



Job Number: 190038
Date: 19 March 2021

Michael Cahalane
Warren Smith & Partners
Level 9, 233 Castlereagh Street
Sydney, NSW, 2000

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 432 477 036
www.grchydro.com.au

Dear Michael,

Re: Kellicar Precinct, Planning Proposal - Flood Policy and Risk Management Strategy Overview

GRC Hydro has been engaged by Warren Smith & Partners to assess the flood characteristics at the Kellicar Road Precinct, Macarthur. As per the Gateway Determination, *'the planning proposal must be amended to:*

- (a) Include the findings of a detailed flood impact assessment for the site and update the consistency of section 9.1 Direction 4.3 Flood Prone Land.'*

This advice presents a framework for the ongoing practical consideration of flood impacts relevant to the Kellicar Road Precinct.

Introduction

The Kellicar Precinct site is located in Campbelltown to the west of the CBD. The 7 Ha site is bound by Kellicar Road to the south, Menangle Road to the north, Narellan Road to the east and Glichrist Drive to the west.

Birunji Creek runs through the site from south to north between Tindall Street and Narellan Road, as a closed culvert system within a 10m wide drainage easement. Immediately south of Kellicar Road, upstream of the development site, Birunji Creek is formalised in an open wetland. Downstream of the site, Birunji Creek discharges through a bridge under the Sydney Trains Main South Line and into Bow Bowling Creek.

Flood modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. Flood characteristics for the site have been assessed based on CSS model results and are discussed below.

Flood Characteristics

Flood characteristics at the site were provided by CSS as TUFLOW model results. The following mapping has been produced for Existing Conditions:

- Figure 1: Existing Conditions – 1% AEP Flood Depth and Levels / Hazard;
- Figure 2: Existing Conditions – 0.1% AEP Flood Depth and Levels / Hazard; and
- Figure 3: Existing Conditions – Probable Maximum Flood Depth and Levels / Hazard.

Flood hazard was calculated in accordance with the Australian Emergency Management Handbook 7 Guideline and ARR2019. A description of the various vulnerability thresholds is presented in Table 1.

Table 1: Flood Hazard – Vulnerability Thresholds

Hazard Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles, children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Existing flood characteristics at the site are summarised below:

- 1% AEP flood characteristics – are noted to be typically shallow overland flows with a H1 hazard classification and are due to local drainage catchments. Birunji Creek flows are fully contained within the previously mentioned closed culvert system, until they discharge to the north of the site near Menangle Road, upstream of the Sydney Trains Main South Line. At this location, some ponding occurs upstream of the Main South Line. Flooding also occurs at a trapped sag on Tindall Street where local catchment flows combined with elevated tailwater conditions and result in flood depths of up to 0.8 m over a limited extent.
- 0.1% AEP flood characteristics – shallow drainage flows are experienced in areas to the west of Tindall Street. Hazardous flooding occurs in the area between Tindall and Narellan Road, with a significant flow path forming through the car park of the Marketfair site (H5 hazard). The Marketfair site car park has approximately 250 parking spaces and flooding of this area is associated with a significant degree of flood risk under existing conditions. Kellicar Road experiences flood hazard up to H5 and is not trafficable.
- Probable Maximum Flood (PMF)¹ characteristics – the area from Tindall Street to Narellan Road is affected by significant flood depths ranging between 2 to 3.5 m. Areas of high hazard flooding are noted on Tindall Street and the Marketfair site car park flow path with an associated H5-H6 hazard classification.

Post development flood characteristics were modelled in TUFLOW by CSS by removing existing buildings within the site and incorporating the Masterplan building layout (presented in Attachment A) into the model. An extreme event overland flow path was allowed for along the eastern site boundary through the new Narellan Park, with general lowering of ground surface elevations incorporated to form an informal swale. The existing Birunji Creek culverts through the site were diverted around the building footprint following the alignment of the above-mentioned swale. Council required that the buildings be modelled as 100% impermeable, which does not allow for storage within the building footprint.

Post Development Conditions flood characteristics are presented in the following maps:

- Figure 4: Post Development Conditions – 1% AEP Flood Depth and Levels / Hazard;
- Figure 5: Post Development Conditions – 0.1% AEP Flood Depth and Levels / Hazard; and

¹ The PMF is the largest flood that could conceivably occur at a particular location. The expected probability of such an event for Birunji Creek at Kellicar Road is in the order of one in 10,000,000 (Generalised Short Duration Method, Bureau of Meteorology, 2003).

- Figure 6: Post Development Conditions – PMF Depth and Levels / Hazard.

Limited differences in flood behaviour relative to Existing Conditions are noted in the 1% AEP event, as mainstream flows are contained within the diverted culverts (see Figure 4). For events rarer than 1% AEP, the Marketfair site flow path is shifted east into the new Narellan Park. The Marketfair site car park is removed thus mitigating the associated flood risk. Increased conveyance capacity through the new Narellan Park results in decreases in flood level in the 0.1% AEP event, however, small increases in flood level are expected in the PMF.

Comparison of pre and post development conditions is presented in the mapping detailed below. These maps show the expected change in peak flood level and flood hazard associated with the proposed Masterplan configuration:

- Figure 7: Flood Impact Mapping – 1% AEP Levels / Hazard Impacts;
- Figure 8: Flood Impact Mapping – 0.1% AEP Levels / Hazard Impacts; and
- Figure 9: Flood Impact Mapping – PMF Levels / Hazard Impacts.

Expected flood impacts at the site are summarised below:

- 1% AEP flood impacts associated with the development are negligible (see Figure 7). Localised changes in flood behaviour within the development site can be managed through appropriate stormwater and landscaping design.
- Widespread reductions in flood levels are noted in the 0.1% AEP event both within the site and upstream (see Figure 8). A localised area of increased flood level on Kellicar Road (< 0.1 m) is shown, however, trafficability is unaffected as the road already experiences high hazard flooding under Existing Conditions (up to H5). Existing development on the south-west corner of Kellicar Road and Centennial Drive experience reduced flood levels. An increase in flood hazard through Narellan Park is presented in the mapping, however, this is due to the shifting of the existing Marketfair car park flow path to the east (i.e. the overall hydraulic hazard is not increased, it is only moved in location).
- PMF flood impacts are noted on Kellicar Road and upstream. Flood level increases of less than 0.2 m are shown by the modelling (see Figure 9) on Kellicar Road. These increases are experienced in an area already subject to significant flood depths ranging between 1.4 to 1.8 m and are not associated with an increase in flood hazard. Increases in flood level of less than 0.1 m are shown proximate to existing development on the south-west corner of Kellicar Road and Centennial Drive, however, are associated with limited/localised changes in flood hazard.

Negligible flood impacts are expected for events up to and including the 1% AEP event. This is consistent with the requirements for typical State Significant Development (SSD) projects for flood related Conditions of Approval (CoA). For events rarer than 1% AEP, limited flood level and hazard impacts are expected.

Planning Policy Overview

The Section 9.1 Direction 4.3 *'applies when a relevant planning authority prepares a planning proposal that creates, removes or alters a zone or a provision that affects flood prone land'*. The Direction aims to ensure that *'the development of flood prone land is consistent with NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005'* (FDM, 2005), including the principles of Planning Circular PS 07-003, *'Guideline on development controls on low risk flood areas'*.

The FDM (2005) *'promotes the use of a merit approach which balances social, economic, environmental and flood risk parameters to determine whether particular development or use of the floodplain is appropriate and sustainable'* and aims to *'avoid the unnecessary sterilisation of flood prone land'*.

Direction 4.3 states that *'a planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-General'* and that a *'planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005'*.

Direction 4.3 states that, *'a planning proposal may be inconsistent with this direction only if the relevant planning authority can satisfy the Director-General (or an officer of the Department nominated by the Director-General) that', 'the planning proposal is in accordance with a floodplain risk management plan prepared in accordance with the principles and guidelines of the Floodplain Development Manual 2005'*.

Planning Circular PS 07-003, 'Guideline on development controls on low risk flood areas' outlines a set of guidelines for *'flood-related development controls on residential development on land above the 1-in-100 year flood and up to the Probable Maximum Flood (PMF)'*. The Guideline confirms that:

- *'unless there are exceptional circumstances, councils should adopt the 100-year flood as the FPL for residential development; and*
- *unless there are exceptional circumstances, councils should not impose flood related development controls on residential development on land above the residential FPL.'*

Review of the Bow Bowling Bunbury Curran Creek Strategic Floodplain Risk Management Study and Plan (BBBCFRMSP, Molino Stewart, 2018) found that there is a recommendation for applying for exceptional circumstances, however this pertains only to the application of a variable freeboard as per the guidelines in Table 2.8.1 of the Campbelltown Development Control Plan (CDCP, 2015). The maximum required freeboard in Table 2.8.1 is 500 mm above the 1% AEP event. In addition, BBCFRMSP does not recommend changes to the land use zoning of the site and states that, the *'next level of strategic planning solution is to rezone the land to permit development which lifts development above the flooding or enables it to span the flooding. This could, for example, involve rezoning the land to permit high rise development instead of low rise'*. The proposed Masterplan is consistent with the strategy presented by Council's floodplain risk management study.

Further to this, Section 7.2 'Flood Planning', of the Campbelltown Local Environmental Plan 2015 (CLEP), *'applies to land at or below the flood planning level'* with *'the flood planning level'* classified as the *'1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard'*.

Accordingly, assessment of Kellicar Road Planning Proposal must necessarily have consideration for the nominated flood planning level of the *'1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard'* as per Council's LEP and the requirements of the Section 9.1 of Direction 4.3.

Recent Policy Updates

In June 2020, the Department of Planning, Infrastructure & Environment (DPIE) exhibited a draft Flood Prone Land Package which includes a draft Local Planning Direction and a draft Planning Guideline for the consideration of flooding in land use.

The draft Local Planning Direction prescribes, inter alia, that land should not be rezoned to permit development in a floodway, or development that will result in significant flood impacts to other properties or which permits a significant increase in the dwelling density in a high hazard areas. Further, the Direction requires that a council's Flood Planning Level(s) must be consistent with the Floodplain Development Manual 2005 (or its update) or as otherwise determined by an adopted Floodplain Risk Management Study.

It is noted that in the subject case the Kellicar Road Planning proposal does not seek to rezone the land to permit development – it merely seeks to increase the height of building restriction that applies to development on the land². Increasing building height restrictions is consistent with strategic planning advice outlined in Council's floodplain risk management study (BBBCFRMSP, Molino Stewart, 2018). Further, the site experiences limited flood liability in the 1% AEP and is thus not situated within a floodway or high hazard area during Council's nominated design flood event.

The draft Planning Guideline reinforces the purpose and usefulness of a flood risk management (FRM) process to understand the implication of flood events, up to and including the PMF, in considering the development of flood-prone land. The Guideline nominates the 1% AEP flood event (plus freeboard) as the appropriate flood planning level and the area of land beneath this level as the Flood Planning Area (FPA), where the majority of flood-related development controls apply. The Guideline allows Councils to set a different FPL where the merit of such an approach is demonstrated and documented.

The Guideline also identifies other categories of flood management – a Regional Evacuation Consideration Area (RECA) and a Special Flood Considerations (SFC) category – these allow for areas of land to be identified for special evacuation consideration and/or for specific controls to be developed for flood events between the FPL and the PMF. These typically relate to the identification and prohibition of sensitive, vulnerable or critical land uses. The Guideline suggests that circumstances defined through an FRM process where development controls might be needed to address risk to life may include areas where development is isolated by floodwaters and terrain for an extended period, areas where development may have evacuation capacity limitations and areas impacted by either high hazard or/and H3 to H6 hazard vulnerability thresholds in the PMF and are unable to safely evacuate.

In the subject case Council's FPL remains at the 1% AEP + 500mm freeboard level and no action has been taken thus far, or suggested to be taken, to nominate the Campbelltown-Macarthur city centre as a Regional Evacuation Consideration Area (RECA). Similarly, there is no policy direction from Council that requires special consideration of events rarer than the FPA.

Notwithstanding, for the subject site and for the purpose of advancing Council's consideration of the Kellicar Road Planning Proposal, additional consideration of flood risk due to flood events exceeding the flood planning level is prudent given the location of Birunji Creek and the flood liability of areas of the site during extreme events.

² The subject land is zoned B4 Mixed Use under Campbelltown LEP 2015. Prior to the current LEP the land (and other nearby land at Macarthur) was zoned 10(a) Regional Comprehensive Centre, reflecting its primary status within the hierarchy of centres across the Campbelltown LGA. Relevant objectives of the 10(a) 'regional centre' zoning included:

- a) to provide land for the City of Campbelltown and the Macarthur region's largest centre of commerce, and
- b) to encourage employment and economic growth.

