction) provides Direction on how to consider flooding implications when considering planning proposals on land identified within a flood planning area or below the probable maximum flood (extreme event).

The objectives of this Direction are as follows:

- a) 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 (replaced by Flood Risk Management Manual 2023), and

- b) ensure that the provisions of an LEP that apply to flood prone land are commensurate with flood behaviour and includes consideration of the potential flood impacts both on and off the subject land.

The controls included the Direction that are relevant to the planning proposal are summarised below with a specific response considering the established flood risk profile for the Site and the proposed development/

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

(a) permit development in floodway areas,

Response: The proposed subdivision plan and lot configuration does not incorporate area that would be defined as floodway in the 1% AEP event. All proposed lots are above the 1% AEP extent.

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

Response: As noted, there is limited flood inundation within proposed lots at the 1% AEP such that future development is unlikely to have any interaction with floodwater at the 1% AEP event. A hypothetical scenario of filling all of the land within the 1% AEP extent has been simulated to consider potential impact. The change in peak 1% AEP flood level for the post-development condition compared to the existing condition is shown in Figure 10. Given the proposed lots are essentially outside the existing 1% AEP extent, no site filling would be required to provide this level of immunity. Only a relatively small volume of fill would be required to provide a higher level flood immunity which is insignificant in relation to the broader floodplain volumes and accordingly there is no corresponding change to existing flood levels adjacent to the Site.

(c) permit development for the purposes of residential accommodation in high hazard areas,

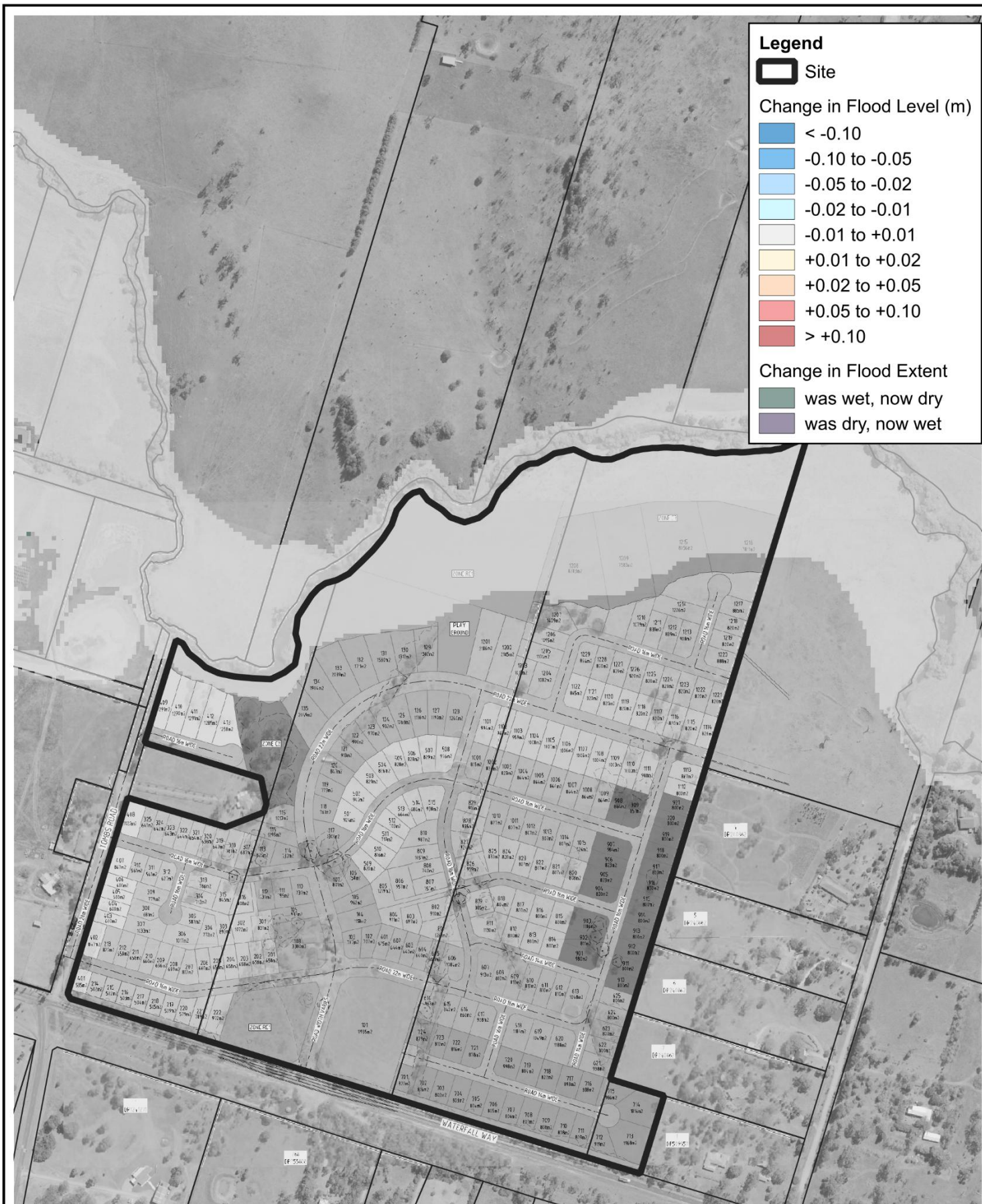
Response: Figure 7 shows the 1% AEP flood hazard classification for the limited flood inundation within the proposed residential lots. On some limited lots there is higher hazard flood conditions up to H4 classification depending on the flood depth at the edge of the floodplain. The majority of the area within the affected lots is flood free providing little constraint to future development infrastructure being located outside inundation extents and high hazard areas.

