



City of Greater Bendigo Flood Emergency Plan

A Sub-Plan of the Integrated Municipal
Emergency Management Plan

Version 1 - April 2018



ACTIVATION OF PLAN

In the event of an emergency within the City of Greater Bendigo contact the Senior Sergeant, Bendigo Police Station, who will activate the Municipal Emergency Management Plan (MEMP).

City of Greater Bendigo

MUNICIPAL RECOVERY MANAGER

24 HOUR EMERGENCY CONTACT NUMBER

0459 111 289

The Municipal Emergency Resource Officer (MERO) or MERO deputies (D/MERO) can also activate the MEMP.

**For Urgent Requests for Resources Contact on duty
Municipal Emergency Resource Officer (MERO) 0407
866 043 or Deputy MERO - 0417 360 873.**

To forward electronic versions of media releases/information updates in an emergency:

Email: moc@bendigo.vic.gov.au

or for hard copies:

Marked "To urgent attention of Municipal Emergency Resource Officer (MERO)"

Fax: (03) 5434 6200

Please note:

The following group email contact is also available for general information dissemination and requests for non-urgent matters:

Email: moc@bendigo.vic.gov.au

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Distribution List

Copy No.	Issue To:		Date
	Name	Organisation	
Original		IMEMP Committee Executive Officer	
1		Council Office Copy	
2		IMEMP Committee Chairman	
3		MERO	
4		Deputy MERO	
5		MRM	
6		MERC (Bendigo Police Station)	
7		RERC	
8		Heathcote Police Station	
9		Elmore Police Station	
		Goornong Police Station	
10		VICSES North West RHQ	
11		VICSES (Bendigo Unit)	
12		VICSES (Heathcote Unit)	
		VICSES (Marong Unit)	
13		North Central Catchment Management Authority	
14		Bureau of Meteorology (Flood Warning)	
15		DELWP Bendigo	
16		Parks Victoria	
17		Ambulance Victoria (Bendigo branch)	
18		CFA \Bendigo Brigade)	
19		CFA (Region 2 Headquarters)	
20		VicRoads Bendigo	
21		DHHS Loddon Mallee Region - Bendigo	
23		Power supplier – Powercor, Ausnet services	
24		Wholesale water supplier Goulburn Murray Water (GMW)	
25		Water Retailer Coliban Water	
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Document Transmittal Form / Amendment Certificate

This Municipal Flood Emergency Plan (MFEP) will be amended, maintained and distributed as required by VICSES in consultation with the City of Greater Bendigo Council

Suggestions for amendments to this Plan should be forwarded to VICSES Regional Office 7 Rohs Rd, East Bendigo 3550 or email northwest@ses.vic.gov.au

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

Amendment Number	Date of Amendment	Amendment Entered By	Summary of Amendment
1	April 2018		Initial Version (amended to include sandbag points)

This Plan will be maintained on both the VICSES ,City of Greater Bendigo and EMCOP websites www.ses.vic.gov.au / www.bendigo.vic.gov.au / <https://cop.em.vic.gov.au>

List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan:

AEP	Annual Exceedance Probability
AHD	Australian Height Datum (the height of a location above mean sea level in metres)
AIIMS	Australasian Inter-service Incident Management System
AoCC	Area of Operations Control Centre / Command Centre
ARI	Average Recurrence Interval
ARMCANZ	Agricultural & Resource Management Council of Australia & New Zealand
AV	Ambulance Victoria
BoM	Bureau of Meteorology
CEO	Chief Executive Officer
CERA	Community Emergency Risk Assessment
CFA	Country Fire Authority
CMA	Catchment Management Authority
COP	Common Operating Picture
RERC	Regional Emergency Response Coordinator
RERCC	Regional Emergency Response Coordination Centre
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning
DET	Department of Education & Training
DHHS	Department of Health & Human Services
EMV	Emergency Management Victoria
EMMV	Emergency Management Manual Victoria
EMT	Emergency Management Team
EO	Executive Officer
EPA	Environmental Protection Authority
ERC	Emergency Relief Centre
FO	Floodway Overlay
FWS	Flood Warning System
FZ	Floodway Zone
IC	Incident Controller
ICC	Incident Control Centre
IMT	Incident Management Team
IMS	Incident Management System
EMLO	Emergency Management Liaison Officer
LSIO	Land Subject to Inundation Overlay
MOC	Municipal Operations Centre
IMEMP	Integrated Municipal Emergency Management Plan
IMEMPC	Integrated Municipal Emergency Management Planning Committee
MERC	Municipal Emergency Response Coordinator
MERO	Municipal Emergency Resource Officer
MFEP	Municipal Flood Emergency Plan
MRM	Municipal Recovery Manager

PMF	Probable Maximum Flood
PV	Parks Victoria
RCC	Regional Control Centre
RDO	Regional Duty Officer
SBO	Special Building Overlay
SCC	State Control Centre
SERP	State Emergency Response Plan SEWS
	Standard Emergency Warning System
SHERP	State Health Emergency Response Plan
SOP	Standard Operating Procedure
TFWS	Total Flood Warning System
VCC	Victorian Council of Churches
VicPol	Victoria Police
VR	Vic Roads
VICSES	Victoria State Emergency Service

Glossary

1% AEP Flood (Annual Exceedance Probability)	A large flood having a 1% chance of occurring in any given year The design flood event that regulates land use planning and construction standards in Victoria i.e. Local Government Planning Schemes
Flash Flooding	Caused by heavy and often localised rainfall, resulting in both artificial and natural drainage systems exceeding capacity, resulting in water flowing along roads and/or land occupied by houses and other buildings.
Flood Warning	Warnings of “Minor, Moderate or Major” flooding in areas where the BoM has installed specialised warning systems. In these areas, the flood-warning message will identify the river valley, the locations expected to be flooded, the likely severity of the flooding and when it is likely to occur.
Flood Watch	Advice of possible flooding, if flood-producing rain is expected to happen in the near future. Identifies the catchments’ that are expected to receive flood-producing rains.
Floodplain	The land, which may be covered by water when the river overflows its banks during floods. The extent of a floodplain will normally be greater than the area covered in a 1% flood.
Lacustrine / Estuarine flooding	Caused by the water level in a lake exceeding capacity resulting in inundation of surrounding land.
Major Flooding	Causes inundation to extensive rural areas and appreciable urban area. Properties and towns are likely to be isolated and major traffic routes are likely to be closed. Numerous evacuations may be required.
Minor Flooding	Causes inconvenience with low-lying areas next to watercourses being inundated, requiring the removal of livestock and equipment. Minor roads may be closed and low level bridges submerged.
Moderate Flooding	May require evacuation of some homes and main traffic routes may be covered. The area of inundation is substantial in rural areas.
Observed river height	Highest river height (in meters) at a river height measuring gauge located along the river. In most cases, a zero reading is the lowest water level that is reached during dry conditions. In many tidal areas and some inland areas, river levels are expressed in meters above mean sea level or Australian height Datum (AHD).
Peak river height	The highest river height (in meters) observed during a flood event at the specified site on the river.
Predicted river height	Height (in meters) to which the river is predicted to rise at the river gauge referred to in the warning. The actual depth of floodwater will vary across the flood plain. Knowledge of past flood events, as well as estimates of flood levels from flood studies, are used by local Councils, emergency services and landowners to determine which areas are likely to be flooded from predicted river height.
Riverine Flooding	Caused by heavy or sustained rainfall in a river or creek exceeding channel capacity resulting in inundation of the adjacent flood plain.
Storm Surge	A storm surge is an offshore rise of water associated with a low pressure weather system. Storm surges are caused primarily by high winds pushing on the ocean's surface.

Part 1. INTRODUCTION

1.1 Municipal Endorsement

This Municipal Flood Emergency Plan (MFEP) has been prepared by the City of Greater Bendigo Municipal Flood Planning Committee (MFPC) and with the authority of Integrated Municipal Emergency Management Planning Committee (IMEMPC) – (refer to section 1.6 endorsement of plan)] pursuant to Section 20 of the Emergency Management Act 1986 (as amended).

The City of Greater Bendigo Council MFPC will undertake consultations with their communities about the arrangements contained within this plan

Context

This MFEP is a sub plan to the Integrated Municipal Emergency Management Plan (IMEMP) , is consistent with the Emergency Management Manual Victoria (EMMV) and the Victorian Floodplain Management Strategy 2016, and takes into account the outcomes of the Community Emergency Risk Management (CERM)/ Community Emergency Risk Assessment (CERA) processes undertaken by the Municipal Emergency Management Planning Committee (MEMPC).

The Municipal Flood Emergency Plan is consistent with the [North West Regional Flood Emergency Plan](#) and the [State Flood Emergency Plan](#).

This Municipal Flood Emergency Plan is a result of the cooperative efforts of the City of Greater Bendigo Flood Planning Committee (MFPC) and its member agencies.

This Plan is endorsed by the Integrated Municipal Emergency Management Planning Committee as a sub-plan to the IMEMP.

Endorsement

.....	
[Enter Name Details]	Date

(Chair – Integrated Municipal Emergency Management Planning Committee)

1.2 The Municipality

An outline of the City of Greater Bendigo in terms of its location, demography and other general matters is provided in the MEMP. An outline of the flood threat is provided in Appendix A of this Plan.

1.3 Municipality Flood Risk

Flooding is a natural hazard in several areas of the City of Greater Bendigo. Whether floods are caused by high rainfall, rising river levels, changed infrastructure or inadequate drainage, they can severely disrupt communities by causing injury, loss of life, property damage, personal hardship, road closures, significant rural impact on livestock and fencing, and the municipality's economy.

Low to moderate flooding is a relatively frequent event in City of Greater Bendigo. Such events are well within the capability and capacity of local emergency services. It is major or widespread flood events dealt with in this Plan. This plan deals with major or widespread flood events.

The following Flood Studies have been completed and are available:

- Bendigo Urban Flood Study (November 2013, adopted by City of Greater Bendigo 2017)
- Heathcote Flood Study (March 2016)

The [Regional Floodplain Management](#) Strategy is being developed and consultation draft is available on this link as at March 2018:

Detailed flood threats, historical flood information, flood peak travel times, local flood emergency plans, community consequences and impacts, maps and general flood and flood infrastructure information for each river system are provided in the Attachments and Appendices to this Plan.

1.4 Purpose and Scope of this Flood Emergency Plan

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

- Identify the flood risk to City of Greater Bendigo;
- Support the implementation of measures to mitigate the causes and impacts of flood incidents within the City of Greater Bendigo;
- 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 flood.

1.5 Municipal Flood Planning Committee (MFPC)

Membership of the City of Greater Bendigo Flood Planning Committee (MFPC) will comprise of the following representatives from the following agencies and organisations:

- VICSES Regional Officer – Emergency Management (**Chair**),
- City of Greater Bendigo Council (Representatives),
- Victoria Police (i.e. Municipal Emergency Response Co-ordinator) (MERC),
- North Central Catchment Management Authority (NCCMA),

- Department of Health & Human Services (DHHS),
- Department of Environment, Land, Water & Planning (DELWP) as required,
- Goulburn Murray Water,
- Coliban Water
- Bureau of Meteorology as required,
- CFA
- Local community representatives and
- Other agencies/organisations as required

1.6 Emergency Management Responsibilities

VICSES is the legislated ‘control’ agency for flood response. There are also a number of agencies with ‘key support roles’, and other agencies/organisation that will act in support of VICSES and provide support to the community in the event of a flood within the Shire. Support may include provision of essential services, personnel, or material support to VICSES or affected people and communities.

