PP-2023-1983 (Council Ref: REZ-0002-2324) – Preliminary Flood Impact and Risk Assessment – Planning Proposal to Rezone Part of 129 Marys Mount Road and Part 110-118 Middle Arm Road, Goulburn

Prepared by Goulburn Mulwaree Council

Version 2 – September 2024

1. Introduction

This Flood Impact and Risk Assessment (FIRA) has been prepared in accordance with the NSW Planning and Environment's *Flood Impact and Risk Assessment – Flood Risk Management Guideline LU01*, 2023. This FIRA should be read in conjunction with the Planning Proposal PP-2023-1983 for 129 Marys Mount Road and part 110-118 Middle Arm Road, Goulburn.

This FIRA is a "simple" assessment in accordance with Section 2.8 of the Guidelines as it is being prepared in the context of a larger development (noting there is an approved residential subdivision over 129 Marys Mount Road known as "Blakely's Run") and to assist in informing future planning noting that a development application will also need to be prepared and submitted for any further subdivision of 110-118 Middle Arm Road.

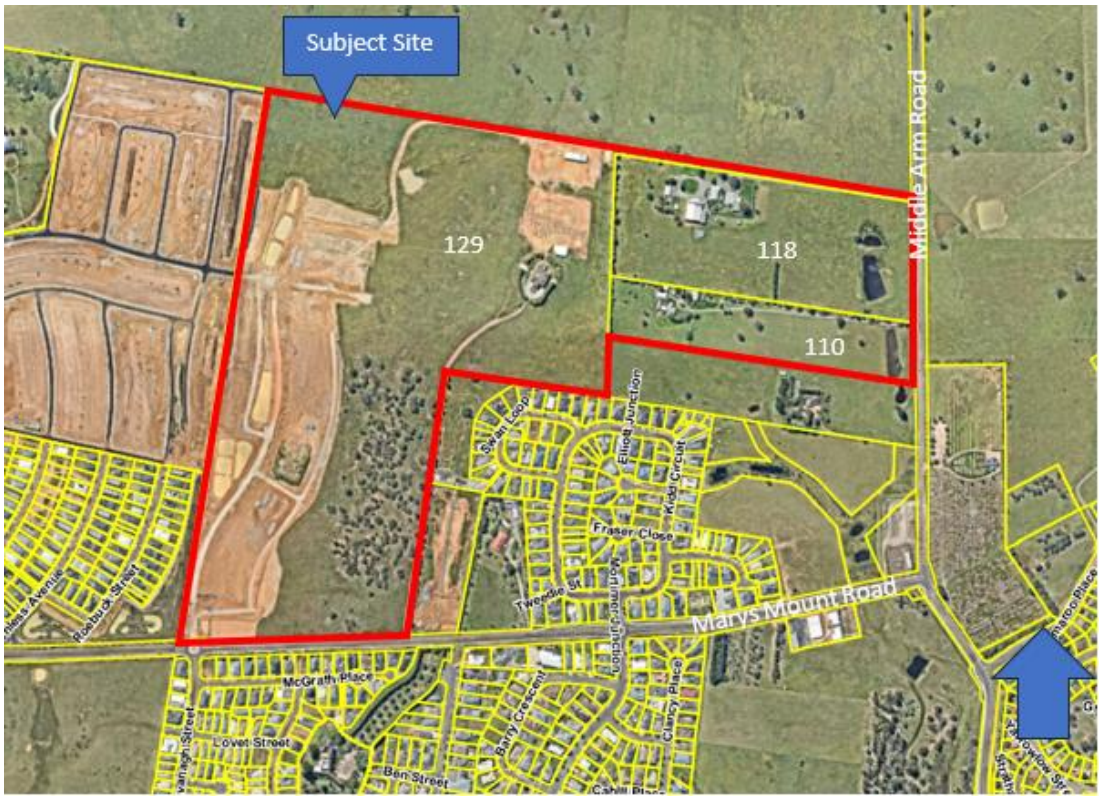
The preparation of this preliminary FIRA has also considered the following guidelines from the *Flood Risk Management Toolkit*:

- *EM01- Support for Emergency Management Planning*
- *FB01- Understanding and Managing Flood Risk*
- *MM01- Flood Risk Management Measures*

2. Need for a flood impact risk assessment.

This planning proposal seeks to rezone a part of 129 Marys Mount Road and a part 110 – 118 Middle Arm Road, Goulburn within the Middle Arm precinct of the *Urban and Fringe Housing Strategy*, to part R2 Low Density Residential and part C2 Environmental Conservation. A site location plan is illustrated in **Figure 1.**

***Figure 1**: Site location plan.*



The subject site comprises four existing lots (Lots 1- 2 DP 1290900 – being 129 Marys Mount Road also known as "Blakely's Run", Lot 2 DP 1290193 -being 110 Middle Arm Road, Lot 3 DP 1290193 – being 118 Middle Arm Road). The site is accessed via Marys Mount Road and Middle Arm Road. The site consists of the 129 Marys Mount Road site which is mostly cleared grazing land, which is being developed as a residential subdivision, with an area of native vegetation which is subject to an approved Biodiversity Development Assessment Report (BDAR) and is being set aside as a reserve. Nos 110 – 118 Middle Arm Road each contain a dwelling and outbuildings and are used for extensive agriculture (grazing).

The planning proposal is proponent led and seeks to rezone a part of the site to R2 Low Density Residential and part C2 Environmental Conservation. The rezoning is intended to identify land which is suitable for urban residential development and to provide a mechanism through zoning to avoid land which is considered to contain significant biodiversity as identified in the BDAR. Some of the affected area is currently zoned RU6 Transition with a 100ha minimum lot size. Subsequent biodiversity assessment has found that some of this area does not have significant biodiversity value (particularly where occurring on 110 – 118 Middle Arm Road and the adjoining portion of 129 Marys Mount Road). Whilst a portion of 129 Marys Mount Road currently zoned R2 Low Density Residential is identified in the BDAR as being significant biodiversity and is included in the avoided area which is proposed to be zoned C2 Environmental Conservation. The C2 zone is a more appropriate zone in relation to its objectives and land uses for a biodiversity avoidance area.

Blakely's Run has been the subject of various development approvals for subdivision. A deferred commencement development consent was granted by Council for a 205-lot residential subdivision (Development Consent No. DA/0311/1617 dated 3 July 2018) including:

- Torrens title subdivision of land zoned R2 Low Density Residential to create 156 allotments.
- Community title subdivision of land zoned RU6 Transition to create 49 allotments including one for the existing residence.
- One (1) residual allotment (containing structural woodland and derived native grassland) to be maintained in perpetuity under a plan of management.

Council subsequently amended the GM Local Environmental Plan (LEP) to require community title subdivision in the RU6 Transition Zone to meet the minimum lot size (to prevent the creation of undersized lots within this zone). Amendment No. 19 to the LEP was made on 27 November 2020.

An Operational Consent was issued on 19 April 2023 for Development Consent No. DA/0311/1617.

In 2022, a Modification Application (MODDA/0088/2122) was submitted to split the approved Stage 1 subdivision into six (6) stages, being Stages 1A – 1F, to augment the bulk earthworks program and to revise the timeframe for the execution of a Voluntary Planning Agreement (VPA). The Modification Application was determined (approved) on 3 May 2023.

A further Development Application (DA/0268/2223) was submitted in December 2022 and is currently being assessed for Stage 2, being:

- Torrens title subdivision of land zoned R2 Low Density Residential to create 55 allotments over two (2) stages (Stages 2A and 2B) and one (1) residual allotment for future subdivision comprising land zoned R2 Low Density Residential and RU6 Transition; and

• Associated civil construction works, landscaping and fencing (including the provision of pedestrian/shared pathways and a pocket park/playground).

The site will be serviced by Goulburn`s reticulated water and sewer system and is immediately contiguous to (and contains) residentially zoned land to the east, west and south at various stages of development for urban residential. The proposal also seeks to amend the minimum lot size for affected portions to align with the proposed zone. A copy of the submitted planning proposal request document is available to view in **Planning Proposal Appendix 1**.

The proponent has submitted a staging plan which includes elements of the approved subdivision for 129 Marys Mount Road. No concept plan is provided for the small area of RU6 Transition zoned land at the rear of 110 – 118 Middle Arm Road. The concept for 129 Marys Mount Road "Blakely's Run" is provided in Figure and **Planning Proposal Appendix 2**.

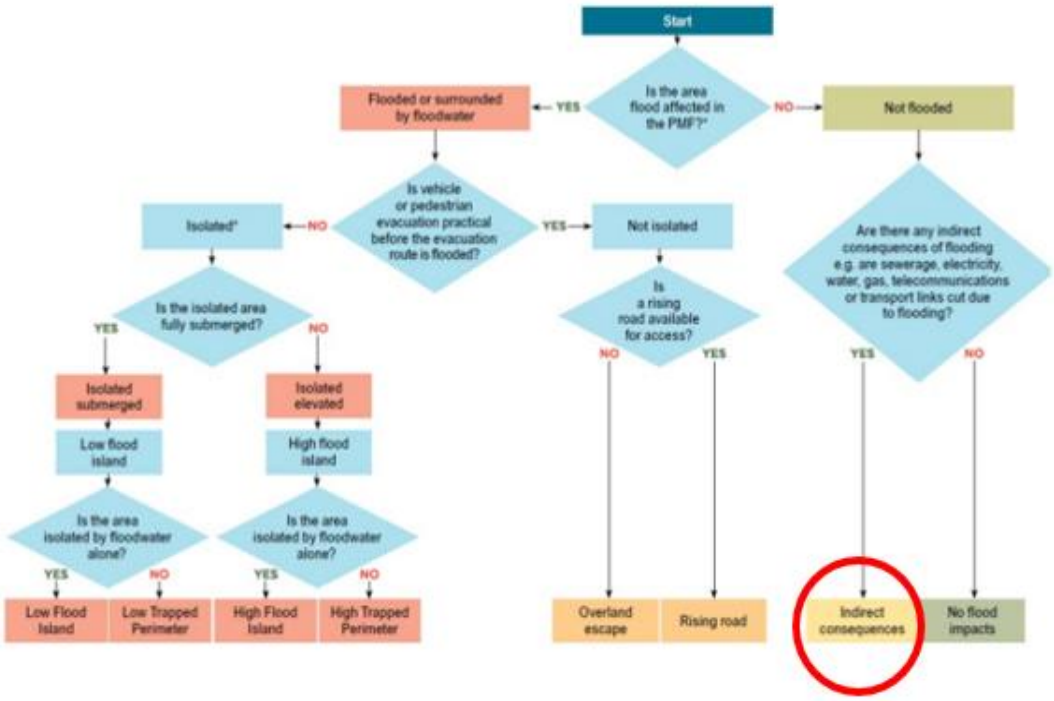
***Figure 2**: Subdivision Staging Plan – Blakely's Run/129 Marys Mount Rd*

This planning proposal will facilitate the identification of appropriate zones based on approved land uses, the conservation of biodiversity significant land, the release of approved lots as Torrens Lots (rather than as Community Title lots – where on RU6 Transition zoned land), and the release of additional residential lots where currently zoned RU6 Transition and there are no biodiversity constraints.

It is considered that the site generally would be classified as a high trapped perimeter using the flood emergency response classifications in EM01 as per the Figure 3 below. Portions of the site are currently flood affected; **however, the proposed areas to be rezoned within the**

site are not flood affected by any design event up to the PMF. Therefore, it is considered that the areas identified for rezoning are only affected by **indirect impacts** in relation to broader access around the precinct in certain events.

Figure 3 *– Flood Emergency Response Classifications*



3. Consultation

Council has undertaken consultation in general terms in relation to flood impact and risk in Goulburn and the approach required when considering planning proposals for rezoning rural land on the town's periphery to residential. Council held two Goulburn Flooding Technical Working Group meetings between Council, SES and NSW DPE staff in October – November 2023 with representatives from NSW SES, NSW DPE (Planning) and NSW DPE (Biodiversity Conservation Division- Flooding). These meetings focused on planning proposals south of the Hume Highway and on the Goulburn central business district (CBD). It should be noted that the overall approach of all agencies towards rezoning land which may be directly or indirectly affected by flooding has informed this FIRA.

Further consultation with the SES and DCCEEW occurred during the NSW DPHI Gateway assessment. SES requested that planning proposals in the precinct be updated to include further information on warning and durations for overland flows affecting roads during various design events. This FIRA has been updated with this additional information.

This FIRA is a preliminary assessment and further consultation is to be undertaken with the SES during the State agency consultation process associated with the planning proposal.

A copy of the presentation slides from the Goulburn Technical Working Group meetings are provided in **Attachment 1** to this FIRA.

