Goulburn Flooding Technical Working Group

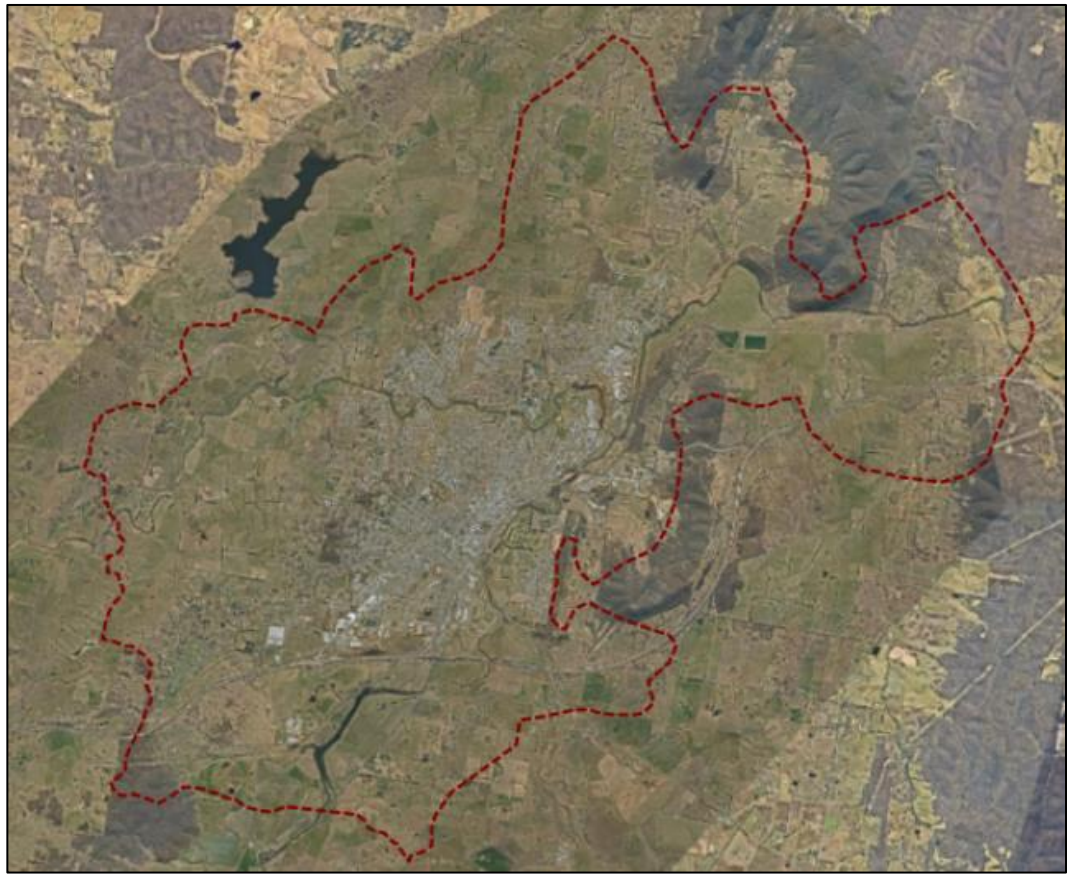
Meeting 1

26th October 2023

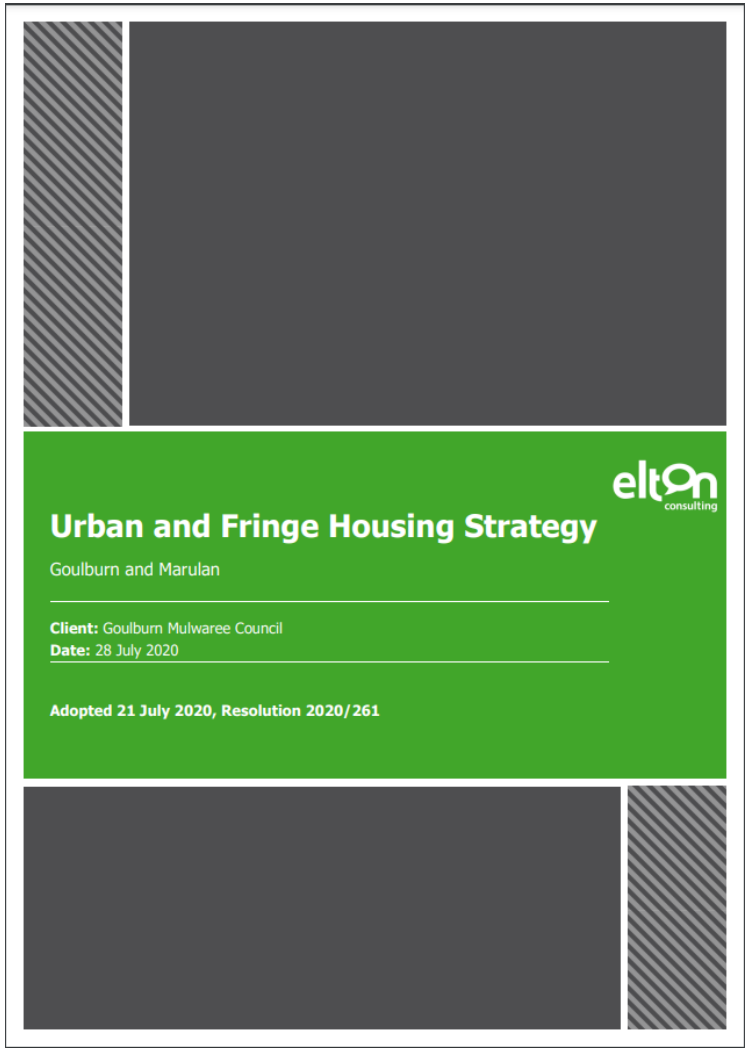
Agenda

- Introductions
- Flood Study & Coverage
- Planned Growth in Goulburn
- Goulburn Flood Situation
  - Issues raised
- Current & Emerging Planning Proposals overview

Goulburn Floodplain Risk Management Study and Plan



- Adopted 16 August 2022
- Prepared by GRC Hydro
- Addresses Riverine Flooding
- Overland flow also modelled
  - Overland Study forthcoming
- Covers all Goulburn urban area
- Covers nearly all growth precincts
- Applies hazard category approach (FPCC 1-4)
- 14 Recommendations



Planned Growth

Urban and Fringe Housing Strategy (Adopted 2020)

- ❑3,045 new dwellings by 2036
  - Serviced- 80%
  - Large Lot- fringe- 12%
  - Infill- 8%
- ❑22% increase in dwellings (2016)
- ❑~ 7308 new residents
- ❑~ 30% increase in city population

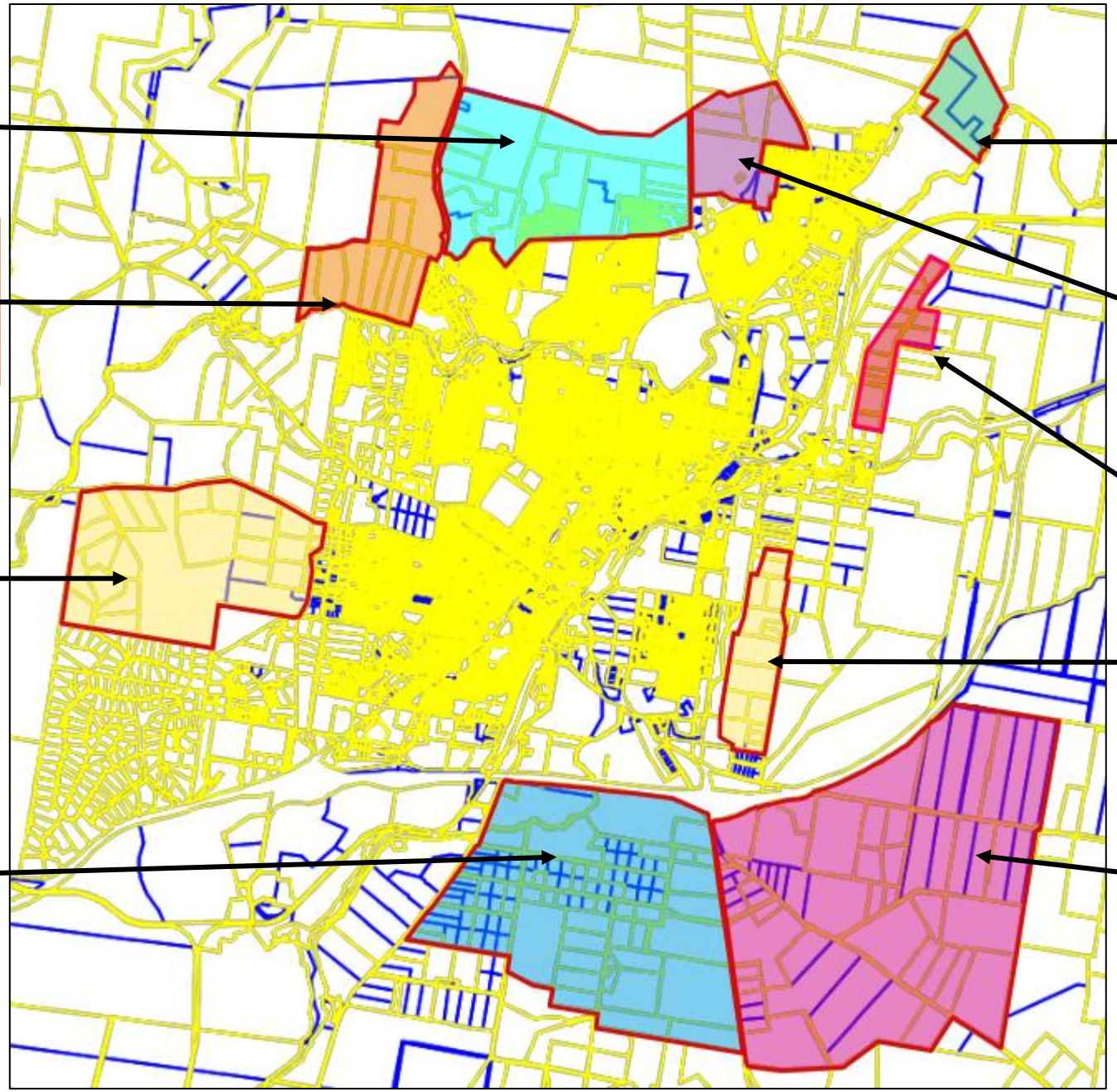
Locations of growth areas- up to 2036

Middle Arm West Precinct
Serviced
Est. 1082 lots (700m2)

Sooley Precinct
Serviced & Unserviced
Est. 18 lots (2ha)- unserviced
Est. 241 lots (700m2)- serviced

Run ‘O’ Waters Precinct
Serviced & Unserviced
Est. 17 lots- unserviced
Est. 1693 lots (700m2)

Brisbane Grove Precinct
Unserviced
Est. <132 lots (2ha)
(*Highly Flood Constrained*)



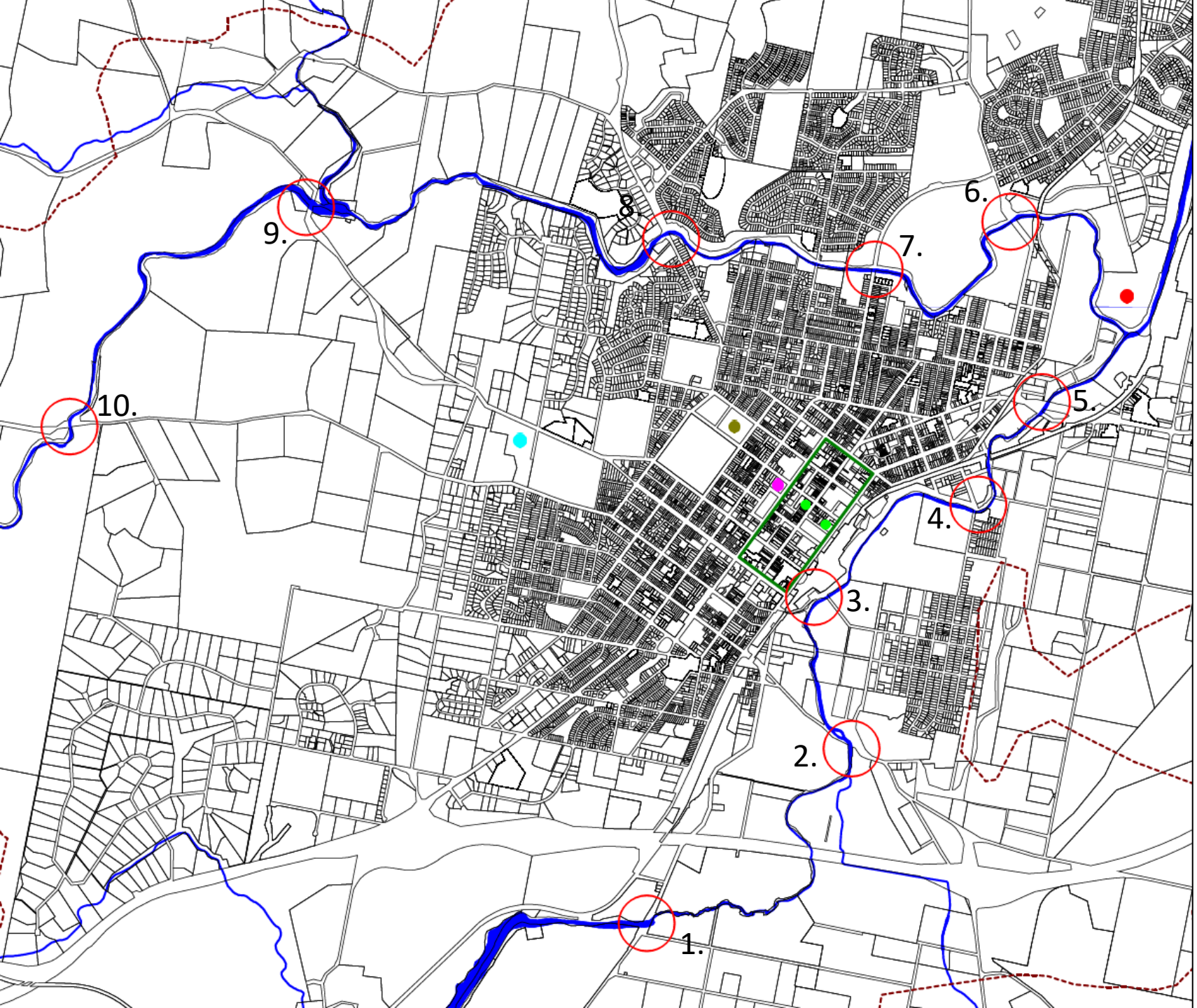
Kenmore Precinct
Serviced
Est.326 lots (700m2)

Middle Arm East Precinct
Serviced
Est. 225 lots (700m2)

Gorman Road Precinct
Serviced
Est. 24 lots (2ha)

Mt Gray East Precinct
Unserviced
Est. 26 lots (2ha)

Mountain Ash Precinct
Unserviced
Est. <164 lots (2ha)
(*Highly Flood Constrained*)



Overview of Goulburn Urban Area

River Crossings

1. Braidwood Rd Bridge
2. Lansdowne Bridge
3. Blackshaw Rd crossing
4. May St Bridge
5. Sydney Rd Bridge
6. Kenmore Bridge
7. Victoria St Bridge
8. Marsden Bridge
9. Rossi Bridge
10. Baw Baw Bridge