The general roles and responsibilities of the key supporting agencies are detailed in the Emergency Management Manual Victoria (EMMV) Part 7 ‘Emergency Management Agency Roles’, the State Flood Emergency Plan and the Regional Flood Emergency Plan and on agency websites.

Some specific flood support roles are expanded upon in Table 1 below. The extent of their implementation will depend on the severity of the flooding.

VICSES ensures that all agencies and organisations mentioned in Table 1 are aware of their roles and responsibilities.

Table 1. Emergency Management Roles and Responsibilities for Flood

Agency/ Communities’	Specific “Flood” Responsibilities	Web links and Comments
Ambulance Victoria (AV)	<ul style="list-style-type: none"> • Support the evacuation of vulnerable people. • Support other agencies. 	
Bureau of Meteorology BOM	<ul style="list-style-type: none"> • Key Support Agency for flood. • Contribute to community awareness of meteorological and hydrological phenomena and warning systems • Provide meteorological forecasts and advice, including Severe Thunderstorm Warnings, Severe Weather Warnings, Flood Watches and Flood Warnings. • Flood monitoring and prediction, this involves: <ul style="list-style-type: none"> ○ meteorological input, ○ collecting data from rainfall and stream flow data networks, ○ operating flood prediction models, ○ preparing and issuing warnings to key agencies and selected media. 	Bureau of Meteorology
Country Fire Authority CFA	<ul style="list-style-type: none"> • Support Agency for flood, supporting VICSES in their response role i.e. provision of personnel. • Aircraft Support: Management of airbases and 	

Agency/ Communities'	Specific "Flood" Responsibilities	Web links and Comments
Communities - Residential & commercial property owners'	<ul style="list-style-type: none"> provision of air observers. Provide assistance, advice and information to other agencies responsible for, or involved in recovery activities. 	
	<ul style="list-style-type: none"> Take an active interest in ensuring that their property and contents are insured and that their insurance premiums are tailored to their flood risk. Residents and business owners in potentially flood prone areas should: <ul style="list-style-type: none"> Understand their flood risk, Prepare a flood emergency plan for their home or business and put in place effective measures to mitigate flood impact for their dwellings and business premises, and to aid in flood recovery, Where physically capable fill and move sandbags to protect their property. As a guide 25 sandbags is a reasonable supply to residents to allow for coverage of doorways, blocking vents, drains and toilets. Additional sandbags may be provided taking into consideration individual issues and local priorities. Following advice from Council regarding the disposal of sandbags from their property, as part of the clean-up. Landholders may clear vegetation from waterways using a licence from the NCCMA, depending on the area. 	<p>Emergency Plans and Kits — Victoria State Emergency Service</p> <p>VICSES has an established community education program to support community and business in responding to flood emergencies Links:</p> <p>FloodSafe — Victoria State Emergency Service</p> <p>Your local flood information — Victoria State Emergency Service</p>
Community - Critical Facility owners'	<ul style="list-style-type: none"> Working with VICSES to develop an effective flood mitigation plan for their property. 	
Department of Economics, Development, Jobs, Transport and Resources DEDJTR	<ul style="list-style-type: none"> Provide advice on animal welfare and dealing with dead and injured animals. With the support of participating and supporting organisations i.e. Council, provide animal care services for pets and companion animals of evacuees. 	
Department of Environment, Land, Water and Planning DELWP	<ul style="list-style-type: none"> Key Support Agency for flood. Coordination of Total Flood Warning System (TFWS) services at the state level in consultation with VICSES, BoM, NCCMA, Council and Coliban Water. Dam Safety management. Flood mapping: Coordinates the statewide flood database, collates flood height and extent mapping data across the state. The data is captured and developed through a number of flood risk assessment investigations and studies. The information is stored as a series of Geographic Information System (GIS) layers, collectively known as the Victorian Flood Database (VFD). Assists Council to manage floodplains and implement mitigation works to reduce the risk of flooding. Facilitates the management of levee systems and the oversight of flood warning systems. Aircraft Support: Management of airbases and 	<p>DELWP - Floodplain management</p>

Agency/ Communities'	Specific "Flood" Responsibilities	Web links and Comments
Parks Victoria PV	<ul style="list-style-type: none"> • provision of air observers. • Environmental impact assessment following a significant flood. • Support the flood response and recovery actions, including IMT's, field operations, reopening of roads and bridges on PV land, and management of park visitors. • Management of any water control structures located on PV land. • Clearing and restoration of roads, bridges and other assets within its parks and reserves. • Response agency for emergency flood situations within its operating area. • Control agency for waterway pollution within its operating area. 	
Department of Education and Training DET School Principals	<ul style="list-style-type: none"> • As requested by the VICSES Incident Controller, arrange for the relocation of students to another school (or staging point) during school hours for those students whose travel arrangements are likely to be disrupted by flooding and/or road closures. When students are relocated to an area outside the flood zone, DET (via individual schools) will make arrangements, with parents, for students to be pick-up or bussed home at the end of the school day. 	
Environment Protection Authority EPA	<ul style="list-style-type: none"> • Works with Councils and DELWP in flood-affected communities, to designate landfill facilities for the disposal of dead livestock. • Works with Councils, farmers and landowners on disposal of waste related to flood events. • EPA also assists the waterway manager on disposal of large numbers of flood-related fish deaths. 	The Environment Protection Authority Victoria (EPA)
Essential Services Operators	<p>The operators of essential services infrastructure are responsible for developing and implementing site specific strategies to mitigate all risks to business including:</p> <ul style="list-style-type: none"> • Assessing risk and consequences posed by flooding • Developing and implementing flood risk mitigation plans for each facility at risk of flooding. • Developing flood response plans. 	
Coliban Water CW	<ul style="list-style-type: none"> • Key Support Agency for flood. • Keep VICSES advised of the status of utilities and the ongoing ability to provide services. • Advise VICSES of the security of critical water and wastewater assets to assist preparedness and response activities in the event of flood. • Maintain or improve the security of critical water and wastewater. • Check and correct where possible the operation of critical water and wastewater assets in times of flood. • Advise the IC in the event of inundation of critical water and wastewater assets. 	

Agency/ Communities'	Specific "Flood" Responsibilities	Web links and Comments
Relief & Recovery Support Services	<ul style="list-style-type: none"> Refer to the Municipal Emergency Management Plan (MEMP) 	Red Cross, VCC, DHHS, Salvation Army, etc.
Powercor	<ul style="list-style-type: none"> Provide advice to the VICSES Incident Controller of any need to disconnect power supplies or of any timetable for reconnection. Clear or make safe any hazard caused by power lines or electrical reticulation equipment. Assess the necessity for and implement the disconnection of customers' electrical installations where these may present a hazard. Advise the public as to the availability or otherwise of the electricity supply. Inspect, test and reconnect customers' electrical installations as conditions allow. 	Powercor - Electricity - Interruptions & Faults
Telstra	<ul style="list-style-type: none"> Maintain Fixed and Mobile telephone services. Repair and restore telephone facilities damaged by flooding. Maintain Victorian Government Emergency Radio Network. Provide additional telecommunications support. This can be done by the use of our mobile base stations for mobile phones and the setup of a complete exchange if one gets damaged. 	
Victoria Police VicPol	<ul style="list-style-type: none"> Co-locate with and assist the Incident Controller with the decision and warning stages if required. Manage the withdrawal, shelter and return stages of the evacuation in consultation with the Incident Controller and Health Commander. With local assistance (MERC/MERO) source and manage resources to facilitate evacuation in consultation with control and support agencies. Maintain ongoing liaison with the Incident Controller for the duration of the evacuation. Monitor the establishment and maintenance of safe access and egress routes for evacuees. In consultation with the Incident Controller and other agencies maintain communications with the affected community. Ensure registration of evacuees is initiated if required. 	
VicRoads	<ul style="list-style-type: none"> Close and reopen roads as necessary and advise the VICSES Incident Controller and Council of the closure and later re-opening. Provide road condition information to the public. 	Incidents & alerts : VicRoads
Victorian State Emergency Service VICSES	<ul style="list-style-type: none"> The VICSES is the state authority responsible for managing response to floods, including public meetings and decisions on flood response such as evacuation. Coordinating activities of supporting agencies and organisations and ensuring that liaison is established with them. Coordinate a public education program so residents of flood prone areas can be made aware of and ready for the flood threat. 	<p>Call 132 500 for emergency SES assistance during a flood or storm.</p> <p>VICSES Information Line (1300 842 737) when activated.</p> <p>Emergency Plans and Kits — Victoria</p>

Agency/ Communities'	Specific "Flood" Responsibilities	Web links and Comments
	<ul style="list-style-type: none"> • Develop and maintain a flood intelligence system. • Coordinate the development and operation of flood warning services for the community. • Ensuring that people/communities at risk of flooding are identified and monitored. • Provide information services in relation to a flooding event. • Direct the conduct of flood rescue and evacuation of people and/or communities in support of VicPol. • Coordinate operations in accordance with its Sandbagging Policy i.e. by providing sandbags and sand to local communities. • Advise the community and supporting agencies when flood operations have been completed. • Support in flood recovery, if requested. • After a significant flood event, VICSES, NCMA and Council will co-ordinate the collection and collation of flood intelligence, including local knowledge. 	<p>State Emergency Service</p> <p>VICSES community education program to support community and business in responding to flood emergencies Link: FloodSafe — Victoria State Emergency Service</p> <p>Your local flood information — Victoria State Emergency Service</p>
VLine	<ul style="list-style-type: none"> • Close and re-open the line as necessary and advise the VICSES Incident Controller. 	
City of Greater Bendigo CGB, or Council	<ul style="list-style-type: none"> • Key Support Agency for flood. • Control development on floodplains through their local planning schemes. • Manage local community flood mitigation infrastructure. • Procure sandbags to protect Council owned facilities including Community Critical Facilities managed by Council. • Identify Community Critical Facilities. • At the request of the VICSES Incident Controller, deploy personnel and resources for flood related activities. • Coordinate the community relief and recovery arrangements in accordance with the Municipal Emergency Management Plan (MEMP). • Close and reopen Council roads as necessary and advise the VICSES Incident Controller and VicRoads of the closure and later re-opening • In conjunction with the DHHS, provide for the management of health hazards associated with flooding. • Ensure premises are fit and safe for reoccupation and assess any need for demolition. • Coordinate clean-up including disposal of sandbags. 	
North Central Catchment Management Authority (NCCMA)	<ul style="list-style-type: none"> • North Central Catchment Management Authority has statutory powers under the <i>Water Act 1989</i> to manage waterways, floodplains and rural drainage. • Prepare a Floodplain Management Strategy for their region. The strategy includes four objectives: <ul style="list-style-type: none"> ○ Adopt a consistent approach to assessing flood risks and prioritising flood management activities, ○ Build relationships and embed accountabilities for floodplain management, ○ Provides transparency and consistency in managing flood risks, ○ Encourage communities to take actions to manage their own risks, allowing local communities to determine their flood service 	

Agency/ Communities'	Specific "Flood" Responsibilities	Web links and Comments
	<p>needs.</p> <ul style="list-style-type: none"> • Provide input to planning schemes, responding to planning permit referrals and helping resolve planning issues. • Facilitate the development, maintenance and upgrading of regional flood warning systems. • Coordinate the collection of flood information such as: flood photography, flood heights and flow rates and velocities in times of significant floods. • During a flood provide emergency support VICSES: <ul style="list-style-type: none"> ○ With advice on the behaviour and movement of floods, ○ By monitoring regional flood warning systems, ○ Coordinating flood monitoring and collecting data. • Develop and prioritise flood recovery programs for CMA assets/waterways, including restoring impacts of river erosion where there is an immediate danger of the formation of river breakaways and/or immediate danger to CMA and public assets. 	