4. Available Flood Studies and Existing Assessment Requirements

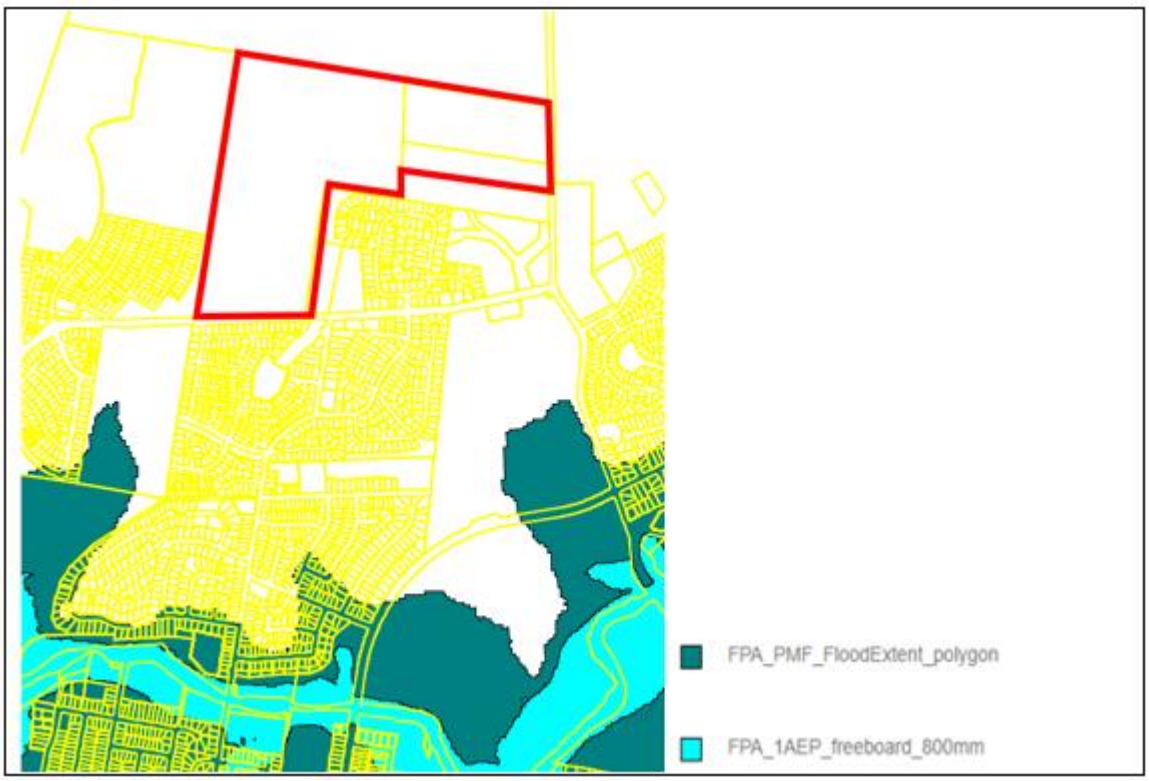
The Goulburn Floodplain Risk Management Study and Plan (The Flood Study) was adopted by Council on 16 August 2022 and was developed in collaboration with the former Department of Planning and Environment- Environment, Energy and Science. The Flood Study was prepared by GRC Hydro in accordance with and consistent with:

- The NSW Flood Prone Land Policy;
- The principles of the Floodplain Development Manual 2005, and
- Considering flooding in land use planning guideline 2021.

The study area includes the subject site but only models the extent of riverine and major tributary flooding. This site is not identified as being subject to riverine flooding for any design event (refer **Figure 4**). However, riverine flooding from the Wollondilly River does restrict access to central Goulburn from this precinct from a 0.2% AEP Event (1 in 500 event).

The Flood Study also included a Development Control Policy which applies controls to both flood prone land within the Flood Study boundaries and areas outside the scope of the Study.

***Figure 4**: FPA and PMF Wollondilly River in Relation to Subject Site*



The Flood Study and DCP flood policy implements Flood Planning Constraint Categories (FPCC) which groups similar types and scales of flood related constraints. Four FPCC's have been established to separate areas of the floodplain from the most constrained and least suitable areas for intensification of land use. The FPCC's are presented in **Figure 5 and 6** below:

***Figure 5**: Extent of Flood Prone Land – Overland Flooding Modelling Using FPCC*

***Figure 6**: Flood Planning Constraint Categories*

Category	Summary
FPCC1	FPCC1 identifies the most significantly constrained areas, with high hazard or significant flood flows present. Intensification of use in FPCC1 is generally very limited except where uses are compatible with flood function and hazard.
FPCC2	FPCC2 areas are the next least suitable for intensification of land use or development because of the effects of flooding on the land, and the consequences to any development and its users.
FPCC3	FPCC3 areas are suitable for most types of development. This is the area of the floodplain where more traditional flood-related development constraints, based on minimum floor and minimum fill levels, will apply.
FPCC4	FPCC4 is the area inundated by the PMF (extent of flood prone land) but outside FPCC1-3. Few flood-related development constraints would be applicable in this area for most development types. Constraints may apply to key community facilities and developments where there are significant consequences to the community if failed evacuations occur.

The DCP flood policy applies different flood planning controls depending on the proposed land use category to ensure that new development does not increase flood risk.

Council has initiated the preparation of the overland flooding study for Goulburn following a successful funding application through the NSW Department of Planning and Environment Floodplain Management Grants program. This project is expected to be finalised in December 2025. However, as an interim measure, Council commissioned overland flood modelling. This modelling utilised the same data and methodology as the riverine flood modelling and mapping within the mainstream Flood Study. This has resulted in a mapping layer which illustrates the

location and likely extent of overland flooding and the relative risk to life and property. The overland flood mapping also includes Flood Planning Constraint Categories which have been identified by the same consultant who prepared the Flood Study (GRC Hydro). This modelling is currently used to inform Council as to the potential for flooding and flood risk beyond riverine areas.

The overland flood model maps are available to view on the Council's website at: https://www.goulburn.nsw.gov.au/Development/Plans-Strategies#section-10

Both the Flood Study and the overland flow modelling have accounted for climate change to determine the projected increase in precipitation intensity. These details have been utilised to determine increased rainfall for the 1%, 0.5% and 0.2% flood events up to 2090 and incorporated into the riverine and overland flow modelling.

The adopted *Goulburn Floodplain Risk Management Study and Plan* (The Flood Study) has assessed riverine flooding and associated risk in Goulburn. The extent of this study area includes the subject site which is not directly impacted by riverine flooding (due to its elevation). The site is included in the area where overland flow modelling has been undertaken as a separate project outside of the Goulburn Flood Study. It illustrates that portions of the site are inundated by overland flooding but this inundation aligns with the locations of the non-perennial water courses. Council's overland flow modelling would suggest that access within the site can be achieved to all lots where a proposed access road follows the southern boundary during each design event through to the probable maximum flood (PMF).

The overland flood modelling, illustrated in **Figure 5**, indicates that the identified drainage channels experience flood inundation.

The identification of the presence of overland flood inundation on site, suggests the subject site is flood prone and as such Ministerial Direction 4.1 applies, although as previously mentioned the specific areas identified for rezoning are not flood affected. Areas currently affected by overland flooding are already zoned R2 Low Density Residential. The management of these areas has been via the Council's planning provisions (LEP/DCP/engineering standards). This has ensured that the existing approved development at 129 Marys Mount Road has considered drainage corridors and flooding within the approved design currently under construction.

The *NSW Flood Prone Land Policy's* (The Flood Policy) primary objective is to reduce the impacts of flooding and improve community resilience. The policy recognises that flood prone land is a valuable resource and proposals for rezoning should be the subject of careful assessment which incorporates consideration of local circumstances.

The policy requires:

- a merit-based approach to be adopted for all development decisions in the floodplain;
- a reduction in flooding impacts and liability on existing developed areas
- limiting the potential for flood losses in all areas proposed for development by the application of ecologically sensitive planning and development controls.

The *Flood Risk Management Manual* (the Manual) requires planning proposal authorities to consider the principles of the Manual and advice provided in the supporting Toolkit. The Manual establishes the following Vision:

> *"Floodplains are strategically managed for the sustainable long-term benefit of the community and the environment, and to improve community resilience to floods".*

and the following 10 principles for flood risk management:

1. Establish sustainable governance arrangements;
2. Think and plan strategically;
3. Be consultative;
4. Make flood information available;
5. Understand flood behaviour and constraints (for the full range of floods);
6. Understand flood risk and how it may change (for the full range of floods);
7. Consider variability and uncertainty;
8. Maintain natural flood functions;
9. Maintain flood risk effectively, and
10. Continually improve the management of flood risk.

The Manual highlights the requirement for a robust understanding and analysis of risk which can then be deployed to determine whether the risk is acceptable and determine if additional action is required to further reduce identified residual risk.

The *Flood Risk Management Toolkit* (the Toolkit) provides more detailed guidance on how to meet the objectives of the Flood Policy and Manual and these documents have been considered in the development of this planning proposal. The following documents in the Toolkit are especially pertinent to this planning proposal:

- *EM01- Support for Emergency Management Planning*
- *LU01- Flood Impact and Risk Assessment*
- *FB01- Understanding and Managing Flood Risk*
- *MM01- Flood Risk Management Measures*

The proposal's consistency with the Flood Policy, The Manual and Toolkit are largely addressed separately in the sections responding to Ministerial Direction 4.1 in the accompanying Planning Proposal.

In relation to this site, the main issues identified for consideration in this Flood Impact Risk Assessment are **site access/evacuation** and the **safe occupation** of proposed residential lots.

5. Warning Times, Evacuation, Isolation, Duration

In accordance with *EM01 Support for emergency management planning*, evacuation is considered in the context of this site, with emergency management responses tested.

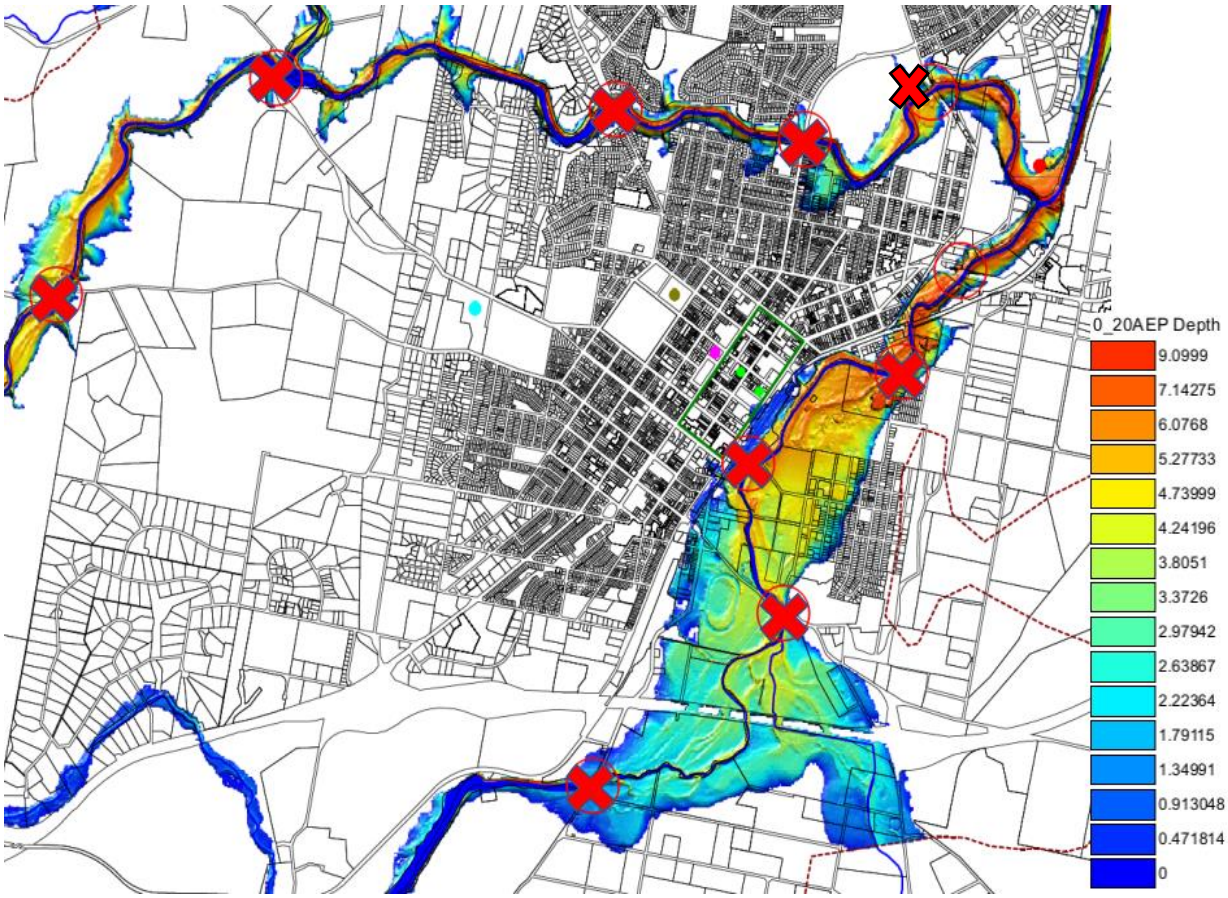
As stated in the NSW SES' *Goulburn Mulwaree LGA Local Flood Plan*, consultation with NSW SES is required as a part of the strategic planning for flood affected land to avoid additional risk. As stated at the beginning of this preliminary FIRA Council will undertake further consultation with the NSW SES in relation to the planning proposal and this FIRA. This FIRA has been updated following further consultation with SES during the Gateway assessment process to include additional data on warning and duration times for overland flooding affecting roads within this precinct.

