Macedon Ranges

Storm and Flood Emergency Plan

A Sub-Plan of the Municipal Emergency Management Plan

For Macedon Ranges Shire Council
and VICSES Gisborne and Woodend Units

Version 2.3
June 2023

Macedon Ranges Shire Council

VICTORIA State Government

SES

Acknowledgement

Macedon Ranges Shire Council and Victoria State Emergency Service acknowledge the Dja Dja Wurrung, Taungurung and Wurundjeri Woi Wurrung Peoples as the Traditional Owners and Custodians of this land and waterways. We recognise their living cultures and ongoing connection to Country and pays respect to their Elders past, and present. Council and VICSES also acknowledge local Aboriginal and Torres Strait Islander residents of Macedon Ranges for their ongoing contribution to the diverse culture of our community.

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Distribution list

Once endorsed and signed VICSES will electronically distribute the Macedon Ranges Municipal Storm and Flood Emergency Plan (MSFEP) to all Municipal Storm and Flood Planning Committee (MSFPC) members and the following agencies. It will then be the responsibility of agencies to arrange for internal distribution of the Plan. Any additional distribution requirements, such as printed copies of maps for Incident Control Centres (ICC), will be undertaken by VICSES in consultation with the MEMPC Chair.

Copy	Role	Organisation	Date
Original		VICSES	
1	Chair	MEMPC	
2	Chief Executive Officer	MRSC	
3	MEMO and Deputy MEMO	MRSC	
4	Municipal Recovery Manager (MRM)	MRSC	
5	Coordinator Emergency Management	MRSC	
6	Municipal Emergency Response Coordinator (MERC)	Victoria Police (VicPol)	
7	Deputy MERC	VicPol	
8	Regional Emergency Response Coordinator (RERC)	VicPol	
9	Operations Officer – Emergency Management	VICSES Western Region	
10	Operations Manager – Unit Support	VICSES Western Region	
11	Senior ACO Unit Support & Regional Operations	VICSES Western Region	
12	Unit Controller	VICSES Gisborne Unit	
13	Unit Controller	VICSES Woodend Unit	
14	Team Leader Flood Preparedness	Melbourne Water	
15	Flood Warning Manager	Bureau of Meteorology (Flood Warning)	
16	Regional Emergency Management Officer	Department of Transport	
17	Emergency Management Unit	Ambulance Victoria	
18	Emergency Management Officer	Department of Education (DEECD)	
19	Emergency Management Coordinator	Department of Families, Fairness and Housing (DFFH)	
20	Commander (District 2)	Country Fire Authority (CFA)	
21	Incident Control Centre – Gisborne	CFA (via Regional Operations Coordinator)	
22	Commander	Fire Rescue Victoria (FRV)	
23	Manager Floodplain	North Central Catchment Management Authority (NCCMA)	
24	Regional Recovery Manager, Loddon Mallee	Emergency Recovery Victoria (ERV)	
25	Manager Emergency Planning and Resilience	Southern Rural Water	
26		Greater Western Water	
27	Headworks Manager	Coliban Water	

Version control

This Plan will be amended, maintained and distributed as required by VICSES in consultation with the Macedon Ranges MEMPC.

Suggestions for amendments to this Plan should be forwarded to:

VICSES Western Region
352a Dowling Street
Wendouree VIC 3355
Phone 03 9256 9300
Email ust.midwest@ses.vic.gov.au

Amendments listed below have been included in this Plan and promulgated to all registered copyholders.

Version	Date	Entered By	Summary
1.0	25 June 2013		
1.1	19 June 2019	R Butler	Update of Appendix F
2.0	September 2022	R McDonald	Woodend flood study, RFRAs for Lauriston, Malmsbury and Tylden, and new Kyneton data added Inclusion of storm (change to MSFEP) Change template to reflect current SEMP doctrine
2.0	February 2023	R McDonald G Kelly	Changes as requested by Committee members.
2.1	March 2023	R McDonald	Added information about Kilmore Road redesign. Inclusion of new Appendix E: Sandbags.
2.2	June 2023	R McDonald	Replaced Woodend Flood Study data with updated info from May 2023 draft report.
2.3	June 2024	R McDonald	Removed Woodend Flood Study data and reverted section to previous approved version.

This Plan will be maintained on the VICSES website (ses.vic.gov.au/plan-and-stay-safe/flood-guides/macedon-ranges-shire-council) and the Macedon Ranges website (mrsc.vic.gov.au/Live-Work/Emergency-Planning/Emergency-Management-Plans).

Abbreviations and acronyms

The following abbreviations and acronyms are used in the Plan			
AAR	After Action Review	FZ	Floodway Zone
AEP	Annual Exceedance Probability	IC	Incident Controller
AHD	Australian Height Datum (the height of a location above mean sea level in metres)	ICC	Incident Control Centre
AIDR	Australian Institute of Disaster Resilience	IMT	Incident Management Team
AIIMS	Australasian Inter-service Incident Management System	IMS	Incident Management System
AoCC	Area of Operations Control Centre / Command Centre	LSIO	Land Subject to Inundation Overlay
ARI	Average Recurrence Interval	MECC/MEOCC	Municipal Emergency Coordination Centre
AV	Ambulance Victoria	MEMP	Municipal Emergency Management Plan
BOM	Bureau of Meteorology	MEMPC	Municipal Emergency Management Planning Committee
CEO	Chief Executive Officer	MERC	Municipal Emergency Management Response Coordinator
CERA	Community Emergency Risk Assessment	MEMO	Municipal Emergency Management Officer
CFA	Country Fire Authority	MRM	Municipal Recovery Manager
CMA	Catchment Management Authority	PMF	Probable Maximum Flood
DFFH	Department of Families, Fairness and Housing	RAC	Regional Agency Commander
DH	Department of Health	RCC	Regional Control Centre
DEECA	Department of Energy, Environment and Climate Action	RDO	Regional Duty Officer
DJPR	Department of Jobs, Precincts and Regions	RERC	Regional Emergency Response Coordinator
DoT	Department of Transport	RERCC	Regional Emergency Response Coordination Centre
EMLO	Emergency Management Liaison Officer	SBO	Special Building Overlay
EMMV	Emergency Management Manual Victoria	SCC	State Control Centre
EMT	Emergency Management Team	SEMP	State Emergency Management Plan
EMV	Emergency Management Victoria	SERP	State Emergency Response Plan
ERV	Emergency Recovery Victoria	SEWS	Standard Emergency Warning Signal
EO	Executive Officer	SHERP	State Health Emergency Response Plan
FO	Floodway Overlay	SOP	Standard Operating Procedure
FRV	Fire Rescue Victoria	VicPol	Victoria Police
FWS	Flood Warning System	VICSES	Victoria State Emergency Service

Glossary

Below are terms defined for the purpose of this Plan:

Term	Definition
Annual Recurrence Interval (ARI)	The average or expected value of the period between exceedances of a given rainfall or flow total, accumulated over a given duration.
Annual Exceedance Probability (AEP)	The probability that a given total rainfall or flow is accumulated over a given duration will be exceeded in any one year.
Draining system	A series of drains and waterways into which surface and storm water flows. Features of a drainage system can include underground pipe drains, open channels, retarding basins, floodways, waterway improvements, water quality works and environment protection measures. All drainage under 60ha is maintained and operated by Council.
Flash flooding	Sudden unexpected flooding caused by local heavy rainfall or rainfall in another area. Often defined as flooding which occurs within six hours of the rain which causes flooding.
Flood mapping	The process where the extent of flooding is documented in mapping software based on flood studies and surface elevations.
Floodplain	Area of land adjacent to a creek, river, estuary, lake, dam or artificial channel, which is subject to inundation.
Hot spot	A known flood problem area which has a history of repeat flooding of a road, crossing or property, often highlighted through anecdotal information and customer complaints. It is a localised issue which will vary from council to council.
Natural drainage system	Flow paths which are largely undeveloped by human sources, these include rivers, streams, natural depressions and wetlands.
Overland flooding	Flooding by local runoff caused by heavier than usual rainfall. Overland flooding can be caused by local flow exceeding the capacity of an urban stormwater drainage system or by the backwater effects of mainstream flooding causing urban stormwater drainage system to overflow.
Retarding basin	A retarding basin is a large, open, free draining basin that temporarily stores collected stormwater runoff. These basins are normally maintained in a dry condition between storm events.
Runoff	The amount of rainfall that enters the stormwater drainage system (via pits, underground pipes, retarding basins, water sensitive structures, overland flow paths, floodway and waterways) after water which is not absorbed into the ground has been taken into account.

Part 1. Introduction

1.1 Approval and endorsement

This Plan has been prepared by the Macedon Ranges MSFPC with the authority of the MEMPC pursuant to Section 60A of the Emergency Management Act 2013 (as amended).

This MSFEP is a sub-plan of the Macedon Ranges Municipal Emergency Management Plan (MEMP). It is consistent with the State Emergency Management Plan (SEMP), State Flood Emergency Plan and State Storm Emergency Plan (sub-plans of the now superseded State Emergency Response Plan and transitioned to be sub-plans of the SEMP).

It is also consistent with the VICSES Loddon Mallee Region Emergency Response Plan – Flood Sub-Plan and Storm Sub-Plan, the Victorian Floodplain Management Strategy, and considers the outcomes of the Community Emergency Risk Assessment (CERA) process undertaken by the Macedon Ranger MEMPC. This MSFEP is a result of the cooperative efforts of the Macedon Ranges MEMPC and its member agencies.

Minor and administrative amendments will be made to this Plan from time to time without re-presenting the Plan to the MEMPC. Any major structural or policy changes will be considered before adoption.

This Plan is endorsed by the Macedon Ranges MEMPC as a sub-plan of the MEMP.

1.1.1 Endorsement

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Maria Weiss Date
Chair
Macedon Ranges Municipal Emergency Management Planning Committee

1.2 Purpose and scope of this Storm and Flood Emergency Plan

The purpose of this Plan is to detail arrangements agreed for the planning, prevention, preparedness, response and recovery from storm and flood incidents within the municipality. As such, the scope of the Plan is to:

- Identify the storm and flood risk to the municipality
- Support the implementation of measures to minimise the causes and impacts of storm and flood incidents within the municipality
- Detail response and recovery arrangements including preparedness, incident management, command and control
- Identify linkages with local, regional and state emergency and wider planning arrangements with specific emphasis on those relevant to storm and flood.

1.3 Municipal Storm and Flood Planning Committee

Membership of the Municipal Storm and Flood Planning Committee (MSFPC) will comprise of representatives from the following agencies and organisations:

- VICSES Operations Officer – Emergency Management (Chair)
- VICSES Gisborne and Woodend Units – Controller, Deputy Controller or delegate
- Macedon Ranges Shire Council
    - Municipal Emergency Management Officer (MEMO)
    - Municipal Recovery Manager (MRM)
    - Coordinator Emergency Management
- North Central Catchment Management Authority
- Victoria Police – Municipal Emergency Response Coordinator (MERC)
- CFA District 2 – Commander, Group Officer(s) or delegate
- Emergency Recovery Victoria (ERV) (as required)
- Department of Families, Fairness and Housing (as required)
- Department of Environment, Land, Water and Planning (as required)
- Bureau of Meteorology (as required)
- Coliban Water (as required)
- Melbourne Water (as required)
- Southern Rural Water (as required)
- Greater Western Water (as required).

1.4 Responsibility for planning, review and maintenance of this Plan

This Plan must be maintained to remain effective. This Plan must be assured, approved and published every three years, or more frequently if required. VICSES, through the MEMPC, has responsibility for preparing, reviewing, maintaining and distributing this Plan. The MSFPC will meet at least once per year. The Plan should be reviewed and where necessary, arrangements and information contained in it should be amended:

- Following any new flood or stormwater drainage studies
- Following a change in non-structural and/or structural flood mitigation measures
- After the occurrence of a significant storm and/or flood event within the municipality.

Part 2. Mitigation arrangements

2.1 Community awareness for all types of storms and flooding

This Plan will be published and maintained on the VICSES website. This will occur following any updates and amendments and in accordance with assurance, approval and publishing requirements.

VICSES, with the support of Macedon Ranges, will coordinate community engagement programs for storm and flooding within the local government area (e.g. Local Flood Guides and public events). Engagement will include raising awareness about the projected impacts on the frequency and intensity of flood and storm events and what actions can be taken to minimise these impacts.

Community engagement programs to support this Plan may be developed in conjunction with the local VICSES unit. VICSES Gisborne and/or Woodend Units may lead the delivery of programs with support from Macedon Ranges and VICSES Western Region.

2.2 Structural mitigation measures

A levee has been constructed at Campaspe Drive and Pyke Street, Woodend. There are no other structural flood mitigation measures on streams within Macedon Ranges Shire. Refer to Appendix B2 for detailed information of structural flood mitigation measures.

2.3 Non-structural mitigation measures

2.3.1 Exercising

Arrangements for exercising this Plan will be at the discretion of the MSFPC, in consultation and conjunction with the MEMPC. This Plan should be regularly exercised (at least every three years and/or reviewed after a significant event).

2.3.2 Storm and flood warnings

Arrangements for storm and flood warning are contained within the State Flood and Storm Emergency Plans (ses.vic.gov.au/prepare/em-planning/state-plans), the SEMP and on the Bureau of Meteorology (BOM) website (bom.gov.au).

Specific details of local storm and flood warning system arrangements are provided in Appendix C.

2.3.3 Local knowledge

Community Flood Observers provide local knowledge to VICSES and the ICC regarding local insights and the potential impacts and consequences of an incident.

There are no official Community Flood Observers within the municipality, however local knowledge is incorporated into this Plan through consultation with local response agencies. In line with the VICSES Local Knowledge Policy, reviews of this Plan will be undertaken with input from multiple local sources to ensure appropriate local knowledge can be captured before, during and after incidents.

Previous event history and likely operational considerations are noted in the Flood Intelligence Cards in Appendix B.

Part 3. Response arrangements

3.1 Introduction

3.1.1 Activation of response

Storm and flood response arrangements may be activated by the VICSES Regional Duty Officer (RDO), Regional Agency Commander (RAC) or Incident Controller (IC).

The VICSES RDO, RAC or IC will activate agencies as required and documented in the VICSES Loddon Mallee Region Storm and Flood Emergency Plans, the State Storm Emergency Plan and the State Flood Emergency Plan (ses.vic.gov.au/about-us/state-and-regional-emergency-plans).

3.1.2 Responsibilities

There are a number of agencies with specific roles that will act in support of VICSES and provide support to the community in the event of a serious storm and/or flood within the municipality. These agencies will be engaged through the Incident Emergency Management Team (IEMT).

The general roles and responsibilities of supporting agencies are as agreed within the MEMP, SEMP (Roles and Responsibilities) and VICSES Loddon Mallee Region Storm and Flood Emergency Plans and State Flood and Storm Emergency Plans (ses.vic.gov.au/prepare/em-planning/state-plans).

3.1.3 Municipal Emergency Operations Coordination Centre (MEOCC)

Where activated, the function, location, establishment and operation of the MEOCC (or similar coordination centre) will be as detailed in the MEMP.

Liaison with the MEOCC (or similar coordination centre) will be through the VICSES Loddon Mallee Region RDO/RAC or established ICC and with notification to the VicPol MERC. If a MEOCC (or similar) is not operating, the Municipal Emergency Management Officer (MEMO) will be contacted.

3.1.4 Escalation

Most storm and/or flood incidents are of local concern and an appropriate response can usually be coordinated using local resources. However, when these resources are exhausted, Regional arrangements provide for further resources to be made available, firstly from neighbouring municipalities (on a Regional basis) and then on a State-wide basis. Resourcing and event escalation arrangements are described in the SEMP.

3.2 State Emergency Management Priorities

To provide guidance to the Incident Management Team (IMT) and Incident Emergency Management Team (IEMT), the following State Emergency Management Priorities shall form the basis of incident action planning processes:

1. **Protection and preservation of life and relief of suffering is paramount.**

   This includes:

   a. Safety of emergency services personnel; and

   b. Safety of community members including vulnerable community members and visitors/tourists.

2. **Issuing of community information and community warnings** detailing incident information that is timely, relevant and tailored to assist community members make informed decisions about their safety.

3. **Protection of critical infrastructure and community assets** that support community resilience.

4. **Protection of residential property** as a place of primary residence.
5. **Protection of assets supporting individual livelihoods and economic production** that supports individual and community financial sustainability.
6. **Protection of environmental and conservation assets** that considers the cultural, biodiversity, and social values of the environment.

Circumstances may arise where the IC is required to vary these priorities, with the exception being that the protection of life should remain the highest. This shall be done in consultation with the State Response Controller and relevant stakeholders based on sound incident predictions and risk assessments.

3.3 Command and control

Arrangements in this MSFEP must be consistent with the State and Regional Flood and Storm Emergency Plans and the MEMP. For further information, refer to the SEMP.

3.3.1 Control

Sections 5(1)(b) and 5(1)(c) of the Victoria State Emergency Service Act 2005 detail the authority for VICSES to plan for and respond to storms and floods.

Table 9 of the SEMP (Roles and Responsibilities) identifies VICSES as the Control Agency for storm and flood. It identifies the Department of Energy, Environment and Climate Action (DEECA) as the Control Agency responsible for dam safety, water and sewerage asset related incidents and other emergencies.

All flood response activities within Macedon Ranges, including those arising from a dam failure or retarding basin/levee bank failure incident, will therefore be under the control of the appointed IC or their delegated representative.

3.3.2 Incident Controller (IC)

An IC will be appointed by the VICSES (as the Control Agency), to command and control available resources in response to a storm and/or flood event on the advice of the BOM (or other reliable source) that a storm and/or flood event will occur or is occurring. The IC responsibilities are as defined in the SEMP.

3.3.3 Incident Control Centre (ICC)

As required, the IC will establish an ICC from which to initiate incident response command and control functions. Decisions on when an ICC should be activated rest with the Control Agency.

Pre-determined Incident Control Centres for storm and flood (as per JSOP 02.03) are:

- **Sunshine ICC** (VICSES)
  239 Proximity Drive
  Sunshine West Vic 3020
  Phone 03 9256 7299
  iccsunses.inc@icc.vic.gov.au
- **Epsom ICC** (DEECA)
  7 Taylor Street
  Epsom Vic 3551
  Phone 03 5430 4444
  iccben.inc@icc.vic.gov.au
- **Ballarat ICC** (VICSES)
  352 Dowling Street
  Wendouree Vic 3355

Phone 03 5339 1122
iccbalses.inc@icc.vic.gov.au

Gisborne ICC (CFA) does not currently have an identified footprint for storm or flood.

3.3.4 Divisions and Sectors

To ensure that effective Command and Control is in place, the IC may establish Divisions and Sectors depending upon the complexity of the event and resource capacities.

Divisions and Sectors may be established to assist with the management of storm and flood impacts within the municipality, with locations to be decided by the IC.

3.3.5 Incident Management Team (IMT)

The IC will form an Incident Management Team. Where possible IMTs should be multi-agency and include relevant local and hazard specific knowledge. Refer to the SEMP (Page 63) for guidance.

3.3.6 Emergency Management Team (EMT)

The Incident Controller will establish a multi-agency IEMT to assist the storm and/or flood response. The IEMT will consist of key personnel (with appropriate authority) from stakeholder agencies and relevant organisations who need to be informed of strategic issues related to incident control and who are able to provide high level strategic guidance and policy advice to the Incident Controller for consideration in developing incident management strategies.

Organisations required within the IEMT (including Macedon Ranges) will provide an Emergency Management Liaison Officer (EMLO) to the ICC if and as required as well as other staff and/or resources identified as being necessary, within the capacity of the organisation.

Refer to the SEMP (Page 60) for guidance.

3.3.7 On receipt of a Flood Watch/Severe Weather Warning

The VICSES RDO will undertake actions as defined within the flood intelligence cards (Appendix B). General considerations by the Incident Controller/VICSES RDO will be as follows:

- Review storm and flood intelligence to assess likely flood consequences
- Monitor weather and flood information (see www.bom.gov.au)
- Assess command and control requirements
- Review local resources and consider needs for further resources regarding personnel, property protection, storm/flood rescue and air support
- Notify and brief appropriate officers. This includes Regional Control Centre (if established), State Control Centre (if established), MEMO (as outlined in the MEMP), other emergency services through the EMT
- Assess Incident Control Centre readiness (including staffing of IMT and EMT) and open if required
- Ensure flood bulletins and community information are prepared and issued to the community
- Monitor watercourses and undertake reconnaissance of low-lying areas
- Develop media and community information management strategy
- Ensure storm and flood mitigation works are being checked by owners
- Develop and issue incident action plan, if required
- Develop and issue situation report, if required.

3.3.8 On receipt of the first and subsequent Storm and/or Flood Warnings

The VICSES RDO/Incident Controller will undertake actions as defined within the flood intelligence cards (Appendix B). General considerations by the VICSES Loddon Mallee RDO/Incident Controller will be as follows:

- Develop an appreciation of current flood levels and predicted levels. Are floodwaters, rising, peaking or falling?
- Review flood intelligence to assess likely flood consequences. Consider:
    - What areas may be at risk of inundation
    - What areas may be at risk of isolation
    - What areas may be at risk of indirect affects as a consequence of power, gas, water, telephone, sewerage, health, transport or emergency service infrastructure interruption
    - The characteristics of the populations at risk
- What areas may be at risk of building damage.
- Determine what the at-risk community need to know and do as the storm and/or flood develops.
- Warn the at-risk community including ensuring that an appropriate warning and community information strategy is implemented including details of:
    - The current storm and/or flood situation
    - Storm and/or flood predictions
    - What the consequences of predicted activity and or levels may be
    - Public safety advice
    - Who to contact for further information
    - Who to contact for emergency assistance.
- Liaise with relevant asset owners as appropriate (i.e. water and power utilities)
- Implement response strategies as required based upon storm and/or flood consequence assessment
- Continue to monitor the storm/flood situation (www.bom.gov.au)
- Continue to conduct reconnaissance of low-lying areas.

3.4 Community information and warnings

Guidelines for the distribution of community information and warnings are contained in the VICSES Loddon Mallee Region Storm and Flood Emergency Plans and State Flood Emergency Plan.

Community information and warnings communication methods available include:

- VicEmergency App, Hotline and website
- Emergency Alert phone messages (including SMS)
- Social media and/or social networking sites (i.e. Twitter and/or Facebook).
- Radio and television
- Community meetings
- Newsletters
- Two-way radio
- Mobile and fixed public address systems
- Sirens
- Verbal messages (i.e. doorknocking)
- Variable message signs (i.e. road signs)
- Newspapers
- Email
- Telephone trees
- Fax stream
- Letter drops.

Refer to Appendix B and Appendix C for the specific details of how community information and warnings are to be provided.

The release of flood bulletins and information regarding response activities at the time of a flood event is the responsibility of VICSES, as the control agency.

Responsibility for public information, including media briefings, rest with VICSES as the control agency. Macedon Ranges Shire will assist VICSES to warn individuals within the community where practicable including activation of flood warning systems, where they exist. Other agencies such as CFA, DEECA and VicPol may also be requested to assist with the communication of community storm and/or flood warnings.

In cases where severe flash flooding is predicted, dam failure is likely or flooding necessitating evacuation of communities is predicted, the Incident Controller may consider the use of the Emergency Alert System and Standard Emergency Warning System (SEWS).

The Department of Health (DH) will coordinate information regarding public health and safety precautions.

3.5 Media communication

The IC through the Public Information Section established at the ICC will manage Media communication. If the ICC is not established the VICSES Loddon Mallee Region RDO will manage all media communication. Macedon Ranges Shire will work with the IC to ensure that consistent and timely messaging occurs.

3.6 Impact Assessment (IA)

IA is conducted in the aftermath of an emergency event (or during depending on the scale). It assesses the impacts of emergencies on communities and informs government of immediate relief and recovery and long-term recovery needs. IA should be community focused to ensure the data and information will assist decision making on how to best support communities impacted by emergencies. A three-stage process is utilised to gather and analyse information following an emergency event:

- Initial Impact Assessment (IIA)
- Secondary Impact Assessment (SIA)
- Post Emergency Needs Assessment (PENA).

3.6.1 Initial Impact Assessment (IIA)

IIA typically begins in the first 24 to 48 hours of an emergency event and is focused on the collation of immediate impact data. ICs can deploy reconnaissance teams to check for hazards prior to the release of IIA Teams or emergency services' personnel to a potentially unsafe area.

IIA is a preliminary assessment generally from visual inspection undertaken by response agencies, assisting in determining the scale and impact of the emergency on people, community infrastructure, and the economic, natural and built environments.

IIA provides early information to assist in the prioritisation of immediate needs of individuals and communities, requirements of SIA and supports commencement of emergency relief and early recovery planning and activities by Macedon Ranges Shire, DFFH and ERV.

3.7 Preliminary deployments

When storm impacts and/or flooding is expected to be severe enough to cut access to towns, suburbs and/or communities the Incident Controller will consult with relevant agencies to ensure that resources are in place if required to provide emergency response. These resources might include emergency service personnel, food and non-food items such as medical supplies, shelter, assembly areas, relief centres, etc.

3.8 Response to storms and flash flooding

Emergency management response to storm and flash flooding should be consistent with the VICSES Loddon Mallee Region Emergency Response Plan – Storm and Flood Sub-plans and the SEMP – Storm Sub-plan.

When conducting pre-event planning for flash floods the following steps should be followed, and in the order as given:

1. Determine if there are barriers to evacuation by considering warning time, safe routes, and resources available.
2. If evacuation is possible, then evacuation should be the adopted strategy and it must be supported by a public information capability and a rescue contingency plan, Contact MERC who liaises with MEMO and MRM about activating ERC (see MEMP).
3. Where it is likely people will become trapped by floodwaters safety advice needs to be provided to people at risk advising them not to attempt to flee by entering floodwater if they become trapped, and that it may be safer to seek the highest point within the building and to telephone 000 if they require rescue; This advice needs to be provided even when evacuation may be possible, due the likelihood that not all community members will evacuate.
4. For buildings known to be structurally unsuitable an earlier evacuation trigger will need to be established (return to step 1 of this cycle).
5. If an earlier evacuation is not possible then specific preparations must be made to rescue occupants trapped in structurally unsuitable buildings either pre-emptively or as those people call for help.
6. Contact MERC and MEMO at the earliest opportunity to allow relief preparation to commence.

Due to the rapid development of storms and flash flooding it will often be difficult to establish emergency relief centres ahead of triggering the evacuation. This is normal practice but this is insufficient justification for not adopting evacuation.

Refer to Appendix B for response arrangements for flash flood events. Refer to the VicTraffic website for road closures (traffic.vicroads.vic.gov.au).

3.9 Evacuation

The decision to recommend or warn people to prepare to evacuate or to evacuate immediately rests with the IC and where possible and practical, in consultation with the IEMT.

Once the decision is made, VicPol are responsible for the coordination of the evacuation process. VICSES and other agencies will assist where practical. VICSES is responsible for the development and communication of evacuation warnings. It is the choice of individuals as to how they respond to this recommendation.

VicPol (or delegate to Australian Red Cross) may take on the responsibility of registering people affected by the emergency (through the Register.Find.Reunite. program) including those who have been evacuated.

Refer to JSOP 03.12 – Evacuation for Major Emergencies and the Macedon Ranges MEMP Section 5.7 – Evacuation for guidance on evacuations for flood emergencies.

There are currently no detailed evacuation arrangements for Macedon Ranges. If evacuation is determined as appropriate, the MEMO should be notified.

3.9.1 Vulnerable persons

Macedon Ranges maintains a list and mapped version of facilities where vulnerable persons may be located (e.g. hospitals, schools) that can be requested via the MEMO.

The Vulnerable Persons Register (VPR), which stores local information about consenting, identified vulnerable people, can be accessed in MECC Central. Access to the VPR is role-based and limited to municipalities, VicPol and DFFH.

The VPR is limited and vulnerable people in emergencies may vary depending on the emergency and location in the Shire. Other vulnerable persons may include:

- Older persons
- Culturally and linguistically diverse (CALD)
- Visitors and new arrivals to the municipality
- Women and children (particularly those at risk of domestic violence)
- Aboriginal and Torres Strait Islanders (or First Nations) community members.

Related plans include:

- Children and Young People Emergency Plan (local)
- Prevention of Violence Against Women in Emergencies Action Plan (local)
- Disability Action Plan 2021-2025 (local)
- Equine Bushfire Survival and Property Plan (local)
- Various Kindergarten Emergency Management Plans (Council sites only: Lancefield, Macedon, Riddells Creek, Romsey and Woodend)
- Hanging Rock Reserve Fire Management Plan (includes some information about visitors)
- Emergency Relief Centre Sub-Plan (local)
- Recovery MEMP Sub-Plan (local)
- Loddon Mallee Region Emergency Relief and Recovery Plan (available on EM-COP)

Note: these plans can be accessed via CrisisWorks or the Coordinator, Emergency Management Council.

3.10 Flood rescue

VicPol as the designated control agency for water rescue coordinates rescues undertaken during flood events. In order to activate water rescue services, VICSES will identify areas at risk of requiring rescue and notify the Officer in Charge of the Water Police Search and Rescue Squad to request pre-deployment of rescue resources to those areas.

VicPol may require the assistance of appropriately trained and equipped personnel. In these circumstances, appropriately trained and equipped VICSES units or other agencies may carry out rescues.

Rescue operations may be undertaken where voluntary evacuation is not possible, has failed or is considered too dangerous for an at-risk person or community. An assessment of available flood rescue resources (if not already done prior to the event) should be undertaken prior to the commencement of rescue operations.

Rescue is considered a high-risk strategy to both rescuers and persons requiring rescue and should not be regarded as a preferred emergency management strategy. Rescuers should always undertake a dynamic risk assessment before attempting to undertake a flood rescue.

The following resources are available within the municipality to assist with rescue operations:

- VICSES Gisborne and Woodend Units – general rescue capability
- CFA Brigades with four-wheel drive appliances.

VicPol and VICSES can access rescue boats, but there is a lead-time required to get them onsite.

There are no known high-risk areas/communities where rescues might be required on a large scale, but experience in other municipalities (e.g. January 2011 and October 2022) has shown that property isolations can occur quickly in some rural areas, as well as stranded person(s) in vehicles trapped in floodwaters and both types of events may require specialist rescue.

3.11 Aircraft management

Aircraft can be used for a variety of purposes during storm and/or flood operations including evacuation, resupply, reconnaissance, intelligence gathering and emergency travel. Air support operations will be conducted under the control of the Incident Controller in line with Interagency Aviation Operating Policy and Procedures (IAOPs). The Incident Controller may request aircraft support through the State Air Desk located at the State Control Centre who will establish priorities.

Suitable airbase facilities are located at:

- Kyneton Airfield, Kyneton-Metcalfe Road
- Melton Airfield, Coburns Road
- Sunbury Airfield (Penfield), Settlement Road
- Bacchus Marsh Airfield, Cummings Road.

3.12 Resupply

Communities, neighbourhoods or households can become isolated during storms and floods because of road closures or damage to roads, bridges and causeways. Under such circumstances, the need may arise to resupply isolated properties or communities with essential items.

When predictions and/or intelligence indicate that communities, neighbourhoods and/or households may become isolated, VICSES will advise businesses and/or households that they should stock up on essential items. After the impact, VICSES can support isolated communities through assisting with the transport of essential items to isolated communities and assisting with logistics functions.

Resupply operations are to be included as part of emergency relief arrangements. VICSES will work with Macedon Ranges Shire and DFFH to service communities that are isolated.

3.13 Critical infrastructure and property protection

Critical infrastructure and property (e.g. residences, businesses, roads, power supply, etc.) may be affected in the event of a storm and/or flood. The Incident Controller will ensure that owners of critical infrastructure are kept advised of the situation. Critical infrastructure providers must keep the Incident Controller informed of their status and ongoing ability to provide services.

Property may be protected by:

- Sandbagging to minimise entry of water into buildings
- Encouraging businesses and households to lift or move contents
- Construction of temporary levees within appropriate approval frameworks may occur in consultation with NCCMA, Melbourne Water, LGA and VicPol.

Sandbag supplies are available through VICSES and/or at hardware stores. The Incident Controller will determine the priorities related to the use of sandbags, which will be consistent with the strategic priorities.

Although not necessarily subject to inundation, the following infrastructure and community facilities have been identified as essential to providing community services that support the safety, health, and wellbeing

of residents, including, but not limited to, emergency response and other public safety activities, hospitals and clinics, libraries and schools:

- Emergency Relief Centres (ERC)
- Gisborne Administration Centre, 40 Robertson Street, Gisborne 3437
- Kyneton Administration Centre, 129 Mollison Street, Kyneton 3444
- Woodend Operations Centre
- Kindergartens at Kyneton, Lancefield, Macedon, Gisborne, Riddells Creek, Romsey and Woodend.
- Maternal and Child Health Centres at Kyneton, Gisborne, Riddells Creek, Romsey and Woodend.

As needed, owners of the above facilities should enact their business continuity plans based upon the current and predicted storm and/or flood situation. Continued operation of these facilities contributes to the successful recovery of community following a storm and/or flood emergency.

Refer to Appendix A for further specific details of critical infrastructure requiring protection. Refer to Appendix E: Sandbags for details on procurement, storage, distribution, use and disposal.

3.14 Disruption to services

Disruption to services other than critical infrastructure and property can occur in storm/flood events. Refer to Appendix A for specific details of likely disruption to services and proposed arrangements to respond to service disruptions in the municipality.

3.15 Levees

Levee owners and operators are responsible for the maintenance, operation and monitoring of their levees, and must keep the Incident Controller informed of levee status and be prepared to provide expert advice to the Incident Controller about the design and construction of their levees.

In accordance with the strategic control priorities, the Incident Controller may assist levee owners to coordinate resources, both technical and physical, to provide advice and affect temporary repairs to or augmentation of levees.

Levees will only be raised by sandbagging or earthworks with the approval of the responsible authority (owner and/or managing authority) and then only after careful consideration and consultation, if time permits, with VICSES, Macedon Ranges Shire, DEECA, NCCMA and/or Melbourne Water.

Levees within the Municipality are listed in Appendix B.

3.16 Road closures

Macedon Ranges Shire and Department of Transport (DoT) are responsible for road closures including observation and placement of warning signs or roadblocks where necessary on the road network, bridges and walking and bike trails. Macedon Ranges staff may also liaise with and advise DoT as to the need for warning signs and/or of closing roads and bridges under DoT jurisdiction. DoT is responsible for designated main roads and highways and the municipality is responsible for the designated local and regional road network.

DoT and the municipality will distribute community information regarding road closures. Within Macedon Ranges, there are several roads that are impacted by floodwater. For details of the highways and arterial roads affected see the Flood Intelligence Cards for each stream in Appendix B. Refer to the VicTraffic website for road closures (traffic.vicroads.vic.gov.au).

