Bega Circulatory Centre

Flood Impact and Risk Assessment

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Executive Summary

This National Circulatory Centre Flood Impact and Risk Assessment (FIRA) has been prepared for the Regional Circularity Cooperative Limited to define the existing flood behaviour in the catchment and to assess, and address, if necessary, the potential impacts arising from the future development of the site.

Development Proposal

Bega Group, with funding support from the NSW Government, is proposing to develop a portion of their North Bega site with a new community information and function centre. The site is currently vacant. It has previously been filled to a level comparable to the adjacent Lagoon Street levels.

The proposed development is comprised of:

- Heritage, history, and education exhibits;
- Restaurant;
- Tourist Information;
- Gift Shop;
- Museum;
- Function space; and,
- Associated storage, facilities, and parking.

Flood Risk

The study area is affected by both riverine and local catchment flooding. Existing flood behaviour from both mechanisms has been assessed in this FIRA.

The site is affected by backwater flooding from the Bega River. In riverine flood events, flood water fills the local depression to the east of the site. As flood levels rise, flood water spills west from this depression across the site. Further increases in flood levels result in the overtopping of first Lagoon Street, and then the Princes Highway. The site is first inundated in the 1% AEP by riverine flooding. Depths over the site remain modest in the 0.2% AEP (generally 0.3 – 0.4m). However, the PMF levels are significantly higher, with depths over the site increasing to 6.5m.

Flooding driven by rainfall on the local catchment in North Bega results in a single primary flowpath that runs from the pasture and open space regions in the west, through the timber yard in the industrial area, to the culverts under the Princes Highway. The highway effectively creates a detention basin. Between the highway and Lagoon Street is another storage area formed by Lagoon Street. There is overtopping on Lagoon Street at the low point when the storage capacity is exceeded, as well as at a second low point at the southern end of the site. In the 1% AEP, this overtopping is limited to the low point in the road. In the PMF, the overtopping is more extensive, with flow occurring across the full length of Lagoon Street adjacent to the site. In the 1% AEP, all flow across the site is classed as H1 hazard. In the PMF event, hazard increases H2 across the site, with some minor areas of H3 at the centre of the flow path across the site.

Response to Flood Risk

A raised building pad was determined to be the primary means by which flood risk could be managed on site as this design approach seeks to provide a level of flood protection for the proposed development for both local catchment and riverine flood events.

The raised pad is proposed to be set at the FPL of 16.4mAHD, which was determined to be the riverine 1% AEP flood level plus 0.5m. The riverine 1% AEP had a higher level across the site than the local catchment 1% AEP and was therefore adopted as the basis for the FPL.

For local flood events, the raised building pad was sufficient to prevent local catchment flooding across the site for all events, up to and including the PMF event.

The landform incorporated an overland flowpath to allow the conveyance of local catchment flows through the site. The flowpath was located within a proposed vegetated area of the site design and incorporated the adjacent car park.

Overland flow that overtops Lagoon Street is diverted to an overland flowpath provided through a vegetated region of the site. In the 1% AEP event, flow through this overland flow path is minor with depths of up to 0.03m and a hazard classification of H1. All flows are fully contained within the vegetated corridor of the proposed design. In the PMF event, depths through the overland flowpath increase to 0.7m, and the hazard increases to H4.

In achieving flood mitigation through site raising, no significant flood impacts result on adjacent properties.

Emergency Response

The subject site is affected by both riverine flooding and local catchment flooding. These two flooding mechanisms present different risk profiles, and consequently require different emergency responses.

The emergency response strategy for the site is based on:

- Evacuation for riverine flood events, due both to the available warning time, and the significant flood depths and flood hazard present across the site in the PMF event; and,
- Shelter in place for local catchment floods, due to the flood immunity provided by the raised pad, and the short duration of this flood mechanism.

Residual Risk

It is important to note that, despite the proposed site design to reduce flood risk, the site has a residual risk in events greater than the 1% AEP event. Significant residual risk in present in the Bega River PMF event with flood depths over the site of 5.8m. These depths cannot be dealt with through site design and will remain present for the life of the development. This residual risk applies to both risk to life and risk to property.

The emergency response arrangement proposed in this FIRA have been developed to address the residual risk to life.

Flood risk to the property and its content will always remain. Whilst these risks can be mitigated to some extent by the incorporation of flood resilient building techniques, the fact remains that events larger than a 1% AEP event may cause some degree of damage to the property and contents, and a PMF event is expected to result in significant damage to the structure and loss of contents. This risk needs to be considered when making decisions on the suitability of building materials and the storage / display of irreplaceable art or cultural objects within the proposed development.

Policy and Planning Review

Within the study area, development is largely controlled through the Bega Valley Local Environmental Plan 2013 (SLEP 2013) and Bega Valley Development Control Plan (DCP) 2013.

In addition to Council Plans, the Minister for Planning can issue Ministerial Directions to issues directions to planning authorities about the preparation of planning schemes and amendments to planning schemes.

A review of the proposed development has been undertaken to determine if the proposed development is in accordance with these flood-related development controls. The review found that the proposed development was aligned with all flood related development controls and the requirements of the Local Planning Direction 4.1.

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1 Introduction

The National Circulatory Centre Flood Impact and Risk Assessment (FIRA) has been prepared for the Regional Circularity Cooperative Limited to define the existing flood behaviour in the catchment and to assess, and address, if necessary, the potential impacts arising from the future development of the site.

This report has been prepared to provide the flood assessment associated with a Planning Proposal for the site, and in doing so considers Local Planning Direction 4.1 Flooding (March 2022).

1.1 Study Area

The study area, comprising the site and its catchment and adjoining areas, is in North Bega, immediately north of the Princes Highway crossing of the Bega River. The site lies on Lagoon Street, bounded by Bridge Street to the north and Ridge Street to the south.

The site is currently vacant. It has previously been filled to a level comparable to the adjacent Lagoon Street levels.

South-east of the site is an industrial zone managed by Bega Cheese. West of the site, on the opposite side of the Princes Highway is a larger industrial precinct comprised of several businesses, including a timber yard, car repairs, steel supplies, plumbing supplies, and a motorcycle dealership.

The site is adjacent to the Bega River and is subject to flooding from both local catchment flows and riverine flooding.

The study area is shown in **Figure 1-1**.

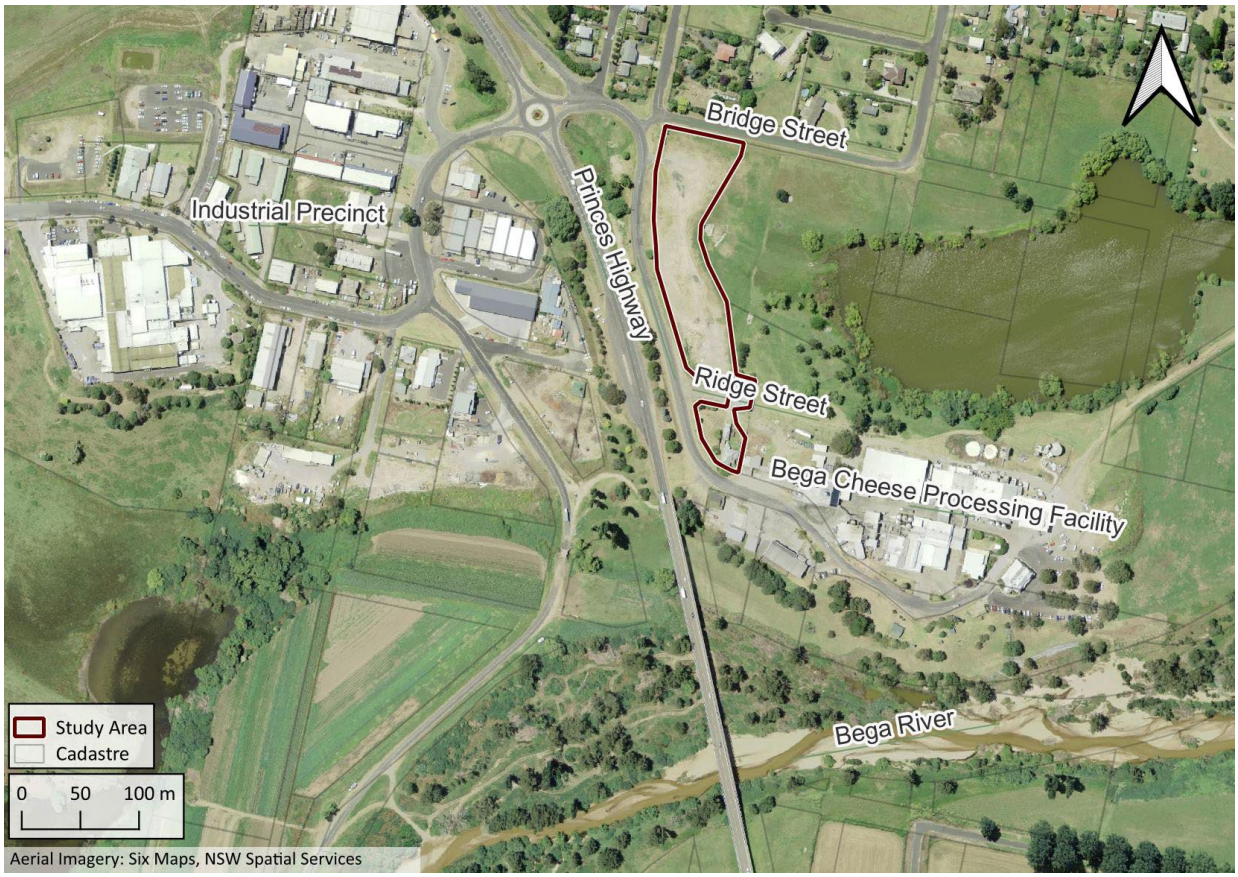

Figure 1-1 Study Area

1.2 Study Background and Context

Bega Group, with funding support from the NSW Government, is proposing to develop a portion of their North Bega site with a new community information and function centre. The development is comprised of:

- Heritage, history, and education exhibits;
- Restaurant;
- Tourist Information;
- Gift Shop;
- Museum;
- Function space; and,
- Associated storage, facilities, and parking.

A preliminary rendering of the proposed development is shown in **Figure 1-2**.

A Planning Proposal was submitted for the development, at which stage comments were raised by Department of Planning and Environment (DPE) as to potential flood risks to occupants and infrastructure. The Planning Proposal was subsequently rejected due to uncertainties about the level of flood risk and its management.

To investigate these concerns, this Flood Impact and Risk Assessment (FIRA) was prepared.

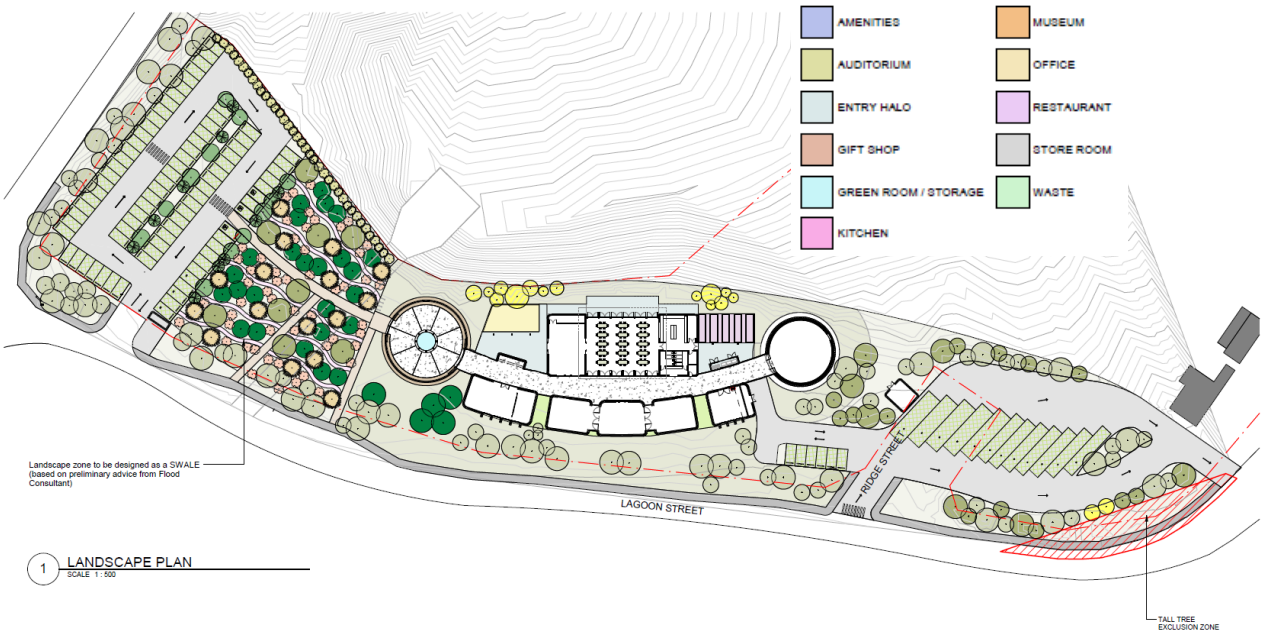

Figure 1-2 Proposed Development (Cox Architecture, 10/07/2023, drawing DA-2001)

1.3 Study Objectives

This FIRA has been prepared in line with the requirements set out in *Flood Impact and Risk Assessment: Flood Risk Management Guide LU01*, prepared by DPE as an accompanying guide to the recently

released Flood Risk Management Manual (State of NSW and Department of Planning and Environment, 2023).

The guideline states that the aim of a FIRA is to:

…support a development proposal to identify and analyse:

- *The impacts of the proposed development on the flood risk to the existing community*
- *The impacts and risks of flooding on the development and its users*
- *How these impacts can be managed to minimise the growth in risk to the community due to the development.*

To demonstrate that the design appropriately addresses and manages flood risk across the site for the purpose of a Planning Proposal, the outcomes and recommendations from this FIRA have been assessed against the requirements of Ministerial Direction 4.1, as well as relevant Council planning controls.

2 Review of Available Data

2.1 Previous Studies and Reports

The Bega and Brogo Rivers Floodplain Risk Management Study and Plan (Cardno, 2018) covers the study area. Modelling was undertaken using RAFTS for the hydrological model and TUFLOW for the hydraulic model.

The study defined flood behaviour for the 10%, 5%, 2%, 1% and 0.2% AEP events and the PMF event.

The study has been used to define the existing riverine flood behaviour, and the TUFLOW model used to assess the flood performance of the proposed development scenario. The only change made to the prior model was the incorporation of revised site survey, to incorporate filling that had been undertaken since the Bega and Brogo River FRMSP had been undertaken. All other aspects of the model remained as per the FRMSP.

No prior studies have been undertaken for local catchment flooding and overland flow.

2.2 Survey Information

2.2.1 LiDAR Data

A 1m DEM and point cloud data was available for the study area via the Foundation Spatial Data Framework's online portal, ELVIS (Elevation and Depth Foundation Spatial Data), available from http://elevation.fsdf.org.au/.

While the 1m DEM is of sufficient resolution for most modelling requirements, the point cloud data can be useful to ensure that terrain features such as retaining walls, or items with sub-metre sizes are appropriately included in the terrain model.

2.2.2 Ground Survey

Ground survey was collected across the site on 17 June 2021, and supplied to Rhelm on 25 August 2023 (73265CD.dwg).

The survey included ground level contours across the site, lot boundaries, drainage easements, and existing building footprints adjacent to the site.

2.3 Drainage Information

Drainage data for the major culverts was supplied on 31 August 2023, with data being provided for:

- Culvert locations and levels, as provided on the Construction Certificate plans (dated 11 August 2010); and,
- Photographs of culvert inlets and outlets, collected on 31 August 2023. Photographs of the inlets of the highway culvert and site culverts banks are shown in **Figure 2-1**.

2.4 GIS Data

Digitally available information such as cadastral boundaries, watercourses, land zoning, vegetation communities and drainage easements were sourced from NSW SIX Maps (https://maps.six.nsw.gov.au/clipnship.html).

2.5 Design Information

A preliminary landscape plan was provided by COX Architecture on 7 September 2023.

The plan is shown below in **Figure 2-2**.

Figure 2-1 Culvert Photographs (Highway inlet left; site inlet, right)

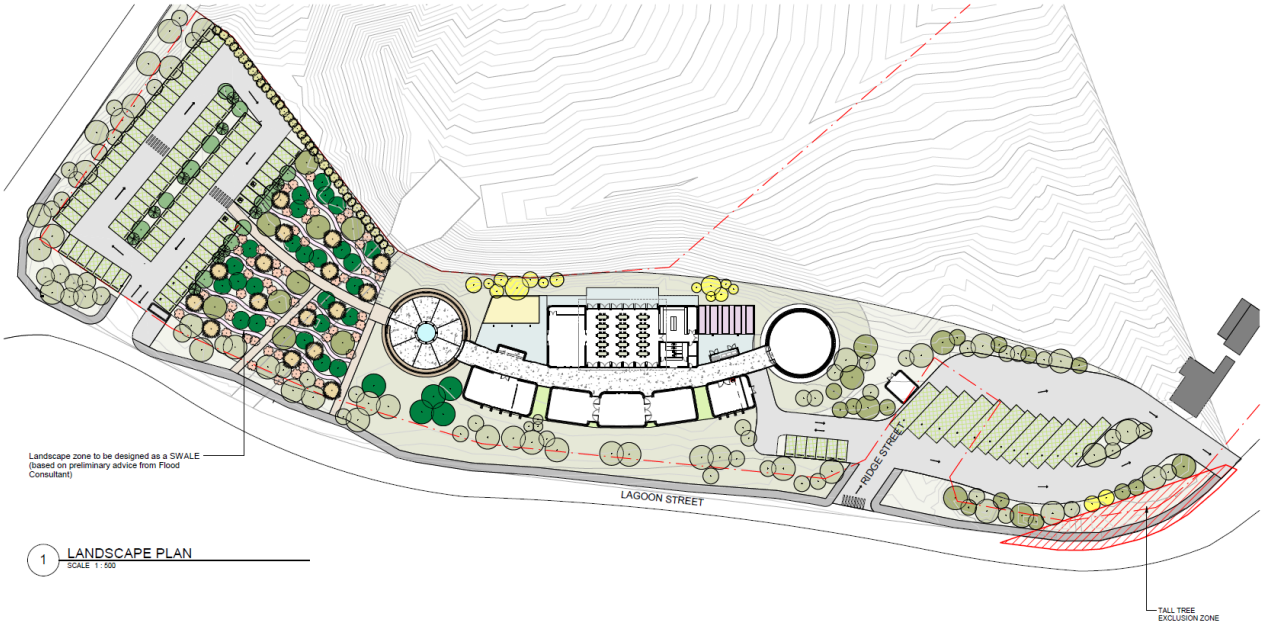

Figure 2-2 Proposed Development (Cox Architecture, 10/07/2023, drawing DA-2001)

3 Local Flood Model Development

3.1 Modelling Approach

The site is affected by flooding from both the Bega River and the local catchment.

The flood behaviour of the Bega River is defined by the *Bega River Floodplain Risk Management Study* (Cardno, 2018). Data and models from the Floodplain Risk Management Study has been used to define the flood behaviour arising from riverine flooding.

To assess the local catchment flood behaviour, a local hydrological and hydraulic model has been developed. The development of these models is described in the following sections.