This FIRA considers:

- the potential for this community to be isolated (noting it has already been established that this community will not be inundated – **refer to Section 10** of this FIRA).
- the availability for warning in this location/warning times
- evacuation capability
- compatibility with the existing EM response strategy
- whether occupants are safe and self-sufficient in the event of a flood.
- ability to self-evacuate to a place of safety.

The main consideration then is the potential for this community to be isolated and an evacuation route from the site to a suitable destination. It should be noted that the entirety of Goulburn (north of the Wollondilly River) is cut off from the central portion of Goulburn once flooding reaches a 0.20%AEP Event (1 in 500) as identified in **Figure 7** below which details when each of the bridge crossings become blocked crossing the Wollondilly River to the north.

Figure 7: *Wollondilly and Mulwaree River Bridges Goulburn – Closures 0.2% AEP*

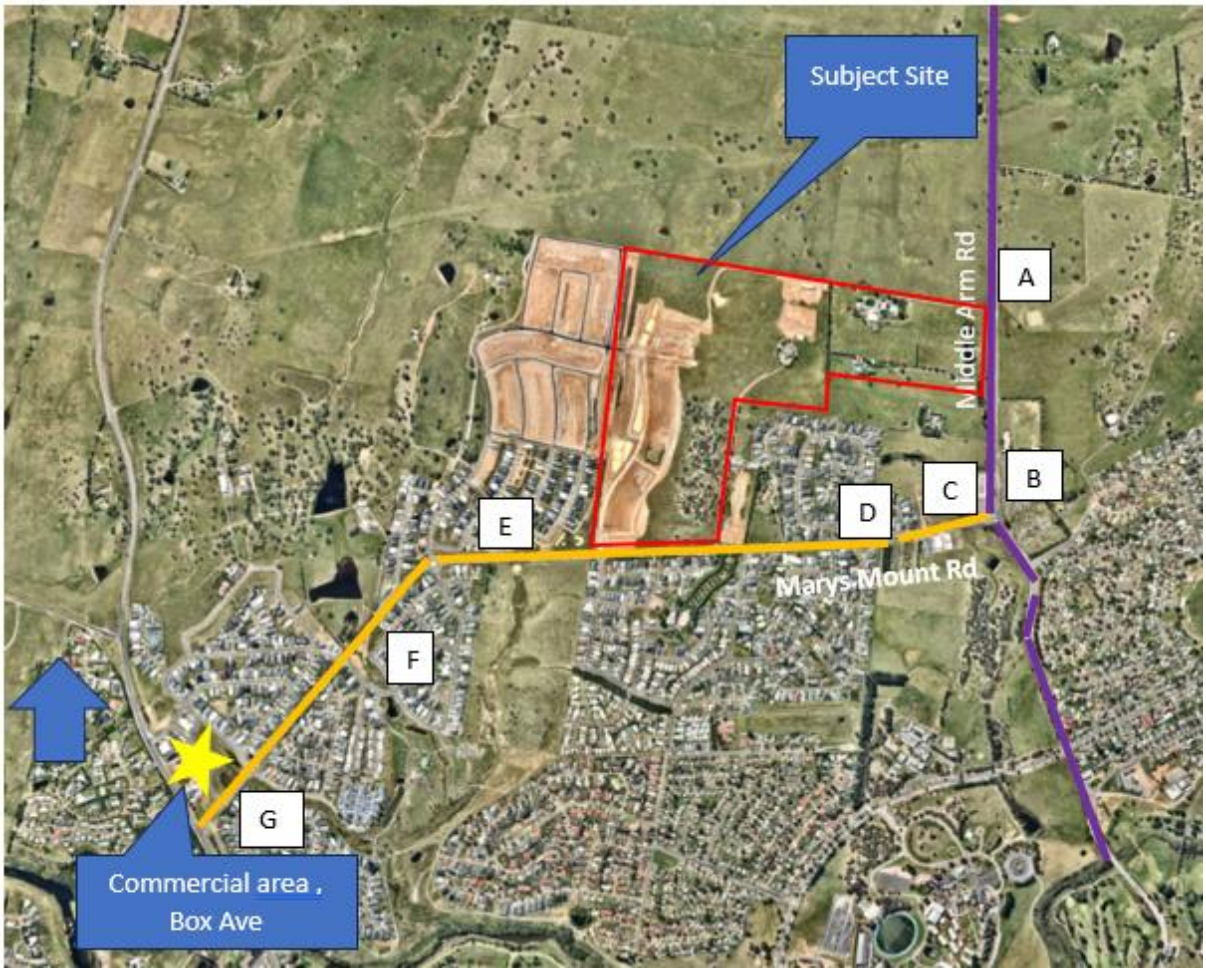


North of Marys Mount Road (and the road itself) is outside of the extent of riverine PMF flood level for the Wollondilly River. Flooding to the north of the river (outside of the major tributaries) is overland flooding and is likely to be characterised as flash flooding (as there will be little to no warning). However, given the relative elevation of the area it is also considered that isolation times outside of riverine crossing points for most design events will be of relatively short duration. Attachment 1 to this FIRA includes and assessment by Worley Consulting of warning and duration times for overland flooding for roads within the precinct.

6. Evacuation Point

The most direct route from the site to a potential evacuation location is via Marys Mount Road frontage to the developing commercial precinct near the intersection of Crookwell Road and Marys Mount Road (3.8 kms) centred on Box Avenue. This commercial area contains an existing childcare centre, gym/commercial building, car wash and café. Furthermore, a supermarket with medical centre is currently under construction and a site has been approved for a future service station. This commercial area is intended to service the North Goulburn/Marys Mount precinct. Therefore, it is likely that if access to the main section of Goulburn south of the Wollondilly (due to a 0.20% AEP Event – PMF event) is blocked, this commercial precinct would be the most likely source of food or other services during a period of isolation. The following **Figure 8** identifies the evacuation route (from both site frontages) and destination point, with various locations marked A – G where overland drainage results in potential flooding of the road.

***Figure 8**: Evacuation Route- Subject Area to Commercial Area (Box Ave)*



The following tables identify the worst depths and velocities in the vicinity of each flood crossing point marked A – G between the site and the new commercial precinct centred on Box Avenue. The hazard categories used are from the Australian Emergency Handbook 7, with the vulnerability thresholds as specified in **Figure 9 and 10** below.

Figure 9: *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.

Figure 10: *Flood Hazard Curves (Australian Emergency Handbook 7)*

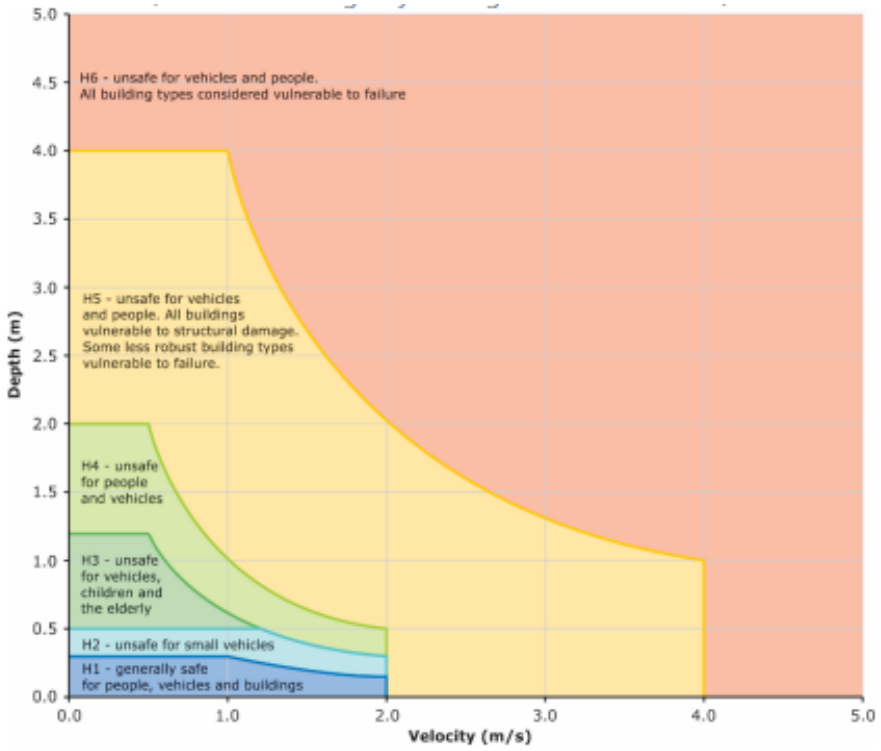


Table 1 :Overland Flooding Points 1% AEP and Hazard Ratings – Site to New Commercial Precinct

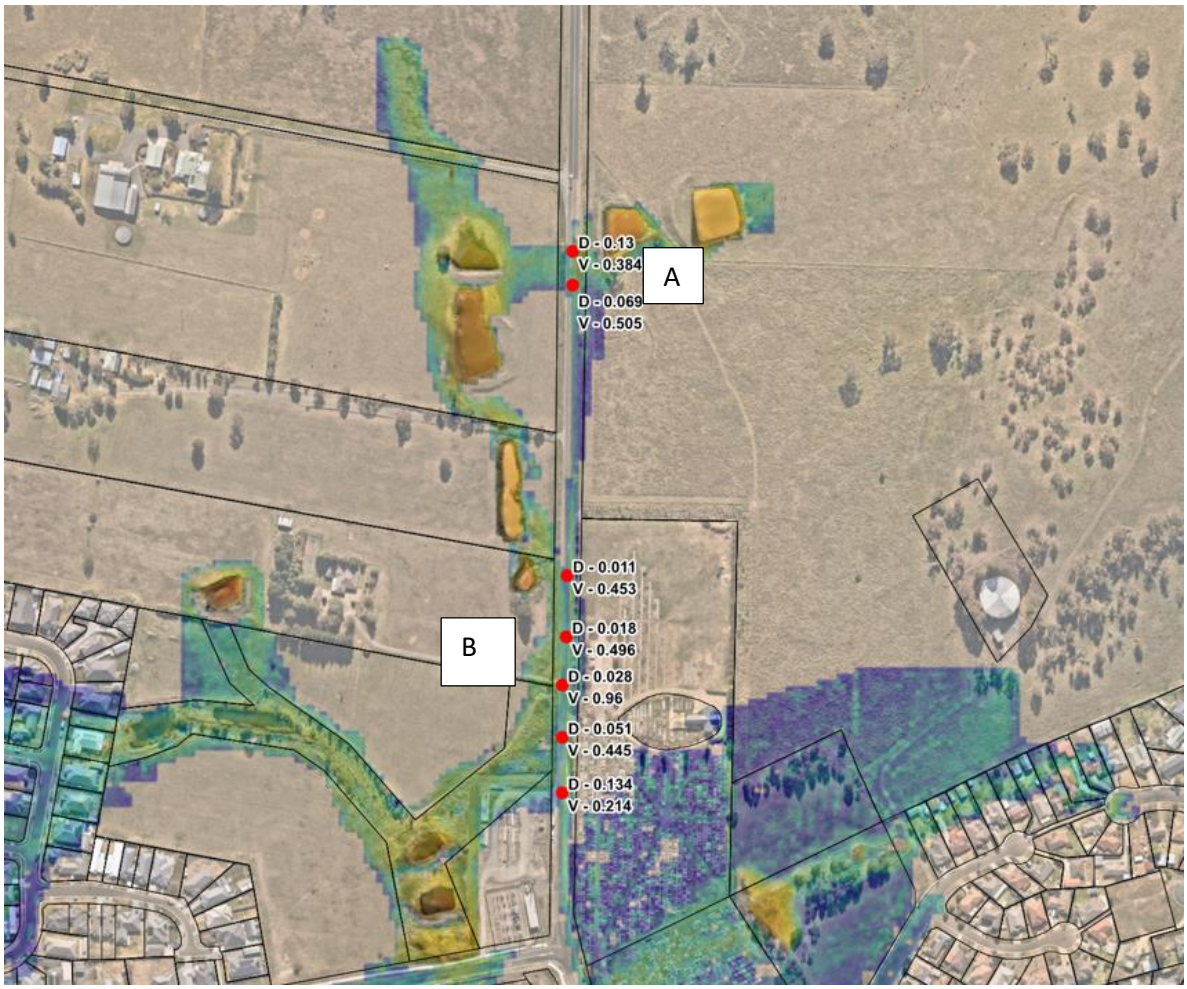
	A	B	C	D	E	F	G
Depth (m)	0.13	0.134	0.239	0.054	0.437	0.272	0.128
Velocity (m/s)	0.384	0.214	0.588	0.953	0.516	0.236	0.212
Hazard Category	H1	H1	H1	H1	H2	H1	H1

Table 2: Overland Flooding Points PMF and Hazard Ratings – Site to New Commercial Precinct

	A	B	C	D	E	F	G
Depth (m)	0.236	0.352	0.626	0.11	0.916	0.719	0.301
Velocity (m/s)	1.055	2.045	2.3	1.637	1.227	1.228	0.719
Hazard Category	H1	H5	H5	H1	H3 – H4	H3 – H4	H1

The following Council modelling has been applied from the Middle Arm Road frontage where it links the site to the existing North Goulburn (Marys Mount) urban area.