(d) permit a significant increase in the development and/or dwelling density of that land,

Response: The planning proposal does provide for a modest increase in dwelling density. The increase in density is not considered significant given the limited number of lots within flood prone land. Notwithstanding this increase, all but three (3) lots have area above the PMF level, with all lots having rising egress to flood free land, such that the nominal increase in dwelling density does not significantly increase overall flood risk.

(g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities.

Response: The planning proposal does provide for a modest increase in dwelling density. The increase in density is not considered significant given the limited number of lots within flood prone land. Notwithstanding this increase, all but three (3) lots have area above the PMF level, with all lots having rising egress to flood free land, such that the nominal increase in dwelling density does not significantly increase overall flood risk, and not provide any increase in demand on flood emergency management and response.



Title:

Peak 1% AEP Peak Flood Level Impact Post-Development Conditions

0 100 200 m

approx. scale

Figure: **10** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Note the other Directions 3(e), 3(f) and 3(h) are not relevant to the planning proposal.

The Direction notes that a planning proposal may be inconsistent with this direction only if the planning proposal authority can satisfy the Planning Secretary (or their nominee) that:

- (a) the planning proposal is in accordance with a floodplain risk management study or plan adopted by the relevant council in accordance with the principles and guidelines of the Floodplain Development Manual 2005 (replaced by Flood Risk Management Manual 2023), or
- (b) where there is no council adopted floodplain risk management study or plan, the planning proposal is consistent with the flood study adopted by the council prepared in accordance with the principles of the Floodplain Development Manual 2005 (replaced by Flood Risk Management Manual 2023) or
- (c) the planning proposal is supported by a flood and risk impact assessment accepted by the relevant planning authority and is prepared in accordance with the principles of the Floodplain Development Manual 2005 (replaced by Flood Risk Management Manual 2023) and consistent with the relevant planning authorities' requirements, or
- (d) the provisions of the planning proposal that are inconsistent are of minor significance as determined by the relevant planning authority.

The responses above to the planning directions consider the planning proposal to be consistent with the Direction. Notwithstanding, any inconsistencies such as development density are considered of minor significance given the low overall flood risk profile of the Site. The flood modelling and risk assessment undertaken is consistent with Council's existing flood planning information and the principles of the Flood Risk Management Manual 2023.

We trust that this letter report meets your requirements. For further information or clarification please contact the undersigned.