3.2 DEM Development

A Digital Elevation Model (DEM) has been developed for input into the local catchment hydraulic model. This DEM is based on the survey data collected, including the LiDAR and ground survey.

One of the important components in the development of hydraulic models is to ensure that key hydraulic controls and features are defined appropriately within the DEM. This includes features such as embankment crest details, road levels where roads overtop etc. These have been incorporated where appropriate with breaklines and other features in TUFLOW.

The DEM developed for the local catchment model is shown in **Figure 3-1**. The DEM indicated that the upstream catchment of the site is relatively modest, with a total upstream catchment area of 47ha.

There is a ridge line immediately north of the site, the diverts northern runoff around the site. South of the site, there is a tributary of the Bega River, which collects the majority of runoff from the western catchment. There is a small ridge immediately west of the catchment. The only runoff that reaches the site is from rainfall that falls between this small ridge, and the larger ridge to the north.

3.3 Hydrological Model Development

Hydrological modelling for the local catchment area has been completed using the hydrological model WBNM. The upstream subcatchment delineation is shown in **Figure 3-2**.

The hydrology has been based on Australian Rainfall and Runoff 1987 (ARR2087), as this was the rainfall methodology adopted in the Bega and Brogo Rivers Floodplain Risk Management Study and allows for consistency between the two.

Inputs to the model and the data sources for those inputs are summarised in **Table 3-1**.

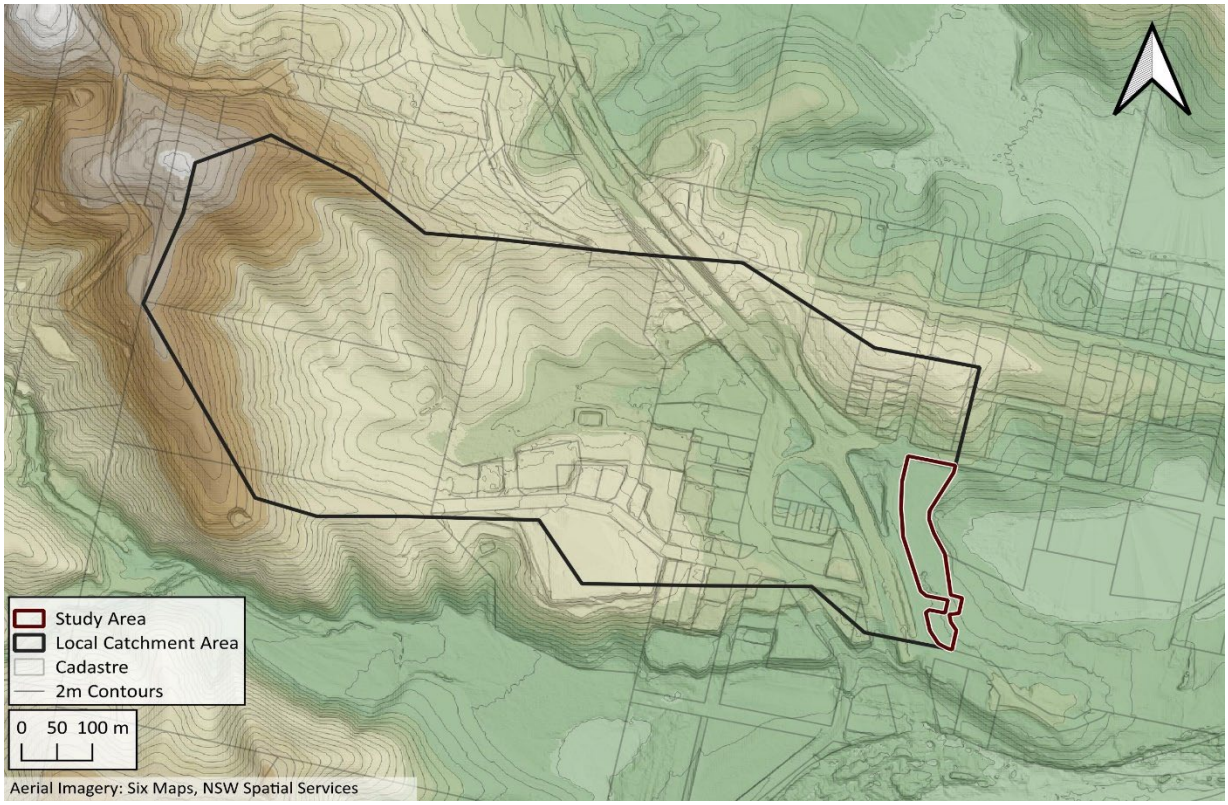

Figure 3-1 Study DEM

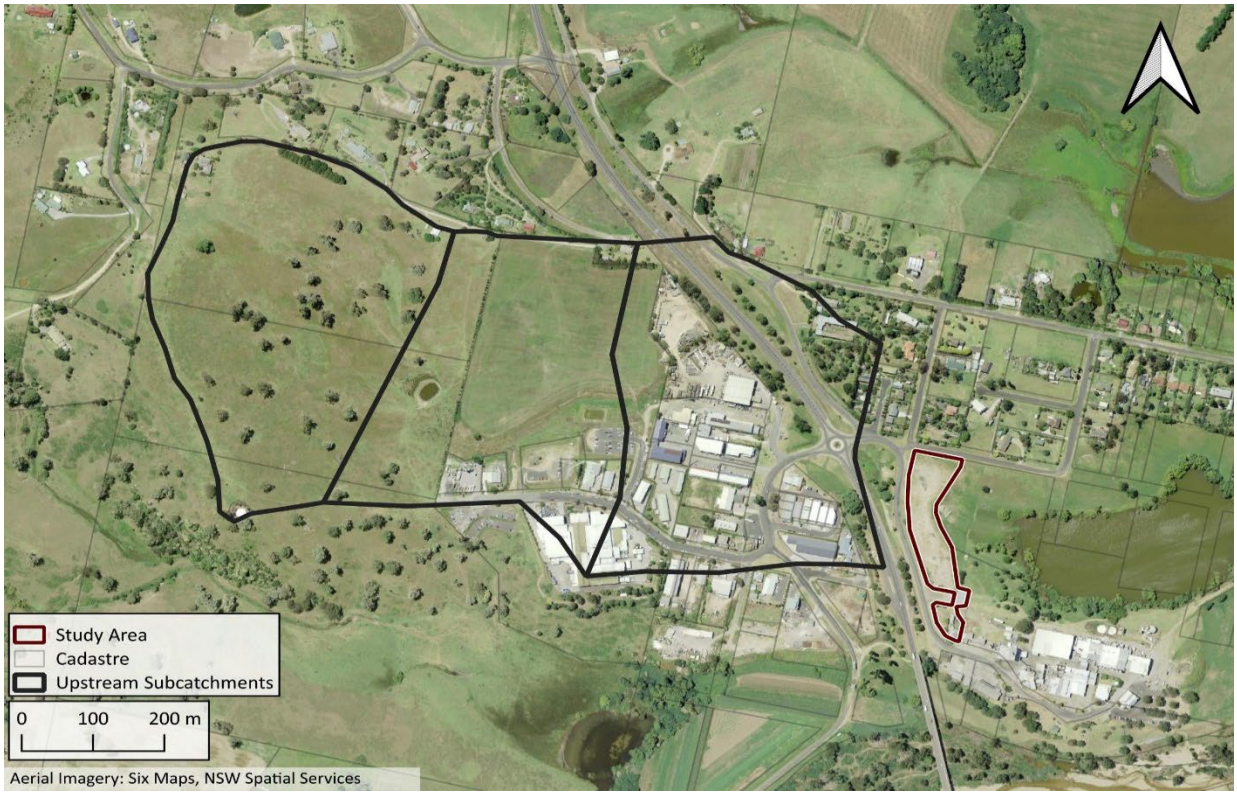

Figure 3-2 WBNM Upstream Subcatchments

Table 3-1 Hydrological Model Input Data

Parameter	Data Source
Sub-catchment extent and area	LiDAR data is available for full catchment and was used for this mapping for the base case local catchment modelling.
Percentage impervious	Percentage impervious areas are largely a factor of development intensity and were determined from aerial imagery. High resolution aerial imagery has been sourced from NearMap (September, 2023). Percentage impervious rates were assumed to be: • 95% for industrial land uses; • 90% for road reserves; • 60% for residential lots; and, • 1% for open space land uses.
Roughness and Runoff Routing	Roughness parameters influence how quickly runoff occurs in a sub-catchment. Routing refers to the transfer of flows from one sub-catchment to another. WBNM manages both these factors through a single model parameter, 'C'. WBNM guidance is that unless site specific calibration data is available, then the 'C' parameter should be set at 1.6. We have adopted this value for the local catchment modelling, as site specific calibration data is no available.
Rainfall losses	Rainfall losses have been adopted as per the wider Bega and Brogo River Floodplain Risk Management Study and Plan to ensure consistency between the studies. These values are: • Initial Loss = 20mm / 2mm (pervious / impervious) • Continuing Loss = 2.5mm / 0mm (pervious / impervious)

3.4 Hydraulic Model Development

Hydraulic modelling was undertaken in TUFLOW. Model features are illustrated in **Figure 3-3**, and discussed in detail below.

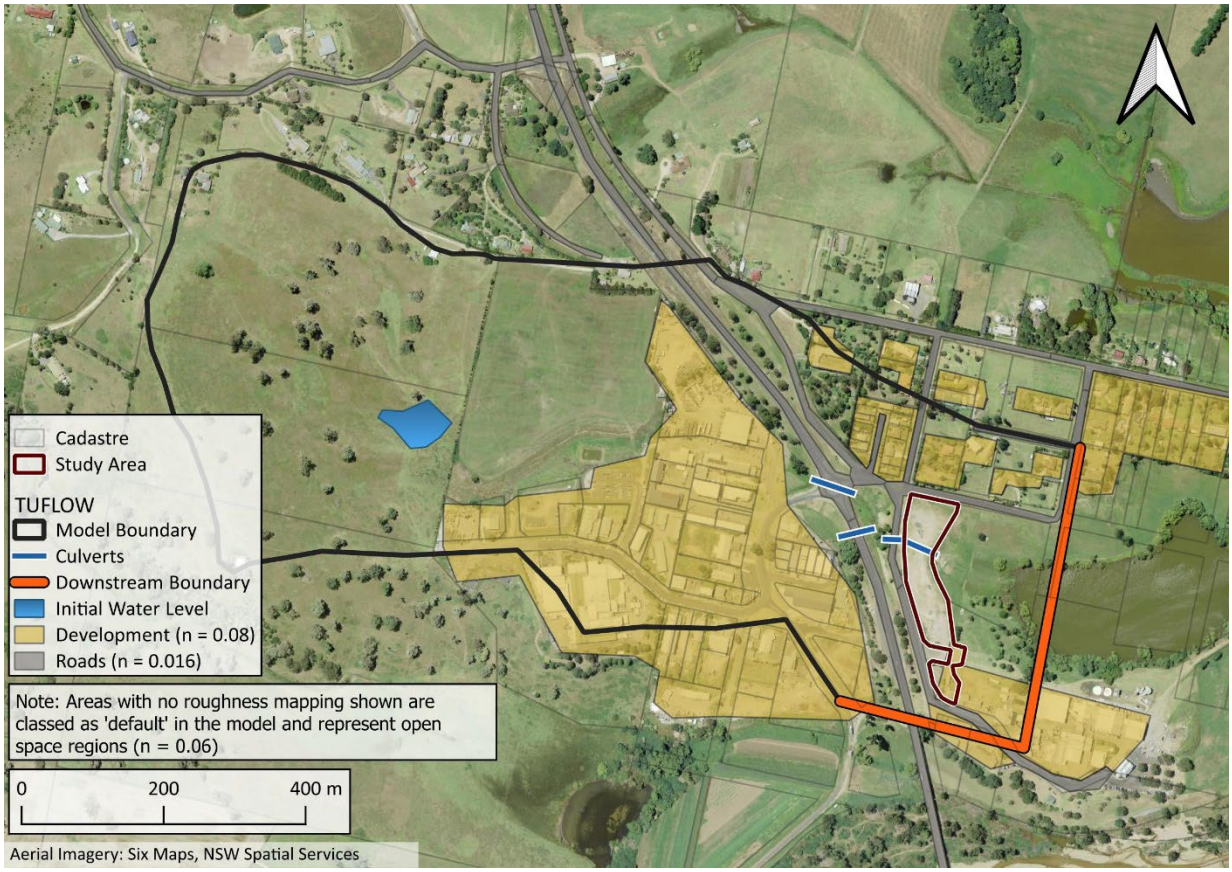

Figure 3-3 TUFLOW Model Layout

3.4.1 Model Area

The full upstream catchment area has been included in the hydraulic model. This was feasible due to the relatively small size of the catchment.

3.4.2 Grid Cell Resolution

The study area required a grid cell resolution fine enough to appropriately define flood risk. A grid cell of 2 metres was adopted which provided a reasonable balance between run times and representation of flood behaviour.

3.4.3 Buildings

Buildings have been incorporated into the model by lot-averaged roughness for developed areas. This approach was adopted to remain consistent with the Bega and Brogo Rivers Floodplain Risk Management Study which utilised the same methodology.

3.4.4 1D Components

Major culverts have been included in the model, specifically:

- 3 x 1m diameter pipes under the roundabout on the Princes Highway;
- A smaller single 0.15m diameter pipe under the highway south of the roundabout;
- 3 x 1m diameter pipes, transitioning to 2 x 1.2m pipes under the study site.

Stormwater drainage has not been incorporated into the model. This approach provides a conservative estimate of overland flooding, as it assumes that the stormwater network is fully blocked.

3.4.5 Blockage

Blockage rates for the culverts was determined based on the guidelines in ARR2019.

A summary of the blockage rates assumed for each culvert are provided in **Table 3-2**.

It is noted that blockage assumptions have the potential to significantly alter the flood behaviour of the site.

Blockage sensitivity testing was undertaken (refer **Section 5.6**) examining:

- A fully blocked scenario;
- A fully unblocked scenario; and,
- A critical blockage scenario, with blockage applied to the downstream culverts only.

Table 3-2 Adopted Blockage Rates

Culvert	Blockage Risk from ARR2019	1% AEP Blockage Rate	PMF Blockage Rate
Princes Highway Culverts (3 x 1m)	High	100%	100%
Princes Highway Relief Culvert (0.15m)	High	100%	100%
Upstream site culvers (3 x 1m)	Medium (1% AEP) High (PMF)	50%	100%

3.4.6 Roughness

Roughness values and extents were taken from the Bega and Brogo Rivers Floodplain Risk Management Study. The values adopted are summarised in **Table 3-3**.

Table 3-3 Adopted Roughness Values

Land Use	Manning's 'n'
Open space	0.06
Medium Vegetation	0.06
Dense vegetation	0.18
Roads / Carparks	0.016
Development	0.08

3.4.7 Inflows

Inflows were applied to the model via SA polygons which apply flows to the lowest cell within the polygon. The polygons used were as per the subcatchment breakdown shown in **Figure 3-2**.

Inflow hydrographs were taken from the WBNM model.

Hydrographs for the critical durations for the 10% AEP, 1% AEP and PMF immediately upstream of the site are shown in **Figure 3-4**.

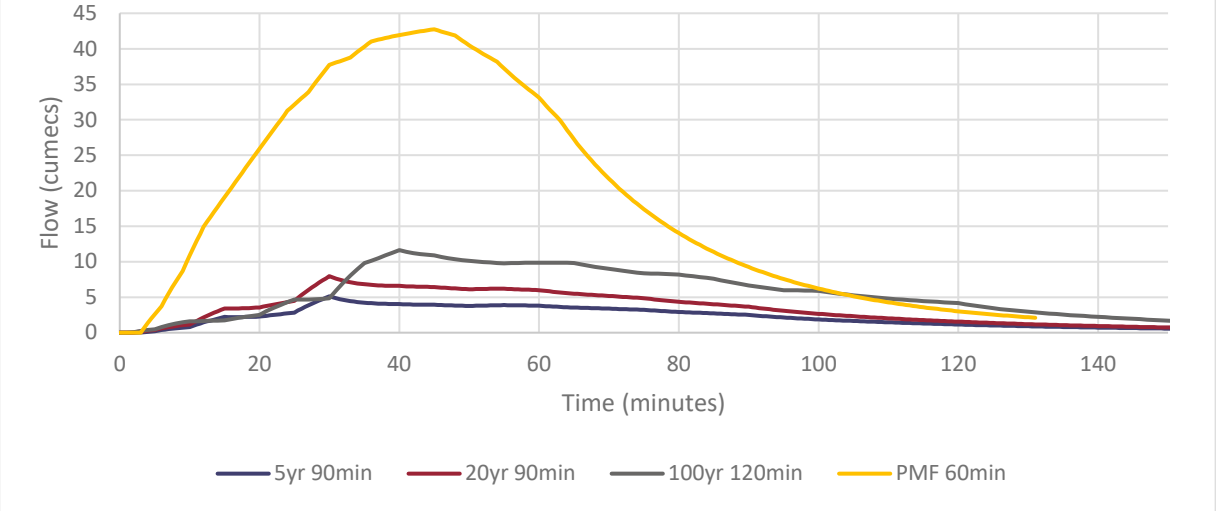

Figure 3-4 Plot of total hydrographs immediately upstream of the site

3.4.8 Downstream Boundary Conditions

The downstream boundary of the model runs along the eastern and southern boundaries of the TUFLOW model. The eastern boundary is the major outlet. The smaller boundary on the southern edge of the model is to allow flows running along the edge of the Princes Highway to discharge from the model.

3.4.9 Initial Water Levels

A single farm dam was identified in the upper reaches of the local catchment. An initial water level of 29.2mAHD was adopted for this dam, which was the level of the dam embankment, and ensures that the dam is at full capacity at the start of the flood events.

3.5 Climate Change

Climate change has not been explicitly included in the models. However, modelling has been undertaken using the ARR87 rainfall methodology, in line with the adopted Bega and Brogo Rivers FRMSP (Cardno, 2018). Council's draft Flood Risk Policy (2023) considers the use of ARR87 a suitable proxy for 2100 rainfall increases.

Furthermore, the adopted FMRSP demonstrated that a sea level rise of 0.9m only resulted in a 0.01m change in peak levels at Bega in the 1% AEP event.

As such, the models used in the study may be considered to appropriately allow for 2100 climate conditions.

4 Existing Flood Behaviour

The study area is affected by both riverine and local catchment flooding. Existing flood behaviour from both mechanisms are discussed below.

4.1 Existing Flood Behaviour – Riverine

The site is affected by backwater flooding from the Bega River. In riverine flood events, flood water fills the local depression to the east of the site. As flood levels rise, flood water spills west from this depression across the site. Further increases in flood levels result in the overtopping of first Lagoon Street, and then the Princes Highway.

A long section through the site, incorporating the existing site filling, is shown in **Figure 4-1** along with peak design event water levels from the Bega and Brogo Rivers FRMSP.

A flood extent map showing the 2%, 1% and 0.2% AEP and PMF riverine flood extents for the existing scenario is shown in **Figure 4-2**.

The results show that the site is first inundated in the 1% AEP by riverine flooding. Depths over the site remain modest in the 0.2% AEP (generally 0.3 – 0.4m). However, in the PMF, there is a significant increase in flood levels, with depths over the site increasing to 6.5m.