1.7 Responsibility for Planning, Review & Maintenance of this Plan

This Municipal Flood Emergency Plan must be maintained in order to remain effective.

VICSES through the Municipal Flood Planning Committee has responsibility for preparing, reviewing, maintaining and distributing this plan.

The MFEP will meet at least once per year.

The plans should be reviewed:

- Following any new flood study;
- Change in non-structural and/or structural flood mitigation measures;
- After the occurrence of a significant flood event within the Municipality to review and where necessary amend arrangements and information contained in this Plan.

1.8 Endorsement of the Plan

The MFEP will be circulated to MFEP members seeking acceptance of the draft plan.

Upon acceptance, the plan is forwarded to the IMEMPC for endorsement with the recommendation to include the MFEP as a sub-plan of the IMEMP.

Part 2. PREVENTION / PREPAREDNESS ARRANGEMENTS

2.1 Floodplain Management

The Victorian Floodplain Management Strategy (VFMS), released in 2016, builds on lessons from the 2010 to 2012 floods; which affected Bendigo & Heathcote in the City of Greater Bendigo. The VFMS ([Link: DELWP - Victorian Floodplain Management Strategy](#)) sets the direction for floodplain management in Victoria and has four key parts:

- **Assessing flood risks and sharing information** provides the technical basis for assessing flood risk and commits to sharing flood risk information. It sets the framework to prioritise flood mitigation activities based on the level of flood risk.
- **Avoiding or minimising future risks** endorses the use of planning controls to manage the potential growth in flood risk. It sets accountabilities in land use planning to avoid increased stormwater runoff from new developments and endorses planning benchmarks that consider predicted increases in sea levels.
- **Reducing existing risks** clarifies the institutional arrangements to mitigate the risk and consequence of floods. It also explains how flood warning systems will be tailored to meet community needs.
- **Managing residual risks** focuses on how access to better information can reduce the

The Regional Floodplain Management Strategy is nearing completion as at March 2018 and draft consultation document is available.

2.2 Flood Studies

The North Central Catchment Authority (NCCMA) has undertaken flood studies for Heathcote & the urban areas of Bendigo. [The Bendigo Urban Flood study](#) area includes the Bendigo Creek catchment from Kangaroo Flat to Huntly including the outlying suburbs of Maiden Gully, Strathfieldsaye and Junortoun.

The study:

- Provides detailed flood information for a range of flood events
- Assists future land use planning and development decisions
- Assists authorities and the community to prepare for and respond to flood events
- Assists the prioritisation of future drainage investments

The [Heathcote Flood Study](#) was undertaken on behalf of NCCMA in partnership with City of Greater Bendigo and completed in March 2016.

Flood studies provide more detailed information about flood behavior in a certain area, including development of sophisticated computer models that incorporate local knowledge, anecdotal information and historical information to determine flood extents, depths and velocities for a variety of flood sizes. After a study has been completed flood inundation maps and information can be used by land planners, the community and emergency services. This information also informs this Plan, in particular in the Attachments and Appendices. Link: [Flood studies | North Central Catchment Management Authority](#)

2.3 Community Awareness for all Types of Flooding

Details of this MFEP will be released to the community through local media, the FloodSafe program, websites (VICSES and the Municipality) upon formal adoption by the City of Greater Bendigo Council.

VICSES with the support of City of Greater Bendigo and North Central Catchment Management Authority will coordinate community education programs for flooding within the council area. E.g. FloodSafe / StormSafe. and through the distribution of a local flood guide

2.4 Structural Flood Mitigation Measures

The following summary of structural flood mitigation measures exist within the Council area:

- Unmanaged levees currently exist on the east (right hand) bank of Bendigo Creek from Scott Street in White Hill to the Bendigo – Tennyson Road in Huntly, a distance of approximately 15km. These levees play an important role in protecting large areas of Epsom and Huntly from inundation during large flow events (Water Technology, 2014). A more detailed description of the levees is available in the 1986 levee audit report by Findlay Irrigation.
- Lined section of Bendigo Creek (Maple St. to Weroona Ave)
- Lined section of Back Creek (Bendigo Ck to Abbott St)
- Storm Water drainage network
- Retarding Basins (location, owner, maintenance responsibility and protection levels) etc.

Refer to appendix C for detailed information of structural flood mitigation measures.

2.5 Flood Intelligence

Flood intelligence describes flood behaviour and its effects on the community. The effects include:

- Inundation (which may lead to a need for evacuation and/or property protection).
- Isolation (creating a need for resupply and/or rescue).
- Disruption to community activities (e.g. road closures)

Flood intelligence is obtained by the process of gathering and assessing information for the purpose of estimating the likely impacts and consequences of pending and future floods. It is used to facilitate operational decision-making and the provision of warnings and information to agencies and the public.

VICSES develops and maintains a flood intelligence system for the municipal footprint, including; records of the effects of flooding at different heights. Information about accessing flood intelligence is contained in Appendix C.

2.6 Flood Warning Services

All Victorian communities receive weather-related warnings such as Flood Watches and Severe Weather Warnings delivered by BoM. These services provide advice on weather conditions that have the potential for heavy rainfall and flooding.

BoM's website also provides near real-time river height data and rainfall data, for most major rivers at risk of flooding. This information allows people to make their own judgements about the rates of change and the potential for local consequences during a flood.

VICSES issues Local Flood Guides to support local communities in preparing for and responding to floods.

Victoria also has a flood warning system that involves several elements: rainfall and stream flow gauging, mapping, warnings and predictions. All these elements need to come together in order for the total system to give communities effectively warnings about approaching floods.

Victoria's flood warning system is called the Total Flood Warning System (TFWS).

2.6.1 Total Flood Warning System Services

The purpose of the Total Flood Warning System (TFWS) is to enable and persuade people, communities and organisations to take action to increase safety and reduce the costs of flooding. It seeks to achieve this by generating appropriate responses from people and organisations at risk, and from the agencies with responsibilities during flood times.¹

The TFWS comprises of six integral parts²:

1. **Prediction** – detecting changes in the environment that lead to flooding, and predicting river levels during flood³.
2. **Interpretation** – identifying in advance the impacts of the predicted flood levels on communities at risk.
3. **Message construction** – devising the content of the message which will warn people of impending flooding.
4. **Communication** – disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood.
5. **Response** – generating appropriate and timely actions from the threatened community and from the agencies involved.
6. **Review** – examining the various aspects of the system with a view to improving its performance.

Communities with high potential for flood damage receive more sophisticated TFWS services. These can include local predictions about the rise and fall of floodwaters, details on the roads and properties likely to be inundated, and local advice about how to prepare for and respond to predicted floods.

2.6.2 Clarifying accountabilities for each TFWS element

The relevant agencies' roles and responsibilities in operating and maintaining the TFWS is as follows:

Data collection network infrastructure: The river height and rainfall gauging network infrastructure is maintained through Regional Water Monitoring Partnership (involving DELWP, Council, CMAs, and local water corporations). The Partnership contributes funds to the maintenance of those parts of the network whose primary function is to support the TFWS.

¹ Mary Barry, *Total flood warning systems*, The Australian Journal of Emergency Management, Vol.23 No. 3, August 2008

² Ibid

³ Note: This Plan acknowledges that not all river systems are serviced by flood monitoring gauges. As part of flood studies future monitoring infrastructure could be determined.

Flood prediction service maintenance: BoM maintains and funds the prediction services for the locations as defined in the Partnership agreement. Maintenance includes continually improving prediction techniques, interpretation (flood mapping) and completion of local flood studies to produce updated flood mapping. DELWP includes updated flood mapping and flood behaviour information into the flood intelligence platform.

Message construction and dissemination: BoM maintain appropriate flood warning messages and associated dissemination channels. VICSES maintains its dissemination channels for flood bulletins. DELWP maintains the flood intelligence platform to enable appropriate information for messages and bulletins to be accessed. Council may relay approved messages from the BoM and VICSES on its website and social media.

Flood response planning and community awareness: VICSES maintains flood response plans and community education material. CMAs supply VICSES with any significant updates.

2.6.3 FloodZoom

DELWP has developed a ground-breaking, web-based tool that provides an authoritative range of flood information to agencies, before, during and after floods – all in the one resource.

FloodZoom brings together flood forecasts, flood mapping, real-time river height gauges and property data to provide flood response agencies with improved knowledge of likely flood impacts.

Flood-prone communities will benefit from more accurate and timely flood warnings that are specific to their local community, improved flood preparedness and flood response activities, and better informed planning decisions.

For further details go to Link: [Flood warning improvements - DELWP](#)

2.6.4 VicEmergency Website

Emergency Management Victoria (EMV) host the [VicEmergency Website](#), a centralised website for Victorians to find emergency information and warnings. You can also access preparedness and recovery information related to emergencies.

The website has a real-time Google Map display with incidents across the state including floods, storms, fires, earthquakes, tsunami, beach closures, shark sightings and more.

2.7 Flash flood warning services

Flash flooding poses a potential threat to life in some regional urban centres. Flash flood warnings centre on a rapid response (less than six hours) to the conditions that might lead to flooding:

- NCCMA, with support from VICSES and Council, identify areas where flash flooding poses a risk to life.
- VICSES will work with DELWP, BoM, and the Emergency Management Victoria to evaluate the potential to provide localised neighbourhood-scale flash flood warning services where there is a history of flash flooding.

2.8 Non-structural Flood Mitigation Measures

2.8.1 Exercising the Plan

Arrangements for exercising this Plan will be at the discretion of the IMEMPC and may be conducted at a cluster level (Northern Victorian Emergency Management Cluster). This Plan

should be regularly exercised, preferably on an annual basis. Refer to Part 6, Section 6.2, subsection 6 of the EMMV for guidance.

2.8.2 Flood Warning

Arrangements for flood warning are contained within the State Flood Emergency Plan and the EMMV (Part 3.7) and on the BoM website.

Specific details of local flood warning system arrangements are provided in appendix E.

2.8.3 Flood Observers (local knowledge)

Flood Observers and local knowledge provide a means of gathering information in real time on flood behaviour along a stream system, and a network for the distribution of community information and warnings to the community along the stream system.

No official flood observers have been appointed within the City of Greater Bendigo Shire. However, local knowledge will be sought and utilised.