3.17 Dam failure

DEECA is the control agency for dam safety incidents (e.g. breach, failure or potential breach/failure of a dam), however VICSES is the control agency for any flooding that may result.

Major dams (generally dams with a capacity in excess of 100ML) with potential to cause structural and community damage within the Municipality are listed in Appendix A. The owner/operators of these dams are required to develop and maintain emergency plans in case of failure.

3.18 Waste water related public health issues and critical sewerage assets

Inundation of critical sewerage assets including septic tanks and sewerage pump stations may result in water quality problems within the municipality. Where this is likely to occur or has occurred the agency responsible for the critical sewerage asset should:

- Advise VICSES of the security of critical sewerage assets to assist preparedness and response activities in the event of flood
- Maintain or improve the security of critical sewerage assets
- Check and correct where possible the operation of critical sewerage assets in times of flood
- Advise the ICC in the event of inundation of critical sewerage assets.

It is the responsibility of the MRSC Environmental Health Officer and/or the Environment Protection Authority (EPA) to inspect and report to the MEMO (or the ICC if activated) any water quality issues that are identified as a result of flooding.

3.19 Access to technical specialists

VICSES has arrangements with technical specialists who can provide technical assistance in the event of flood operations. Refer to VICSES SOP061 for the procedure to engage these specialists.

3.20 After Action Review

An After Action Review (AAR) should follow all emergencies. This local debriefing process allows groups to learn from an event and address issues as soon as possible, leading to improved performance and communication. Formal debriefs are usually more structured and can be used to raise issues, highlight positive outcomes, identify areas for improvement and propose actions.

[Fundamental of Emergency Management, February 2015]

All agencies involved in the flood incident should be represented at the AAR.

Part 4. Relief and recovery arrangements

4.1 General

Arrangements for emergency relief/recovery from any emergency, including storm/flood incident within the municipality are detailed in the MEMP (Recovery Sub-Plan and Emergency Relief Centre Sub-Plan).

4.2 Emergency relief

The IC is responsible for recommending the activation of relief services and ensuring that relief arrangements have been considered and implemented in consultation with IEMT, including the MRM, in accordance with the SEMP (Page 25) and in line with the MEMP (Emergency Relief Centre Sub-Plan).

The range and type of emergency relief services to be provided in response to a storm/flood event will be dependent upon the size, impact, and scale of the storm or flood. Refer to SEMP (Table 12).

Macedon Ranges has many facilities suitable for relief activities; those identified for use during floods are detailed in the MEMP.

4.3 Animal welfare

Matters relating to the welfare of livestock and companion animals (including emergency supply and/or delivery of fodder to stranded livestock or for livestock rescue) are to be referred to DJPR.

Matters relating to companion animals will be shared between Animal Aid and Council, who assists in the rehousing of displaced companion animals.

Matters relating to the welfare of wildlife are to be referred to DEECA. Refer to the Macedon Ranges Animal Welfare Plan for details relating to livestock and companion animals.

Refer to the Victorian Emergency Animal Welfare Plan for detailed arrangements.

4.4 Transition from response to recovery

VICSES as the Control Agency is responsible for ensuring effective transition from response to recovery. This transition will be conducted in accordance with existing arrangements as detailed in the SEMP (Pg 28 and 29) and the Macedon Ranges MEMP Section 5.8 – *Transition from response to recovery.*

Note: Some municipal emergency plans and MEMP Sub-Plans may not be available or current. In the absence of these plans, regional and state emergency management plans should be referenced including:

- Loddon Mallee Region Emergency Management Plan
- Loddon Mallee Region Emergency Relief and Recovery Plan (available on EM-COP)
- State Emergency Management Plan
- State Emergency Relief arrangements
- State Emergency Recovery arrangements.

Accuracy and confidentiality

The information in the following Appendices provides a guide to the likelihood and possible effects of a flood. The information is based on estimates of rainfall rates and depths and on flood behaviours at particular heights or flows following actual flood events and/or hydrologic and hydraulic modelling. However, as all floods are different, those behaviours and effects may occur as a result of different rainfalls and/or heights and flows. They may also occur at different heights in different floods.

This document may contain sensitive information about the effects of flooding on private property. Specific reference to private addresses or businesses may be made directly to owners or other emergency services but should not be made public via broadcast or print media unless authorised specifically by the Incident Controller.

Appendix A1: Flood threats for Macedon Ranges

1. General

The Macedon Ranges Shire is bounded by Mitchell Shire to the east, Hume City, Melton City and Moorabool Shire to the south, Hepburn Shire to the west and Mount Alexander Shire in the north. Jacksons Creek forms part of the boundary (approximately 10.5km) between the Shire and the City of Hume while Deep and Boyd creeks form part of the boundary (approximately 12km and 7km respectively) with Mitchell Shire.

The Macedon Ranges (effectively the end of the Great Dividing Range) dominate the southwest of the municipality. The Range separates the North Central and Port Phillip & Westernport catchments, with almost half of the municipality falling within each. A very small region in the northeast of the Shire is within the Goulburn catchment.

The largest town in the Shire is Gisborne. Kyneton, Romsey and Woodend are other significant towns. Other towns are Riddells Creek, Lancefield, Macedon and Malmsbury. The area is semi-rural in character.

Key waterways in the Shire include the Campaspe and Coliban Rivers, as well as Deep, Riddells, Bolinda, Jacksons and Five Mile creeks. Many of the Shire's natural waterways originate in the ranges (higher areas) and flow southeast to the flat, lower parts. Most of these are tributaries of the Maribyrnong River, which forms to the southeast of the municipality.

The main flooding risks are associated with tributaries to the Maribyrnong River, particularly Deep Creek and Jacksons Creek. Deep Creek rises to the east of Woodend on the northern face of the ranges and flows through Lancefield and Romsey before joining with Boyd Creek at Darraweit Guim. It passes out of the municipality to the southeast and joins the Maribyrnong River a few kilometres upstream of Bulla.

Jacksons Creek flows from above Rosslynne Reservoir, passes through Gisborne and joins the Maribyrnong River a few kilometres downstream from Bulla.

The Campaspe River and in many tributary creeks including the Coliban River, drain the western and northern parts of the Shire. The Coliban River originates just outside the Shire but passes through its north-western edge. These two large rivers can present flooding issues in Kyneton and Malmsbury, towns in the west of the municipality. Five Mile Creek, one of the Campaspe tributaries causes flooding problems in Woodend.

A small area of the Shire to the south of Gisborne is within the Werribee River basin and drains to the Werribee River.

There are a number of reservoirs within the municipality, notably Rosslynne Reservoir, just upstream of Gisborne, and Upper Coliban, Lauriston and Malmsbury Reservoirs on the Coliban River near Malmsbury. Several smaller reservoirs exist in the headwaters of Riddells Creek, on the southern slopes of Mount Macedon. The status of these storages in the lead up to and during a storm event can have a large impact on downstream flood levels and inundation extents.

2. Major waterways

The Campaspe and Coliban rivers as well as Deep, Riddells, Bolinda, Jacksons and Five Mile creeks are the main waterways within the Shire. There are however a large number of smaller creeks and a number of drains within the municipality as listed below.

Main drains

- Riddells Creek Main Drain
- Romsey South Drain
- South Gisborne Drain
- Gisborne Peak Creek
- Tributary of South Gisborne Drain
- Tributary of 6856
- Tributary of Jacksons Creek

Retarding basins

- Carinya Drive Retarding Basin
- Kurung Court West Retarding Basin
- Basins within the Howey Creek catchment at Gisborne
- Quarry Road Detention Basin in Woodend

Waterways (small ones are not included)

Axle Creek	Back Creek	Barringo Creek	Big Hill Creek
Billet Creek	Black Creek	Bolinda Creek	Boyd Creek
Campaspe River	Cataract Creek	Charlies Creek	Coliban Channel
Coliban River	Deep Creek	Distill Creek	Djerriwarrh Creek
Dry Creek	Duckhole Creek	Emu Creek	Falls Creek
Five Mile Creek	Garden Hut Creek	Gisborne Creek	Goodman Creek
Jacksons Creek	Jews Harp Creek	Jocks Gully	Jones Creek
Kangaroo Creek	Konagaderra Creek	Kororoit Ck East Branch	Kororoit Ck West Branch
Kurkuruc Creek	Lintons Creek	Little Coliban River	Long Gully Creek
Main Creek	Milking Yard Creek	Mollison Creek	Monument Creek
Number Three Creek	Pipers Creek	Pohlman Creek	Post Office Creek
Pyrites Creek	Riddells Creek	Ritchies Creek	Salty Creek
Sandy Creek	Scotties Gully	Shepherds Hut Creek	Slaty Creek
Smokers Creek	Stockyard Creek	Todds Creek	Toolern Creek
Turitable Creek	Tysons Gully	Willimigongon Creek	

3. Flood risks

Macedon Ranges experiences both riverine flooding and flash flooding.

There are a large number of creeks within the Shire that are subject to flooding as well as the Campaspe and Coliban Rivers. Flooding affects rural areas along the creeks, many local and larger roads and a number of the urban areas. Many of the roads affected result in isolation and transport disruption, details of which are listed later in this document.

The major flood risks within the Shire are associated with:

- Deep Creek at Lancefield, Romsey and Darraweit Guim
- Jacksons Creek and Howey Creek at Gisborne
- High flows in the many smaller tributaries to the Maribyrnong River on the southern slopes of the Ranges
- Five Mile Creek at Woodend although the risk to houses has been reduced due to a levee
- Coliban River at Malmsbury
- Campaspe River at Kyneton
- Local runoff and stormwater flooding within Gisborne and the Shire's other larger towns although the many grassed swales in Romsey assist in reducing stormwater flooding issues in the town
- Aging and capacity constrained infrastructure and limited overland flow paths within the older urban areas leading to flooding of some properties, some over-floor
- Urban encroachment in areas that have not been identified as floodplains or subject to flooding.

A number of the urban areas have been the subject of flood and related studies. Most of these studies have delivered flood inundation and extent maps. Available maps are available from Macedon Ranges Shire.

4. Riverine flooding

Prolonged moderate to heavy rain often leads to riverine flooding within the municipality. Generally, a wet catchment and a period of heavy rain are required to produce severe flooding.

The more severe riverine floods within the municipality generally occur as a result of:

- Moist warm airflow from northern or north western Australia (perhaps from a decaying tropical cyclone) bringing moderate to heavy rainfall over a period of 12 hours or more following a period of general rainfall. The period of general rainfall “wets up” the catchments and (partially) fills both the on-stream dams and the natural floodplain storage. These combine to increase the runoff generated during the subsequent period of heavy rainfall.
- Successive cold fronts, often during winter and spring, that bring periods of rain that wet up the catchments and prime them for flooding from a further front or complex low pressure system that is perhaps slow moving and brings moderate to heavy rainfall.
- A low pressure system with a good moisture feed stalled or moving slowly over southern Victoria or slightly to the south (i.e. directing moisture over the Maribyrnong and associated catchments) as a result of a (complex) blocking pattern to the east.

5. Flash flooding, overland flows and stormwater flooding

Short duration, high intensity rainfall (usually associated with severe thunderstorms or small scale weather systems that are locally intense and slow moving) can cause flash flooding. Such events, which are mainly confined to the summer months, do not generally create widespread flooding since they only last for a short time and affect limited areas. Flooding from these storms occurs with little warning.

As a general rule, high intensity rainfall such as associated with thunderstorms giving average rainfall rates of typically more than about 40 mm/hour for 30 minutes or so (i.e. 20mm or so in 30 minutes) is likely to lead to high flows in local creeks and / or along overland flow paths, even on a dry catchment. Flooding is also likely in urban areas as the capacity of the stormwater drainage system is likely to be exceeded.

Blocked or capacity impaired stormwater drains can also lead to overland flows and associated flooding: the drains surcharge and excess water flows above ground.

On a wet catchment, this amount of rain would be likely to cause higher flows within the larger creeks or rivers but unlikely to result in any flooding. The depth, extent and duration of the higher flows would be determined by the volume of rain and the period over which it fell.

6. Dam failure flood risk

All dams have a risk of failure. All major dams are subject to rigorous dam safety management programs implemented by the managing entity and are the subject of individual Dam Safety Emergency Plans (DSEP).

DSEPs identify possible dam failure scenarios and provide direction on the order and detail of the necessary communications and incident management tasks to be initiated. They also refer to intelligence and maximum inundation extent mapping arising from detailed dam break analyses. Intelligence can include travel times to key locations, maximum depths and velocities and the time to reach those maxima at those key locations, as well as other information that would inform the response effort. Close communication with the dam manager is essential in the event of a dam safety incident.

7. Major water storages

Notable reservoirs within the municipality include Rosslynne Reservoir, just upstream of Gisborne, and Upper Coliban, Lauriston and Malmsbury Reservoirs on the Coliban River near Malmsbury. Several smaller reservoirs exist in the headwaters of Riddells Creek, on the southern slopes of Mount Macedon.

Dam	Responsible authority	Full Supply Level (mAHD)	Dam Capacity (ML)	Comments
Rosslynne Reservoir	SRW	450.90	25,368	Fixed crest spillway
Upper Coliban Reservoir	Coliban Water	505.56	37,800	Fixed crest spillway
Lauriston Reservoir	Coliban Water	479.50	19,800	Weir gates
Malmsbury Reservoir	Coliban Water	447.80	11,800	Fixed crest spillway

Other reservoirs include:

Firth Dam
Willimigongon Reservoir
Pierce Reservoir
Lancefield Number One Reservoir
Lancefield Number Two Reservoir
Trentham Number One Reservoir
Trentham Number Two Reservoir
Fernhill Number One Reservoir (Tylden Reservoir)
Fernhill Number Two Reservoir
Kitty English Reservoir
Mcdonalds Reservoir
Sanatorium Lake
Frank Mann Reservoir
Romsey Reservoir

8. Health and environmental risks

There are many septic tanks within the Shire that may be inundated by floodwaters. Further, chemicals and fuel may be stored in farm sheds and tanks on floodplains.

9. Properties at risk

Information on property floor levels and the likelihood of over-floor flooding is available for Gisborne (Water Technology, 2006) and Woodend (Cardno, 2022).

	Number of properties flooded over-floor				
Location / Catchment	1% AEP	2% AEP	5% AEP	10% AEP	20% AEP
Gisborne	20	4	2	-	0
Woodend	131	88	52	14	14
Tylden	2	2	2	2	2
Lauriston	3	2	2	0	0
Malmsbury	2	2	2	2	0
Kyneton	14	6	3	2	2

In addition, overland flows and flash flooding can affect localised areas for short durations.

This may include some over-floor flooding. There are no caravan parks within Macedon Ranges known to be at risk of being flooded during a 1% AEP event.

10. Infrastructure at risk

Major infrastructure within Macedon Ranges includes major highways and the Melbourne to Bendigo rail line.

10.1 Major roads

Dependant on flood magnitude the following roads may be inundated. Many minor roads may also be inundated. Some of these are mentioned in the list of flooding hot spots.

- Kilmore - Lancefield Road - flooded by Deep Creek
- Lancefield - Tooborac Road - flooded by Deep Creek
- Kilmore Road at the bridge over Jacksons Creek in Gisborne
- Gisborne – Kilmore Road either side of the bridge over Jacksons Creek in Gisborne
- Baynton Road at the ford over Deep Creek in Lancefield
- High Street over File Mile Creek at Woodend
- Romsey Road over Five Mile Creek at Woodend
- Calder Highway/Mollison Street over the Coliban River at Malmsbury
- Tylden – Woodend Road over Little Coliban River at Tylden

Note that while West Goldie Road outside Lancefield would not be classified as a major road, its closure due to periodic flooding does create major issues for residents (they become isolated) as it is the sole access road for several properties east of Deep Creek.

10.2 Other infrastructure

- Fulton Hogan Tylden Quarry may become inundated at a 20% AEP event.
- The Gisborne Recycled Water Plant (wastewater treatment) is unlikely to be flooded.

There are no other water treatment plans, mobile towers, sewer pump stations, electrical infrastructure or community facilities that are known to be subject to inundation.

11. Flooding hotspots

Below is a list of flood hotspots as identified in a workshop run by SKM with the Shire and related agencies on 13 December 2012, with further locations added based on results of hydraulic modelling from the draft Woodend Flood Study (Cardno, 2022).

Gisborne

- Wyralla Crescent in South Gisborne experiences high flows and floods houses on the south side of the road. Flows enter a series of detention basins that starts here. Road overtops if grates are blocked (common).
- The open drain near Wyralla Crescent in South Gisborne (behind properties in Collis Court and Kennington Rise) is not large enough to cope with flow. Kennington Rise floods and downstream roads flood to more than a 1m deep.
- A dam was filled in when Fowler Court in South Gisborne was developed during the 1980s. Results in flooding where previously there was none. Swale conveys low flow otherwise road and land floods.
- Flooding occurs on the upstream side of the Howey Street road embankment.
- Howey Creek flows under Jonathan Road through 1.80m diameter culvert. These drown out and the road acts as a retention system. Houses are affected upstream and downstream of the crossing. Residents have constructed levees as garden beds to divert flows.
- Debris build-up in the bluestone lined creek channel between Howey Street and Melbourne Road and at the Melbourne Road Bridge can lead to flooding of adjacent properties.
- Approximately 17 units are being built near confluence of the Howey Creek branches (Fersfield Road?) - potential for inundation

- Properties inundated in Fisher Street next to the Howey Creek crossing.
- High flows in Jacksons Creek near Robertsons Road and Aitken Street causes above-floor flooding in the CBD area.
- The Nexus Centre basement floods.
- The Kilmore Road floods either side of the Kilmore Road Bridge at Jacksons Creek in Gisborne.
- Willowbank Road development, - increasing development prone to flash flooding.
- The major picnic spot in town.
- Emergency services are in areas subject to flooding.

Woodend

- Rear of the properties between Patricia Way and Washington Lane.
- Flooding occurring at Urquhart Street, downstream of the Quarry Road Detention Basin.
- Flooding along Five Mile Creek impacting the Lawn Bowls Club, the Football Oval and lower parts of the Woodend Primary School Oval.
- Roxanne Court conveys flow from the railway area. Floods houses and sits at the intersection with Sullivans Road.
- Flooding south of South Road and on Quarry Road.
- Woodend Main drain through town floods shops and surrounding land.
- Washington Lane Drain in Woodend – causes localised flooding.
- Tylden - Woodend Road inundated at the Axle Creek bridge.

Riddells Creek

- Filmer Place floods at the bottom of the court. Can isolate properties for up to 8 hours. New developments have changed flow paths and capacities around this area.
- Developments along Bolithos Road are quite new. Road has a large upstream catchment (from Mount Charlie) and is frequently inundated.
- Flooding occurs near the intersection of Bolithos Road and Main Road.
- Railway acts as a dam wall to Riddells Creek and tributaries near the intersection of Riddells Road and the Gisborne - Kilmore Road.
- There are high flows in Gap Road. Driveways and culverts frequently washed away due to high velocity water.
- The easement from Argent Court to Wurrundjeri Creek overflows and floods land and one house.
- Properties are isolated when Barringo Road or Govans Lane is flooded by Barringo Creek.
- Rangeview estate.

Romsey

- The drain running parallel to Ewing Drive often floods Kathryn Street and areas downstream.
- Floods near the supermarket and shops but does not inundate the road where the creek crosses (due to lack of capacity in the stormwater drainage system).
- Sheehans Road is potentially cut off for a long time when it floods.

Lancefield

- The Baynton Road ford over Deep Creek frequently floods and is impassable.

- West Goldie Road and the Kilmore - Lancefield Road can flood simultaneously, which isolates properties to the north. These are the only roads servicing that area. In January 2011, some over-floor flooding occurred along West Goldie Road.

Darraweit Guim

- Darraweit Guim school impacted regularly.

Carlsruhe

- Three Chain Road floods at Twin Bridges - road is inundated / cut in several places causing disruption to traffic. Multiple closures in January 2011.

Macedon

- The Macedon train station floods and water dams behind the railway line.
- Properties are isolated when Mount Macedon Road or Waterfall Road is inundated.
- Tony Clarke Recreation Reserve floods.

Hanging Rock

- Over road flooding - Straws Lane.

Kyneton

- Kyneton Racecourse inundated frequently.
- Hall Court properties likely impacted by flooding from Post Office Creek.

Tylden

- Flooding from Little Coliban River may flow into Fulton Hogan Tylden Quarry.

12. Flood inundation mapping

A series of flood inundation maps has been produced for Gisborne, Kyneton, Tylden, Lauriston and Malmsbury. A subset of these maps is included in this at Appendix D.

Coarse flood extent maps were developed for parts of the Municipality in 2000 as part of a state-wide Flood Data Transfer Project (FDTP) (DNRE, 2000). Although some of this flood extent mapping has a low level of accuracy, the maps can be a useful guide to highlight areas subject to flooding where detailed mapping is not yet available. The associated reports provide guidance on likely accuracies and associated confidence in delineations.

13. Historic floods

Floods occurred within the Shire in February 1951, November 1971, May 1974, August 1978, October 1983, October 1985, December 1987, June 1989, November 1992, September 1993, October 2000, September 2010, January 2011 and October 2022. Regarding the frequency of floods, the Macedon Ranges MEMP (2012) states: “Various areas and townships are subject to flooding from time to time. Flooding is generally confined to local areas with potential threat to homes.”

21 November 1992

The Washington Lane Drain catchment in Woodend experienced significant flooding. Five Mile Creek also flooded. Many areas of the town, notably the Campaspe Drive area, Duffy Street / Anslow Street “Housing Commission” houses, the High Street supermarket, properties and at least one house in Timber and Booth Lanes and the Macedon – Woodend Rd (closed) were impacted.

14 and 15 September 1993

The September 1993 flood inundated parts of the Jacksons Creek floodplain upstream of the Aitken Street Bridge, threatened the main business precinct, overtopped Aitken Street and flooded a number of houses over-floor within Beech Court and the adjacent Skyline Park Estate.

Five Mile Creek at Woodend also flooded. Many areas of the town, notably the Campaspe Drive area, Duffy Street / Anslow Street “Housing Commission” houses, the High Street supermarket, properties and at least one house in Timber and Booth Lanes and the Macedon – Woodend Rd (closed) were impacted.

23 to 25 October 2000

In October 2000, heavy rain was recorded around Trentham, following a wet start to spring. Reservoirs along the Coliban River were quickly filled, with a 1.5% AEP (60-year ARI) flood recorded at Mannings Bridge, just upstream of the Upper Coliban Reservoir. The flood was assessed as a 6.67% AEP (15-year ARI) event at Malmsbury. The main road and shops in Malmsbury were flooded, as were a series of roads in Woodend.

January 2011

Significant widespread rainfall affected the majority of the State in January 2011, the wettest January on record. The event was significant enough for the Bureau of Meteorology to publish Special Climate Statement 26 to describe the synoptic conditions associated with the event. In summary, the extreme rainfall recorded was generated by the passing of complex and persistent low-pressure systems.

A broad slow-moving trough centred over western Victoria and a ridge of high pressure to the south of Tasmania were the main drivers for the rainfall that started to fall on 9th January. The two systems created exceptionally humid conditions and an unstable easterly flow across Victoria. The trough strengthened on the 12th and developed into a low-pressure system over eastern South Australia on the 14th as a high-pressure system moved into the Tasman Sea. The low-pressure system cleared the State on the 14th after adding an additional 50 to 100mm to the deluge already received.

The rain caused flash flooding across the Shire, and more than 230mm of rainfall was recorded in some areas. Roads were closed or damaged in Kyneton, Woodend, Riddells Creek, Romsey, Lancefield and Carlsruhe, and power was lost in towns including Gisborne. Gravel roads, footpaths and driveways were washed away, causing traffic and access impacts, and the damage to culverts and crossings caused closures and emergency works.

Rising creek levels in Woodend flooded roads and properties including the Woodend Bowls Club, Swimming Pool, Football Ground and near the Primary School. In addition, severe flooding of the Campaspe River affected Kyneton while the Coliban River caused floods in Malmsbury.

January 2022

In the early morning on 27 January 2022, heavy rainfall was recorded at Malmsbury, Kyneton and Gisborne. The Melbourne Water rainfall gauge at Rosslynne Reservoir recorded 55mm rainfall between 6am and 7am. This rainfall event is in the magnitude of 0.2% AEP. Many local roads and several buildings were subject to inundation during this rainfall event, including buildings at 11 Prince Street and 25 Hamilton Street and the following roads:

- Hamilton Street
- Farrell Street
- Farrell Street and Station Street intersection
- Station Road
- Services Road between Farrell Road and Colwyn Court
- Prince Street
- Brantome Street.

14. Flood mitigation

A levee has been constructed at Campaspe Drive and Pyke Street in Woodend. It provides 1% AEP protection to nearby houses. A gauge has also been installed on Five Mile Creek at Campaspe Drive. The gauge alerts the Shire at pre-set levels to assist management of the levee system (starting of pumps) and the evacuation of recreational areas.

There are no other structural flood mitigation measures on streams within the Shire.

Mitigation measures were proposed as part of the Gisborne Flood Study (Water Technology, 2006); none have been implemented to date.

15. Digital flood extent datasets and flood photography

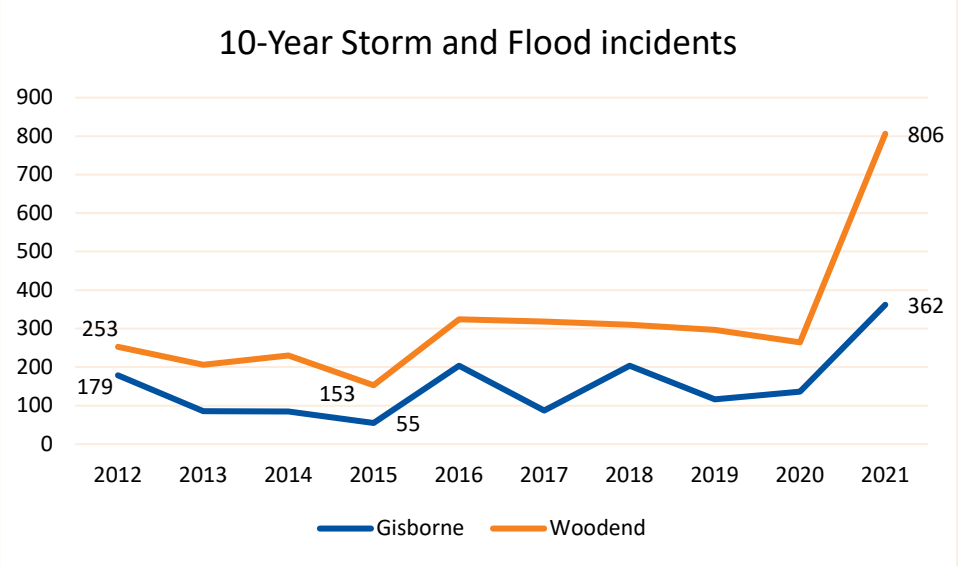
Melbourne Water maintains a quantity of flood related data in GIS format. NCCMA, Melbourne Water, Western Water and the Shire hold a variety of other datasets that include:

- Contour and survey information, including LiDAR data
- Drainage and road infrastructure data
- Sewer and related plans
- Digital cadastral information.

Appendix A2: Severe weather (storm) events

Storms are a serious threat to life and property in Macedon Ranges and have been known to occur at any time of the year. Recent events have impacted large segments of the municipality and taken significant time to reinstate. Typically, the damage will be in the form of fallen trees or tree branches and damage to residential/commercial roof structures and infrastructure.

Macedon Ranges have on average **511** storm and/or flood related incidents per year. (Source: average VICSES requests for assistance for Gisborne and Woodend Units from 2011/12 to 2021/22).



1. Large storm events

June 2021

On 9 and 10 June 2021, a severe storm caused widespread destruction across Macedon Ranges. Thousands of residents, and hundreds of houses, fences, outbuildings and sheds were impacted. Extensive tree falls occurred, resulting in closures to roads and public spaces such as parks.

This event closed many roads across the Shire, caused prolonged power and telecommunications outages, destroyed at least two homes and damaged numerous other homes and outbuildings including sheds.

Whole streets were cut off due to large trees over roads and many were isolated without phone reception.

In the days immediately after the storm, people were trapped on their properties without power or mobile coverage for days or weeks, and hundreds of trees down across roads in the shire cut off people's ability to move about as they usually would. Over 1,400 residents registered with Council as having experienced some form of damage from the June storm.

Some of the broader consequences include Ambulance Victoria having to relocate two stations and the potential loss of a key communications tower on Mount Macedon.

The cost associated with clean-up and restoration of roads will be more than $15 million and doesn't include the clearing of fire access tracks.

Appendix B1: Gisborne community flood emergency plan

The township of Gisborne, located approximately 50km northwest of Melbourne, sits on the floodplain of Jacksons Creek and straddles the significant urban and rural drainage line of Howey Creek. The town is also encroaching on the catchment of the un-named creek that passes through the golf course to the west of Aitken Street.

Gisborne comprises a variety of land uses ranging from residential with complementary commercial sector that includes a shopping centre through to light industrial. The town's main business precinct lies a little to the south of the creek. A number of buildings including the Police Station, Ambulance Station, SES Depot and Western Region Water Authority's office are located adjacent to the creek.

The town has been subject to flooding on a number of occasions resulting in inundation, road closures and other flood risks to the community.

Jacksons Creek is part of the upper Maribyrnong catchment. The area of the Jacksons Creek catchment to the Calder Highway is approximately 112km^2. Major tributaries include Salt Water Creek, Slaty Creek, Bullengarook Creek and Howey Creek. A key feature of the Jacksons Creek catchment is Rosslynne Reservoir, located around 2km upstream of Gisborne. The reservoir has a catchment area of 90km^2, a storage capacity of 25,368ML at full supply level (EL 450.90mAHD) and a dam wall height of 37.9m. The capacity of valves used to control the release of water from the dam is small relative to expected flood flows. The spillway has a fixed crest (there are no gates) and thus there is no opportunity to control flows from the dam once it reaches full supply level. The dam does not therefore provide any formal flood mitigation function.

The catchment upstream of the reservoir is largely rural with small pockets of residential land use.

The valley downstream of the dam is around 300-500m wide. The northern side of the floodplain is relatively steep with numerous rocky outcrops and minimal vegetation. Slopes on the southern side are much gentler. A number of small tributary creeks emanate from the south between the dam and Gisborne.

The Howey Creek catchment has an area of 4.5km^2. The mid to upper parts of the catchment are rural and reasonably flat. The creek descends steeply through residential areas of Gisborne to meet Jacksons Creek between the two main road bridges in Gisborne: at Aitken Street and at Kilmore Road. The lower reaches of the creek channel are bluestone lined.

There is significant and continuing pressure for further development in and around Gisborne particularly within the Jacksons Creek floodplain and particularly along the lower reaches of Howey Creek. Examples in the area immediately upstream of the Aitken Street Bridge include the Skyline Park Estate on the left (northern) bank of the creek and a variety of commercial and related developments on the right (southern) bank.

1. Flood behaviour

Jacksons Creek at Gisborne has a history of flooding with floods recorded on 18 February 1951 and on 7 November 1971, in August 1978, October 1983 and October 1985, on 2 December 1987 and most recently in September 1993.

The 1951 event was large, overtopping Aitken Street (the Calder Highway at the time) and the Aitken Street Bridge.

In November 1971, another large flood inundated the Jacksons Creek floodplain. Similar to the 1951 event, it overtopped Aitken Street on both sides of the, by then, higher bridge. A single flood level 413.33mAHD in the old factory on the site between Aitken, Brantome and Robertson Streets) appears in DEPI records.

The largest flood, post-Rosslynne Reservoir, occurred in October 1985. This was a smaller flood than in 1971 but still resulted in substantial flooding of the Jacksons Creek floodplain.

The September 1993 flood has been assessed as being somewhere between a 10% and 5% AEP event. It inundated parts of the Jacksons Creek floodplain upstream of the Aitken Street Bridge, threatened the main business precinct, overtopped Aitken Street and flooded a number of houses over-floor within Beech Court and the adjacent Skyline Park Estate.

A number of flood levels from these events have been captured to the VFD datasets.

Hydraulic modelling (Water Technology, 2006) has shown that Jacksons Creek through Gisborne has limited flow capacity. Development on the floodplain in Gisborne, the Beech Court area and in sections of Howey Creek will be subject to significant inundation from around the 5% AEP event.

Beech Court is in a very low-lying area of the floodplain with a small catchment to the north. It is located on the fringe of the Skyline Park Estate, adjacent to the north bank of Jacksons Creek, to the west of the Gisborne - Kilmore Road (Station Road) and upstream of the Aitken Street Bridge. It is inundated very early in a large storm event due to the runoff from the local catchment and poor drainage.

The Aitken Street Bridge acts as a hydraulic control point, restricting flow downstream and increasing water levels upstream. During a flood event, debris can build up against the bridge further reducing its capacity.

Rosslynne Reservoir is the primary control to flood flows onto the Gisborne floodplain: 80% of the catchment area passes through the reservoir. It does attenuate and delay flows in Jacksons Creek and has a significant effect on likely flooding at Gisborne. The storage level at the start of an event is key as to whether Gisborne will be flooded. For example, if the storage is at or near FSL at the start of a significant rain event, the time to peak at Gisborne can be as short as 10 to 12 hours. With the storage well down from FSL at the start of an event that causes the reservoir to fill and spill, the time from the start of rainfall to flood peak at Gisborne has ranged from around 28 to 40 hours or so. If the reservoir was near empty at the beginning of an event, there would be significant if not complete attenuation of a flood and very little if any outflow.

During the 1% AEP event, 7 residential and 13 commercial properties are inundated above floor level, with 163 residential and commercial properties flooded below floor level (Water Technology, 2006).

The Howey Creek crossing at Howey Street significantly influences flood behaviour downstream. The culverts beneath Howey Street have limited capacity, which corresponds to that of the bluestone channel passing under Melbourne Road. Accordingly, there is limited flooding in the downstream areas of Howey Creek during a 1% AEP event although between Howey Street and Melbourne Road the capacity of the bluestone channel and that of the Melbourne Road Bridge can be significantly reduced by debris build-up. This can lead to flooding of adjacent properties. Due to the limited capacity of the culverts at Howey Street, upstream water levels can get very deep (up to 6m deep in a 1% AEP event) and cause inundation. Moreover, the volume of water trapped behind Howey Street is a significant concern, as it is unlikely that the road embankment was designed and constructed to act as a dam wall. If the road embankment did fail there would be very little (if any) warning time and the consequences downstream would be devastating.