The hazard across the site is driven by these flood depths, as velocities are less than 0.5m/s for all events including the PMF, due to the backwater nature of the flood behaviour.

For the 1% AEP and 0.2% AEP, flood hazard is typically low (H1 and H2). The hazard increases to H6 in the PMF due to the significant depth.

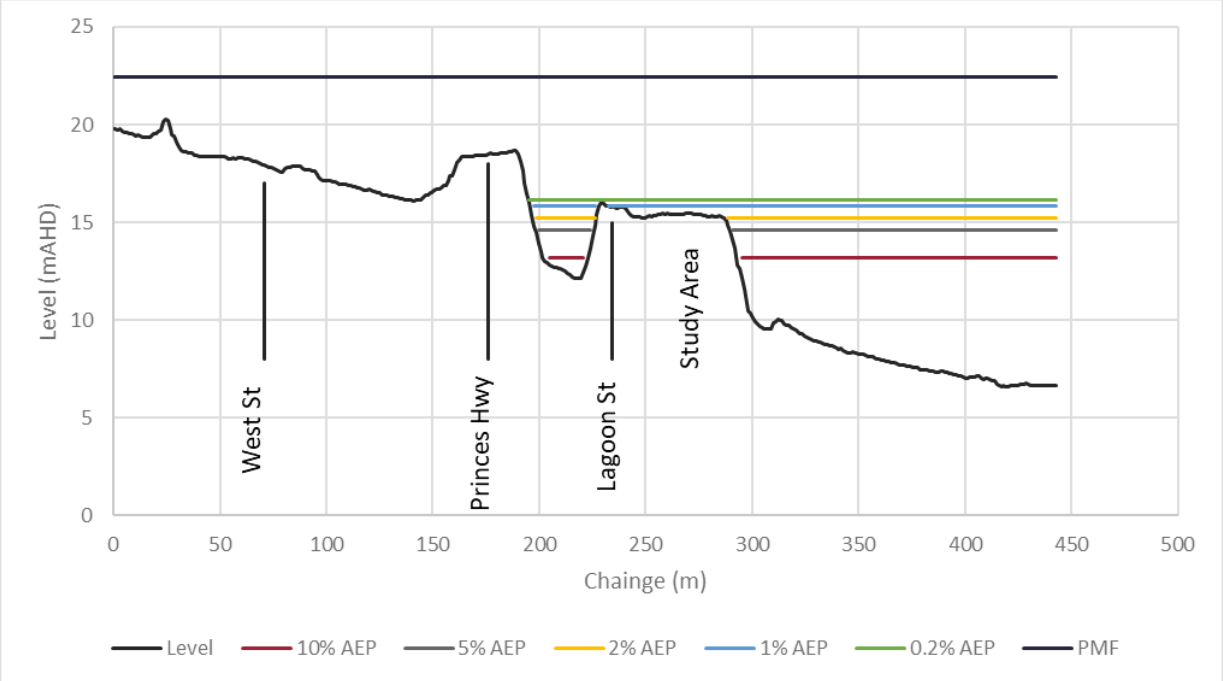

Figure 4-1 **Site Long Section with Riverine Flooding**

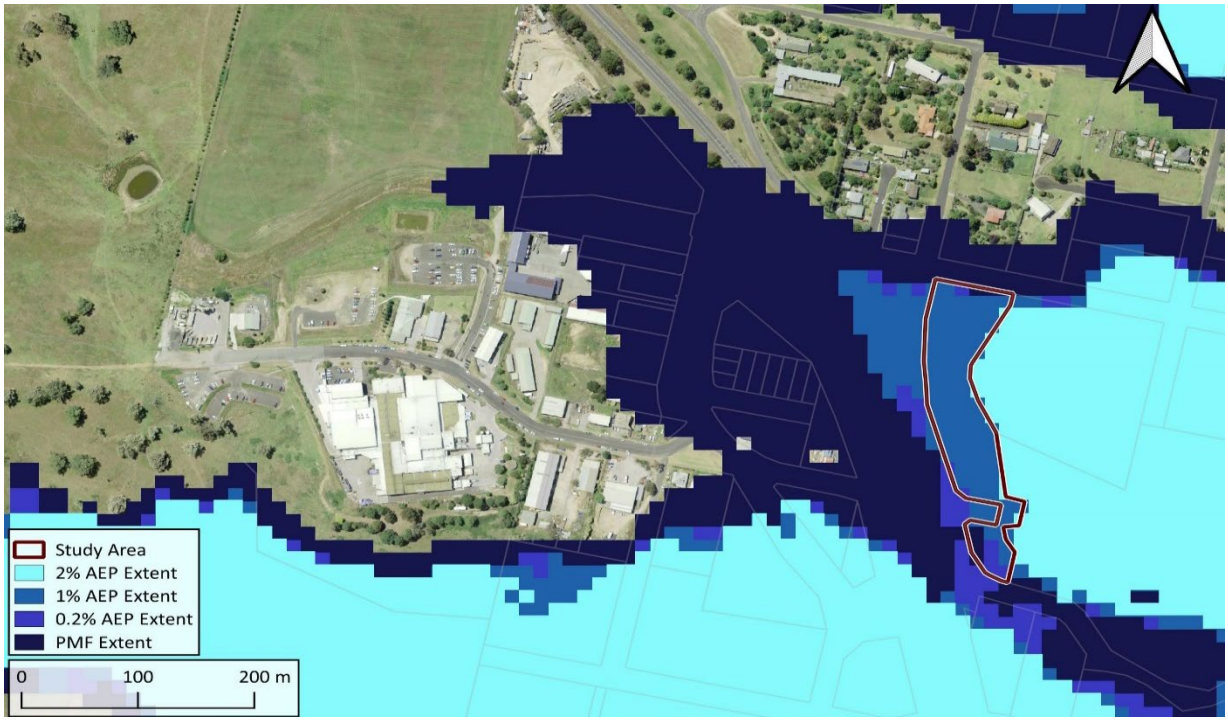

Figure 4-2 Existing Scenario Riverine Flood Extents

4.2 Existing Flood Behaviour – Local Catchment

The local catchment model was run for the 1% AEP and PMF events. Peak depths and flood hazard categories for the 1% AEP and PMF events in the exiting scenario are shown below in **Figure 4-3** to **Figure 4-6**.

The overall behaviour of the two events was similar. There was a single primary flowpath that runs from the pasture and open space regions in the west, through the timber yard in the industrial area, to the culverts under the Princes Highway.

The highway effectively creates a detention basin, with both events showing a large storage area upstream of the highway. The ponding in this storage region results in overtopping of West Street, the access route to the industrial precinct. This behaviour is compounded by the blockage assumptions, though storage in these regions still occurs if the culverts are assumed to be fully unblocked (refer **Sections 3.4.5** and **5.6**).

Between the highway and Lagoon Street is another storage area formed by Lagoon Street. There is overtopping on Lagoon Street at the low point when the storage capacity is exceeded, as well as at a second low point at the southern end of the site. In the 1% AEP, this overtopping is limited to the low point in the road. In the PMF, the overtopping is more extensive, with flow occurring across the full length of Lagoon Street adjacent to the site.

In the 1% AEP, all flow across the site is classed as H1 hazard. H2 hazard flow occurs on the highway, whilst H5 hazard occurs in the basins, driven by the flood depth.

In the PMF event, hazard increases H2 across the site, with some minor areas of H3 at the centre of the flow path across the site. Hazard on the highway increases to H4, and regions of the upstream basins experience H6 flooding, again driven by flood depth.