Part 3. RESPONSE ARRANGEMENTS

3.1 Response Triggers and Activation

Severe Weather Warnings aim to provide advance notice of high winds and or heavy rainfall that is likely to lead to flash flooding or storm surge. Warnings are issued by the BoM when severe weather is expected to affect land-based communities within the next 24 hours (but is not directly the result of severe thunderstorms, tropical cyclone or fire weather warnings) and are issued for a Weather District. City of Greater Bendigo falls in the 'Northern Country Weather District.

Flood Watches are issued by the BoM when predicted rainfall may lead to flooding. They are issued 24 to 36 hours in advance of any likely flooding and are issued for a Weather District.

3.1.1 Activation of Response

Flood response arrangements may be activated by the Regional Duty Officer (RDO) VICSES North West Region or Incident Controller.

The Incident Controller/RDO VICSES will activate agencies as required and documented in the State Flood Emergency Plan.

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 flood within the City of Greater Bendigo. These agencies will be engaged through the EMT.

The general roles and responsibilities of supporting agencies are as agreed within the Integrated MEMP, EMMV (Part 7 'Emergency Management Agency Roles'), State Flood Emergency Plan and Regional Flood Emergency Plan.

3.1.3 Municipal Operations Centre (MOC)

Liaison with the MOC will be through the established Division/Sector Command and through Municipal involvement in the Incident EMT, in particular the Municipal Emergency Response Coordinator (MERC). The VICSES RDO / ICC will liaise with the MOC directly if no Division/Sector Command is established.

The function, location, establishment and operation of the MOC will be as detailed in the IMEMP.

3.1.4 Escalation

Most flood incidents are of local concern and an appropriate response can usually be coordinated using local resources. However, when these resources are exhausted, the State's 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 arrangements are described in the EMMV ('State Emergency Response Plan' – Part 3, Section 6.3).

3.2 Strategic Control Priorities

To provide guidance to the Incident Management Team (IMT), the following strategic control priorities shall form the basis of incident action planning processes:

1. Protection and preservation of life is paramount - this includes:
 - a. Safety of emergency services personnel, and;
 - b. Safety of community members including vulnerable community members and visitors/tourist located within the incident area.
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 supports 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 values that considers the cultural, biodiversity, and social values of the environment;

Circumstances may arise where the Incident Controller 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 Controller and relevant stakeholders based on sound incident predictions and risk assessments.

3.3 Command, Control & Coordination

The Command, Control and Coordination arrangements in this Municipal Flood Emergency Plan are consistent with those detailed in the State Emergency Response Plan (SERP)⁴ - Part 3 of the EMMV. For further information, refer to sections 3.5, 3.6 & 3.7 of the EMMV.

3.3.1 Control

Functions 5(a) and 5(c) at Part 2 of *the Victoria State Emergency Service Act 1986 (as amended)* detail the authority for VICSES to plan for and respond to flood.

Part 7.1 of the EMMV prepared under the *Emergency Management Act 1986 (as amended)*, identifies VICSES as the Control Agency for flood. It identifies DELWP as the Control Agency responsible for “*dam safety, water and sewerage asset related incidents*” and other emergencies

All flood response activities within the City of Greater Bendigo including those arising from a dam failure or retarding basin / levee bank failure incident will therefore be under the control of the appointed Incident Controller, or his / her delegated representative.

⁴ [Emergency Management Manual Victoria | Emergency Management Victoria](#)

3.3.2 Incident Controller (IC)

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

3.3.3 Incident Control Centre (ICC)

As required, the Incident Controller will establish an Incident Control Centre (ICC) from which to initiate incident response command and control functions. The decision as to if and when the ICC should be activated, rests with the Control Agency (i.e. VICSES).

Pre-determined Incident Control Centre locations are

- **Level 1⁵** – Local VICSES Unit
- **Level 2** – SES Regional HQ, 7 Rohs Rd East Bendigo
- **Level 3** – DELWP, Cnr Taylors Rd & Midland Hwy Epsom.

All ICC's are listed in the [North West Regional Flood Emergency Plan](#).

3.3.4 Divisions and Sectors

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

The following Divisions and Sectors may be established to assist with the management of flooding within the Municipality (additional divisions/sectors may be identified by the Incident Controller if required):

Division	Sector
Bendigo SES Unit (64 Adam St, Bendigo)	Redesdale (CFA) – Heathcote-Kyneton Rd. Redesdale
Secondary: CFA Group HQ (Adam St.)	Bendigo (SES) – 64 Adam St, Bendigo
	Huntly (CFA)
	Heathcote (SES)
	Marong (SES)

3.3.5 Incident Management Team (IMT)

The Incident Controller will form an Incident Management Team (IMT).

Refer to 4.4 of the EMMV for guidance on IMTs and Incident Management Systems (IMSS).

3.3.6 Emergency Management Team (EMT)

The function of the Emergency Management Team (EMT) is to support the IC in determining and implementing appropriate incident management strategies for the flood event.

If the flood event requires a response by more than one agency, the IC is responsible for forming the EMT.

The EMT consists of:

⁵ Level 1, 2 and 3 incidents are described in the SERP

- Incident Controller
- Support Agency commanders
- Commander of supporting health agencies
- Regional Recovery Coordinator (DHHS) and/or Municipal Recovery Manager (Council)
- Emergency Response Co-ordinator (MERC or RERC) , and
- Other specialist persons as required.

For detailed information in relation to roles and responsibilities of the EMT refer to the SERP at Part 3 of the EMMV and Practice Note Emergency Management Team available from the [Emergency Management Manual Victoria | Emergency Management Victoria website](#)

Organisations, including City of Greater Bendigo required within the EMT 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.

3.3.7 On Receipt of a Flood Watch / Severe Weather Warning

Incident Controller or VICSES RDO (until an incident controller is appointed) will undertake actions as defined within the flood intelligence cards (appendix C). General considerations by the Incident Controller/VICSES RDO will be as follows:

- Review flood intelligence to assess likely flood consequences
- Monitor weather and flood information – www.bom.gov.au
- Assess Command and Control requirements.
- Review local resources and consider needs for further resources regarding personnel, property protection, flood rescue and air support
- Notify and brief appropriate officers. This includes Regional Control Centre (RCC) (if established), State Control Centre (SCC) (if established), Council, other emergency services through the EMT.
- Assess ICC 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 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 Flood Warnings

Incident Controller/VICSES RDO (until an incident controller is appointed) will undertake actions as defined within the flood intelligence cards (appendix C). General considerations by the Incident Controller/VICSES RDO 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
- Determine what the at-risk community need to know and do as the flood develops.
- Warn the at-risk community including ensuring that an appropriate warning and community information strategy is implemented including details of:
 - The current flood situation
 - Flood predictions
 - What the consequences of predicted 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 flood consequence assessment.
- Continue to monitor the flood situation – www.bom.gov.au/vic/flood/
- 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 State Flood Emergency Plan.

Community information and warnings communication methods available include:

- Vic Emergency Website & VicEmergency App
- Emergency Alert;
- Phone messages (including SMS);
- Radio and Television;
- VicEmergency Hotline (1800 226 226)
- Two-way radio;
- Mobile and fixed public address systems;
- Sirens;
- Verbal Messages (i.e. Doorknocking);
- Agency Websites;
- Variable Message Signs (i.e. road signs);
- Community meetings;
- Newspapers;
- Email;
- Telephone trees;

- Community Flood Wardens;
- Fax Stream;
- Newsletters;
- Letter drops;
- Social media and/or social networking sites (i.e. twitter and/or facebook).

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

The release of flood bulletins and information with regard to response activities at the time of a flood event is the responsibility of VICSES, as the Control Agency.

Council has the responsibility to assist VICSES to warn individuals within the community including activation of flood warning systems, where they exist. Responsibility for public information, including media briefings, rest with VICSES as the Control Agency.

Other agencies such as CFA, DELWP and VICPOL may be requested to assist VICSES with the communication of community 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 Signal (SEWS).

DHHS will coordinate information regarding public health and safety precautions.

3.5 Media Communication

The Incident Controller through the Information Unit established at the ICC will manage Media communication. If the ICC is not established the RDO will manage all media communication.

3.6 Initial impact assessment

The IC is responsible for initiating the impact assessment process. Once it is initiated the IC will request the appointment of a coordinator to manage the first phase of assessment.

Impact Assessment is not the responsibility of a single agency; it encompasses data drawn from a number of different agencies and government departments. Whilst the Initial Impact Assessment phase is essentially a visual inspection by first responders, the Secondary Impact Assessment utilise data drawn from various sources including the affected community, response agencies, Council, DET, DHHS, DELWP, VicRoads and subject matter expert's depending on the nature and scale of the event.

This information may then be used to provide the basis for further needs assessment and recovery planning by DHHS, Council and other recovery agencies.

Further details on the impact assessment process can be found Section 3.5.9 of the Emergency Management Victoria Impact Assessment Guidelines for Class 1 Emergencies 2015.

3.7 Preliminary Deployments

When 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 items and non-food items such as medical supplies, shelter, assembly areas, relief centres etc.

3.8 Response to Flash Flooding

Emergency management response to flash flooding should be consistent with the guideline for the emergency management of flash flooding contained within the State Flood Emergency 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, resources available and etc;
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;
3. Where it is likely people will become trapped by floodwaters due to limited evacuation options 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 un-suitable 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.

During a flash flood it will often be difficult, due the rapid development of flooding, to establish evacuation (relief) centres ahead of actually triggering the evacuation as is normal practice but this is insufficient justification for not adopting evacuation.

Refer to appendix C for response arrangements for flash flood events.

3.9 Evacuation

The decision to recommend or warn people to prepare to evacuate or to evacuate immediately rests with the Incident Controller.

Once the decision is made VicPol are responsible for the management of the evacuation process where possible. VICSES and other agencies will assist where practical. VICSES is responsible for the development and communication of evacuation warnings.

VicPol and/or Australian Red Cross may take on the responsibility of registering people affected by a flood emergency including those who have been evacuated.

Refer to section 3.11.2 of the EMMV and the Evacuation Guidelines (Appendix D) for guidance of evacuations for flood emergencies.

3.10 Flood Rescue

VICSES may conduct flood rescues. Appropriately trained and equipped VICSES units or other agencies that have appropriate training, equipment and support 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.

Where the water is flowing at or above walking pace it is considered to be swift water. The responsibility for swift water rescue sits with Victorian Water Police who will provide a Senior Sergeant from Water Police to attend the local ICC to manage swift water rescues

Rescue Boats: A number of SES rescue boats for flood response are available across the region and can be quickly deployed to the required location. Consideration should be given to the type of flood and the expected conditions and uses for boats when deploying this resource. Rescue boat locations can be found in Appendix 6 of the North West Region, [Regional Flood Emergency Plan](#).

3.11 Aircraft Management

Aircraft can be used for a variety of purposes during flood operations including evacuation, resupply, reconnaissance, intelligence gathering and emergency travel.

Air support operations will be conducted under the control of the Incident Controller.

The Incident Controller may request aircraft support through the State Air Desk located at the State Control Centre will establish priorities.

Suitable airbase facilities are located at:

- Bendigo Airport – Victa Rd, East Bendigo

3.12 Resupply

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

When predictions/intelligence indicates 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 the emergency relief arrangements with VICSES working with the relief agencies to service communities that are isolated.