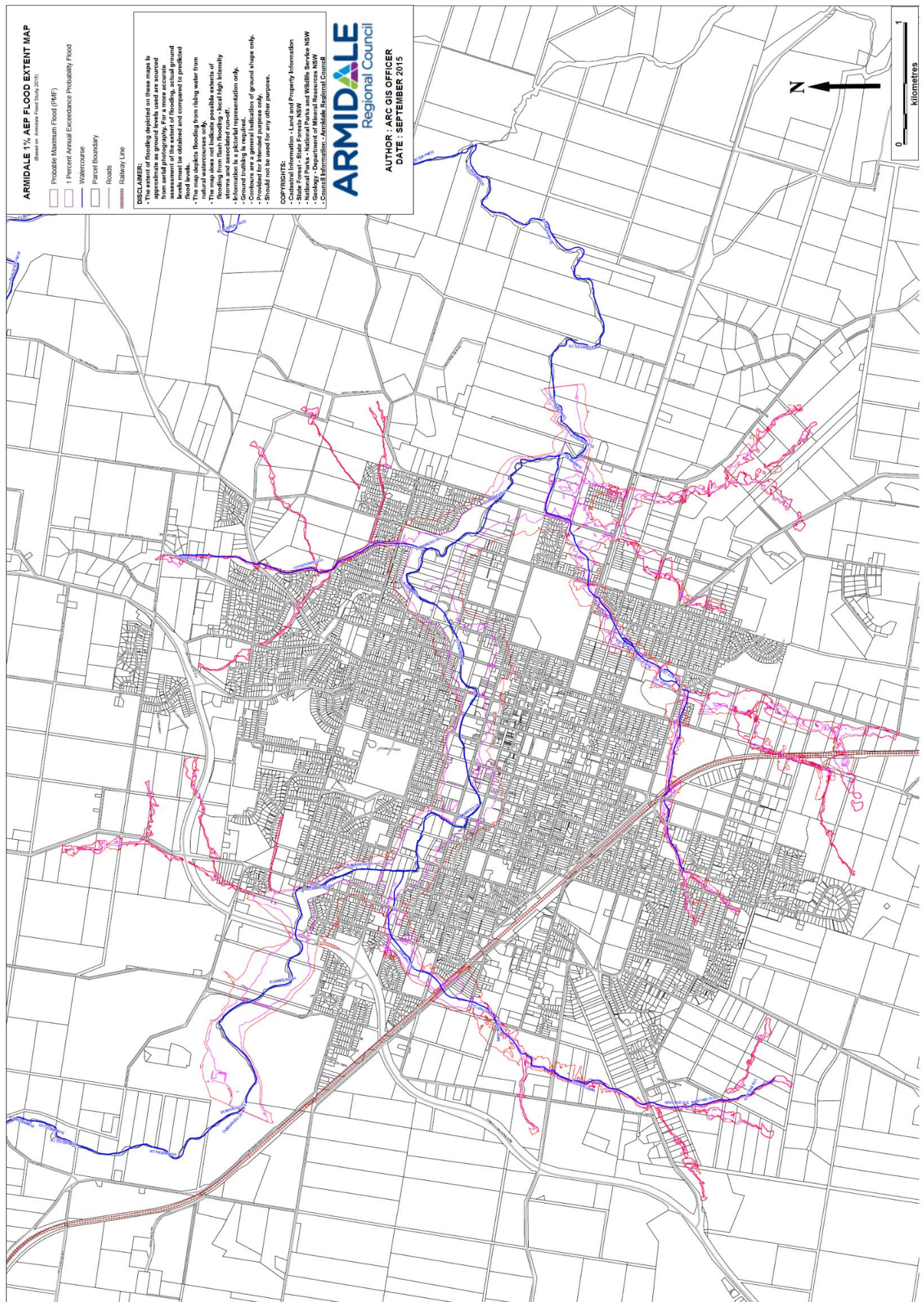
Yours faithfully

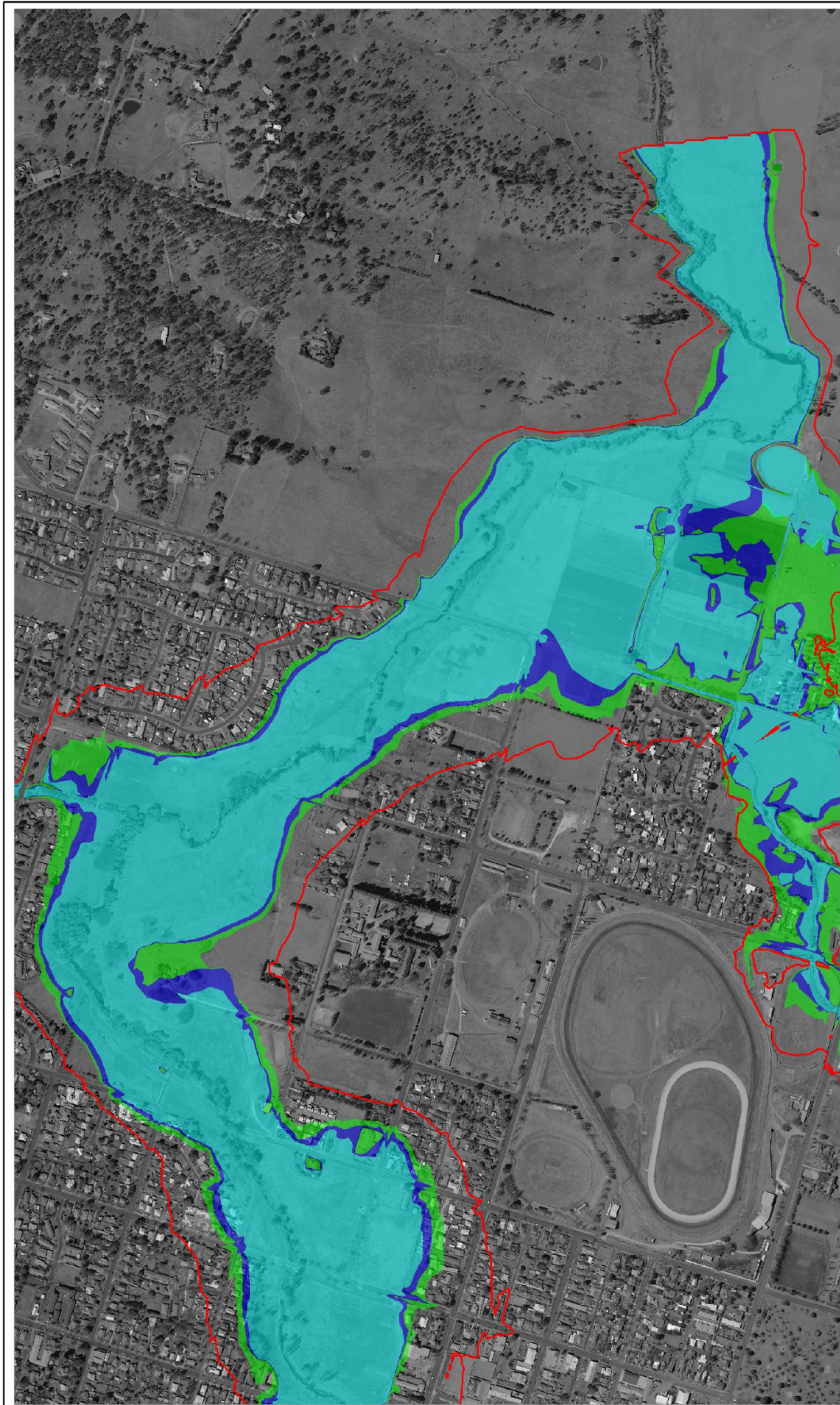
Torrent Consulting



Darren Lyons
Principal Water Resources Engineer
CPEng MIEAust RPEQ

Appendix A – Council Flood Mapping





Title: Dumaresq Creek Flood Map Sheet C		Figure: FM/DC/C	Rev: A
BUT WBM undertakes 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.			
LEGEND ■ Flood Planning Level Extent ■ 20 Year Flood Extent ■ 100 Year Flood Extent ■ PMF Flood Extent			
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