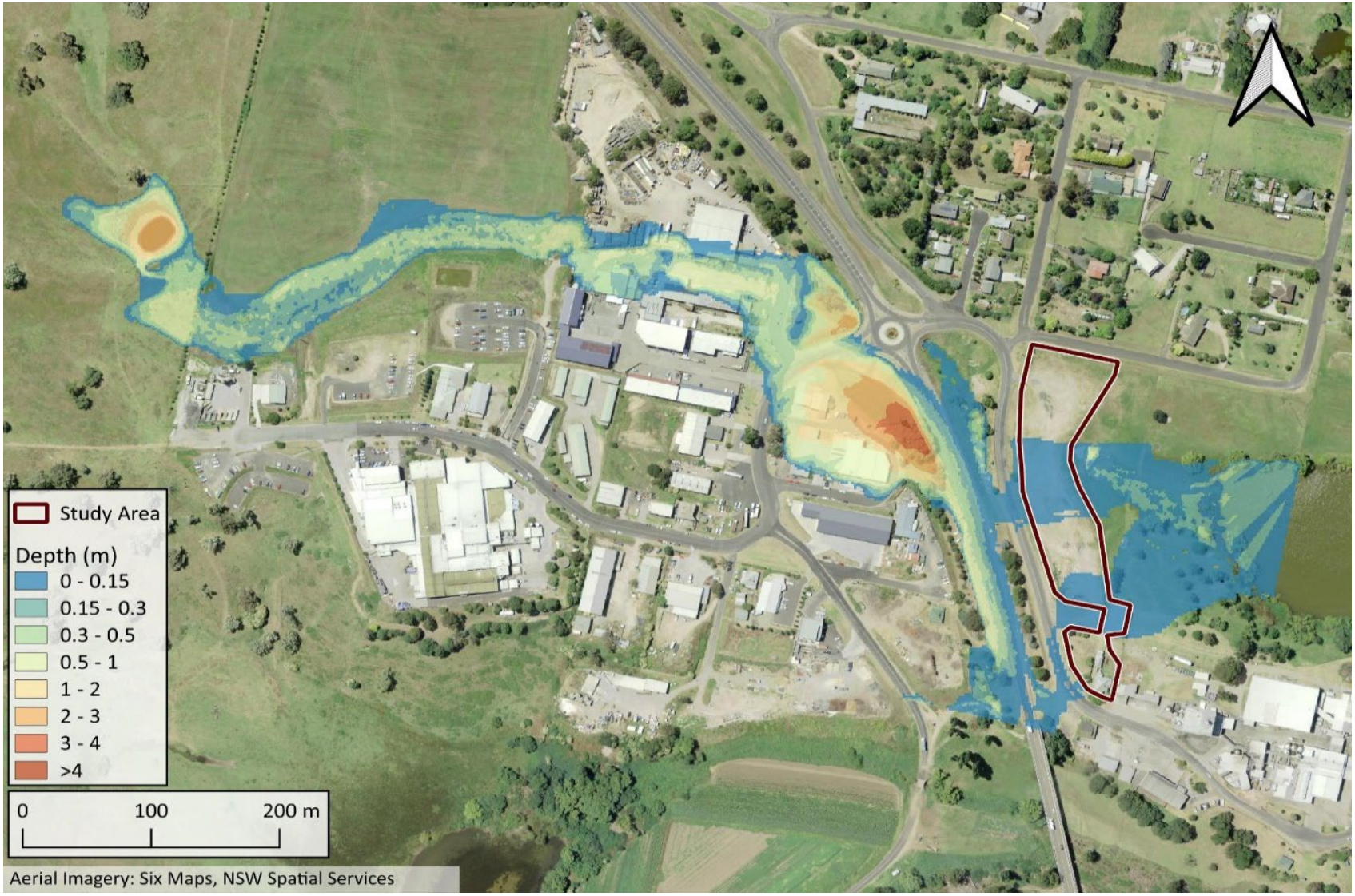

Figure 4-3 Local Catchment Existing 1% AEP Flood Depth

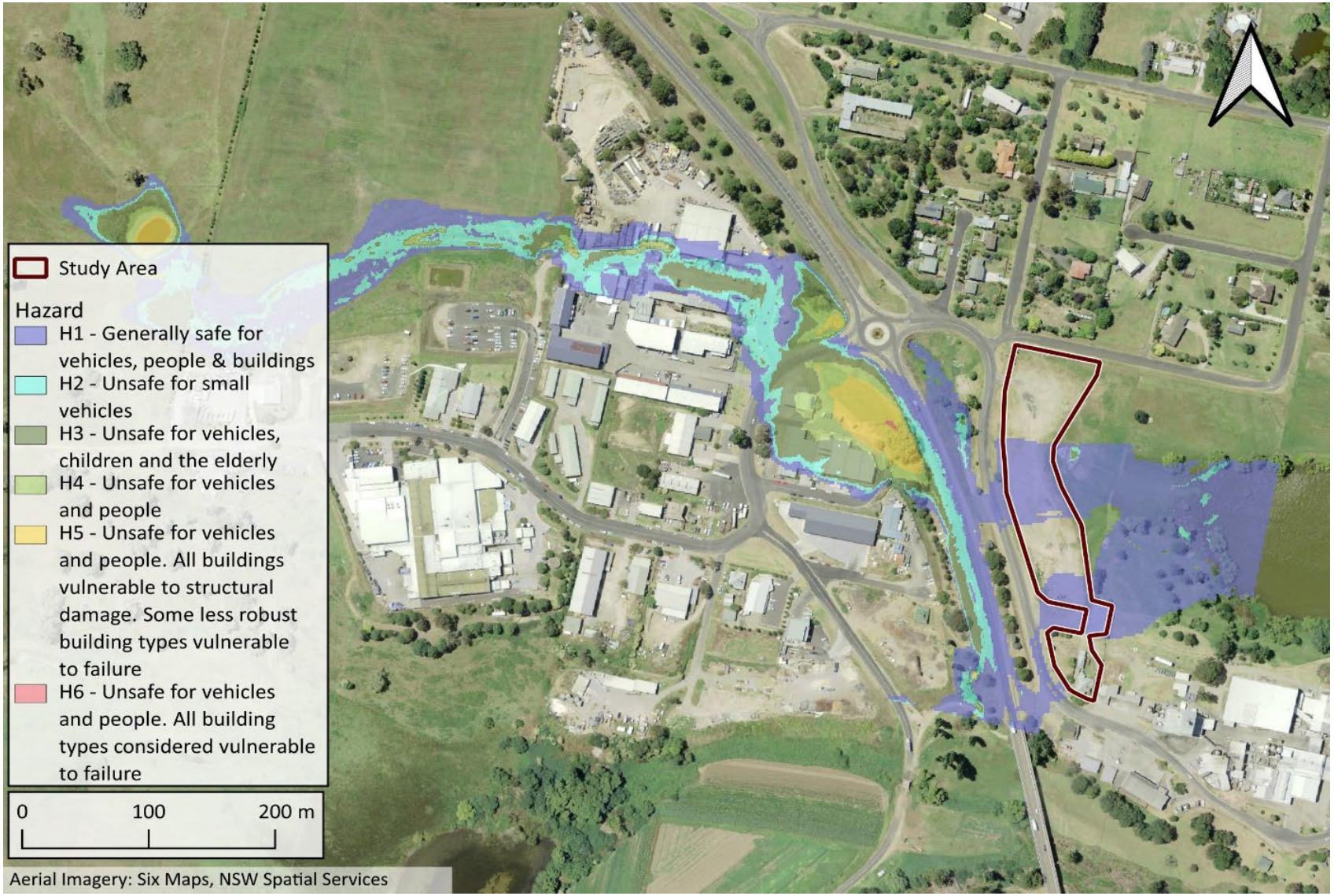

Figure 4-4 Local Catchment Existing 1% AEP Flood Hazard

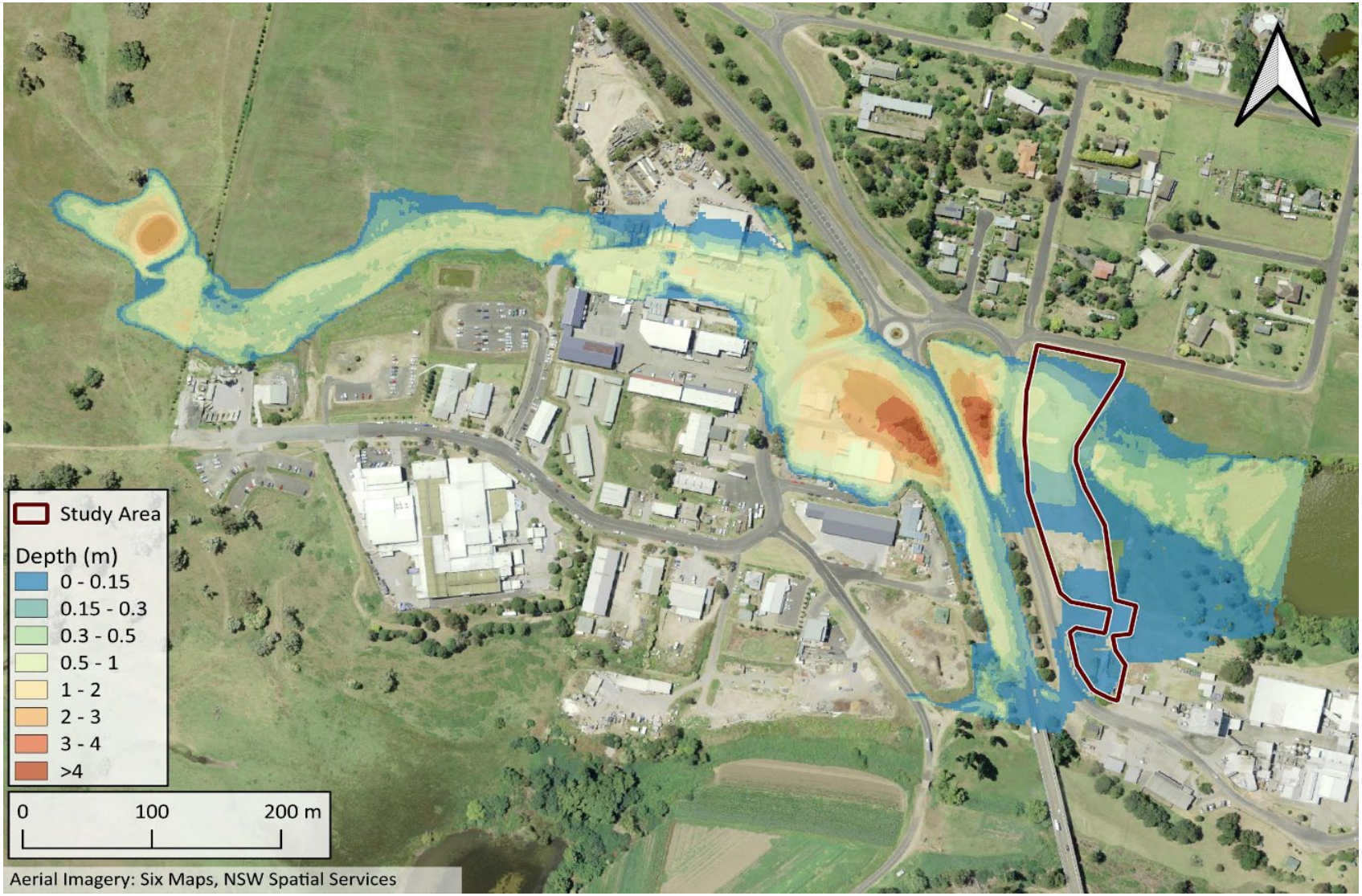

Figure 4-5 Local Catchment Existing PMF Flood Depth

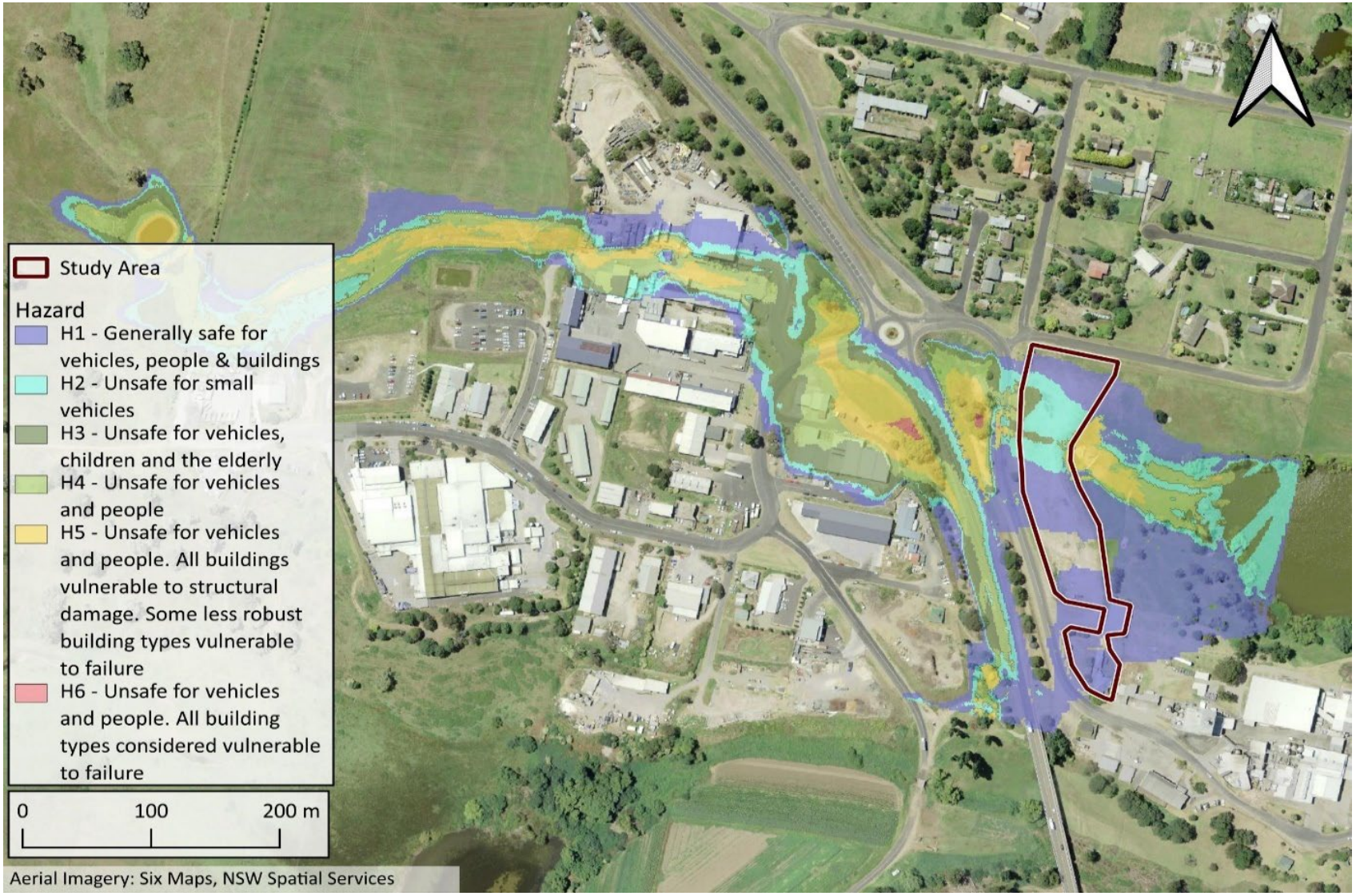

Figure 4-6 Local Catchment Existing PMF Hazard

5 Developed Flood Behaviour

5.1 Proposed Developed Landform

A raised building pad was determined to be the primary means by which flood risk could be managed on site as this design approach seeks to provide a level of flood protection for the proposed development for both local catchment and riverine flood events.

The raised pad was set at the FPL of 16.4mAHD, which was determined to be the riverine 1% AEP flood level plus 0.5m. The riverine 1% AEP had a higher level across the site than the local catchment 1% AEP and was therefore adopted as the basis for the FPL.

The landform incorporated an overland flowpath to allow the conveyance of local catchment flows through the site. The flowpath was located within a proposed vegetated area of the site design and incorporated the adjacent car park.

The proposed building pad is illustrated in **Figure 5-1** and **Figure 5-2**.

The proposed building pad was modelled in both the riverine and local catchment model. The behaviour and flood impacts are discussed below

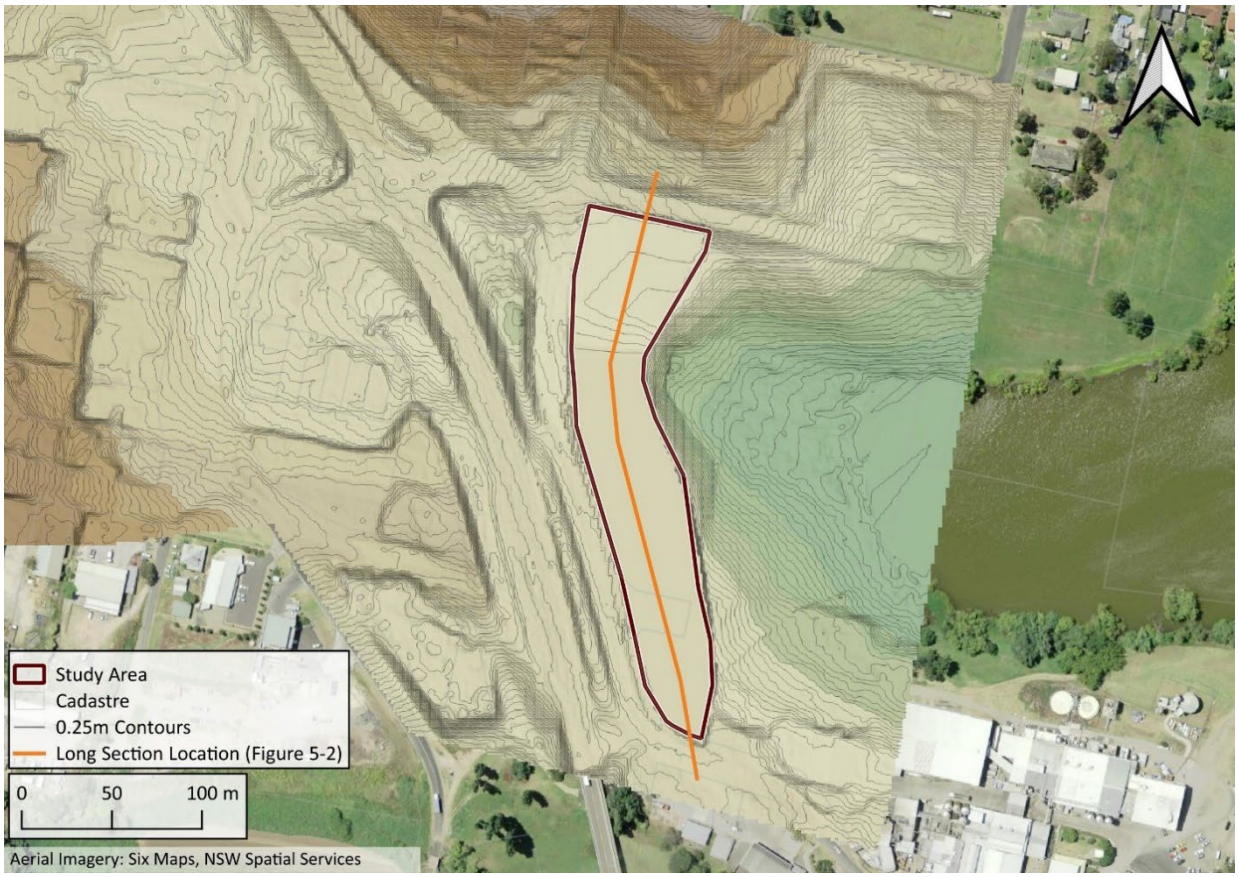

Figure 5-1 Proposed Building Pad – Plan

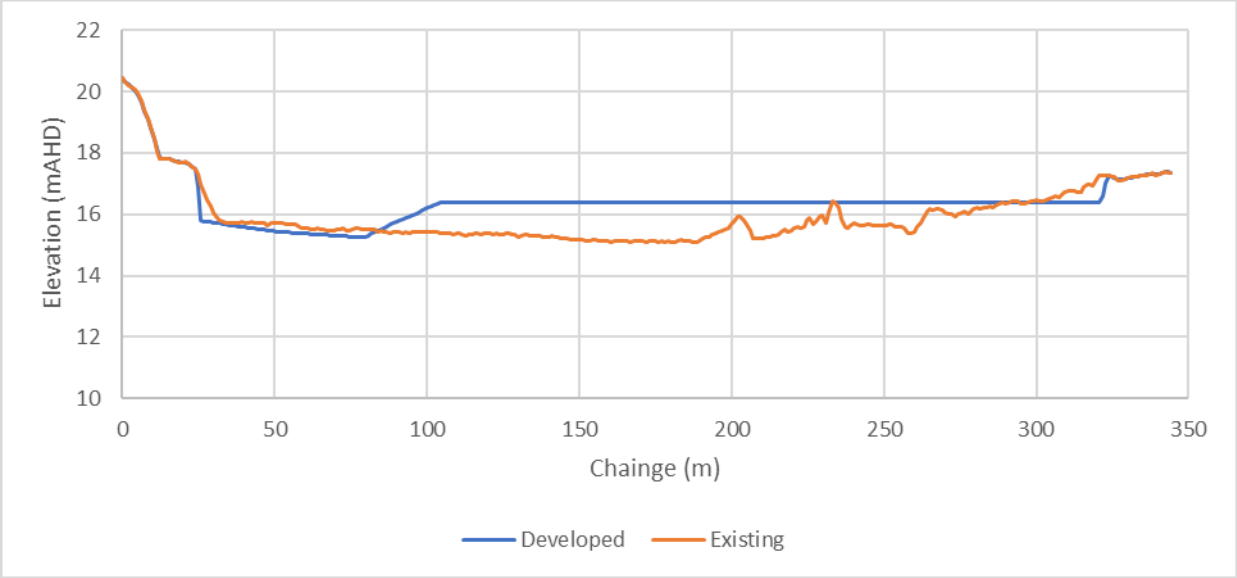

Figure 5-2 Proposed Building Pad – Long Section

5.2 Developed Flood Behaviour – Riverine

The developed riverine flood extents are shown below in **Figure 5-3**.

The proposed development does not affect riverine flood behaviour for any events up to and including the PMF.

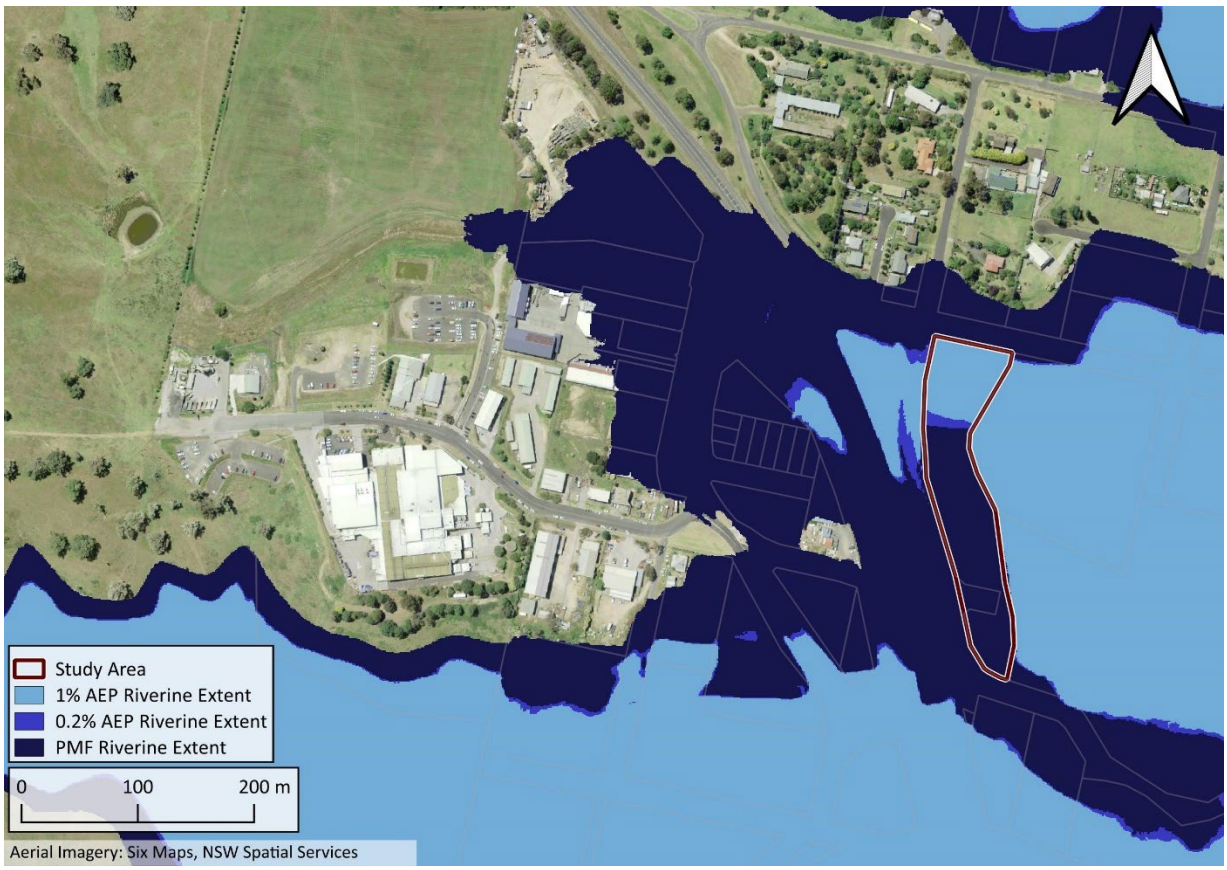

Figure 5-3 Developed Riverine Flood Extents

This is due to:

- the site being located outside of active flow areas, and so does not impact riverine conveyance; and,
- the loss of storage due to the raised building pad is negligible compared to the storage available in the wider Bega River floodplain.

The provision of the central flowpath for managing local catchment flows, which ties into the existing low point of Lagoon Avenue, also means that road inundation remains as per the existing scenario for riverine flood events, as flood waters are permitted to backup through this central flowpath.

The only change in flood behaviour is that the raised pad is lifted out of the 1% AEP flood extent, though the central overland flow area remains inundated. There is also a reduction in flood depths on the site in the PMF due to the raising, but flood depths remain significant (5.8m) and flood hazard remains classed as H6 in the PMF.

5.3 Developed Flood Behaviour – Local Catchment

Peak flood depths and hazard for the 1% AEP and PMF events are shown in **Figure 5-4** to **Figure 5-7** for the developed scenario. The results incorporate the adopted ARR2019 blockage rates (as discussed in **Section 3.4.5**). Sensitivity tests of these blockage assumptions have been undertaken (refer **Section 5.6**).

The results demonstrate that the raised building pad is sufficient to prevent local catchment flooding across the site for all events, up to and including the PMF event.

Overland flow that overtops Lagoon Street is diverted to an overland flowpath provided through a vegetated region of the site. This diversion is largely accomplished via the raised pad. However, as Lagoon Street rises to the south, a small bund or wall is required to prevent water spilling from Lagoon Street onto the building pad. This structure has been modelled as 0.15m high and is only required where levels of Lagoon Street adjacent to the site exceed the pad level of 16.4mAHD.

In the 1% AEP event, flow through this overland flow path is minor with depths of up to 0.03m and a hazard classification of H1. All flows are fully contained within the vegetated corridor of the proposed design. In the 1% AEP event, occupants would be able to safely cross this region and reach the car park. The entrance to the car park from Lagoon Street remains flood free in the 1% AEP event.

In the PMF event, depths through the overland flowpath increase to 0.7m, and the hazard increases to H4. Whilst much of the conveyance is contained within the vegetated region, regions of H3 hazard extend into the car park. The car park entrance is flooded by H2 to H3 hazard flow. These conditions would prevent occupants from reaching the car park from the centre, as well as leaving the car park to reach Lagoon Street. In the local catchment PMF event, occupants would need to remain withing the centre for the duration of flooding, which is in the order of 1 to 2 hours for the PMF.