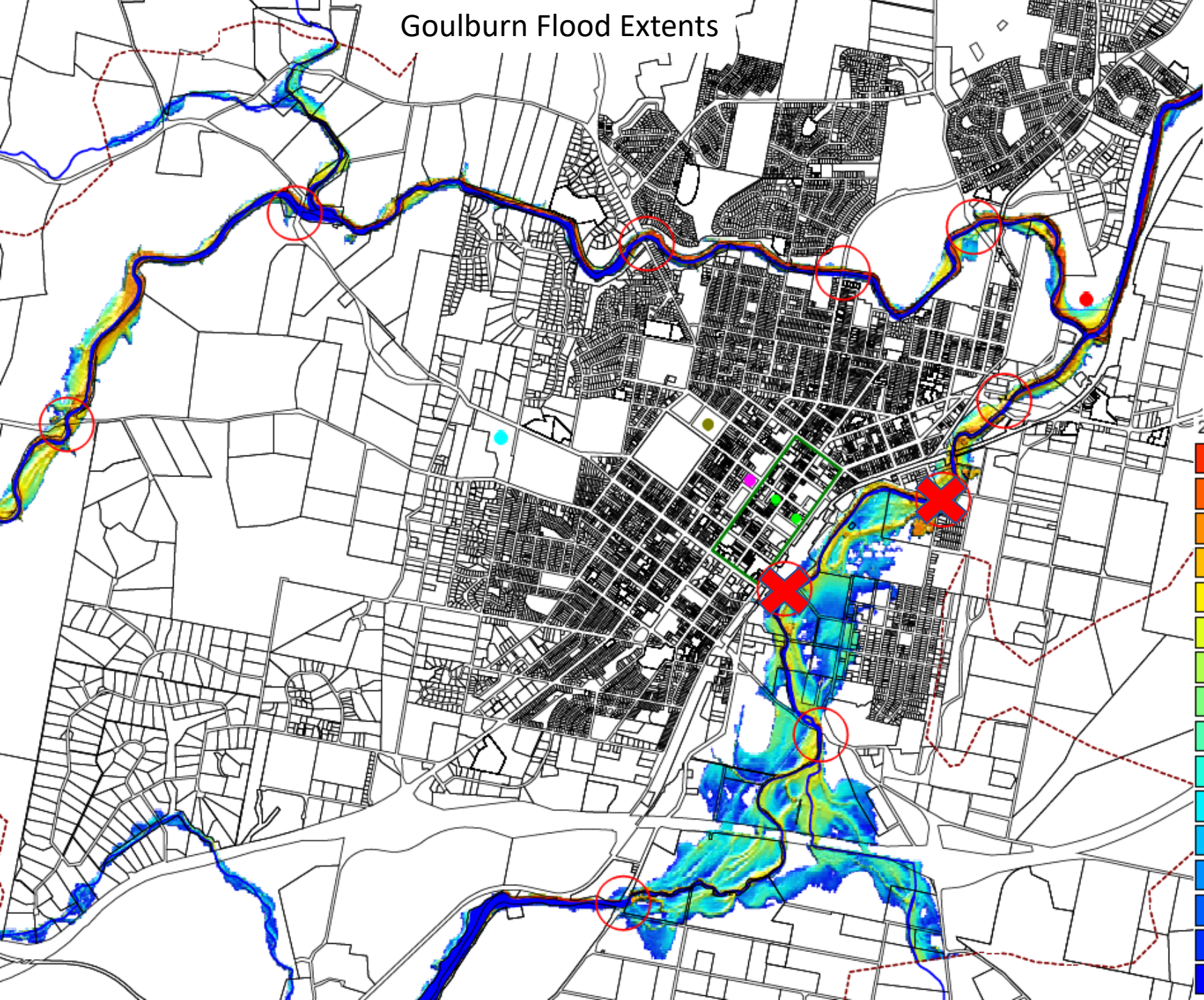
Legend

- Flood Study Extents
- Bridges
- Water Filtration Plant
- Sewerage Treatment Plant
- Goulburn CBD
- Property Boundaries
- Creeks and Rivers
- Clubs / Evacuation Centres
- Council Office
- Hospital

Goulburn Flood Extents

20% AEP
1 in 5yr

- Minor flood extent
- Inundation of Sports Fields, Golf Course & Nature reserve
- Blackshaw Road crossing & roads leading to May Street Bridge inundated



20AEP Depth
5.58242
3.8131
2.89048
2.24523
1.75765
1.43064
1.17079
0.945976
0.779554
0.639409
0.510944
0.399996
0.300727
0.201458
0.099269
0

Legend
Flood Study Extents
Bridges
Water Filtration Plant
Sewerage Treatment Plant
Goulburn CBD
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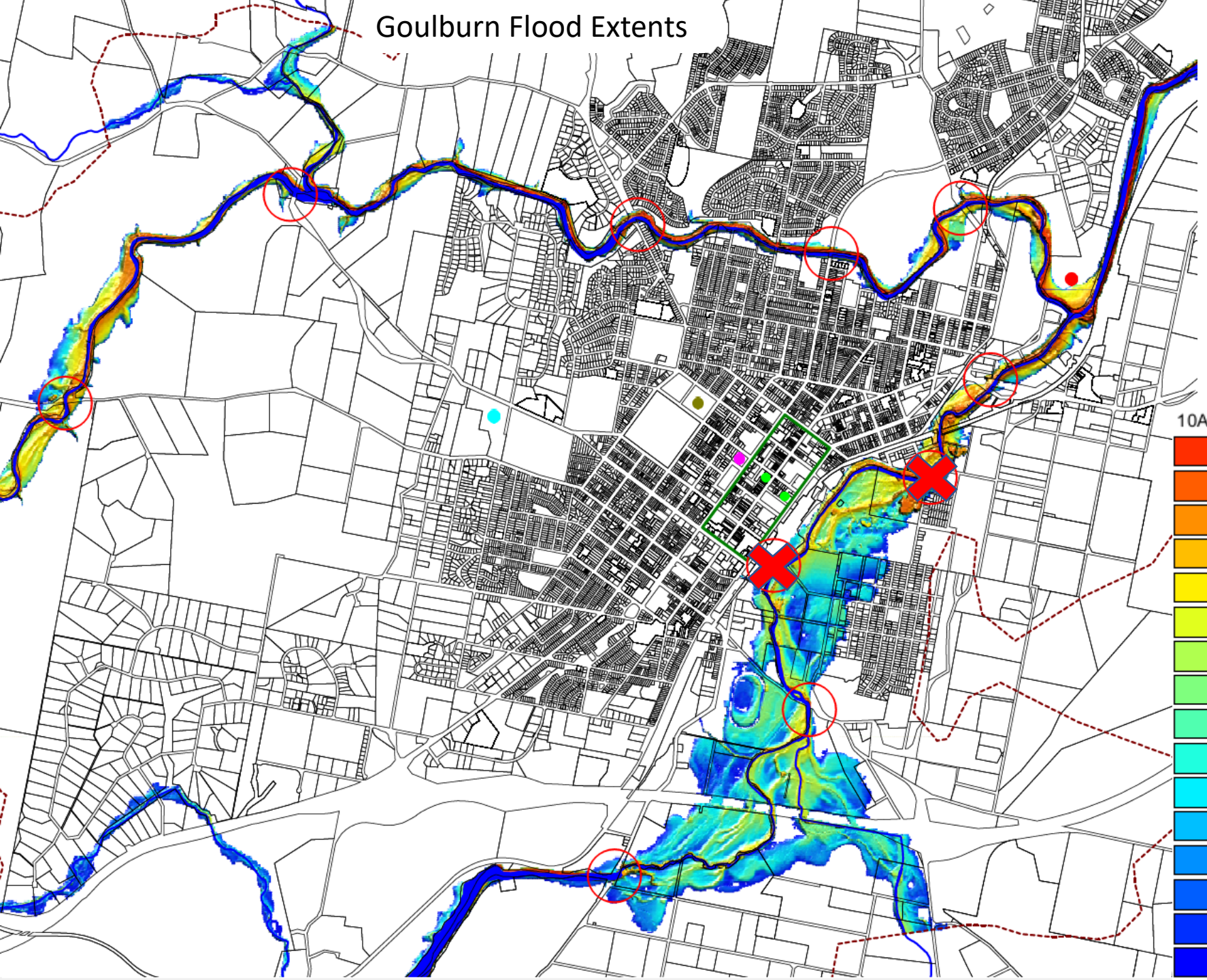
Goulburn Flood Extents



10% AEP
1 in 10yr

Minor flood extent
Inundation of:

- Sports Fields
- Recreation ground
- Nature Reserve

10AEP Depth

- 6.07249
- 4.33215
- 3.34346
- 2.67913
- 2.17699
- 1.77465
- 1.47212
- 1.21325
- 1.0074
- 0.845221
- 0.701752
- 0.573877
- 0.449121
- 0.308771
- 0.155945
- 0

Legend

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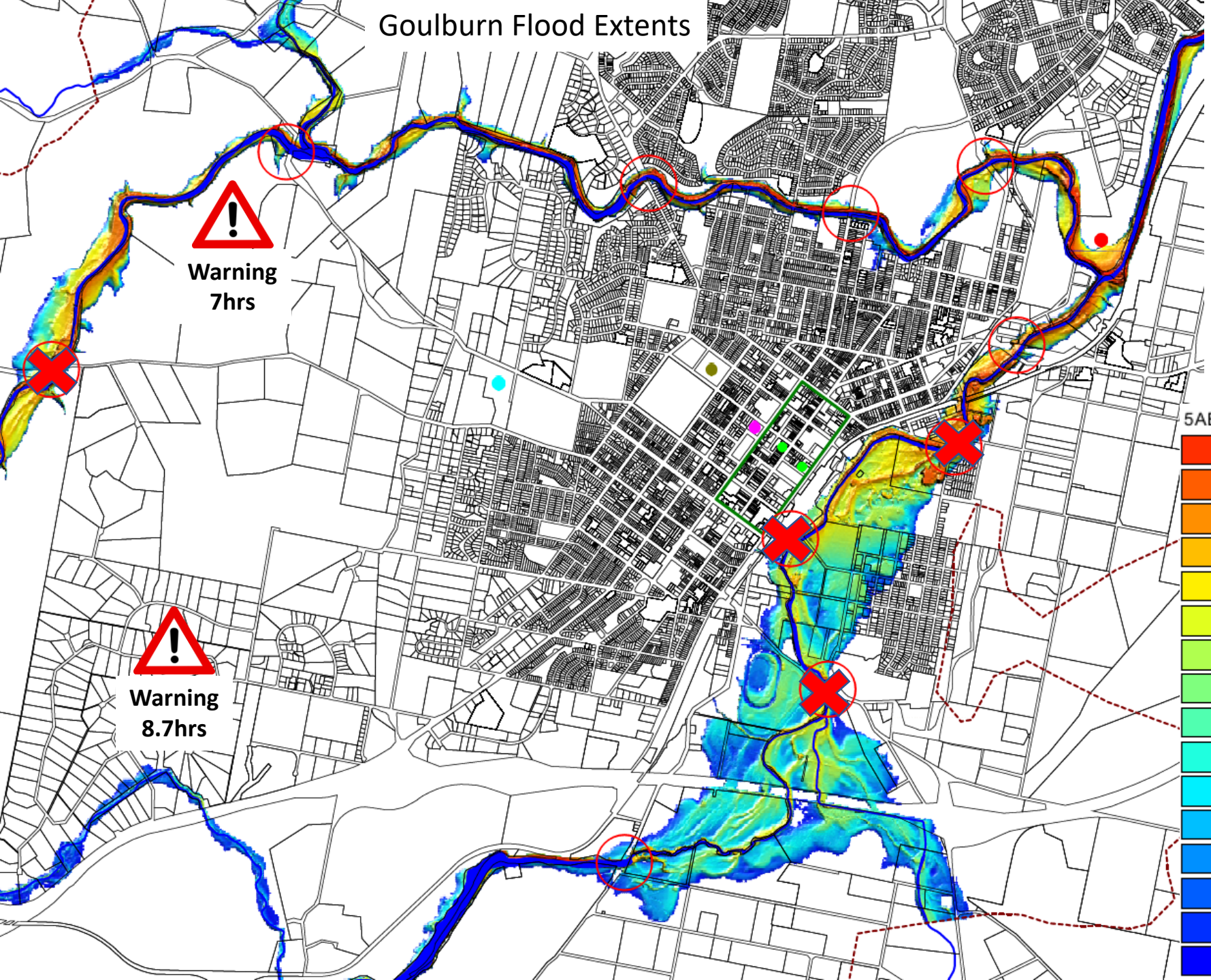
Goulburn Flood Extents

5% AEP
1 in 20yr

Inundation of:

- approach roads to Lansdowne Bridge & Baw Baw Bridge inundated



5AEP Depth

- 6.60021
- 4.82387
- 3.81353
- 3.10035
- 2.54896
- 2.10322
- 1.76314
- 1.48579
- 1.26457
- 1.07307
- 0.904682
- 0.746197
- 0.564601
- 0.379702
- 0.178295
- 0

Legend

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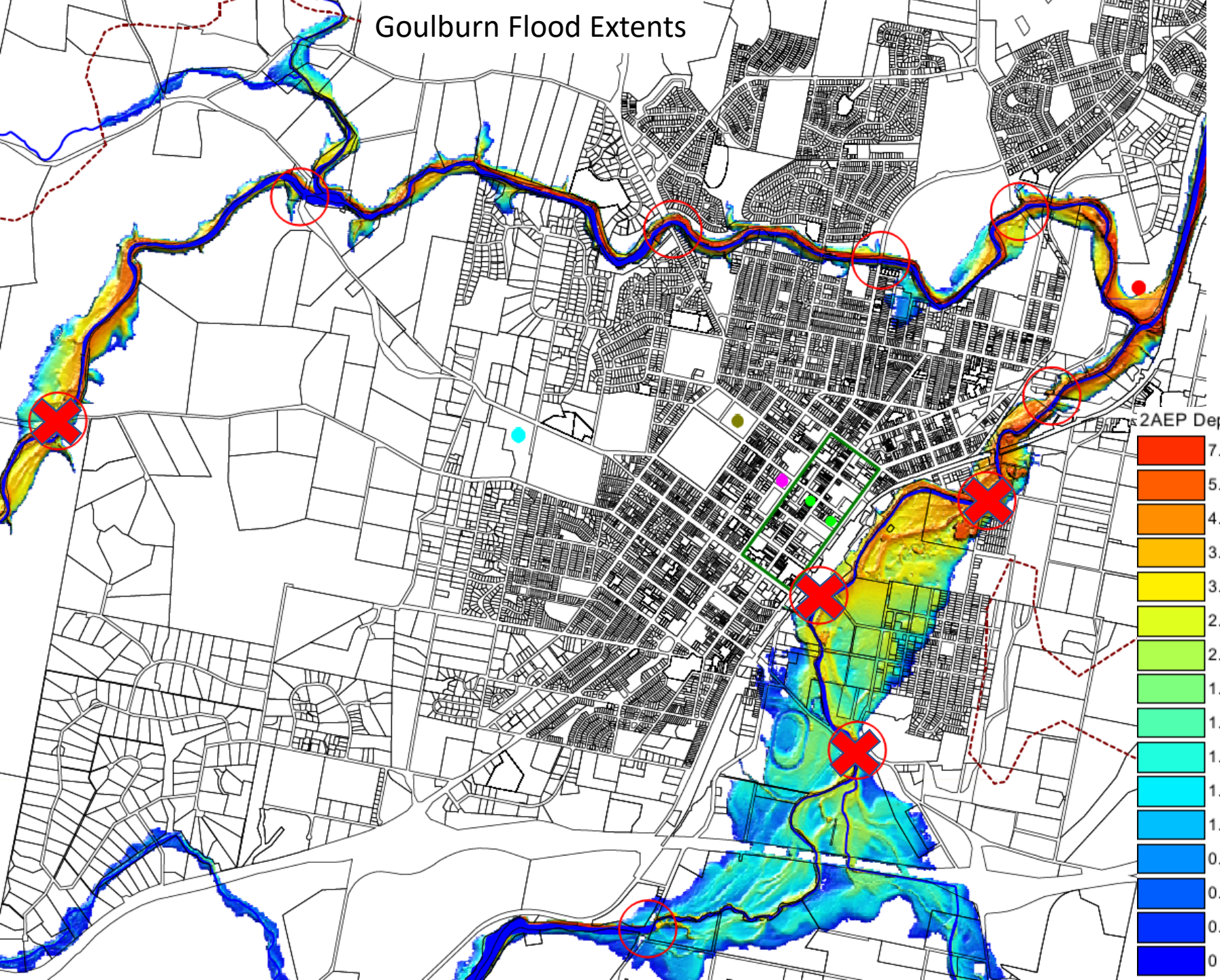
Goulburn Flood Extents

2% AEP
1 in 50yr



2AEP Depth
7.31218
5.48149
4.44445
3.66491
3.0829
2.64551
2.28572
1.9612
1.67902
1.4321
1.22752
1.02646
0.793652
0.543211
0.275133
0

Legend
Flood Study Extents
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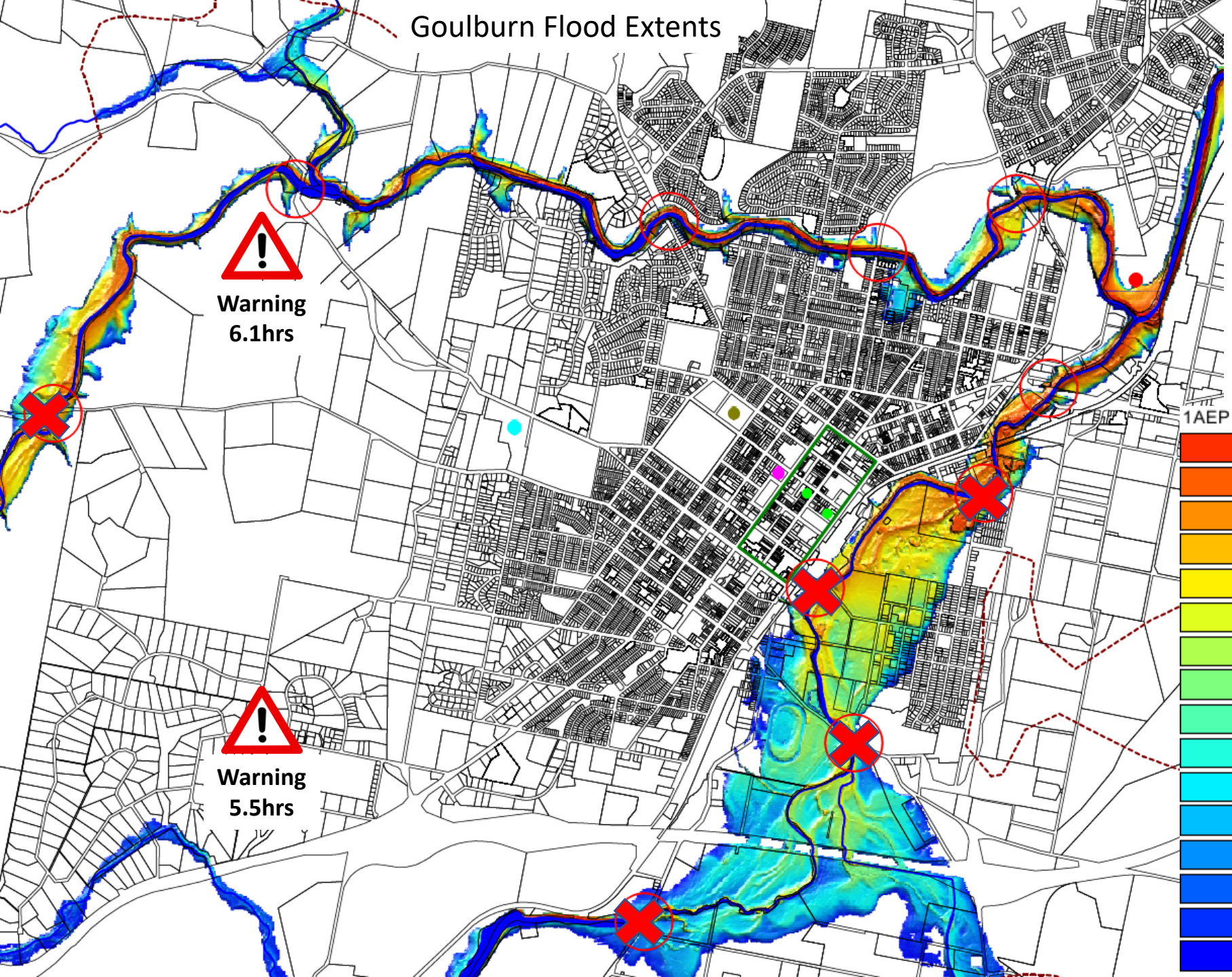
Goulburn Flood Extents