Figure 11*: 1% AEP Event – Middle Arm Road, South of the Subject Site and the intersection of Middle Arm Road and Marys Mount Road in metres*



The modelling shows for the 1% AEP that depths of flood water over Middle Arm Road do not exceed 14cm at any one point. Therefore, the flood risk for evacuation through this area is low risk. Additionally, Council's *Development Control Plan (DCP) 2009*, identifies existing drainage to be controlled through this section of Middle Arm Road consistent with the drainage corridors identified in the overland flood modelling.

Figure 12: *Flood Evacuation Route via Middle Arm Road, PMF Event Depths and Velocities (m)*

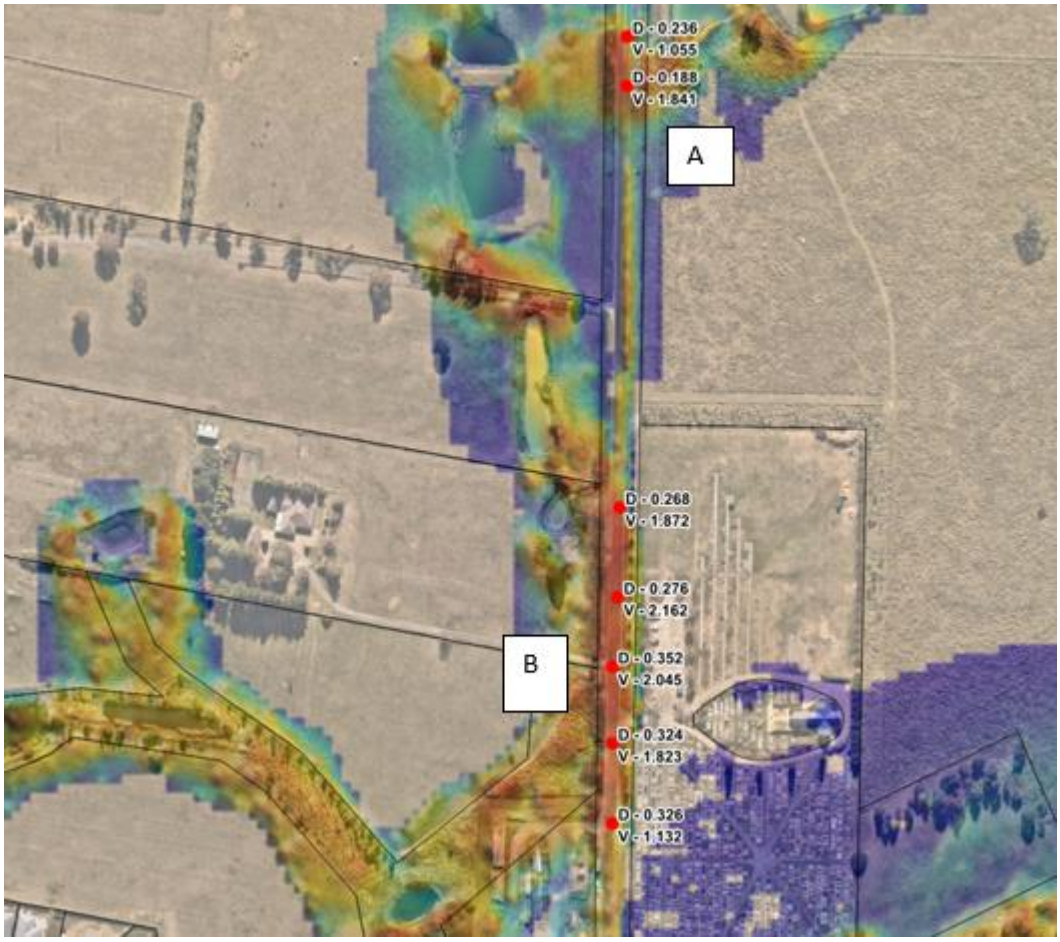


Figure 13*– Evacuation Route 1% AEP via Marys Mount Road – Points C- D*

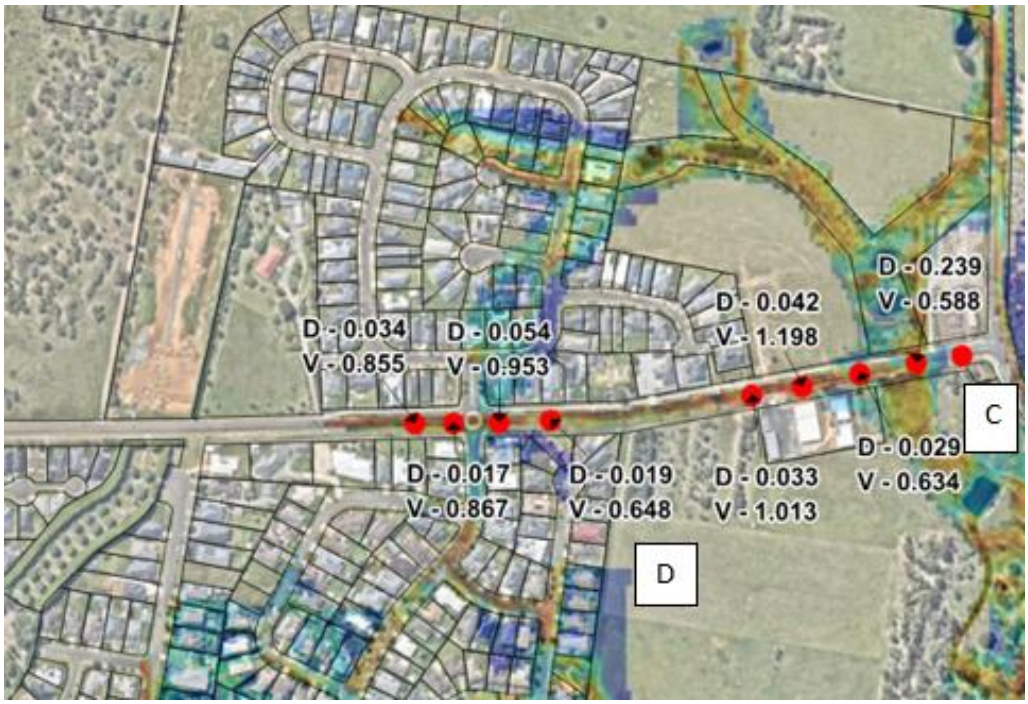


Figure 14 *– Evacuation Route 1% AEP via Marys Mount Road Points E - G*

Figure 15 *– Evacuation Route PMF via Marys Mount Road Points C - D*

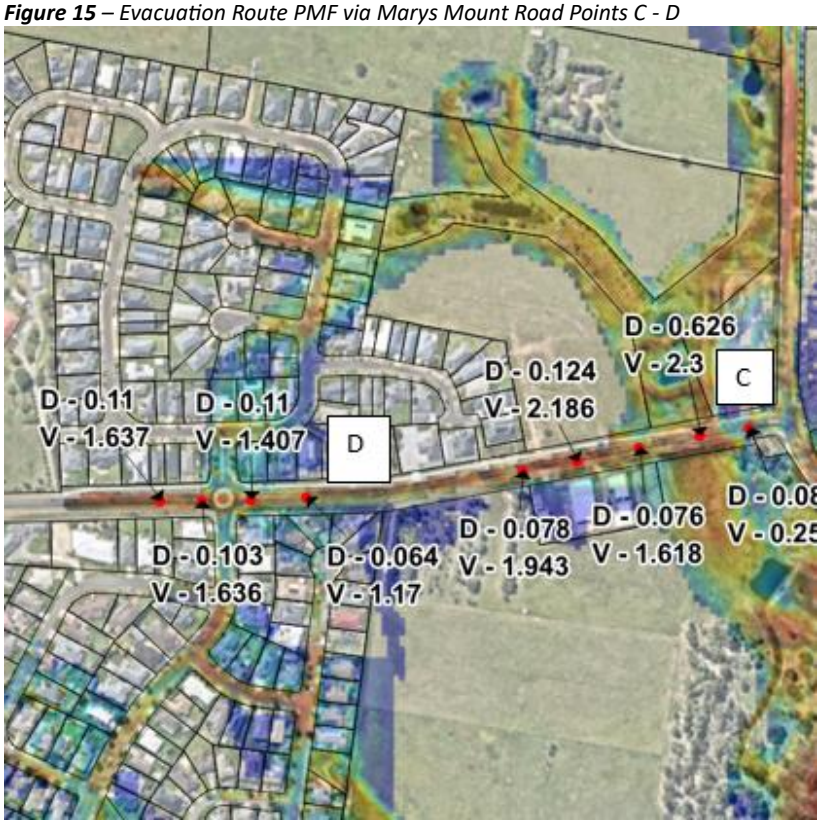
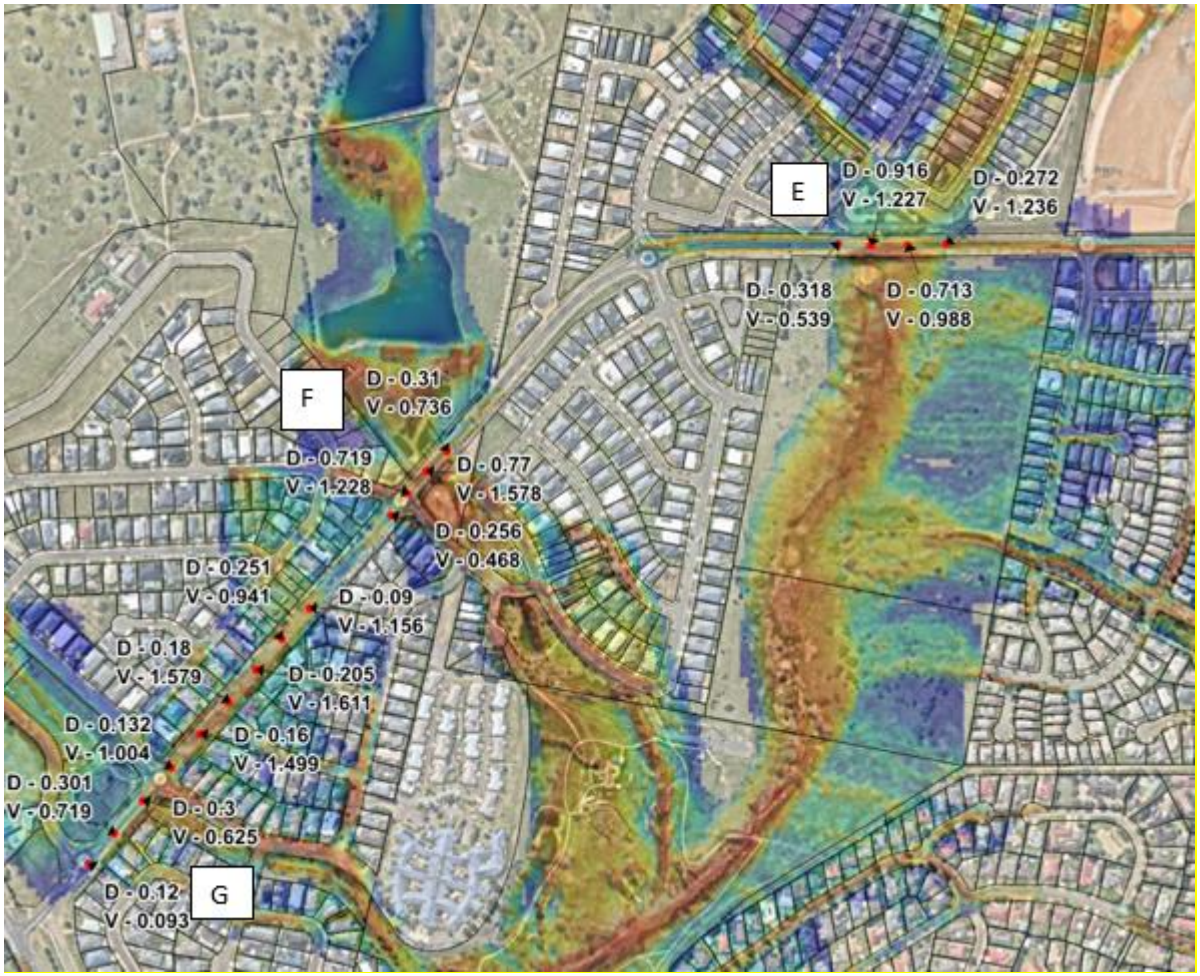


Figure 16– *Evacuation Route PMF via Marys Mount Road Points E - G*



The hazard categorisations for the various intersections vary greatly in a PMF event (refer Table 2) for each crossing on the main evacuation route.