Under current and previous zonings, the subject land has long been identified for intensive urban development.

Management of Residual Flood Risk

As previously described, part of the Kellicar Road Precinct between Tindall Street and Narellan Road is subject to significant flood hazard during events rarer than the 1% AEP flood. The probability of occurrence of these types of events is low, however, the consequence of major flooding may be significant if appropriate design and risk management measures are not incorporated into development of the site. Risk due to events rarer than the 1% AEP is known as 'residual flood risk'.

The current Masterplan proposes a Retail Anchor for the areas subject to residual flood risk to the east of Tindall Street. The finished floor level of the Retail Anchor is proposed at the FPL which is slightly above existing ground level, with residential development situated above the Retail Anchor and above PMF flood level. Positioning of residential development above the FPL and PMF flood level reduces the risk to occupants and exceeds the requirements of the Section 9.1 Direction 4.3.

The placement of commercial development at ground level also provides opportunity for the management of flood risk through a coordinated response overseen by the building managers. Development on the flood affected part of the precinct would be expected to have the following plans in place:

- Flood risk management plans;
- Evacuation plans; and
- Flood Emergency response plans.

As the Birunji Creek catchment is small and catchment response times are quick, outcomes of these steps and procedures will most likely result in a shelter-in-place evacuation strategy, with the proposed multi-storey development potentially suitable for vertical evacuation due to the large areas available for refuge above the level of the PMF. High level walkways or similar (see 'Suggested Flood Related Development Controls' section below) could allow for flood access and egress as well as access for emergency services personnel.

It must be noted that the illustrative Masterplan that accompanies the Planning Proposal is indicative of future development across the precinct. Through application of appropriate planning controls, however, flood risk management measures can be incorporated into the design of any future development of the site. The site's development for urban purposes envisaged by the Kellicar Road Masterplan, or any similar masterplan, can be developed to provide both user and public safety through application of the suggested flood related development controls discussed below.

Planning controls should aim to ensure that development is sympathetic to the flood risk at the site and would be expected to include provision for:

- An extreme event overland flow path for events exceeding the capacity of the Birunji Creek stormwater system;
- Basement access from above the level of PMF to ensure that the ingress of flows cannot occur. Access could potentially be from flood free areas to the west of Tindall Street, or from the first floor of the Retail Anchor (which is above the PMF level);
- Publicly accessible refuge areas above the PMF level;
- Rising DDA access to refuge areas (both internal and external to the site), that are easily accessible, even during extreme weather events where loss of power may be an issue. These would potentially be informal ramps, both internal and external to the building, that allow passive access to the above-mentioned refuge area as flood waters rise;

- Incorporation of flood gates to mitigate the ingress of flow once the finished floor level of the building is overtopped; and
- High level walkways between residential towers, refuge areas and areas outside of the PMF extent to allow emergency access and egress.

Suggested Flood Related Development Controls for the Kellicar Road Precinct

The flood risk management measures presented as part of the planning proposal should be applied at the Development Application stage through Council's implementation of the site-specific Kellicar Road Precinct DCP. The following proposed DCP controls aim to ensure responsible development of the site in a manner commensurate with its level of flood risk.

Suggested controls are as follows:

Floor Level Controls

- Floor level controls as per the CDCP (2015);
- Provision of a publicly accessible refuge area is to be provided above the PMF for developments within the FPA.

Building Components and Methods

- All structures are to have flood compatible building components below the FPL;
- Demonstration that structures can withstand the forces of floodwater, debris and buoyancy is required;
- Provision of overland flow paths for events exceeding the capacity of the stormwater system.

Car Parking

- Basement car parking and other underground spaces shall be protected from inundation for events up to the PMF;
- Flood free pedestrian access to parking areas shall be provided.

Evacuation

- Rising DDA access is required from all areas of the development to a refuge area above the level of the PMF;
- Rising DDA access is required from public spaces and roads surrounding the development to a refuge area above the level of the PMF;
- Flood free pedestrian access is to be provided to areas outside of the floodplain, above the level of the PMF;
- The development is to be consistent with the relevant local flood evacuation strategies;
- The evacuation requirements of the development are to be considered up to the PMF level.

Management and Design

- A site-specific flood risk management plan is to be prepared for developments on land within the FPA;
- Site-specific Flood Emergency Response and Evacuation Plans are to be prepared for developments on land within the FPA.

Conclusions

This advice presents a framework for the ongoing practical consideration of flood impacts relevant to the Kellicar Road Precinct.

The relevant flood planning level for the site is the 1% AEP flood event plus 0.5 metre freeboard. All proposed buildings across the Kellicar Road Precinct will be set at or above this minimum level. The culvert system that traverses the site adequately accommodates 1% AEP flows and deviation of the stormwater system shall ensure the conveyance capacity is maintained. Negligible flood impacts are expected for events up to and including the 1% AEP event which is consistent with typical State Significant Development Conditions of Approval.

For very rare to extreme events, provision of a flow path through Narellan Park manages flood impacts for events up to the PMF. Whilst minor (<0.2 m) flood level increases are noted, appropriate design and planning controls can be implemented to manage the site's residual flood risk.

The development of the site as an urban precinct allows for the incorporation of such controls into the layout and arrangement of buildings, enabling floor levels to be set at relevant levels that provide both user and public safety.

In particular, for that part of the site that is most affected by extreme flood events, it is possible for residential towers to be positioned above a retail/commercial podium such that all residential floor levels are above the PMF. Additional risk management strategies, incorporated into the design through implementation of proposed flood related development controls, further reduces flood risk during extreme events. A reduction in flood risk relative to existing conditions at the site can be achieved through appropriate application of the proposed controls.

Whilst flood modelling shows that areas of the site are subject to residual flood risk, development of the site for urban purposes has always been anticipated and is not changed by the current Kellicar Road Precinct Planning Proposal.

The planning proposal seeks to adjust the site's height of building control but does not change its underlying zoning, nor does it increase the site's development capacity. It merely seeks to demonstrate that a high-quality public domain can be achieved for the site if coupled with taller buildings. The '*rezoning of land to permit high rise development*' is consistent with the strategic planning strategy presented in Council's floodplain risk management study (BBBCFRMSP, Molino Stewart, 2018).

The arrangement of buildings presented by the planning proposal's illustrative masterplan is indicative of the site's future development and may itself be modified prior to development occurring. Notwithstanding the form of future development across the site, it is critical that development of the precinct is sympathetic to flood risk and includes provision for appropriate building floor levels, public refuge areas, protection of underground carparks and appropriate evacuation measures, as outlined in this report.

Provided these measures are adopted, the development of the site as an urban precinct is consistent with the Section 9.1 Direction 4.3 Flood Prone Land directives.