Under 5% AEP flood conditions

- Water up to 0.5m deep:
    - is in Beech Court and on the south side of Frith Road
    - is on the north side of Robertson Street
    - is on both sides of Robertson Street from Prince Street to Aitken Street
    - extends around 30m up Prince Street and Brantome Street
    - is over Aitken Street on the town (south) side of the bridge
    - is over Kilmore Road on the south side of the bridge.

- Water in Howey Creek more than 2m deep is backed-up behind Fisher Street and Howey Street and Curtis Court.
- There are 80 properties flooded, 2 over-floor.

Under 2% AEP flood conditions

- Water up to 0.5m deep:
    - is in Beech Court, Frith Road and Ash Close and pushing into Acacia Court
    - extends across Robertson Street from Neil Street
    - extends around 80m up Prince Street and Brantome Street
    - extends around 100m along the west (upstream) side of Aitken Street
    - is in properties from Goode Street to Aitken Street
    - is over Aitken Street on both sides of bridge.
- Water is up to 2m deep over Kilmore Road on the south side of the bridge.
- Water in Howey Creek more than 2m deep is backed-up behind Fisher Street and Howey Street and Curtis Court.
- There are 133 properties flooded, 4 over-floor.

Under 1% AEP flood conditions

- Water is up to 1m deep in Beech Court and Frith Road.
- Water up to 0.5m deep:
    - is in properties in Beech Court, Frith Road, Ash Close and Acacia Court
    - is across Robertson Street from Neil Street
    - at the corner of Goode Street and Robertson Street
    - extends around 80m up Prince Street
    - extends up Brantome Street to Hamilton Street
    - extends around 150m along the west (upstream) side of Aitken Street
    - is in properties from Goode Street to Aitken Street
    - is over Aitken Street on both sides of bridge.
- Water is up to 1m deep at corner of Robertson and Aitken Streets.
- Water is up to 2m deep over Kilmore Road for around 50m on the south side of the bridge.
- Water in Howey Creek is backed-up behind Fisher Street and Howey Street and Curtis Court. It is up to 6m deep upstream of Howey Street.
- There are 183 properties flooded, 20 over-floor.

Under 0.2% AEP flood conditions

- Water is up to 2m deep in Beech Court and Frith Road.
- Water up to 1m deep:
    - is in properties in Beech Court, Frith Road, Ash Close and Acacia Court
    - is across Robertson Street from Neil Street
    - extends around 50m up Prince Street
    - extends around 150m along the west (upstream) side of Aitken Street

- is in properties from Goode Street to Aitken Street - see map and list
- Water is up to 2m deep near the corner of Robertson and Aitken Streets.
- Water up to 0.5m deep:
  - extends for around ~30m along Prince Street near Hamilton Street
  - extends up most of Brantome Street to Hamilton Street.
- Aitken Street is flooded from Hamilton Street to the north side of the bridge with water up to 2m in places.
- Kilmore Road Bridge is drowned and water more than 2m deep extends for around 200m.
- Water is backing-up the bottom end of Howey Creek towards Fisher Street - properties affected.
- Water in Howey Creek is backed-up behind Fisher Street and Howey Street and Curtis Court. It is very deep (overtopped?) at Howey Street.
- There is a further increase in the number of properties flooded above ground and over-floor.

Jacksons Creek – Typical flood peak travel times			
Location from	**Location to**	**Typical travel time**	**Comments**
Start of rainfall	Gisborne	10 to 12 hours	Rosslynne Reservoir near FSL before rain
	Gisborne	28 to 40 hours	Rosslynne Reservoir not at FSL and spills
Rosslynne Reservoir	Gisborne	0.5 hours	

Design flood levels for Jacksons Creek (Water Technology, 2006)			
Design flood event AEP (%)	**Rosslynne Reservoir Head Gauge (mAHD) (Melbourne Water)**	**Flood level Upstream side of road bridge (mAHD)**	
		Aitken Street	**Kilmore Road**
10%	451.81		
5%	452.01	413.32	411.81
2%	452.26	413.65	412.24
1%	452.44	413.86	412.71
0.2%		414.33	413.72
PMF		418.67	418.54

Design flood levels for Howey Creek (Water Technology, 2006)				
Design flood event AEP (%)	**Flood level Upstream side of road (m AHD)**			
	Melbourne Road	**Fisher Street**	**Howey Street**	**Curtis Court**
5%	412.27	415.93	420.76	424.14
2%	412.32	415.98	421.87	424.27
1%	412.37	416.04	422.68	424.40
0.2%	413.75	416.26	423.35	424.62
PMF	418.58	418.98	426.13	426.82

***Note** that in the event of a flood and the absence of any staff gauges at the above locations, the above levels could be used with a locally installed PALS (or similar) and the inundation maps to drive local flood response. This would enable maximum value to be extracted from the intelligence contained in this Plan.*

Design flood flows for Jacksons Creek				
Location	Design peak flow (m3/s)			
	5% AEP	2% AEP	1% AEP	0.2% AEP
Jacksons Creek d/s Rosslynne Reservoir	151	201	251	379
Jacksons Creek at Calder Freeway	167	229	293	439

Design flood levels for Howey Creek				
Location	Design peak flow (m3/s)			
	5% AEP	2% AEP	1% AEP	0.2% AEP
Howey Ck at confluence with Jacksons Ck	18.5	23.1	26.9	36.9

***Note** that modelling assumes Rosslynne Reservoir is full at event start. This is conservative. If the reservoir was near empty at event start, there would be significant attenuation of the flood and very little if any outflow. All modelling also assumes that the Howey Creek catchment is "fully developed".*

2. Overview of flooding consequences

2.1 Warning times

The flood warning time for Gisborne ranges from around 8 to more than 36 hours, depending on how full Rosslynne Reservoir is at the start of the event.

The approximate time between start of rain and flooding in Gisborne is:

- 10 -12 hours if Rosslynne Reservoir is at or near FSL, and
- 28 - 40 hours if there is significant airspace in Rosslynne Reservoir.

The flood travel time from the reservoir to Gisborne is approximately 30 minutes.

2.2 Areas affected

The first residential area affected by Jacksons Creek within Gisborne is Beech Court in the Skyline Park Estate. Water begins to encroach on the area from about the moderate level (ie. 51.75m at Rosslynne Reservoir head gauge). The maps at Appendix D provide further guidance on where flooding is likely to occur within Gisborne for flood events ranging from the 5% AEP event up to the 0.2% AEP event on both Jacksons Creek and Howey Creek.

Jacksons Creek Reserve and Sankey Reserve footbridges

The footbridges at Jacksons Creek Reserve and Sankey Reserve were replaced in 2022. Both footbridges were unable to be constructed at or above the 1% AEP flood level due to their location. With both Aitken Street and Kilmore Road estimated to be overtopped from the 10% AEP event, there is potentially no pedestrian access across Jacksons Creek in times of flooding. The only other nearby crossing of Jacksons Creek is the Calder Freeway.

2.3 Roads affected

The Gisborne - Kilmore Road (Aitken Street and Station Road) and Kilmore Road are worst affected in Gisborne. Robertson Street, Goode Street, Prince Street, Brantome Street, Frith Road, Beech Court, Ash Close, Acacia Court, Fisher Street and Howey Street are also affected to varying degrees depending on the magnitude of the flood.

Water first flows over Aitken Street and Kilmore Road from around the 10% AEP event.

2.4 Properties affected

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor is provided in Section 7.3 of this Appendix.

Detailed list

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground flooding and the likely depth of over-floor inundation is provided in Section 7.4 of this Appendix. It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix D) and the indicative flood guidance tool provided in Section 7.5.

Update of list of properties likely to be flooded

The list of properties likely to be flooded (with corresponding levels and indication of over-floor flood depth) should be updated within twelve (12) weeks of a flood. Update should occur with information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief. Information on the collective experience of the IMT should also be gathered and utilised.

2.5 Isolation

Gisborne is not likely to be isolated by flooding but the town is effectively cut in half from around the 10% AEP event.

2.6 Critical infrastructure

There is no known critical infrastructure affected by flooding in Gisborne.

2.7 Kilmore Road intersection upgrade in Gisborne

In 2022, the Department of Transport and Planning (DTP) conducted road works as part of the Melbourne Road, Hamilton Street and Kilmore Road intersection upgrade in Gisborne. The area is subject to flooding from both Bunjil Creek (also referred to as the South Gisborne Drain) and Jacksons Creek.

DTP's preliminary design was a new bridge at Bunjil Creek that crossed over the old bridge and maintained some aesthetic elements of the old bridge. The proposed road crest of the preliminary design at the bridge crossing and the approach roads was higher than corresponding existing road levels and it was found to cause significant and unacceptable increases to flood levels at nearby private properties.

Following consultation with Council and Melbourne Water, DPT revised the design and the upgrade consists of a new roundabout and the replacement of the existing Bunjil Creek bridge crossing with a box culvert structure to ensure road levels were maintained similar to existing road levels.

The following table displays the flood level afflux (difference) that results from the proposed road design, including the Bunjil Creek culvert upgrade, when compared to existing conditions and for all three scenarios assessed by Engeny Water Management (2021):

Location	Owner	Flood level afflux results
3 Hamilton Street and 2-6 Melbourne Road	Private	The improved conveyance of flows within the proposed Bunjil Creek culvert results in a flood level decrease of up to 30 mm upstream of the structure for the high Jacksons Creek tailwater level influence scenario.
1 Kilmore Road (Macedon House property immediately east of Melbourne Road)	DTP and Private	The design changes to the Melbourne Road surface elevation result in a flood depth increase of up to 13 mm from the existing conditions flood depth of approximately 200 mm. This increase is contained to the southwestern corner of the No. 1 Kilmore Road / Macedon House property in the High Tailwater Level scenario – noting that a majority of the flood level increases on the east of Melbourne Road are within the parcel understood to form part of the wider road reserve and not on the Macedon House property. The 13 mm flood level increase (marginally above Melbourne Water's model

		accuracy tolerance of 10 mm) does not impact the existing building / structure on the parcel. As described below (at location 3) there is also an overall reduction in flood levels to the property.
1 Kilmore Road (immediately south of proposed raised Kilmore Road section)	Private	Flood level decreases on the southern side of Kilmore Road (by up to 28 mm) in the high Jacksons Creek tailwater level influence scenario. Considering the marginal increase described above at Location 2, this still presents an overall reduction to the flood level for the Macedon House parcel.
6-8 Hamilton Street (Gisborne Library and carpark)	Council	Flood level decrease of up to 80 mm on the northern side of Hamilton Street extending into the existing Gisborne Library and Skate Park properties in the high Jacksons Creek tailwater level influence scenario.
2-4 Hamilton Street (Court House)	Council	Flood level increase of up to 22 mm on the grassed parkland between the creek and the Court House (contained to the south-eastern corner of the property) in the high Jacksons Creek tailwater level influence scenario. The existing conditions flood depth is approximately 200 – 400 mm within the property's area of flood depth increases. The Court House building is not impacted by a flood depth increase.
2 Kilmore Road (Bowls Club)	Council	Flood level increase of up to 100 mm on the northern side of the proposed raised Kilmore Road section in the high Jacksons Creek tailwater level influence scenario. The existing conditions flood depth is approximately 400 – 650 mm within the area impacted by flood depth increases.
2 Kilmore Road (near Recreation Reserve and skate park)	Council	Flood level increase of up to 20 mm in the high Jacksons Creek tailwater level influence scenario.
Downstream of Kilmore Road bridge within Jacksons Creek floodplain	Council and Private	No recorded changes to flood levels in the high Jacksons Creek tailwater level influence scenario.

Summary

Given the road levels were maintained similar to existing road levels with an increase to the conveyance of flows provided through the proposed new Bunjil Creek box culvert structure, the corresponding flood depth changes are limited to the following:

- Increases of up to 100mm in the high Jacksons Creek tailwater level scenario on Council-owned and managed recreation reserves and sports grounds.
- A reduction of up to 30mm in the high Jacksons Creek tailwater level scenario within private properties located immediately upstream of the Bunjil Creek crossing (Properties at 6 Hamilton Street and 2-6 Melbourne Road).

3. Flood mitigation

Note: Flood intelligence must have regard for changes within the catchment that modify likely flood behaviour (e.g. mitigation works that reduce the severity of flood risk).

Flood protection levees

There are no formal flood mitigation levees in place at Gisborne.

Drainage works and retarding basins

There are several small retarding basins within the Howey Creek catchment and along other creeks within Gisborne.

4. Flood impacts and required actions

Refer to the following Flood Intelligence Card. Note that users of the flood intelligence card could consider rainfall depth and rates at locations near Gisborne and use the indicative tool at Section 5.4 to better appreciate the likely severity of flooding and its impacts in the town. Local data and/or data from the BOM website (www.bom.gov.au) for Rosslynne Reservoir should be used.

5. Flood intelligence card, property inundation list and Flood / No Flood guidance tool

Melbourne Water in association with BOM provides flood forecasts for Gisborne in terms of minor, moderate and major flooding. It is difficult to immediately relate these warnings to the flood intelligence and inundation maps contained in this Plan. To assist that process, it is suggested that rainfall data from the Rosslynne Reservoir rain gauge (or other nearby rain gauges) is used with the indicative Flood / No Flood guidance tool provided at Section 5.4. Instructions for use of the tool are also provided in Section 5.4.

Note: While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intelligence detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences.

- All levels, impacts and actions listed in the following flood intelligence card and indicative Flood / No Flood guidance tool may need to be adjusted to better reflect experience.

3.1 Flood intelligence card

AEP of flood	Water level at Rosslynne Reservoir Head Gauge (m)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
In the event of flooding (say above 10% AEP level) consider deploying PALS units at key locations in Gisborne in order to facilitate better use of and to build on this Plan.			
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.			
FSL	50.90	Flow begins on primary spillway	▪
Minor flood level	51.40	Downstream level - 1.8m Calder Highway - 1.4m	▪ Monitor rainfall and water levels.
20% AEP	51.64	Flooding likely in Beech Court and Frith Road in the Skyline Park Estate.	▪ Continue to monitor rainfall and water levels. ▪ Advise Beech Court and Frith Road (Skyline Park Estate) residents.

AEP of flood	Water level at Rosslynne Reservoir Head Gauge (m)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
In the event of flooding (say above 10% AEP level) consider deploying PALS units at key locations in Gisborne in order to facilitate better use of and to build on this Plan.			
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.			
Moderate flood level	51.75	Flooding starting in Beech Court. Water likely to begin flowing over Aitken Street on the southern (town) side of the bridge and over Kilmore Road.	▪ Continue to monitor rainfall and water levels. ▪ Ensure Skyline Park Estate residents are informed of likely impacts. ▪ Secure necessary resourcing. ▪ Establish sectors in the knowledge that the town will soon be cut in half. ▪ Protect 2 x properties in Robertson Street from over-floor flooding.
10% AEP	51.81		▪ Continue to monitor rainfall and water levels. ▪ Deploy “water over road signs” and consider closing Aitken St & Kilmore Rd.
5% AEP	52.01	Water up to 0.5m deep: ▪ In Beech Court and on south side of Frith Road with a number of properties affected - see map & list. ▪ On north side of Robertson Street. ▪ On both sides of Robertson Street from Prince Street to Aitken Street. ▪ ~30m up Prince Street and Brantome Street. ▪ Over Aitken Street on town (south) side of bridge. ▪ Over Kilmore Road on south side of bridge Howey Creek backed-up behind Fisher & Howey Streets and Curtis Court. More than 2m deep. 80 properties flooded, 2 over-floor.	▪ Continue to monitor rainfall and water levels. ▪ Refer to indicated maps and impacts. ▪ Implement appropriate response actions and secure necessary resourcing. ▪ Deploy “water over road” and other signs. ▪ Close Aitken Street and Kilmore Road. ▪ If flood likely to be bigger than a 2% AEP event, identify and plan to operationalise evacuation centres and plan to evacuate identified properties.
Major flood level	52.1		
~2% AEP	52.26	Water up to 0.5m deep: ▪ In Beech Court, Frith Road and Ash Close pushing into Acacia Court with a number of properties affected - see map & list. ▪ Across Robertson Street from Neil Street. ▪ ~80m up Prince Street and Brantome Street. ▪ ~100m along the west (upstream) side of Aitken Street.	▪ Continue to monitor rainfall and water levels. ▪ Refer to indicated maps and impacts. ▪ Implement appropriate response actions and check resourcing. Actions may include protection of further properties from over-floor flooding and / or removal of household effects. ▪ Consider school situation and related transport.

AEP of flood	Water level at Rosslynne Reservoir Head Gauge (m)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
In the event of flooding (say above 10% AEP level) consider deploying PALS units at key locations in Gisborne in order to facilitate better use of and to build on this Plan.			
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.			
		▪ In properties from Goode Street to Aitken Street - see map & list. ▪ Over Aitken Street on both sides of bridge. Up to 2m deep over Kilmore Road on south side of bridge. Howey Creek backed-up behind Fisher & Howey Streets and Curtis Court. More than 2m deep. 133 properties flooded, 4 over-floor.	▪ If not already done, close Aitken Street and Kilmore Road. ▪ Review evacuation list. ▪ Continue to evacuate identified properties. ▪ Keep all but essential vehicles out of flooded areas. ▪ Record flood impacts and ensure this Plan is updated.
1% AEP	52.44	Water up to 1m deep in Beech Court and Frith Road. Water up to 0.5m deep: ▪ In properties in Beech Court, Frith Road, Ash Close and Acacia Court - see map & list. ▪ Across Robertson Street from Neil Street. ▪ At the corner of Goode Street and Robertson Street. ▪ ~80m up Prince Street ▪ Up Brantome Street to Hamilton Street. ▪ ~150m along the west (upstream) side of Aitken Street ▪ In properties from Goode Street to Aitken Street - see map & list. ▪ Over Aitken Street on both sides of bridge. Up to 1m deep at corner of Robertson and Aitken Streets. Up to 2m deep over Kilmore Road for ~50m on south side of bridge. Howey Creek backed-up behind Fisher & Howey Streets and Curtis Court. Up to 6m deep at Howey Street. 183 properties flooded, 20 over-floor.	▪ Continue to monitor rainfall and water levels. ▪ Refer to indicated maps and impacts. ▪ Continue to deliver appropriate response actions and monitor implementation of plans – evacuation, removal of furniture etc from buildings, sandbagging, etc. ▪ Keep all but essential vehicles out of flooded areas. ▪ Record flood impacts and ensure this Plan is updated.
0.2% AEP		Water up to 2m deep in Beech Court and Frith Road. Water up to 1m deep: ▪ In properties in Beech Court, Frith Road, Ash Close and Acacia Court - see map & list.	▪ Continue to monitor rainfall and water levels. ▪ Refer to indicated maps and impacts. ▪ Continue to deliver appropriate response actions. ▪ Continue to monitor implementation of plans – evacuation, sandbagging, etc.

AEP of flood	Water level at Rosslynne Reservoir Head Gauge (m)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
In the event of flooding (say above 10% AEP level) consider deploying PALS units at key locations in Gisborne in order to facilitate better use of and to build on this Plan.			
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.			
		▪ Across Robertson Street from Neil Street. ▪ ~50m up Prince Street ▪ ~150m along the west (upstream) side of Aitken Street ▪ In properties from Goode Street to Aitken Street - see map & list. Up to 2m deep near corner of Robertson and Aitken Streets. Water up to 0.5m deep: ▪ For ~30m along Prince Street near Hamilton Street. ▪ Up most of Brantome Street to Hamilton Street. Aitken Street flooded from Hamilton Street to north side of bridge with water up to 2m in places. Kilmore Road Bridge drowned and water more than 2m deep for ~200m. Water backed-up bottom end of Howey Creek towards Fisher Street - properties affected. Howey Creek backed-up behind Fisher & Howey Streets and Curtis Court. Very deep (overtopped?) at Howey Street. Increase in number of properties flooded, above-ground and over-floor.	▪ Keep all but essential vehicles out of town. ▪ Record flood impacts and ensure this Plan is updated.

3.2 Summary of properties flooded

Summary of number of flood affected properties in Gisborne – EXISTING CONDITIONS (Water Technology, 2006)						
	Design Flood AEP (%)					
	20%	10%	5%	2%	1%	0.5%
Level at Rosslynne Reservoir Head Gauge (m)	**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
Number of properties flooded above floor	0		2	4	20	
Number of properties flooded below floor only	0		78	129	163	
Total number of flooded properties	**0**		**80**	**133**	**183**	

3.3 Detailed list of properties flooded

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
1 Acacia Court					0.06							
2 Acacia Court					0.06							
3 Acacia Court					0.09							
4 Acacia Court					0.10							
5 Acacia Court					0.05							
16 Acacia Court					0.11							
17 Acacia Court					0.19							
Aitken Street				0.06	0.11							
Aitken Street				0.04	0.15							
Aitken Street				0.04	0.15							
Aitken Street				0.01	0.05							
Aitken Street			0.39	0.49	0.89							
8 Aitken Street			0.17	0.34	0.49							
10 Aitken Street			0.27	0.42	0.54							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
10 Aitken Street			0.22	0.30	0.38							
22 Aitken Street			0.20	0.26	0.28							
26 Aitken Street				0.03	0.08							
26 Aitken Street				0.09	0.13							
26 Aitken Street				0.08	0.11							
28 Aitken Street				0.08	0.14							
28 Aitken Street				0.10	0.18						0.12	
32 Aitken Street				0.09	0.19							
34 Aitken Street				0.04	0.10						0.10	
35 Aitken Street			0.16	0.32	0.61							
36 Aitken Street				0.02	0.05							
38 Aitken Street					0.01							
39 Aitken Street					0.14							
65 Aitken Street			0.35	0.39	0.42							
67 Aitken Street			0.02	0.08	0.05							
69 Aitken Street			0.05	0.09	0.13							
71 Aitken Street					0.04							
81 Aitken Street			0.38	1.02	1.49							
83 Aitken Street			0.35	0.91	1.34							
85 Aitken Street			1.27	2.06	2.59							
89 Aitken Street			1.47	1.85	2.33							
93 Aitken Street			1.55	2.12	2.06							
97 Aitken Street			1.51	2.06	2.44							
99 Aitken Street			1.09	1.61	2.03							
109 Aitken Street			1.55	1.72	1.80							
1 Ash Close				0.02	0.21							
2 Ash Close				0.06	0.17							
3 Ash Close				0.06	0.18							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
4 Ash Close				0.06	0.20							
Bacchus March Rd			0.41	0.43	0.46							
5 Banksia Grove					0.08							
6 Banksia Grove					0.05							
6 Banksia Grove				0.04	0.16							
4 Beattie Court			0.43	0.64	0.69							
5 Beattie Court			0.41	0.54	0.59							
1 Beech Court				0.02	0.10							
2 Beech Court			0.03	0.07	0.15							
3 Beech Court			0.08	0.19	0.37						0.14	
4 Beech Court			0.11	0.23	0.42							
5 Beech Court			0.10	0.34	0.53							
6 Beech Court			0.14	0.38	0.57							
7 Beech Court			0.09	0.30	0.49							
8 Beech Court			0.07	0.21	0.40							
Brantome Street					0.06							
16 Brantome Street			0.15	0.26	0.37							
22 Brantome Street					0.13							
22 Brantome Street					0.06							
22 Brantome Street				0.06	0.20							
1/22 Brantome St			0.04	0.09	0.18							
2/22 Brantome St				0.03	0.05							
3/22 Brantome St					0.06							
5/22 Brantome St					0.03							
15/22 Brantome St					0.02							
16/22 Brantome St					0.07							
17/22 Brantome St				0.03	0.16							
18/22 Brantome St				0.07	0.22							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
19/22 Brantome St				0.09	0.24							
28/22 Brantome St			0.11	0.24	0.36							
23 Brantome Street			0.08	0.14	0.20							
23 Brantome Street				0.08	0.23							
27 Brantome Street			0.02	0.23	0.31							
29 Brantome Street				0.04	0.12							
29 Brantome Street				0.14	0.22							
31 Brantome Street				0.01	0.08							
2/31 Brantome St					0.08							
3/31 Brantome St				0.02	0.10							
4/31 Brantome St					0.07							
5/31 Brantome St					0.06							
33 Brantome Street				0.12	0.14							
33 Brantome Street				0.08	0.08							
35 Brantome Street					0.23						0.14	
38 Brantome Street					0.04							
40 Brantome Street					0.04							
Calthorpe Street			0.24	0.23	0.25							
2 Calthorpe Street			1.00	1.05	1.05							
2 Calthorpe Street			1.10	1.07	1.12							
1/2 Calthorpe Street			1.14	1.18	1.14							
8 Calthorpe Street			1.18	1.19	0.60							
10 Calthorpe Street			0.84	0.88	0.91							
22 Calthorpe Street			0.28	0.30	0.33							
7 Curtis Court			0.03	0.10	0.16							
8 Curtis Court			1.72	1.79	1.86							
9 Curtis Court				0.09	0.15							
78 Fersfield Road			0.01	0.31	0.44							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
80 Fersfield Road			1.43	1.78	1.89							
14 Fisher Street			0.51	0.54	0.57							
17 Fisher Street			0.27	0.28	0.30							
1 Frith Road					0.08							
49 Frith Road					0.04							
51 Frith Road					0.10							
53 Frith Road					0.10							
55 Frith Road					0.05							
57 Frith Road					0.04							
58 Frith Road					0.02							
59 Frith Road					0.05							
60 Frith Road					0.03							
61 Frith Road				0.02	0.06							
62 Frith Road				0.04	0.09							
63 Frith Road				0.03	0.12							
64 Frith Road				0.06	0.14							
65 Frith Road				0.02	0.12							
66 Frith Road				0.06	0.12							
68 Frith Road				0.06	0.10							
70 Frith Road				0.09	0.13							
72 Frith Road			0.17	0.13	0.20							
76 Frith Road				0.05	0.13							
80 Frith Road			0.06	0.11	0.19							
84 Frith Road				0.14	0.23							
88 Frith Road			0.02	0.08	0.17							
90 Frith Road			0.13	0.24	0.38							
92 Frith Road			0.06	0.15	0.28						0.12	
94 Frith Road			0.05	0.13	0.26							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
96 Frith Road			0.07	0.13	0.27							
97 Frith Road				0.05	0.18							
98 Frith Road			0.07	0.16	0.28							
99 Frith Road			0.03	0.18	0.32							
100 Frith Road			0.10	0.14	0.28						0.14	
101 Frith Road				0.15	0.29						0.16	
102 Frith Road			0.07	0.16	0.30							
103 Frith Road				0.11	0.23						0.18	
104 Frith Road			0.07	0.20	0.35						0.08	
105 Frith Road					0.02							
106 Frith Road				0.01	0.07							
6/3 Hamilton Street					0.01							
7/3 Hamilton Street					0.07							
8/3 Hamilton Street					0.18							
9/3 Hamilton Street					0.14							
10/3 Hamilton St					0.06							
11/3 Hamilton St					0.01							
5 Hamilton Street					0.03							
6 Hamilton Street			0.18	0.41	0.82						0.12	
8 Hamilton Street			0.24	0.30	0.69					0.48	0.88	
8 Hamilton Street			0.87	1.25	1.67							
12 Hamilton Street			0.13	0.26	0.46							
16 Hamilton Street				0.14	0.28							
26 Hamilton Street					0.11							
1/30 Hamilton St					0.02							
2/30 Hamilton St					0.03							
3/30 Hamilton St					0.04							
4/30 Hamilton St					0.07							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
32 Hamilton Street			0.11	0.12	0.13							
19 Heritage Way				0.07	0.17							
34 Hamilton Street					0.06							
Howey Street			0.74	1.69	2.31							
1 Kilmore Road			0.89	1.06	1.43							
6 Lyell Street				0.06	0.13							
1/6 Lyell Street				0.04	0.10							
7 Oakley Court					0.08							
8 Oakley Court				0.21	0.37							
9 Oakley Court				0.13	0.51							
10 Oakley Court				0.20	0.59							
11 Oakley Court			0.03	0.50	0.91							
12 Oakley Court			0.08	0.65	1.14							
13 Oakley Court			1.21	1.84	2.40							
14 Oakley Court			1.68	2.35	2.94							
15 Oakley Court			1.54	1.99	2.32							
Prince Street				0.05	0.08							
10 Prince Street				0.11	0.24							
10 Robertson Street			0.35	0.50	0.63				0.19	0.34	0.49	
12 Robertson Street			0.15	0.28	0.41					0.09	0.22	
14 Robertson Street			0.12	0.25	0.36						0.13	
16 Robertson Street			0.17	0.31	0.43						0.11	
18 Robertson Street			0.23	0.38	0.51				0.20		0.14	
20 Robertson Street			0.30	0.45	0.58					0.12	0.25	
25 Robertson Street				0.22	0.38							
25 Robertson Street				0.19	0.35							
25 Robertson Street				0.05	0.09							
25 Robertson Street				0.05	0.09							

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
25 Robertson Street				0.14	0.25							
31 Robertson Street				0.01	0.06							
40 Robertson Street			0.66	0.76	0.85							
40 Robertson Street			0.66	0.76	0.85							
89 Ross Watt Road			1.12	1.26	1.34							
89 Ross Watt Road			0.27	0.37	0.47							
19 Station Road			0.01	0.07	0.17						0.21	
21 Station Road				0.05	0.13							
Unnamed			0.36	0.50	0.61							
Unnamed			0.24	0.49	0.68							
Unnamed			0.90	1.41	1.85							
Unnamed			1.03	1.08	1.14							
Unnamed				0.02	0.13							
Unnamed			0.63	0.65	0.84							
Unnamed					0.07							
Unnamed				0.05	0.08							
Unnamed				0.06	0.14							
Unnamed				0.06	0.14							
Unnamed					0.02							
Unnamed				0.10	0.16							
Unnamed			1.24	1.29	1.34							
Unnamed			0.05	0.12	0.26							
Unnamed			0.15	0.19	0.22							
Unnamed			1.12	1.15	0.95							
Unnamed				0.13	0.20							
Unnamed				0.06	0.09							
Unnamed				0.35	0.70							
Unnamed			0.40	0.31	0.72						0.22	

Gisborne – EXISTING CONDITIONS (Water Technology, 2006) *It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Gisborne*												
LEGEND		Not used						Depth of over-floor flooding				
Location (Number and street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**					
	0.2EY	**10%**	**5%**	**2%**	**1%**	**0.2%**	**0.2EY**	**10%**	**5%**	**2%**	**1%**	**0.2%**
	51.64	**51.81**	**52.01**	**52.26**	**52.44**		**51.64**	**51.81**	**52.01**	**52.26**	**52.44**	
Unnamed			0.24	0.49	0.91						0.39	
Unnamed					0.17							

3.4 Indicative Flood / No Flood guidance tool for Gisborne

In the lead up to and during a flood event

Rainfall data from the rain gauge at Rosslynne Reservoir should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below, unless data from alternative locations considered to be more representative of rain occurring and / or considered likely to experience the heaviest rainfall is available. Care should be exercised however, as it must be remembered that runoff from headwater as well as low land areas contribute to flooding.

The status of Rosslynne Reservoir is key to whether Gisborne may experience a Jacksons Creek flood.

For a Jacksons Creek flood

Use the indicative Rosslynne Reservoir spill tool to determine at what stage the rainfall being recorded by the gauge should start to be used on the indicative flood / no flood tool. The location at which the current head gauge level meets the horizontal line indicates the approximate depth of rainfall required during the current event in order to fill the reservoir and cause a spillway flow. Any rainfall (either predicted or recorded) that is in excess of this amount should be applied to the indicative flood / no flood tool beginning at zero time) in order to determine the likelihood and severity of flooding at Gisborne. Both approaches outlined below should be utilised.

For a Howey Creek flood

The indicative flood / no flood tool should be applied in order to determine the likelihood and severity of flooding. Both approaches outlined below should be utilised.

Using the tool

Two approaches can be used during a rainfall event to determine an indication of the likelihood and severity of flooding at Gisborne. Both approaches can be used simultaneously using the same copy of the tool. **Unless there are unusual circumstances, actions as per the Flood Intelligence Card should be initiated as soon as the tool suggests flooding is likely**. Response can be escalated if the tool indicates an increase in the expected severity of flooding.

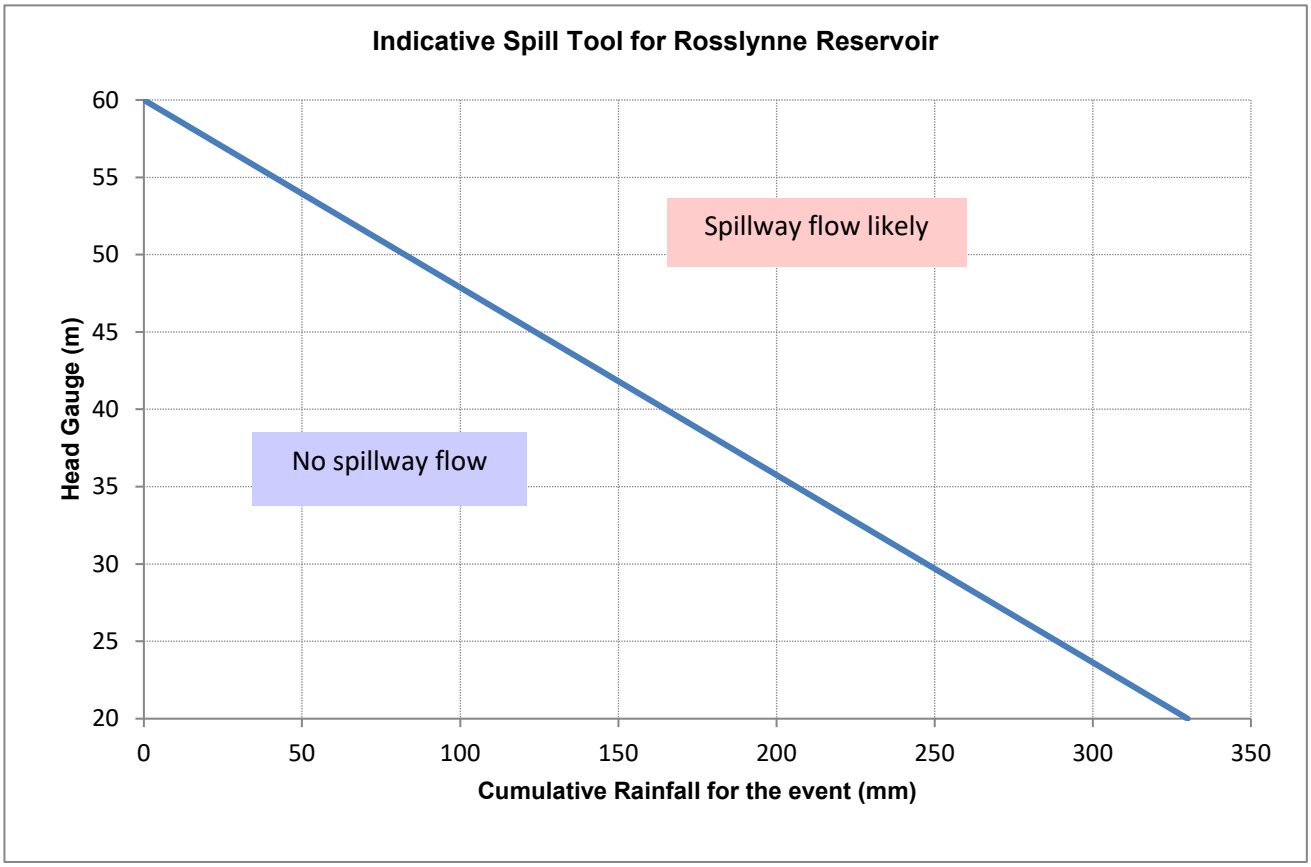
Approach 1: Using the total rainfall depth obtained from the start of the event (discount early drizzle or very light rain), plot the rainfall depth against elapsed time on a copy of the tool. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A series of plots with different start times could be maintained.