This site can achieve evacuation to the North Goulburn (Marys Mount) urban area for a range of flood events up to and including the 1%AEP. As development occurs along Marys Mount Road and Middle Arm Road further improvements to drainage, culverts etc are identified in Council's DCP 2009. However, the route from the site to the identified destination (new commercial area Box Avenue) is affected by more hazardous levels of flooding beyond the 1%AEP.

7. Evacuation - Alternative Routes

One alternative route is identified and are assesses as follows:

Alternate Route 2 – Marys Mount Road - Middle Arm Road (south)– Queen Street (to IGA supermarket Cnr Queen Street and Ross Street) 2.7kms. This route has an alternative destination which is the existing IGA supermarket on the corner of Queen and Ross Streets in Bradfordville. Unlike the new commercial area this is a standalone supermarket with no other medical or other services planned for or provided. The following Figure… details the alternate route.

Figure 17: *Alternate Evacuation Route – Subject Site to Supermarket Cnr Queen/Ross Streets*

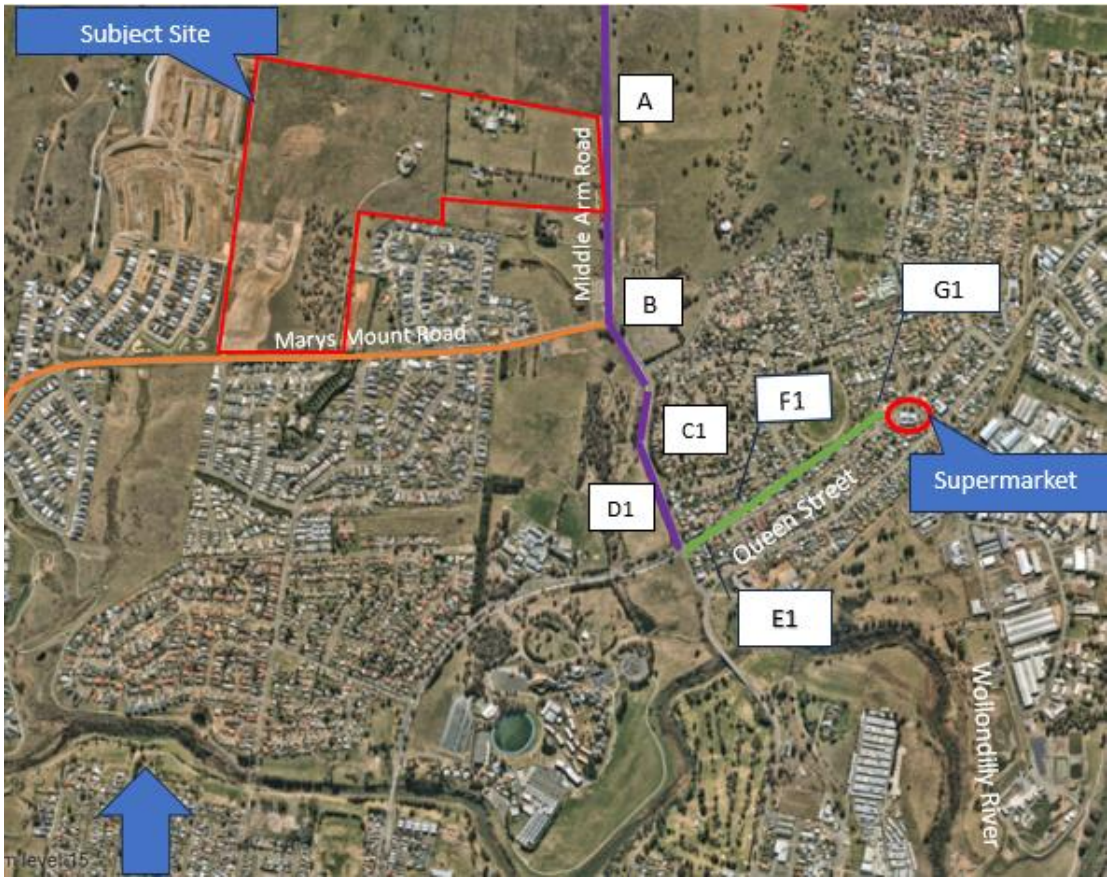


Figure 18: *Alternative Evacuation Route – 1% AEP - Points C1 – G1*

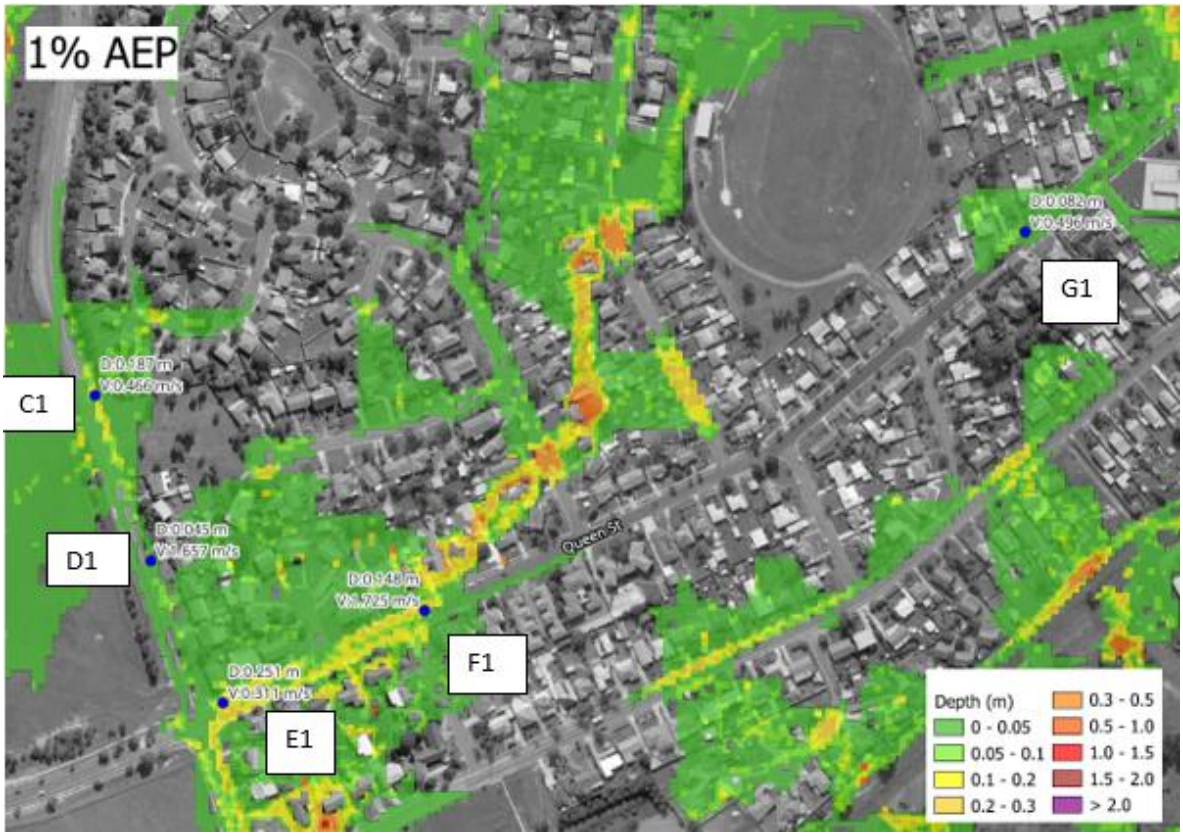


Table 3: Overland Flooding Points 1% AEP and Hazard Ratings – Alternate Route to Supermarket

	A	B	C1	D1	E1	F1	G1
Depth (m)	0.13	0.134	0.187	0.045	0.251	0.148	0.082
Velocity (m/s)	0.384	0.214	0.466	1.657	0.311	1.725	0.496
Hazard Category	H1	H1	H1	H1	H1	H1	H1

Figure 19: *Alternative Evacuation Route – PMF - Points C1 – G1*

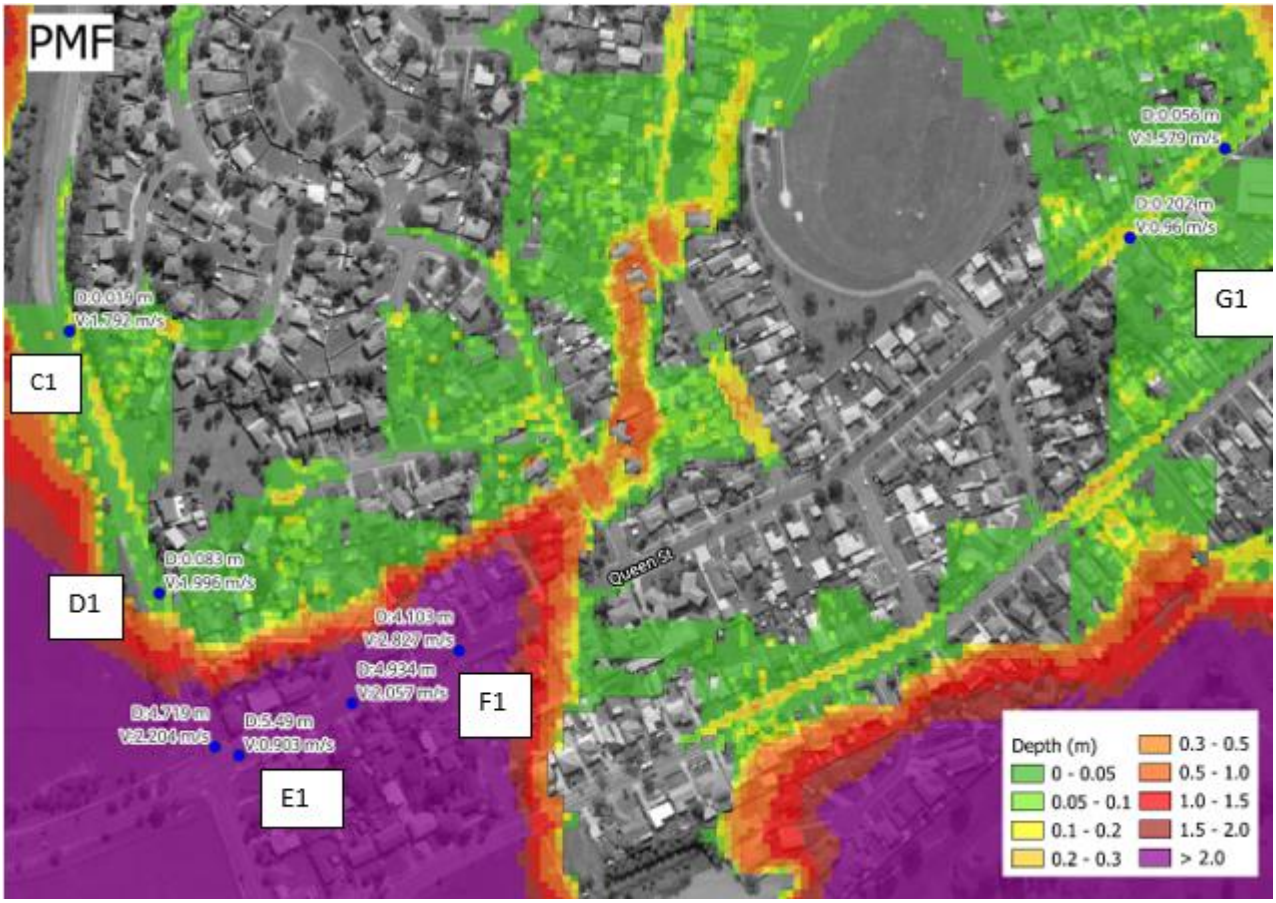


Table 4: Overland Flooding Points PMF and Hazard Ratings – Alternate Route to Supermarket

	A	B	C1	D1	E1	F1	G1
Depth (m)	0.236	0.352	0.019	0.083	5.49	4.934	0.202
Velocity (m/s)	1.055	2.045	1.792	1.996	0.903	2.057	0.96
Hazard Category	H1	H5	H1	H1	H6	H6	H1

As identified in Table 4 above, the route experiences high depths and velocities near the intersection of Middle Arm Road and Queen Street. This is due to the overland flooding

interacting at this elevation with the riverine PMF from the Wollondilly River. This route becomes too dangerous and is blocked at this point. However, it is possible to avoid this area of deeper riverine flooding by taking another more indirect alternate route via Amaroo Place, Woodward Street and Yarrowlow Street to Queen Street.