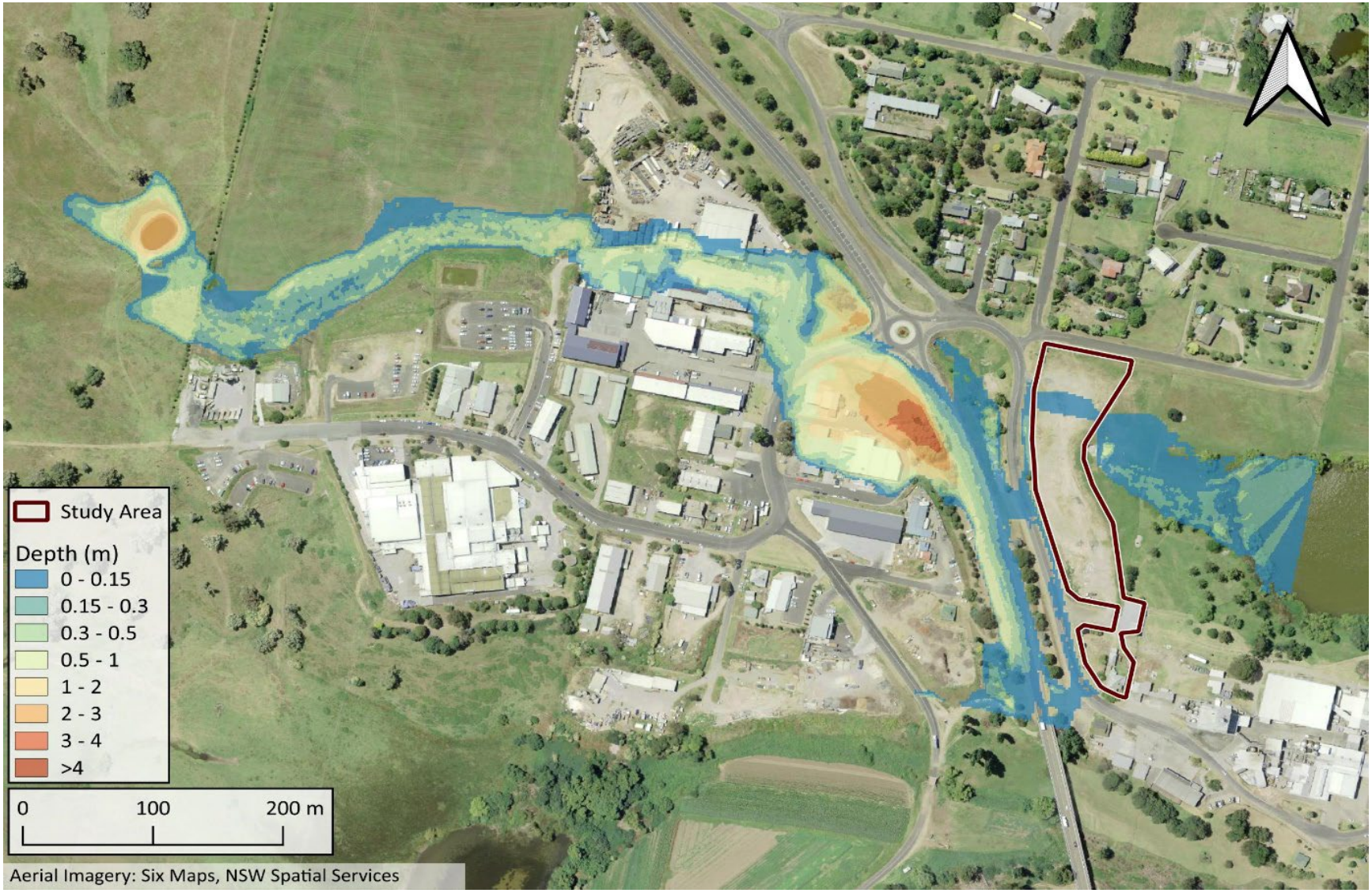

Figure 5-4 Local Catchment Developed 1% AEP Flood Depth

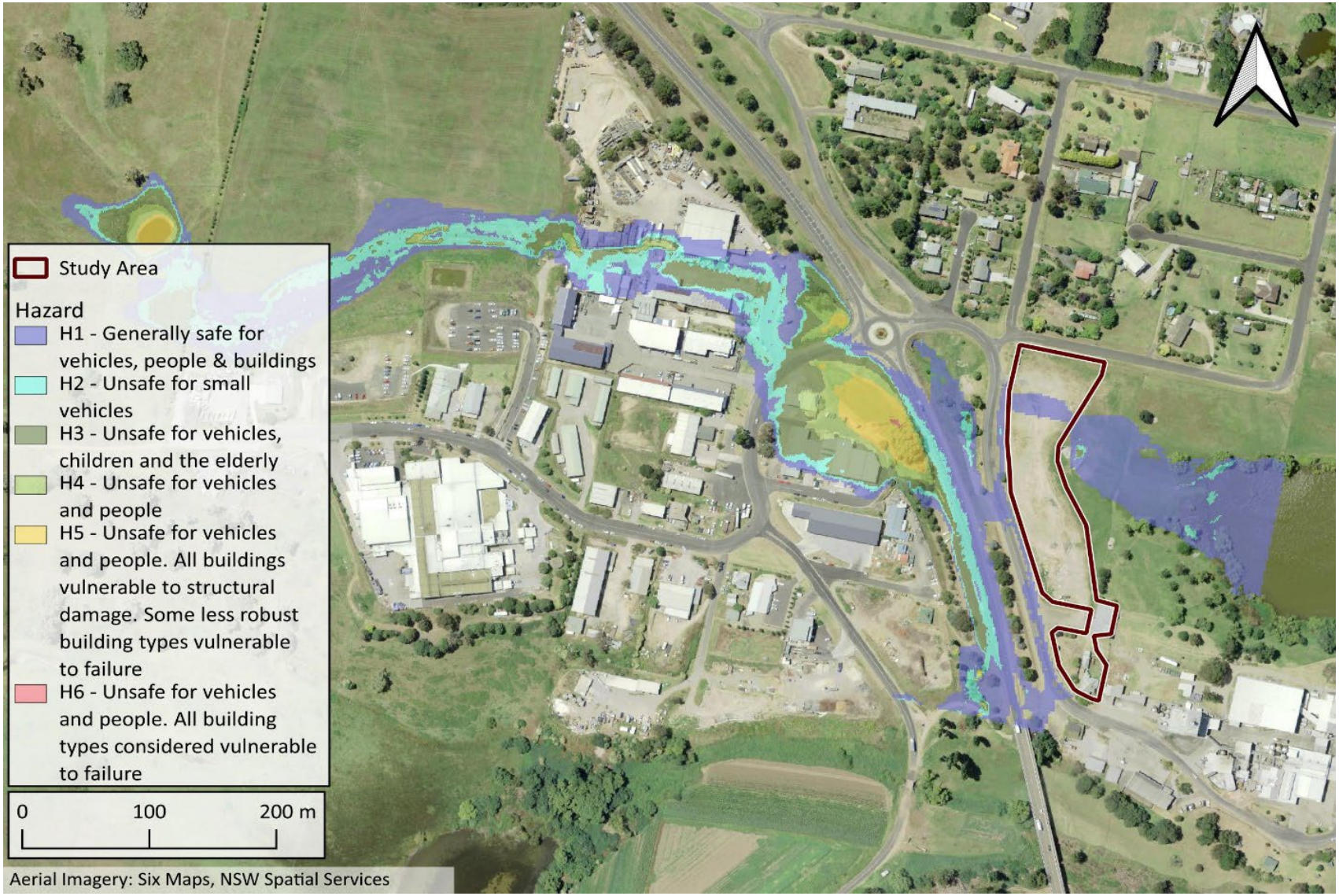

Figure 5-5 Local Catchment Developed 1% AEP Flood Hazard

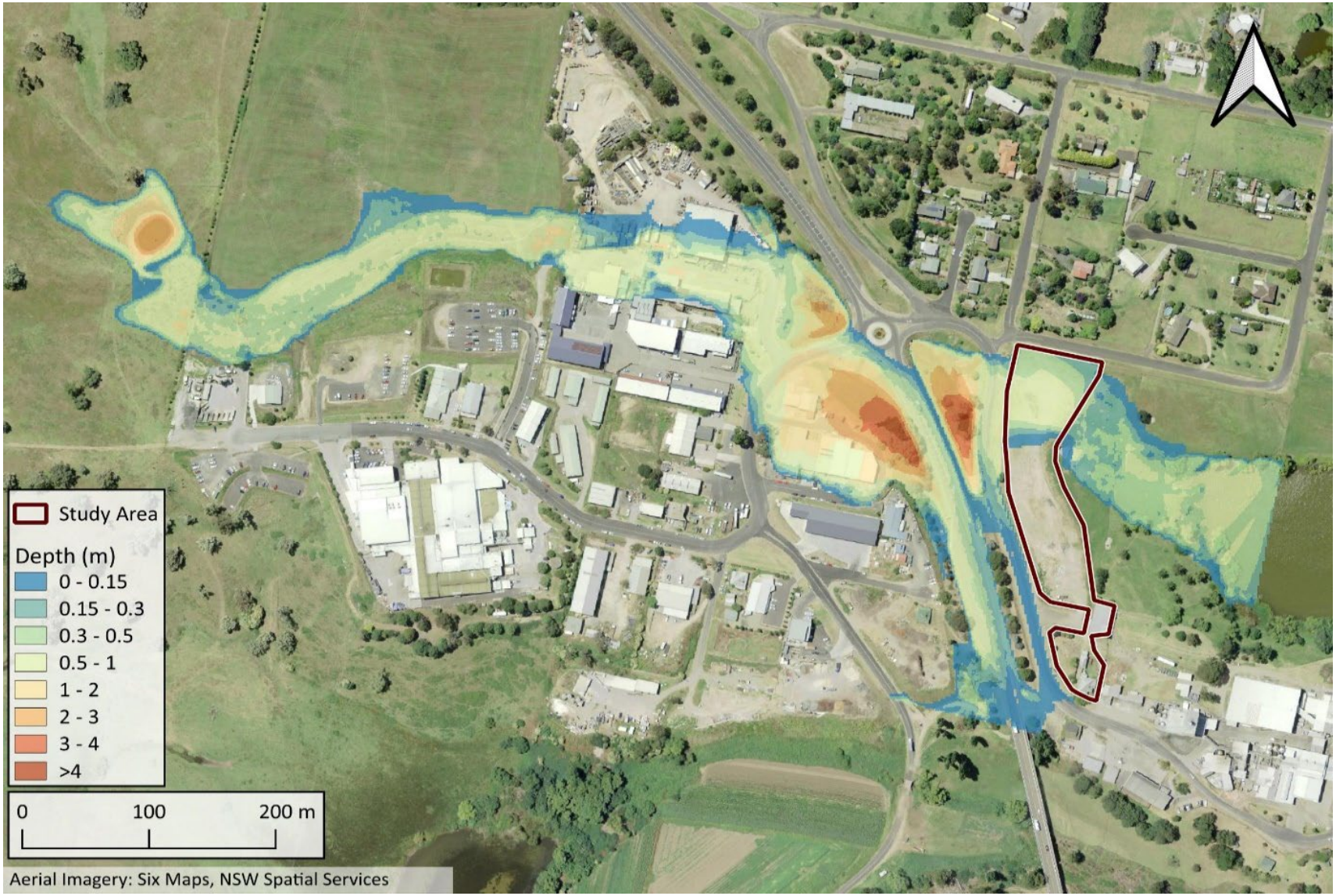

Figure 5-6 Local Catchment Developed PMF Flood Depth

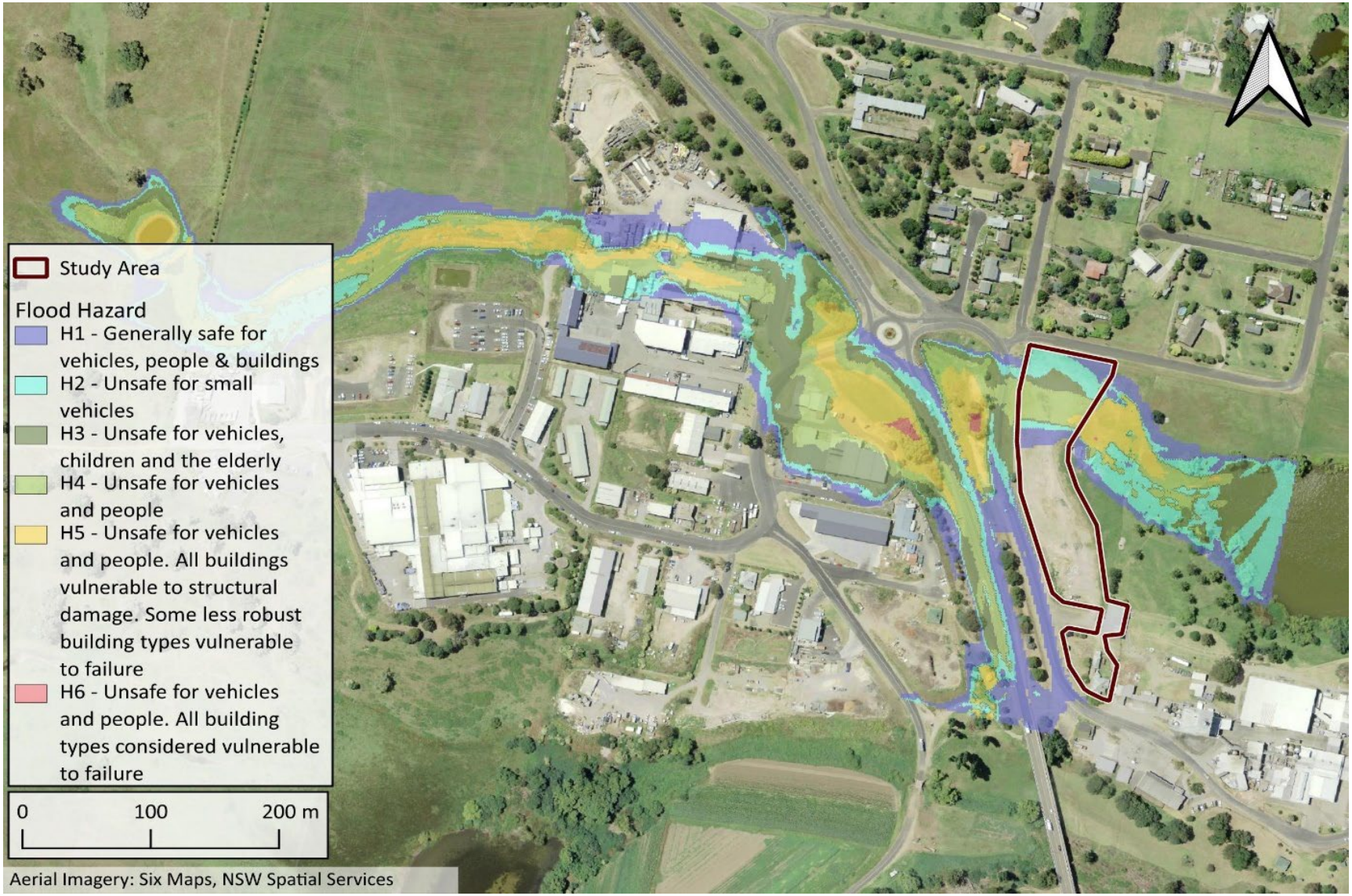

Figure 5-7 Local Catchment Developed PMF Flood Hazard

5.4 Developed Flood Impacts

Flood level impacts are shown for the 1% AEP and PMF events in **Figure 5-8** and **Figure 5-9**.

In the 1% AEP event, water level impacts were minor. There were increases of up to 0.2m adjacent to the raised pads for a length of 30m along Lagoon Stret. These impacts were fully contained withing the open space beside the road and did not affect Lagoon Street. The lack of impacts is because overtopping in the 1% AEP is minor under existing conditions, and the provided overland flow path has sufficient capacity to convey this flow without impacting upstream levels.

In the PMF event, peak levels on Lagoon Street, immediately upstream of the site increase by 0.45m. Increases of 0.1m were also observed in the basin between Lagoon Street and the Princes Highway.

Existing depths over the road were 0.6m in the PMF, making the road unsafe for vehicles under existing conditions. Whilst the developed scenario made these depths greater, it did not result in any change to the duration of flooding, so that while peak levels increased, the period for which access is lost along Lagoon Street remains as per the existing scenario.

Flood impacts did not extend beyond the Princes Highway, with flooding across the highway and the industrial precinct remaining as per the existing scenario.

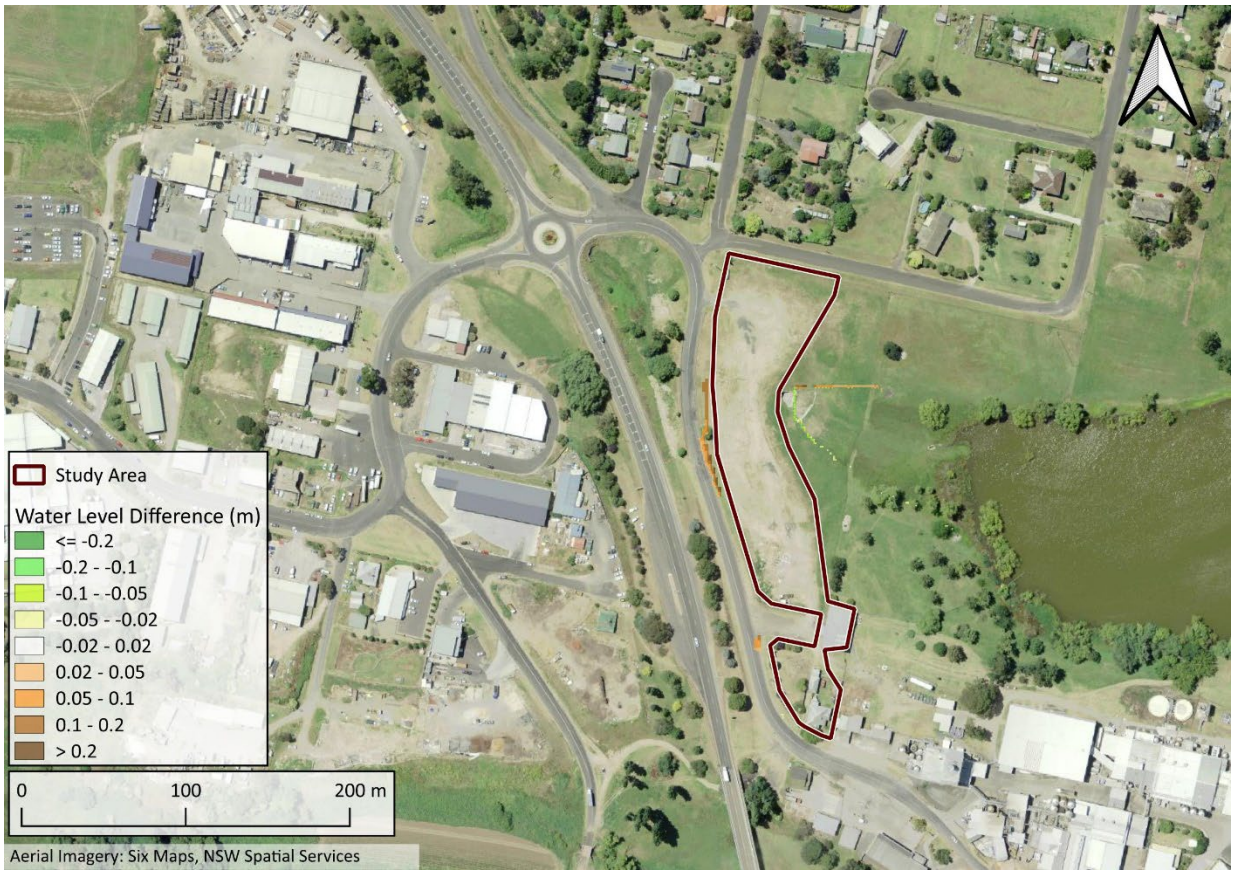

Figure 5-8 **Local Catchment Developed 1% AEP Flood Impacts**

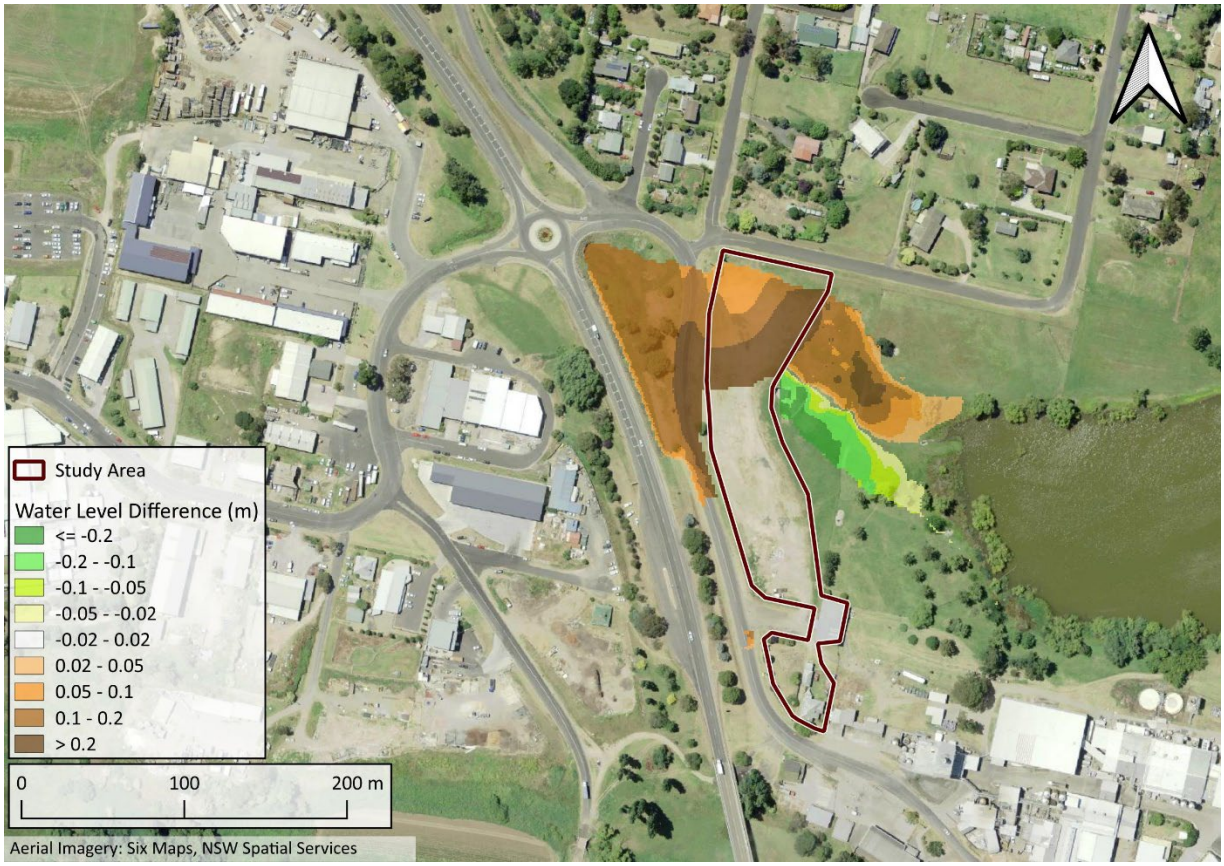

Figure 5-9 Local Catchment Developed PMF Flood Impacts

5.5 Residual Risk

It is important to note that the site has a significant residual risk, driven by the fact that the Bega River PMF event results in flood depths over the site of 5.8m. These depths cannot be dealt with through site design and will remain present for the life of the development. This residual risk applies to both risk to life and risk to property.