3.13 Essential Community Infrastructure and Property Protection

Essential Community Infrastructure and Property (e.g. residences, businesses, roads, power supply etc.) may be affected in the event of a flood.

The City of Greater Bendigo maintains a small stock of sandbags at the works depot and back-up supplies are available through the VICSES Regional Headquarters. The Incident

Controller will determine the priorities related the use of sandbags, which will be consistent with the strategic priorities.

If VICSES sandbags are becoming limited in supply, then priority will be given to protection of Essential Community Infrastructure. Other high priorities may include for example the protection of historical buildings.

Property may be protected by:

- Sandbagging to minimise entry of water into buildings, Ref; [VICSES Sandbag Quick Reference Guide](#).
- Encouraging businesses and households to lift or move contents
- Construction of temporary levees in consultation with the CMA, LGA and VICPOL and within appropriate approval frameworks.

The Incident Controller will ensure that owners of Essential Community Infrastructure are kept advised of the flood situation. Essential Community Infrastructure providers must keep the Incident Controller informed of their status and ongoing ability to provide services.

Refer to Appendix C for further details of essential infrastructure requiring protection.

3.14 Disruption to Services

Disruption to services other than essential community infrastructure and property can occur in flood events. Refer to appendix C for specific details of likely disruption to services and proposed arrangements to respond to service disruptions in City of Greater Bendigo

3.15 Road Closures

City of Greater Bendigo and VicRoads will carry out their formal functions of road closures including observation and placement of warning signs, road blocks etc. to its designated local and regional roads, bridges, walking and bike trails. City of Greater Bendigo staff may also liaise with and advise VicRoads as to the need or advisability of erecting warning signs and / or of closing roads and bridges under its jurisdiction. VicRoads are responsible for designated main roads and highways and Councils are responsible for the designated local and regional road network.

VICROADS and City of Greater Bendigo will communicate community information regarding road closures, these can also be found on [VicTraffic](#) website.

If an ICC has been established, VICPOL will provide a Traffic Management Manager for the development of traffic management plans as required.

3.16 Dam Failure

DELWP 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.

Dams and retardation basins with potential to cause significant structural and community damage within the Municipality are contained in Appendix A.

3.17 Waste Water related Public Health Issues and Critical Sewerage Assets

Inundation of critical sewerage assets including septic tanks (CoGB) and sewerage pump stations may result in water quality problems within the Municipality. Where this is likely to

occur, or has occurred, the responsible agency (Coliban Water) for the critical sewerage asset should undertake the following:

- 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 City of Greater Bendigo Environmental Health Officer to inspect and report to the MERO and the ICC on any water quality issues relating to flooding.

3.18 After Action Review

VICSES will coordinate the after action review arrangements of flood operations as soon as practical following an event.

All agencies involved in the flood incident should be represented at the after action review.

Part 4. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS

4.1 General

Arrangements for recovery from a flood incident within the City of Greater Bendigo are detailed in the IMEMP.

4.2 Emergency Relief

The Incident controllers determine the need to activate relief services, with advice from the emergency management team. Incident Controllers are responsible for ensuring that relief arrangements have been considered and implemented where required under the State Emergency Relief and Recovery Plan (Part 4 of the EMMV).

The range and type of emergency relief services to be provided in response to a flood event will be dependent upon the size, impact, and scale of the flood. Refer to section 4.4 of the EMMV for details of the range of emergency relief services that may be provided.

Suitable relief facilities identified for use during floods are in the IMEMP.

Details of the relief arrangements are available in the IMEMP.

4.3 Animal Welfare

Matters relating to the welfare of livestock, companion animals and wildlife (including feeding and rescue) are to be referred to DEDJTR.

Requests for emergency supply and/or delivery of fodder to stranded livestock or for livestock rescue are passed to DEDJTR.

Matters relating to the welfare of wildlife are to be referred to DELWP.

Refer to the CoGB Animal Welfare Plan for further details

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 Part 3 Section 4.6 of the EMMV.

ACCURACY

The information in the following Appendices provides a guide to the likelihood and possible effects of flooding. 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.

APPENDIX A – FLOOD THREATS FOR THE MUNICIPALITY

1. General

The City of Greater Bendigo is located around 150km North West of Melbourne in North Central Victoria. It covers an area of 3,048km². It is mostly within the operating area of the North Central Catchment Management Authority although a small part (the area east and north of Heathcote – the area east of the Northern Highway) is within the Goulburn Broken Catchment Management Authority operating area. It is bounded by the Mitchell and Mount Alexander Shires to the south, the Loddon Shire to the west, the Campaspe Shire to the north and the Campaspe and Strathbogie Shires to the east. The Municipal boundary runs along the Campaspe River from around 14km downstream from Lake Eppalock to around 6km upstream of Rochester. Other boundaries tend to follow roads although a few short sections of the southern boundary with Mount Alexander Shire follow short sections of a number of small creeks.

The Municipality is within the Murray Darling Basin and covers parts of the Campaspe and Loddon catchments as well as a small part of the Goulburn catchment to the east of the Northern Highway. This latter area drains generally through many small creeks, including to Major Creek and the Goulburn River and also to Cornella Creek which runs to the east of Rushworth and Waranga Basin.

Bullock Creek, Bendigo Creek, Myers Creek and their many tributaries all rise in the hills around Bendigo. Their upper reaches are totally within the Municipality as are the western tributary creeks to the Campaspe River between Lake Eppalock and Rochester. The majority of the catchments of the creeks feeding Lake Eppalock (from both the west, south and east) as well as Lake Eppalock itself are also within the Municipality.

The Campaspe River enters the Municipality at Redesdale and leaves it around 15km downstream from Elmore. The boundary is also around 6km upstream of Rochester and around 3km downstream from Campaspe Weir.

The City of Greater Bendigo has a population of around 110,000 and is expected to grow to about 200,000 by 2050. Suburbs of Bendigo include Eaglehawk, Kangaroo Flat, Epsom, Strathdale and Strathfieldsaye. Smaller communities include Axedale, Elmore, Goornong, Heathcote, Huntly, Marong, Maiden Gully, Raywood and Redesdale. Other smaller settlements are dotted throughout the Municipality.

The Municipality is traversed by a number of major roads including the Midland, Calder, Loddon Valley and McIvor Highways which intersect at Bendigo as well as the Northern Highway. A number of important rail lines also pass through the Municipality: the Castlemaine - Bendigo line (the main rail link to Melbourne) as well as the Bendigo - Echuca line and the Bendigo - Swan Hill line..

2. Major Waterways

Major waterways within the Municipality include:

- ◆ Within the Campaspe basin:
 - The Campaspe River from Redesdale upstream of Lake Eppalock to around 15km downstream from Elmore although from around 14km downstream from Lake Eppalock to around 6km upstream of Rochester only the western side of the catchment is within the Municipality.
 - Lake Eppalock and its tributaries including Mt Ida Creek.

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- > Mcivor Creek which affects Heathcote before joining with Mt Ida Creek to discharge into Lake Eppalock.

The western tributaries to the Campaspe River between Lake Eppalock and Campaspe Weir (e.g. Sheepwash Creek and Axe Creek). Axe Creek affects Strathfieldsaye.

- > The upper reaches of Mt Pleasant Creek (upstream of Toolleen) which joins the Campaspe River upstream of Elmore from the east.

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- ◆ Within the Loddon basin:
 - Bendigo Creek and its many tributaries from their headwaters within the City of Bendigo through Huntly and Goornong to Drummartin (the creek was previously known as Piccaninny Creek downstream from Goornong).
 - Upper parts of Myers Creek and its tributaries (Marong to Raywood).
 - Upper parts of Bullock Creek and its tributaries (Harcourt to Marong).
 - Bradford Creek and Little Creek, eastern tributaries to the Loddon River.
- ◆ Within the Goulburn basin (to the east of the Northern Highway):
 - Cornella Creek and its tributaries (Redcastle).
 - Tributaries to Major Creek.

3. Flood Risks

The City of Greater Bendigo experiences riverine flooding associated with the Campaspe River and the larger creeks, flash flooding along the shorter and steeper waterways and stormwater flooding in urban areas. Bendigo is subject to flash flooding⁶ associated with both stormwater flooding and flooding from Bendigo Creek and its many tributaries.

The streams most likely to pose a risk to property as a result of flooding are:

- ◆ Mclvor Creek, Mt Ida Creek and Mt Pleasant Creek.
- ◆ Of particular importance for **Heathcote** is that following significant rainfall in the Tooborac Hills area, Mclvor Creek begins to rise between 3 and 6 hours from the start of rain although the rise can be delayed by up to 10 hours. Rises are rapid with the peak generally occurring between 10 and 12 hours after the start of rise. The size of the flood does not appear to drive the rate of rise but a second flood on a wet catchment does rise a little quicker. Timing can be as short as 8 hours from start of rise to peak.
- ◆ Bendigo Creek and its many tributaries.
If a significant storm occurred around **Kangaroo Flat**, both **Charing Cross** and the **Bendigo CBD** would experience high flows / be flooded within about 1½ hours. Parts of **Junortoun** and **Maiden Gully** also experience flooding from time to time.
- ◆ Myers Creek and Bullock Creek and tributaries.
The primary concerns for these creeks and their immediate tributaries is road inundation which, although it generally only normally lasts for half day to one day, can be significant. Some stock losses, primarily sheep, have been experienced during previous floods.
- ◆ Axe Creek and Sheepwash Creek and tributaries.
Concerns for this creek network are similar to those for Myers and Bullock creeks. However, with development in the **Mandurang** and **Strathfieldsaye** areas, some properties could be at risk during a significant flood event.
- ◆ Campaspe River
Flooding occurs around **Redesdale** and also downstream from **Lake Eppalock to the Municipal boundary** just upstream (south) of Rochester (around 3km downstream / north of Campaspe Weir).

Areas currently considered most at risk of experiencing flooding as a result of exceedance of stormwater drainage system capacities are the urban areas of Bendigo and Heathcote.

⁶ Flash flooding is defined as “flooding occurring within about 6 hours of rain, usually the result of intense local rain and characterized by rapid rises in water level” (Bureau of Meteorology, *Weather Services Handbook*).

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Parts of Strathdale, Strathfieldsaye and Kangaroo Flat have been impacted previously. It is possible that any of the low-lying sections within the Municipality's urban areas could be at risk, depending on where a severe storm event occurred.

Levees along parts of Bendigo Creek in the vicinity of Howard Street in Bendigo provide a degree of protection from smaller floods.

BENDIGO CREEK – EPSOM & HUNTLY

A spoil pile dating from early dredging works of the Bendigo Creek extends along the eastern side of the creek between Scott Street in White Hills and the Bendigo-Tennyson Road north of Huntly.

This unmanaged embankment provides significant flood protection to the majority of the Epsom and Huntly areas, however ownership and management of the embankment is still to be resolved (this is a specific action in the Regional Floodplain management strategy)

BACK CREEK – ASCOT & HUNTLY

The waterway that runs from Junortoun, through Ascot and Huntly before meeting the Bendigo Creek near the Bendigo-Tennyson Road shares the name Back Creek with other, separate waterways within the Greater Bendigo area.