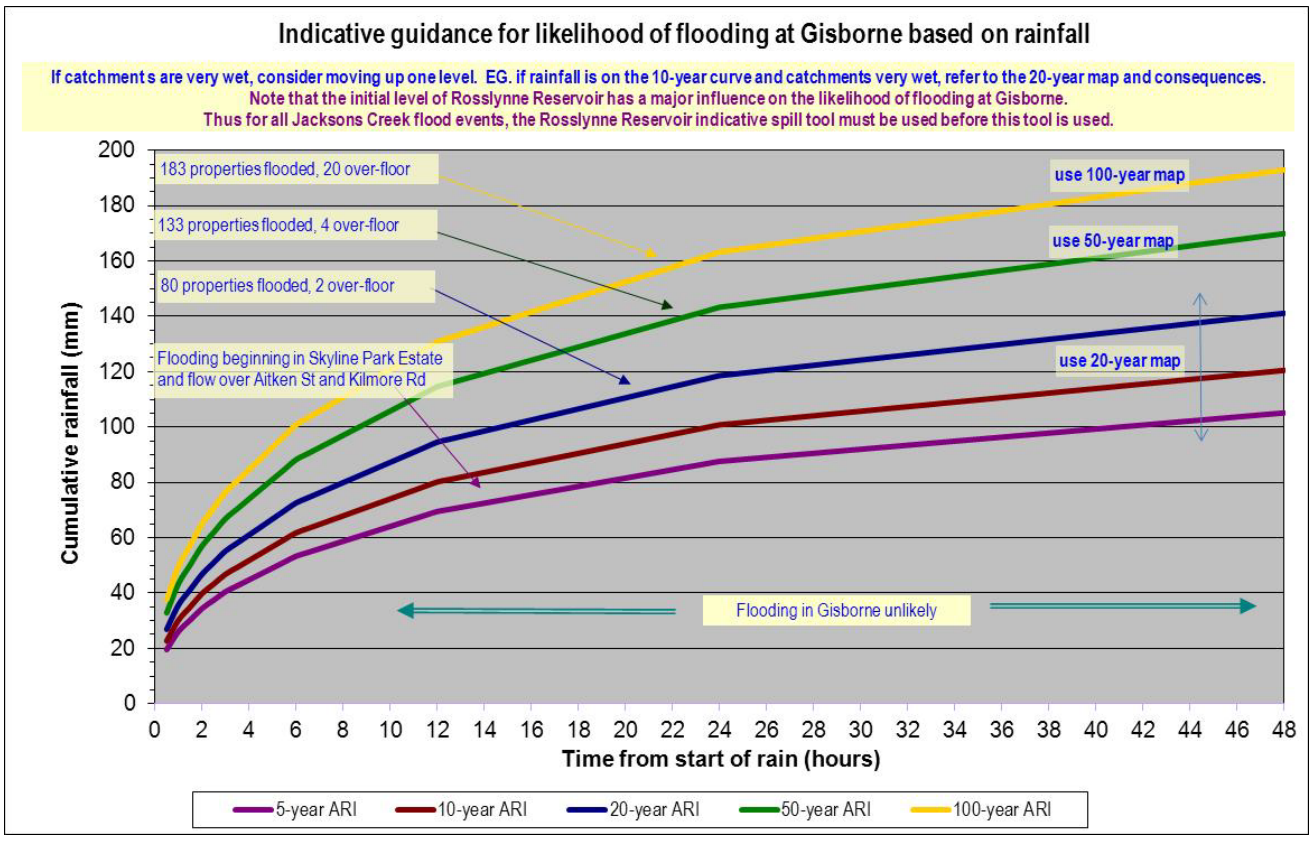
Approach 2: Discount the early lighter rain from consideration (i.e. begin calculating rainfall depth from start of heavy rain) and plot depth against time on a copy of the tool. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A series of plots with different start times could be maintained.

CAUTION: Both tools are based on a number of gross assumptions and generalisations. They are indicative only and while it will not always indicate the expected severity of flooding correctly. However, the tools do provide a quick answer to questions such as “will we flood” and “how bad will it be” and will usually give a heads up to severe flooding and thus of likely consequences. The tool is not location specific and does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or the likely consequences.

After a flood event

Plot the event rainfall depth (with date) on the tool and include an overview of the event, including antecedent conditions, in Appendix B1.


Indicative Spill Tool for Rosslynne Reservoir
Head Gauge (m)
60
55
50
45
40
35
30
25
20
0
50
100
150
200
250
300
350
Cumulative Rainfall for the event (mm)
Spillway flow likely
No spillway flow


Indicative guidance for likelihood of flooding at Gisborne based on rainfall
If catchments are very wet, consider moving up one level. EG. if rainfall is on the 10-year curve and catchments very wet, refer to the 20-year map and consequences.
Note that the initial level of Rosslynne Reservoir has a major influence on the likelihood of flooding at Gisborne.
Thus for all Jacksons Creek flood events, the Rosslynne Reservoir indicative spill tool must be used before this tool is used.
Cumulative rainfall (mm)
200
180
160
140
120
100
80
60
40
20
0
183 properties flooded, 20 over-floor
133 properties flooded, 4 over-floor
80 properties flooded, 2 over-floor
Flooding beginning in Skyline Park Estate and flow over Aitken St and Kilmore Rd
use 100-year map
use 50-year map
use 20-year map
Flooding in Gisborne unlikely
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time from start of rain (hours)
5-year ARI
10-year ARI
20-year ARI
50-year ARI
100-year ARI

Appendix B2: Woodend community flood emergency plan

Woodend is subject to stormwater drainage flooding as well as flooding from Five Mile Creek.

There are effectively ten urban catchments within Woodend: Washington Lane, Campaspe Drive, Racecourse Reserve, Timber Lane, Quahlee Estate, Goldies Lane, Beves Lane, Tennyson Street, East Street and Davy Street.

The Five Mile Creek catchment upstream of Gregory Street covers 45.7km2 of mainly pastoral and forested land. The creek rises in the Mount Macedon Regional Park and flows some 14km through farmland to Woodend at the Macedon – Woodend Rd. Downstream of the Lancefield – Woodend Road, the creek flows through residential areas, some of which are subject to inundation.

The Five Mile Creek catchment responds quickly within one (1) or two (2) hours of the start of rainfall. During heavy rain events, creek levels rise quickly.

Floods have occurred in Woodend in February 1989, on 21st November 1992, 14th-15th September 1993, in October 1993, and on 1st-2nd November 1993. The most significant events were the November 1992 and September 1993 floods. The Washington Lane Drain catchment in Woodend experienced what has been adopted as the 100-year ARI flood for the area. Five Mile Creek also flooded. Many areas of the town, notably the Campaspe Drive area, Duffy Street / Anslow Street “Housing Commission” houses, the High Street supermarket, properties and at least one house in Timber and Booth Lanes and the Macedon – Woodend Rd (closed) were impacted.

Coomes undertook a Township Drainage Study in 1997. That study identified flooding issues around Woodend and delivered a number of recommendations to address those issues. It also determined the 100-year ARI flood extent through the town, between the Lancefield - Woodend Road and the Racecourse.

Coomes found that there were numerous flooding concerns in the vicinity of Campaspe Drive and No 22 Tennyson Street. They also reported flooding problems in the Andrews Avenue area and along Slaty Creek but details were sparse.

In response to some of Coomes’ recommendations, the Shire of Macedon Ranges Shire has constructed a levee at Campaspe Park adjacent to Five Mile Creek. The levee provides protection for 12 houses. Pumps transfer local stormwater through the levee into the creek. However, as these pumps often need to be engaged manually, a flood warning system was installed on the creek at Campaspe Drive. The system notifies the Manager Community Safety who advises the MERO to monitor creek levels – see attached Five Mile Creek procedure.

Appendix B3: Lauriston community flood emergency plan

Lauriston has a population of approximately 236 and is downstream of Lauriston Reservoir, approximately 65 km south-east of Bendigo. The Coliban River runs through the centre of the town. The upstream catchment area is 221 km². The river channel is well defined within the study area. Flow in the Coliban River is significantly regulated by the two large storages (Upper Coliban and Lauriston Reservoir) upstream of the town. Figure 77 shows the location.

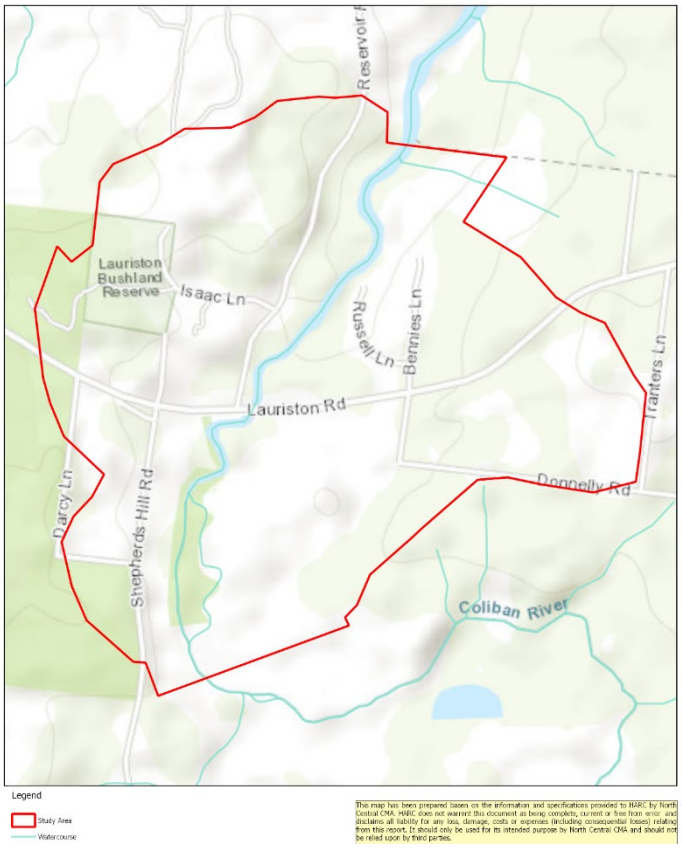


Figure 77: Map of Lauriston Study Area

1. Overview of flooding consequences

1.1 Warning times

Flooding in Lauriston can be caused by either overland flooding from the local catchment, or from riverine flooding from the Coliban River. Stormwater runoff will begin within minutes of intense rainfall over the town. If the upstream storages are full, flood waters in the Coliban River will begin to rise within a few hours of heavy rainfall commencing. Flooding occurs over a long period with floods peaking approximately 20 hours after stream levels begin to rise. Figure 78 shows typical response and times to rise for a number of design floods. Figure 79 shows the location of the hydrographs.

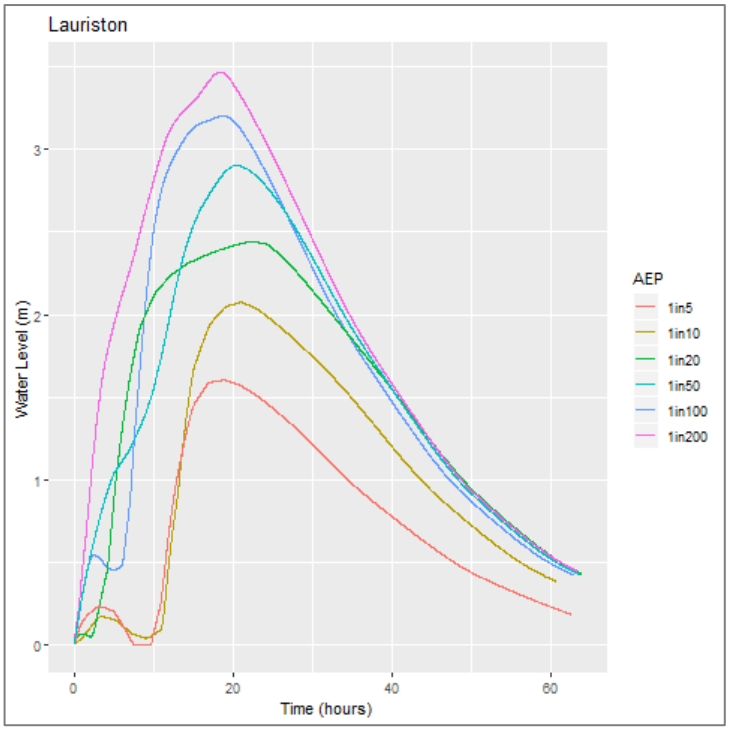


Figure 77: Design Event Hydrographs (HARC, 2020)

Figure 79: Reporting location

1.2 Areas affected

Maps at Appendix D provide guidance on where flooding is likely to occur.

Floodwaters break out of the Coliban River and inundate properties during a 2% AEP event. A summary of flooding for a number of design events is given in Table 90. Details of individual properties and buildings inundated are provided in Table 92. See inundation maps at Appendix D.

Table 90: Summary of impacts of flooding	
AEP (1 in Y)	**Impact**
5	No properties are inundated
10	No properties are inundated
20	No properties are inundated
50	Four properties are inundated just downstream of Lauriston Road
100	Four properties are inundated as above
200	Four properties are inundated as above

1.3 Properties affected

A summary of the number of properties likely to be flooded at Lauriston is provided in Table 91.

Table 91: Summary of properties affected						
AEP	**1 in 5**	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**
Buildings Flooded Above Floor	0	0	0	2	3	3
Properties Flooded but Below Floor Level	0	0	0	2	1	1
Total Properties Flooded	0	0	0	4	4	4

The list of properties likely to be flooded (with corresponding levels and indication of over-floor flood depth) as provided below should be updated within twelve (12) weeks of a flood. Information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief as well as from the collective experience of the IMT should be used.

Table 92: Detailed list of properties flooded												
	Depth of flooding near building for each AEP						**Depth of over floor flooding for each AEP**					
Address	**20%**	**10%**	**5%**	**2%**	**1%**	**0.5%**	**20%**	**10%**	**5%**	**2%**	**1%**	**0.5%**
411 Lauriston Road*				0.2	0.5	0.7						
411 Lauriston Road*				0.2	0.4	0.6				0.1	0.3	0.5
411 Lauriston Road*				< 0.1	0.3	0.5				0.2	0.5	0.7
14 Reservoir Road				0.2	0.5	0.7					0.1	0.3

** Buildings located on the same property*

1.4 Isolation

The main access road for Lauriston is Lauriston Road. This remains flood free up to and including the 1 in 200 AEP event. Events larger than the 1 in 200 AEP event haven't been modelled.

1.5 Flood intelligence card

A flood intelligence card has been prepared and is found in Table 93. Flood intelligence cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Disaster Resilience Handbook Collection (previously Australian Emergency Management Manuals) flood series.

Table 93: Flood intelligence card			
AEP (1 in X)	**Rainfall depth (mm)**	**Consequence / Impacts**	**Action**
-	Heavy rain on wet catchment	The capacity of the town stormwater drainage system maybe exceeded. Local nuisance flooding will occur along the side of roads and within some properties. No over-floor flooding expected.	▪ Consider deploying “water over road signs” at hot spots. ▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event.
5	~20mm in 1hr to ~30 mm in 3hr	▪ Flows out onto the floodplain but fairly contained to the river	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event. ▪ Refer to indicated maps for impacts.
10	~25mm in 1hr to ~35 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 5 AEP with increased depths	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts.
20	~30mm in 1hr to ~40 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 10 AEP with increased depths	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts.
50	~35mm in 1hr to ~45 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 20 AEP with increased depths ▪ 4 properties flooded with 2 above floor level. Refer to **Error! Reference source not found.**. Note that two of the buildings are on the same property	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps).
100	~40mm in 1hr to ~50 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 50 AEP with increased depths ▪ 4 properties flooded with 3 above floor level. Refer to **Error! Reference source not found.**. Note that two of the buildings are on the same property	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps).
200	A little above the 1 in 100 AEP line on the quick look flood / no flood tool	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 100 AEP with increased depths ▪ 4 properties flooded with 3 above floor level. Refer to **Error! Reference source not found.**. Note that two of the buildings are on the same property ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.**).

2. Indicative quick look Flood / No Flood tool

The tool is aimed at providing a rapid indication of whether flooding is likely with some lead time. It is intended to be indicative only and will not provide a forecast of expected flood depth. The tool is designed to be linked to the mapping and intelligence produced by this project and in that way provides an indication of likely consequences.

The tool is driven by rainfall recorded at Coliban River at Springhill-Tylden Road (406250). IFD data from this location has been compared to the study area specific IFD data. Adjusted rainfall depths were then plotted against time to produce the tool as shown in Figure 80.

Unless there are unusual circumstances, actions as per the Flood Intelligence Card in the Plan should be initiated as soon as the tool suggests flooding is likely. Response can be escalated if the tool indicates an increase in the expected severity of flooding. The tool may not perform to expectations in severe thunderstorm situations and/or when there is locally heavy rainfall embedded in more general rain.

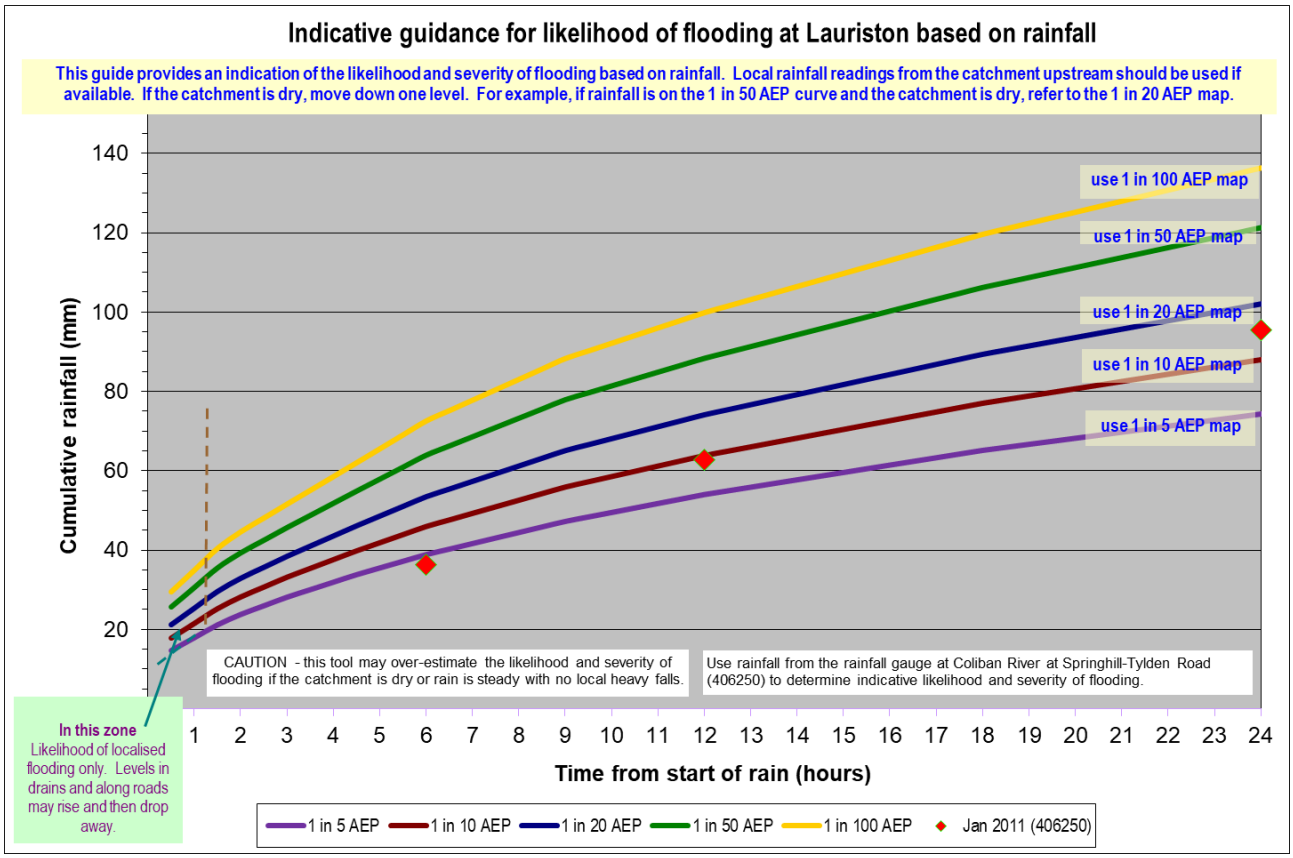


Figure 80: Quick look tool example

Appendix B4: Malmsbury community flood emergency plan

Malmsbury has a population of approximately 831 and is located immediately downstream of Malmsbury Reservoir, approximately 54 km south-east of Bendigo. The Coliban River runs through the centre of the town. The upstream catchment area is 289 km². The river channel is well defined within the study area. Flow in the Coliban River is significantly regulated by several large storages (Upper Coliban, Lauriston and Malmsbury Reservoir) upstream of the town.

Figure 72: Map of Malmsbury Study Area and reporting location

1. Overview of flooding consequences

1.1 Warning times

Flooding in Malmsbury can be caused by either overland flooding from the local catchment, or from riverine flooding from the Coliban River. Stormwater runoff will begin within minutes of intense rainfall over the town.

If the Coliban storages are full, flood waters in the Coliban River will begin to rise within a few hours of heavy rainfall commencing. Flooding occurs over a long period of time with floods peaking approximately 10 - 60 hours after stream levels begin to rise. Figure 73 shows typical response and times to rise for a number of design floods. Note that stream response is heavily influenced by the upstream storages. The more frequent events are governed by the volume required to spill the dams (therefore longer duration storms) while the rarer events are governed by the peak flow (therefore shorter duration storms). Figure 74 shows the study area and location of the hydrographs.

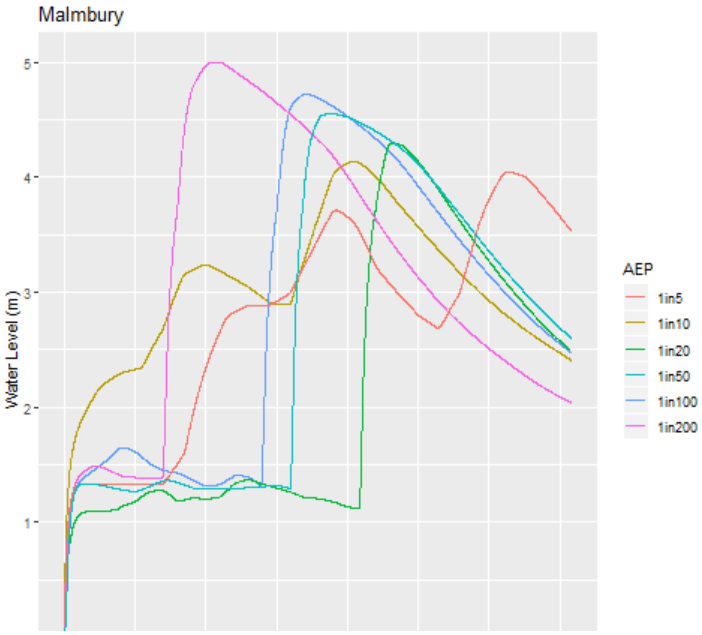


Figure 73: Design Event Hydrographs (HARC, 2020)

1.2 Areas affected

Maps at Appendix D provide guidance on where flooding is likely to occur.

Floodwaters break out of the Coliban River and inundate Mollison Street (Calder Highway) in a 1 in 20 AEP event. Two buildings are inundated in a 1 in 10 AEP event. A summary of flooding for a number of design events is given in Table 84. Details of individual properties and buildings inundated are provided in Table 86. See inundation maps at Appendix D.

Table 84: Summary of impacts of flooding	
AEP (1 in Y)	**Impact**
5	No properties are inundated
10	Two properties are inundated at Malmsbury Sports Ground
20	Mollison Street (Calder Hwy) overtopped. Two properties are inundated as above
50	Mollison Street (Calder Hwy) overtopped. Two properties are inundated as above
100	Mollison Street (Calder Hwy) overtopped. Two properties are inundated as above
200	Four additional properties are inundated. One is upstream of Mollison Street and three are near Raleigh Street

1.3 Properties affected

A summary of the number of properties likely to be flooded at Malmsbury is provided in Table 85.

Table 85: Summary of properties affected						
AEP	**1 in 5**	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**
Buildings Flooded Above Floor	0	2	2	2	2	3
Properties Flooded but Below Floor Level	0	0	0	0	0	3
Total Properties Flooded	0	2	2	2	2	6

The list of properties likely to be flooded (with corresponding levels and indication of over-floor flood depth) as provided below should be updated within twelve (12) weeks of a flood. Information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief as well as from the collective experience of the IMT should be used.

Table 86: Detailed list of properties flooded										
	Depth of flooding near building for each AEP					**Depth of over floor flooding for each AEP**				
Address	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**
91 Mollison St					0.3					
Malmsbury Cricket and Recreation Reserve	< 0.1	0.1	0.4	0.7	1.2	0.1*	0.2*	0.4*	0.7*	1.2*
Malmsbury Cricket and Recreation Reserve	0.1	0.2	0.4	0.7	1.2	0.2*	0.3*	0.5*	0.8*	1.3*
48 Cameron St					0.3					
39 Raleigh St					0.4					< 0.1
Ellesmere Hollow, 50-52 Raleigh St					0.2					

**These values are higher than the depth of flooding as the surveyed floor level is lower than the LIDAR data used to calculate depth of flooding*

1.4 Isolation

The main access road for Malmsbury is Mollison Street (the Calder Highway). Mollison Street begins to overtop in a 1 in 20 AEP event. Events larger than the 1 in 200 AEP event haven't been modelled. Table 87 summarises the main road inundation. Along with the main roads there are a number of local roads which also being to become inundated during a 1 in 5 AEP event.

Table 87: Summary of road inundation			
AEP (1 in Y)	Roads impacted by flooding	Maximum depth over road (m)	Duration of inundation (hours)
5	Mollison Street	0	0
10	Mollison Street	0	0
20	Mollison Street	< 0.1	4
50	Mollison Street	0.2	14
100	Mollison Street	0.2	15
200	Mollison Street	0.4	21

1.5 Flood intelligence card

A flood intelligence card has been prepared and is found in Table 88. The gauge location where river heights are reported is at Coliban River @ Malmsbury Rail Bridge (406200).

Flood intelligence cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Disaster Resilience Handbook Collection (previously Australian Emergency Management Manuals) flood series.

Table 88: Flood intelligence card				
AEP (1 in X)	River height (m)^	Rainfall depth (mm)	Consequence / Impacts	Action
-	-	Heavy rain on wet catchment	The capacity of the town stormwater drainage system maybe exceeded. Local nuisance flooding will occur along the side of roads and within some properties. No over-floor flooding expected.	▪ Consider deploying “water over road signs” at hot spots. ▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event.
5	3.2	~20mm in 1hr to ~30 mm in 3hr	▪ Flows out onto the floodplain with extensive flooding on eastern side of river ▪ Several local roads inundated	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event. ▪ Refer to indicated maps for impacts. ▪ Implement appropriate response actions that may include deploying “water over road” signs.
10	3.5	~25mm in 1hr to ~35 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 5 AEP with increased depths ▪ Several local roads inundated ▪ 2 properties flooded above floor level. Refer to **Error! Reference source not found.**	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Implement appropriate response actions that may include deploying “water over road” signs. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps).
20	3.8	~30mm in 1hr to ~40 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 10 AEP with increased depths ▪ 2 properties flooded above floor level. Refer to **Error!**	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of

Table 88: Flood intelligence card				
AEP (1 in X)	**River height (m)^**	**Rainfall depth (mm)**	**Consequence / Impacts**	**Action**
			Reference source not found. ▪ Mollison Street just starting to overtop ▪ Several local roads inundated	flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Mollison Street.
50	4.2*	~35mm in 1hr to ~45 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 20 AEP with additional flooding across Ellesmere Place with increased depths ▪ 2 properties flooded above floor level. Refer to **Error! Reference source not found.** ▪ Mollison Road / Calder Highway overtopped by 200mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Mollison Street.
100	4.5*	~40mm in 1hr to ~50 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 50 AEP with increased depths ▪ 2 properties flooded above floor level. Refer to **Error! Reference source not found.** ▪ Mollison Road / Calder Highway overtopped by 200mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Mollison Street.
200	4.7*	A little above the 1 in 100 AEP line on the quick look flood / no flood tool	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 100 AEP with increased depths ▪ 6 properties flooded with 3 above floor level. Refer to **Error! Reference source not found.** ▪ Mollison Road / Calder Highway overtopped by 400mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Mollison Street.

^ River heights are reported at Coliban River @ Malmsbury Rail Bridge (406200). River heights are based on current rating curve (June 2020).

** Beyond rating curve therefore less accurate.*

1.6 Indicative quick look Flood / No Flood tool

The tool is aimed at providing a rapid indication of whether flooding is likely with some lead time. It is intended to be indicative only and will not provide a forecast of expected flood depth. The tool is designed to be linked to the mapping and intelligence produced by this project and in that way provides an indication of likely consequences.

The tool is driven by rainfall recorded at Coliban River at Springhill-Tylden Road (406250). IFD data from this location has been compared to the study area specific IFD data. Adjusted rainfall depths were then plotted against time to produce the tool as shown in Figure 75.

Unless there are unusual circumstances, actions as per the Flood Intelligence Card in the Plan should be initiated as soon as the tool suggests flooding is likely. Response can be escalated if the tool indicates an increase in the expected severity of flooding. The tool may not perform to expectations in severe thunderstorm situations and/or when there is locally heavy rainfall embedded in more general rain.

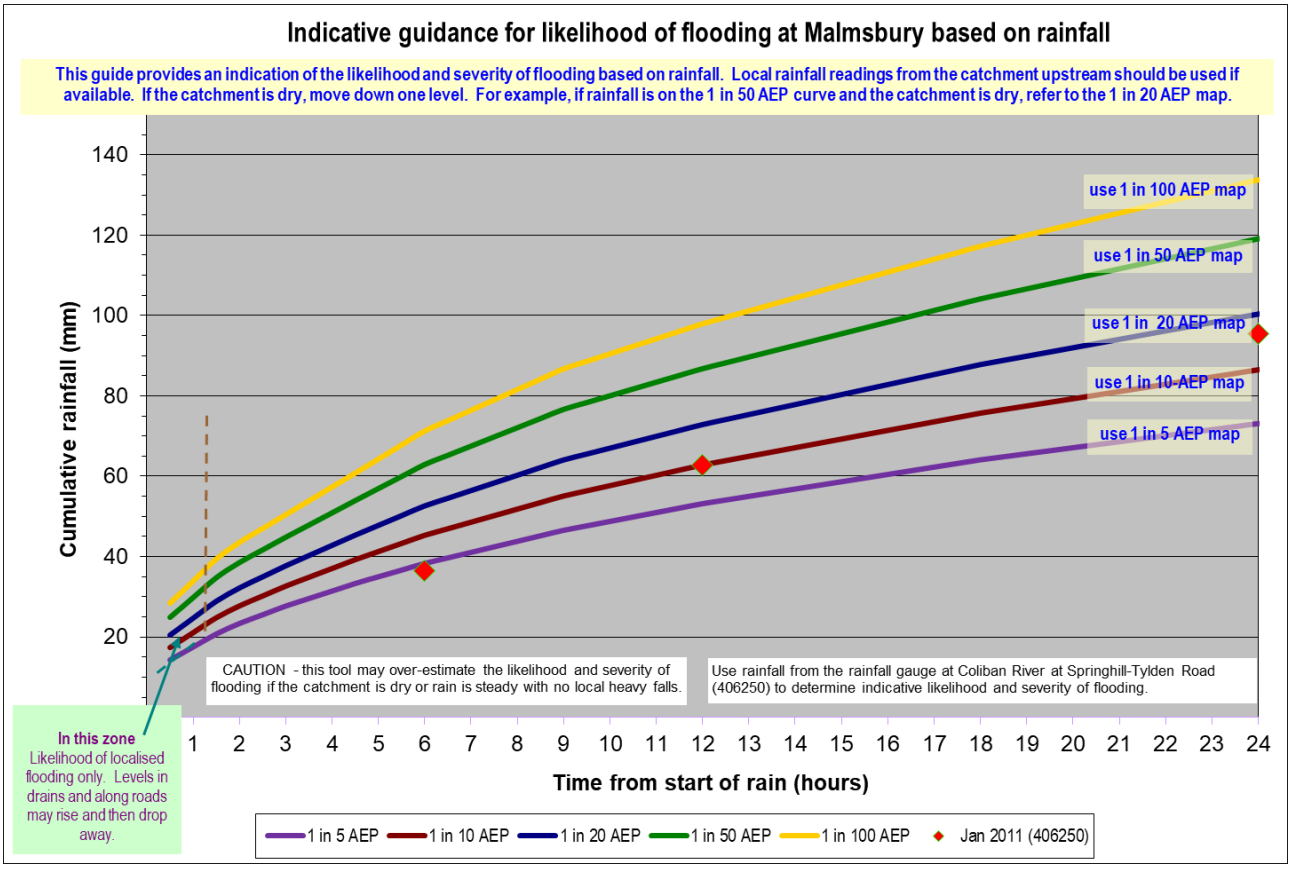


Figure 75: Quick look tool

Appendix B5: Tylden community flood emergency plan

Tylden has a population of approximately 236 and is upstream of the Upper Coliban Reservoir, located approximately 70 km south-east of Bendigo and upstream of the Little Coliban Reservoir.

The Little Coliban River and Jones Creek run to the south of the town and have a combined upstream catchment area of 41 km². A small unnamed creek rises immediately to the south west of Tylden-Woodend Road and flows to the north east through the town. Watercourse channels are well defined within the study area.