1% AEP
1 in 100yr

Inundation of:

- approach roads to Braidwood Bridge inundated



1AEP Depth

7.85681
5.99261
4.9322
4.13218
3.56236
3.13216
2.74724
2.39251
2.0642
1.76231
1.52457
1.26796
0.969836
0.641526
0.305668
0

Legend

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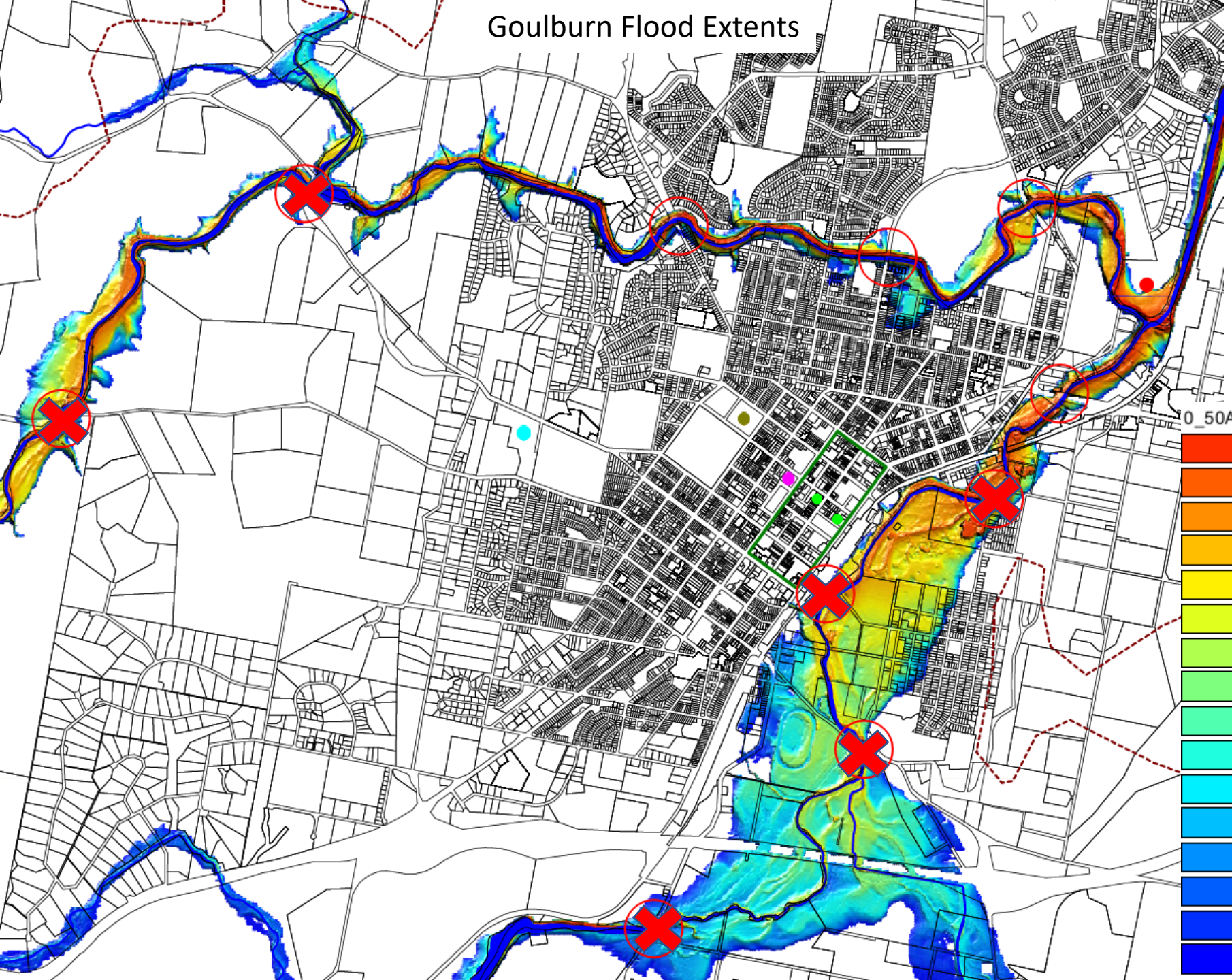
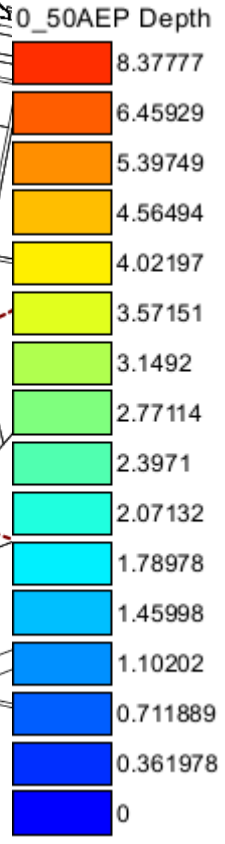
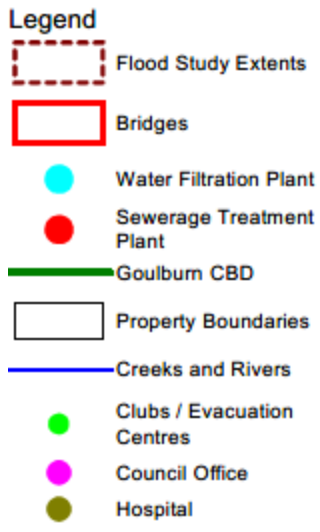
Goulburn Flood Extents

0.5% AEP
1 in 200yr

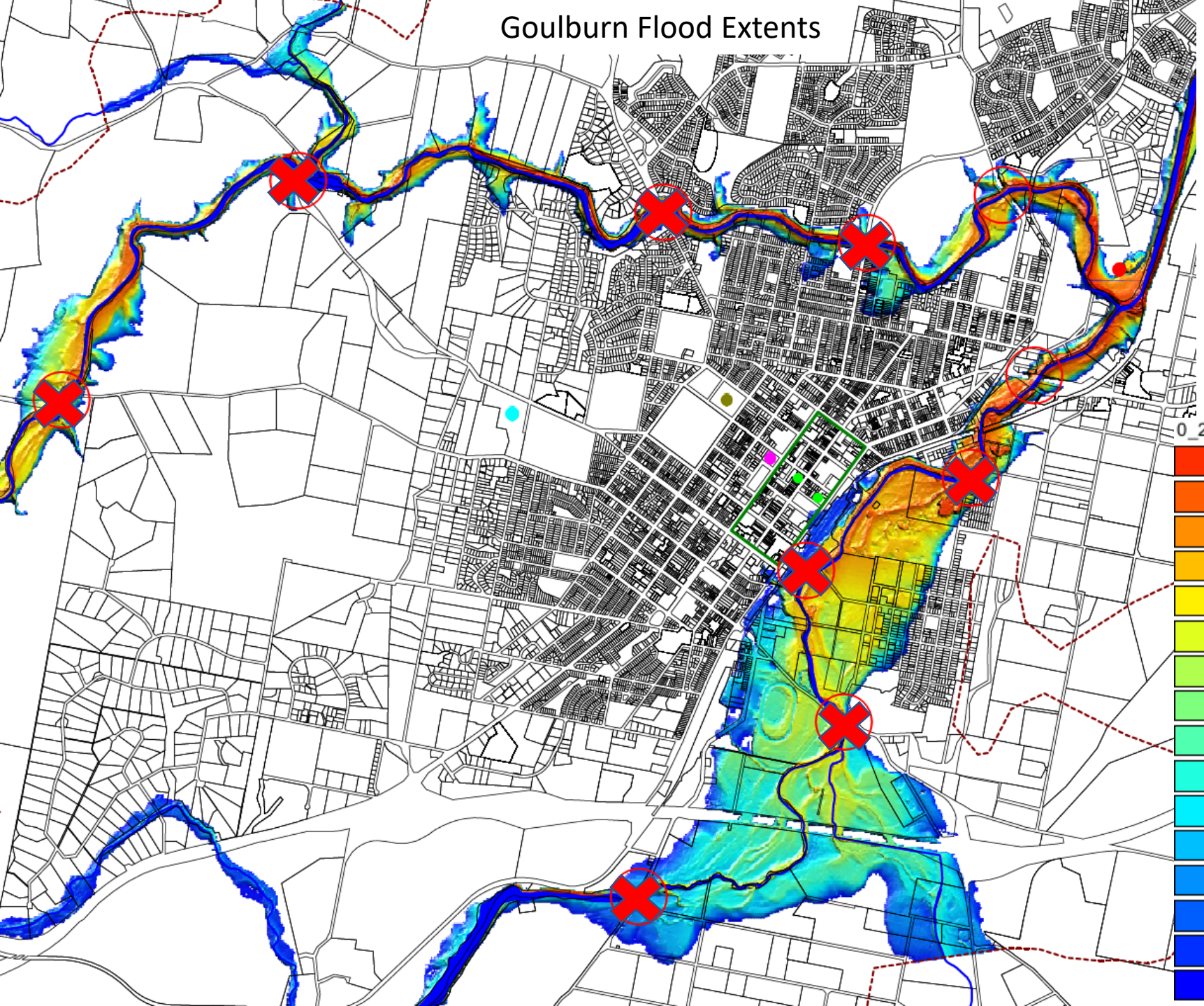
Inundation- Lots on lower part of Eastgrove
Rossi Street Bridge becomes inundated







Goulburn Flood Extents



0.2% AEP
1 in 500yr

Inundation-

- Lots on lower part of Eastgrove
- Rossi Street Bridge becomes inundated
- Kenmore Bridge
- Sydney Road Bridge
- Victoria Street Bridge

0_20AEP Depth

9.0999
7.14275
6.0768
5.27733
4.73999
4.24196
3.8051
3.3726
2.97942
2.63867
2.22364
1.79115
1.34991
0.913048
0.471814
0

Legend

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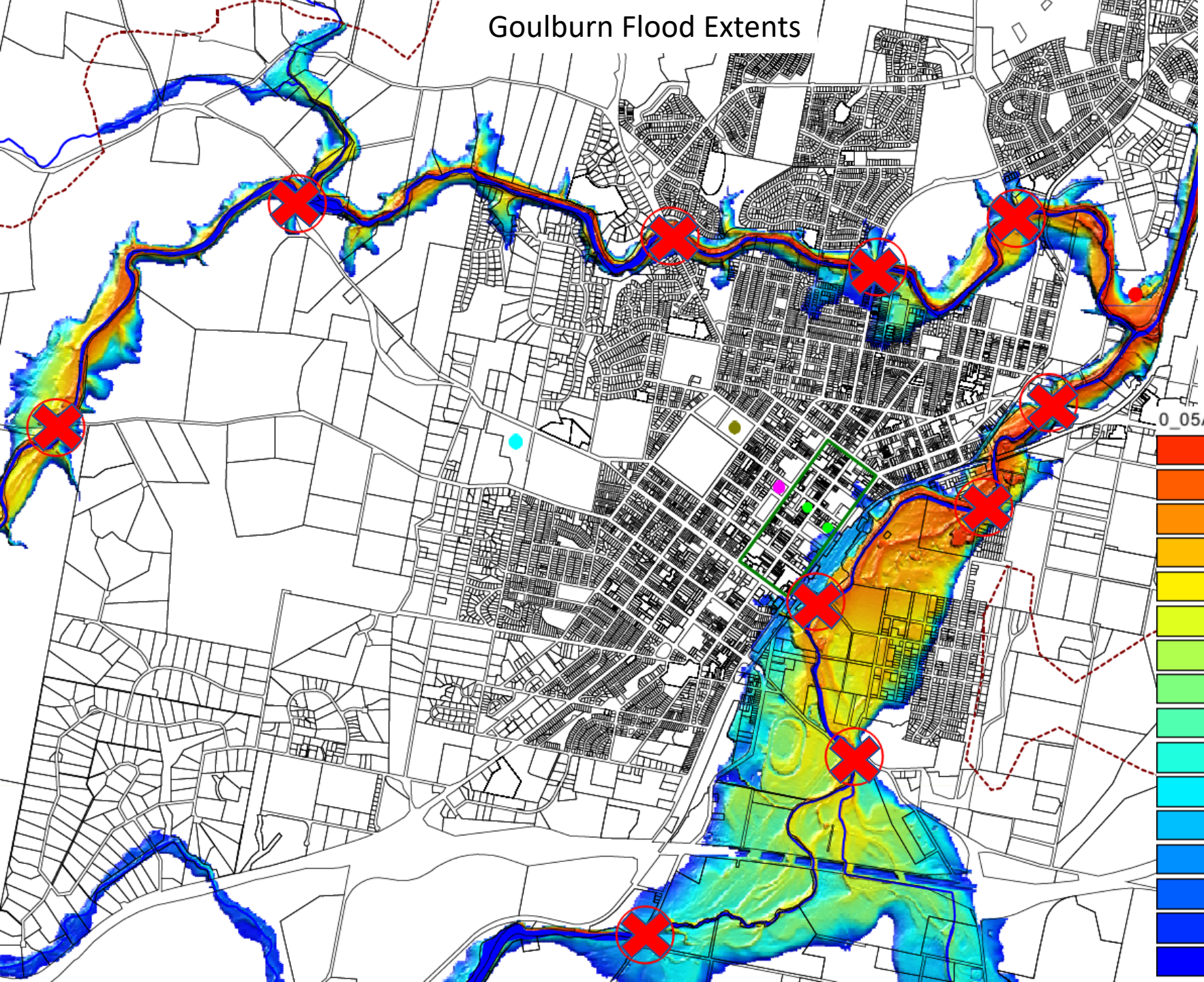
Goulburn Flood Extents

0.05% AEP
1 in 2000yr

Inundation of:

- All bridges and approach roads crossing the Mulwaree & Wollondilly rivers
- Encroachment of inundation into lower CBD Core
- Goulburn Central urban area isolated



0_05AEP Depth
10.1205
8.23828
7.16204
6.40916
5.82519
5.29431
4.74895
4.32425
3.91885
3.39762
2.86192
2.36
1.77121
1.1245
0.569488
0