Yours Sincerely

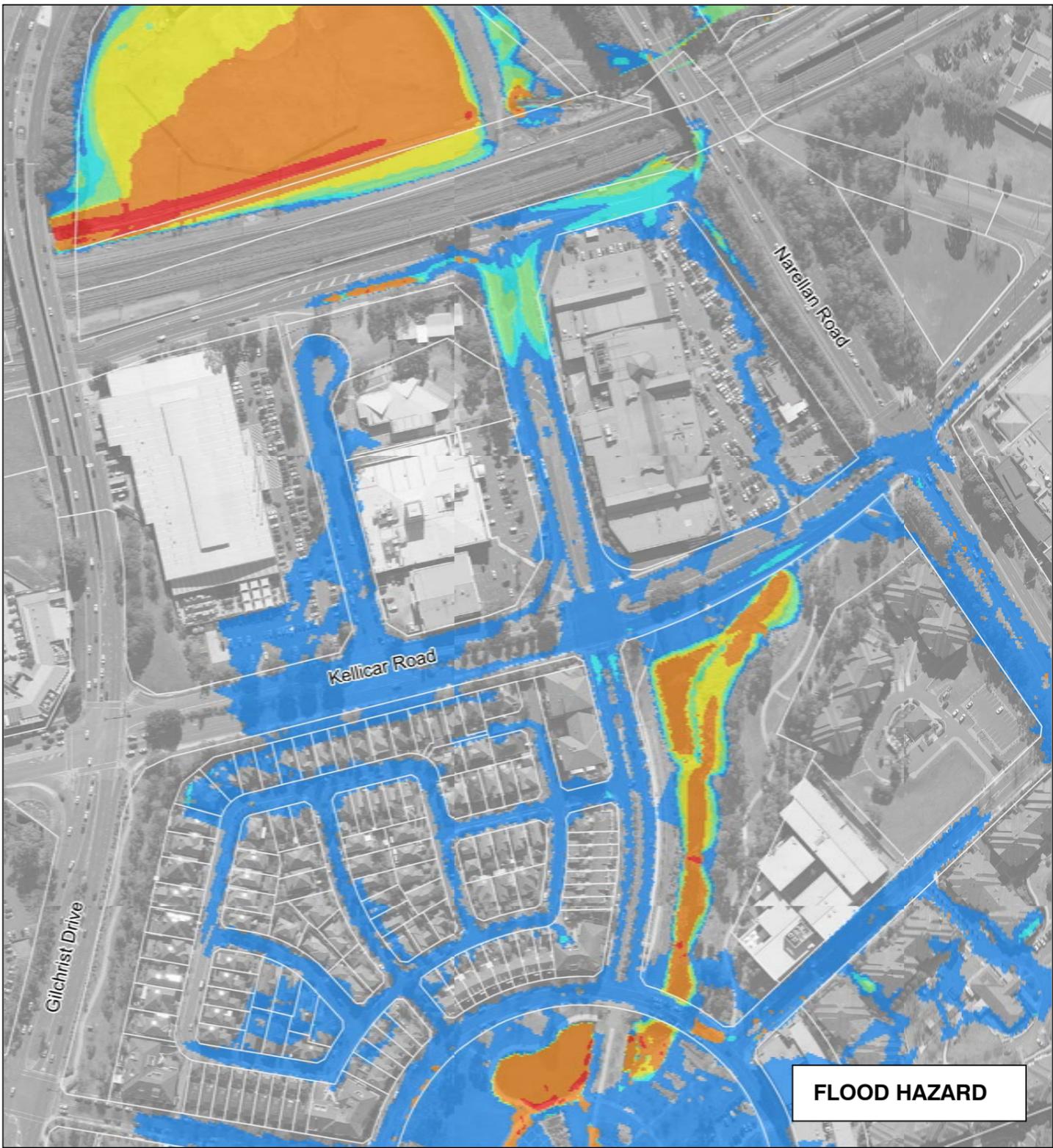
Zac Richards

Director

Email: richards@grchydro.com.au

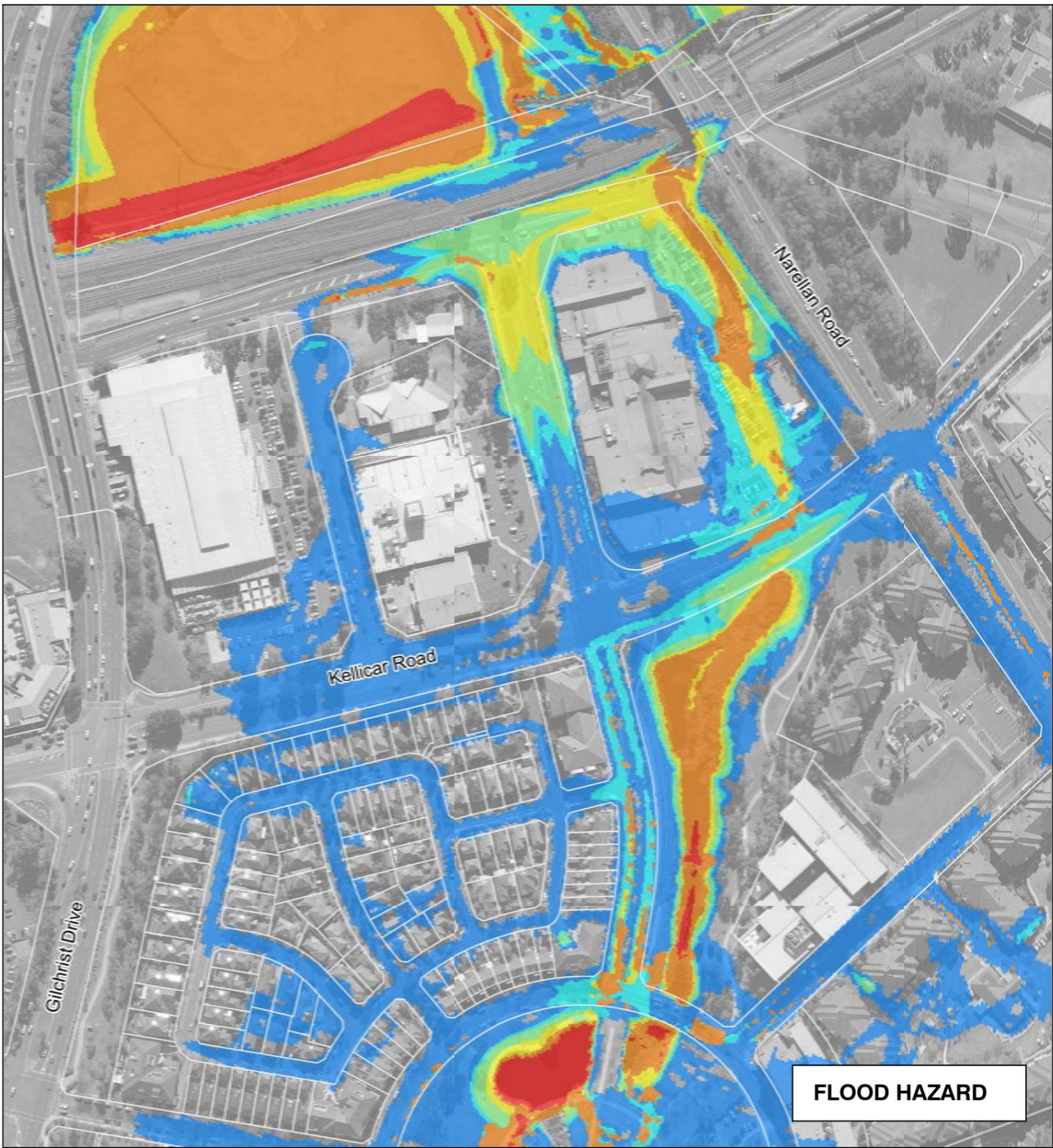
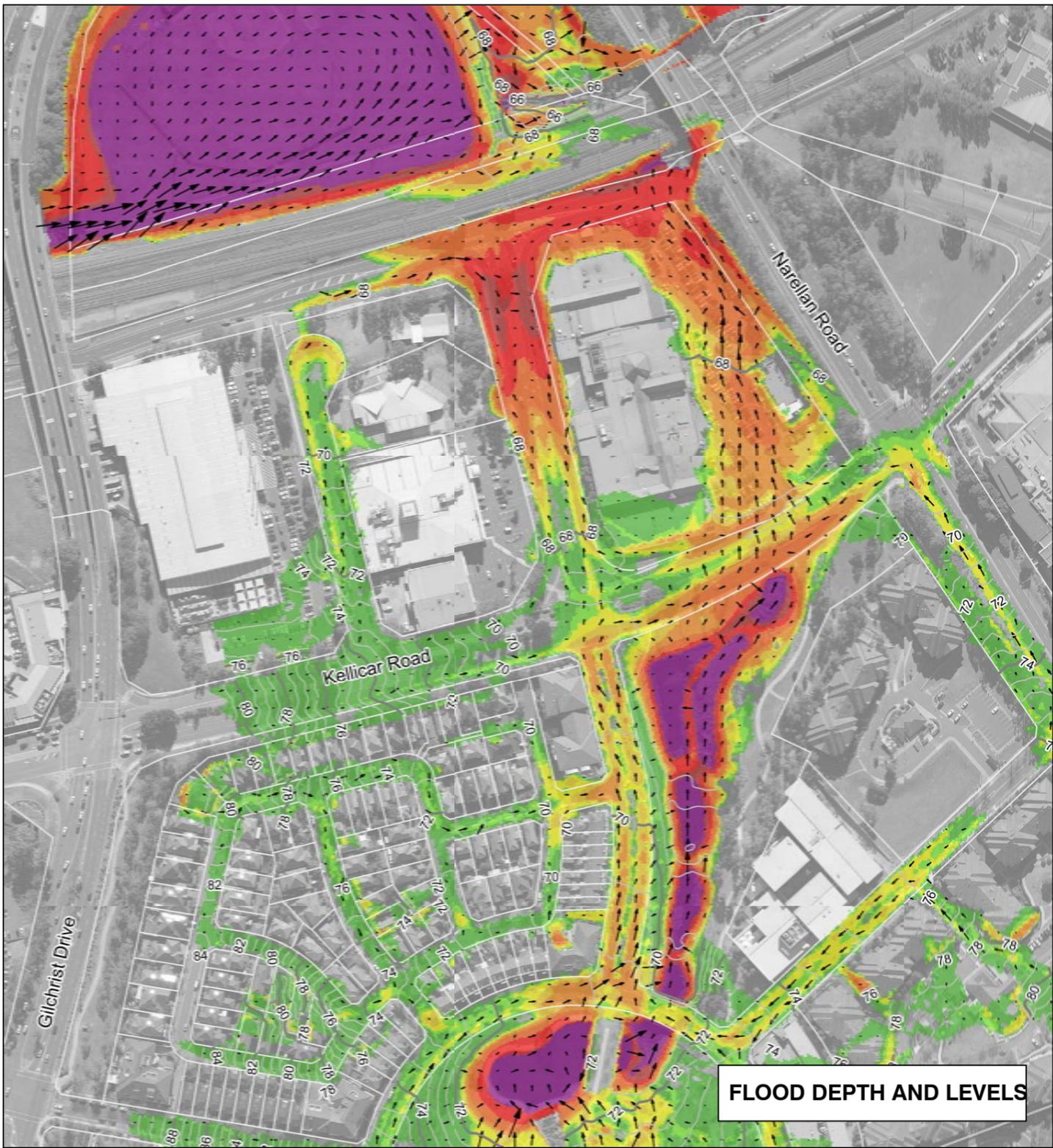
Tel: +61 432 477 036

Figures



<ul style="list-style-type: none"> Cadastral Boundaries Flood Level Major Contour (Spacing = 2m) Flood Level Minor Contour (Spacing = 0.5 m) 	<p>Flood Depths (m)</p> <table border="0"> <tr> <td style="background-color: #00FF00; width: 20px; height: 10px;"></td> <td>0 to 0.05</td> <td style="background-color: #800000; width: 20px; height: 10px;"></td> <td>1.5 to 2.0</td> </tr> <tr> <td style="background-color: #00FF00; width: 20px; height: 10px;"></td> <td>0.05 to 0.1</td> <td style="background-color: #800080; width: 20px; height: 10px;"></td> <td>> 2.0</td> </tr> <tr> <td style="background-color: #FFFF00; width: 20px; height: 10px;"></td> <td>0.1 to 0.2</td> <td></td> <td></td> </tr> <tr> <td style="background-color: #FFA500; width: 20px; height: 10px;"></td> <td>0.2 to 0.3</td> <td></td> <td></td> </tr> <tr> <td style="background-color: #FF4500; width: 20px; height: 10px;"></td> <td>0.3 to 0.5</td> <td></td> <td></td> </tr> <tr> <td style="background-color: #FF0000; width: 20px; height: 10px;"></td> <td>0.5 to 1.0</td> <td></td> <td></td> </tr> <tr> <td style="background-color: #FF0000; width: 20px; height: 10px;"></td> <td>1.0 to 1.5</td> <td></td> <td></td> </tr> </table>		0 to 0.05		1.5 to 2.0		0.05 to 0.1		> 2.0		0.1 to 0.2				0.2 to 0.3				0.3 to 0.5				0.5 to 1.0				1.0 to 1.5			<p>Flood Hazard</p> <table border="0"> <tr> <td style="background-color: #0000FF; width: 20px; height: 10px;"></td> <td>H1</td> </tr> <tr> <td style="background-color: #00FFFF; width: 20px; height: 10px;"></td> <td>H2</td> </tr> <tr> <td style="background-color: #90EE90; width: 20px; height: 10px;"></td> <td>H3</td> </tr> <tr> <td style="background-color: #FFFF00; width: 20px; height: 10px;"></td> <td>H4</td> </tr> <tr> <td style="background-color: #FF8C00; width: 20px; height: 10px;"></td> <td>H5</td> </tr> <tr> <td style="background-color: #FF0000; width: 20px; height: 10px;"></td> <td>H6</td> </tr> </table>		H1		H2		H3		H4		H5		H6			
	0 to 0.05		1.5 to 2.0																																										
	0.05 to 0.1		> 2.0																																										
	0.1 to 0.2																																												
	0.2 to 0.3																																												
	0.3 to 0.5																																												
	0.5 to 1.0																																												
	1.0 to 1.5																																												
	H1																																												
	H2																																												
	H3																																												
	H4																																												
	H5																																												
	H6																																												

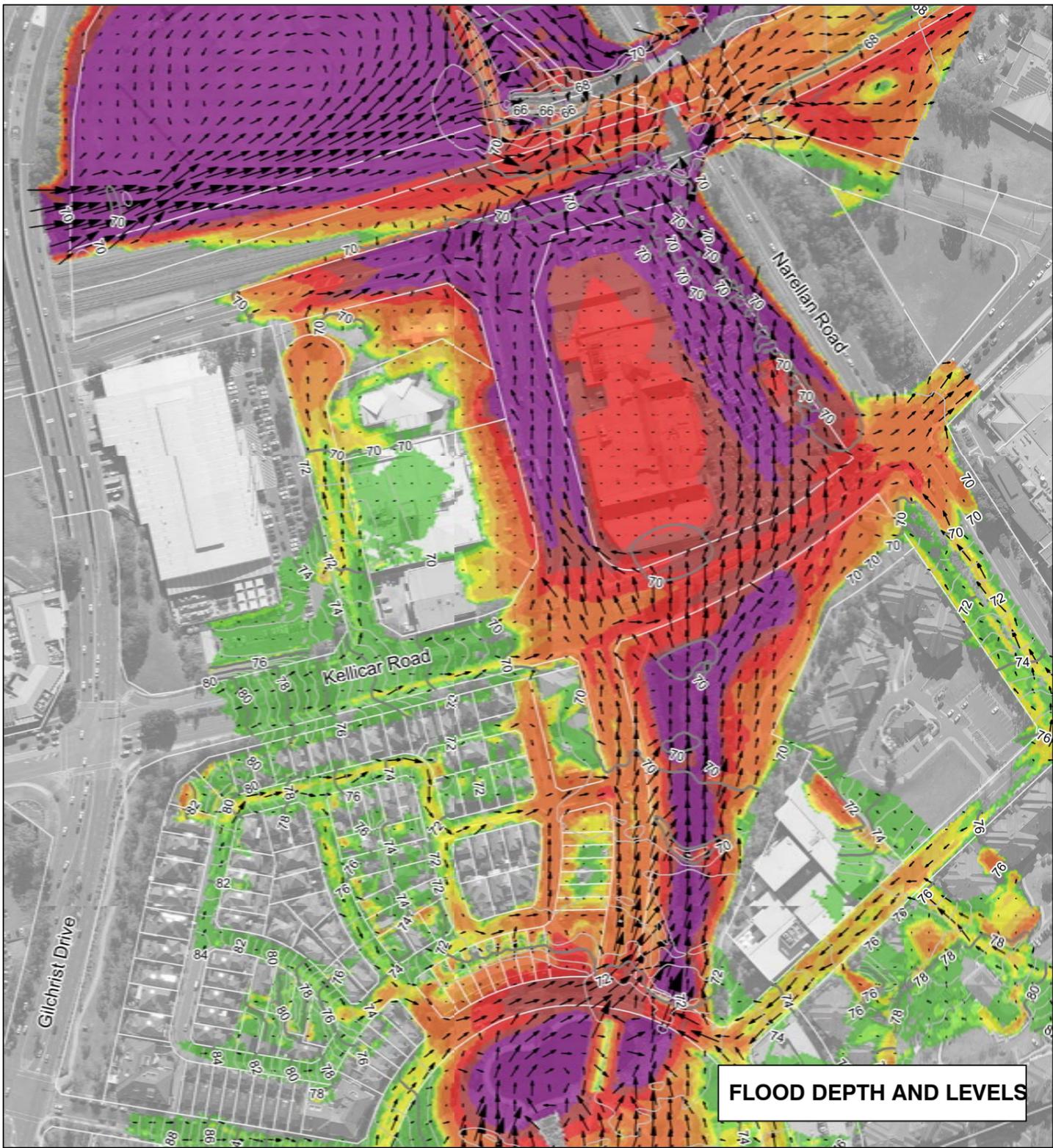
Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