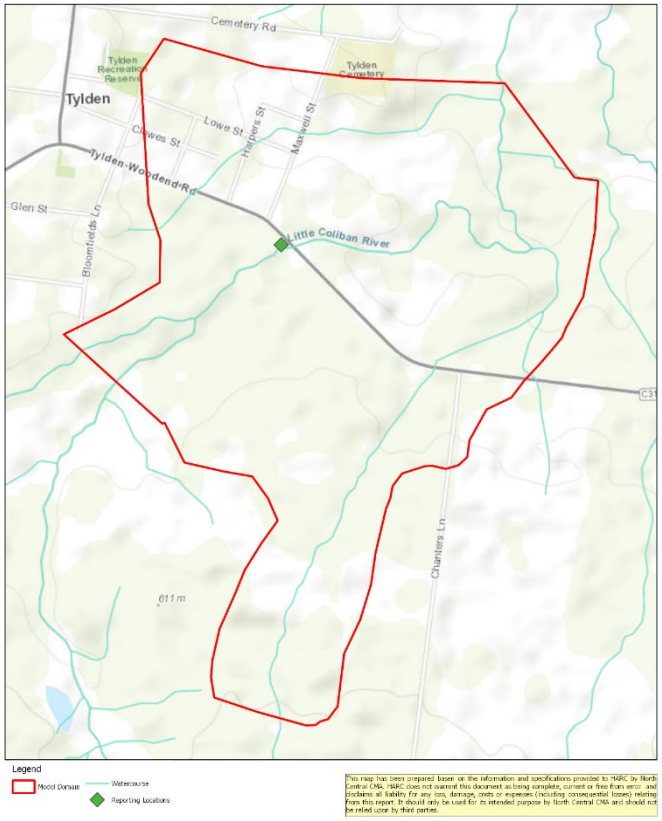


Figure 83: Map of Tylden study area and reporting location

1. Overview of flooding consequences

1.1 Warning times

Flooding in Tylden can be caused by either overland flooding from the local catchment and creek, or from riverine flooding from Little Coliban River. Stormwater runoff will begin within minutes of intense rainfall over the town.

Flood waters in the local creek and Little Coliban River will begin to rise within a few hours of heavy rainfall commencing. Flooding occurs over a reasonable amount of time with floods peaking approximately 10 to 30 hours after stream levels begin to rise. Figure 84 shows typical response and times to rise for a number of design floods. Figure 83 shows the study area and location of the hydrographs.

1.2 Areas affected

Floodwaters break out and inundate Tylden-Woodend Road in a 1 in 5 AEP event along with a number of properties. A summary of flooding for a number of design events is given in Table 95. Details of individual properties and buildings inundated are provided in Table 96. Inundation maps at Appendix D provide guidance on where flooding is likely to occur.

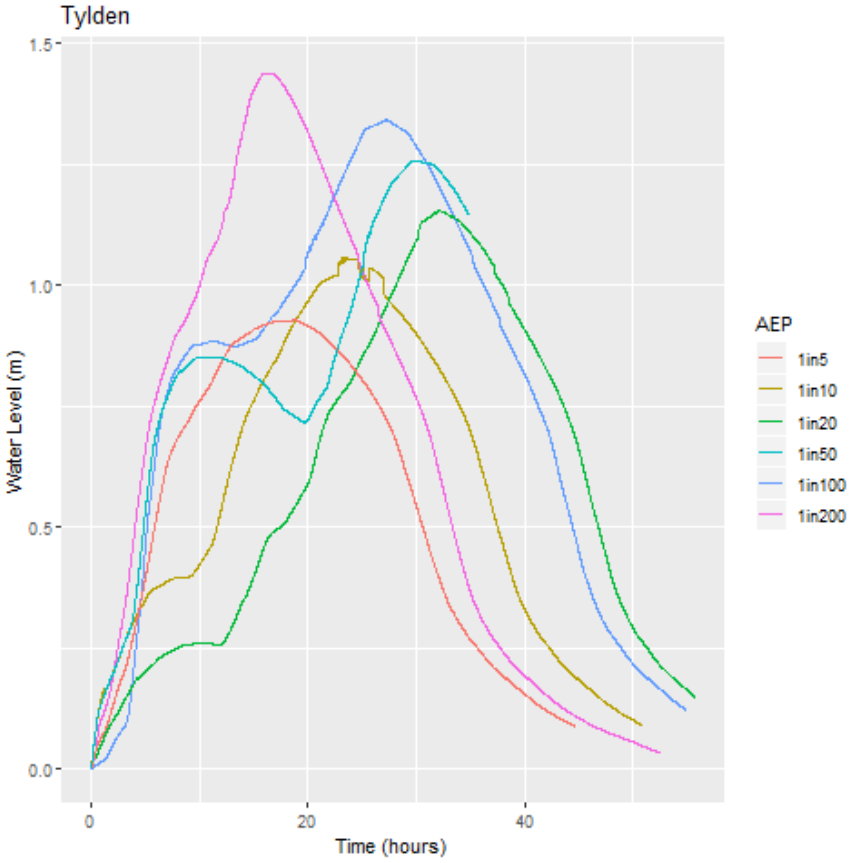


Figure 84: Design Event Hydrographs (HARC, 2020)

Table 95: Summary of impacts of flooding	
AEP (1 in Y)	**Impact**
5	Tylden-Woodend Road overtopped. Four properties are inundated within the township. One is inundated upstream of Tylden-Woodend Road near Little Coliban River and one is within the quarry. Fulton Hogan Tylden Quarry may become inundated.
10	Six properties are inundated as above
20	Six properties are inundated as above
50	Six properties are inundated as above
100	Six properties are inundated as above
200	Six properties are inundated as above

1.3 Properties affected

A summary of the number of properties likely to be flooded at Tylden is provided in Table 96.

Table 96: Summary of properties affected						
AEP	**1 in 5**	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**
Buildings Flooded Above Floor	2	2	2	2	2	2
Properties Flooded but Below Floor Level	4	4	4	4	4	4
Total Properties Flooded	6	6	6	6	6	6

The list of properties likely to be flooded as provided below should be updated within twelve (12) weeks of a flood. Information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief as well as from the collective experience of the IMT should be used.

Table 97: Detailed list of properties flooded												
Address	**Depth of flooding near building for each AEP**						**Depth of over floor flooding for each AEP**					
	1 in 5	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**	**1 in 5**	**1 in 10**	**1 in 20**	**1 in 50**	**1 in 100**	**1 in 200**
42 Tylden-Woodend Rd	0.1	0.1	0.1	0.2	0.2	0.2						
46 Tylden-Woodend Rd	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
44 Tylden-Woodend Rd	0.1	0.1	0.2	0.2	0.2	0.3						
5 Harpers St	0.6	0.6	0.6	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.3	0.3
1115 Tylden-Woodend Rd	0.1	0.1	0.2	0.3	0.4	0.5						
1122 Tylden-Woodend Rd	0.2	0.3	0.3	0.3	0.3	0.3						

1.4 Isolation

The main access road for Tylden is Tylden-Woodend Road. Tylden-Woodend Road overtops in a 1 in 5 AEP event. Events larger than the 1 in 200 AEP event haven't been modelled. Table 98 summarises the main road inundation. Along with the main road there are a number of local roads which also being to become inundated during a 1 in 5 AEP event.

1.5 Flood intelligence card

A flood intelligence card has been prepared and is found in Table 99. Flood intelligence cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its

use can be found in the Australian Disaster Resilience Handbook Collection (previously Australian Emergency Management Manuals) flood series.

Table 98: Summary of road inundation			
AEP (1 in Y)	**Roads impacted by flooding**	**Maximum depth over road (m)**	**Duration of inundation (hours)**
5	Tylden-Woodend Road	0.2	18
10	Tylden-Woodend Road	0.3	20
20	Tylden-Woodend Road	0.4	22
50	Tylden-Woodend Road	0.5	36
100	Tylden-Woodend Road	0.6	36
200	Tylden-Woodend Road	0.7	36

Table 99: Flood intelligence card			
AEP (1 in X)	**Rainfall depth (mm)**	**Consequence / Impacts**	**Action**
-	Heavy rain on wet catchment	The capacity of the town stormwater drainage system maybe exceeded. Local nuisance flooding will occur along the side of roads and within some properties. No over-floor flooding expected.	▪ Consider deploying “water over road signs” at hot spots. ▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event.
5	~20mm in 1hr to ~30 mm in 3hr	▪ Flows out onto the floodplain including flooding of the quarry ▪ Several local roads inundated ▪ 6 properties flooded 2 above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 200mm	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event. ▪ Refer to indicated maps for impacts. ▪ Implement appropriate response actions that may include deploying “water over road” signs. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Put out “road closed” signs for Tylden – Wooden Road
10	~25mm in 1hr to ~35 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 5 AEP with increased depths including at the quarry ▪ Several local roads inundated ▪ 6 properties flooded 2 above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 300mm	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Implement appropriate response actions that may include deploying “water over road” signs. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Put out “road closed” signs for Tylden – Wooden Road
20	~30mm in 1hr to ~40 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 10 AEP with increased depths ▪ 6 properties flooded 2 above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 400mm ▪ Several local roads	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs

Table 99: Flood intelligence card			
AEP (1 in X)	**Rainfall depth (mm)**	**Consequence / Impacts**	**Action**
		inundated	▪ Put out “road closed” signs for Tylden – Wooden Road.
50	~35mm in 1hr to ~50 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 20 AEP with increased depths ▪ 6 properties flooded 2 above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 500mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Tylden – Wooden Road.
100	~40mm in 1hr to ~60 mm in 3hr	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 50 AEP with increased depths ▪ 6 properties flooded 2 properties flooded above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 600mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Tylden – Wooden Road.
200	A little above the 1 in 100 AEP line on the quick look flood / no flood tool	▪ Flows out onto the floodplain. Extent is fairly similar to the 1 in 100 AEP with increased depths ▪ 6 properties flooded 2 above floor level. Refer to **Error! Reference source not found.** ▪ Tylden-Woodend Road overtopped by 700mm ▪ Several local roads inundated	▪ Continue to monitor rainfall and water levels. ▪ Continue to use / maintain plot on the quick look flood / no flood tool in order to further develop appreciation of likely scale of flood event. ▪ Refer to indicated maps for impacts. ▪ Sandbag buildings that are at risk (Refer to **Error! Reference source not found.** and maps). ▪ Implement appropriate response actions that may include deploying “water over road” signs ▪ Put out “road closed” signs for Tylden – Wooden Road.

1.6 Indicative quick look Flood / No Flood tool

The tool is aimed at providing a rapid indication of whether flooding is likely with some lead time. It is intended to be indicative only and will not provide a forecast of expected flood depth. The tool is designed to be linked to the mapping and intelligence produced by this project and in that way provides an indication of likely consequences.

The tool is driven by rainfall recorded at Coliban River at Springhill-Tylden Road (406250). IFD data from this location has been compared to the study area specific IFD data. Adjusted rainfall depths were then plotted against time to produce the tool as shown in Figure 85.

In the lead up to a flood

The quick look indicative flood / no-flood tool provided in Figure 85 gives guidance on the likelihood and severity of expected flooding at Tylden.

Rainfall recorded at Coliban River at Springhill-Tylden Road (406250) was used to develop the quick look tool. As the data being used comes from a rain gauge that is outside the Lockwood catchment, the tool may not perform to expectations in severe thunderstorm situations and/or when there is locally heavy rainfall

embedded in more general rain. In such situations, rainfalls recorded more locally are likely to drive a more accurate indication of flooding and likely severity.

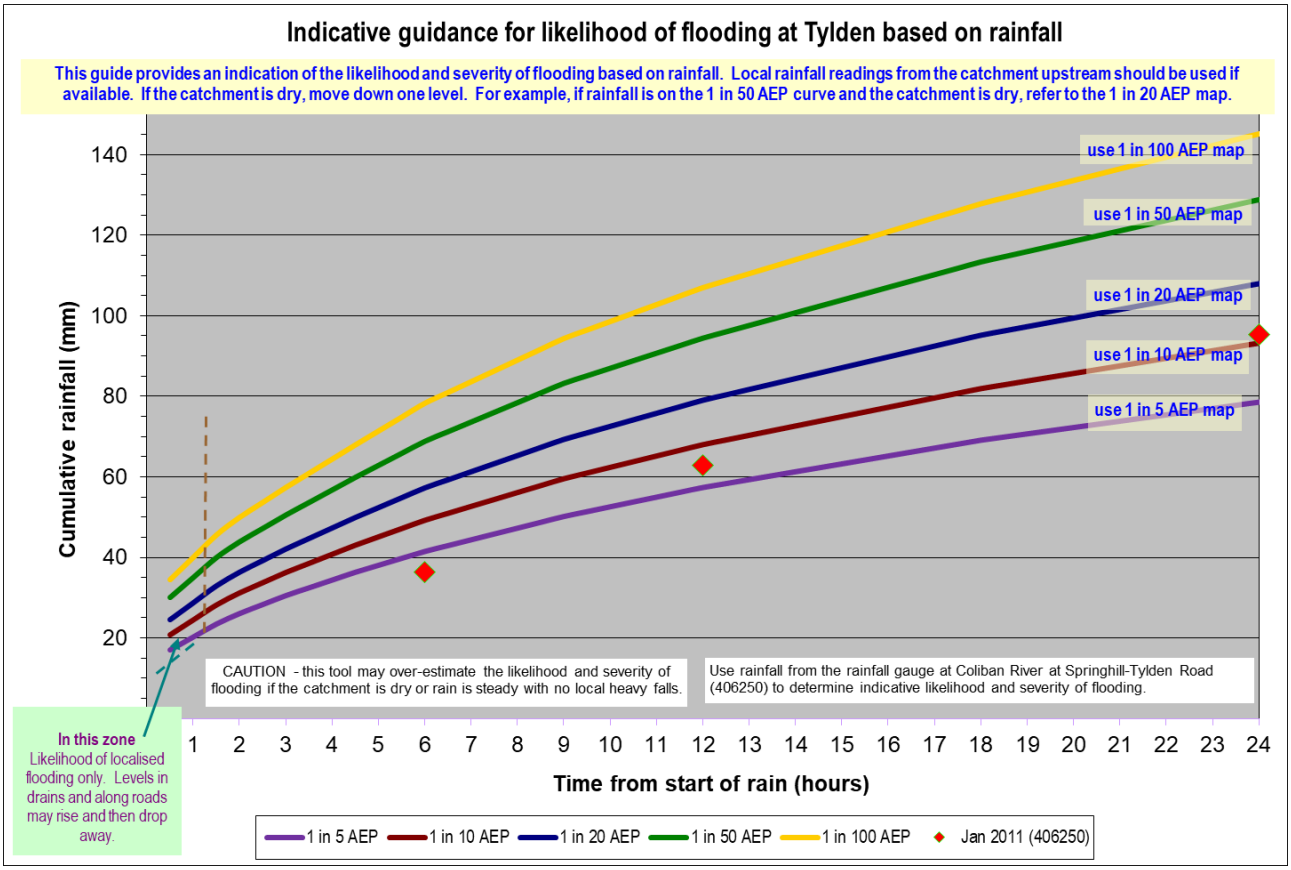


Figure 85: Quick look tool

Appendix B6: Kyneton community flood emergency plan

Kyneton has a population of approximately 7,513 and primarily located on the north-eastern bank of the Campaspe River, with new residential development currently expanding on the south-western side of the river. The upstream catchment is 233km^2. The Campaspe floodplain through the town is confined by the steep valley and hence impacts on the township are relatively limited. Floodwaters are generally contained within the river except immediately north of the township where water breaks out onto the floodplain, impacting the Kyneton Racecourse.

A significant tributary of the Campaspe River, Post Office Creek, is situated at the northern extent of the township and the confluence of the two waterways is located north of the Kyneton Township. Although Post Office Creek has a much smaller catchment (12km^2) than the Campaspe River, it is surrounded by existing residential and industrial development which may be impacted by flooding. The response time of this catchment is also much quicker than the Campaspe River, with the onset of flooding within hours of heavy rainfall.

The following information is based on the Kyneton Flood Study 2019 (North Central Catchment Management Authority).

1. Flood behaviour

Campaspe River - Typical flood peak travel times			
Location from	**Location to**	**Typical travel time**	**Comments**
Start of rainfall	Kyneton	5 to 15 hours	Begin to rise from normal levels
Start of rainfall	Kyneton	20 to 30 hours	Time to peak

Post Office flooding - Typical flood peak travel times			
Location from	**Location to**	**Typical travel time**	**Comments**
Start of rainfall	Kyneton	1 to 8 hours	Begin to rise from normal levels
Start of rainfall	Kyneton	4 to 12 hours	Time to peak

2. Overview of flooding consequences

2.1 Essential community infrastructure

Jeffrey Street sewer pump station – only potentially impacted in a 0.5% AEP flood event and greater. If flooding occurs at the pump station building, where pumps and electrical equipment are housed, and the electrical switchboards are flooded, there is a risk the pump station is offline for an extended period. Currently Coliban Water utilise an open basin adjacent to the Jeffrey St pump station for sewer overflows in emergency scenarios when the capacity of the pump station is exceeded. Usually this will be in significant rainfall events. The basin is immediately to the South of the pump station.

If flooding were to impact that basin, the risk is that a pool of untreated sewer would mix with the floodwater at this location. If Coliban Water are able to access the site via Jeffrey St in that scenario, we eduction trucks may be utilised to remove the sewer from the basin to ensure this doesn't happen.

There are plans to upgrade the pump station in the next five years which will likely factor in some of these flooding impacts and may include having switchboards above ground and extra measures to prevent ingress into pump station structures.

Other impacts may need to be considered – discuss with relevant agencies.

2.2 Isolation risk

Riverview Estate, a large residential development to the south of Kyneton Township, relies on access via Campaspe Dr. From approximately the 10% AEP flood event, Campaspe Drive is inundated to a depth of at least 50cm, isolating properties in Riverside Estate. This road may be flooded for approximately 24 hours.

The residential and farming area bounded by Post Office Creek to the south and the Calder Freeway to the north becomes isolated from approximately the 1% AEP flood event, when both Wedge Street and Ebden Street are overtopped. The duration of isolation may be approximately 4 hours.

2.3 Major road closures

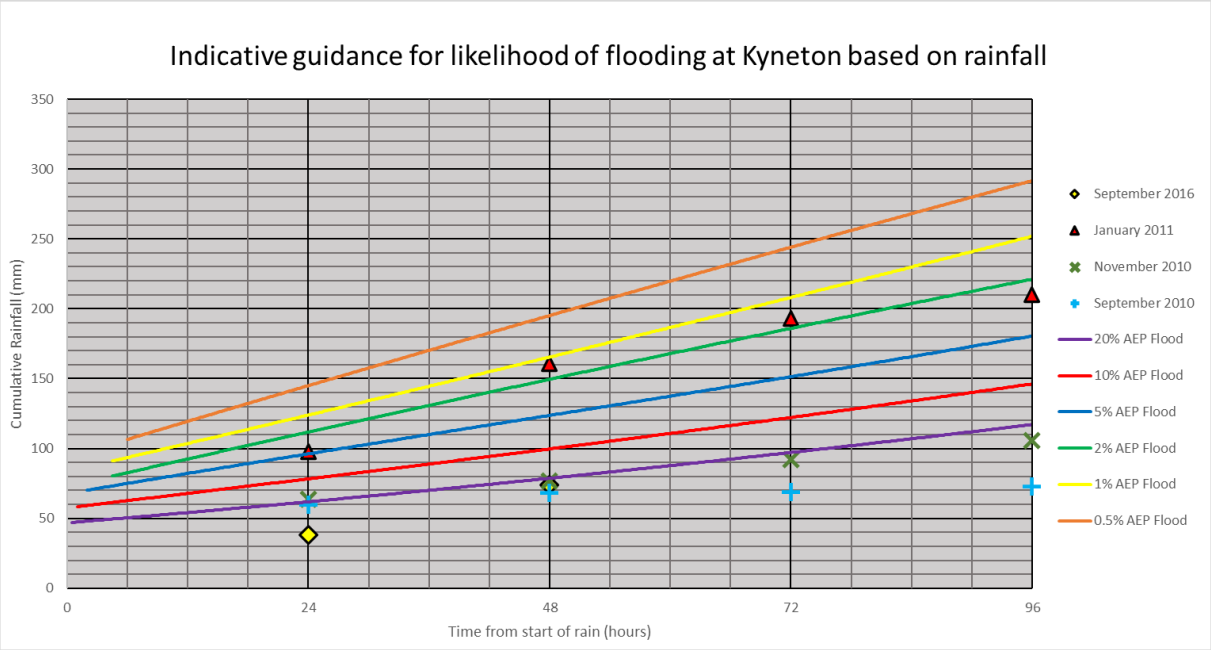
Several key roads which are impacted by flooding are listed below along with the depth of overtopping in various flood events. Other roads are also affected to various degrees depending on the flood magnitude as listed in the following tables and maps provided.

Road name	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP
Burton Avenue	NA	NA	0.1m	0.2m	0.3m	0.6m
Piper Street	NA	NA	NA	NA	NA	0.2m
Ebden Street (over Post Office Creek)	NA	NA	NA	NA	0.4m	0.45m
Campaspe Drive (at intersection with Windridge Way)	NA	0.5m	0.9m	1.2m	1.5m	2.0m

2.4 Indicative quick look Flood / No Flood guidance tool

The tool is aimed at providing a rapid indication of whether flooding is likely with some lead time. It is intended to be indicative only and will not provide a forecast of expected flood depth. The tool is designed to be linked to the mapping and intelligence produced by this project and in that way provides an indication of likely consequences. Unless there are unusual circumstances, actions as per the Flood Intelligence Card should be initiated as soon as the tool suggests flooding is likely. Response can be escalated if the tool indicates an increase in the expected severity of flooding.

The tool is driven by rainfall recorded at Five Mile Creek at Woodend Treatment Plant rain gauge (406266). IFD data from this location has been compared to the study area specific IFD data. Adjusted rainfall depths were then plotted against time to produce the tool as shown below. Rainfall data from this gauge should be used unless data from an alternative location is considered to be more representative of rainfall occurring in the catchment. If the catchment is dry, consider moving down one level. For example, if rainfall is on the 2% AEP curve and the catchment is dry, refer to the 5% AEP map.



3. Flood intelligence card

This flood intelligence card details the relationship between flood magnitude and flood consequences. Please note:

- While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Institute of Disaster Resilience (AIDR) Handbook series on Managing the Floodplain.
- All levels, impacts and actions listed in the following flood intelligence card and indicative Flood / No Flood guidance tool may need to be adjusted to better reflect experience.

Rainfall depth (mm)	Annual Exceedance Probability (%)	Consequence/ Impact	Action Actions may include: Evacuation, closure of road, sandbagging, issue warning and who is responsible etc.
USING THIS INTELLIGENCE CARD. Obtain rainfall data (e.g. 406266 Five Mile Creek @ Woodend Treatment Plant rain gauge) and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.			

50mm in 12 hours to 80mm in 48 hours	20% AEP	▪ 2 properties flooded above floor, 90 properties flooded below floor.
		▪ Campaspe River:
		  ▪ Several properties along Ebden Street and Pultney Street in Carlsruhe flooded.
		  ▪ Significant flooding on rural properties north of Carlsruhe
		  ▪ Intersection of Trio Road and Murphys Road inundated to a depth of over 0.5 metres.
		  ▪ Several properties in Kyneton flooded: Degraves Court, Mill Street, Jennings Street, Argyle Lane, Campaspe Place and Lennox Street.
		  ▪ Northern end of St Agnes Place subject to shallow flooding.
		  ▪ Kyneton Racecourse entirely inundated.
		  ▪ Farmland downstream of Kyneton Township inundated.
		▪ Post Office Creek:
		  ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding is unlikely.
		  ▪ Shallow flooding over Wedge Street bridge.
			▪ Monitor rainfall and water levels.
			▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts.
			▪ Consider actions to protect buildings subject to above floor flooding located in: Campaspe Place and the Kyneton Racecourse.
			▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place and Wedge Street.

70mm in 12 hours to	10% AEP	▪ 2 properties flooded above floor, 100 properties flooded below floor.	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an

100mm in 48 hours		▪ Campaspe River: ▪ Impacts similar to 20% AEP flood event. ▪ The rear of properties along Mill Street and St Agnes Place flooded. ▪ Campaspe Drive inundated to a depth of approximately 0.5 metres, isolating the Riverside Estate residential area located south of the township. ▪ Additional roads impacted: Franklin Place ▪ Post Office Creek: ▪ Impacts similar to 20% AEP flood event. ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding is unlikely.	appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts. ▪ Consider actions to protect buildings subject to above floor flooding located in: Campaspe Place and the Kyneton Racecourse. ▪ Monitor impacts to properties in Hall Court and consider sandbagging or relocating household effects. ▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place, Wedge Street,Franklin Place and Campaspe Drive. ▪ Consider impacts of Riverside Estate becoming isolated due to flooding of Campaspe Drive.
80mm in 12 hours to 120mm in 48 hours	5% AEP	▪ 3 properties flooded above floor, 114 properties flooded below floor. ▪ Campaspe River: ▪ Impacts similar to 10% AEP flood event. ▪ Additional properties impacted: Burton Avenue ▪ Additional roads impacted: Burton Avenue ▪ Post Office Creek: ▪ Impacts similar to 10% AEP flood event. ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding of some dwellings is possible.	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts. ▪ Consider actions to protect buildings subject to above floor flooding located in: Campaspe Place, Mill Street and the Kyneton Racecourse. ▪ Monitor impacts to properties in Hall Court and consider sandbagging or relocating household effects. ▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place, Wedge Street, Franklin Place, Campaspe Drive and Burton Avenue. • Consider impacts of Riverside Estate becoming isolated due to flooding of Campaspe Drive.
90mm in 12 hours to 150mm in 48 hours	2% AEP	▪ 6 properties flooded above floor, 122 properties flooded below floor. ▪ Campaspe River: ▪ Impacts similar to 5% AEP flood event. ▪ Post Office Creek: ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding of some dwellings is likely. ▪ Additional properties impacted: Ward Street and Powlett Street. ▪ Additional roads impacted: Johnson Court, Mollison Street, Ward Street	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts. ▪ Consider actions to protect buildings subject to above floor flooding located in: Campaspe Place, Mill Street, St Agnes Place, Windridge Way and the Kyneton Racecourse. ▪ Monitor impacts to properties in Hall Court and consider sandbagging or relocating household effects. ▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place, Wedge Street, Franklin Place, Campaspe Drive, Burton Avenue, Johnson Court, Mollison Street and Ward Street. ▪ Consider impacts of Riverside Estate becoming isolated due to flooding of Campaspe Drive.

100mm in 12 hours to 160mm in 48 hours	1% AEP	▪ 14 properties flooded above floor, 134 properties flooded below floor.
		▪ Campaspe River:
		  ▪ Impacts similar to 2% AEP flood event.
		  ▪ Additional roads impacted: Victoria Road
		▪ Post Office Creek:
		  ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding of some dwellings is likely.
		  ▪ Additional properties impacted: Ebden Street
		  ▪ Additional roads impacted: Ebden Street
		  ▪ With both Wedge Street and Ebden Street overtopped, the residential and farming area bounded by Post Office Creek to the south and the Calder Freeway to the north becomes isolated.
			▪ Monitor rainfall and water levels.
			▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts.
			▪ Consider actions to protect buildings subject to above floor flooding located in: Campaspe Place, Mill Street, St Agnes Place, Windridge Way, Ebden Street, Powlett Street, Ward Street and the Kyneton Racecourse.
			▪ Monitor impacts to properties in Hall Court and consider sandbagging or relocating household effects.
			▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place, Wedge Street, Franklin Place, Campaspe Drive, Burton Avenue, Johnson Court, Mollison Street, Ward Street, Victoria Road and Ebden Street.
			▪ Consider impacts of Riverside Estate becoming isolated due to flooding of Campaspe Drive.
			▪ Consider impacts of the residential and farming land bounded by Post Office Creek to the south and the Calder Freeway to the north becoming isolated due to overtopping of both Wedge Street and Ebden Street.

120mm in 12 hours to 190mm in 48 hours	0.5% AEP	▪ 17 properties flooded above floor, 143 properties flooded below floor. ▪ Campaspe River: ▪ Impacts similar to 1% AEP flood event. ▪ Additional roads impacted: Piper Street, and Cobb and Co Road in Carlsruhe ▪ Post Office Creek: ▪ Likely flooding of Hall Court properties fronting Post Office Creek. Above floor flooding of some dwellings is likely.	▪ Monitor rainfall and water levels. ▪ Use the quick look flood / no flood tool to develop an appreciation of the likely scale of the flood event and refer to indicated maps and tables for potential impacts. ▪ Monitor impacts to properties in Hall Court and consider sandbagging or relocating household effects. ▪ Deploy “water over road signs” and consider closing Trio Road/Murphys Road intersection, St Agnes Place, Wedge Street, Franklin Place, Campaspe Drive, Burton Avenue, Johnson Court, Mollison Street, Ward Street, Victoria Road, Ebden Street, Piper Street, and Cobb and Co Road (Carlsruhe). ▪ Consider impacts of Riverside Estate becoming isolated due to flooding of Campaspe Drive. ▪ Consider impacts of the residential and farming land bounded by Post Office Creek to the south and the Calder Freeway to the north becoming isolated due to overtopping of both Wedge Street and Ebden Street.

3.1 Summary of properties flooded

Summary of number of flood affected properties in Kyneton (Existing conditions) (NCCMA, 2019)						
	Design flood AEP (%)					
	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP
Number of properties flooded above floor	2	2	3	6	14	17
Number of properties flooded below floor only	90	100	114	122	134	143
Total number of flooded properties	92	102	117	128	148	160

3.2 Detailed list of properties flooded

Kyneton – EXISTING CONDITIONS (ref NCCMA, 2019)													
LEGEND		Within ~100mm of flooding over-floor						Depth of over-floor flooding					**Comments**
	Depth of flooding near building for each AEP						**Depth of over-floor flooding at property for each AEP**						
Location (Number & Street)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	
24 Argyle Lane						0.48							Dwelling
171 Burton Avenue				0.13	0.24	0.48							Dwelling
11 Campaspe Drive					0.16	0.74							Dwelling
2 Campaspe Place						0.01							Dwelling
38 Campaspe Place	0.29	0.40	0.47	0.55	0.60	0.76	0.29	0.40	0.47	0.55	0.60	0.76	Shed/Horse Stable
44 Campaspe Place							0.27	0.44	0.56	0.64	0.72	0.91	Racecourse - First Aid Room at the back of the Main Building
44 Campaspe							0.45	0.59	0.70	0.79	0.86	1.05	Racecourse -

Kyneton – EXISTING CONDITIONS (ref NCCMA, 2019)													
LEGEND		Within ~100mm of flooding over-floor						Depth of over-floor flooding					
Location (Number & Street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**						**Comments**
	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	
Place													Elms Room
44 Campaspe Place									0.07	0.15	0.22	0.39	Racecourse - Northern Shed
44 Campaspe Place							0.06	0.12	0.19	0.25	0.31	0.47	Racecourse - TAB Building
44 Campaspe Place								0.39	0.48	0.55	0.61	0.78	Racecourse - Lucky Bean Bar at the back of the Main Building
83 Ebden Street					0.52	0.52							Dwelling
84 Ebden Street				0.34	0.98	0.98					0.44	0.44	Dwelling
Hall Court													A number of dwellings on Hall Court potentially impacted but extent of flooding is unknown.
13 Mill Street					0.01	0.45			0.12	0.33	0.51	0.95	Dwelling
93 Mitchell Street			0.16	0.31	0.44	0.73							Dwelling
94 Mitchell Street					0.73	1.03							Dwelling
1/79-81 Powlett					0.18	0.32							Dwelling

Kyneton – EXISTING CONDITIONS (ref NCCMA, 2019)													
LEGEND		Within ~100mm of flooding over-floor						Depth of over-floor flooding					**Comments**
	Depth of flooding near building for each AEP						**Depth of over-floor flooding at property for each AEP**						
Location (Number & Street)	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	
Street													
2/79-81 Powlett Street						0.25							Dwelling
3/79-81 Powlett Street					0.17	0.28					0.13	0.24	Dwelling
4/79-81 Powlett Street					0.10	0.21						0.02	Dwelling
2 St Agnes Place				0.49	0.57	0.91							Dwelling
4 St Agnes Place				0.39	0.48	0.79				0.05	0.14	0.45	Dwelling
6 St Agnes Place			0.11	0.33	0.55	0.95						0.24	Dwelling
8 St Agnes Place		0.40	0.68	0.90	1.08	1.53				0.06	0.25	0.70	Dwelling
10 St Agnes Place		0.22	0.49	0.70	0.89	1.35					0.15	0.61	Dwelling
1C Ward Street					0.17	0.17							Dwelling
1D Ward Street					0.22	0.22							Dwelling
3 Ward Street					0.87	0.87							Dwelling
5 Ward Street					0.73	0.73					0.44	0.44	Dwelling
7 Ward Street					0.52	0.52					0.04	0.04	Dwelling
1/9 Ward Street					0.64	0.64							Dwelling
2/9 Ward Street					0.06	0.06							Dwelling
11 Ward Street				0.33	0.98	0.98					0.31	0.31	Dwelling
1/13 Ward Street					0.56	0.56					0.50	0.50	Dwelling

Kyneton – EXISTING CONDITIONS (ref NCCMA, 2019)													
LEGEND		Within ~100mm of flooding over-floor						Depth of over-floor flooding					**Comments**
Location (Number & Street)	**Depth of flooding near building for each AEP**						**Depth of over-floor flooding at property for each AEP**						
	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	
2/13 Ward Street					0.38	0.38					0.14	0.14	Dwelling
86 Wedge Street				0.02	0.08	0.14							Dwelling
2 Windridge Way		0.22	0.62	0.90	1.19	1.77				0.11	0.40	0.98	Dwelling
4 Windridge Way						0.55						0.11	Dwelling
5 Windridge Way						0.11							Dwelling

Appendix C: Flood warning systems

1. Introduction

Flood Warning products and Flood Class Levels can be found on the BOM website. Flood Warning products include Severe Thunderstorm Warnings, Severe Weather Warnings, Flood Watches and Flood Warnings.

2. Severe Thunderstorm and Severe Weather Warnings

BOM can forecast the environment in which severe thunderstorms or small-scale weather systems that are locally intense and slow moving may occur and provides a generalised service to that effect. However, it is not yet scientifically possible to predict individual flash flooding events except on time scales of tens of minutes at the very best.

BOM issues warnings for flash flooding when it becomes apparent that an event has commenced which may lead to flash flooding or when flash flooding has commenced.

3. Flood Watches

Flood watches are issued by BOM to notify communities and other stakeholders within broad areas (rather than specific catchments) of the potential flood threat from a developing weather situation. They provide a 'heads up' of likely flooding.