Legend
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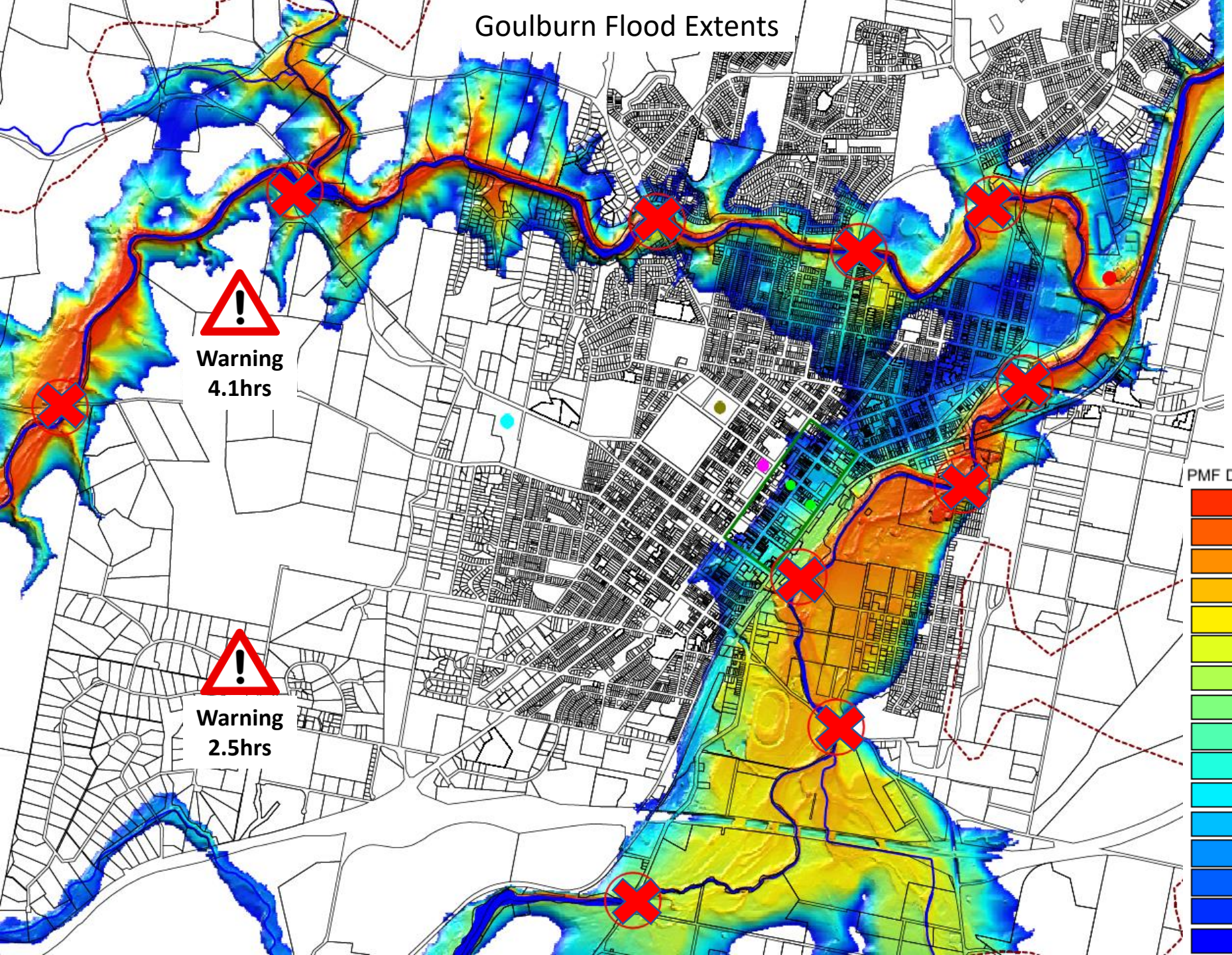
Goulburn Flood Extents



PMF
1 in a million yr

- Sewage treatment plant becomes inundated
- Nominated Evacuation Centres inundated
- Power substations inundated

PMF Depth

16.2713
14.2804
12.9442
11.8576
10.8655
10.0219
9.00962
7.93656
6.78252
5.56099
4.45419
3.45537
2.51729
1.68045
0.877341
0

Legend

- Flood Study Extents
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Issues

- Goulburn Urban Area isolated between 0.2% & 0.05% events- N.Goulburn cut off
- Nominated Evacuation Centres inundated during PMF event
- Substations and Sewage Treatment plant inundated during PMF event

Is Goulburn Central suitable Evacuation location?

When should a FIRA be requested?

Can Evacuation be achieved without a warning system?

What are considered 'adequate services'?

- Brisbane Grove & Mountain Ash Growth Precincts isolated at 1%

Is there an acceptable isolation duration?

How can in-direct isolation impacts be reduced?

1. Is the 0.05% (1 in 2000yr) a more appropriate Evacuation benchmark?
2. Can we establish an agreed policy position?- FIRA Requirements
   Evacuation centres
   Adequate Services

Current Planning Proposals

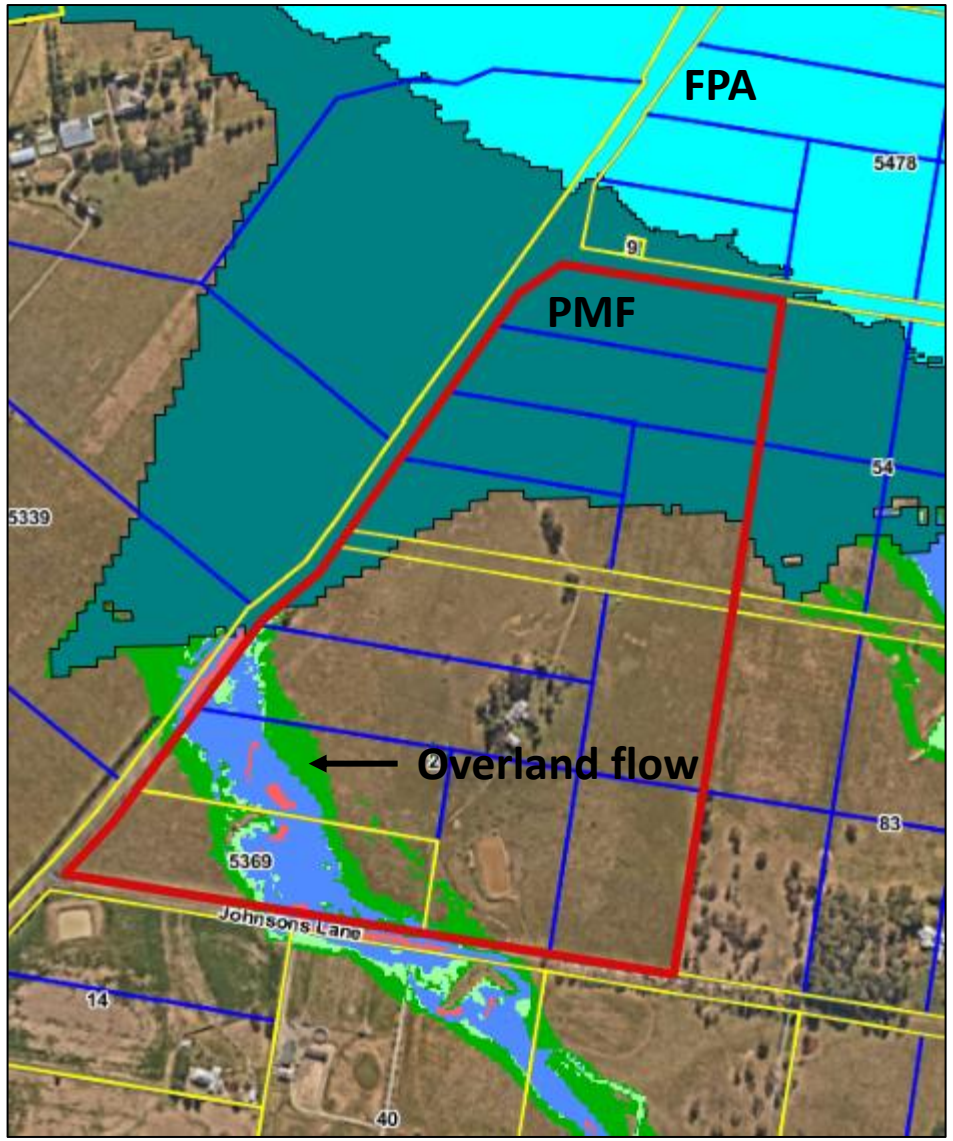
- 137 Brisbane Grove *(PP_2021_7390)*
- Allfarthing, 2 Brisbane Grove *(PP_2021_6932)*
- 292 Rosemont Rd & 100 Mountain Ash Rd *(PP_2022_1180)*
- 274 Mountain Ash Road *(PP_2021_7072)*

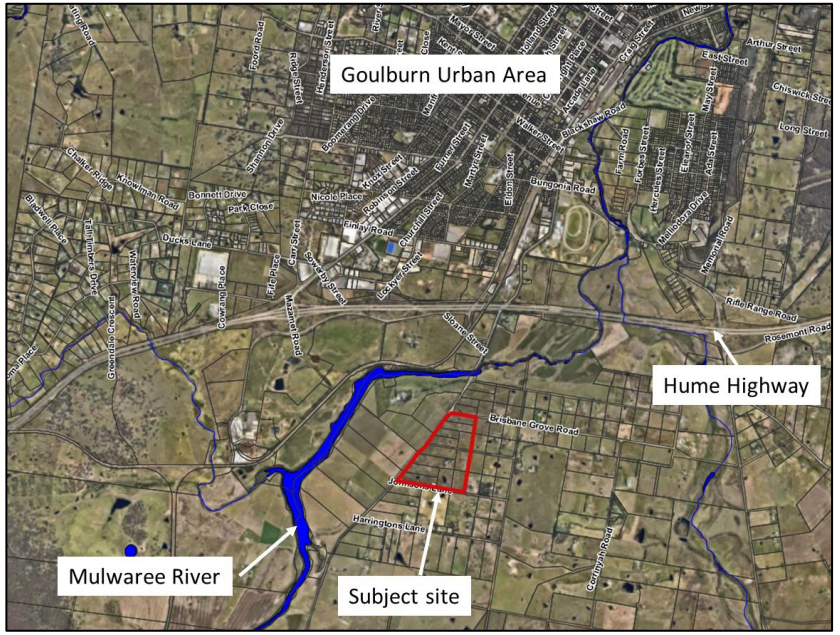
Allfarthing, 2 Brisbane Grove

Brisbane Grove Precinct

Inside Flood Study

- 34.8ha site
- 12 existing lots
- 13 lots proposed
- >2ha Lot size
- RU6 Rural Transition to R5 Large Lot Residential & C2 Environmental Conservation
- FIRA underway





22ha Outside Flood prone land

FPCC_Overland_2021

- Category 1
- Category 2
- Category 3
- Category 4

Allfarthing, 2 Brisbane Grove Road

Brisbane Grove Precinct

Latest Concept Layout Plan

- 14 Proposed lots
- Dwelling pads all outside flood prone land
- PMF & overland flow corridor zoned C2 Environmental Conservation
- Isolated from Goulburn Urban area during a 1% event

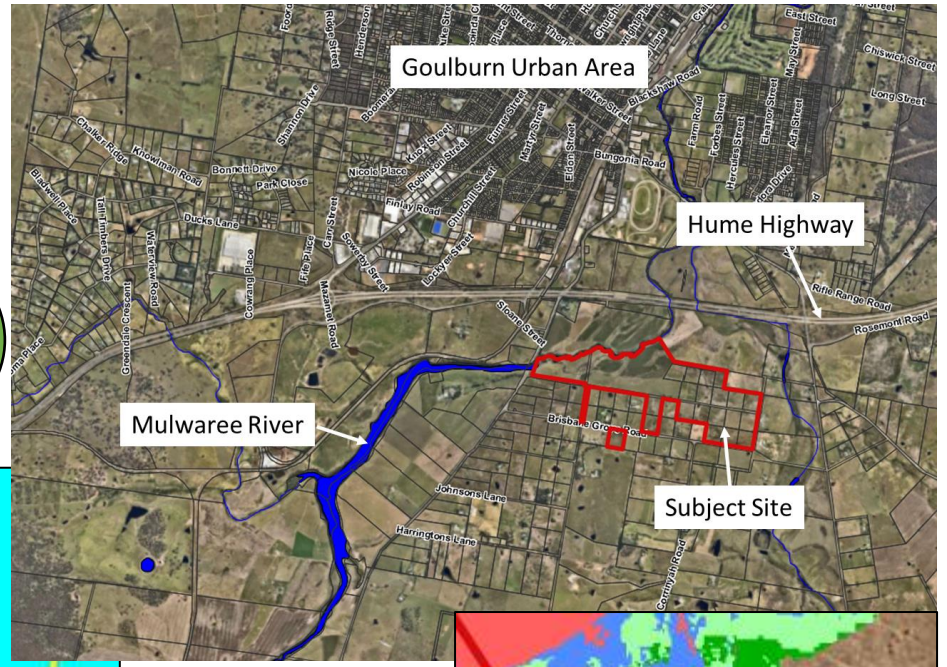
- 83.7ha site
- 22 existing lots
- 21 lots proposed
- >2ha Lot size
- RU6 Rural Transition & RU1 Primary Production to R5 Large Lot Residential & C2 Environmental Conservation