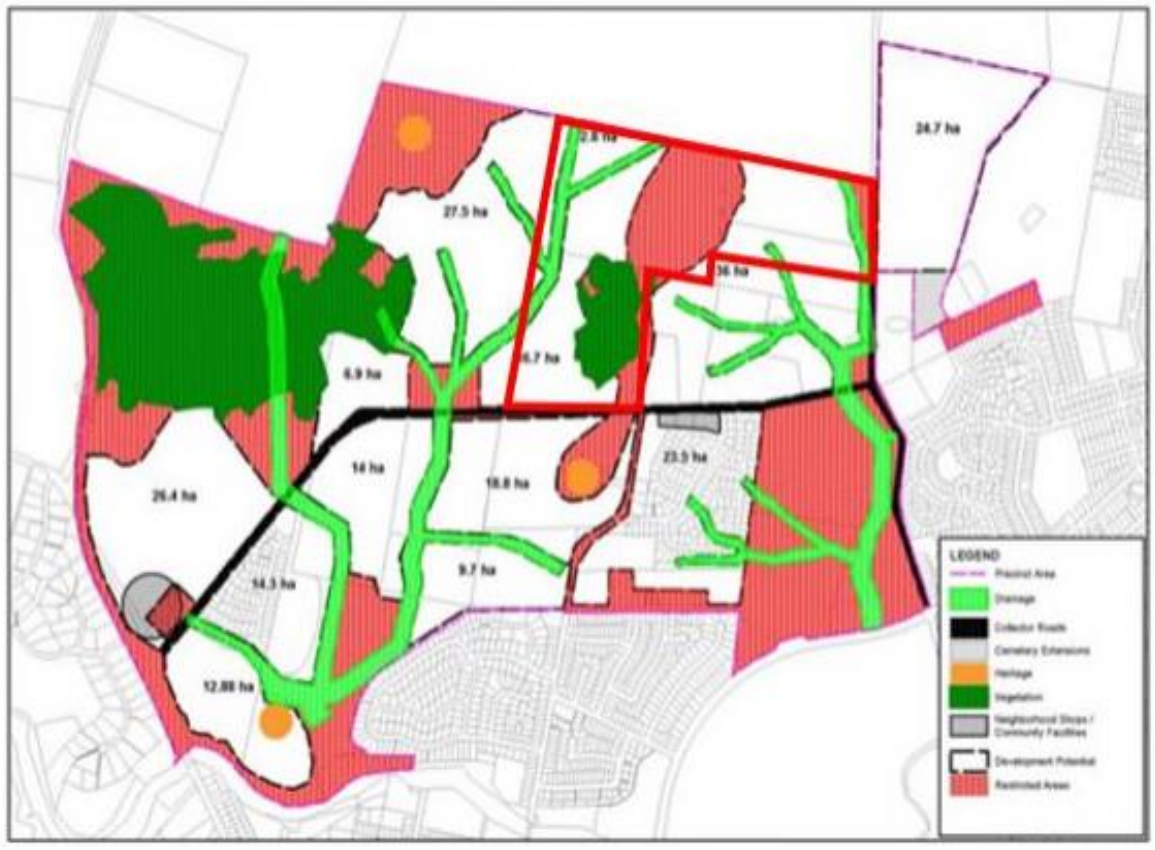
It is anticipated that overland flooding points A – B for both routes could be mitigated by future road drainage upgrades as the area develops (as identified in the Goulburn Mulwaree DCP structure plan for this precinct which identifies these drainage corridors). Should this occur the indirect route via Amaroo Place may be a viable option for horizontal evacuation across the precinct above the riverine PMF.

8. Potential Mitigations for Evacuation– Planning Provisions

It should be noted that the LiDAR data which the overland flood modelling is based on is from 2011. Many of the road improvements and stormwater detention work undertaken with newer subdivisions within the urban release area would have been constructed after this date.

The North Goulburn/Marys Mount Urban Release area has been identified since 2009. The planning for this release area identified the same drainage corridors that the subsequent overland flow modelling has identified. These corridors are shown in the following extract from the Goulburn Mulwaree DCP 2009 detailing their location.

Figure 20: *GM DCP 2009 identifying drainage channels in light green in the Marys Mount including alongside Middle Arm Road*



Each subdivision approved within the precinct has necessitated some formalisation of these drainage corridors with associated works such as on-site detention basins, roads and pit/pipework installation or upgrades. However, it should be noted that it is standard engineering practice that the piped drainage system is only designed "*for a 1 in 5 year storm event. Higher order storm events to be based on an overland flow systems along natural drainage lines*". **This is an important point for general consideration as all drainage systems (including those associated with local roads) outside natural drainage corridors are likely to be affected by any more than a 20%AEP event**.

Essentially the trigger for ongoing road upgrades at drainage points is the progression of new development within the area as a catalyst for improvements. Therefore, new development is required to facilitate upgrades to road drainage.

9. Warning Times

The concept plan in association with the Council modelling would suggest that all sections of the site can achieve access to Marys Mount Road in all design events and that no flooding within internal roadways is identified. Future development of 110-118 Marys Mount Road can be connected through 129 Marys Mount Road (Blakely's Run) as per the approved subdivision plan.

The precinct is relatively elevated and sits above the floodplain for the Wollondilly River. Drainage corridors on site have either already been considered in the approved subdivision (Blakely's Run at 129 Marys Mount Road) or are identified in the DCP structure plan. Whilst some warning may be available for crossing points at the Wollondilly River (where riverine flooding occurs) warning times associated with overland flooding and non-perennial water courses where crossing roads is likely to be short (flash flooding). It is also noted due to the relative elevation of this precinct that durations would be relatively short for isolation within the precinct itself. Following consultation during the Gateway process with SES further information has been sought from Worley Consulting to clarify warning times and durations for roads within the precinct (**Attachment 1 to FIRA**).

In summary, the following points are made in relation to evacuation, warning times, isolation, and duration:

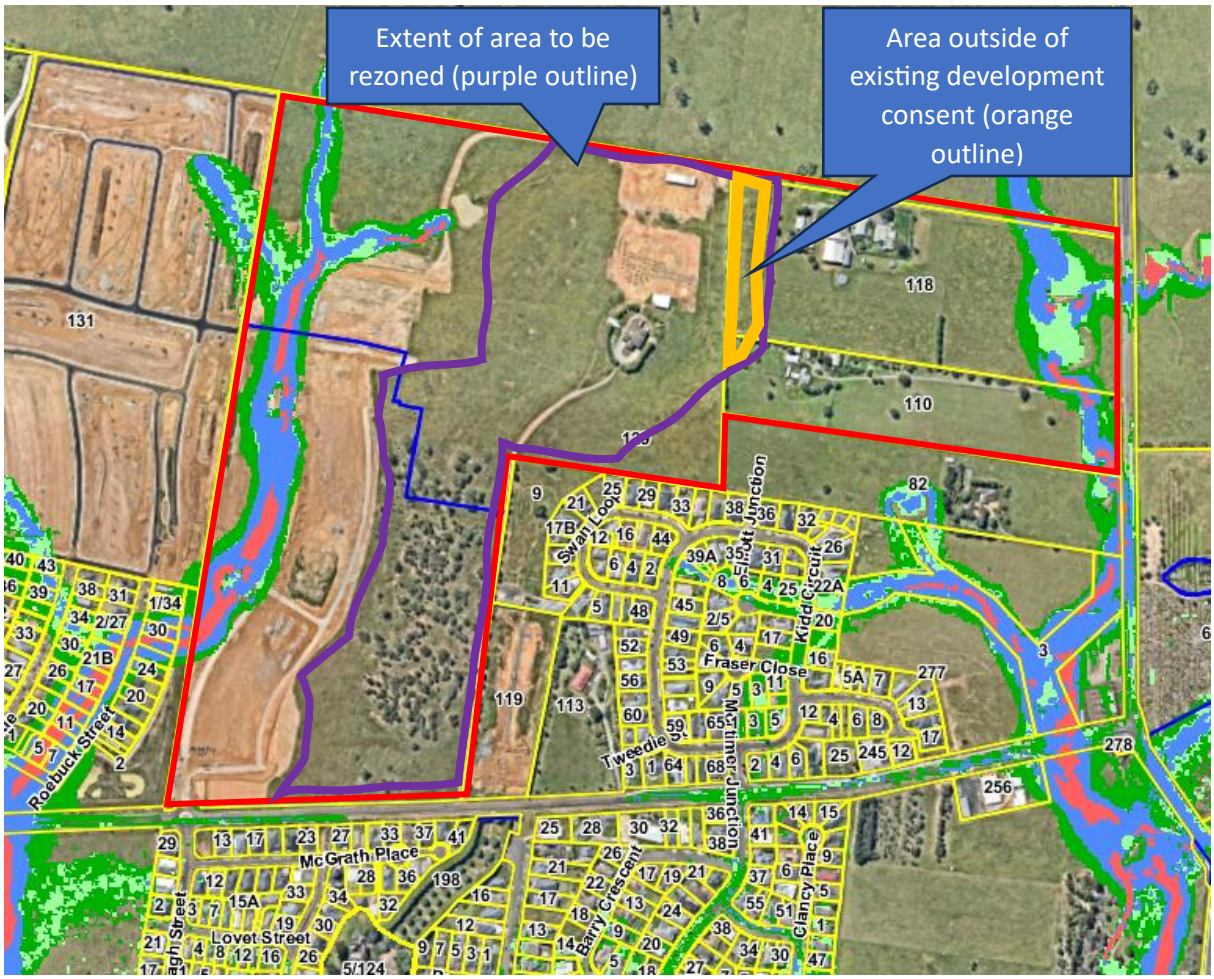
- The context of flooding on the site as discussed later in Section 10 would suggest that evacuation as per the NSW SES *Goulburn Mulwaree LGA Local Flood Plan* (Refer Section 5.8) would not be required.
- The Marys Mount Precinct has been identified as an urban release area since 2009 with several large subdivisions under construction.
- This site is contiguous with the existing urban release area under development.
- Evacuation would largely be horizontal – moving across an elevated area above the Wollondilly floodplain.
- The main evacuation points prior to a 1 in 500 event would be to within central Goulburn but after this more realistically it would be either to the new commercial area centred on Box Avenue or the supermarket at Bradfordville (i.e. within areas north of the Wollondilly River).
- Currently access to both evacuation points (or for food/other services) involves several crossing points which are at H1 – H2 hazard levels in a 1% AEP event.

- Drainage corridors subject to flooding are identified in the DCP 2009 and road drainage is being incrementally upgraded as the subdivisions progress as per the structure plan.
- Currently the hazard categories for crossing points for either evacuation are too hazardous in some locations for a PMF event however once upgrades to Marys Mount Road and Middle Arm Road occur with the development of residentially zoned land, there may be some capacity to evacuate in the rarer events also (but only within the precinct) to the Box Avenue commercial area or to the supermarket area in Queen/Ross Streets.

10. Safe Occupation

This planning proposal is seeking the rezoning of part of the existing RU6 Transition zoned area to R2 Low Density Residential and a part of the RU6 Transition Zone (and R2 Residential zone) to C2 Environmental Conservation (to avoid significant biodiversity and cultural heritage areas). As previously noted, however, portions of the subject area to be rezoned are outside of the area identified by overland flood modelling as indicated in the figure below.

Figure 21: *Extent of Area to be Rezoned and Area outside of Approved Subdivision to be Rezoned in Relation to Overland Flooding.*



As detailed in the figure above, no portion of the site identified for rezoning falls within the overland flooding areas. Furthermore, most of the area (129 Marys Mount Road) is subject to an approved subdivision which is under construction. Only a small area of the site to be rezoned falls outside of the subdivision approval as indicated in orange in the above figure.