This particular Back Creek has been subject to extensive historic siltation and realignment through Ascot and Huntly, leaving in a waterway that is frequently unable to convey all of the flood-waters attempting to pass through it.

The resulting overbank flooding covers substantial areas of both residential and farming land, a problem that has been exacerbated and perpetuated by historic decisions regarding land-use.

RACECOURSE CREEK – EPSOM

Racecourse Creek enters Bendigo Creek just upstream of Howard Street and consists of an excavated unlined channel between its confluence with the Bendigo Creek and the Bendigo-Echuca Railway Bridge.

The surrounding floodplain is not well defined and existing remnant silt mounds from early dredging of the creek are not effective in containing large floods.

Floodwaters leave Racecourse Creek during frequent events, resulting in significant flooding throughout Epsom, Ascot and Huntly.

Lake Eppalock can play an important role in reducing flooding in the Campaspe River downstream of the dam as it provides significant attenuation of flows if not full at the start of an event.

The table below summarises the key flood risks with the City of Greater Bendigo determined as through the application of the Community Emergency Risk Assessment process.

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		People	Property	Environment	Economy
Bendigo Creek system	Extreme	Y	Y	Y	Y
Mclvor Creek system	High	Y	Y	Y	N
Sheep Wash / Emu / Axe Creek system	Moderate	Y	Y	N	N
Myers / Bullock Creek system	Moderate	Y	Y	N	N
Campaspe River – above Eppalock	Low	N	Y	N	N
Campaspe River – below Eppalock	Low	N	Y	N	N

In using the information contained in the following Appendices, consideration needs to be given to the time of travel of the flood peak. A flood on a 'dry' waterway will generally travel more slowly than a flood on a 'wet' waterway (e.g. the first flood after a dry period will travel more slowly than the second flood in a series of floods). Hence, recent flood history, soil moisture and forecast weather conditions all need to be considered when using the following information to direct flood response activities.

A history of notable flood events within the Municipality is provided in Section 13 of this Appendix.

4. Riverine Flooding

Generally, a wet catchment and a period of heavy rain are required to produce riverine flooding within the Municipality. This includes in the Campaspe River around Redesdale, along the tributary creeks to both Lake Eppalock and the Campaspe River and in the Bendigo and Bullock creek systems. However, spill from Lake Eppalock is generally required before anything more severe than minor flooding occurs along the river downstream from the Lake to the Municipal boundary near Campaspe Weir. The amount of free storage in Lake Eppalock prior to a rain event is therefore a critical consideration for flooding in that part of the Municipality north of Lake Eppalock.

Large riverine floods generally occur within the Municipality (and on the Campaspe River downstream from Lake Eppalock if the Lake is at or near full supply level prior to rain) as a result of either:

- A moist warm airflow from northern or north western Australia (perhaps from a decaying tropical cyclone such as occurred in January 2011) bringing heavy rainfall over a period of 12 hours or more following a period of general rainfall. The initial period of general rainfall "wets up" the catchments and (partially) fills the on- and off-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 prolonged 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 heavy rainfall.
- Heavy rain from 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 north

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central Victoria) 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 also cause flash flooding across the Municipality. 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, but can have a large impact on Bendigo. Flooding from these storms occurs with little warning.

Around Bendigo and in other urban areas around the Municipality (e.g. Heathcote), high intensity rainfall such as associated with thunderstorms giving average rainfall rates of typically more than 20 mm/hour sustained over a period of up to 2 hours or so and delivering 40mm or more of rain is likely to lead to flooding flows in drainage channels and urban stormwater drainage systems (and in the case of Bendigo, in the local creeks), even following a period of dry weather. The more intense the rain, the more likely that flooding will affect properties, flood some houses over-floor and inundate roads.

This amount of rain on a wet catchment would result in more severe flooding.

Large floods within the urban area of Bendigo have also resulted from more general heavy rain events (see for example the history of flooding at Section 13.1 of this Appendix). Such events are often associated with a warm moist unstable airflow from northern Australia and occur mainly in summer although they may occur in spring and autumn.

Less severe floods can result from heavy rain following a sequence of cold fronts. These cold fronts occur generally during winter and spring and progressively wet up the catchments and fill the natural floodplain storage ahead of the heavy rain.

Floodwaters pass quickly through the hilly upper and middle parts of the creek catchments around Bendigo. Flooding is usually not very deep but moves very quickly and can be dangerous. Water levels rise quickly. Around Epsom and Huntly where the landscape is relatively flat, flood water spreads out more, is deeper and travels (and rises) more slowly.

Blocked or capacity impaired stormwater drains can also lead to overland flows and associated flooding: the drain surcharges and excess water flows above ground. The likely location of such flooding is hard to predict other than in cases where a drain has a past history of surcharging. Council maintenance records may provide some guidance in such cases.

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 Management Plans (DSEPs). 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.

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7. Dams and Stormwater Retarding Basins

The most significant dam within the Municipality is Lake Eppalock. It is located east of Bendigo on the Campaspe River downstream of its junction with the Coliban River and is owned and operated by G-MW.

A number of other significant water storages are located within the Campaspe catchment, upstream of Lake Eppalock and thus outside the Municipality. (e.g. the Upper Coliban Storages: Upper Coliban Reservoir, Lauriston Reservoir and Malmsbury Reservoir – all owned and operated by Coliban Water).

There are a number of smaller dams in and around Bendigo (including Heathcote) as well as numerous farm dams together with around 50 stormwater retarding basins. The largest are Crusoe Reservoir, No 7 Reservoir, Spring Gully Reservoir, Sandhurst Reservoir, Gateway Park Lake, Specimen Hill Reservoir, Grassy Park Reservoir No 1 and Jackass Flat Reservoir. Three of these were owned previously by Coliban Water but are now owned by the City of Greater Bendigo (see table below). The above storages (with the exception of Specimen Hill Reservoir, Grassy Park Reservoir No 1 and Jackass Flat Reservoir) are considered to be off-line as they have catch drains that divert water from their upstream catchments around the reservoir and back into the water course. The catch drains at Crusoe have been modified so that the reservoir now receives an inflow from its catchment. It is also understood that the spillway has been lowered.

In addition to a number of small informal farm dams upstream of Heathcote, there are two relatively small storages, both of which have very small upstream catchments:

- Caledonia Gully Reservoir which is operated by Coliban Water and is used to supply water to Heathcote and Tooborac. It is located around 5km south of the town near the intersection of Dairy Flat Road and Hedleys Dam Track; and
- Hedleys Dam which is located at the head of Argyle Gully around 500m north west of Caledonia Gully Reservoir (nearer Heathcote) along Hedleys Dam Track. Ownership details are not readily available.

The main dams are listed in the following table.

Location	Owner	Dam Height	Dam Capacity	Comments
Lake Eppalock				
Lake Eppalock is located east of Bendigo on the Campaspe River downstream of its junction with the Coliban River	Goulburn Murray Water	47 m high earth and rock fill embankment	304,651ML at Full Supply Level (FSL) of 193.91mAHD.	Fixed crest thus at FSL inflow = outflow. Dam was constructed between 1960 and 1964. G-MW completed a major upgrade of the main embankment in 1999 and 2003. A Dam Safety Emergency Plan has been prepared for Lake Eppalock
Crusoe Reservoir				
On Bendigo Creek immediately upstream of Kangaroo Flat in Robinson Crusoe	City of Greater Bendigo	12metres	890ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1880. Coliban completed a

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Location	Owner	Dam Height	Dam Capacity	Comments
Gully				major upgrade of the main embankment and lowered spillway in 2000s. A Dam Safety Emergency Plan has been drafted
No 7 Reservoir				
South of Granter Street in Kangaroo Flat	City of Greater Bendigo	9 metres	105ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1880. Coliban completed a major upgrade of the main embankment and lowered spillway in 2000s. A Dam Safety Emergency Plan has been drafted
Spring Gully Reservoir				
Upstream of Spring Gully to the south of Bendigo	Coliban Water	18 metres	1680ML	Recycled Water
Sandhurst Reservoir				
Located at Big Hill upstream of Cusoe Reservoir and on the eastern side of Calder Highway	Coliban Water	26 metres	2,590ML at FSL	Bendigo Drinking Water Supply
Kennington Reservoir				
On Grassy Flat Creek north of Condon Street between Crook Street and Reservoir Road in Kennington	City of Greater Bendigo	8.5 metres	118 ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1870. A Dam Safety Emergency Plan has been drafted.
Lake Neangar				
Located off Butts Road between Simpsons Road and Napier Street Eaglehawk	City of Greater Bendigo	6 metres	60 ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1883. A Dam Safety Emergency Plan prepared.
Lake Tom Thumb				
Located off Averys Road between Simpsons Road and Victoria Street Eaglehawk	City of Greater Bendigo	3 metres	45 ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1980. A Dam Safety Emergency Plan prepared.
Golf Leaf Dam (Doc Smith Reserve)				
Located off Airey Road, Huntly	City of Greater Bendigo	4 metres	40 ML	Fixed crest thus at FSL inflow = outflow. A Dam Safety Emergency Plan prepared

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Location	Owner	Dam Height	Dam Capacity	Comments
Ritchies Dam				
Located off Ritchies Drive between Queen Street and Wesley Street Kangaroo Flat	City of Greater Bendigo	5 metres	30 ML	Fixed crest thus at FSL inflow = outflow. Dam was constructed in 1870. A Dam Safety Emergency Plan has been drafted.
Caledonia Gully Reservoir				
Located around 5km south of Heathcote near the intersection of Dairy Flat Road and Hedleys Dam Track	Coliban Water			Very small upstream catchment Water is pumped from Lake Eppalock via a 24km rising main and stored in the Reservoir before being treated and supplied to Heathcote and Tooborac.

Dam Safety Emergency Plans are available on [EMCOP](#)

While the Campaspe Weir (owned and operated by G-MW) is not a dam as such, it is a fixed crest weir with two small gates, and it does hold back some water in order to provide a driving head for the diversion of water into the irrigation channel system. In 2011 the water level was almost the same both sides on the weir: it was effectively drowned out. As the weir is about level with the top of the river bank, it is very unlikely that significant damage would occur downstream if it failed.

8. Health and Environmental Risks

There are a number of septic tanks and private water storage within the Municipality that may be inundated by floodwaters. Further, chemicals and fuel may be stored in farm sheds and tanks on floodplains.

9. Properties at Risk

Detailed information on property floor levels and the likelihood of over-floor flooding is not currently available for locations within the Municipality, other than at Heathcote (see Appendix C2).

10. Infrastructure at Risk

10.1 Overview

Major infrastructure within the Municipality affected by flooding includes:

- Major transport corridors (e.g. Midland, Calder, Loddon Valley, McIvor and Northern Highways – various locations including in Bendigo and Heathcote);
- Railway lines (e.g. the Castlemaine - Bendigo line (the main rail link to Melbourne), the Bendigo - Echuca line, and the Bendigo - Swan Hill line
- The Bendigo Central Business District.

10.2 Major Roads

Dependant on flood magnitude the following roads may be inundated.