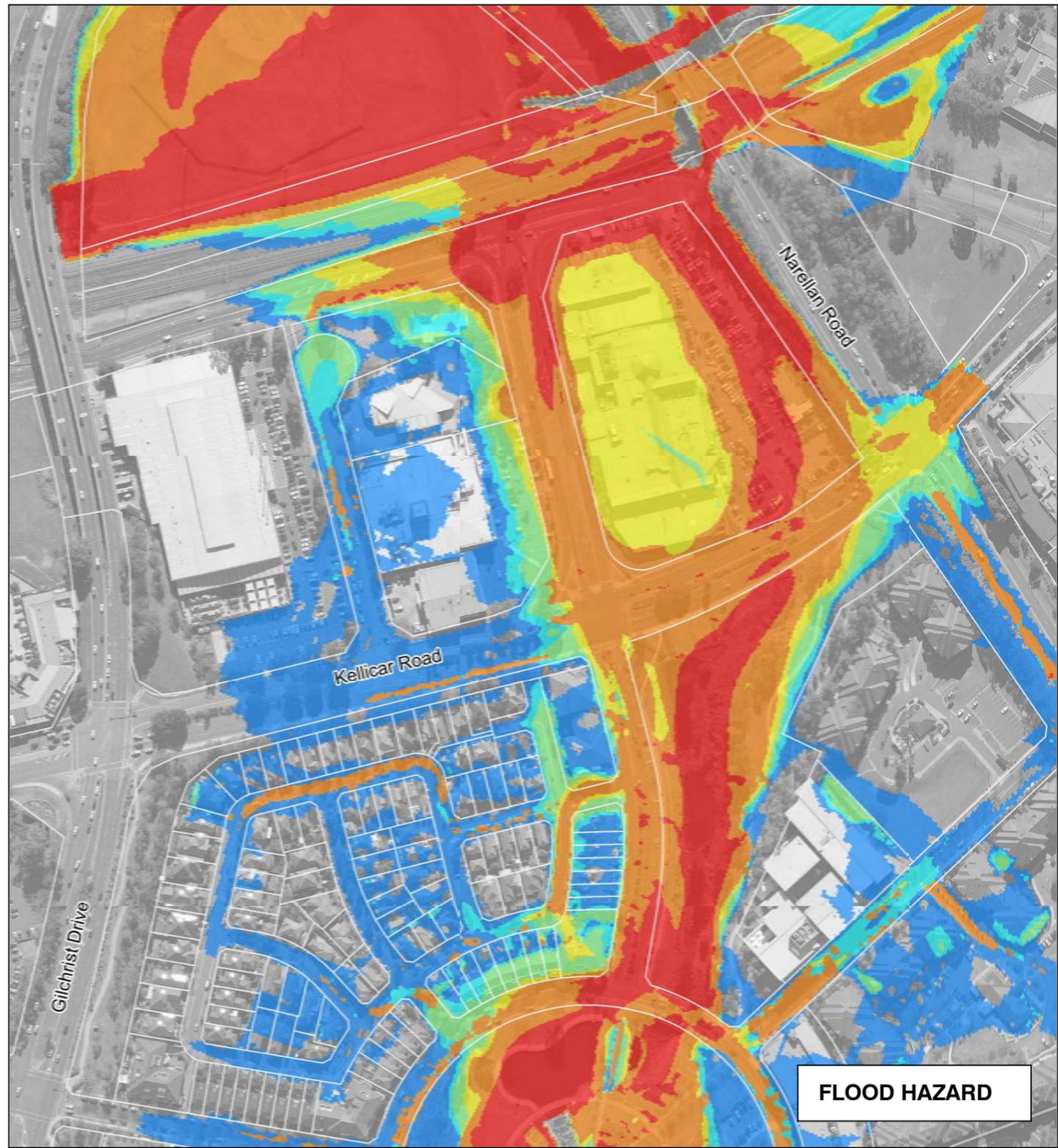
<ul style="list-style-type: none"> Cadastral Boundaries Flood Level Major Contour (Spacing = 2m) Flood Level Minor Contour (Spacing = 0.5 m) 	<p>Flood Depths (m)</p> <table border="0"> <tr> <td></td><td>0 to 0.05</td> <td></td><td>1.5 to 2.0</td> </tr> <tr> <td></td><td>0.05 to 0.1</td> <td></td><td>> 2.0</td> </tr> <tr> <td></td><td>0.1 to 0.2</td> <td></td><td></td> </tr> <tr> <td></td><td>0.2 to 0.3</td> <td></td><td></td> </tr> <tr> <td></td><td>0.3 to 0.5</td> <td></td><td></td> </tr> <tr> <td></td><td>0.5 to 1.0</td> <td></td><td></td> </tr> <tr> <td></td><td>1.0 to 1.5</td> <td></td><td></td> </tr> </table>		0 to 0.05		1.5 to 2.0		0.05 to 0.1		> 2.0		0.1 to 0.2				0.2 to 0.3				0.3 to 0.5				0.5 to 1.0				1.0 to 1.5			<p>Flood Hazard</p> <table border="0"> <tr><td></td><td>H1</td></tr> <tr><td></td><td>H2</td></tr> <tr><td></td><td>H3</td></tr> <tr><td></td><td>H4</td></tr> <tr><td></td><td>H5</td></tr> <tr><td></td><td>H6</td></tr> </table>		H1		H2		H3		H4		H5		H6			
	0 to 0.05		1.5 to 2.0																																										
	0.05 to 0.1		> 2.0																																										
	0.1 to 0.2																																												
	0.2 to 0.3																																												
	0.3 to 0.5																																												
	0.5 to 1.0																																												
	1.0 to 1.5																																												
	H1																																												
	H2																																												
	H3																																												
	H4																																												
	H5																																												
	H6																																												

TITLE Pre-Development Conditions - 0.1% AEP	PROJECT: Kellicar - Planning Proposal	PROJECT No. 190038	DATE: March 2021	SCALE: 1:3000	FIGURE No. 02
--	--	---------------------------	-------------------------	----------------------	----------------------

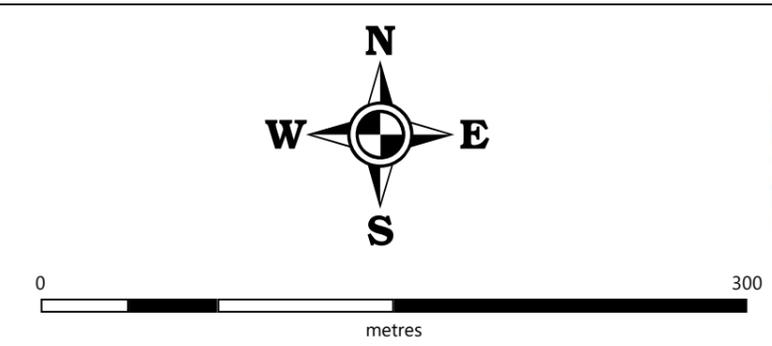
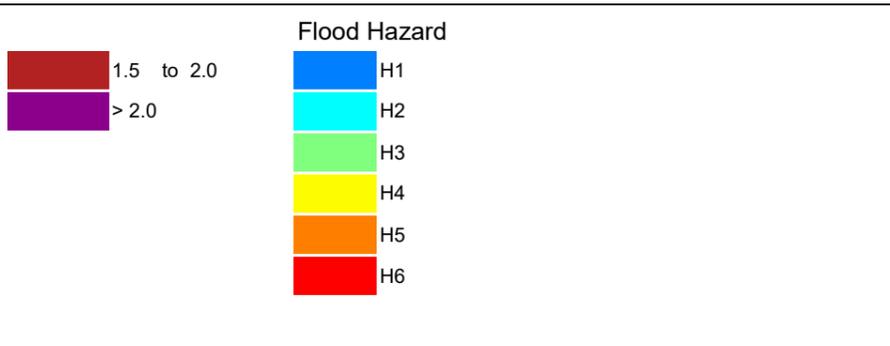
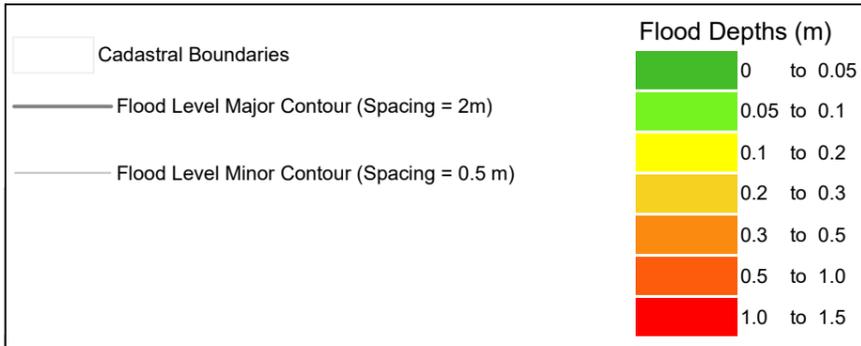
Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