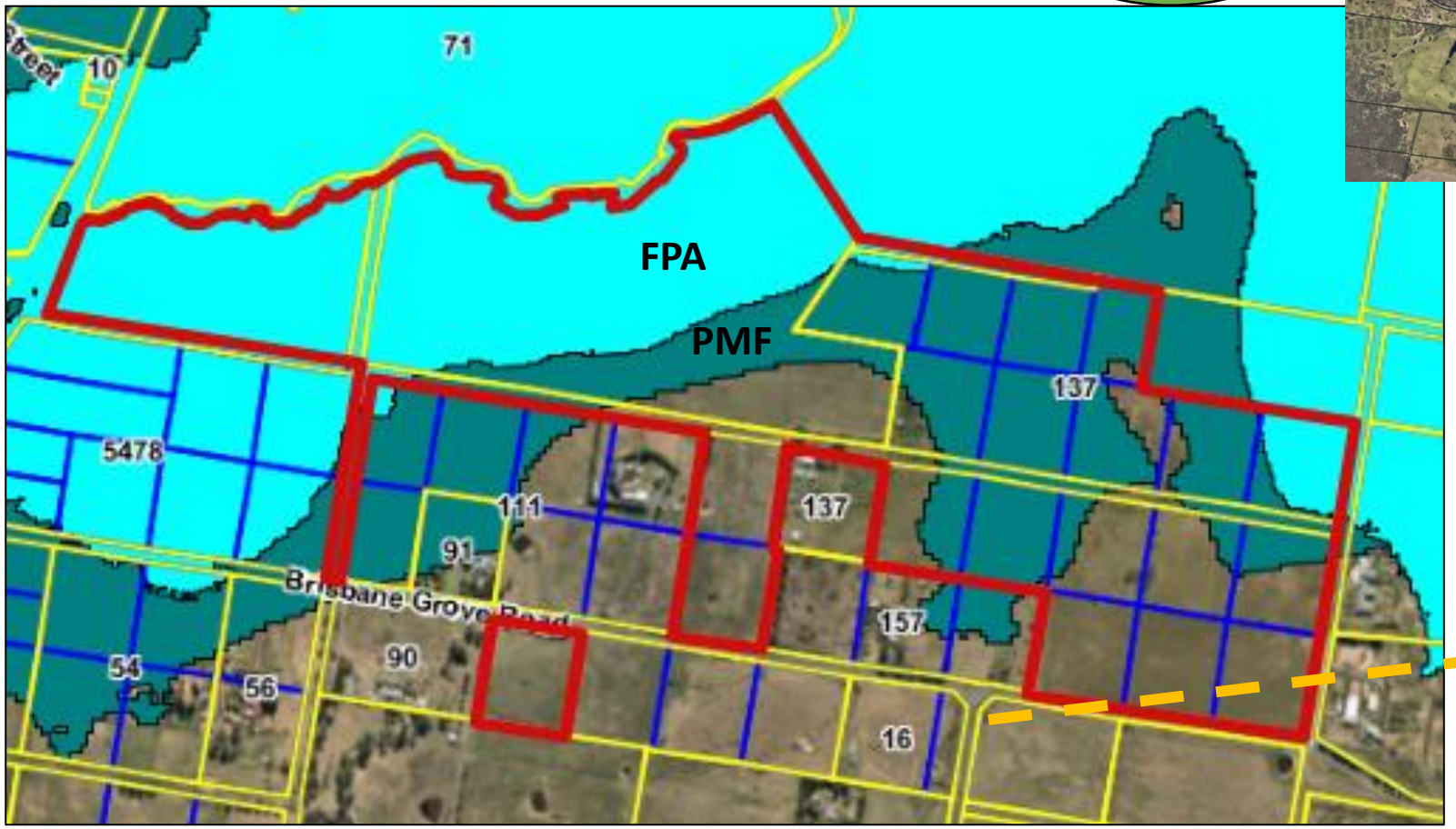
137 Brisbane Grove Road

Brisbane Grove Precinct

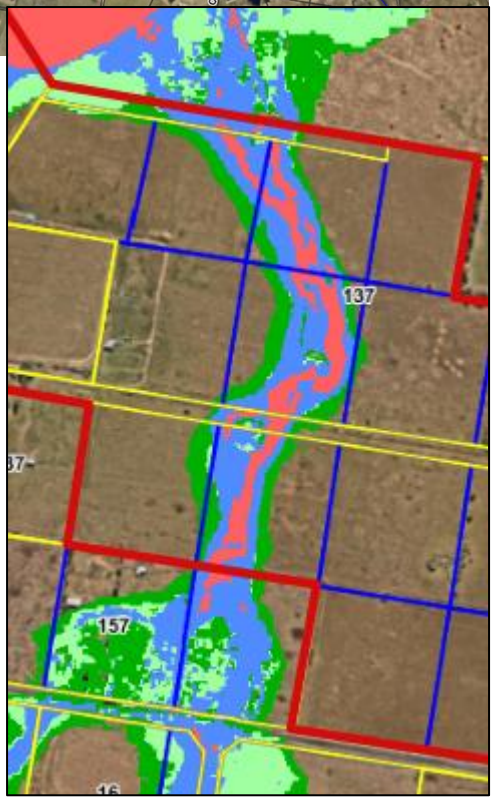
Mostly inside Flood Study

>25ha Outside Flood prone land





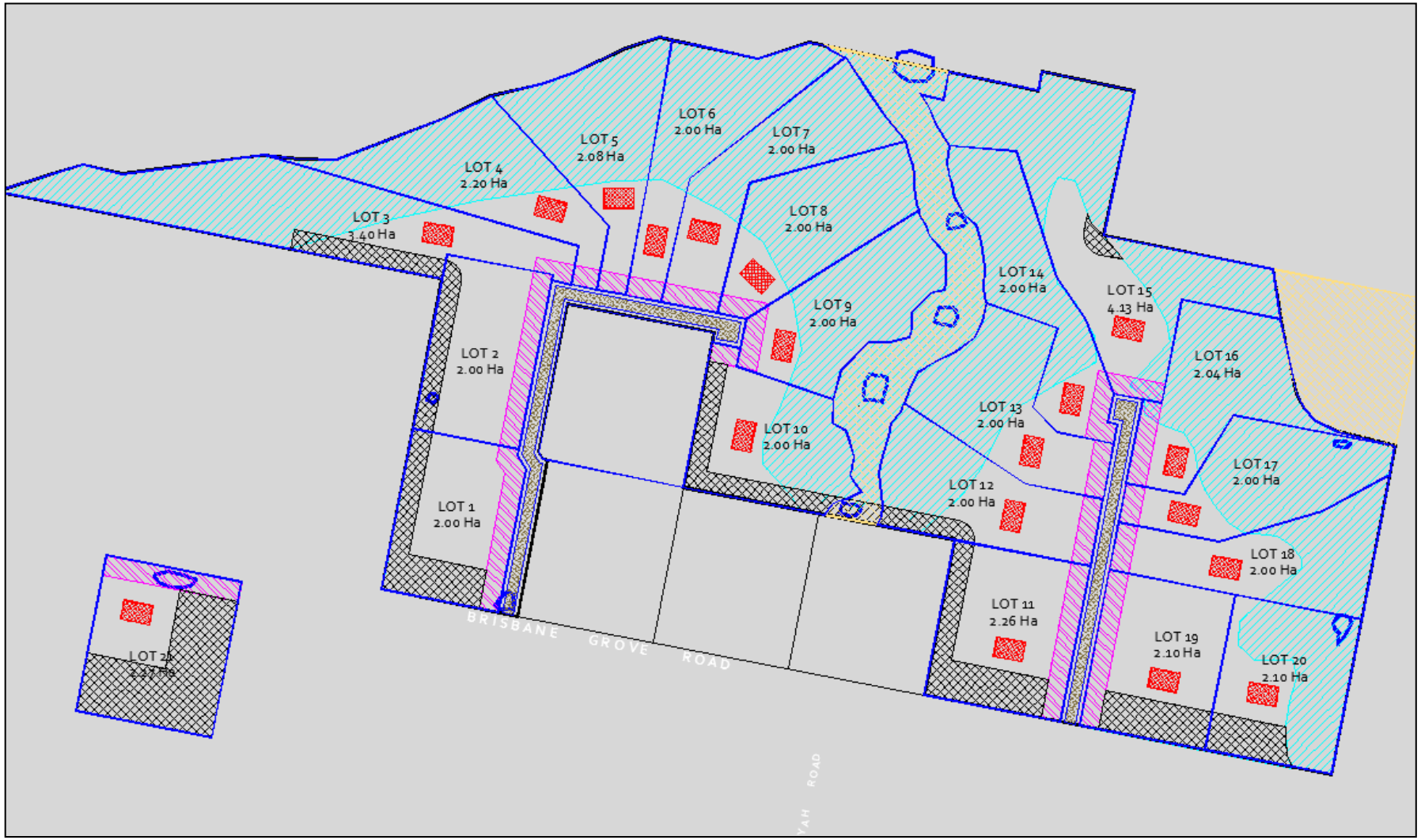
Outside



137 Brisbane Grove Road

Brisbane Grove Precinct

- 21 Proposed lots
- Dwelling pads all outside flood prone land
- FPA & overland flow corridor zoned C2 Environmental Conservation
- Isolated from Goulburn Urban area during a 1% event

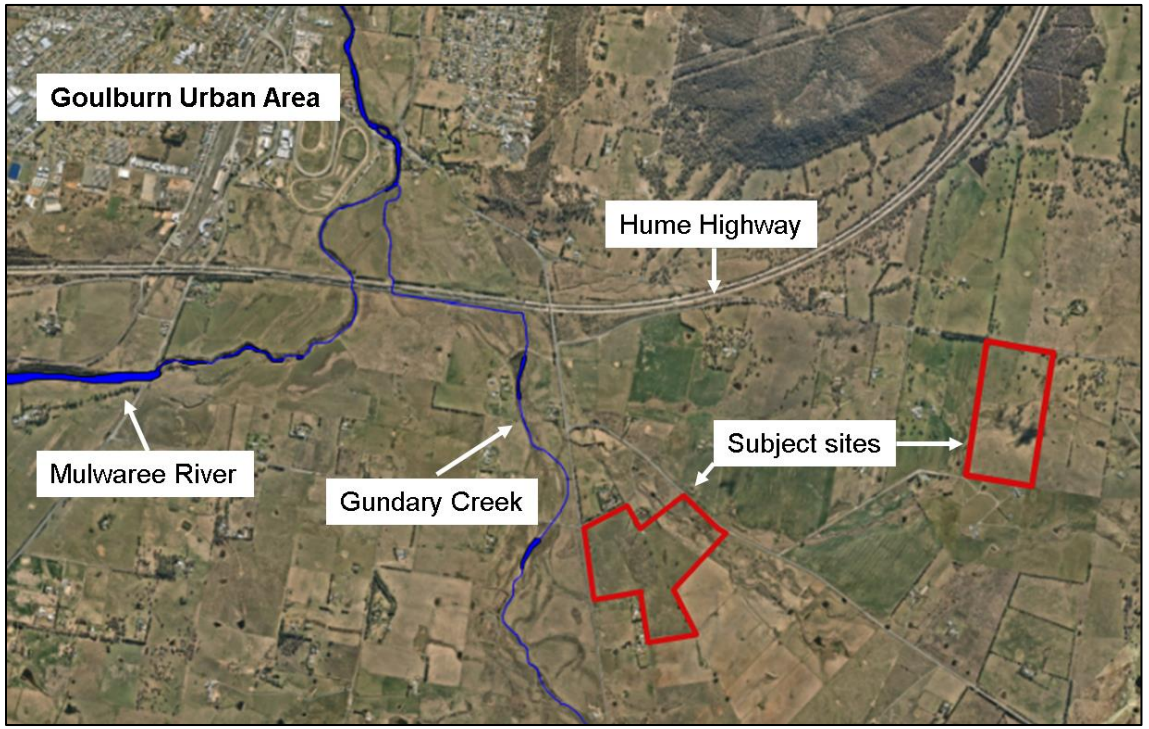


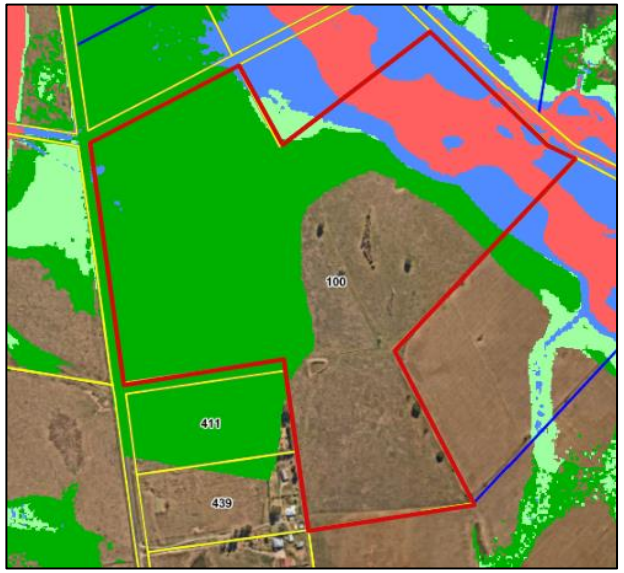
- 73.7ha total site (40.98ha & 32.74ha)
- 3 existing lots
- ~14 lots proposed
- >2ha Lot size
- RU6 Rural Transition to R5 Large Lot Residential & C2 Environmental Conservation
- FIRA underway

292 Rosemont Rd & 100 Mountain Ash Rd

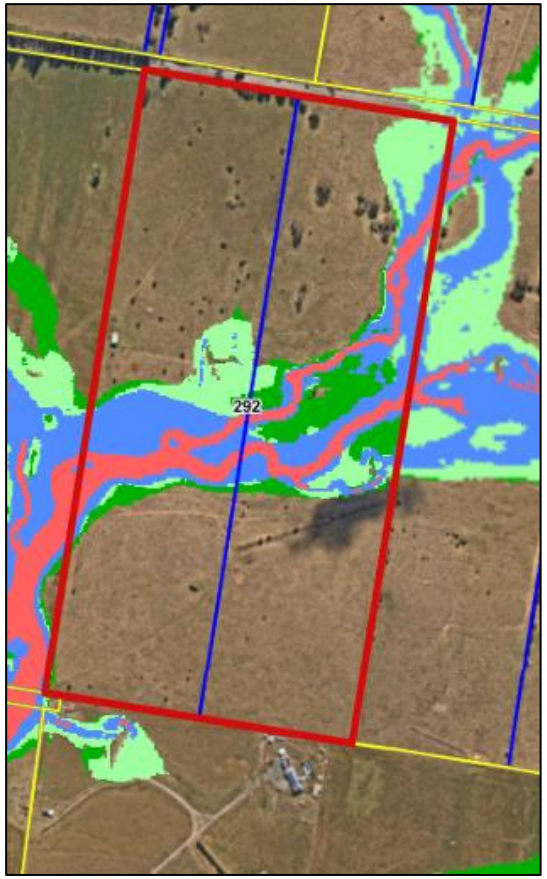
Mountain Ash Precinct

Outside Flood Study





14.5ha Outside Flood prone land



18ha Outside Flood prone land

FPCC_Overland_2021

Category 1

Category 2

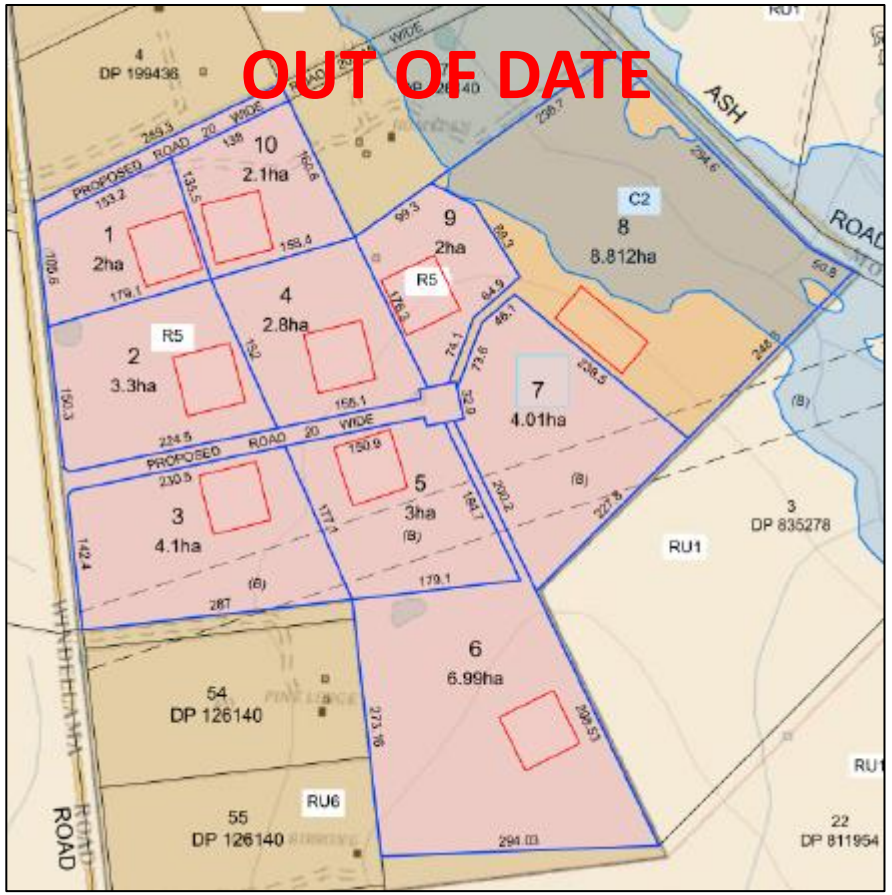
Category 3

Category 4

292 Rosemont Rd & 100 Mountain Ash Rd

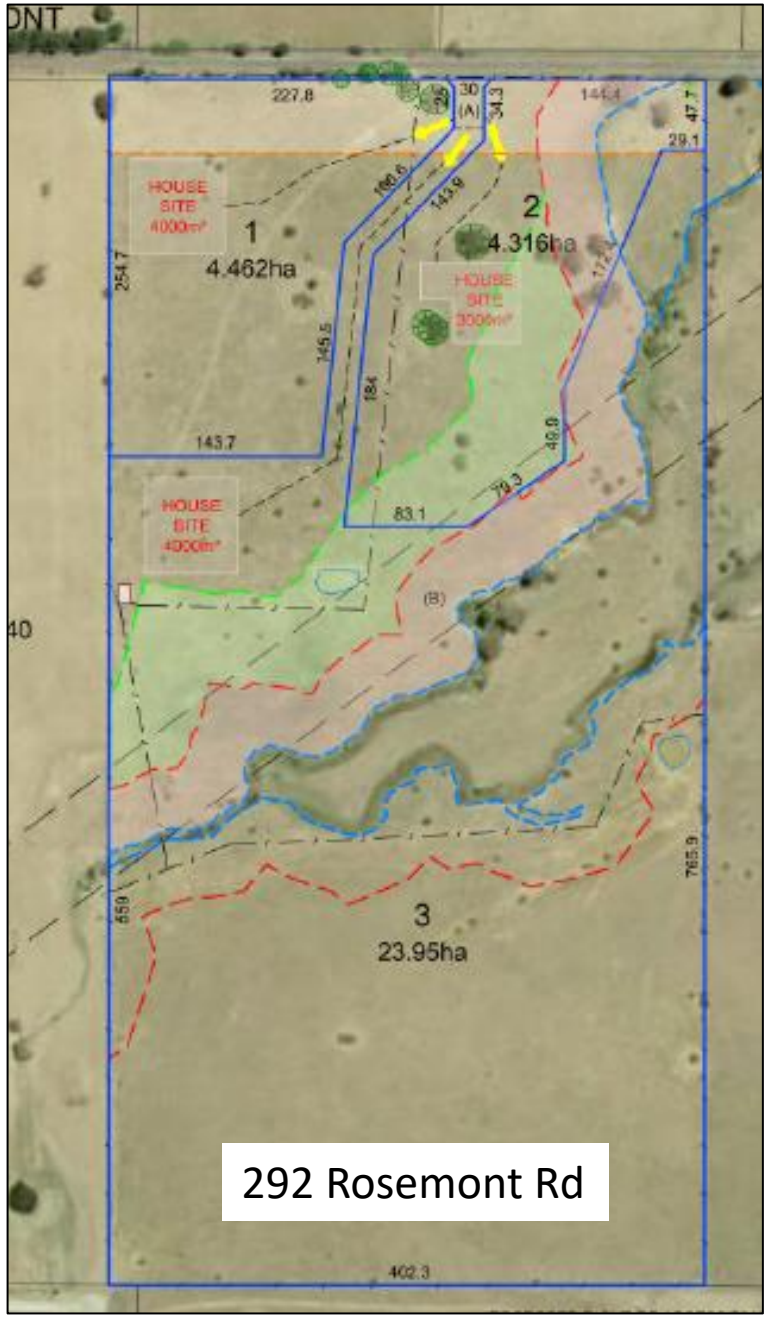
Mountain Ash Precinct

- 14 Proposed lots
- Proposed dwelling pads all outside flood prone land
- Overland flow corridor zoned C2 Environmental Conservation