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- Many roads in and around Bendigo and its suburbs, particularly those close to creeks and drainage lines
- The Midland, Calder, Loddon Valley and Mclvor Highways,
- Loddon Valley Highway - between Myers Flat (Bendigo) and Murray Valley Highway (Kerang);
- Bendigo-Pyramid Rd - between Raywood and Pyramid Hill
- Bendigo-Murchison Rd – between Midland Highway to Northern Highway
- Bendigo Tennyson Rd – between Elmore - Raywood Road and Prairie - Rochester Rd

Roads in and around Heathcote including the Mclvor and Northern Highways and the Heathcote – Nagambie Road (see Appendix C2). During heavy and / or prolonged rain events, many minor roads across the Municipality are also likely to be inundated.

10.3 Other Infrastructure

Wastewater treatment plants – unlikely to be flooded.

Sewer pump stations – unknown.

Water treatment plants – unlikely to be flooded.

Potable water pump stations – unknown.

Mobile network telephone towers – none known.

Electrical power kiosks / zone sub-stations (cabinets) – Assets are designed to be non-susceptible to flooding. No electrical assets in CoGB are at risk of flooding .

Community facilities at Bendigo

- Significant disruption within the Central Business District
- Hospital and other essential facilities likely to remain unaffected by floodwaters.

Tourism likely to be affected

- Central Deborah Goldmines possible disruption to service
- Bendigo Tramways possible disruption to service
- Visitor Information Centre (basement flooding) possible disruption to service

Caravan Parks at Bendigo likely to be affected

- Dower Park Recreation Reserve Caravan Park , Station Street, Kangaroo Flat
- Gold Nugget Tourist Park, Midland Highway, Epsom

Caravan Park at Heathcote

- Queens Meadow Caravan Park – impacted from a little above the 10-year ARI event

11. Flooding Hotspots

Flooding routinely occurs in low lying areas along:

- Campaspe River – Redesdale, Axedale, Barnadown
- Axe Creek – Axe Creek, Longlea
- Bendigo Creek

12. Flood Mitigation Measures within the Municipality

Levees currently exist on the east (right hand) bank of Bendigo Creek from Scott Street in White Hill to the Bendigo – Tennyson Road in Huntly, a distance of approximately 15km. These levees play an important role in protecting large areas of Epsom and Huntly from inundation during large flow events (Water Technology, 2014). A more detailed description of the levees is available in the 1986 levee audit report by Findlay Irrigation.

There are no other formal structural flood mitigation measures recorded on streams within the City of Greater Bendigo.

13. Historic Floods

13.1

Date	Area Affected	Rainfall	Event	Properties Affected	Other
1867	Heathcote				Flood event no detail available
1870	Heathcote				Flood event no detail available
1871 (7 Feb)	CBD- Charing Cross, High St, Pall Mall, Bridge St	3.22 inches (82mm)	24 hour rainfall event	Businesses & Reserves inundated	Believed to be largest flood ever experienced
1871 (23 Feb)	CBD- Charing Cross, High St, Pall Mall, Bridge St	2.42 inches (61 mm)	Rainfall event	Businesses & Reserves	
1883	Heathcote				Flood event no detail available
1899 (22 June)	Heathcote				Reported as the highest in the creek since 1887.
1906	Heathcote	3.36 inches (85mm)			Reported as the biggest flood since 1870. Estimated peak flow of more than 350m ³ /s.
1916 (25 Sept)	Mclvor Creek	6.25 inches (158 mm)	2 day rain event	Bridge on Bendigo Road, other road infrastructure	Reported as the largest flood to have occurred within the catchment since settlement.

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1916 (20 Oct)	Mclvor Creek	2.83 inches (72mm)	Rainfall	Inundated lower parts Heathcote (limited damage)	
1920 (April)	Heathcote				Flood event no detail available
1923 (June)	Bendigo Creek		Rainfall	Bagshot area	Road closures
1923 (14 Dec)	Bendigo		Severe Storm	Several businesses flooded	
1923 (23 Dec)	Bendigo area		Thunderstorm	Several businesses & sports events cancelled	
1924 (19 Feb)	Bendigo CBD, Roads in Long Gully, Back Creek & Bagshot		Severe Storm		Significant stock loss, land under water
1930 (May)	Bagshot , Railway line to Rochester)		Torrential Rain		Sections railway line washed out. Damage to roads
1930 (10 May)	Mt. Camel area, (Redcastle, Tooleen, Heathcote)	8 inches(203mm) 2.72 inches (69mm) recorded in Heathcote)	2 day event	Bridges, road and property damage	Wide spread damage & stock loss
1930 (10 Dec)	Mclvor Creek & Mt Camel	4.73 inches (120 mm)	2 day event	Mclvor Creek ran banker	Property & stock loss at Mt Camel
1930 (15 Dec)	Sandy Creek, Huntly, Epsom & White Hills, Axe Creek		Severe Thunderstorm	Axe Creek Flooded	Washed away bridges Businesses
1930 (15 Dec)	Mclvor Creek	2.60 inches (66mm) overnight. 3.75 inches(95	Severe Thunderstorm	Mclvor Creek, south Heathcote	Washed away bridges, Axe Creek Severe damage to properties at the south

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		mm) at Tooborac			end of Heathcote Damage to market gardens in Sandy Creek
1932 (March and April)	Heathcote				Flood event no detail available
1933 (26 Jan)	Bendigo	1.8 inches (46mm)	2 storm bursts	High St (between Short & Myrtle st)	Flooding to properties & businesses
1933 (30 Nov)	Bendigo Creek, Kangaroo Flat & Golden Square, High St, Murray Road Epsom		Severe Floods (most severe recorded in many years)	100 Houses in High St (near creek), bridge in Alder st	NB Rises extremely rapid, over flowing Bendigo Creek banks. Damage properties, roads & footpaths. Murray road Epsom under 1.2 m water
1934 (15 Feb)	Mclvor Creek	1.7 inches (43 mm)	Severe Thunderstorm, overnight	Mclvor Creek ran bankers, Wild Duck Creek	Bridge washed away (Wild Duck Creek)
1934 (Apr)	Heathcote				Flood event no detail available
1939 (7 Apr)	Mclvor Creek	3.57 inches (91 mm) (NB: 1.27 inches/32 mm fell in 1.5 hours	Rain fall event	Mclvor Creek, property damage	Serious damage to roads, culverts & bridges Reported as the worst event in 20 years. Peak flow estimated to be more than 350m ³ /s.
1949 (6 Nov)	Bendigo Creek, Charing Cross, High St Golden Square	3 inches (76 mm)	Rainfall	Business & property	Water reached 4 feet (1.2 m) part of High Street, Golden Square
1951	Bendigo Creek- Bagshot/Epsom, Kangaroo Flat 7 Long Gully	3.2 inches (81 mm)	2 day rain event	Properties & business across Bendigo	800m railway line washed away Bagshot, large market garden acreages Epsom & Huntly. Flooding Bendigo Pottery. Water waist deep K'Flat & Long

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					Gully Bendigo Creek broke its banks flooded Bendigo Pottery with approx. 900mm
1954	Heathcote				
1955 (24 Sept)	Heathcote	3.29 inches (84mm)			Biggest flood since 1939
1956 (July/Aug)	Campaspe River, Rochester	115.19 mAHD (town gauge)			At time the highest on record
1958 (18 Feb)	Huntly	1.5 inches (38 mm)	'Freak' cloud burst, 30 mins duration		
1962 (18 Feb)	Bendigo CBD	1 inch (38 mm)	Rainfall, 15 min duration	Wide spread flooding CBD, business & property	
1973 (Feb)	California Gully (Eaglehawk Road)	3.9 inches (99 mm)	Rainfall event, 24 hours	Property damage, major roads under water	
1973 (Aug)	Campaspe River, Rochester				Moderate flooding along lower reaches of Campaspe, more significant event west of Campaspe
1974 (May – Oct)	Widespread flooding Significant along Campaspe				
1974 (14 May)	Mclvor Creek Heathcote	5 inches (127 mm)	Rain event 2 days	Low lying areas Heathcote, inundating houses	Fence & swing bridge damage. There was water over the oval as well as the Northern Highway / High Street. Largest flood in recent memory for Heathcote. Peak flow estimated at 220m ³ /s.

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1975 (Nov)	Campaspe River		Significant flood (Rochester)		
1983 (29 July)	Campaspe River, McIvor Creek		Minor flooding	Property (minor flood)	
1983 (8 Sept)	Campaspe River, Beauchamp & Jennings St, Heathcote		Constant rain 2 week period	Minor flooding yards	
1984	Heathcote				
1996 (1 Jan)	Kangaroo Flat		Heavy Thunderstorms	Shops & residences Kangaroo Flat	
1996 (16 Mar)	No details?				
1999 (26 Dec)	Bendigo East – Epsom	2.9 inches (75 mm)	Thunderstorm, 45 min duration	Extensive flooding 10+ residences	100 year ARI
1999 (27 Dec)	Strathdale, Bendigo East	0.8 inches (21 mm)	Thunderstorm, 15 min duration	Moderate property flooding, 1 house affected	35 years ARI
2000 (14 Nov)	Campaspe River, Heathcote	2.55 inches (65 mm)	Rainfall event, majority fell within 1 hour	1 house flooded	
2000 (24 Oct)	Eaglehawk, Huntly, Kennington, Strathdale, Kangaroo Flat		Thunderstorm	5 properties	
2000 (14 Nov)	Goornong, Huntly, Bagshot		Heavy Rain	1 house flooded, 3 properties affected	
2000 (16 Nov)	Heathcote	74mm	Localised short duration intense storm event	Several homes and at least 1 business flooded. Yards were flooded in Eden, Playne, High and Chauncey	15 sections of the McIvor Highway were submerged along with several roads within Heathcote.

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				Streets.	
2000 (Dec)	Long Gully, Maiden Gully, Bendigo East		Thunderstorm	1 house flooded, 6 properties affected	
2001 (1 Feb)	Strathdale	0.75 inch (19 mm)	Thunderstorm, 9 mins	1 property	50 year ARI
2001 (1 Feb)	Strathdale	1 inch (25 mm)	Thunderstorm, 9 mins	3 properties	
2003 (18 May)	Bendigo, Golden Square, Strathdale, Kennington, Maiden Gully, Strathfieldsaye	2.7 inches (68 mm)	Tornado/Thunderstorm, 45 min duration	10 houses flooded, numerous impacted	
2010 (5 Mar)	Bendigo, Huntly	3.5 inches (89mm)	3 day rain event, 40 mm dumped in 2 hours		<5-year ARI
2010 (4 Sept)	Bendigo, Huntly	3.15 inches (80 mm)	Rain event, 28 hour period (approx. 40mm dumped fell 10 hours)		<5-year ARI
2010- 2011 (Sept – Feb)	Campaspe, western catchments , Lake Eppalock		Heavy Rain	Severe flooding Rochester	
2011 (Jan)	Mclvor Creek	179mm	Rain event, 6 day duration, approx. 59mm fell in 1 day.	Several properties in Jennings, Wright and Thomas Streets flooded.	10% AEP flood Flood peak of 107m ³ /s. The Northern Highway (High Street) was flooded. The stockyards were surrounded and the tennis courts were partly inundated. Local drainage caused flooding in Pohlman Street and also in Wright Street. Lake Eppalock was above

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					FSL (at its highest recorded level since it was completed in 1962) which resulted in backed-up water in Mt Ida Creek inundating sections of the Mclvor Highway to the west of Heathcote.
2011 (10 Jan)	Bendigo, Huntly	150-175mm	Rain event, 5 day duration, approx. 64mm fell in 1 day.		5-10% AEP flood
2011 (Jan)	Marong	150 – 175mm	Rain event, 5 day duration, approx.. 64mm fell in one day		Estimated to be 1% AEP flood
2011 (5 Feb)	Bendigo, Huntly	3.9 inches (99 mm)	Rain event, 48 hour duration, approx. 2 inches (50 mm) fell in 5 hours. Main rain burst were separated by 16 hours without rain	Caravan Park,	50- year ARI
2015 (Jan)	Bendigo, Maiden Gully	45 – 130mm Approx. 50mm fell in 1 hour in Bendigo CBD	Rain event (2 day duration) and thunderstorm	House & business impacted	Highest rainfall totals around Maiden Gully
2016 (13-15 Sep)	Bendigo	76.8mm	Rain event over 3 days		
2016 (13-15 Sep)	Marong	100mm	Rain event, 3 day duration, approx. 66mm fell in 1 day.		79m3/s
2016 (13-15 Sep)	Heathcote	68.2mm	Rain event over 3 days		

Other Creeks

To be completed as information becomes available.