FLOOD DEPTH AND LEVELS



FLOOD HAZARD



TITLE **Pre-Development Conditions - PMF**

PROJECT: **Kellicar - Planning Proposal**

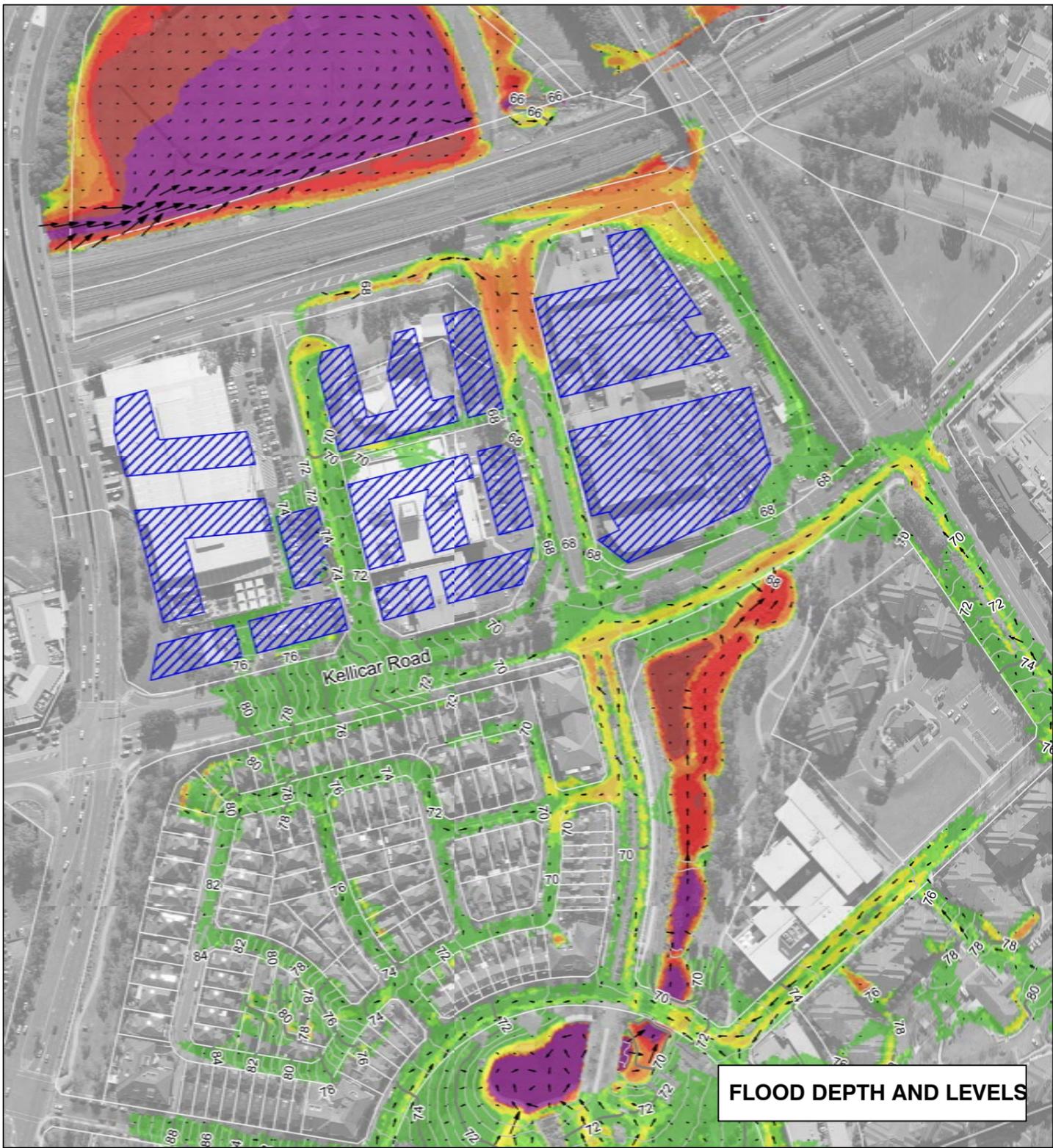
PROJECT No. **190038**

DATE: **March 2021**

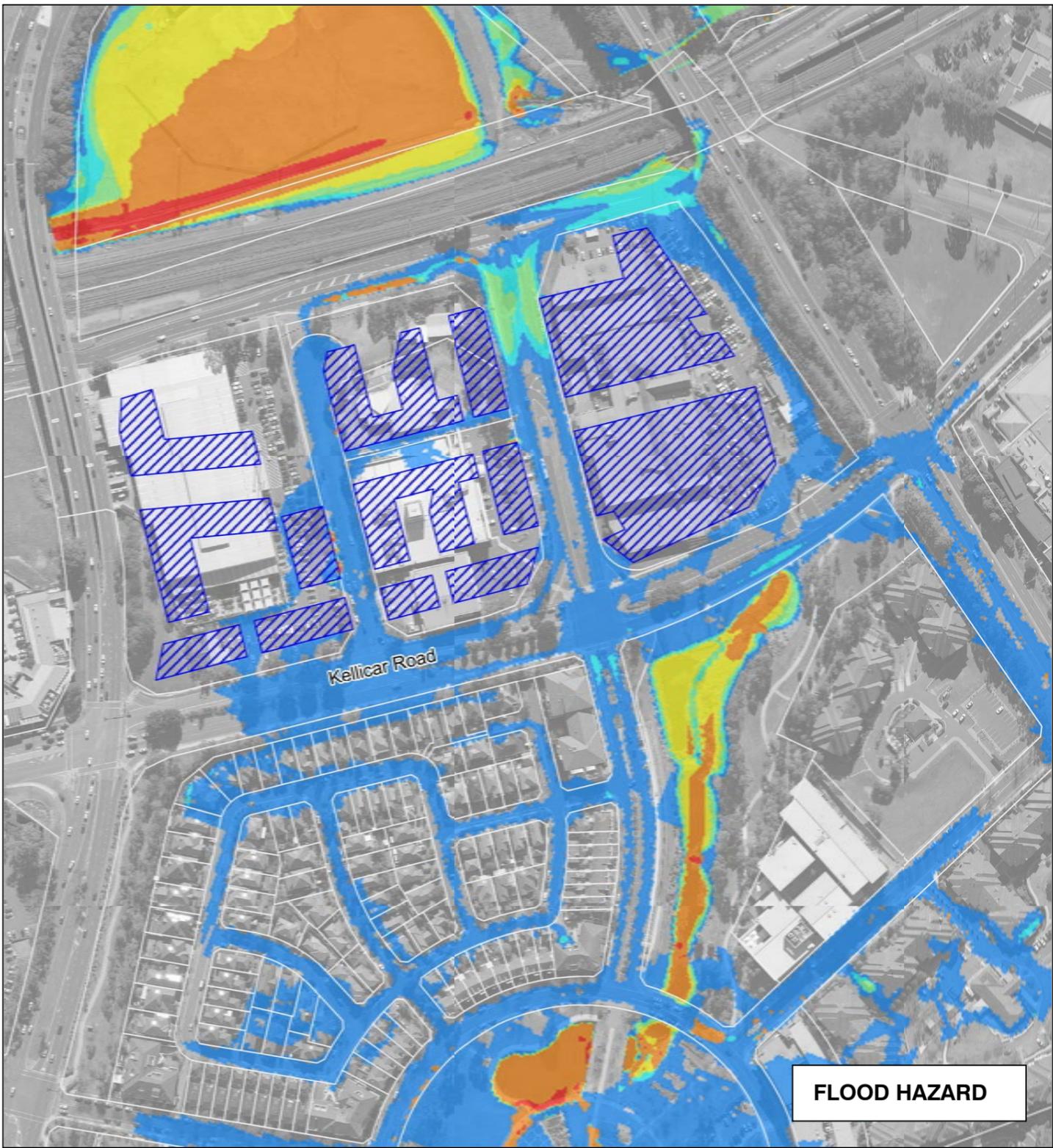
SCALE: **1:3000**

FIGURE No. **03**

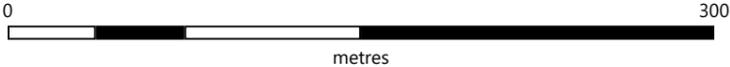
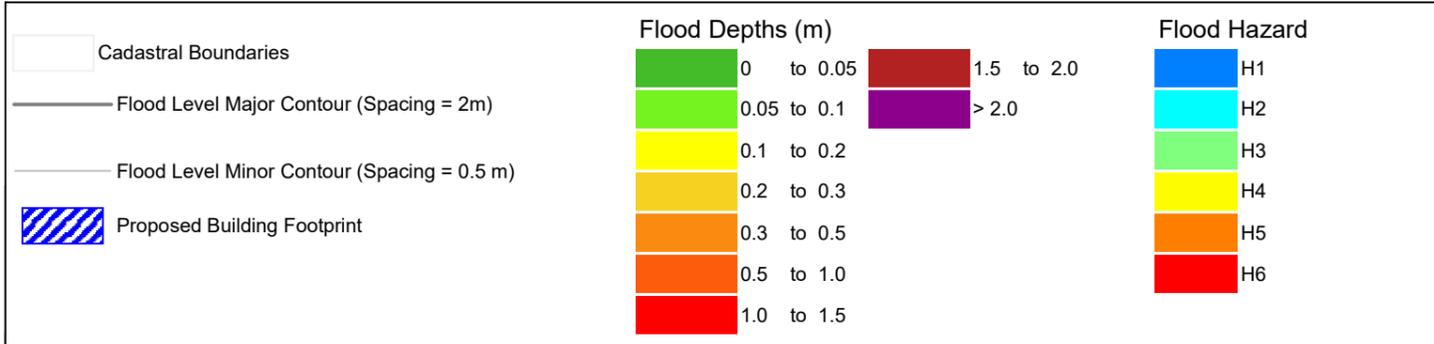
Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



FLOOD DEPTH AND LEVELS

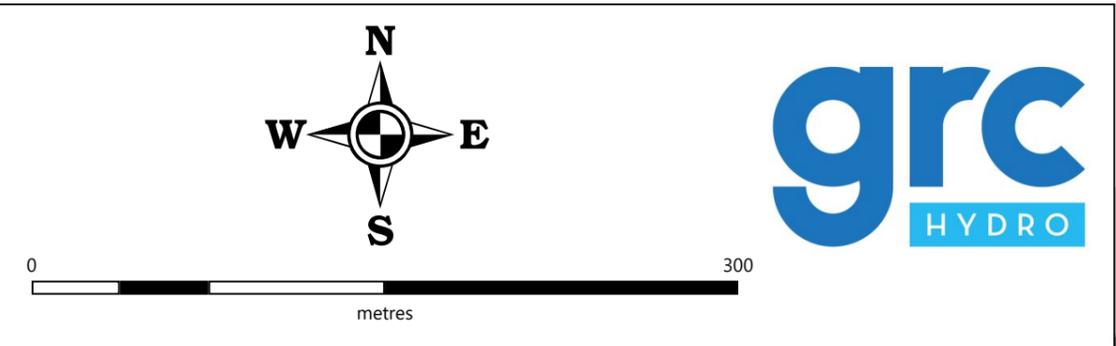
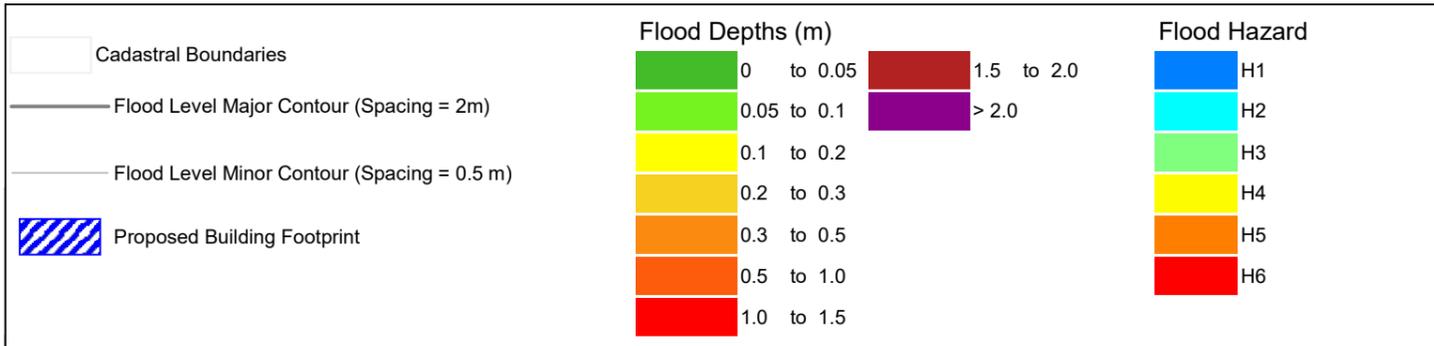
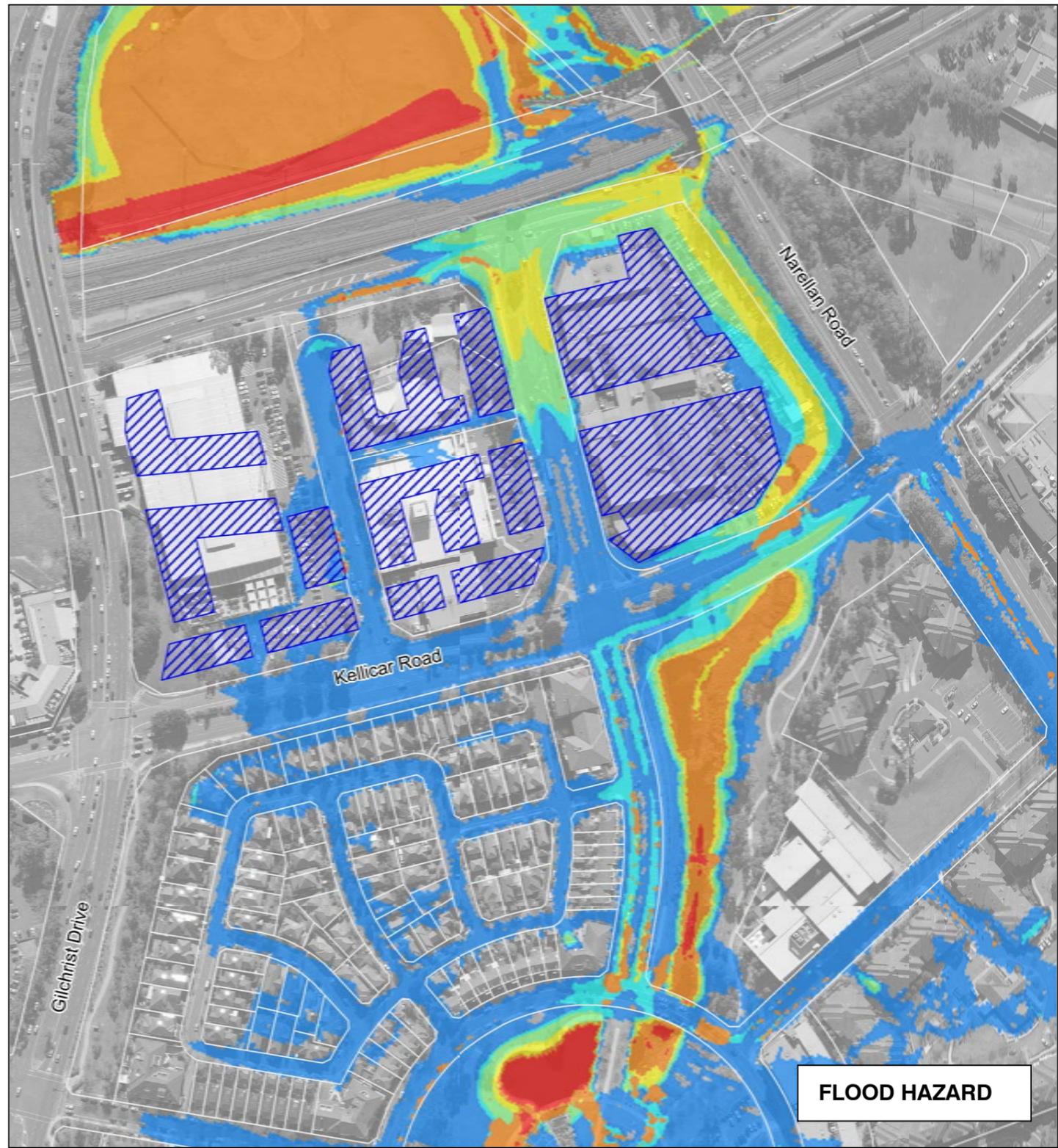
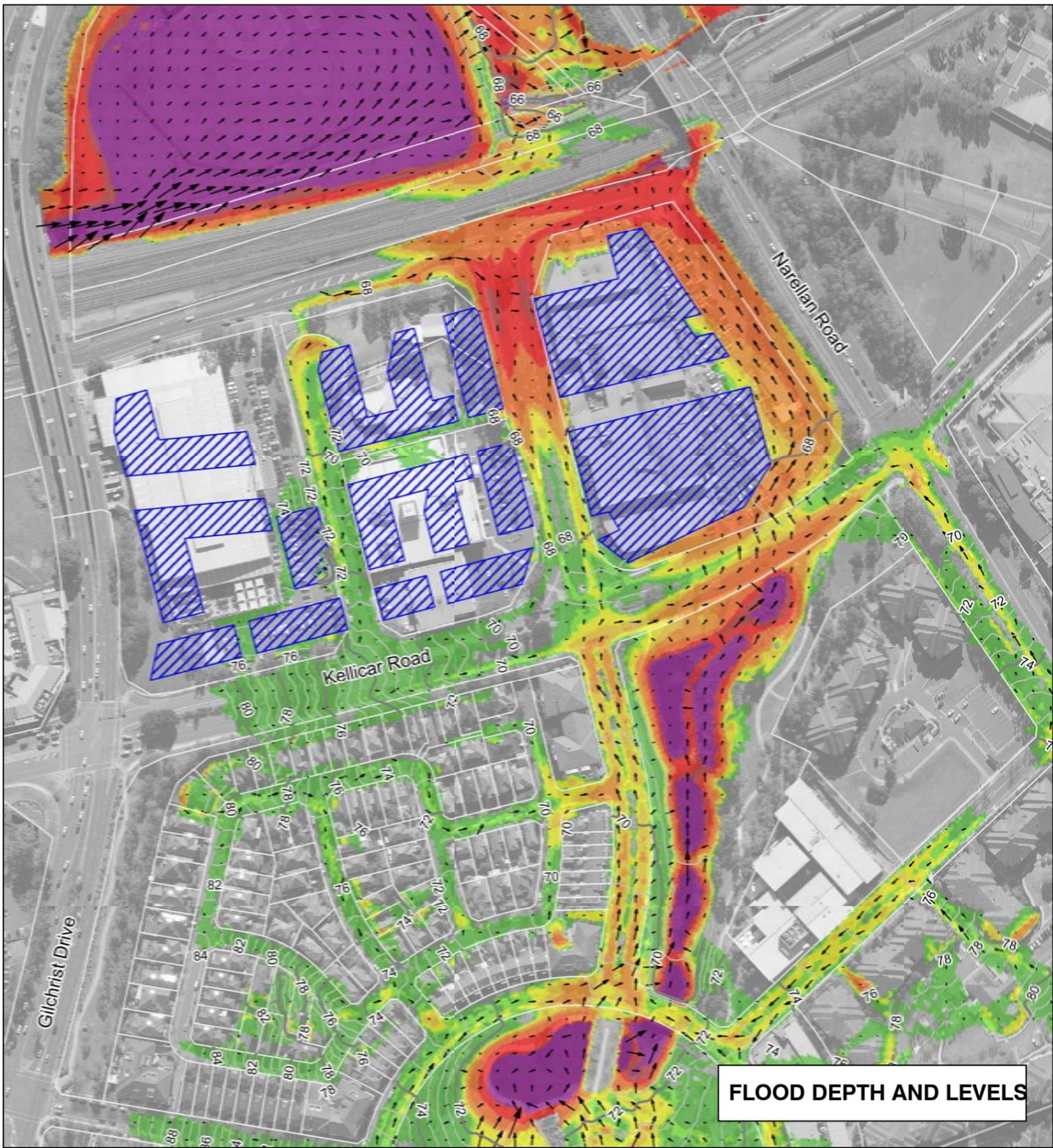