100 Mountain Ash Rd

Isolated from Goulburn Urban area during a 2% event

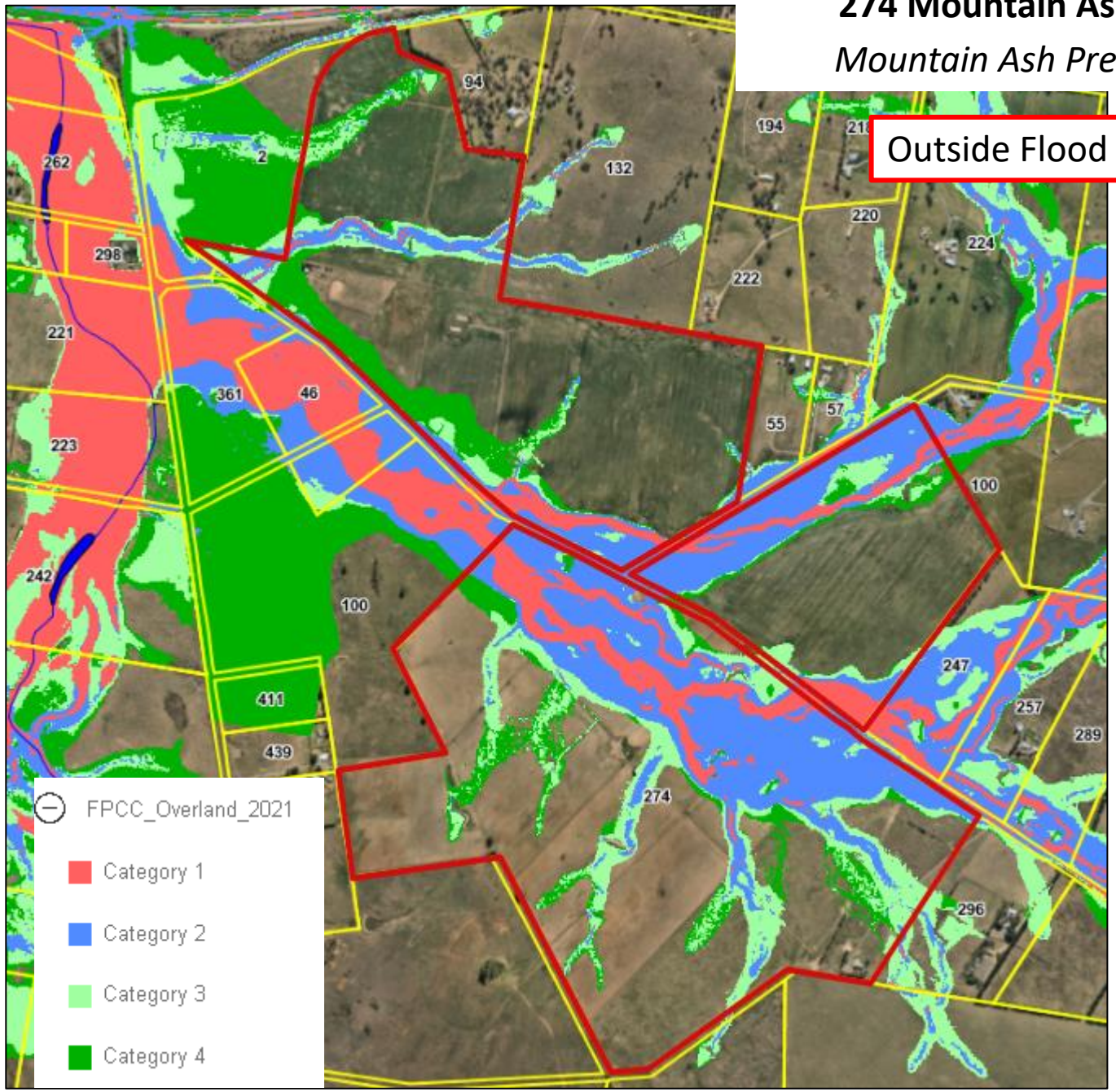


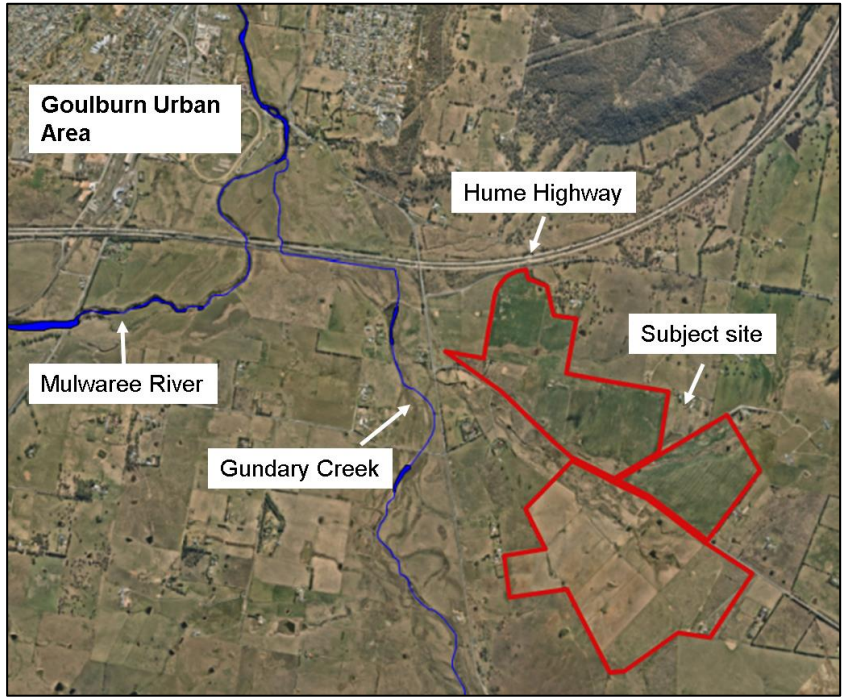
292 Rosemont Rd

Isolated from Goulburn Urban area during a PMF event

274 Mountain Ash Rd

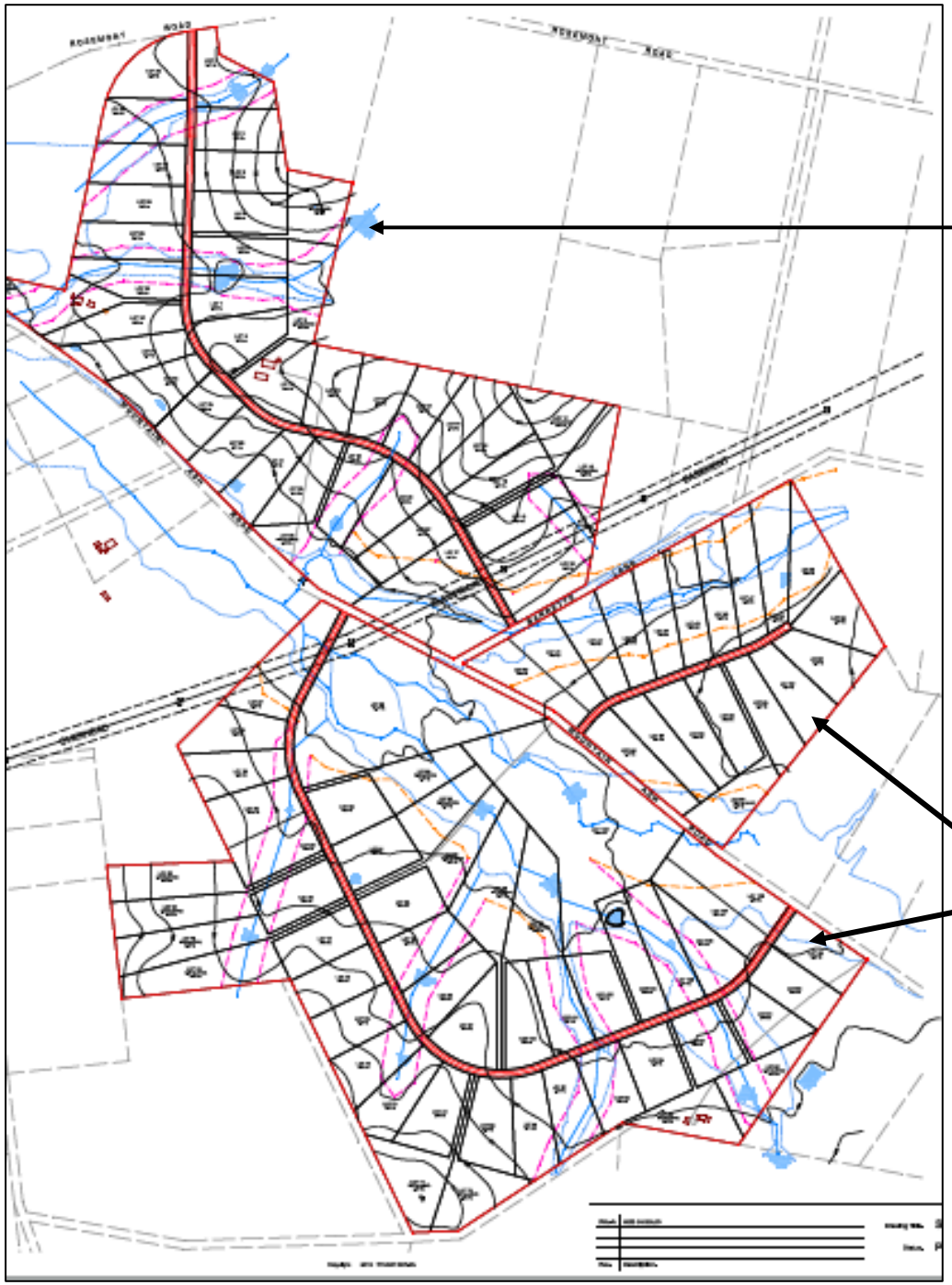
Mountain Ash Precinct





- 270ha total site
- 13 existing lots
- ~100 lots proposed
- >2ha Lot size
- RU1 Primary Production to R5 Large Lot Residential & C2 Environmental Conservation
- FIRA submitted

162Ha Outside Flood prone land



274 Mountain Ash Rd

Mountain Ash Precinct

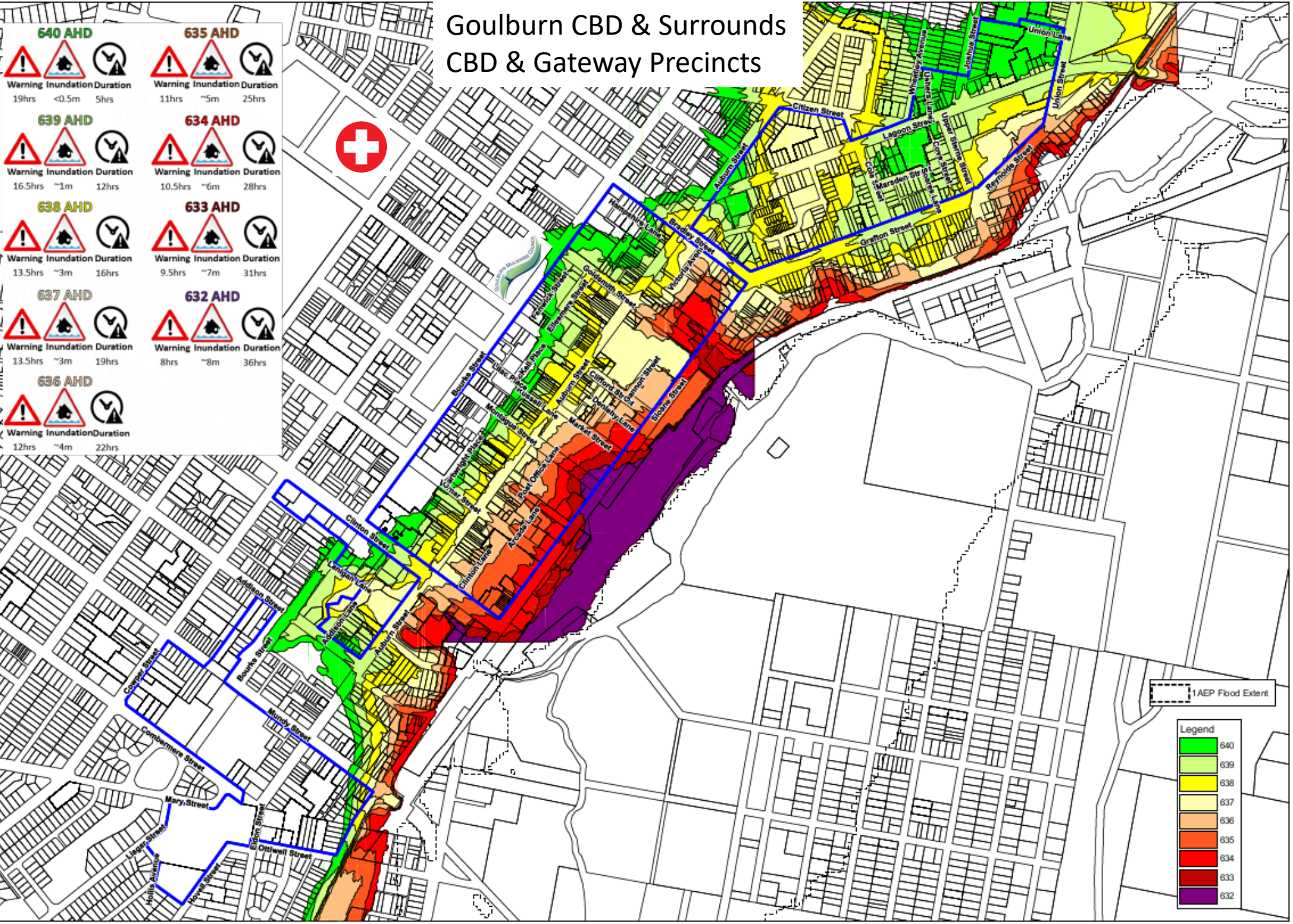
- Over 100 proposed lots
- Proposed dwelling pads all outside flood prone land
- Overland flow corridor zoned C2 Environmental Conservation

Stage 1 isolated from Goulburn Urban Area during a PMF event

Stage 2 & 3 Isolated from Goulburn Urban Area during a 5% event

Emerging Planning Proposal

- Goulburn CBD & Surrounds
  - Seeks to increase residential density (FSR, HOB, MLS, Zoning)
  - No additional permissibility's



Inside Flood Study

- Reflects a PMF event
- Outside 1% AEP
- Warning = 8-19hrs
- Inundation = 0.5m- 8m
- Duration = 5-36 hours
- Flood waters rise ~1m every 90mins
- Evacuation above PMF achievable
- No FIRA proposed

Not Isolated from Goulburn Urban area

Next Meeting- Meeting 2
2 Nov 2023

- Addressing Isolation
  - Levels of acceptable duration?
  - Associated risks

- Evacuation requirements
  - Where to?
  - What Services?

- Shelter in Place Policy
  - Specific to Brisbane Grove & Mountain Ash growth precincts
  - What should be required?

- Brisbane Grove Flood Consultant

Goulburn Flooding Technical Working Group

Meeting 2

2 November 2023

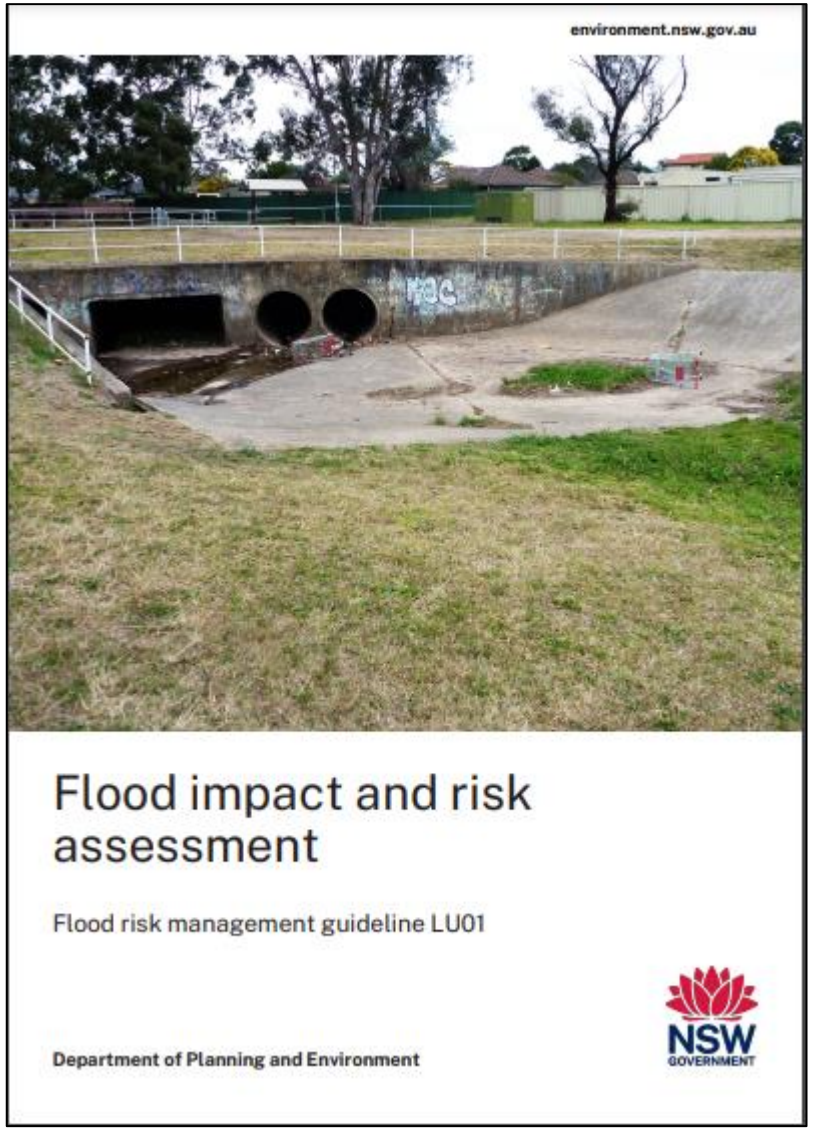
Agenda

- Hazard Risk approach of FRMSP
  - Current DCP Flood Policy
- Brisbane Grove Planning Proposals recap
- Ministerial Direction 4.1- Flooding
  - How it relates to the Brisbane Grove PP`s
  - Special Flood Consideration Clause
  - Isolation
- Zac from GRC Hydro- Brisbane Grove FIRA`s

Flood Impact & Risk Assessment Guideline

- The varying flood constraints should be assessed consistent with the approach included in the Council's DCP- identifying what areas are suitable for different development types.
- The consent authority and/or local council (generally through a DCP) will often have advice in relation to typical considerations and standards required by different types of development, depending on the flood constraints in the area.
- Any assumptions relating to identification of and acceptability of risk will need to be clearly documented and considered in the context of the consent authority's adopted risk management approach.