Flood watches are based on an assessment of the developing weather situation and indicators of current catchment wetness. They provide generalised statements about expected forecast rainfall totals, the current state of the catchments within the target area and the streams at risk from flooding. Instructions for obtaining rain and stream level observations and access to updated Watches and Warnings are also included.

Normally, BOM would issue a Flood Watch 24 to 36 hours in advance of any likely flooding and issue updates as required. If at any time during that period there was an imminent threat of floods occurring, the Flood Watch would be upgraded to a Flood Warning.

4. Flood Warnings

Flood Warnings are firm predictions of flooding based on actual rainfall and river height information as well as the results of stream flow based models of catchment behaviour that take account of antecedent conditions (i.e. the 'wetness' of the catchment, storage levels within dams, etc) and likely future rainfall. Releases from dams are an essential input to such models.

Flood Warnings are categorised as 'minor', 'moderate' or 'major' (see BOM website for an explanation of these terms and current flood class levels) and indicate the expected severity of the flood for agreed key locations along the river. More specifically, flood warnings usually include:

- Rainfall amounts for selected locations within and adjacent to the catchment
- River heights and trends (rising, steady, falling) at key locations within the catchment
- Outflows (in ML/d) from any major dams within the catchment
- Forecasts of the height and time of flood peaks at key locations
- Weather forecast and the likely impact of expected rainfall on flooding
- A warning re-issue date and time.

Note 1: The term "local flooding" may be used for localised flooding resulting from intense rainfall over a small area.

Note 2: The term “significant rises” may be used in the early stages of an event when it is clear that river levels will rise but it is too early to say whether they will reach flood level.

Additional information (e.g. weather radar and satellite images as well as updated rain and river level information) can also be obtained at www.bom.gov.au/vic/flood/rain_river.shtml or by calling 1300 659 217.

4.1 Gisborne

Flood forecasts and warnings are provided to Rosslynne Reservoir Head Gauge, the downstream gauge and the gauge at the Calder Highway Bridge in Gisborne in terms of minor, moderate and major flooding. The tool provided in Section 5.4 of Appendix B1 provides additional indicative guidance on the likelihood and expected severity of flooding at Gisborne based on consideration of rainfall.

4.2 Kyneton

Flood warnings are currently not provided for the Campaspe River upstream of Kyneton. The tool provided in Section 2.4 of Appendix B6 provides additional indicative guidance on the likelihood and expected severity of flooding at Kyneton based on consideration of rainfall.

4.3 Other towns

Flood warnings are currently not provided for other towns within the municipality. The tools provided in Appendices B3, B4 and B5 provide additional indicative guidance on the likelihood and expected severity of flooding at Lauriston, Malmsbury and Tylden respectively based on consideration of rainfall.

5. Public information and warnings

VICSES uses EM-COP Public Publishing to distribute riverine and flash flood warnings in Victoria. The platform enables automatic publishing to the VicEmergency app, website and hotline (1800 226 226). Communities can also access this information through VICSES social media channels (Victoria State Emergency Service on Facebook and VICSES News on Twitter) and emergency broadcasters, such as Sky News TV and various radio stations (current list available via the EMV website).

VICSES Regions (or ICCs where established) lead the issuing of warnings for riverine flood events when pre-determined triggers are met (issuing of a BOM Flood Watch or Warning) and share locally tailored information via the standard VICSES communication channels (social media, traditional media, web and face to face). These activities are coordinated by the VICSES RDO and approved by the VICSES RAC, or the PIO and IC respectively (when an ICC is active).

VICSES at the state tier (or SCC Public Information Section) plays an important role in sharing riverine and flash flood information via state-based standard communication channels. If verified reports are received of flash flooding posing, or resulting in, a significant threat to life or property, VICSES Regions (or ICCs) will issue a flash flood warning product via EM-COP.

During some emergencies, VICSES may alert communities by sounding a local siren, or by using the Emergency Alert (EA) platform to send an SMS to mobile phones or a voice message to landlines. The use of sirens for higher-end warnings has been pre-determined, and mapped to relevant warning templates in EM-COP.

EM-COP Public Publishing Business Rules for Riverine and Flash Flood are available in the **Public Information tab** of the IMT Toolbox, providing further guidance on specific triggers, roles and responsibilities. VICSES SOP057 and JSOP 04.01 provide further guidance.

6. Local Flood Alerting / Warning Arrangements

6.1 Five Mile Creek at Woodend

A levee has been constructed at Campaspe Drive and Pyke Street in Woodend. It provides 1% AEP flood protection from Five Mile Creek. The pumps associated with the system often need to be manually engaged. The gauge installed on Five Mile Creek at Campaspe Drive and Pyke Street notifies the Manager Safer Communities who advises the MEMO to monitor creek levels – see Five Mile Creek procedure.

There are no other local flood warning systems or arrangements in place within the Shire.

7. Flood class levels

The occurrence of a certain class of flooding at one point in a catchment will not necessarily lead to the same class of flooding at other points – for example along the main river and its tributary creeks or along a drainage network's overland flow paths. This is because the floodplain physiography and use (and thus flood impact) varies along the river or flow path and also because antecedent conditions combined with where and how rainfall occurs (both in time and space) will drive how a flood develops and progresses.

The flood class levels quoted in the table below refer to that part of the watercourse where the flood effects can be related to the reading from the actual or proposed gauge. It is important to remember that flood impact is dependent on more than the peak height or flow. The rate of rise, duration, extent and season of flooding are also important. For this reason, flood class levels can only be considered as a guide to flood severity.

8. Details of relevant gauges

Station No	River / Creek	Station	Flood Class Levels (m)			Gauge Zero (m AHD)
			Minor	Moderate	Major	
230101	Emu Creek	Clarkefield				
230107	Deep Creek	Konagaderra				
230119	Deep Creek	Lancefield (Doggetts Bridge)				
230232	Deep Creek	Bolinda				
230100	Deep Creek	Darraweit Guim	5.5	6.1	6.5	230.830
230217	Garden Hut Ck	U/s of Lancefield Reservoir				
230204	Riddells Creek	Riddells Creek				
230209	Barringo Creek	Barringo (u/s of Diversion)				
230213	Turitable Creek	Mount Macedon				
230231	Willimigongon Ck	Mt Macedon-Anzac Road				
230210	Salt Water Creek	Bullengarook				
230226	Slaty Creek	Blackwood Road				
230223	Slaty Creek	Rosslynne Reservoir				
230222	Gisborne Creek	U/s Rosslynne Reservoir				
230103	Jacksons Creek	Rosslynne Reservoir HG	51.4	51.75	52.1	400.000
230202	Jacksons Creek	Sunbury				
230206	Jacksons Creek	Gisborne	1.4	2.0	2.4	
	Jacksons Creek	D/s Rosslynne Reservoir	1.8	2.5	3.6	418.772
230233	Jacksons Creek	Gisborne Treatment Plant				
406200	Coliban River	Malmsbury				
406250	Coliban River	Springhill-Tylden Road				
406266	Five Mile Creek	Woodend				
406269	Five Mile Creek	Woodend Township				
406208	Campaspe River	Ashbourne				

Appendix D: Maps

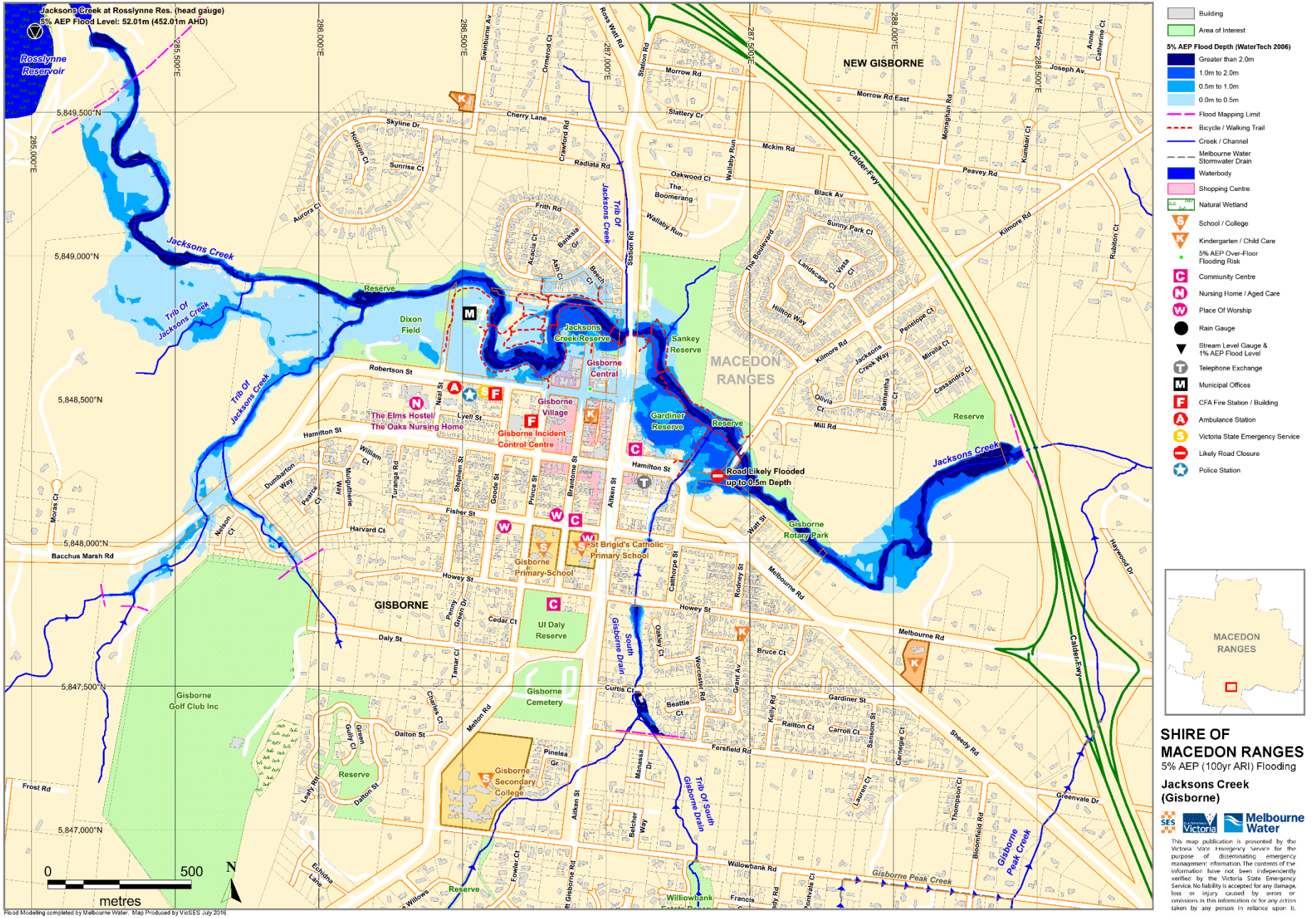
Maps considered useful to flood response are included in this Appendix. They comprise:

- Maps showing flood extents and depths at Gisborne for the design flood events considered in the Gisborne Flood Study (Water Technology, 2006), including:
  - 5%, 2% and 1% AEP (with key features marked)
  - 0.2% AEP
  - Probable Maximum Flood (PMF)
- A map of Gisborne showing the modelled flood extents and the locations of affected properties extracted from the Gisborne Flood Study report (Water Technology, 2006).
- 1% AEP flood extents for Riddells Creek at:
  - Macedon
  - Riddells Creek.
- 1% AEP flood extents for:
  - Five Mile Creek in Romsey
  - Deep Creek at Darraweit Guim
  - Peak Creek at Gisborne
  - Campaspe River at Kyneton
  - Coliban River at Malmsbury
  - Five Mile Creek at Woodend
- A set of maps showing flood extents for several design flood events (20% to 0.5% AEP) for Kyneton.
- A map of Kyneton showing the modelled flood extent and the locations of affected properties.

Note:

- A 2022 upgrade to the Kilmore Road intersection in Gisborne has altered the extents shown in maps generated by the 2006 Gisborne Flood Study. A new flood study has not been commissioned as no funding is available, however this is a high priority for the Municipal Storm and Flood Planning Committee. **Please refer to Appendix B1 and seek local advice from Council and/or VICSES when using the following maps for operational purposes.**
- FloodZoom is a web-based tool that provides an authoritative range of flood information before, during and after floods. This tool contains information collated and produced from all flood studies that have been undertaken in Macedon Ranges. This tool cannot be accessed by the general public but can be accessed by registered users from the relevant emergency services including Council, VICSES and CMAs. The information available includes flood extents, flood depths, flow velocities and water surface elevations for a range of possible flood events as well as past flood information.
- Maps showing the Urban Flood Zone, Floodway Overlay and Land Subject to Inundation Overlay are included in the Macedon Ranges Planning Scheme. These maps can be used as a guide to areas that may flood during an event. The maps can be found in hard copy form in the Shire Offices or online at the Department of Transport and Planning website (see the list of references in Appendix G)

Jacksons Creek – Gisborne – 5% AEP (Water Technology, 2006)



Flood Modelling completed by Melbourne Water. Map Produced by VicSES July 2016.

Building
Area of Interest

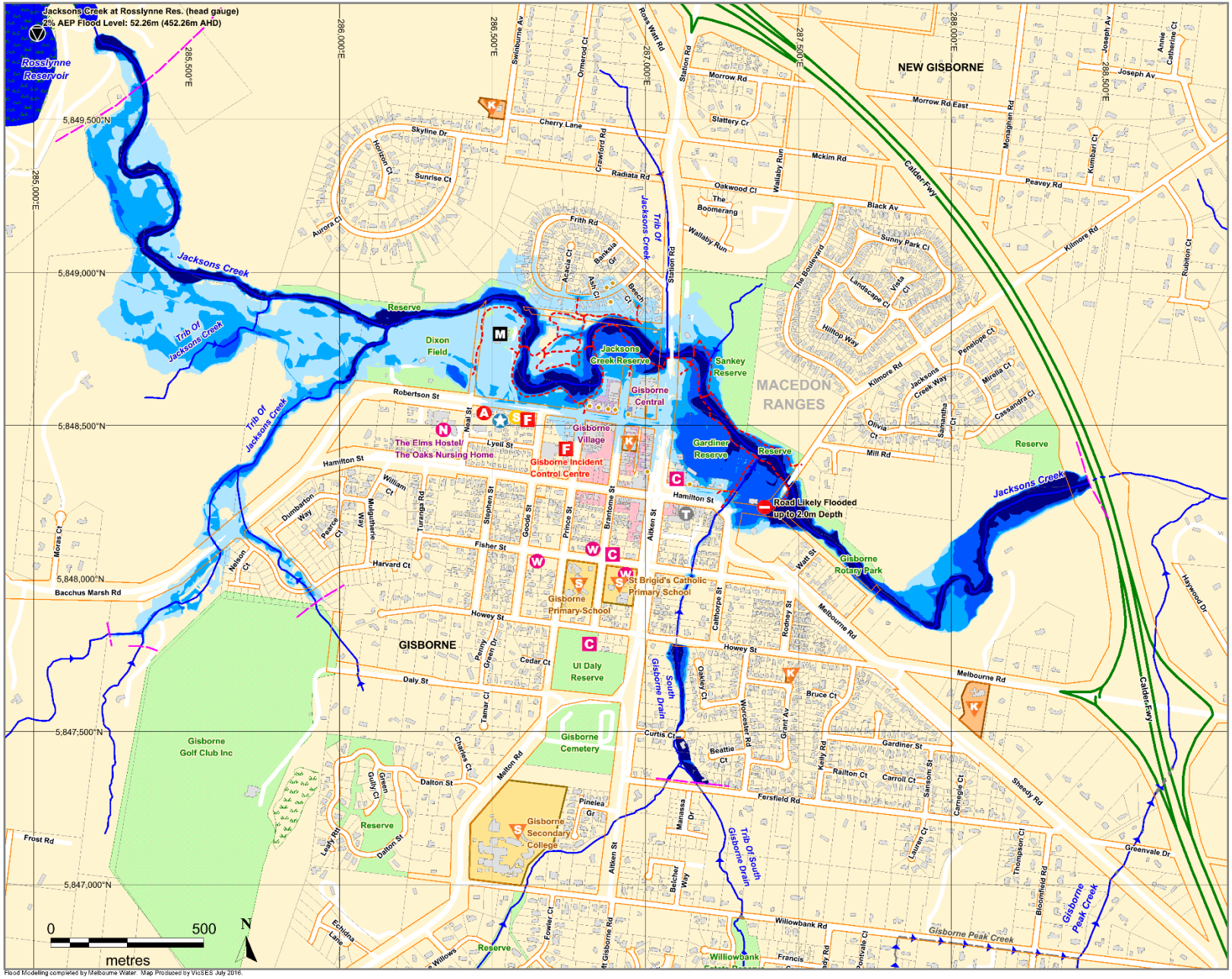
5% AEP Flood Depth (WaterTech 2006)

- Greater than 2.0m
- 1.0m to 2.0m
- 0.5m to 1.0m
- 0.0m to 0.5m
- Flood Mapping Limit
- Bicycle / Walking Trail
- Creek / Channel
- Melbourne Water Stormwater Drain
- Waterbody
- Shopping Centre
- Natural Wetland
- School / College
- Kindergarten / Child Care
- 5% AEP Over-Floor Flooding Risk
- Community Centre
- Nursing Home / Aged Care
- Place Of Worship
- Rain Gauge
- Stream Level Gauge & 1% AEP Flood Level
- Telephone Exchange
- Municipal Offices
- CFA Fire Station / Building
- Ambulance Station
- Victoria State Emergency Service
- Likely Road Closure
- Police Station

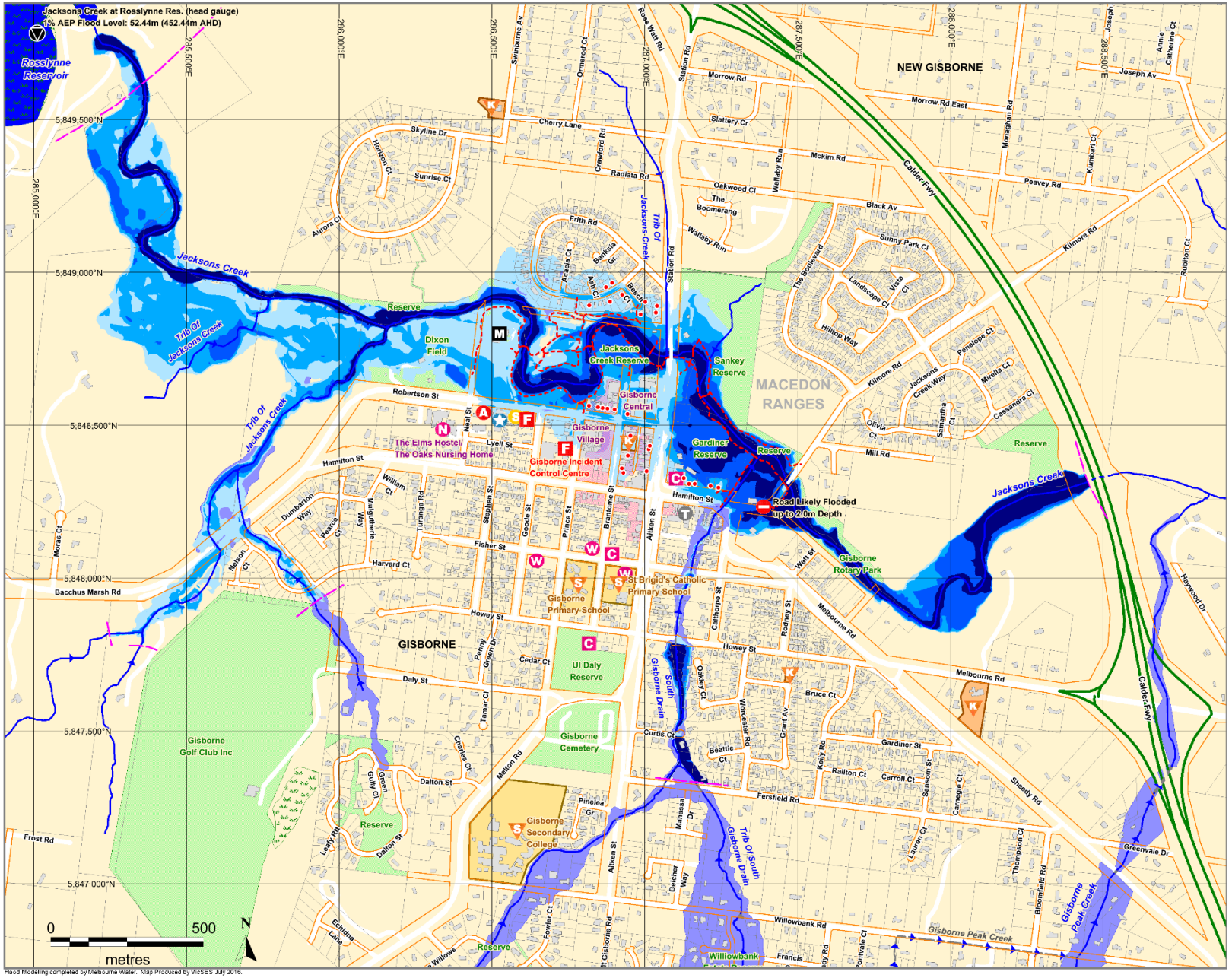
SHIRE OF MACEDON RANGES
5% AEP (100yr ARI) Flooding
Jacksons Creek (Gisborne)

SES Victoria Melbourne Water

Jacksons Creek – Gisborne – 2% AEP (Water Technology, 2006)



Jacksons Creek – Gisborne – 1% AEP (Water Technology, 2006)

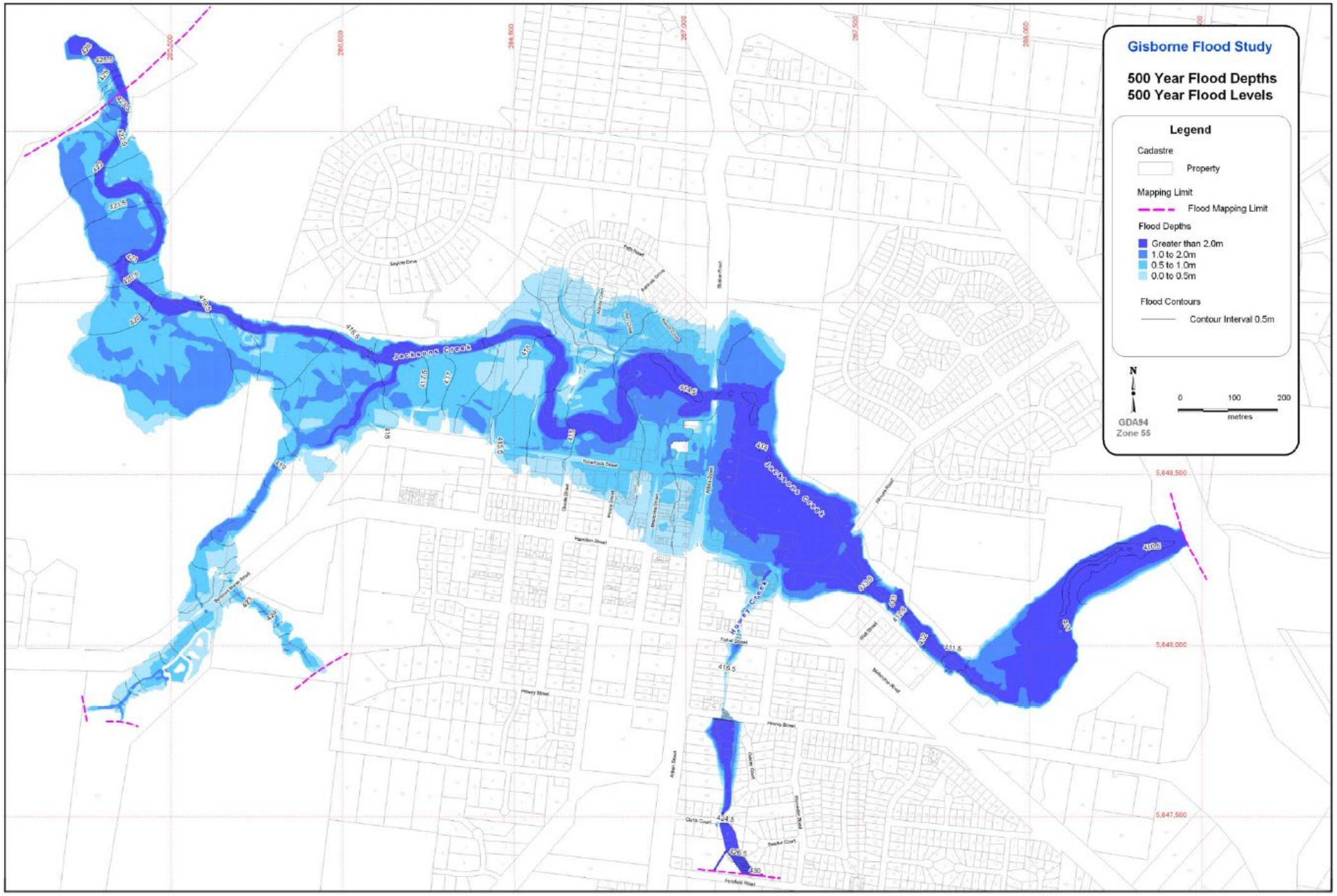


Building
Area of Interest
1% AEP Flood Depth (WaterTech 2006)
Greater than 2.0m
1.0m to 2.0m
0.5m to 1.0m
0.0m to 0.5m
Flood Mapping Limit
Bicycle / Walking Trail
Creek / Channel
Melbourne Water Stormwater Drain
1% AEP Riverine Flood Extent (Depth Unavailable)
Waterbody
Shopping Centre
Natural Wetland
School / College
Kindergarten / Child Care
1% AEP Over-Floor Flooding Risk
Community Centre
Nursing Home / Aged Care
Place Of Worship
Rain Gauge
Stream Level Gauge & 1% AEP Flood Level
Telephone Exchange
Municipal Offices
CFA Fire Station / Building
Ambulance Station
Victoria State Emergency Service
Likely Road Closure
Police Station

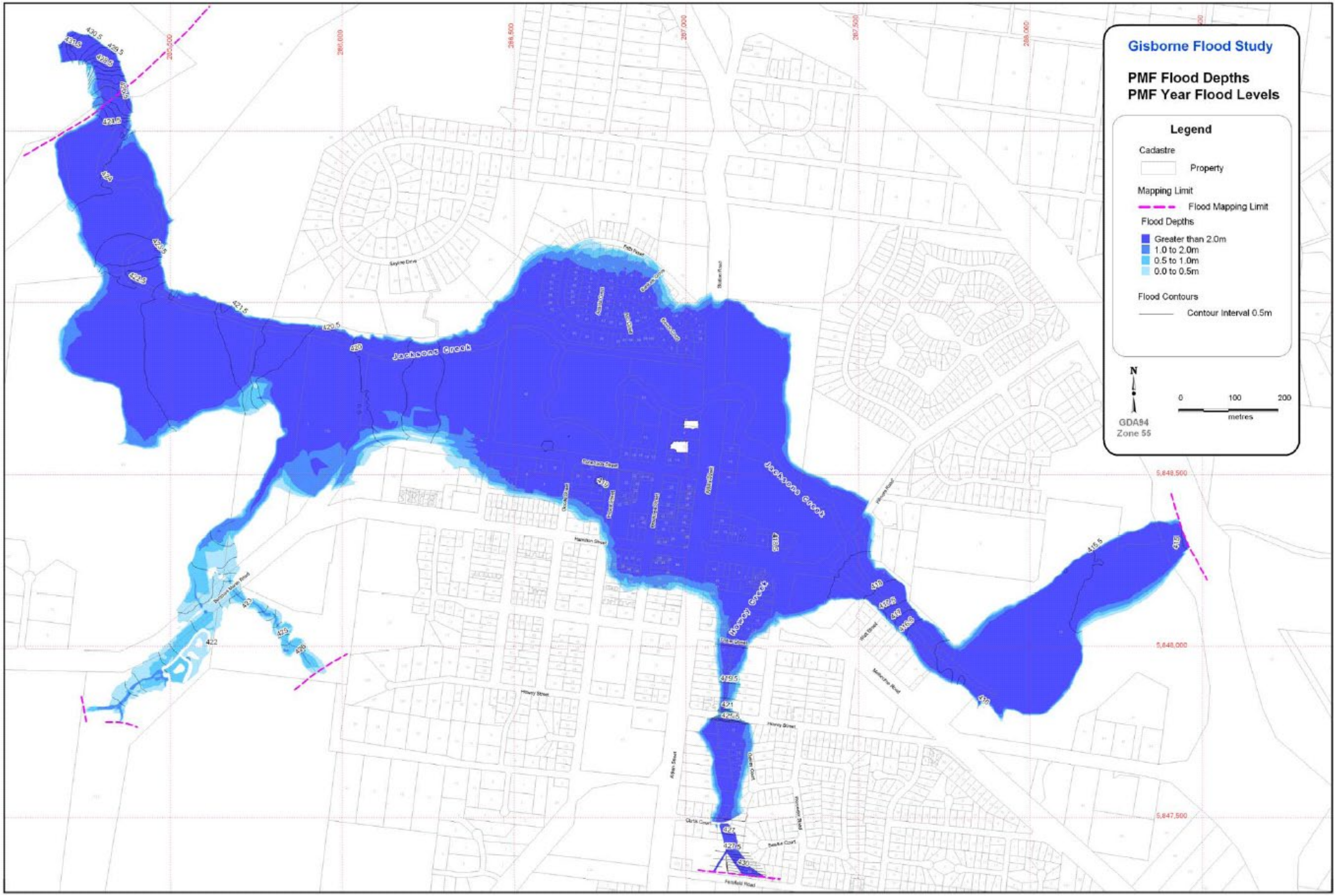
SHIRE OF MACEDON RANGES
1% AEP (100yr ARI) Flooding
Jacksons Creek (Gisborne)

SES Victoria Melbourne Water

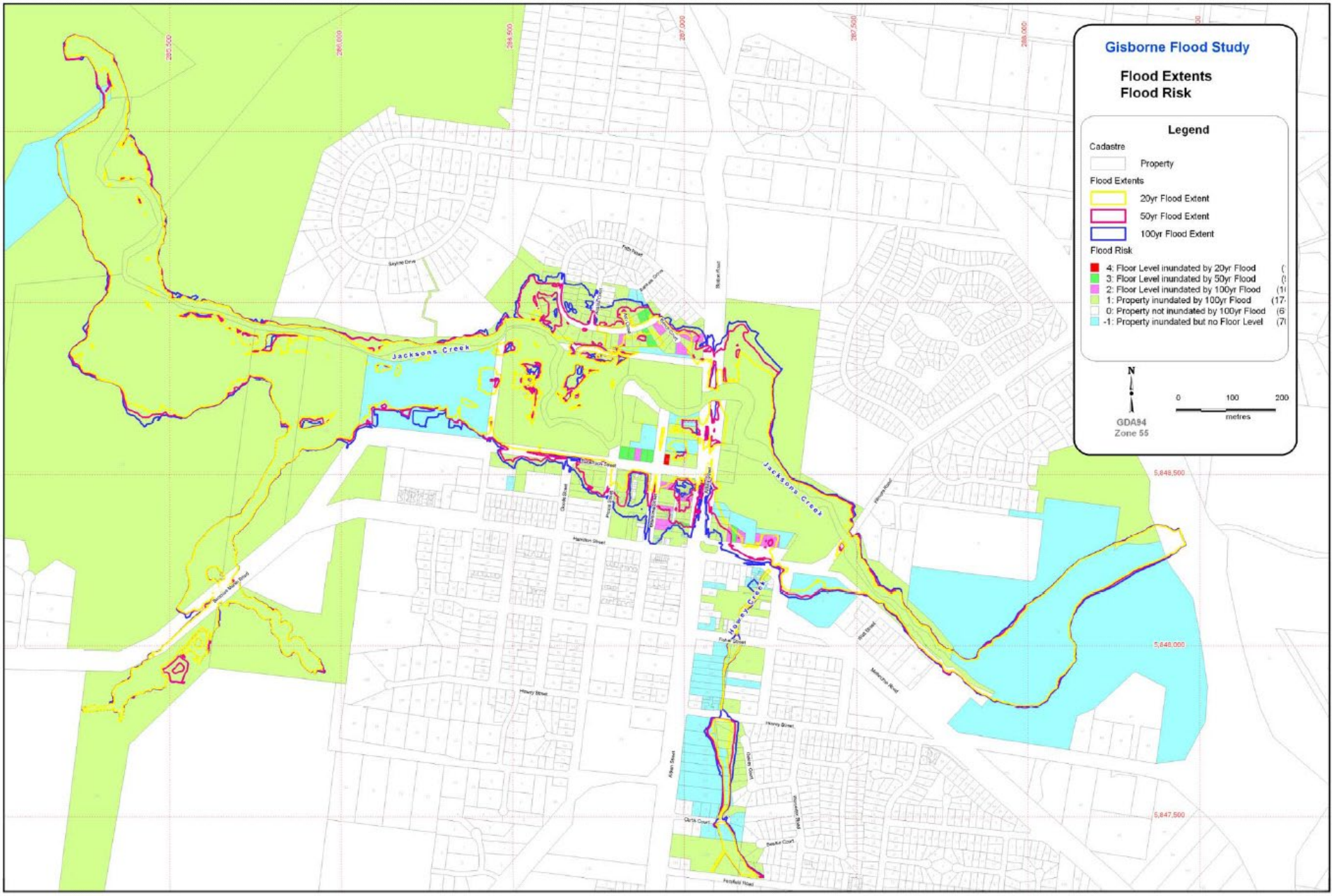
Jacksons Creek – Gisborne – 0.2% AEP (Water Technology, 2006)