Mitigation of risk to life is to be undertaken through appropriate emergency response and evacuation strategies. These are discussed further in **Section 6**.

Flood risk to the property will always remain. Whilst these risks can be mitigated to some extent by the incorporation of flood resilient building techniques, the fact remains that events larger than a 1% AEP event may cause some degree of damage to the property and contents, and a PMF event is likely to result in significant damage to the structure and loss of contents.

It is appreciated that the likelihood of the PMF event is small, and that the proposal provides flood immunity for the site up to the 1% AEP event, and that from a commercial perspective this risk may be acceptable if alternative flood free sites are not available, or do not offer a comparable level of service.

5.6 Sensitivity

Sensitivity testing has been undertaken on the culvert blockage rates, to determine the influence they have on overall flood behaviour.

The design blockage rates were determined in accordance with ARR2019. Sensitivity testing has been undertaken for the 1% AEP on:

- A fully unblocked scenario;
- A fully blocked scenario;
- A critical blockage scenario with the upstream culverts at the highway fully unblocked, and the site culverts fully blocked;
- A high site roughness scenario; and,
- A 5% AEP tailwater scenario.

These results are shown in **Figure 5-10** to **Figure 5-14**.

The unblocked results (**Figure 5-10**) indicated that the unblocked culverts had sufficient capacity to prevent overtopping of the Princes Highway, Lagoon Street, and the study area. All flow was conveyed in the pipes, though ponding still occurred upstream of both the Princes Highway and Lagoon Street. Increases were observed downstream of the culvert because of the increased culvert capacity.

The fully blocked scenario (**Figure 5-11**) showed relatively little change compared to the existing scenario, since the upstream culverts are fully blocked, and the site culverts are 50% blocked in the design scenario. Fully blocking the site culverts resulted in additional ponding upstream of Lagoon Street, and a reduction in outlet flows. There was no significant change in flood levels across roadways or the study area.

The critical blockage scenario examined the flood behaviour changes if the upstream Highway culvert was fully open, but the site culvert became fully blocked. These impacts are shown in **Figure 5-12**. The critical scenario resulted in reduced levels upstream of the highway, but an increase in levels upstream of the Lagoon Street. The fully blocked site culvert resulted in all flows being forced overland, increasing both the extent of overtopping of Lagoon Street and the extend of flow through the site. Despite this increase in flow, the period of overtopping of Lagoon Street remained as per the design scenario (loss of access was driven by the southern overtopping location) and the overland flow through the site was fully contained within the vegetated and carpark areas and did not impact the building pad.

The results indicate that the building pad provides a suitable level of flood protection in the 1% AEP event regardless of the blockage condition.

Blockage sensitivity runs were not undertaken for the PMF, as in this event the culverts are fully blocked in the design scenario.

A sensitivity test was also conducted on the roughness of the vegetated corridor through the site. The design roughness was 0.06, representing light to medium vegetation. A sensitivity test was run for the PMF with a roughness of 0.18 representing very dense vegetation. The results, shown in **Figure 5-13**, indicate that with this higher roughness the building pad is inundated in the PMF by depths of 0.05m.

The results indicate that as the design progresses, consideration will need to be given to the vegetation and planting density through this region to ensure that appropriate conveyance is maintained for the PMF event.

The final sensitivity test examined the impact of a coincident riverine event on local flood behaviour. For the sensitivity test, a constant downstream level set at the peak 5% AEP was adopted along with a 1% AEP local rainfall event. The results are shown in **Figure 5-14.**

Downstream of the site, there is a significant increase in flood extent due to the adopted boundary condition. There was also an increase in the basin formed between the highway and Lagoon Street, to the west of the site. These increases were fully contained within the open space region and did not affect access roads or properties. These increases were driven by the higher tailwater condition reducing the capacity of the culverts draining under the site.

The results indicate that the overall hydraulic performance of the proposed development remains similar for independent and coincident flooding with the Bega River.

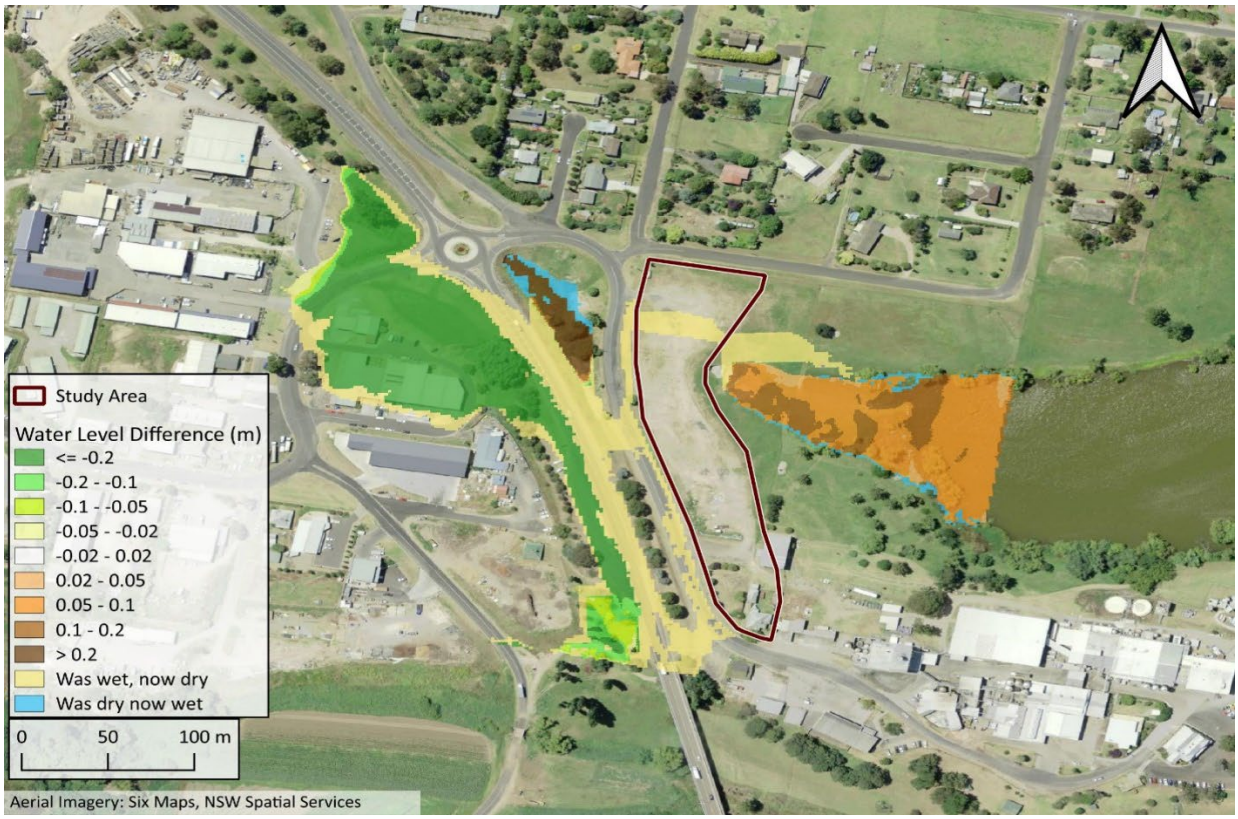

Figure 5-10 Blockage Sensitivity - Unblocked

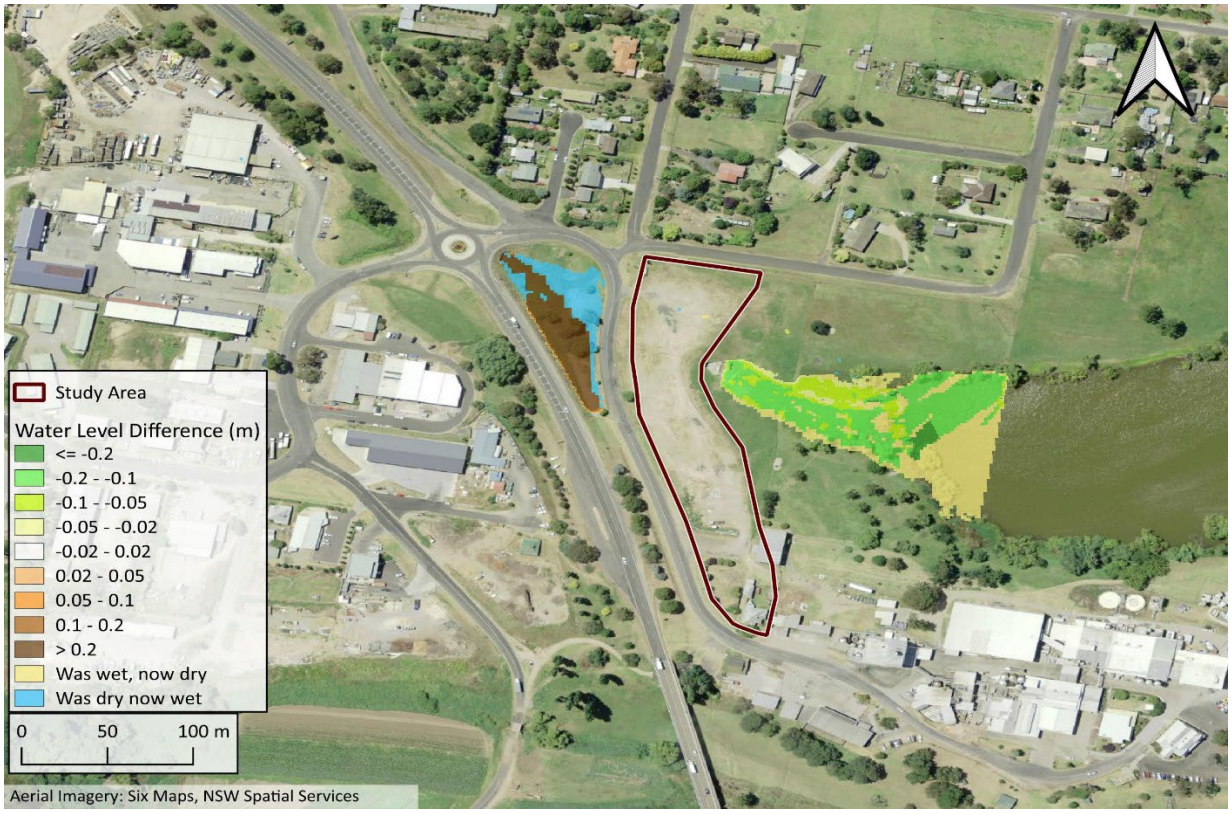

Figure 5-11 Blockage Sensitivity – Fully Blocked

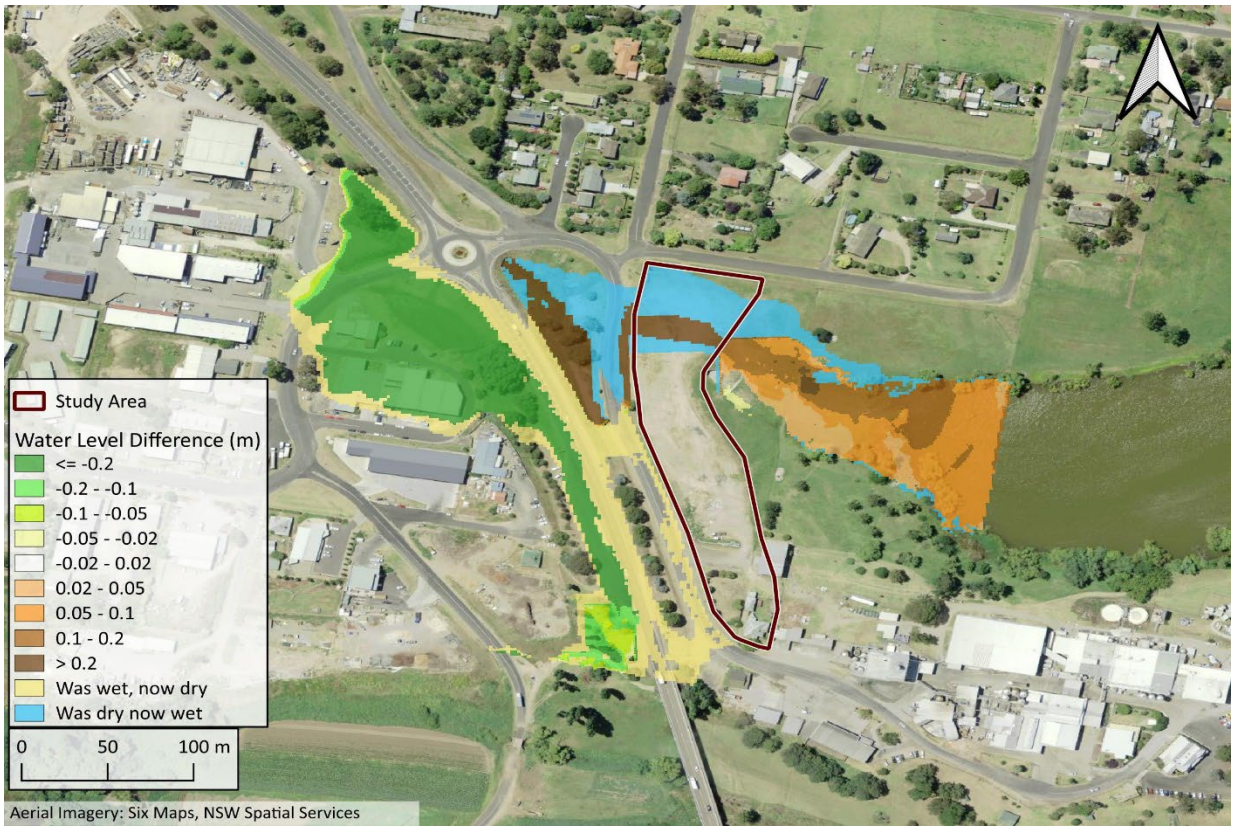

Figure 5-12 Blockage Sensitivity – Critical Blockage

Figure 5-13 Roughness Sensitivity

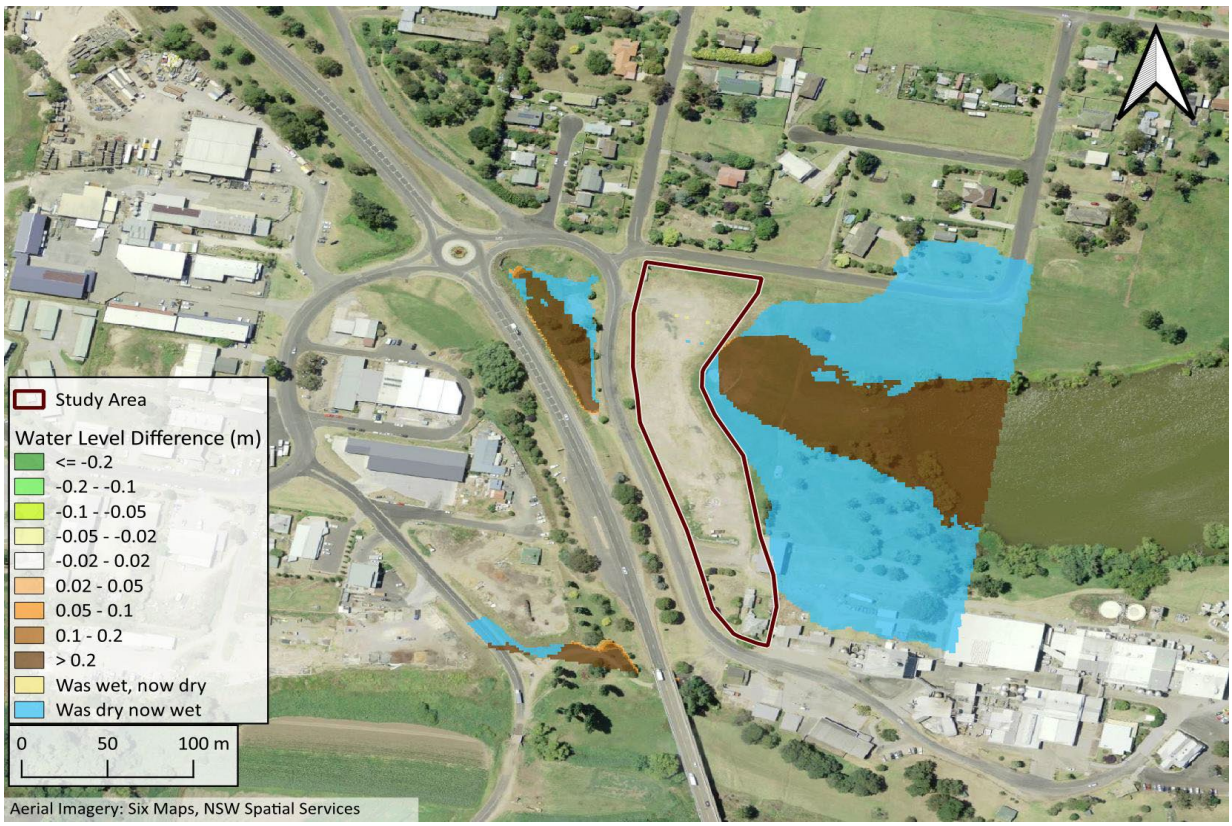

Figure 5-14 Tailwater Sensitivity

6 Emergency Response

As discussed in the previous sections of this report, the subject site is affected by both riverine flooding and local catchment flooding. These two flooding mechanisms present different risk profiles, and consequently require different emergency responses.

The emergency response strategy for the site is based on:

- Evacuation for riverine flood events, due both to the available warning time, and the significant flood depths and flood hazard present across the site in the PMF event; and,
- Shelter in place for local catchment floods, due to the flood immunity provided by the raised pad, and the short duration of this flood mechanism.

Further details on these approaches are provided below.

6.1 Site Use and Exposure

In defining the emergency response requirements, it is important to define the site use and risk exposure. The premises are proposed to be commercial in nature, which results in a different use and risk exposure compared to residential properties.