A focus on DCP Flood Policy & adopted Floodplain Risk Management Study

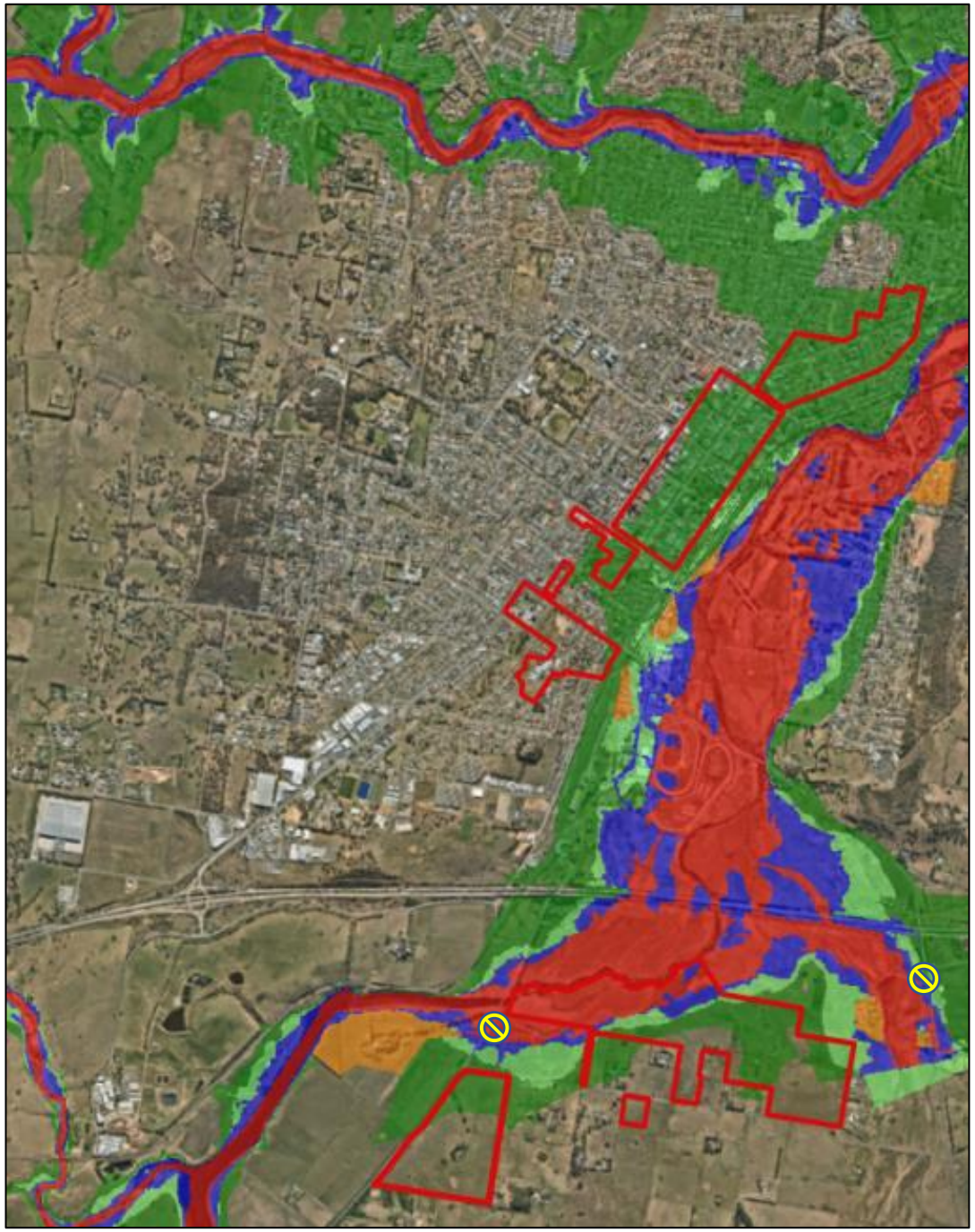


Councils Risk Management Approach

Flood Planning Constraint Categories

Flood Planning Area (1% + 0.8m)

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 FPA	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 PMF	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.



Councils Risk Management Approach

Goulburn Mulwaree Council Development Control Plan
Flood Planning Controls

Controls tailored to risk & development type

CBD

FPCC 1

	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
Floor Level						A1	A1	
Building Components								
Structural Soundness								
Parking & Driveway						F2 F5	F1 F3 F4	
Evacuation and Refuge						G1 G3 G4	G1	
Management and Design						H2 H3 H4	H2 H3 H4	
Flood Impacts						J1	J1	

FPCC 2 (Subcategory a,b,c,e)

	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
Floor Level					A2 A6	A1	A2	A2
Building Components					D1	D1	D1	D1
Structural Soundness					E1	E1	E1	E1
Parking & Driveway					F1 F3 F4 F5	F2 F5	F1 F3 F4	F5
Evacuation and Refuge					G2 G3	G1 G3 G4	G1	G1 G3
Management and Design					H2 H3 H4	H2 H3 H4	H2 H3 H4	
Flood Impacts					J1	J1	J1	J1

FPCC 2 (Subcategory d)

	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
Floor Level				A4 A6	A2 A6	A1	A2	A3
Building Components				D1	D1	D1	D1	D1
Structural Soundness				E1	E1	E1	E1	E1
Parking & Driveway			F1 F3 F4 F5	F1 F3 F4 F5	F1 F3 F4 F5	F2 F5	F1 F3 F4	
Evacuation and Refuge			G3 G4	G3	G3	G3		
Management and Design			H1 H5		H2 H3 H4	H2 H3 H4	H2 H3 H4	
Flood Impacts			J1	J1	J1	J1	J1	J1

FPCC 3

	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
Floor Level				A4 A6	A2 A6	A1	A2	A3
Building Components				D1	D1	D1	D1	D1
Structural Soundness				E1	E1	E1	E1	E1
Parking & Driveway			F1 F3 F4 F5	F1 F3 F4 F5	F1 F3 F4 F5	F2 F5	F1 F3 F4	
Evacuation and Refuge			G2 G3 G4	G2 G3	G2 G3	G3 G4	G1	
Management and Design			H1 H5		H2 H3 H4	H2 H3 H4	H2 H3 H4	
Flood Impacts			J1	J1	J1	J1	J1	J1

FPCC 4

	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
Floor Level	A5 A6	A5 A6						
Building Components	D2	D2						
Structural Soundness	E2	E2						
Parking & Driveway	F2 F3	F2 F3						
Evacuation and Refuge	G2 G3 G4	G2 G3 G4	G2 G3 G4					
Management and Design			H1 H5					
Flood Impacts								

Detailed controls

Limited controls

No applicable flood controls

PMF Flood Controls

Applies to Critical & Sensitive Uses & Lot Subdivision only

Lot Subdivision

FPCC 4							
Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercial & Industrial	Recreation & Non-urban	Sheds & Outbuildings	Minor Additions
A5 A6	A5 A6						
D2	D2						
E2	E2						
F2 F3	F2 F3						
G2 G3 G4	G2 G3 G4	G2 G3 G4					
		H1 H5					

G2. Reliable access for pedestrians or vehicles required during a 1% AEP flood to a publicly accessible location above the PMF.

G3. The development is to be consistent with any relevant flood evacuation strategy or similar plan.

G4. The evacuation requirements of the development are to be considered. An engineer's report will be required if circumstances are possible where the evacuation of persons might not be achieved within the effective warning time.

H1. Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP.

H5. Finished land levels in new release areas shall be not less than the 1% AEP mainstream flood plus 0.5 m, unless justified by site specific assessment. A surveyor's certificate will be required upon completion certifying that the final levels are not less than the required level.

PMF Flood Controls

Applies to Critical & Sensitive Uses & Lot Subdivision only

Critical & Sensitive Uses

A5. All floor levels to be equal to or greater than the PMF flood level.

A6. Entrance levels to underground spaces (basements, carparking etc.) are required to be above the level of the FPL (1% AEP flood level plus 0.8 m freeboard) or PMF level, whichever is higher.

D2. All structures to have flood compatible building components below the FPL (1% AEP flood level plus 0.8 m freeboard) or the PMF level, whichever is the highest.

E2. Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including the FPL (1% AEP flood level plus 0.8 m freeboard) or a PMF, whichever is greater.

F2. The minimum surface level of open car parking spaces, carports or garages shall be as high as practical. The driveway providing access between the road and parking space shall be as high as practical and generally rising in the egress direction.

F3. Garages capable of accommodating more than three motor vehicles on land zoned for urban purposes, or enclosed car parking, must be protected from inundation by floods up to the FPL (1% AEP flood level plus 0.8 m freeboard).

137 Brisbane Grove Road Planning Proposal

>25ha Outside Flood prone land

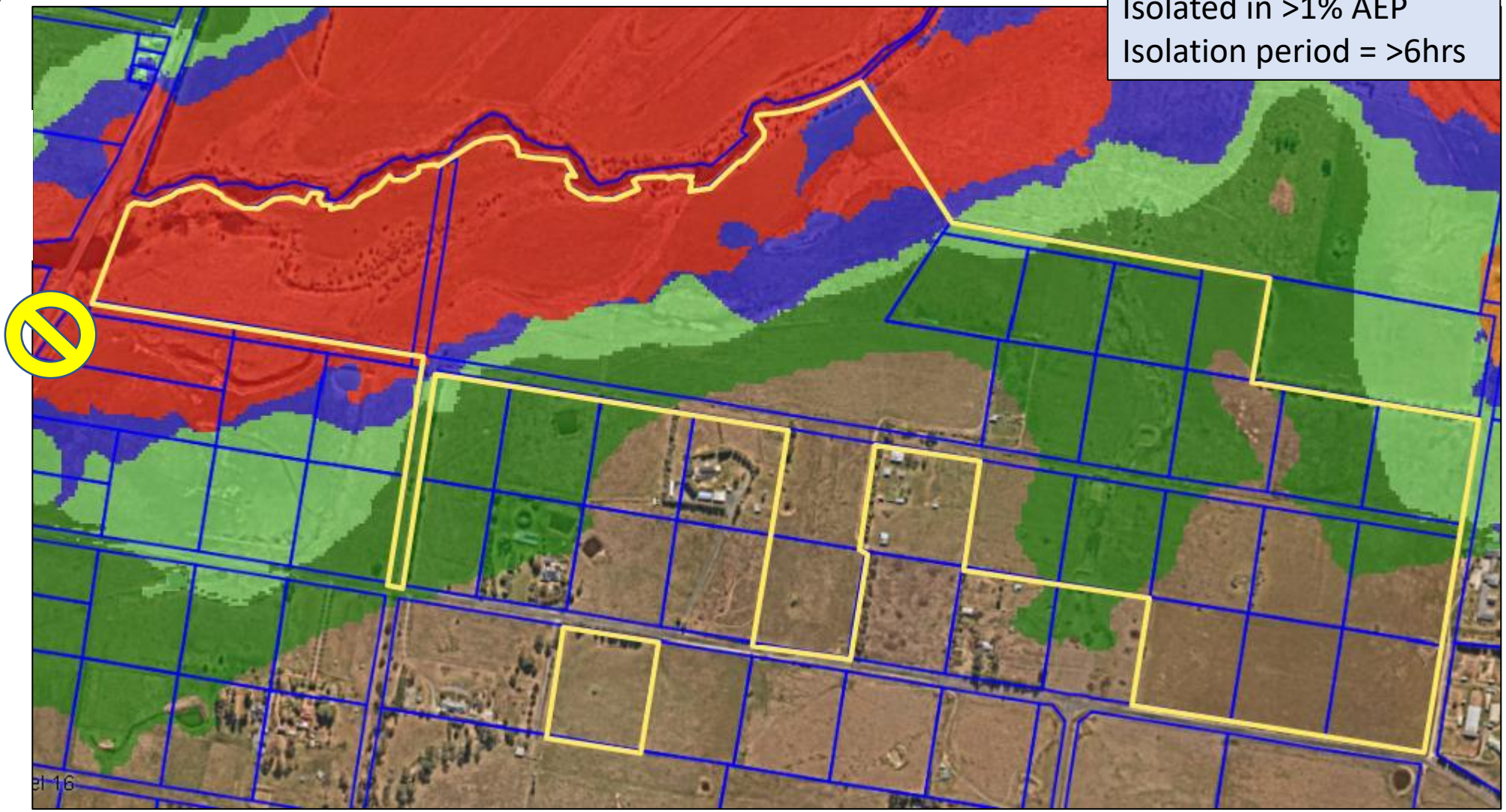
FPCC1
Most significantly constrained areas, high hazard, significant flow

FPCC2
Next least suitable for intensification of land use or development

FPCC3
Areas suitable for most types of development

FPCC4
Few flood related development constraints applicable

Flood-free dwelling pads
Isolated in >1% AEP
Isolation period = >6hrs



Allfarthing, 2 Brisbane Grove Road Planning Proposal

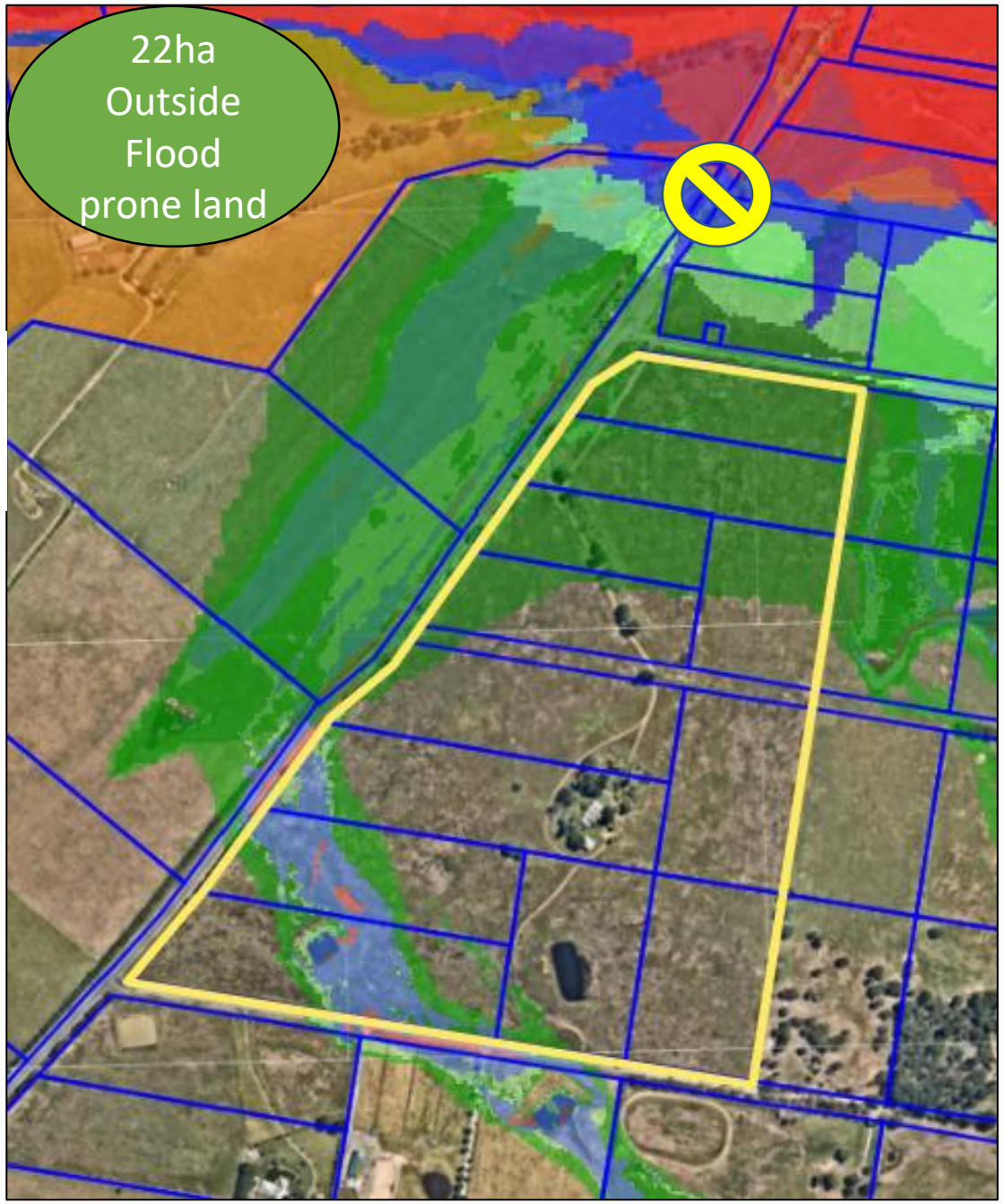
Flood-free dwelling pads
Isolated in >1% AEP
Isolation period >6hrs