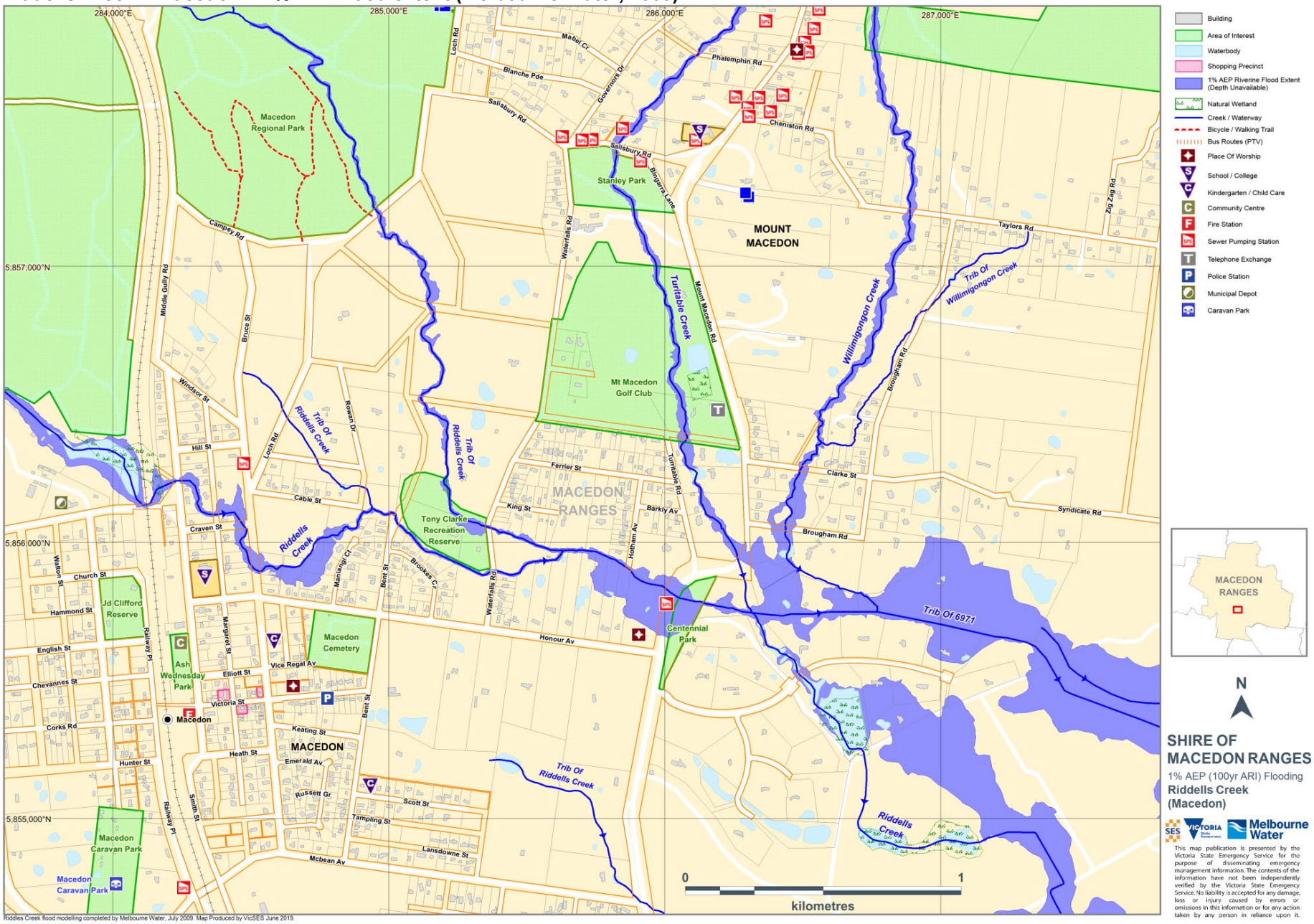
Jacksons Creek – Gisborne – Probable Maximum Flood (PMF) (Water Technology, 2006)



Jacksons Creek – Gisborne – Properties inundated under/above floor level (Water Technology, 2006)

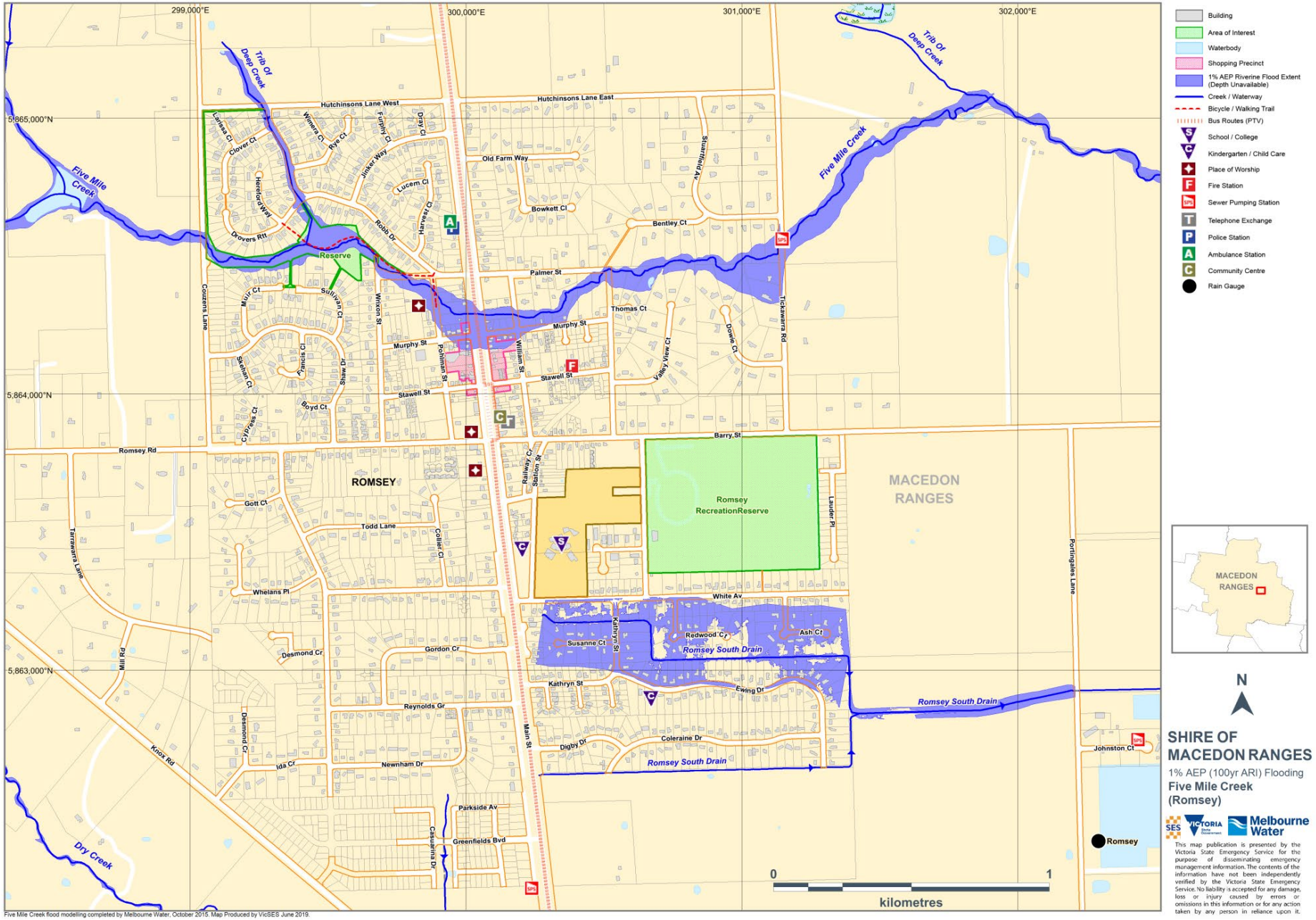


Riddells Creek – Macedon – 1% AEP flood extent (Melbourne Water, 2009)

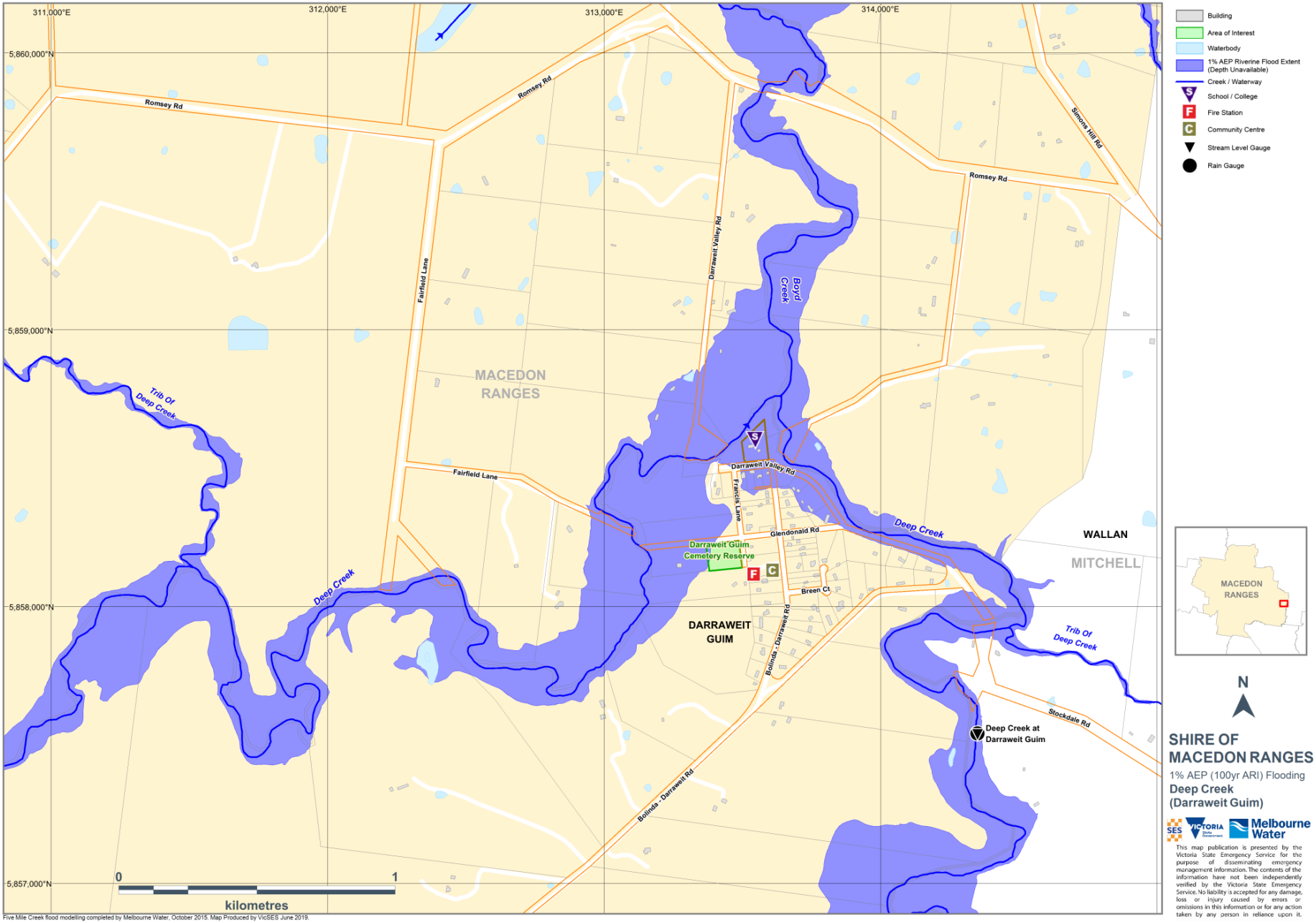


Riddells Creek – Riddells Creek – 1% AEP flood extent (Melbourne Water, 2009)

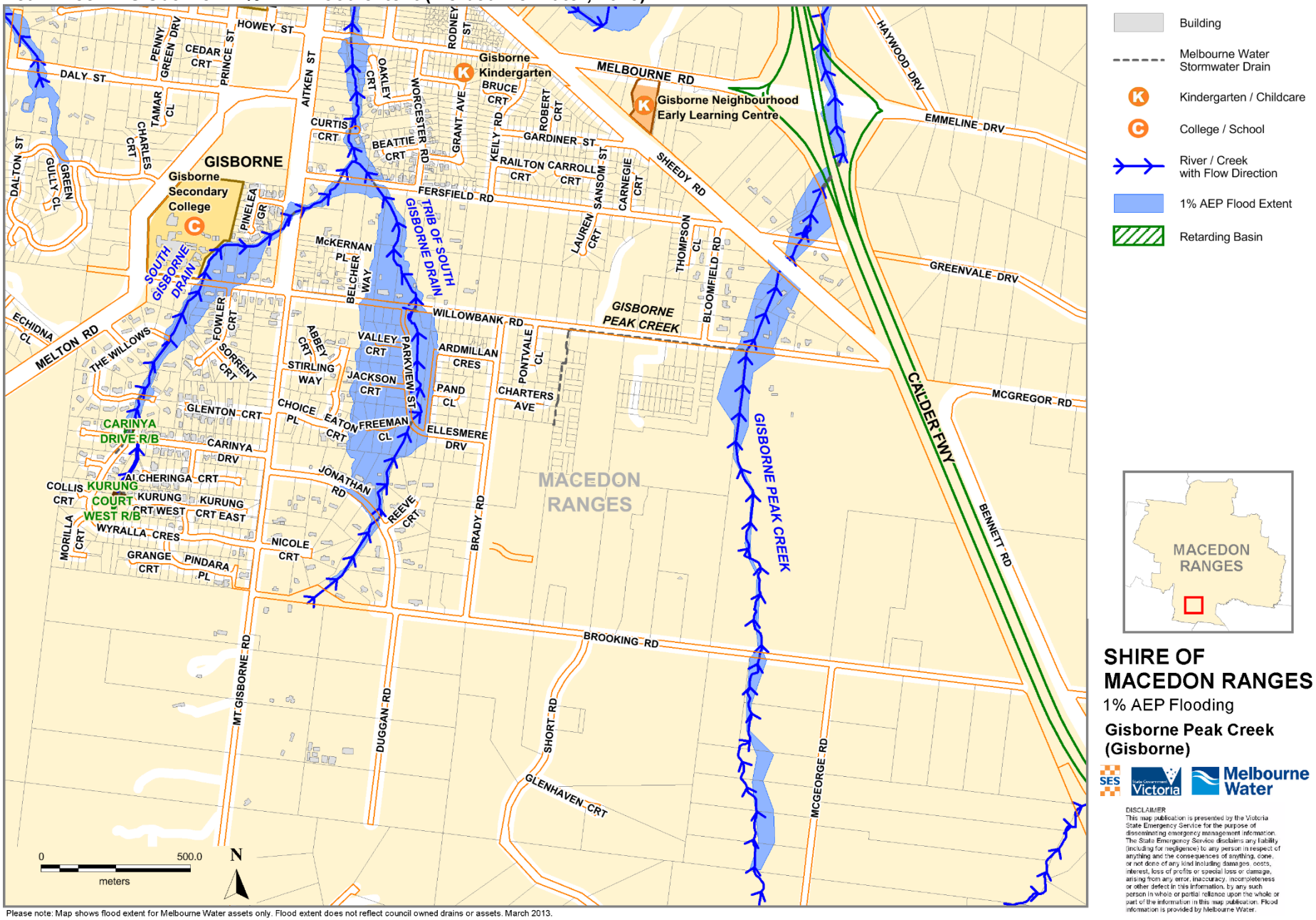
Five Mile Creek – Romsey – 1% AEP flood extent (Melbourne Water, 2015)



Deep Creek – Darraweit Guim – 1% AEP flood extent (Melbourne Water, 2015)

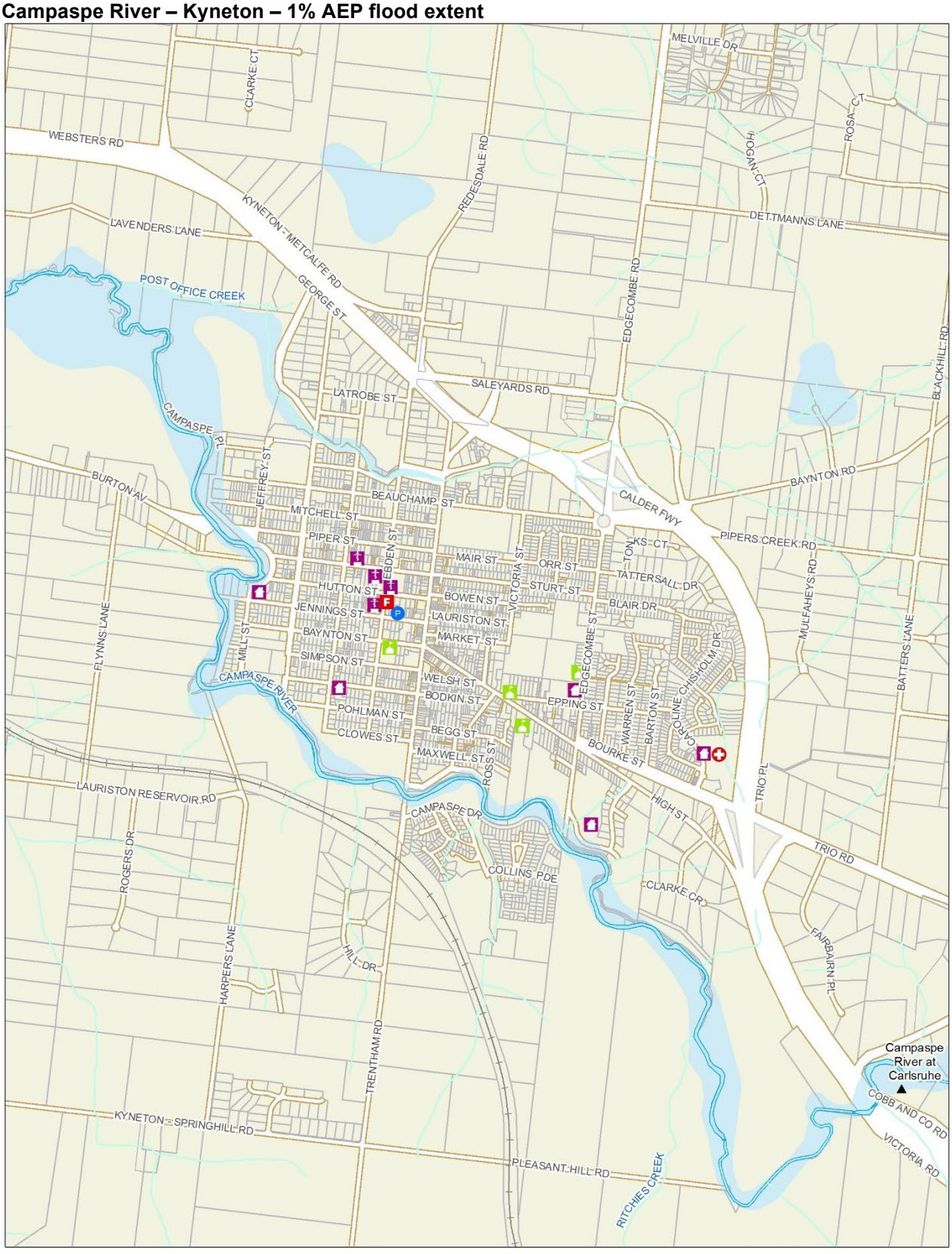


Peak Creek – Gisborne – 1% AEP flood extent (Melbourne Water, 2013)



Please note: Map shows flood extent for Melbourne Water assets only. Flood extent does not reflect council owned drains or assets. March 2013.

Campaspe River – Kyneton – 1% AEP flood extent



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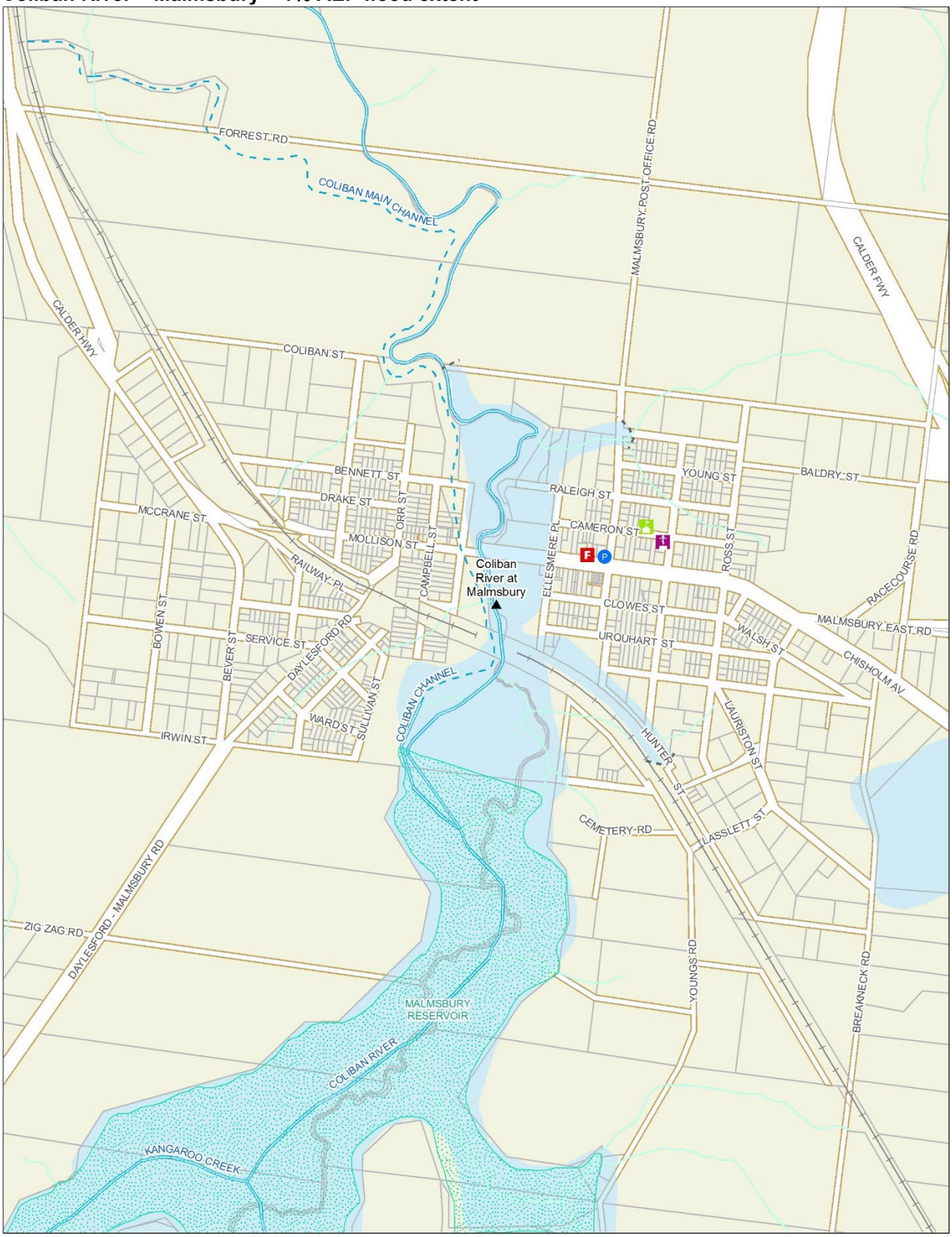
Coliban River – Malmsbury – 1% AEP flood extent



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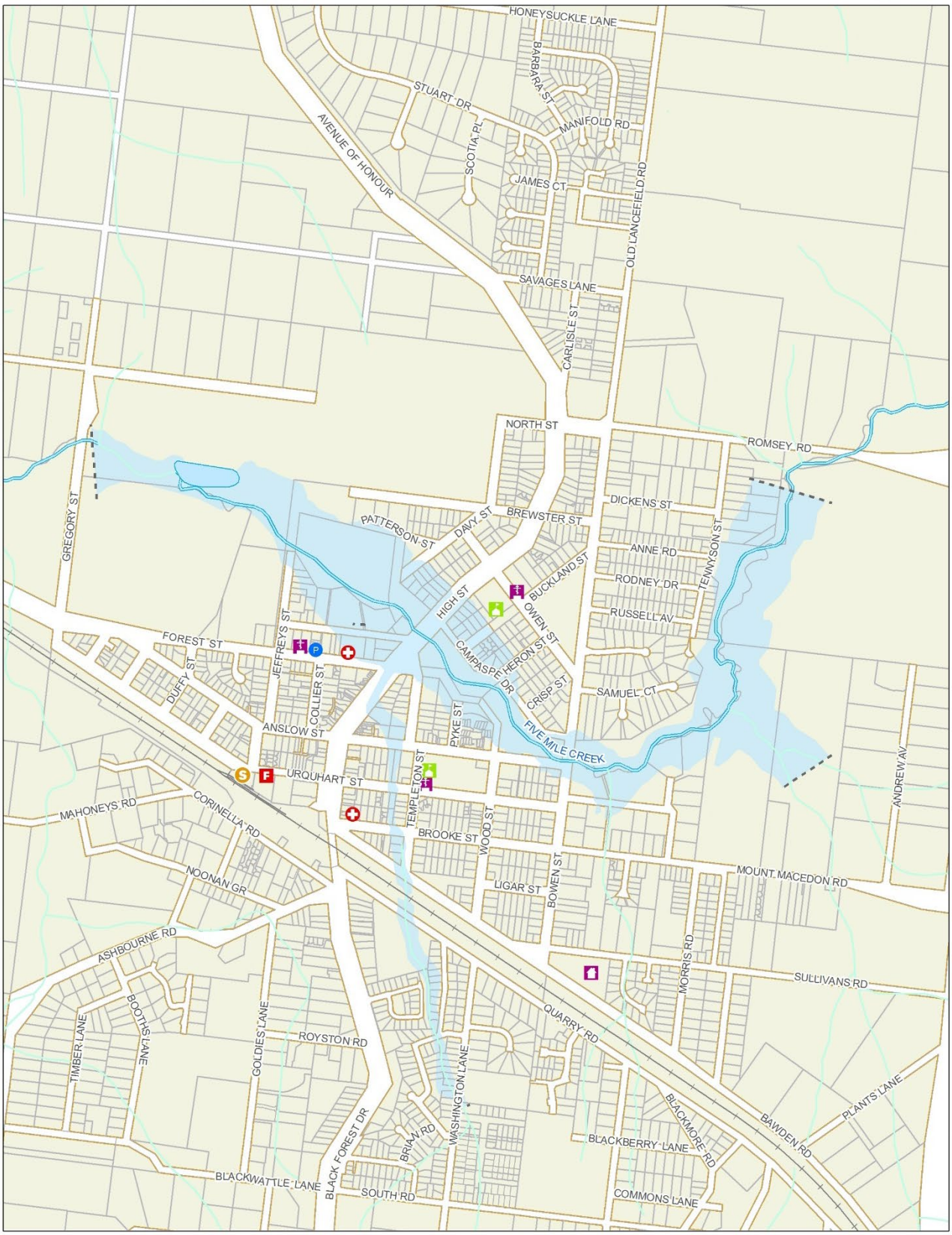
Five Mile Creek – Woodend – 1% AEP flood extent



N

Scale at A4

Metres

0 100 200 400

1:15,000

- Fire Station
- Medical Centre
- Police Station
- SES Unit
- School
- Nursing Home
- Church
- Rail Line
- Road
- Extent of Flood Data
- River/Creek
- Creek/Stream
- 1% AEP Flood
- November 1992 Flood Event
- Cadastre

SES

Macedon Ranges

NORTH CENTRAL

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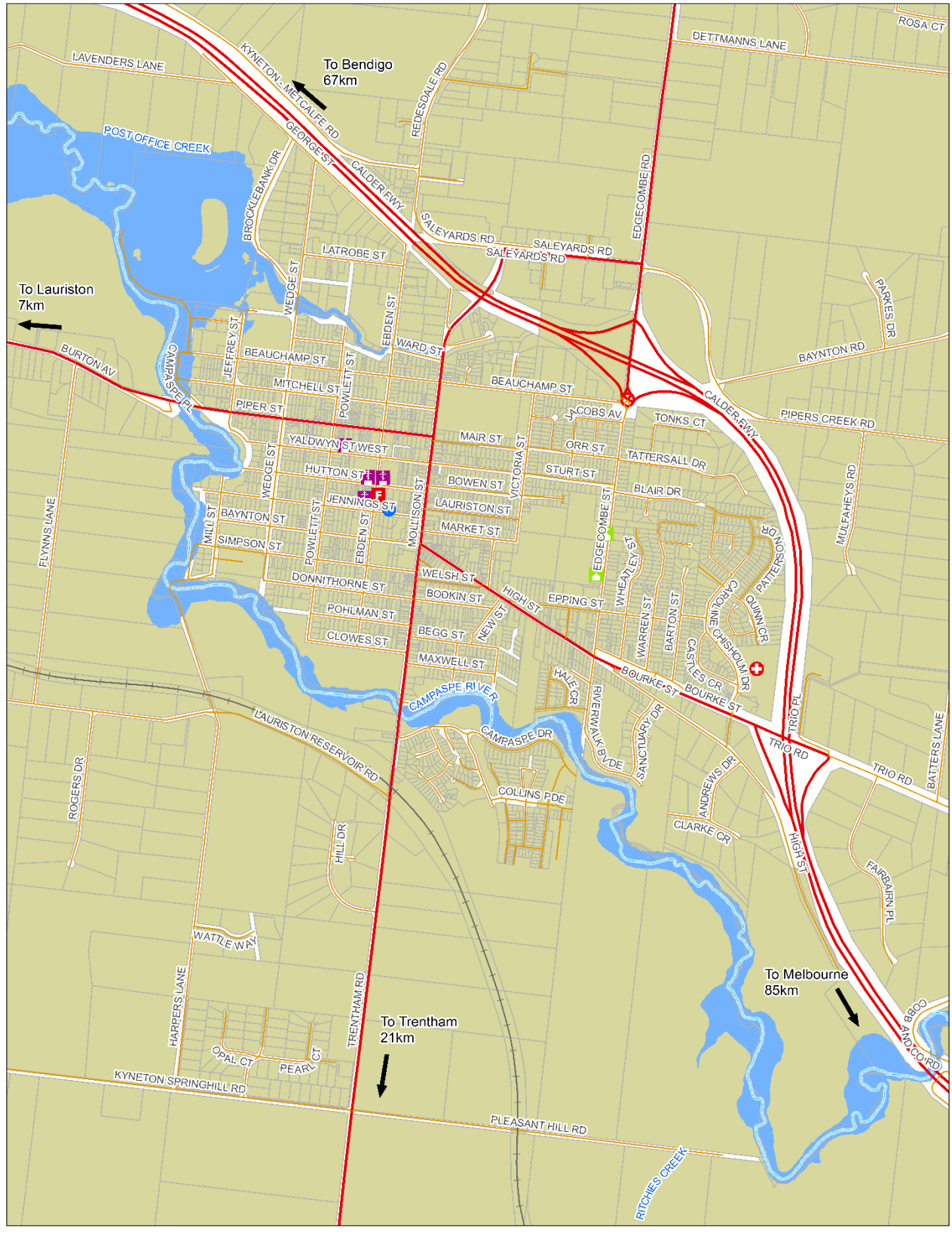
Campaspe River – Kyneton – 20% AEP flood extent (North Central CMA, 2019)



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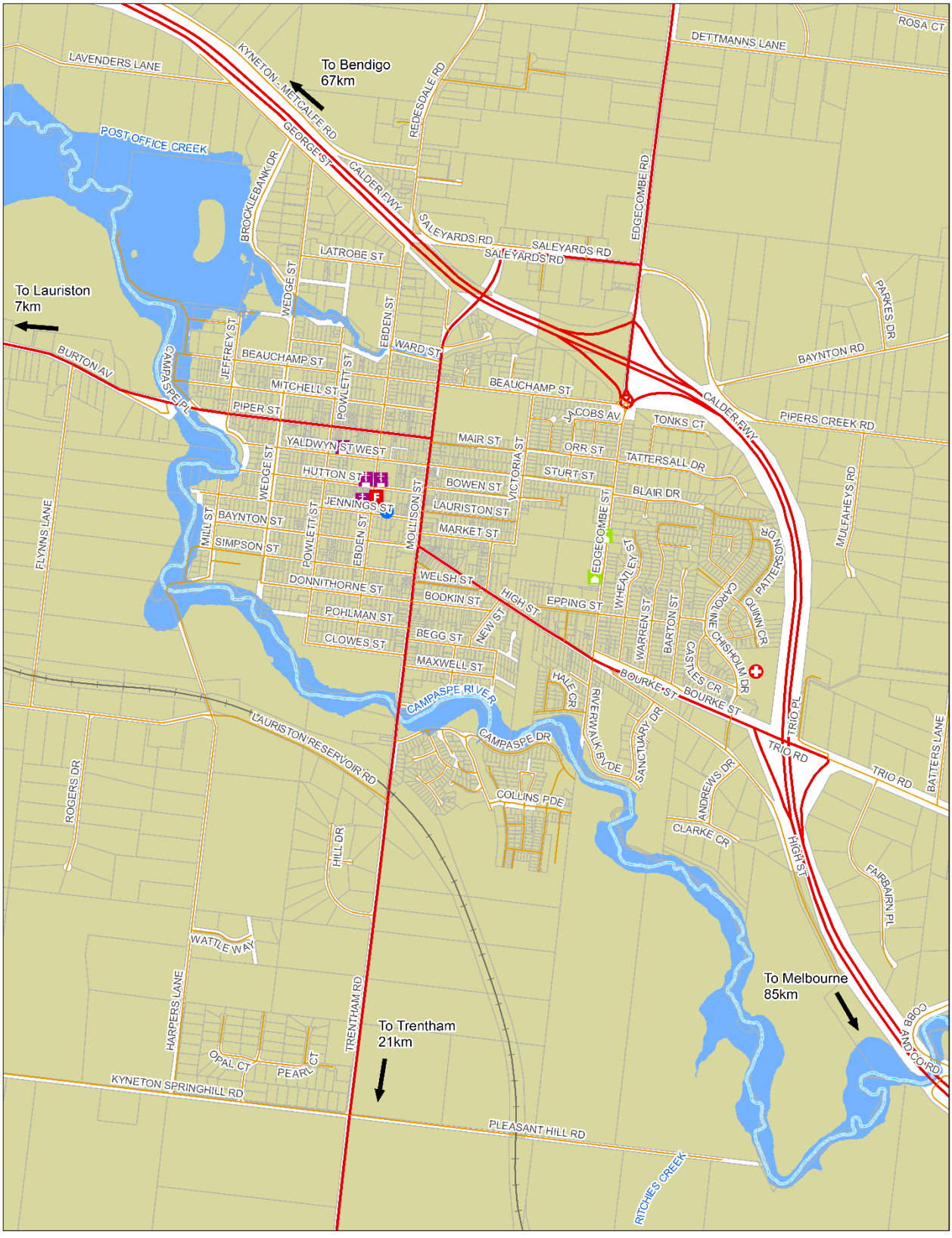
Date: 19/09/2022

Campaspe River – Kyneton – 10% AEP flood extent (North Central CMA, 2019)