Whilst the full details of the site usage are still being determined, it is likely that the usage will broadly be:

- Typical opening hours of 7am to 5pm;
- Occasional evening functions, most likely on weekends, with the premises vacated by 10pm;
- A permanent staff of 10 – 12 during daily operations;
- Approximately 10 – 12 staff to manage evening events;
- Expected visitation by the community of approximately 1,000 people per day during typical opening hours (noting not all these visitors will be present at once), and up to 120 during evening functions; and,
- Whenever the site is operating, a site manager will be present on site.

This site usage means that the site will only be occupied during operational hours, and not for the full 24-hours of the day. Furthermore, all occupants will be awake whilst at the site (no overnight accommodation).

In addition, the management of the site by a single entity, with a building manager on site at all times, would assist in making sure any evacuation or emergency response activities are carried out promptly and appropriately.

6.2 Flood Warning

The Bega River catchment upstream of Bega has several river gauges that can be used to inform flood warning for the Bega River floodplain. Those nearest to Bega are shown in **Figure 6-1**.

The travel time of the flood peak between these locations is summarised in **Table 6-1**.

The travel times have been determined based on riverine velocity of 2.5m/s, a typical riverine velocity as reported in the hydraulic model developed as part of the *Bega and Brogo Rivers Floodplain Risk Management Study* (Cardno, 2018).

All these gauges provide a reasonable representation of flow timing, as the Lower Bega River does not have any major incoming tributaries between these gauges and the study area. The confluence with the Brogo River is downstream of the study area.

While these travel times represent the time between the peak at each location, the warning time will likely be longer, as the BoM will provide flood warnings based on forecast rainfall. The estimated warning times should be determined in conjunction with the BoM and SES as part of the preparation of a detailed site flood emergency response plan.

With respect to the Bega River at Kanoona gauge, which is immediately upstream of the site, a summary is provided in **Table 6-2** of warning times to loss of access to the site and the building pad becoming isolated in the PMF is provided for a variety of trigger levels.

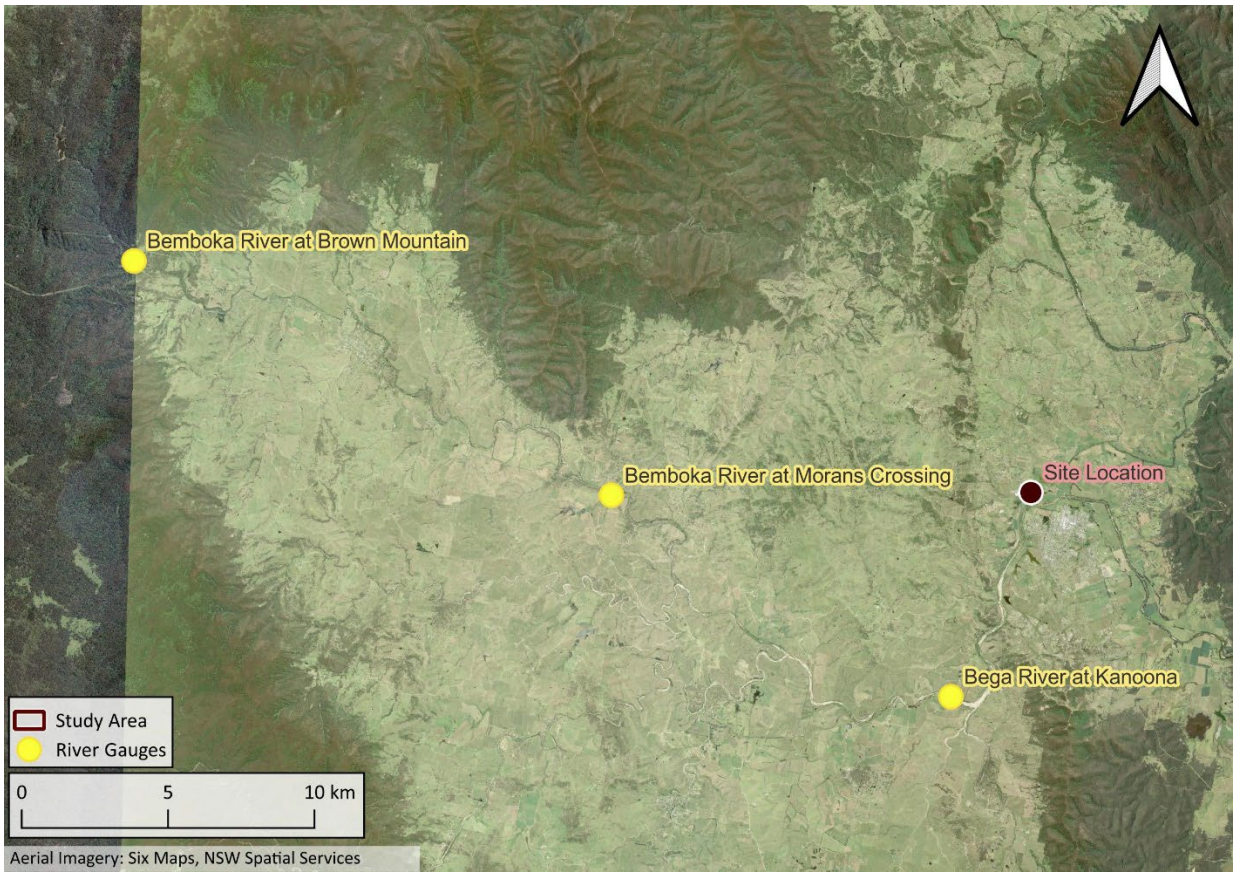

Figure 6-1 **Bega River Gauge Locations**

Table 6-1 Travel Time Between Bega River Gauges

Gauge	Distance Upstream of Bega Bridge (km)	Flood Travel Time to Bega Bridge (hrs)
Bemboka River at Brown Mountain	50	20
Bemboka River at Moran's Crossing	25	10
Bega River at Kanoona	8	3

Table 6-2 Warning time for isolation from variety of trigger levels at Bega River Kanoona Gauge

Depth at Gauge	Time to Loss of Access at Site (hours)
4m (approximately a 10% AEP)	7
5m	6
6m (approximately a 5% AEP)	5.5
7m (approximately a 2% AEP)	4

6.3 Evacuation

6.3.1 Flood Impacts on Access

Evacuation from the site is via Lagoon Street. Lagoon Street joins Bridge Street immediately north of the site which then meets the Princes Highway at the roundabout. The Princes Highway runs south to Bega passing over the Bega River. Heading north, the Princes Highway passes through several smaller townships with the next major centre being Narooma, approximately 80km north.

Flooding affects both local and regional roads, in both local catchment and riverine floods.

Within the study area, for local catchment flood events:

- Lagoon Street is flooded by depths of 0.03m (H1 hazard) in the 1% AEP and 0.6m (H4 hazard) in the PMF;
- Princes Highway is flooded by depths of 0.3m (H2 hazard) in the 1% AEP and 0.4m (H4 hazard) in the PMF; and,
- Bridge Street and the highway roundabout remain flood free up to and including the PMF.

Within the study area, for riverine flood events:

- Roads surrounding the site remain open, up to and including the 2% AEP event;
- Lagoon Street is flooded by depths of 0.2m (H1 hazard) in the 1% AEP, 0.5m (H3 hazard) in the 0.2% AEP and 6.6m (H6 hazard) in the PMF event.
- Princes Highway remains flood free in the 1% AEP and 0.2% AEP events and is flooded by 4m (H6 hazard) in the PMF event.

Access routes and evacuation locations (see below) are illustrated in **Figure 6-2**.

6.3.2 Flood Evacuation Locations

In extreme riverine flood events, it is desirable that evacuation is commenced with sufficient time to allow occupants to evacuate to Bega CBD. Given the location of the site, it is expected that all occupants

would have their own transport (either private vehicles, or a tour bus or similar). Evacuation to Bega CBD would ensure that people have access to services for the duration of the flood event.

As a fall-back option (due to vehicle breakdown, the Bega Bridge being non-trafficable due to an accident, etc.), there is high ground located 100m west and north of the site which is above the PMF. The Bega Group also operates a site 400m west that is above the PMF and could serve as an emergency evacuation location.

A long section along the access roads to this location is shown in **Figure 6-3**. The plot shows that there is rising road access from the site to Lagoon Street. From Lagoon Street, the road continues to rise to the roundabout on the Highway, before dropping to the timberyard driveway, after which is rises consistently to the Bega facility on the ridge. Whilst the road does dip, the low point of this dip is at 17.8mAHD, which is above the carpark entry level of 15.7mAHD. As such, when flood water first enters the site, there is flood free access available to flood free land above the PMF.

It is noted that the Bega Group has additional assets on lower ground to the east of the proposed development, and that the potential emergency options could also serve to reduce the existing risk for occupants of these facilities.

It is noted that these local evacuation locations within the industrial area lack the services that would be available in Bega.

It is recommended that the flood emergency response plan for the site adopt appropriate warnings and triggers to allow evacuation to Bega CBD as a priority and only using the refuge area in the Industrial Area as a backup.

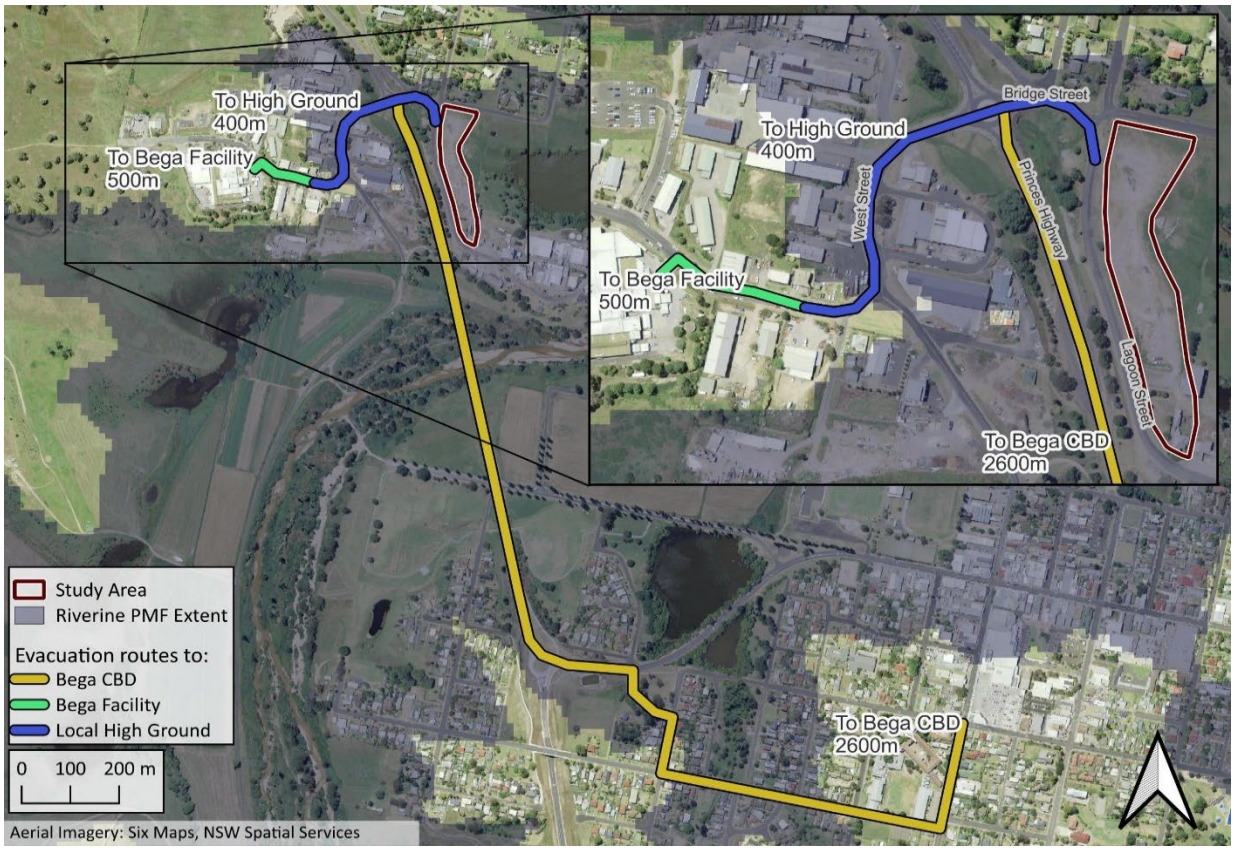

Figure 6-2 Evacuation Routes

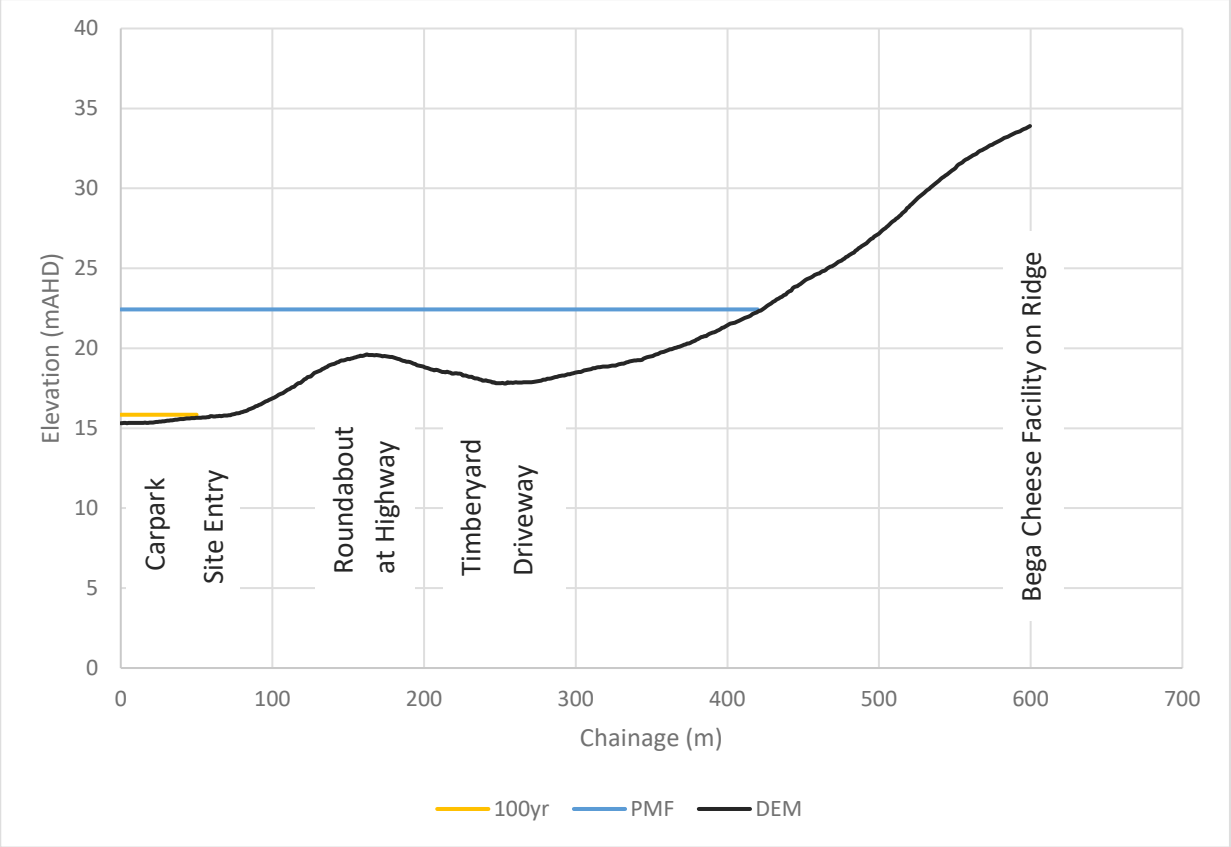

Figure 6-3 Evacuation Long Section

6.3.3 Evacuation Potential

With the raised building pad, the level of the site and associated buildings is lifted above the low point of the adjacent access road, Lagoon Street. As such, the site becomes a high flood island in local catchment PMF events, and a low flood island in riverine PMF events, as access is lost prior to inundation of the building site.

For a local flood event, evacuation is not recommended, due to unsafe conditions on the roads (namely heavy rainfall and lack of visibility). Whilst access is lost in the local catchment PMF event, the period of isolation (where road flooding is H3 or greater) is less than 1 hour. As the building remains above the local catchment PMF, shelter in place is considered a reasonable option for local catchment events. This is further discussion in **Section 6.3.4** below. It is noted that closing the site and cancelling bookings when extreme weather conditions are predicted would be possible and would further reduce the likelihood of occupants becoming isolated in a PMF event local catchment event.

For Bega River flooding, evacuation is required in events greater than the 1% AEP event as the site can become flooded, with significant flood depths experienced in the PMF event, making it unsafe for occupants. When the building pad is first inundated, flood depths at the low point of Lagoon Street are 0.7m, making the road inaccessible. As such, it is critical that any evacuation is undertaken in advance of flood waters reaching the top of the building pad; by this time, safe evacuation may not be possible.

As discussed above in **Section 6.2**, there is sufficient flood warning available to permit an orderly evacuation in advance of the loss of access. As per the local catchment discussion above, closing the centre in response to extreme weather forecasts or flood alerts would reduce the likelihood of people being on site during an event that would require their evacuation.

6.3.4 Shelter in Place

For riverine flooding, shelter in place is not a suitable option for responding to flood events greater than the 1% AEP event from Bega River flooding (riverine) due to the potential for over floor flooding in events great than this, and significant flood depths experienced in the PMF event. Evacuation is the only suitable response to extreme riverine flood events.

However, the flood behaviour and risk profile for local catchment events is substantially different. The proposed development would see the site raised above the local catchment PMF level (excluding carparks).

The draft Shelter in Place Guideline (DPE, 2023) states that while evacuation is preferred method of emergency response, shelter in place may be appropriate it:

- The flood duration is less than six hours;
- The development is not located in an area of high risk (floodway, H5 or H6 hazard);
- Access to on-site systems are above peak flood levels;
- Food, water, and medical equipment is located above the PMF;
- The location used for shelter is:
    - Above the PMF;
    - Provides a suitable floor space per person; and,
    - Is structurally safe and accessible in the PMF.

For local catchment events, the site and the flood behaviour meet the requirements in the draft guideline for shelter in place.

7 Policy and Planning Review

7.1 Overview

Within the study area, development is largely controlled through the Bega Valley Local Environmental Plan 2013 (SLEP 2013) and Bega Valley Development Control Plan (DCP) 2013. The LEP is an environmental planning instrument (EPI) which designates land uses and development in the study area, while the DCP regulates development in the relevant zones with specific guidelines and parameters.

In addition to Council Plans, the Minister for Planning can issue Ministerial Directions to issues directions to planning authorities about the preparation of planning schemes and amendments to planning schemes.

Planning authorities must comply with the Ministerial Direction on the Form and Content of Planning Schemes, issued under Section 9.1(2) of the *Environmental Planning and Assessment Act 1979*. The direction applies to planning scheme layout and required information – including amendments to those planning schemes – and should be read together with the Planning Provisions.

A review of the proposed development has been undertaken to determine if the proposed development is in accordance with these flood-related development controls and Local Planning Direction 4.1, and if not, whether these departures are justified.