FLOOD HAZARD



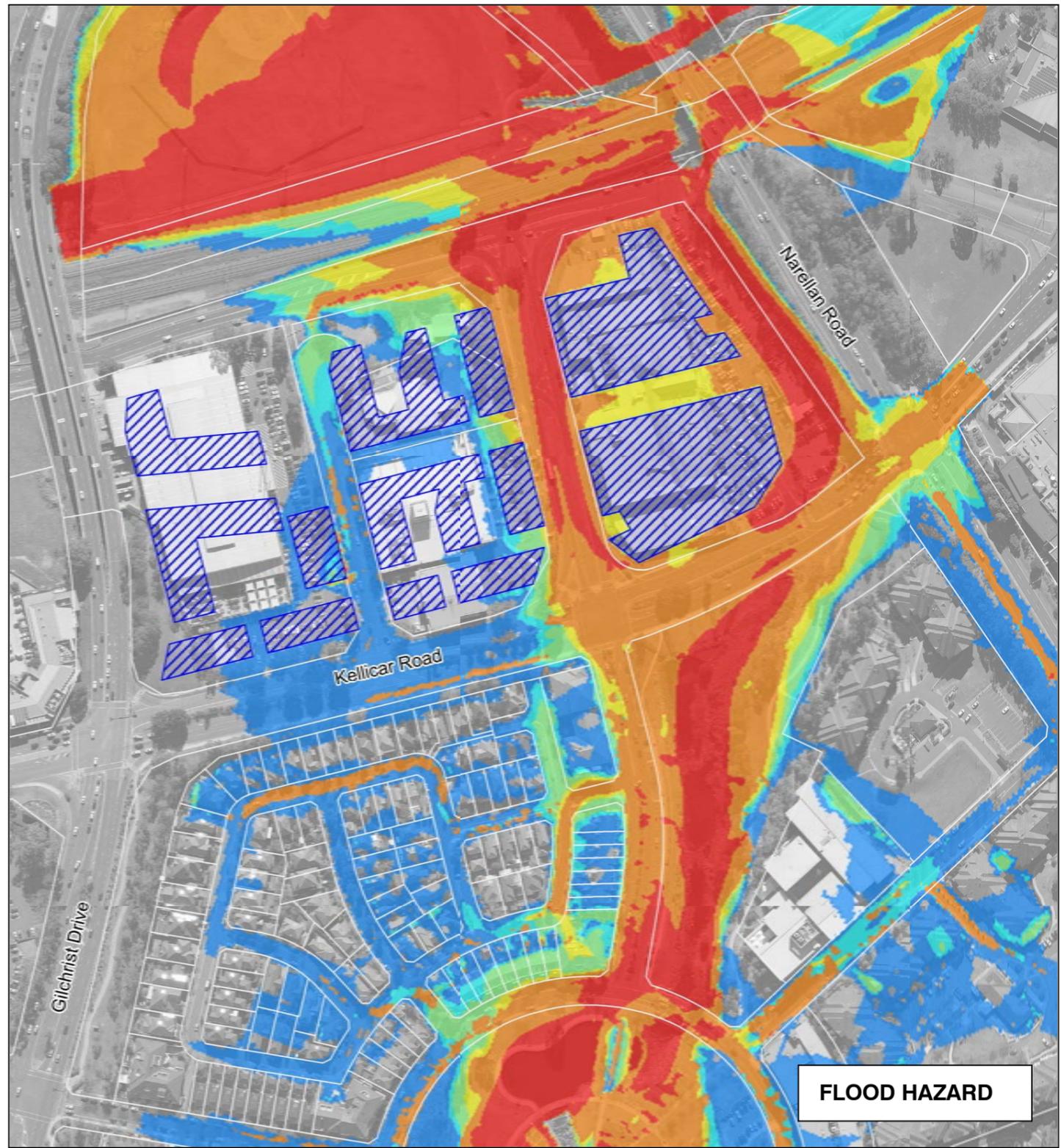
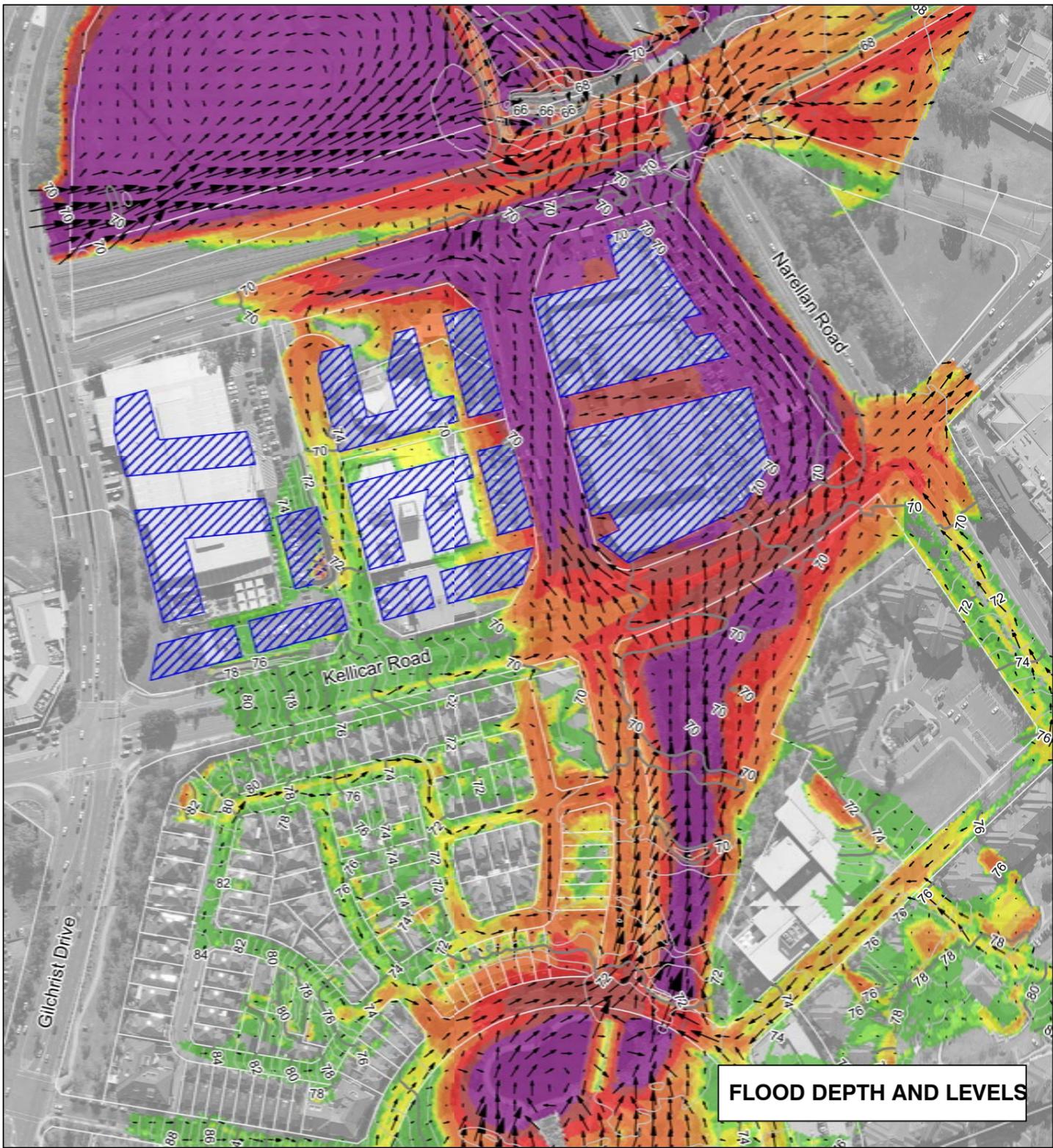
TITLE : Post Development Conditions - 1% AEP	PROJECT: Kellicar - Planning Proposal	PROJECT No. 190038	DATE: March 2021	SCALE: 1:3000	FIGURE No. 04
---	--	---------------------------	-------------------------	----------------------	----------------------

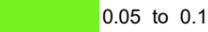
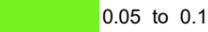
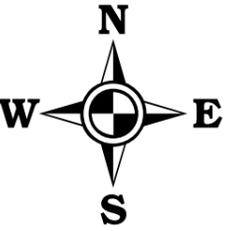
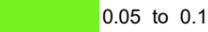
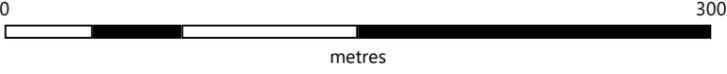
Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