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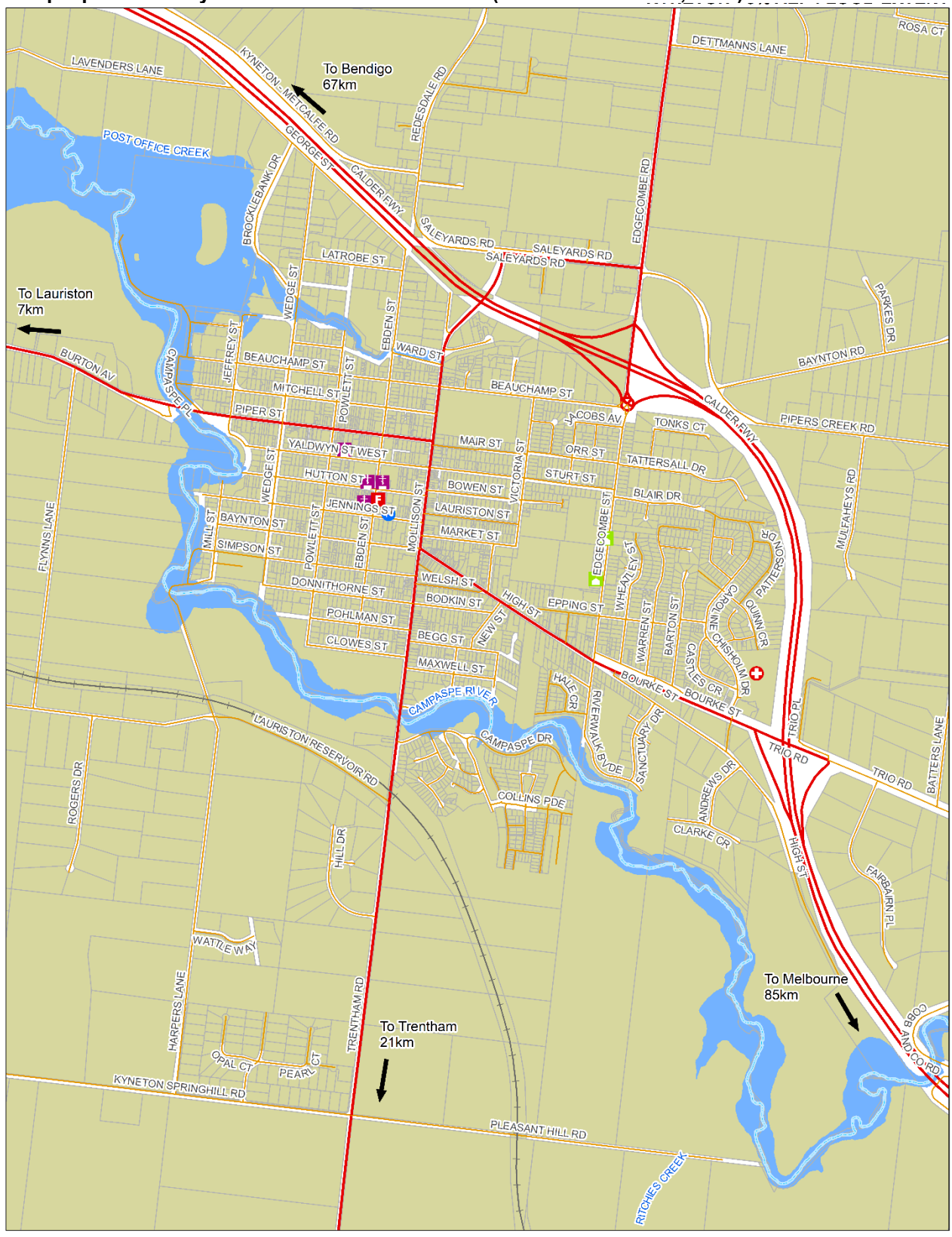
Date: 19/09/2022

Campaspe River – Kyneton – 5% AEP flood extent (North Central CMA, 2019)



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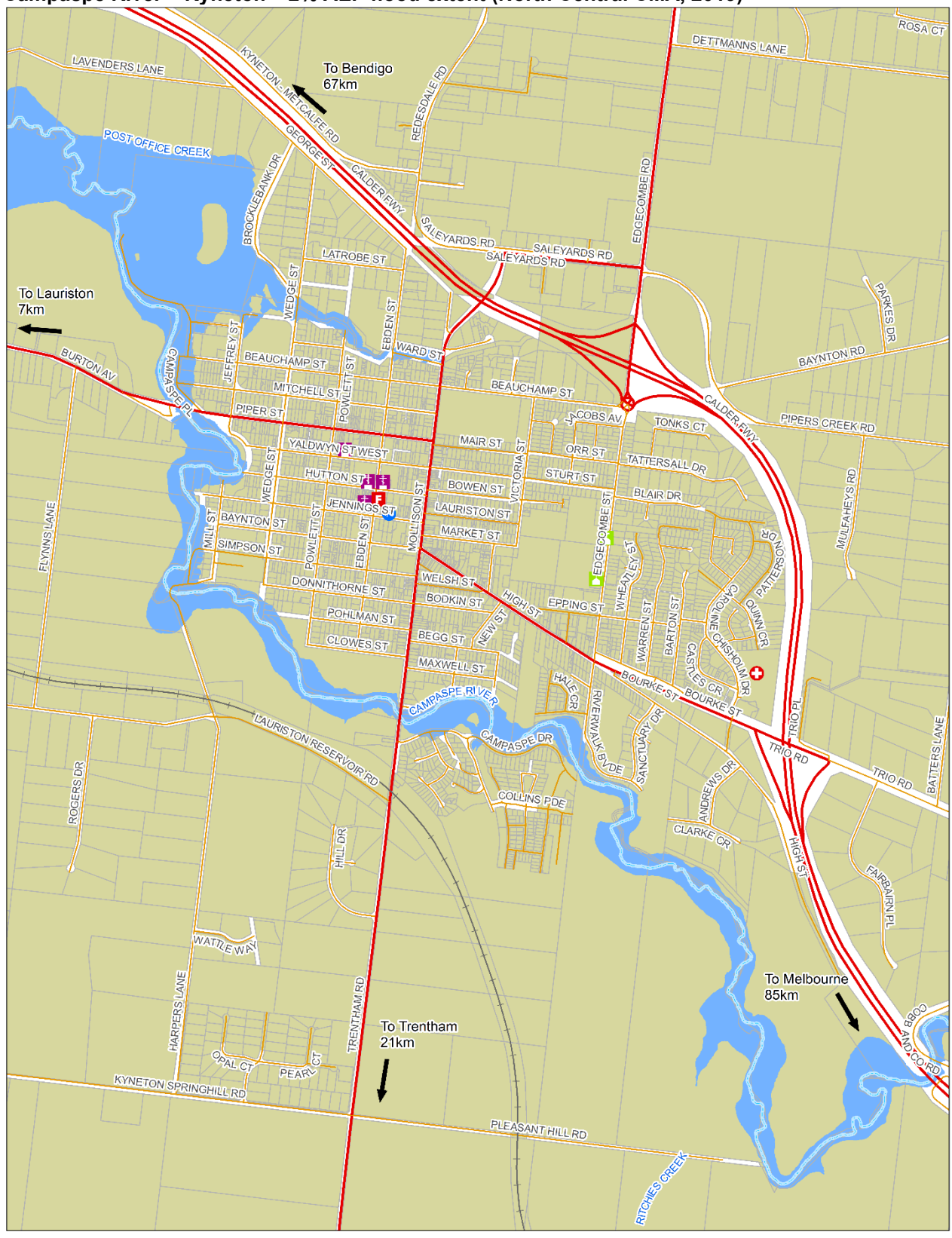
Date: 19/09/2022

Campaspe River – Kyneton – 2% AEP flood extent (North Central CMA, 2019)



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Date: 19/09/2022

Campaspe River – Kyneton – 1% AEP flood extent (North Central CMA, 2019)

N

Scale at A4

Metres

200 400 800

1:22,000

River Gauge
hospital
ses unit
school
police station
fire station
church
camp ground

Major Road
Minor Road
Railway
River/Creek
Levee
Extent of Flood Data
Cadastre
Flood Extent

VICTORIA State Government

SES

Macedon Ranges Shire Council

North Central CMA

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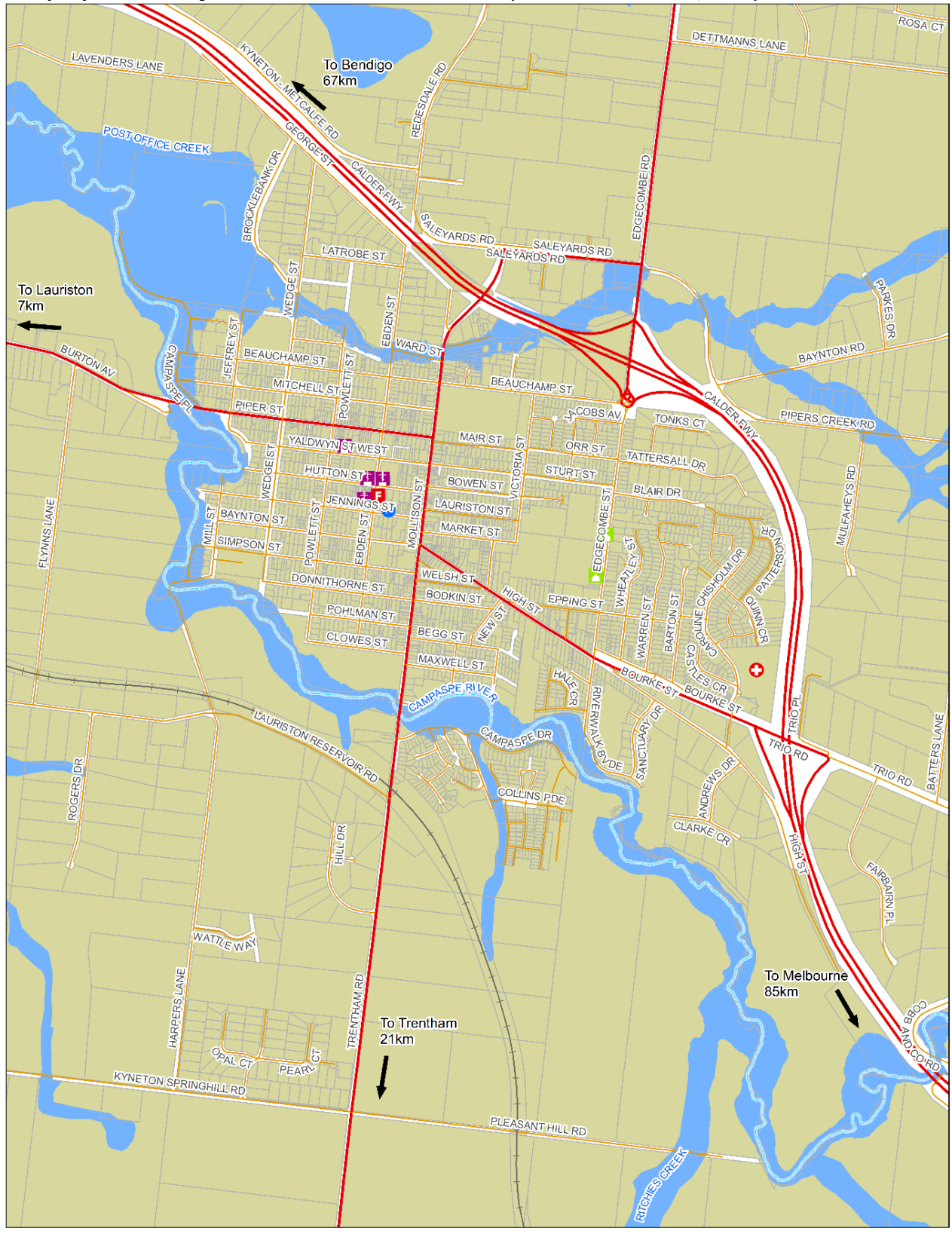
Date: 19/09/2022

Campaspe River – Kyneton – 0.5% AEP flood extent (North Central CMA, 2019)



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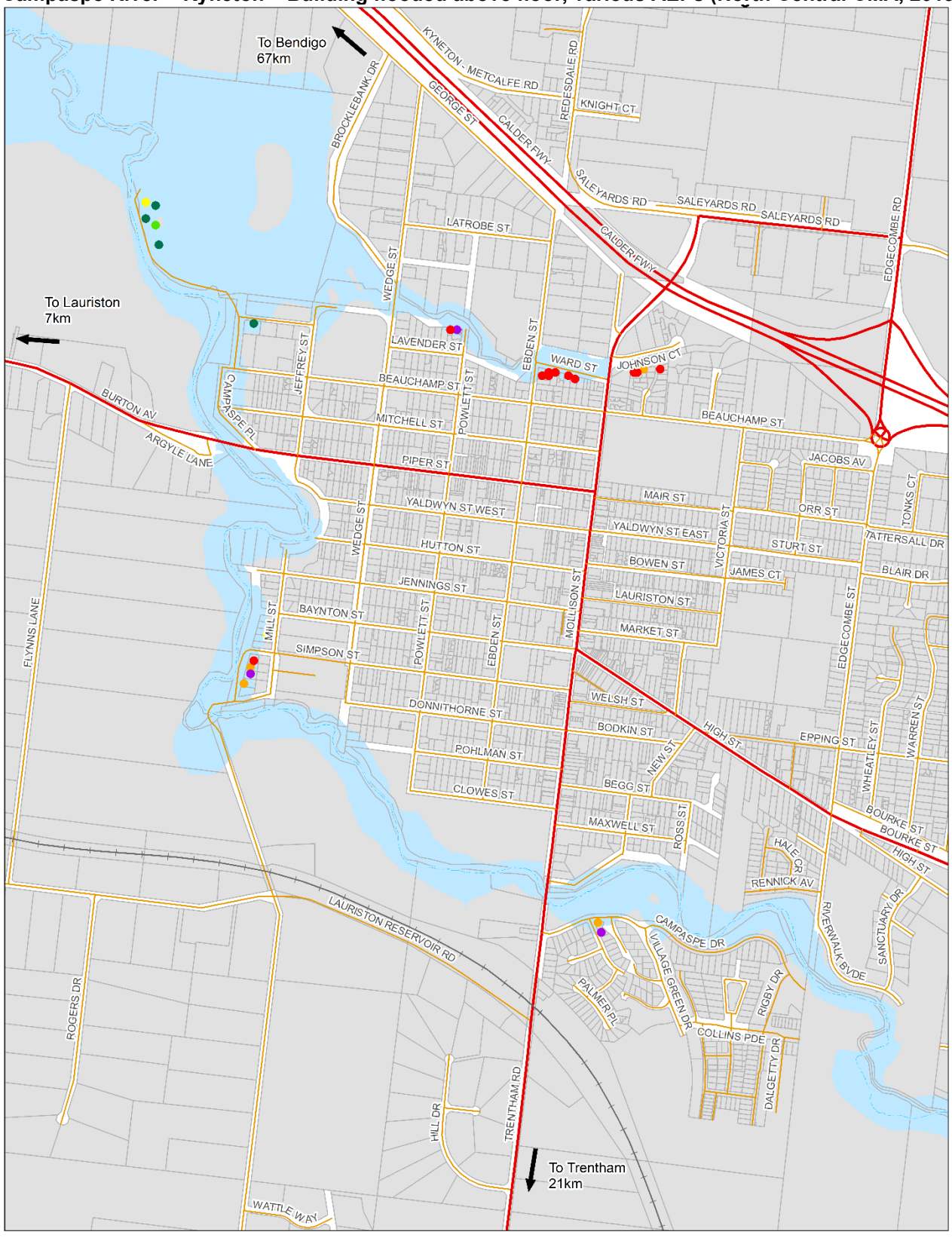
Date: 19/09/2022

Campaspe River – Kyneton – Building flooded above floor, various AEPs (North Central CMA, 2019)



N

Scale at A4
Metres
200 400
1:15,000

Buildings Flooded Above Floor
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP

- Major Road
- Minor Road
- Railway
- River/Creek
- Levee
- Extent of Flood Data
- Cadastre
- 1% AEP Flood Extent

VICTORIA State Government
SES
Macedon Ranges Shire Council
North Central CMA

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Date: 19/09/2022

Appendix E: Sandbags

This applies to the procurement, storage, distribution, use and disposal of sandbags during flood emergencies, primarily riverine flood events. Sandbag distribution in response to flash flood events, due to their quick nature, may be directed by the local VICSES Unit.

1. Use

Sandbags can be used to block doorways, drains and other openings into properties as well as to weigh-down manhole covers, garden furniture and to block sinks, toilets and bath drains to prevent water backing up. They have proven to be successful in keeping water out for short periods of time.

Sandbagging is not always the most effective option and should be considered in the context of this Plan which includes alternatives for managing flood risk. Other alternatives include moving possessions to higher places, securing objects so they do not float away and placing valuables in water tight containers. During a flood event the Incident Controller or VICSES Incident Agency Commander (IAC) will assess the overall risk to communities and allocate sandbag resources based on risk.

2. Responsibilities

VICSES

- The management of state-wide procurement and storage of sandbags for flood emergencies
- Providing sandbags to local areas for distribution based on requirements identified in this Plan
- Identifying distribution arrangements
- Community education and awareness on sandbag management and safe use
- Identifying Critical Infrastructure and Community Critical Facilities
- Providing a support role in flood recovery.

Council

- Supporting VICSES in developing the MSFEP
- Providing a support role during flood response
- Identifying Community Critical Facilities at a municipal level which are captured in our Vulnerable Groups and Facilities Register by Township (D19-115025)
- Procuring sandbags to protect council owned facilities including Community Critical Facilities managed by council
- Providing locations, where available and capable, to support sandbagging operations as agreed in this Plnan
- Coordinating the clean-up and community recovery arrangements.

Community Critical Facility owners' responsibilities

- Working with VICSES to develop an effective flood mitigation plan for their property as part of the MSFEP with a priority for permanent structures.

Other 'Response' agencies responsibilities

- Supporting VICSES in their response role.

Residential and commercial property owners

- Understanding their own flood risk
- Preparing an emergency plan for their home or business
- Procurement and storage of sandbags to protect their own property
- Filling and movement of sandbags to protect their property

- Seek advice from Macedon Ranges Shire Council regarding the removal of sandbags from their property, as part of the community recovery.

3. Community and business education

VICSES has an established community education program to support community and business in responding to flood emergencies. VICSES will use these community education tools and programs (such as Local Flood Guides) to promote practical information on:

- The purpose, use and disposal of sandbags
- Obtaining sandbags
- Safety considerations (e.g. OHS, manual handling, safe use and disposal)
- Alternative flood mitigation strategies
- Where to get information (e.g. VicEmergency Hotline 1800 226 226)
- The responsibilities of critical infrastructure owners, businesses and private individuals to understand their flood risk and develop a flood plan.

Key messages may include:

- Emergency response agencies will not always have the capacity to provide sandbags due to other competing priorities.
- Businesses and individuals need to understand the flood risk to their property and, where appropriate, develop a Flood Emergency Plan.
- Sandbagging is only one way of protecting properties against floodwater and not always the most effective option. Sandbagging should be considered in the context of a Flood Emergency Plan which considers alternatives for managing flood risk.

4. Procurement

VICSES

- VICSES will maintain a supply of sandbags to support the effective readiness and response to flood emergencies as identified in this Plan.
- The number of sandbags required will be determined from information provided through the planning process. There may be occasions where the supply of sandbags is limited and priorities for distribution will need to be determined through local emergency management arrangements.
- VICSES will maintain the current mutual aid arrangements for flood emergencies and will also work with local councils to access resource sharing arrangements established between councils during emergencies.

Council

- Council will procure sandbags to protect Council-owned facilities including Community Critical Facilities managed by Council.

Residential and commercial property owners

- Sandbags may be obtained (purchased) from hardware suppliers or rural suppliers. Sand may be obtained from sand and soil suppliers.

5. Storage

Sandbags will be stored by VICSES in appropriate locations across the municipality. VICSES will monitor the condition of its sandbags for deterioration. Sandbag storage locations and initial quantities:

- Gisborne VICSES Unit Local Headquarters (LHQ) – 4000 bags (minimum)
- Woodend VICSES Unit Local Headquarters (LHQ) – 4000 bags (minimum)

Additional sandbag supplies are held at the VICSES office located in Bendigo. These can be accessed for replenishment or additional requirements. Additional sandbags will be supplied to these locations in the lead up to a flood event.

Sandbags will be stored at appropriate Council locations across the municipality. Council will monitor the condition of its sandbags for deterioration. Council sandbag storage locations and quantities:

- Woodend Council works depot – 2000 bags and 3600kgs of sand (approximately)

NB: Sand will be kept separate to the bags to ensure extended shelf life with arrangements in place to obtain additional sand locally, during business hours.

Council is a signatory to the Municipal Association of Victoria Protocol for Inter-Council Emergency Management Resource Sharing. Council also has an arrangement with neighbouring Councils and with Northern Victorian Cluster Councils for sharing resources, as required.

6. Distribution

Priorities

The Incident Controller may make sandbags and sand available for flood mitigation activities during declared flood emergencies. Consistent with the State Emergency Management Priorities and the SEMP Flood Sub-Plan, sandbags will be issued in priority order of protecting:

1. Community Critical Infrastructure identified:
    a. in the MEMP or this Plan; or
    b. by the Incident Management Team
2. Residential properties identified in the potential flood area
3. Commercial properties identified in the potential flood area
4. Environmental and conservation areas identified in the potential flood area.

Any properties identified as being outside the potential flood area will be referred to an alternative source of sandbags (e.g. local hardware store or sandbag supplier). If sandbag supplies are limited, then priority will be given to protection of critical infrastructure.

As a guide, 25 sandbags are reasonable to supply to residents to allow for coverage of doorways, blocking vents, drains and toilets. Households in floor prone areas are encouraged to plan for potential risk of flooding and purchase 25 empty Hessian sandbags or more according to their need.

Distribution points

In preparation for a significant flood emergency, VICSES will work with local councils and other agencies to identify appropriate locations for sandbag collection points. Location considerations will include access, safety, human resources and machinery requirements.

Suggested sandbag collection points:

- Kyneton Showgrounds, 184-194 Mollison Street, Kyneton 3444
- Woodend Racecourse Reserve, 1-27 Forest Street, Woodend 3442
- Lancefield Park Recreation Reserve, 69 Chauncey Street, Lancefield 3435

  This is not a council owned or managed site and permission is needed from the venue's Committee of Management.
- Romsey Recreation Reserve, 12 Park Lane, Romsey 3434
- Darraweit Guim Fire Brigade, 37 Francis Lane, Darraweit Guim 3756
- Dixon Field, 40 Robertson Street, Gisborne 3437
- Tony Clarke Reserve, 37 Waterfalls Road, Macedon 3440
- Tylden Recreation Reserve, 5 Tylden Woodend Road, Tylden 3444
- The Common, Drygen Street & Nicholson Street, Carlsruhe 3442

- Riddells Creek Recreation Reserve, 26-32 Sutherlands Road, Riddells Creek 3431

Additional and/or alternate points can be nominated by the IC based on risk and need. Where suitable and by mutual agreement, CFA brigades may also be considered for sandbagging points:

- Gisborne, 31 Robertson Street 3437
- Riddells Creek, 67 Main Road 3431
- Bolinda & Monegeetta, 1675 Kilmore Road, Monegeetta 3433
- Darraweit Guim, 37 Francis Lane 3756
- Bullengarook, 695 Bacchus Marsh Road 3437
- Macedon, 3 Victoria Street 3440
- Mount Macedon, 753 Mount Macedon Road 3441
- Woodend, Urquart Street 3442
- Carlsruhe, 359 Cobb & Co Road 3442
- Kyneton, 46-48 Ebden Street 3444
- Lancefield, 2b The Crescent 3435
- Romsey, 24 Stawell Street 3434
- Clarkefield & District, 29 Station Street 3430
- Newham, 1293 Rochford Road 3442

The VICSES Sandbag Quick Reference Guide provides details to community members about the indicative number of sandbags required for residential property protection and guidance on the safe use, filling and laying of sandbags.

During response, the Incident Controller will track distribution of sandbags through the IMT and will provide this information to the recovery team as part of the transition from response to recovery.

7. Provision of sand

VICSES has plans in place to acquire sand through its own supply arrangements and where necessary through the emergency management arrangements. Some sand suppliers are identified in this Plan; VICSES Units maintain a list of suppliers for their local area.

During a localised non-declared flood event, sand will be procured by the local responding VICSES Unit. During a declared flood event, sand will be procured via the ICC.

Council will have arrangements in place to acquire sand for its own purposes. Sand will be sourced from local suppliers (e.g. garden supply centres) and once Council have confirmed a supplier through a required tender process.

8. Disposal and relocation of used sandbags

Sandbags may be contaminated after use and local councils should ensure that clean up and disposal is considered as part of recovery. Removal and disposal of sandbags used for flood mitigation shall be dealt with under the clean up and community recovery arrangements outlined in the SEMP. The disposal of sandbags is a shared responsibility between different agencies.

Incident Controllers will provide information on sandbag locations to councils, to assist with clean-up. VICSES will continue to work with relevant agencies to develop protocols for the safe and environmentally responsible disposal of sandbags.

Appendix F: References

The following studies are useful in understanding the nature of flooding in Macedon Ranges.

- Cardno (August 2022): Interim Report Woodend Flood Study
- Engeny Water Management (2021): Department of Transport Gisborne Intersection Upgrade Hydraulic and Flood Impact Assessment Report
- HARC (2020): Lauriston Rapid Flood Risk Assessment
- HARC (2020): Malmsbury Rapid Flood Risk Assessment
- HARC (2020): Tylden Rapid Flood Risk Assessment
- North Central CMA (2019): Kyneton Flood Study
- Macedon Ranges Shire (2011): Kyneton Township Stormwater Drainage Study
- Macedon Ranges Shire (2011): Riddells Creek Drainage Study
- Macedon Ranges Shire (2011): Gisborne / New Gisborne Drainage Study
- Macedon Ranges Shire (2009): Romsey Township Stormwater Drainage Study
- Water Technology (2006): Gisborne Flood Study
- Coomes Consulting Group (1997): Woodend Township Drainage Study.

Other sources of information with direct relevance to the municipality include:

- Macedon Ranges Municipal Emergency Management Plan (MEMP)
- North Central Catchment Management Authority for various references
- Planning Maps Online allows you to find a property and lets you turn on planning zones and overlays within a Council Planning Scheme.
- Planning Schemes Online provides access to all of Victoria's planning scheme provisions (planning controls) and maps.
- Water Measurement Information System (WMIS) for surface water (level, flow and quality) and groundwater (level and quality) monitoring data. WMIS contains real time data (less than 1 hour old) data for all telemetered surface water gauges and groundwater bores.
- Bureau of Meteorology (BOM) for river gauge readings and flood warnings
- BOM Special Climate Statement 26: Record wet January brings unprecedented flooding to northwest Victoria
- Flood Victoria provides links to information from several different government departments and agencies and can direct you to other websites.
- Victoria State Emergency Service
- DELWP provides ongoing emergency recovery services to help Victorians respond to, rebuild and recover from floods, storms and bushfires.
- FloodZoom brings together flood forecasts, flood mapping, real-time river height gauges and property data to provide response agencies with improved knowledge of likely flood impacts.
- MRSC, NCCMA, Melbourne Water and VICSES Geographical Information System (GIS) – these contain layers showing drainage assets, flooding extents, flood related call-out locations, roads, title boundaries and other useful information.
- Water Technology (2012): Strategic Flood Intelligence Report – Campaspe and Maribyrnong Basins.

Relevant but more general references include:

- Agriculture and Resource Management Council of Australia and New Zealand. Standing Committee on Agriculture and Resource Management (SCARM) (2000): Report No 73: Floodplain management in Australia: best practice principles and guidelines.
- Bureau of Meteorology (2018): National Arrangements for Flood Forecasting and Warning
- EGIS Consulting (2000): Flood Data Transfer Project
- VICSES Caravan Park Emergency Management Plan tool to assist caravan park owners to meet

their statutory obligations under the Residential Tenancies (Caravan Parks and Movable Dwellings Registration and Standards) Regulations 2010 (Regulations 22-25).

- Victorian Floodplain Management Strategy
- Water Act 1989
- Emergency Management Act 1986
- Emergency Management Act 2013
- Emergency Management Legislation Amendment Act 2018
- Australian Disaster Resilience Handbook Collection
  - Public Information and Warnings Handbook
  - Managing the Floodplain Handbook
  - Flood Emergency Planning for Disaster Resilience Handbook
  - Emergency Planning Handbook
  - Manual 21: Flood Warning (2009)

1. Guidance on the use of the quick look Flood / No Flood tool

During a flood - using the quick look tool

Plot cumulative rainfall depth against elapsed time on a copy of the tool. Do not start using the tool until rainfall exceeds approximately 2 mm an hour (i.e. ignore early drizzle or very light rain).

At each time step, after plotting the cumulative rainfall, assess the likelihood and expected severity of flooding from the curves. Some degree of judgement is required to determine if the quick look tool is providing an answer that is in line with expected outcomes. When plotted rainfall data crosses a curve on Figure 5 this indicates that flooding of around that severity is possible.

If the catchment is dry, it would generally be appropriate to step down one level. For example, if the rainfall plot is on the 1 in 50 AEP curve and the catchment is dry, refer to the 1 in 20 AEP map and associated consequences listed in the flood intelligence card available in the Plan. The exception to this would be if there was very heavy rain on a dry catchment. In that circumstance, adopt a cautious approach and do not step down a level. If the catchment is dry and/or rain extends over more than 12 hours, the quick look tool will tend to over-estimate the likelihood of flooding.

The tool is based on reservoirs upstream being at FSL or very close to it (i.e. spilling during the event). If the storage is below FSL and unlikely to spill during the event, it would be appropriate to step down a level.

After a flood – updating the tool

After a flood event, plot the event rainfall depth (with date) on the quick look tool. At the same time, include an overview of the event, along with commentary on antecedent conditions and other relevant information, in the relevant Appendix of the Plan.

Example use of the quick look tool

The section below is a fictitious example of how to use the quick look tool. Table 94 shows the rainfall depths recorded at the rain gauge and the action to take on the basis of the recorded rainfall. Figure 81 shows the fictitious example plotted up on the quick look tool.

Note that in cases where the tool has not been used from the start of rain (i.e. from early in the event), data should be either picked up from the start of the event or the first data plotted should include an estimate of how much rain has fallen and the time over which it has fallen. If this is not done, the tool will likely under-estimate likely flood severity.

Table 94: Rainfall depths for example use of tool		
Time (hours)	**Rainfall Depth (mm)**	**Action**
0	1	Ignore
1	2	Ignore
3	2	Ignore
4	1	Ignore
5	15	Plot as 15 mm at 1 hour
6	2	Plot as 17 mm at 2 hours
7	10	Plot as 27 mm at 3 hours
8	5	Plot as 32 mm at 4 hours Indicates it may be a 5-year (20% AEP) event
9	12	Plot as 44 mm at 5 hours Indicates it may be a 10-year (10% AEP) event Start planning for a 10% AEP event
10	2	Plot as 46 mm at 6 hours More confident that a 10% AEP event is likely
11	5	Plot as 51 mm at 7 hours
12	1	Plot as 52 mm at 8 hours
13	3	Plot as 55 mm at 9 hours
14	10	Plot as 65 mm at 10 hours Indicates it may be a 20-year (5% AEP) event.
15	5	Plot as 70 mm at 11 hours More confident that a 5% AEP event is likely
16	2	Plot as 72 mm at 12 hours

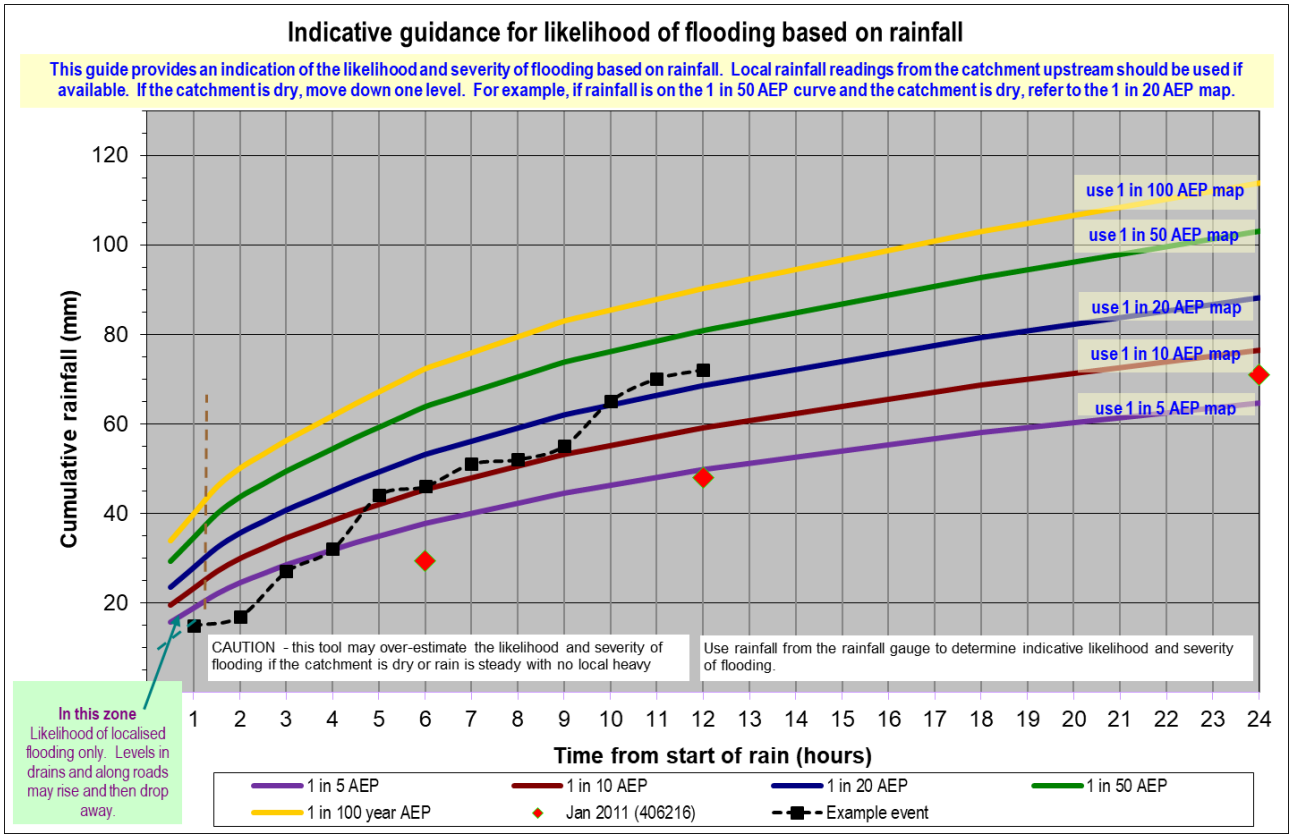

Figure 81: Quick look tool example