Safe occupation can be achieved for all parts of the subject area where rezoning is proposed for all design events through to the PMF.

11. Planning Risk Management Measures – Future Subdivision

As identified in Section 4 of *MM01 – Flood risk management measures*. There are a number of planning measures which can be undertaken to reduce risk, in this case the use of land use zoning and Development Control Plan (DCP) controls are considered to be an effective means of reducing risk.

As stated in Section 10 no area proposed to be rezoned is affected by flooding and therefore safe occupation can be achieved. Furthermore, there are other risk management measure available to Council. The *Goulburn Mulwaree Local Environmental Plan* (LEP) 2009 contains the following provisions that relate specifically to flooding:

5.21 Flood planning

(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.

(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 river banks or watercourses.

(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.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline means the *Considering Flooding in Land Use Planning Guideline* published on the Department's website on 14 July 2021.

flood planning area has the same meaning as it has in the Flood Risk Management Manual.

Flood Risk Management Manual means the *Flood Risk Management Manual,* ISBN 978-1-923076-17-4, published by the NSW Government in June 2023.

And

5.22 Special flood considerations

(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.

(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.

(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.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline—see clause 5.21(5).

flood planning area—see clause 5.21(5).

Flood Risk Management Manual—see clause 5.21(5).

probable maximum flood has the same meaning as in the Flood Risk Management Manual.

sensitive and hazardous development means development for the following purposes—

(a) caravan parks,

(b) correctional centres,

(c) educational establishments,

(d) emergency services facilities,

(e) hazardous industries,

(f) hazardous storage establishments,

(g) hospitals.

There is no adopted flood planning area for this site. In situations such as this the 1%AEP Event plus a freeboard of .5m is applied as per Chapter 3 of the *Goulburn Mulwaree Development Control Plan* (DCP) 2009 (and Appendix J – Flood Policy). However, the nature of the depth of the PMF on the periphery of the drainage channels would suggest that there is little chance of scaling occurring outside of the PMF extent.

Additionally, it should be noted that the *Building Code of Australia* also specifies minimum floor levels for dwellings being:

- 150mm for slab on ground (although it can be reduced depending on drainage arrangements around the building but these would need to be demonstrated).
- 400mm for suspended floor (bearers and joists) this is more to do with ventilation and termite control.

In summary the main points identified in relation to safe occupation are:

- The Marys Mount Precinct is an existing urban release area at various stages of construction. This site is contiguous to this precinct and is identified as an urban growth area in Council's UFHS.
- The site is elevated and not affected by riverine flooding.
- The portion of the subject area to be rezoned is not flood affected.
- Overland flooding occurs on areas of the site already zoned residential. The majority of the subject area contains an approved residential subdivision currently under construction. This subdivision has considered the western drainage corridor in its design and engineering.
- Clauses 5.21 and 5.22 of Goulburn Mulwaree LEP 2009 may be applied.
- Council's DCP and Flood Policy will apply to any further subdivision.
- The DCP requires a FPA of 0.5m (above 1% AEP) for areas not affected by riverine flooding as per current requirements.
- The Building Code of Australia also specifies minimum floor levels for dwellings (regardless of other planning provisions).
- It is considered that the site has the capacity to be developed with all lots having access and dwellings located above flood affected land.

12. Ability of Residents to Be Self Sufficient During Events

Residents would be able to self-evacuate and travel within the precinct subject to some crossing of roads at low hazard categories (H1- H2) in a 1% AEP. Crossing of the Wollondilly River will not be possible from a 0.20 % AEP event and upwards. During a 1% AEP event, residents would have access to either the new commercial precinct on Box Avenue or the supermarket on the corner of Queen Street and Ross Street.

Some mobility within the northern precinct beyond the Wollondilly Floodplain would be possible within a short duration of a PMF event. Beyond the floodplain to the north the precinct is relatively elevated and more likely to be prone to flash flooding with road closures being of a briefer duration. Lower sections of the precinct falling within the riverine PMF area

are likely to experience significant durations for flooding. Evacuation points to two separate supermarkets for supplies have been identified in this FIRA.

In relation to self-sufficiency, the proposed sites are intended to be served by Council's reticulated water and sewer network. Water provision is gravity fed and given the elevation of the site and proximity to Council's reservoirs; water provision is unlikely to be affected in most events. Furthermore, being located within the Sydney drinking water catchment typically requires the provision of roof water tanks to new dwellings.

Given the relative elevation of the site to Council's sewer system the provision of sewer is likely to still be available, although there is likely to be no capacity at the Goulburn wastewater treatment plant to treat sewer should it become inundated in a PMF.

13. Compatibility with Emergency Response Plans

The context of flooding on the site as already discussed would suggest that evacuation generally as per the NSW SES *Goulburn Mulwaree LGA Local Flood Plan* (Refer Section 5.8) would not be required. Dwellings will not be subject to any level of flood event; therefore, evacuation would not be desirable as per the Local Flood Plan, unless due to a medical event.

14. Additional Impact on Emergency Services

The site is contiguous to an urban release area which is under construction and has been identified by Council since 2009.

The site is within an elevated precinct well above the riverine floodplain of the Wollondilly River. Safe occupation of dwellings is achievable during all flood events including the PMF. Therefore, no evacuation should be required **except during a medical emergency**.

It is noted that emergency services are located either in central Goulburn (south of the Wollondilly River) including NSW Police, Goulburn Base Hospital, NSW Ambulance.

The new SES Operations Centre under construction is located on the northern side of the Mulwaree (Hetherington Street) and is further separated from the central section of Goulburn, noting Sydney Road is cut off during a PMF event.

Some NSW Police support may be available in association with the Police Academy which is located on the northern side of the Wollondilly River.

15. Conclusion

In conclusion, the site is contiguous to other areas currently being developed in the Marys Mount precinct urban release area and is largely also covered by an approved subdivision under construction. The areas identified for rezoning within the subject area are not flood affected by any design event through to the PMF, accordingly safe occupation can be achieved.

The precinct to the north of Marys Mount Road is located above the Wollondilly floodplain and is therefore not subject to riverine flooding. The area would be cut off from central Goulburn in a 0.20%AEP (1 in 500) Event. Horizontal evacuation can currently be achieved across the precinct up to at least a 1%AEP Event based on available information. Data is not available for other events up between the 1%AEP and PMF. However, Council is

incrementally improving road drainage across the precinct with each new subdivision. These drainage corridors have been identified from the earliest planning of this urban release area in 2009.

Council considers the flood risk associated with the development of this site to be low and acceptable. Improvements to road drainage can only occur incrementally as development of the precinct continues.

The urban release area has been identified for some time and is progressively extending. This site is not considered to be isolated in relation to this precinct.

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The General Manager
Goulburn Mulwaree Council
184 Bourke Street
GOULBURN NSW 2580

13th September 2024

Attention: Ms Kate Wooll

Dear Kate,

GOULBURN OVERLAND FLOODING RISK STUDY & MANAGEMENT PLAN
NORTH GOULBURN PLANNING PROPOSALS – OVERLAND FLOODING AFFECTATION OF ROADS

1. Background

I refer to our fee proposal dated 7th August 2024 to provide additional information to support a number of planning proposals in North Goulburn. The relevant planning proposals are listed below.

- Large lot residential subdivision at 515 Crookwell Road, Kingsdale.
- Rezoning of 44 Middle Arm Road, Goulburn.
- Rezoning of a part of 129 Marys Mount Road and a part of 110-118 Middle Arm Road, Goulburn.
- Rezoning of 407 & 457 Crookwell Road, Goulburn.

Goulburn Mulwaree Council (Council) has completed preliminary Flood Impact and Risk Assessments (FIRA) for these planning proposals using existing flood model results from the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021).

It is understood that the NSW State Emergency Service (SES) is generally accepting of the findings presented in the FIRAs prepared by Council but requires additional information such as warning times and the estimated duration of inundation of several key roads in the vicinity of the subject lots. These key roads have been nominated as part of proposed evacuation routes for the four planning proposals listed above. The key roads to be assessed are shown in **Figure 1**.

Worley Consulting is currently engaged by Council to undertake the Goulburn Overland Flooding Risk Study and Management Plan. As part of this project, Council has provided a copy of the flood models developed for the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021).

Accordingly, Council has requested Worley Consulting to extract flood model results from the existing models developed for the 2021 overland flows study to determine warning times and duration of inundation of the key roads shown in **Figure 1**.

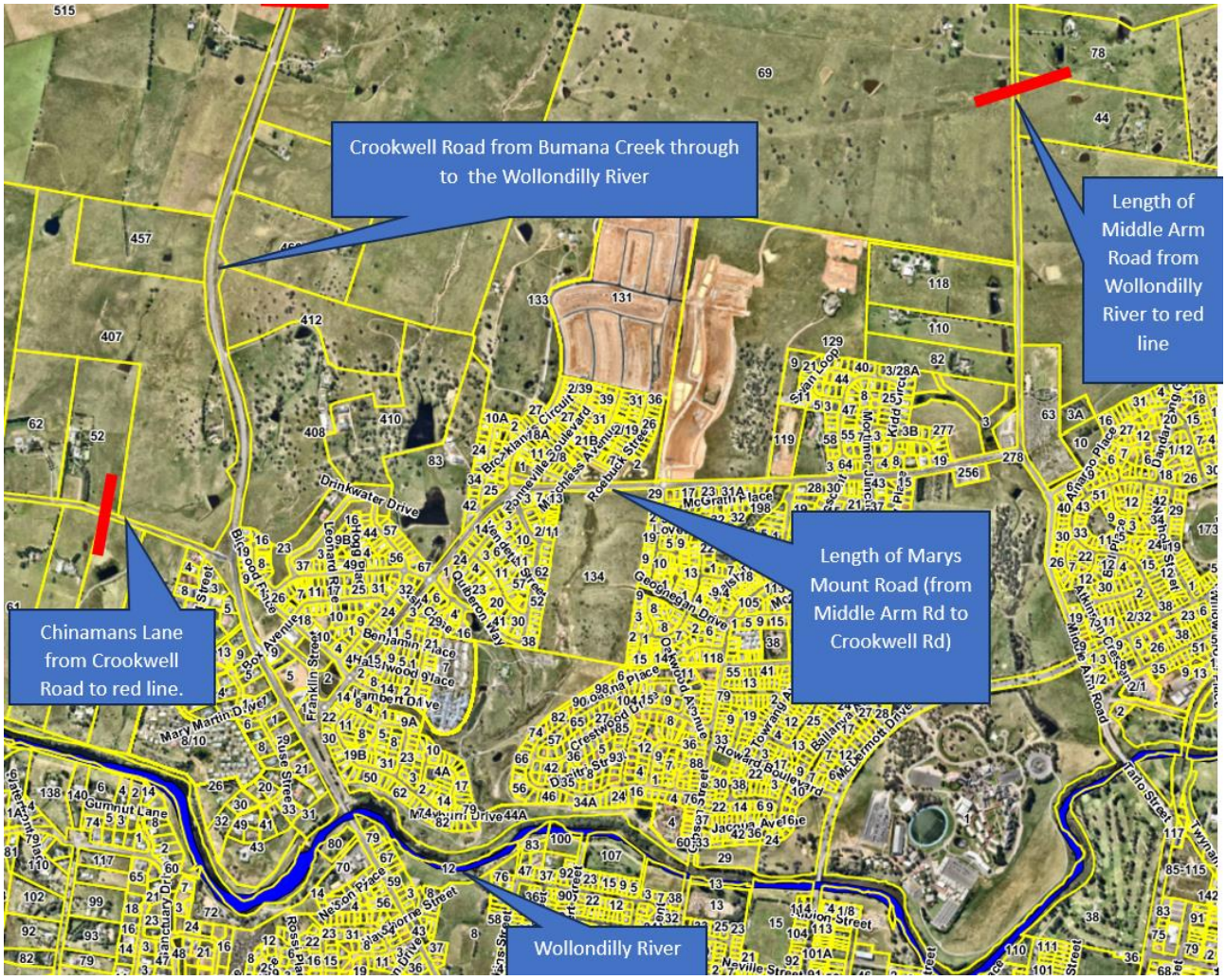


Figure 1 Location of roads to be analysed

2. Methodology and Assumptions

Worley Consulting has completed the following tasks.

- Established the provided WBNM and TUFLOW flood models which were developed for the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021).
- Utilised the existing flood models to simulate the critical duration storms for the 1% AEP event (2 hour and 9 hour storms), the 1 in 2000 AEP event (1 hour and 6 hour storms) and the Probable Maximum Flood (1 hour storm). These critical durations were specified in Section 6.1 of the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021).
- Extracted and tabulated available warning times and duration of inundation for the roads nominated by Council (refer **Figure 1**) for the five design events nominated above.