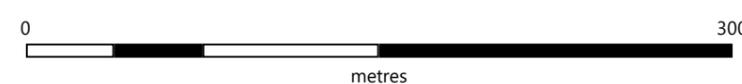
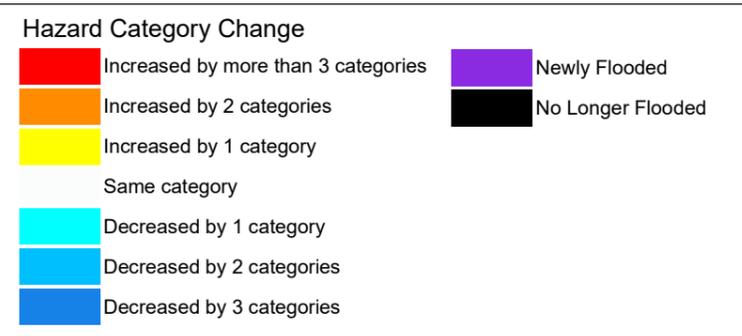
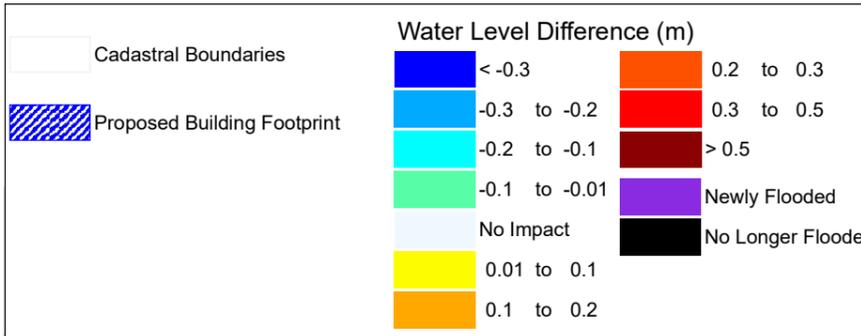
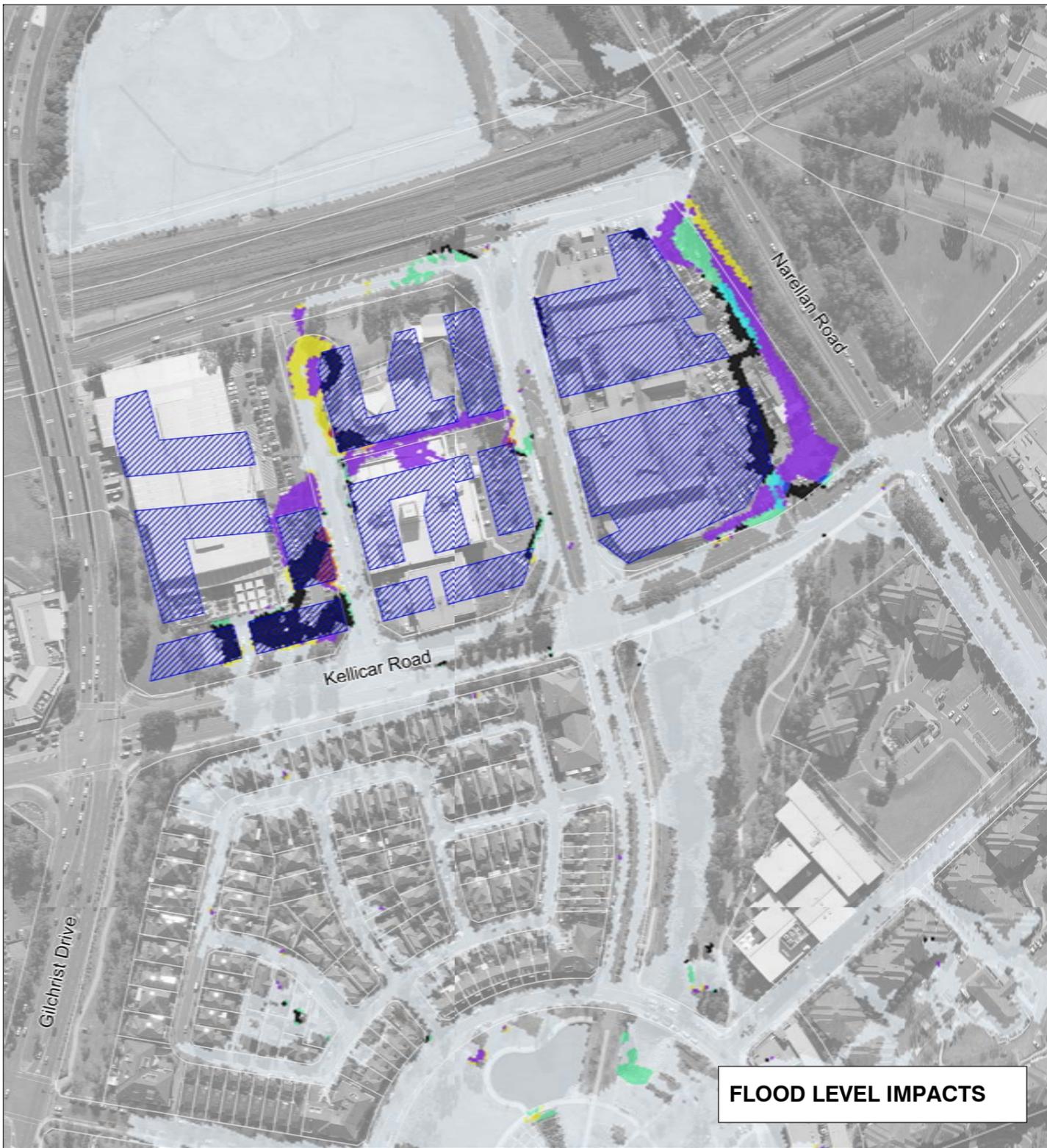
TITLE Post Development Conditions - 0.1% AEP	PROJECT: Kellicar - Planning Proposal	PROJECT No. 190038	DATE: March 2021	SCALE: 1:3000	FIGURE No. 05
---	--	---------------------------	-------------------------	----------------------	----------------------

Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



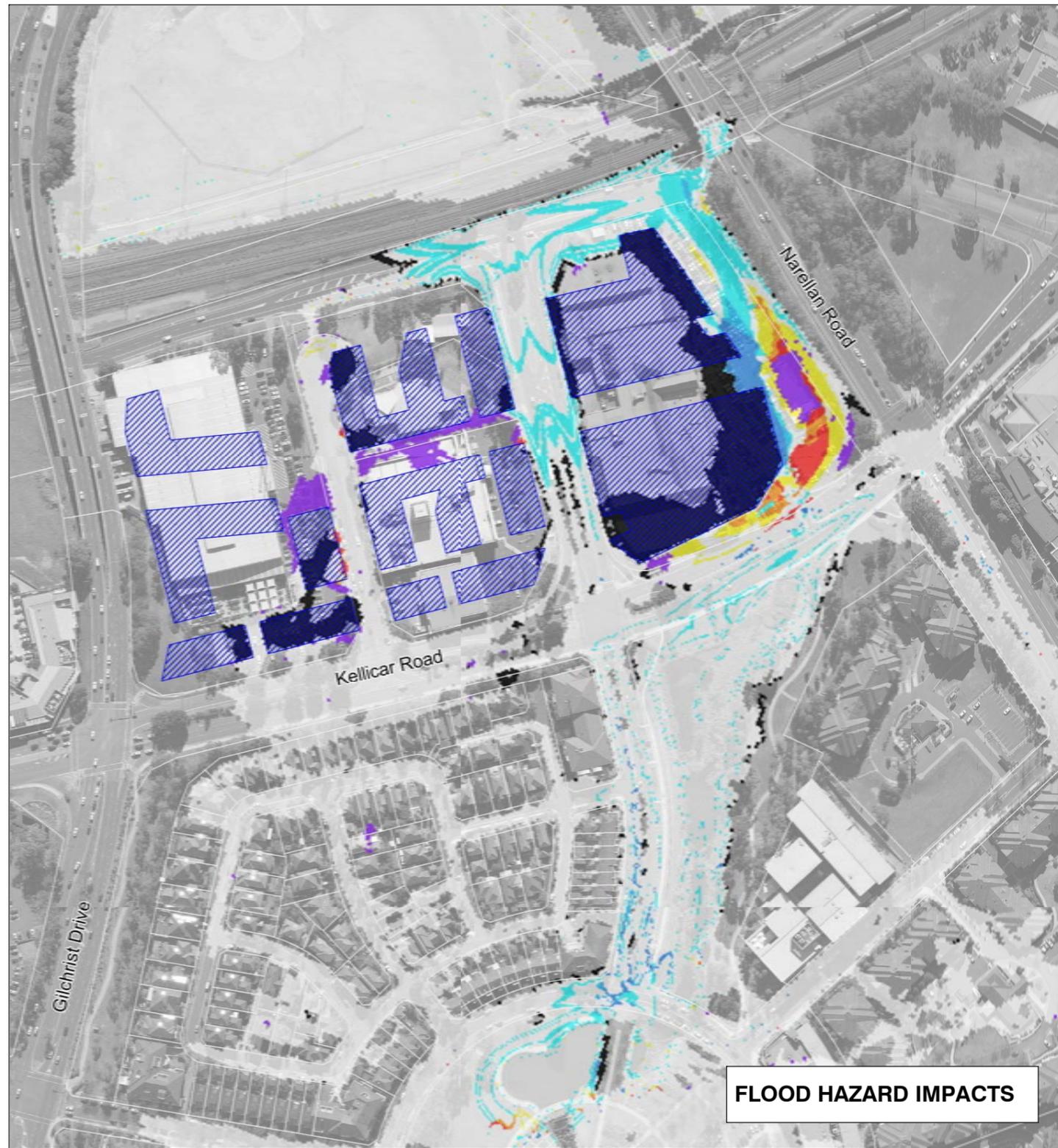
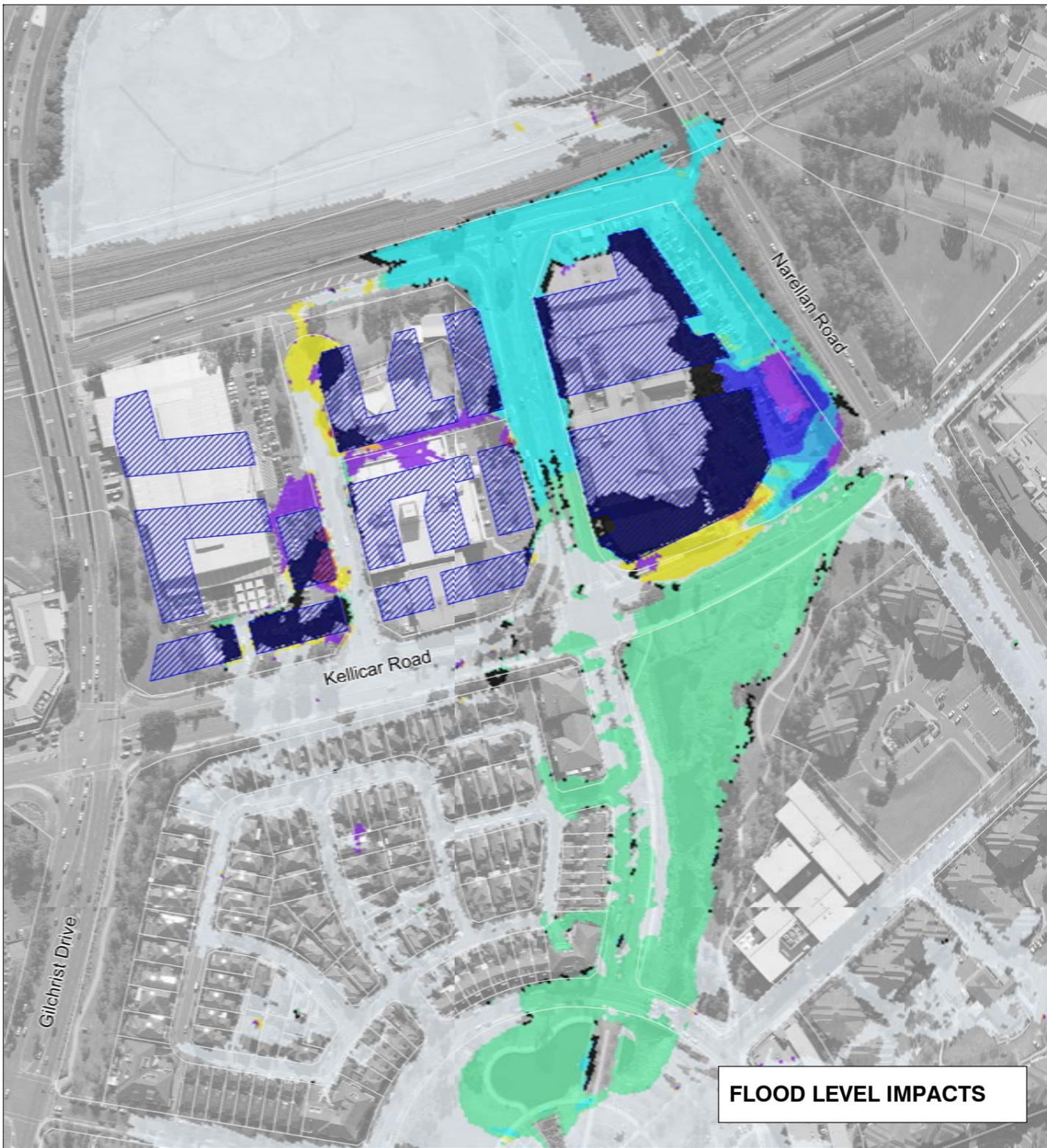
<ul style="list-style-type: none">  Cadastral Boundaries  Flood Level Major Contour (Spacing = 2m)  Flood Level Minor Contour (Spacing = 0.5 m)  Proposed Building Footprint 	<p>Flood Depths (m)</p> <table border="0"> <tr> <td> 0 to 0.05</td> <td> 1.5 to 2.0</td> </tr> <tr> <td> 0.05 to 0.1</td> <td> > 2.0</td> </tr> <tr> <td> 0.1 to 0.2</td> <td></td> </tr> <tr> <td> 0.2 to 0.3</td> <td></td> </tr> <tr> <td> 0.3 to 0.5</td> <td></td> </tr> <tr> <td> 0.5 to 1.0</td> <td></td> </tr> <tr> <td> 1.0 to 1.5</td> <td></td> </tr> </table>	 0 to 0.05	 1.5 to 2.0	 0.05 to 0.1	 > 2.0	 0.1 to 0.2		 0.2 to 0.3		 0.3 to 0.5		 0.5 to 1.0		 1.0 to 1.5		<p>Flood Hazard</p> <table border="0"> <tr><td> H1</td></tr> <tr><td> H2</td></tr> <tr><td> H3</td></tr> <tr><td> H4</td></tr> <tr><td> H5</td></tr> <tr><td> H6</td></tr> </table>	 H1	 H2	 H3	 H4	 H5	 H6		
 0 to 0.05	 1.5 to 2.0																							
 0.05 to 0.1	 > 2.0																							
 0.1 to 0.2																								
 0.2 to 0.3																								
 0.3 to 0.5																								
 0.5 to 1.0																								
 1.0 to 1.5																								
 H1																								
 H2																								
 H3																								
 H4																								
 H5																								
 H6																								
																								

Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



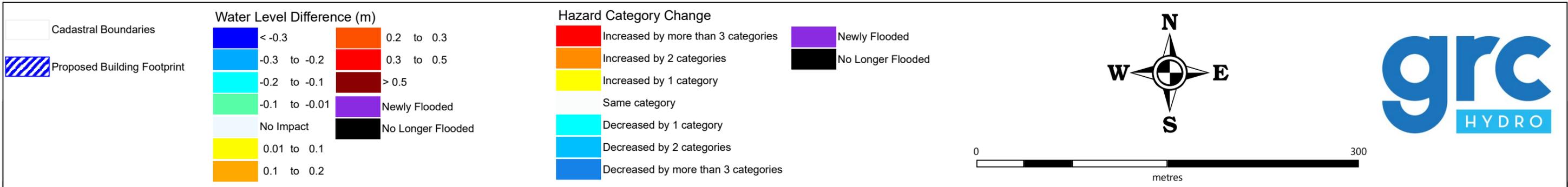
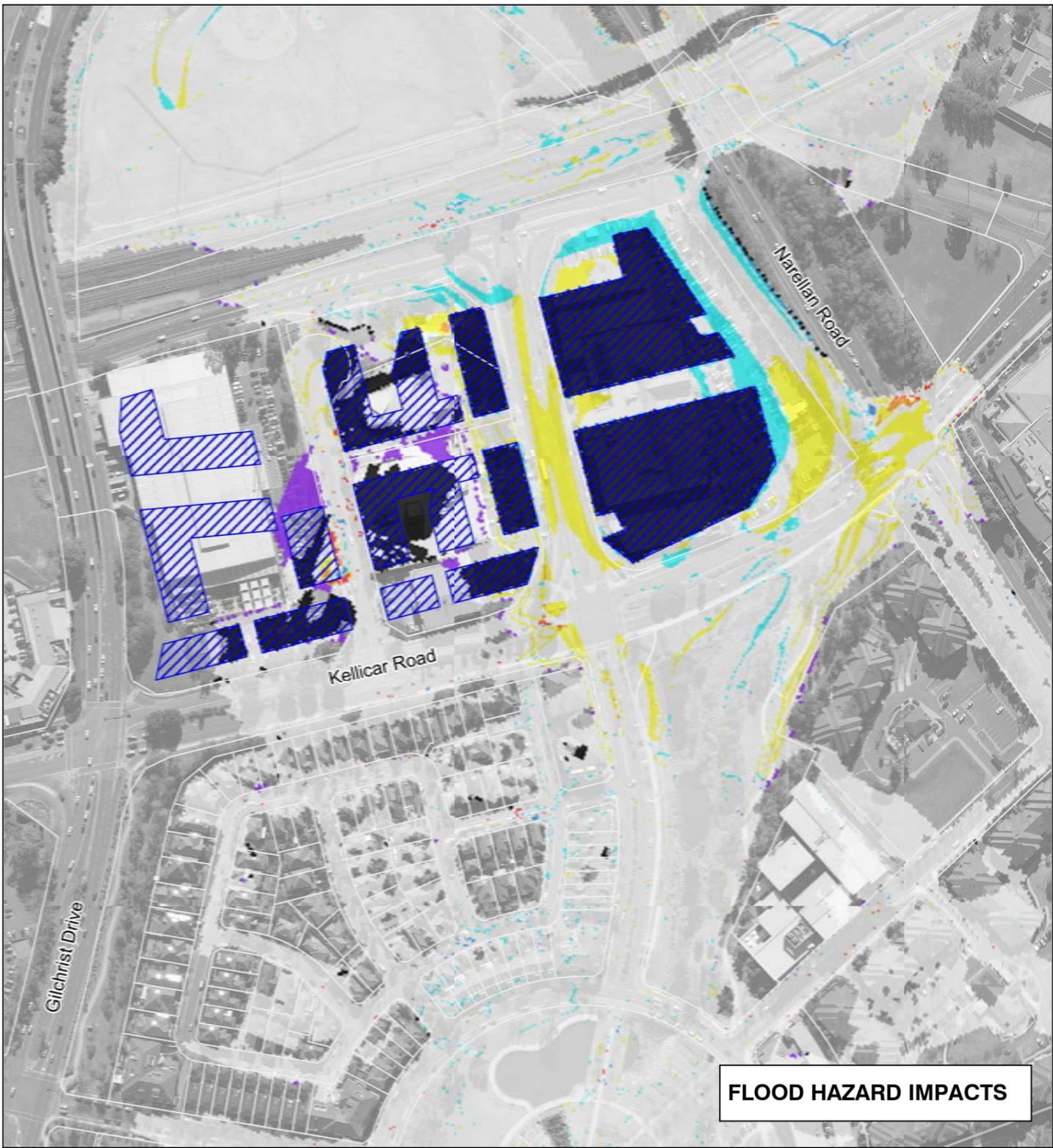
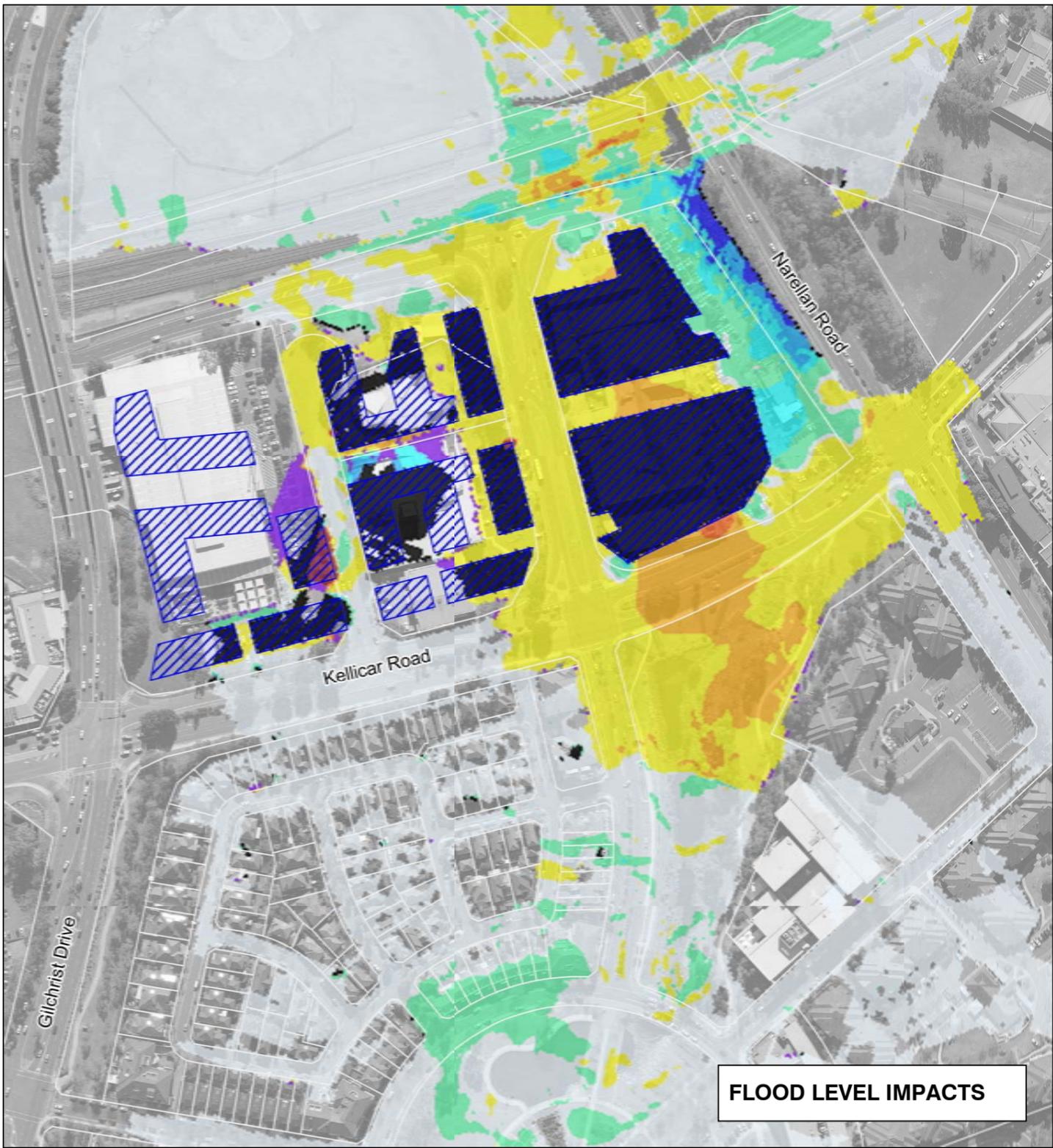
TITLE Post Development Conditions - 1% AEP	PROJECT: Kellicar - Planning Proposal	PROJECT No. 190038	DATE: March 2021	SCALE: 1:3000	FIGURE No. 07
---	--	---------------------------	-------------------------	----------------------	----------------------

Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



<p>Cadastral Boundaries</p> <p>Proposed Building Footprint</p>	<p>Water Level Difference (m)</p> <ul style="list-style-type: none"> < -0.3 -0.3 to -0.2 -0.2 to -0.1 -0.1 to -0.01 No Impact 0.01 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.5 > 0.5 Newly Flooded No Longer Flooded 	<p>Hazard Category Change</p> <ul style="list-style-type: none"> Increased by more than 3 categories Increased by 2 categories Increased by 1 category Same category Decreased by 1 category Decreased by 2 categories Decreased by 3 categories Newly Flooded No Longer Flooded 			
--	---	--	--	--	--

Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.



TITLE Post Development Conditions - PMF	PROJECT: Kellicar - Planning Proposal	PROJECT No. 190038	DATE: March 2021	SCALE: 1:3000	FIGURE No. 09
--	--	---------------------------	-------------------------	----------------------	----------------------

Flood Modelling has been undertaken by Catchment Simulation Solutions (CSS) who are Council's nominated flood modelling consultant. The results presented herein have been provided by CSS.

Attachment A