FPCC1
Most significantly constrained areas, high hazard, significant flow

FPCC2
Next least suitable for intensification of land use or development

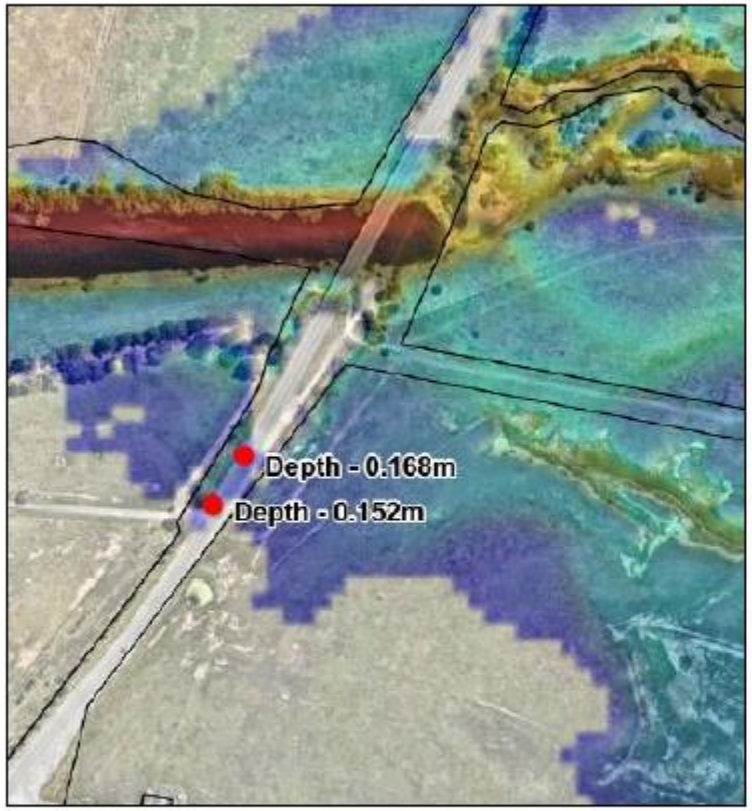
FPCC3
Areas suitable for most types of development

FPCC4
Few flood related development constraints applicable



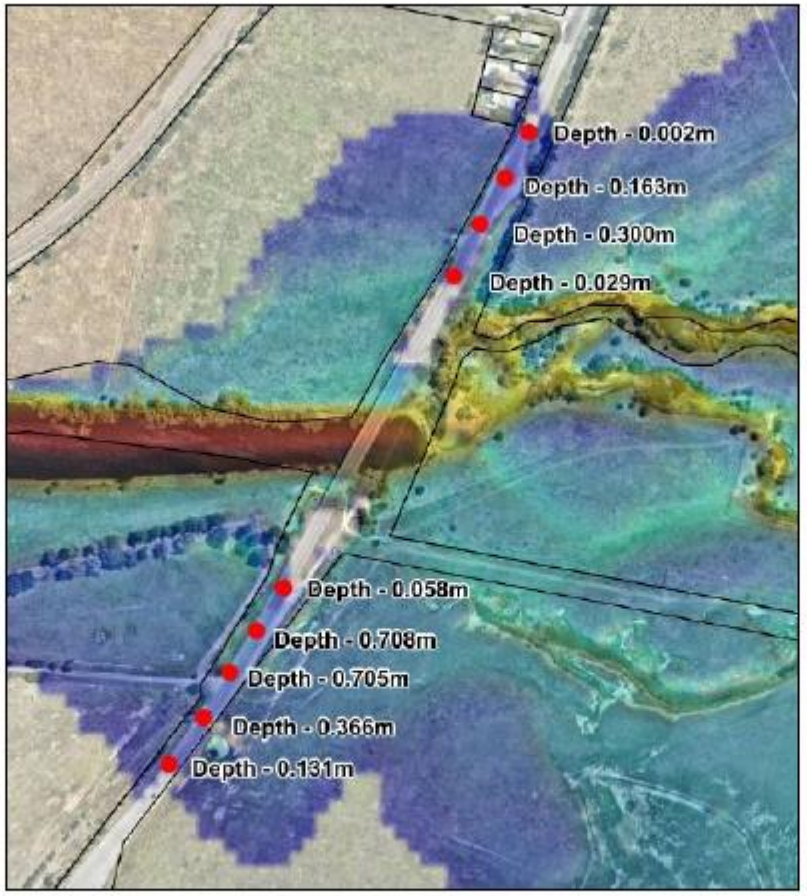
Braidwood Road Bridge approach roads
Flood Depths

Area A- 5% AEP



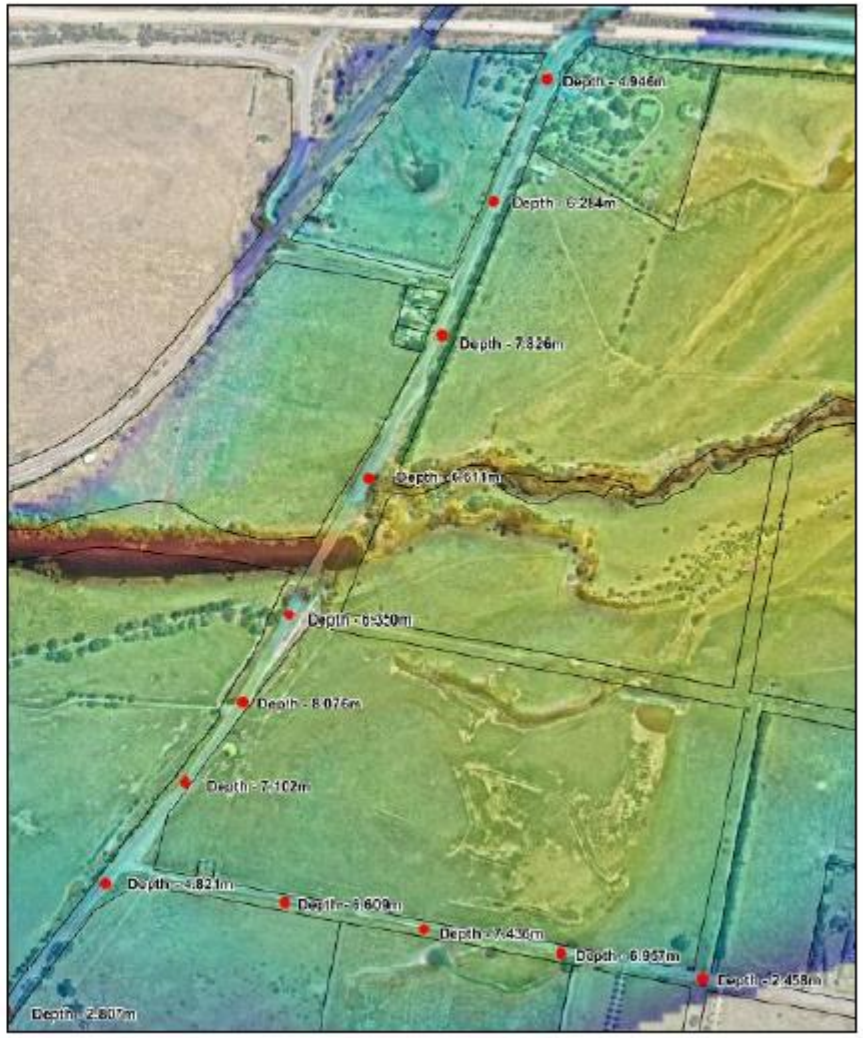
Approx. 15cm

Area A- 1% AEP



Reaches approx. 70cm

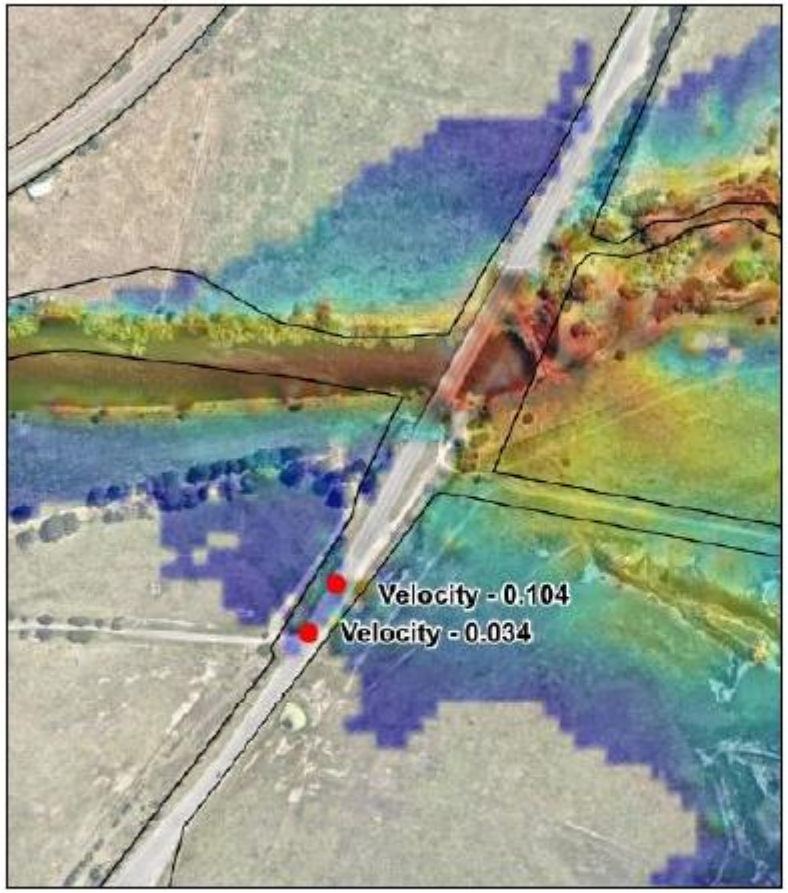
Area A- PMF



Reaches approx. 8m

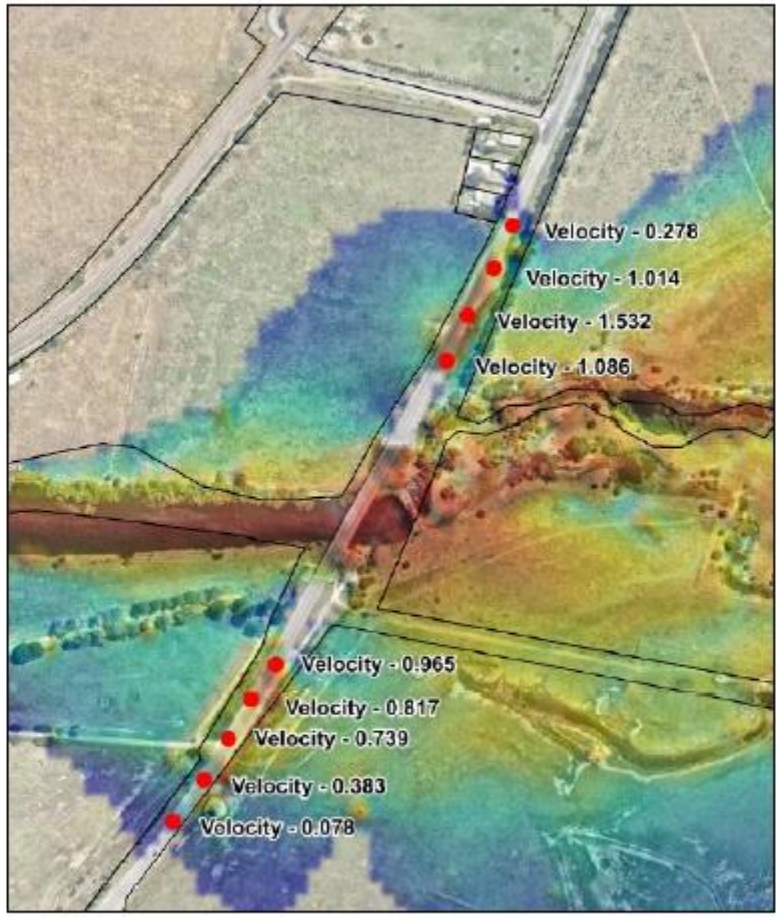
Braidwood Road Bridge approach roads
Flood Velocities

Area A- 5% AEP



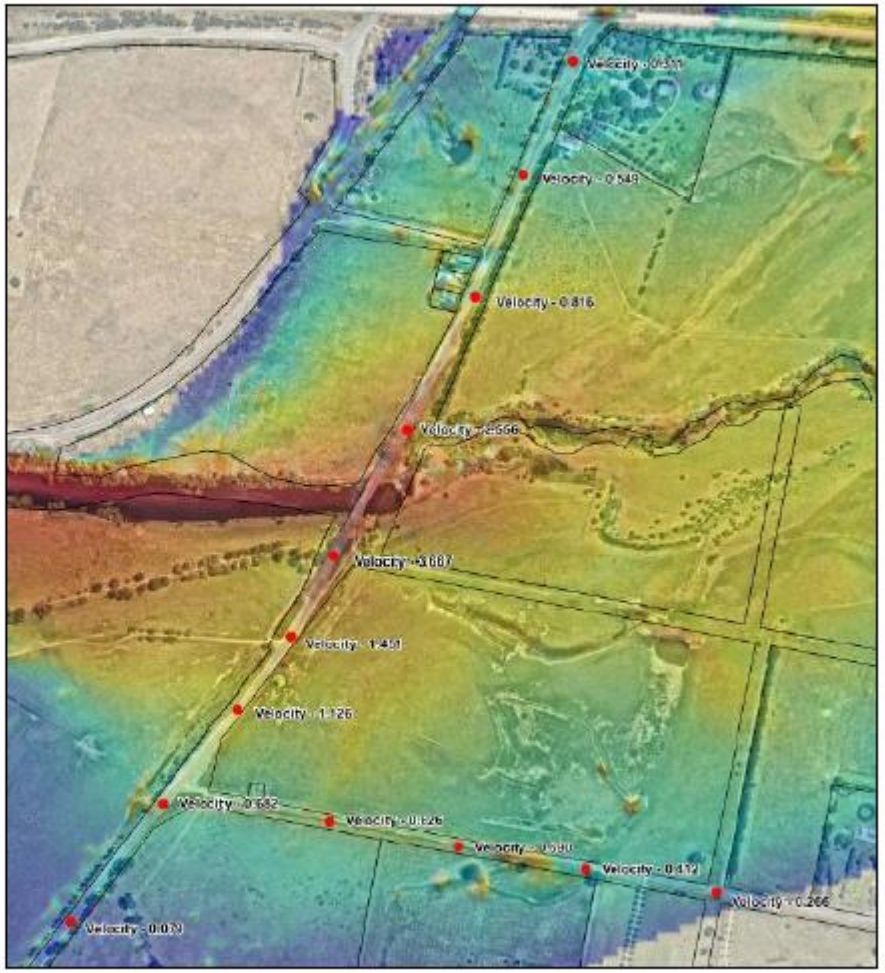
Up to 0.1m/s

Area A- 1% AEP



Up to 1.5m/s

Area A- PMF



Up to 3.6m/s

Ministerial Direction 4.1- Flooding

Clause 1- A planning proposal must include provisions that give effect to and are consistent with:

(a) the NSW Flood Prone Land Policy

(b) The principles of the Floodplain Development Manual 2005

(c) The Considering flooding in land use planning guideline 2021

(d) Any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council

Is our 2022 adopted Flood Study and Floodplain Risk Management Study out of date?

Will/When will this be expanded/amended to include:

- Flood Risk Management Manual
- FBO1 Understanding and Managing Flood Risk
- EMO1 Support for Emergency Management Planning
- LUO1 Flood Impact and Risk Assessment
- Shelter in Place Guidance

Isolation & Safe Occupation

Ministerial Direction 4.1- Flooding

1% AEP + 0.8m

Clause 2
A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.

Brisbane Groves
- No residential rezoning in FPA
- C2 Environmental Conservation only
- All R5 zoning outside FPA

Ministerial Direction 4.1- Flooding

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

(a) A permit development in floodway areas

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

(c) Permit development for the purpose of residential accommodation in high hazard areas

(d) Permit a significant increase in the development density

(e) Permit development for uses difficult to evacuate

(f) Permit development to be carried out with development consent- except exempt development & agriculture

(g) Are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, or

(h) Permit hazardous industries or hazardous storage establishments

- C2 Environment Conservation Zone only
- Very limited range of permissible development
- No additional development density
- No development without consent
- Hazardous industries prohibited

Ministerial Direction 4.1- Flooding

Clause 4
A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which:

a) A permit development in floodway areas

b) Permit development that will result in significant flood impacts to other properties

c) Permit a significant increase in the dwelling density

d) Permit development for uses difficult to evacuate

e) Are likely to affect the safe occupation of and efficient evacuation of the lot

f) Are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures….

- Endorsed by Council to include in LEP on 2 November 2021

- Applicable to;
  - Correctional Centres,
  - Hospitals,
  - Hazardous Industries & Storage
  - Emergency services facilities.

- Not applied to GM LEP yet
- Development types not applicable

Special Flood Consideration Clause
Standard Instrument – Principal Local Environmental Plan

(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.

Council Judgement?

All flood affected land?

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—

(a) will not 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 not adversely affect the environment in the event of a flood.

Safe occupation & efficient evacuation must be satisfied

Ministerial Direction 4.1- Flooding

Clause 5
For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.

Goulburn Floodplain Risk Management Study	Brisbane Grove PP`s
Flood Planning Area	Flood Planning Area
1% AEP + 0.8m freeboard	1% AEP + 0.8m freeboard

Isolation & Residual Risk

- When efficient and safe evacuation is not possible, what measures can be required to enable safe occupation?