The following items were assumed when extracting available warning times and duration of inundation.

- It was assumed that the models developed for the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021) and which were provided by Council were suitable for the purposes of this analysis.
- It is understood that the flood models developed for the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021) were completed using rainfall data and techniques from Australian Rainfall and Runoff 1987 (ARR 1987). Therefore, the outcomes of this analysis may be subject to change when the modelling

is updated to Australian Rainfall and Runoff 2019 (ARR 2019) as part of the *Goulburn Overland Flooding Risk Study & Management Plan*.

- It is noted that the *Goulburn Overland Flow Modelling Report* (GRC Hydro, 2021) undertook a preliminary comparison of ARR 2019 and ARR 1987 rainfall data for the purposes of assessing overland flooding. The 2021 report recommended the adoption of ARR 1987 rainfall data and techniques as it achieved a closer match to the outcomes of an at-site rainfall intensity frequency analysis which was undertaken for the Bungonia (Inverary Park) gauge (gauge number 070012).
- Therefore, the adoption of ARR 1987 rainfall data and techniques for the purposes of assessing overland flooding of the key roads near the North Goulburn sites is considered appropriate.

3. Findings

The available warning time and duration of inundation for the key roads shown in **Figure 1** for the five nominated design events is documented in **Table 1**. The available warning time refers to the length of time from the onset of rainfall to the time when floodwaters first inundate the road.

It is noted that not all locations that become inundated have been reported, given that there are some locations where significant stretches of the road are inundated at the peak of the storm. Information has been provided for the locations where the earliest or most severe inundation is expected.

The locations where warning time and duration of inundation is provided is shown in **Figure 2**.

I trust that the findings documented above suitably addresses the requirements to update Council's existing Flood Impact and Risk Assessment for the North Goulburn Planning Proposals. Please feel free to contact me on 02 8456 7238 should you require anything further.

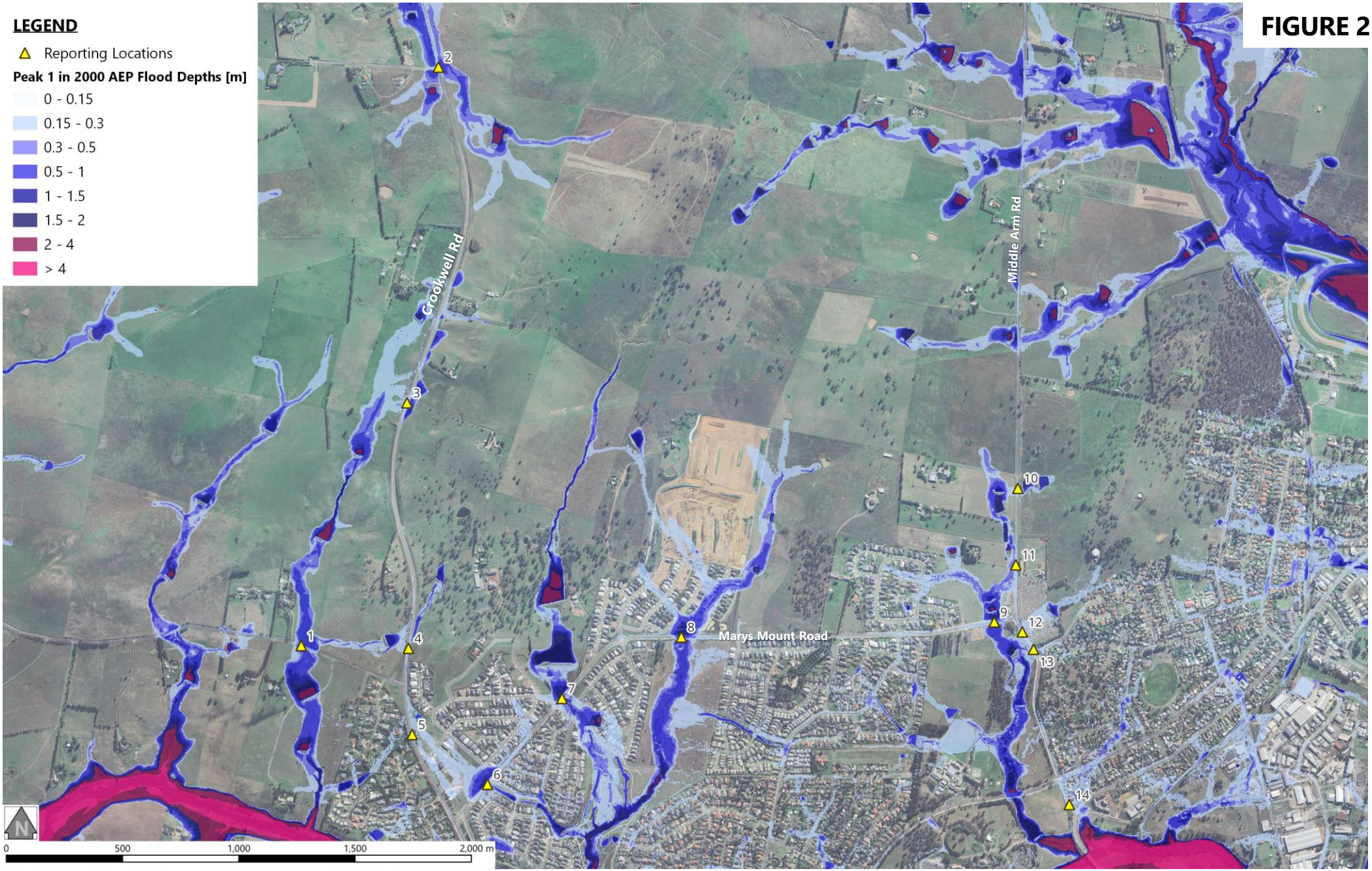
Yours faithfully,

WORLEY CONSULTING

Lennox To

Water Resources Engineer

FIGURE 2



Prepared by:

worley consulting

REPORTING LOCATIONS

Table 1 Summary of warning times and duration of inundation at key locations

ID	Road	Location	Event	Peak flood depth (m)	Inundation greater than 0.00 m		Inundation greater than 0.15 m	
					Time to inundation (min)	Duration of inundation# (mins)	Time to inundation (min)	Duration of inundation# (min)
1	Chinamans Ln	480m west of Crookwell Rd / Chinamans Ln intersection	1% AEP 2 hour storm	0.34	41	140	44	137
			1% AEP 9 hour storm	0.37	170	911	180	463
			1 in 2000 AEP 1 hr storm	0.63	15	106	17	104
			1 in 2000 AEP 6 hr storm	0.47	43	578	47	453
			PMF 6hr storm	0.80	8	113	9	112
2	Crookwell Rd	Onslow Rd / Crookwell Rd intersection	1% AEP 2 hour storm	<0.01	64	19	N/A*	N/A*
			1% AEP 9 hour storm	<0.01	302	30	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.18	25	53	42	14
			1 in 2000 AEP 6 hr storm	0.02	61	244	N/A*	N/A*
			PMF 6hr storm	0.34	15	70	25	44
3	Crookwell Rd	1.2km north of Crookwell Rd / Chinamans Ln intersection	1% AEP 2 hour storm	0.12	58	123	N/A*	N/A*
			1% AEP 9 hour storm	0.12	224	857	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.21	21	100	24	45
			1 in 2000 AEP 6 hr storm	0.16	58	539	67	105
			PMF 6hr storm	0.27	11	110	14	60
4	Crookwell Rd	150m north of Crookwell Rd / Chinamans Ln intersection	1% AEP 2 hour storm	0.07	34	90	N/A*	N/A*
			1% AEP 9 hour storm	0.07	176	149	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.18	10	97	26	40
			1 in 2000 AEP 6 hr storm	0.14	37	328	N/A*	N/A*
			PMF 6hr storm	0.20	3	118	10	62
5	Crookwell Rd	100m north of Crookwell Rd / Box Av intersection	1% AEP 2 hour storm	<0.01	50	99	N/A*	N/A*
			1% AEP 9 hour storm	<0.01	302	109	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	<0.01	22	99	N/A*	N/A*
			1 in 2000 AEP 6 hr storm	<0.01	55	332	N/A*	N/A*
			PMF 6hr storm	<0.01	14	107	N/A*	N/A*

ID	Road	Location	Event	Peak flood depth (m)	Inundation greater than 0.00 m		Inundation greater than 0.15 m	
					Time to inundation (min)	Duration of inundation# (mins)	Time to inundation (min)	Duration of inundation# (min)
6	Marys Mount Rd	Lambert Dr / Marys Mount Rd intersection	1% AEP 2 hour storm	0.13	46	135	N/A*	N/A*
			1% AEP 9 hour storm	0.18	184	897	326	37
			1 in 2000 AEP 1 hr storm	0.29	20	101	26	75
			1 in 2000 AEP 6 hr storm	0.23	46	512	70	279
			PMF 6hr storm	0.35	14	107	16	105
7	Marys Mount Rd	Donnelly Cr / Marys Mount Rd intersection	1% AEP 2 hour storm	0.28	7	174	43	86
			1% AEP 9 hour storm	0.38	11	1070	299	176
			1 in 2000 AEP 1 hr storm	0.64	4	117	14	107
			1 in 2000 AEP 6 hr storm	0.52	5	478	47	387
			PMF 6hr storm	0.88	3	118	8	113
8	Marys Mount Rd	250m west of Kavanagh St / Marys Mount Rd intersection	1% AEP 2 hour storm	0.39	19	162	44	111
			1% AEP 9 hour storm	0.38	41	1040	206	238
			1 in 2000 AEP 1 hr storm	0.67	10	111	15	106
			1 in 2000 AEP 6 hr storm	0.50	17	425	48	349
			PMF 6hr storm	0.83	7	114	9	112
9	Marys Mount Rd	90m east of Middle Arm Rd / Marys Mount Rd intersection	1% AEP 2 hour storm	0.28	10	171	42	83
			1% AEP 9 hour storm	0.28	16	1065	287	98
			1 in 2000 AEP 1 hr storm	0.57	6	115	12	104
			1 in 2000 AEP 6 hr storm	0.41	8	713	49	318
			PMF 6hr storm	0.71	5	116	7	114
10	Middle Arm Rd	560m north of Middle Arm Rd / Marys Mount Rd intersection	1% AEP 2 hour storm	0.26	42	139	45	136
			1% AEP 9 hour storm	0.26	108	973	130	951
			1 in 2000 AEP 1 hr storm	0.36	18	103	20	101
			1 in 2000 AEP 6 hr storm	0.29	41	680	47	489
			PMF 6hr storm	0.42	12	109	13	108

ID	Road	Location	Event	Peak flood depth (m)	Inundation greater than 0.00 m		Inundation greater than 0.15 m	
					Time to inundation (min)	Duration of inundation# (mins)	Time to inundation (min)	Duration of inundation# (min)
11	Middle Arm Rd	230m north of Middle Arm Rd / Marys Mount Rd intersection	1% AEP 2 hour storm	0.10	59	122	N/A*	N/A*
			1% AEP 9 hour storm	0.08	202	879	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.32	15	106	19	46
			1 in 2000 AEP 6 hr storm	0.15	62	659	69	1
			PMF 6hr storm	0.47	6	115	8	67
12	Middle Arm Rd	70m south of Middle Arm Rd / Marys Mount Rd intersection	1% AEP 2 hour storm	0.04	23	131	N/A*	N/A*
			1% AEP 9 hour storm	0.04	180	270	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.24	3	118	21	40
			1 in 2000 AEP 6 hr storm	0.14	22	380	N/A*	N/A*
			PMF 6hr storm	0.33	2	119	14	53
13	Middle Arm Rd	Amaroo Pl / Middle Arm Rd intersection	1% AEP 2 hour storm	0.14	11	170	N/A*	N/A*
			1% AEP 9 hour storm	0.13	35	1046	N/A*	N/A*
			1 in 2000 AEP 1 hr storm	0.27	5	116	11	58
			1 in 2000 AEP 6 hr storm	0.19	8	713	53	209
			PMF 6hr storm	0.32	3	118	6	68
14	Middle Arm Rd	Taralga Rd / Middle Arm Rd intersection	1% AEP 2 hour storm	0.20	11	170	37	46
			1% AEP 9 hour storm	0.18	18	1063	290	50
			1 in 2000 AEP 1 hr storm	0.26	6	115	12	66
			1 in 2000 AEP 6 hr storm	0.21	9	638	41	273
			PMF 6hr storm	0.30	4	117	6	77

Notes:

- Duration of inundation varies across design storm events given the different critical durations for the 1% AEP, 1 in 2000 AEP and PMF events

* - Peak depth of flooding at this location is shallower than 0.15 metres