This review does not specifically deal with matters related to building construction (such as the National Construction Code, which includes the Building Code of Australia, both of which are updated every three years by the Australian Building Codes Board). However, it is important to note that these types of controls are sometimes called or referenced in planning controls and therefore their content and direction are of relevance. In this regard, how they are applied is directed under the NSW Planning System via numerous mechanisms but primarily via Building System Circulars issued by the Department of Planning and Environment. The most relevant circular is BS 13-004, dated 16 July 2013 entitled *The NSW Planning System and the Building Code of Australia 2013: Construction of Buildings in Flood Hazard Areas*. Importantly the BCA deals with the concept of the 'defined flood event' (DFE) and imposes minimum a construction standard across Australia for specified building classifications 'flood hazard areas' (FHA) up to the DFE. However, the 2023 version of the BCA contains flood-related guidance largely for Class 1 buildings only and does not directly apply to the types of buildings anticipated in the Precinct.

Note that there are several State Environmental Planning Policies (SEPPs) that apply to the Precinct. A review of these EPIs has not been completed as part of this assessment.

7.2 Policies and Plans

7.2.1 Bega Valley LEP 2013

The Bega Valley Local Environmental Plan 2013 (BVLEP 2013) sets the direction for land use and development in the study area by providing controls and guidelines for development. It determines what can be built, where it can be built and what activities can occur on land.

The BVLEP 2013 is based on a standard format used by all Councils in NSW and can be viewed on the NSW legislation website (www.legislation.nsw.gov.au).

7.2.2 Land Use Zones

The full site is zoned E4 *General Industrial*. The land use zones across and surrounding the site are shown in **Figure 7-1**. It is noted that the IN1 and IN2 land uses shown on the LEP mapping have both been converted into the E4 land use as part of the NSW State Government's *Employment Zones Reform* (April 2023).

The proposed land use zones for the site are summarised in **Table 7-1**. The development is largely permissible under the current zoning, though zoning amendment would be required to allow the retail, function centre, entertainment centre and community facility aspects of the development.

It is understood that the Planning Proposal would be seeking to (Zenith Town Planning, 2023):

> *Insert an entry into Schedule 1 Additional permitted uses of* Bega Valley LEP 2023 *to list Part Lot 1 DP 1264640, No. 10 Lagoon Street, Bega in Schedule 1 Additional permitted uses with development for the purposes of retail remises, a function centre, an entertainment facility and a community facility as permitted with consent.*

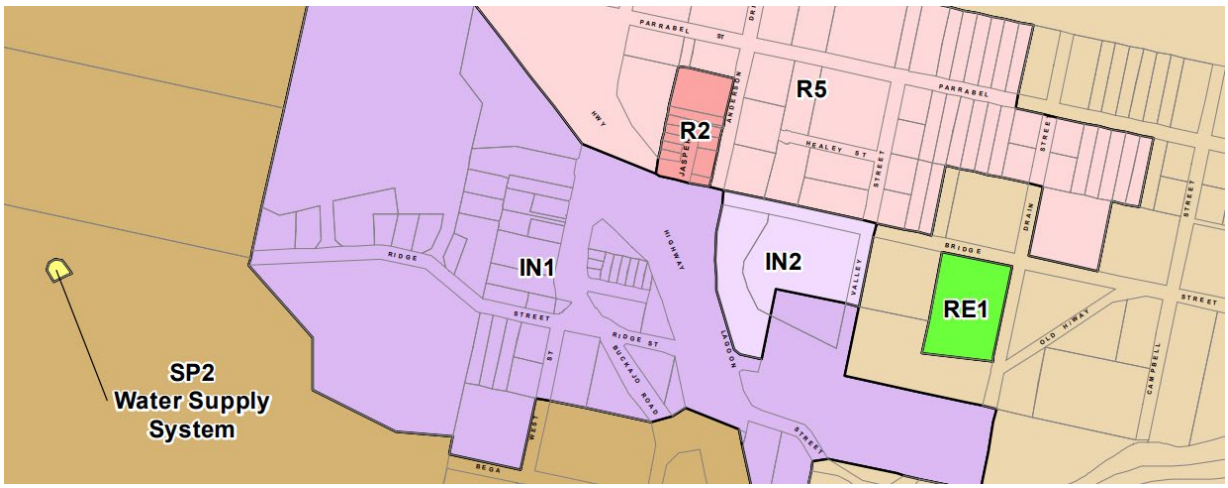

Figure 7-1 Land Zoning (BVLEP, 2013)

Table 7-1 Proposed Land Uses (Zenith Town Planning, 2023)

Proposed Land Use	LEP Definition	Permissible / Prohibited
Gift Shop / Tourism	Information and education	Permissible
	Retail premises	**Prohibited**
Offices / meeting rooms	Office premises	Permissible
	Ancillary use	Permissible
Exhibition rooms	Information and education	Permissible
café	Food and drink premises	Permissible
	Take away food and drink premises	Permissible
Amenities	Ancillary use	Permissible
Hall	**Function centre**	**Prohibited**
	Entertainment centre	**Prohibited**

Proposed Land Use	LEP Definition	Permissible / Prohibited
	Community facility	**Prohibited**
Kitchen	Ancillary use	Permissible
Storage / workshop	Ancillary use	Permissible
Auditorium	**Function centre**	**Prohibited**
	Entertainment centre	**Prohibited**
	Community facility	**Prohibited**

7.2.3 Flood Planning

The site is located within the Bega River Flood Planning Area (FPA).

The objectives for development within the FPA (which is defined in Council's DCP) are outlined in Clause 5.21 of the BVLEP. The objectives of this clause are:

- to minimise the flood risk to life and property associated with the use of land;
- to allow development on land that is compatible with the flood function and behaviour on the land, considering projected changes because of climate change;
- to avoid adverse or cumulative impacts on flood behaviour and the environment; and,
- to enable the safe occupation and efficient evacuation of people in the event of a flood.

It is stated that development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

- is compatible with the flood function and behaviour on the land;
- will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties;
- will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood;
- incorporates appropriate measures to manage risk to life in the event of a flood; and,
- will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.

The 2021 Flood Prone Land Package provided advice to Council regarding the consideration of flooding in land-use planning. Part of the package was a revision to the standard LEP instrument.

It is noted that Section 5.21 was inserted in the LEP (in July 2021) in accordance with the 2021 Flood Prone Land Package.

It is also noted that Council has opted into the optional Section 5.22 (Special Flood Considerations), which applies controls and restrictions to land beyond the FPA. The Special Considerations Clause allows for Council to implement and enforce planning controls between the FPL and the PMF.

7.2.4 Compliance with the BVLEP

A summary of relevant BVLEP requirements, and if and how the proposed development complies these requirements is provided in **Table 7-2**.

Table 7-2 Compliance with SLEP 5.21 Requirements

Consistency with the LEP Clause 5.21 Flood Planning	
Requirements	Compliance and Justification
(1) The objectives of this clause are as follows— *(a) to minimise the flood risk to life and property associated with the use of land,* *(b) to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,* *(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,* *(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.*	**Compliant**. The proposed development meets these objectives. The specific actions to achieve these objectives are documented against the proscriptive development controls below.
(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development— *(a) is compatible with the flood function and behaviour on the land, and* *(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and* *(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and* *(d) incorporates appropriate measures to manage risk to life in the event of a flood, and* *(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.*	**Compliant**. The proposal provides a site that remains flood free for events up to the FPL for both riverine and local catchment flooding. .
(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters— *(a) the impact of the development on projected changes to flood behaviour as a result of climate change,* *(b) the intended design and scale of buildings resulting from the development,* *(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,* *(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.*	**Compliant**. As discussed **in Section 3.5**, Council's draft Flood Risk Policy (2023) considers the use of ARR87 a suitable proxy for 2100 rainfall increases. Furthermore, the proposal includes: • Appropriate development (commercial) given the flood risk profile; and, • Measures to reduce risk to life and property.

Table 7-3 Compliance with SLEP 5.22 Requirements

Consistency with the LEP Clause 5.22 Flood Planning	
Requirements	Alignment
(1) The objectives of this clause are as follows— ***(a) to enable the safe occupation and evacuation of people subject to flooding,*** *(b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood,* *(c) to avoid adverse or cumulative impacts on flood behaviour,* *(d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events,* *(e) to avoid adverse effects of hazardous development on the environment during flood events.*	**Aligns**. The proposed development meets these objectives. The specific actions to achieve these objectives are documented against the proscriptive development controls below.
(2) This clause applies to— ***(a) for sensitive and hazardous development—land between the flood planning area and the probable maximum flood, and*** *(b) for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may—* *(i) cause a particular risk to life, and* *(ii) require the evacuation of people or other safety considerations.*	It is noted that this clause is triggered by the need for evacuation of people in events larger than the FPL. The site is not classed as sensitive or hazardous development.
(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority has considered whether the development— ***(a) will affect the safe occupation and efficient evacuation of people in the event of a flood, and*** *(b) incorporates appropriate measures to manage risk to life in the event of a flood, and* *(c) will adversely affect the environment in the event of a flood.*	**Compliant**. The proposed emergency response arrangements discussed in **Section 6.3** allow for the safe occupation and efficient evacuation of people in the event of a flood, and appropriately manages risk to life during these extreme events. Flood modelling of the proposed development undertaken in **Section 5.4** demonstrated that the development would not adversely affect local flood behaviour, nor affect evacuation potential.

7.3 Bega Valley Development Control Plan 2013

A Development Control Plan (DCP) gives effect to the requirements of the LEP by specifying detailed development guidelines and controls.

The primary chapter for the provision of flood controls is *Chapter 5.8 – Planning for Hazards*.

The Chapter has three objectives:

- Minimise the impacts of flooding on development within flood prone land or potentially flood prone land;
- Ensure that development on flood prone land is consistent with the objectives of the NSW Flood Prone Land Policy 1984 and the NSW Floodplain Development Manual 2005; and
- Ensure the impact of climate change is considered when assessing development on flood prone land.

A summary of relevant DCP controls, and if and how the proposed development complies these controls is provided in **Table 7-3**.

Table 7-4 Compliance with DCP Controls

Consistency with the DCP Chapter 5.8	
Requirements	Compliance and Justification
5.8.1.1 General Requirements *All new subdivision or major development applications must include the impact of 0.9m sea level rise.*	**Compliant**. As discussed in **Section 3.5**, the Bega and Brogo Rivers FRMSP (Cardno, 2018) demonstrated that 0.9m of sea level rise only resulted in a peak flood level increase of 0.01m at Bega. Sea level rise does not impact local catchment flooding.
5.8.1.2 Requirements for development at or below Flood Planning Level • *Buildings and structures will be designed and constructed with appropriate water-resistant materials.* • *Building foundations will be designed by a suitably qualified geotechnical engineer to be suitable for grounds with potentially reduced bearing capacity under flood conditions.* • *Development must comply with the principles of ecologically sustainable development taking into account floodplain ecology and integrity.* • *Any fill or excavation must be minimised and must not adversely affect neighbouring properties or the overall flood behaviour and flood storage volume.* • *Development in areas designated as flood storage is not permitted unless it can be demonstrated that there will be no decrease in net flood storage available on the site.* • *All development applications must demonstrate that the proposed structure can withstand the force of floodwater, debris and buoyancy through a report prepared by a suitably qualified and experienced engineer.* • *All habitable rooms within residential development must be at or above the flood planning level.* • *Flood free access is required for all dwellings, caravan parks, schools, hospitals, and other public building.* • *No excavated underground car parking in commercial and industrial development is permitted on land at or below the flood planning level. Ground floor parking is however appropriate.* • *All development applications for industrial and commercial development must be supported by a flood emergency plan. Appropriate warning and advisory signage must be prominently visible at entry/exit points.*	**Compliant / To be confirmed in detailed design**. Some aspects of this provision (i.e. structural design) are related to detailed design and comment on their compliance cannot be made at this time. With respect to aspects of this provision that are applicable at the planning stage, the proposal: • Minimises fill and has ensured no adverse impacts to adjacent properties; • No development in flood storage areas at or below the FPL; and, • Proposed development is supported by a Flood Emergency Plan.

7.4 Ministerial Local Planning Directions

The Minister for Planning can issue Ministerial Directions to issues directions to planning authorities about the preparation of planning schemes and amendments to planning schemes.

Planning authorities must comply with the Ministerial Direction on the Form and Content of Planning Schemes, issued under Section 9.1(2) of the *Environmental Planning and Assessment Act 1979*. The direction applies to planning scheme layout and required information – including amendments to those planning schemes – and should be read together with the Planning Provisions.

On 1 March 2022, revised Local Planning Directions were issued relating to, in part, flood resilience and hazard. The Directions (Direction 4.1 Flooding) were issued to commence 1 March 2022 (replacing previous Direction 4.3).

The objectives of this direction are to:

(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, 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.

A summary of if and how the proposed development complies these directions is provided in **Table 7-4**.

Table 7-5 Compliance with Ministerial Direction 4.1

Consistency with Ministerial Direction 4.1	
Requirements	Compliance and Justification
(1) A planning proposal must include provisions that give effect to and are consistent with: *(a) the NSW Flood Prone Land Policy,* *(b) the principles of the Floodplain Development Manual 2005,* *(c) the Considering flooding in land use planning guideline 2021, and* *(d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.*	**Compliant**. The FIRA has been prepared with reference to relevant plans and policies, and to adopted floodplain risk management studies. The 2023 Floodplain Risk Management Manual has been referenced in place of the 2005 Manual.
(2) A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Business, Industrial or Special Purpose Zones.	**Compliant**. The proposal does not seek to rezone these land uses.
(3) A planning proposal must not contain provisions that apply to the flood planning area which: *(a) permit development in floodway areas,* *(b) permit development that will result in significant flood impacts to other properties,* *(c) permit development for the purposes of residential accommodation in high hazard areas,* *(d) permit a significant increase in the development and/or dwelling density of that land,* *(e) permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes,*	**Compliant**. Within the flood planning area, the development does not: • Permit development in 1% AEP floodway areas; • Result in significant impacts to other properties; • Include residential development; • Include any flood sensitive land uses;

Consistency with Ministerial Direction 4.1	
Requirements	Compliance and Justification
hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate, *(f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent,* *(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, or* *(h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.*	• Permit development to be carried out without development consent; • Increase emergency management requirements for events up to the FPL.
(4) A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which: *(a) permit development in floodway areas,* *(b) permit development that will result in significant flood impacts to other properties,* *(c) permit a significant increase in the dwelling density of that land,* *(d) permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,* *(e) are likely to affect the safe occupation of and efficient evacuation of the lot, or* *(f) are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.*	**Compliant** The proposed land use does not fall within the list to which Special Flood Considerations apply.
(5) For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.	**Compliant**. The Bega Centre FIRA has been prepared in accordance with the *Flood Impact and Risk Assessment Flood Risk Management Guideline LU01* issued as part of the *Flood Risk Management Manual* (State of NSW and Department of Planning and Environment, 2023)
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, 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*	**Compliant**. A Floodplain Risk Management Study and Plan have been prepared for riverine flooding. This preceding study has been utilised as appropriate in this FIRA. An additional flood model has been developed for the local catchment in accordance with the *Flood Risk Management Manual* (State of NSW and Department of Planning and Environment, 2023), as no prior study was available to define this flood

Consistency with Ministerial Direction 4.1	
Requirements	Compliance and Justification
prepared in accordance with the principles of the Floodplain Development Manual 2005 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 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.*	behaviour. The local catchment model has been prepared using the same methodology and model parameters as the riverine risk management study.

8 Conclusion and Findings

8.1 Study Process and Deliverables

The National Circulatory Centre Flood Impact and Risk Assessment (FIRA) has been prepared for the Regional Circularity Cooperative Limited to define the existing flood behaviour in the catchment and to assess, and address, if necessary, the potential impacts arising from the future development of the site.

This report has been prepared to provide the flood assessment associated with a Planning Proposal for the site and, in doing so, considers Local Planning Direction 4.1 Flooding (March 2022).

Bega Group, with funding support from the NSW Government, is proposing to develop a portion of their North Bega site with a new information and education centre. The development is comprised of:

- Heritage, history, and education exhibits;
- Restaurant;
- Tourist Information;
- Gift Shop;
- Museum;
- Function space; and,
- Associated storage, facilities, and parking.

A preliminary rendering of the proposed development is shown in **Figure 1-2**.

A Planning Proposal was submitted for the development, at which stage comments were raised by Department of Planning and Environment (DPE) as to potential flood risks to occupants and infrastructure. The Planning Proposal was subsequently rejected due to uncertainties about the level of flood risk and its management.

The FIRA was required to establish:

- If the developed resulted in adverse impacts to existing infrastructure or development;
- The impacts of the proposed development on the flood risk to the existing community
- The impacts and risks of flooding on the development and its users
- How these impacts can be managed to minimise the growth in risk to the community due to the development.

To undertake this assessment:

- A review was undertaken of available data and studies. Of particular relevance was the *Bega and Brogo Rivers Floodplain Risk Management Study and Plan* (Cardno, 2018) which was used to define the riverine flood behaviour.
- A local catchment flood model was constructed to define the flood behaviour arising from local catchment events.
- The existing flood behaviour (depth, levels, velocity, and hazard) were defined for both the local catchment and riverine flood events.
- An iterative assessment of potential landforms was undertaken to determine a landform that was feasible and did not result in adverse flood impacts.
- A review of flood risk across the Precinct was undertaken.

- An assessment was undertaken to examine flood warning time and potential emergency response and evacuation for the Precinct.
- A review was undertaken of Council's existing plans and policies and Local Planning Direction 4.1 (March 2022) to ensure that the proposed Precinct development is compatible with these controls.

8.2 Findings

As a result of the assessments undertaken as part of this study it was found that:

Flood risk is primarily mitigated through:

- Raising the building pad to the FPL was sufficient to prevent flooding of the site for all local catchment flood events, up to and including the PMF.
- Overland flow through the site was managed by a depressed vegetated corridor, with additional capacity provided for the PMF by allowing flow through the adjacent carpark.

In achieving flood mitigation through site raising, no significant flood impacts result on adjacent properties.

The confidence in the flood modelling was confirmed through sensitivity testing:

- Sensitivity testing demonstrated that the flood behaviour and risk through and surrounding the site was not significantly affected by culvert blockage assumptions;
- Local catchment PMF flooding was found to be somewhat sensitive to the roughness of the proposed overland flow path. It is recommended that the proposed vegetation types and densities in this region keep this in mind to ensure sufficient conveyance is provided for the PMF to prevent overtopping of the building pad.

The recommended emergency response for the site was:

- Evacuation for riverine flood events; and,
- Shelter in place for local catchment flood events.

Sufficient warning time was found to be available from existing riverine gauges to enable evacuation of the site in advance of a riverine flood. Further warning time would be available if rainfall forecasts were used to inform site closure and evacuation.

It is acknowledged that despite the mitigation measures above there is a significant residual flood risk from rare and extreme riverine flood events that cannot be mitigated. PMF flood depths of approximately 6m occur across the site.

Overall, the development was found to be compliant with all planning and development controls and the requirements of the Local Planning Direction 4.1.

9 References

Cardno. (2018). *Bega River Floodplain Risk Management Study and Plan.*

DPE. (2023). *Draft Shelfter in Place Guidelines.*

State of NSW and Department of Planning and Environment. (2023). *Flood Risk Management Manual: The policy and manual for the management of flood liable land.* Parramatta NSW: Environment and Heritage Group, Department of Planning and Environment.

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