14. River Gauges

Refer to the list in Appendix E.

15. Flood Inundation Mapping

A complete set of flood inundation maps for the urban area of Bendigo, covering the main stem of Bendigo Creek along with its many tributaries as well as the stormwater drainage systems within the many sub-catchments from the headwaters to the Bendigo Creek at Huntly stream gauge, were produced by the Bendigo Urban Flood Study (Water Technology, 2014). Access to those maps is discussed in Appendix F1.

Flood inundation maps are also available for Mclvor Creek at Heathcote (WBM, 2015A) and for Town Drainage at Heathcote (WBM, 2015B). Refer to Appendices F2-1 and F2-2.

The Bendigo Planning Scheme shows areas along watercourses likely to be inundated by a 1% AEP (100-year ARI) flood event where detailed flood mapping has been completed, as LSIO. While it is not practical to reproduce the LSIO as an attachment to this Plan, hard copies are available from the Municipality. They are also available in PDF digital form at the MOC and in digital form at the DELWP website <http://planningschemes.dpcd.vic.gov.au/schemes/vpps>.

Coarse flood extent maps were also developed in 2000 as part of a state-wide Flood Data Transfer Project (FDTP) (DNRE, 2000). Although 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.

16. Digital Flood Extent Datasets and Flood Photography

The Victorian Flood Data (VFD) datasets (available from NCCMA) contain a significant quantity of flood information in GIS format. For the waterways within the City of Greater Bendigo this includes a number of surveyed flood levels.

A number of ground level still photographs are available from NCCMA.

The NCCMA, Coliban Water and the City hold a variety of other datasets that include:

- Contour and survey information, including LiDAR data.
- Drainage and road infrastructure data.
- Digital cadastral information.
- Flood and non-flood aerial photography including:
 - Flood photomosaics for Bendigo Creek downstream from Goornong for September – October 1973 as produced by the State Rivers and Water Supply Commission
 - Flood photomosaics for Bendigo Creek from Minto to the Warranga Western Channel for September 1993.

17. Flood Intelligence Cards – see Appendix C

All 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. Flood intelligence details the relationship between flood magnitude and flood consequences and provides practical guidance on appropriate flood response actions.

Further information about flood intelligence and its use can be found on the 'Australian Institute for Disaster Resilience, website, <https://knowledge.aidr.org.au/collections/handbook-collection/> and in particular in Handbook 7, Managing the Floodplain: a guide to best practice in flood risk management in Australia'.

APPENDIX A

APPENDIX B – TYPICAL FLOOD RISE, RECESSION AND PEAK TRAVEL TIMES

Definitive information on the time it takes flash flooding (i.e. resulting from heavy rainfall associated with severe weather or thunderstorm activity) to develop (i.e. to arrive at a location) following the start of heavy rain and the time it takes for the maximum water depth / extent to be reached is not available. **Timing is however likely to be short: of order 1 to 2 hours for Bendigo Creek to the Bendigo CBD, 6 to 8 hours for Mclvor Creek at Heathcote, and 6 to 12 hours for the other creeks within the Municipality.**

In the case of riverine flooding, the time of travel of a flood peak will be influenced by antecedent conditions. A flood on a 'dry' watercourse will generally travel more slowly than a flood on a 'wet' watercourse (e.g. the first flood after a dry period will travel more slowly than the second flood in a series of floods) and big floods tend to travel faster than small floods. Hence, the size of the flood, recent flood history, soil moisture and forecast weather conditions all need to be considered when using the following information to direct flood response activities.

Note that flooding will start some time ahead of the time indicated by the following travel times – these are the time between the flood peaks at respective sites.

Location From	Location To	Typical approx Travel Time	Comments
FLASH FLOODING – Bendigo Creek			
It is emphasised that the times quoted below are approximate only and are for heavy rain on a wet catchment. Lighter rain or rain on a drier catchment result in much slower response times. In addition, a multi-burst rain event that extends over a number of days will obscure response times: initial rain will wet up the catchment and later (heavy) rain will cause very quick and significant rises in creek levels with possible areas of flooding.			
Floods are characterised by rapid rises and falls.			
Start of rainfall	Upper catchment	< 1 hour	To start of rise on a wet catchment. Longer for a dry catchment unless rain very heavy in which case response is similar to a wet catchment. Overbank flows occur soon after.
	CBD	1 to 2 hours	To start of rise with peak soon after.
	Huntly	2 – 5 hours	To start of rise on a wet (and dry) catchment. Overbank flows occur within an hour or so of initial rise.
Kangaroo Flat	CBD	< 1 hour - <2 hours	
CBD	Huntly	1 - 3 hours	Huntly will start to rise around 3 hours after the CBD for smaller floods but this reduces to around 1 hour for larger floods
		6 hours	Peak to peak travel time for smaller floods

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Location From	Location To	Typical approx Travel Time	Comments
		3 to 4 hours	Peak to peak travel time for larger floods

FLASH FLOODING – Mclvor Creek and Wild Duck Creek

Start of rainfall	Heathcote	3 to 6 hours	From start of heavy rain to start of rise at Heathcote but can be delayed by up to 10 hours.
Start of rise at Heathcote	Peak at Heathcote	8 to 12 hours but generally 10 to 12 hrs	The size of the flood does not appear to drive the rate of rise strongly but a second flood on a wet catchment does rise a little quicker.
Water over the road at Tooborac Bridge	Flooding at Heathcote	1.5 hours	Local rule of thumb

FLASH FLOODING – Mt Ida Creek

Start of rainfall	Start of rise	2 to 5 hours	Responds and rises a little quicker than Mclvor Creek to Heathcote and peaks a little earlier. In general, Mclvor Creek flows tend to sit behind Mt Ida Creek flows. The size of the flood does not appear to drive the rate of rise but a second flood on a wet catchment does rise a little quicker.
Start of rise	Peak	6 to 10 hours	

FLASH FLOODING – Mt Pleasant Creek

Start of rainfall		TBA	To start of rise
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FLASH FLOODING – Axe Creek

Start of rainfall		TBA	To start of rise
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FLASH FLOODING – Sheepwash Creek

Start of rainfall		TBA	To start of rise
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STORMWATER FLOODING

APPENDIX B

Start of rainfall			
RIVERINE FLOODING – Myers and Bullock Creek			
Start of rainfall		TBA	To start of rise

RIVERINE FLOODING – Campaspe River				
<p style="color: blue;">Floods are characterised by steady rises, peaks that extend for a number of hours and recessions that are around one-half to one-third the rate of rise for flows that pass through Lake Eppalock and somewhat quicker if the majority of water comes from tributary streams. The further down the catchment the longer the peak and the slower the recession.</p>				
Rainfall – upper catchment	Redesdale	~6 to 10 hours	Depends heavily on antecedent conditions	
	Rochester	~36 to 48 hours	Provided Lake Eppalock is at or near FSL at start of event	
Redesdale	Lake Eppalock	~8 hours and longer	January 2011 event fastest	
Lake Eppalock	Barnadown	12 to 20 hours	The January 2011 event (big flood) was fastest at 12 hours	Note -Axe Creek flows can mask actual travel times
	Campaspe Weir	~20 hours	January 2011	The weir is ~9km upstream of Rochester
	Rochester Town gauge	28 to 40 hours	The January 2011 event (big flood) was fastest	Note -Mt Pleasant Ck flows can mask travel times
Longlea	Barnadown	10 to 15 hours		
Barnadown	Campaspe Weir	~8 hours	January 2011	The weir is ~9km upstream of Rochester
	Rochester Town gauge	~16 to 22 hours	The January 2011 event (big flood) was fastest	Note -Mt Pleasant Ck flows can mask travel times
	Rochester Syphon	19 hours	January 2011	
Runnymede	Campaspe Weir	~17 hours	January 2011	The weir is ~9km upstream of Rochester
	Rochester	~25 hours		

APPENDIX B

APPENDIX C1 – BENDIGO COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Bendigo is located around 150km north west of Melbourne in north central Victoria. It has a population of around 110,000 and is the largest urban area within the City of Greater Bendigo. Important transport routes pass through the city. For example, the Midland, Calder, Loddon Valley and Mclvor Highways all meet at Bendigo, while the Castlemaine - Bendigo line (the main rail link to Melbourne) splits to become the Bendigo - Echuca line and the Bendigo - Swan Hill line. The latter also services the branch line to Bridgewater and places beyond.

Bendigo Creek, Bullock Creek, Myers Creek and their many tributaries all rise in the hills around Bendigo.

The Bendigo Creek catchment ranges from areas of moderate topographical relief at the top (southern end) of the catchment to the relatively flat floodplains of Huntly and the even flatter floodplains around Drummartin. The urban area of Bendigo is built around and over Bendigo Creek (it flows underneath the Central Business District) and its many tributaries. Thus there are many residential, commercial and industrial areas within Bendigo, as well as the rural floodplain on the downstream outskirts, at risk of flooding from the creek and its tributaries. The upper catchment contains a significant greater urban area than the lower catchment.

As the catchments are relatively small, are generally quite narrow, are reasonably hydraulically steep in the upper reaches and support varying degrees of development (i.e. a fair proportion of the catchment is developed with a corresponding higher percentage impervious area), high intensity short duration storms (i.e. severe thunderstorms) typically cause flooding. The catchment therefore responds quickly to thunderstorms / heavy rain.



Figure C1-1: Bendigo Creek looking upstream towards the CBD (courtesy of Water Technology Pty Ltd, 2011)

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Figure C1-2: Various parts of Bendigo Creek (courtesy of Water Technology Pty Ltd, 2011 & 2012)

Most of the creeks within the Bendigo Creek catchment have been modified with buildings constructed in close proximity. The creek channels are not large, some sections are bluestone and / or concrete lined and there are numerous road crossings. Bendigo Creek itself has also been substantially modified over time by deepening, widening and lining. It is now, in effect, a constructed drain along much of its length to downstream of Charing Cross and the Bendigo Central Business District. See Figures C1-1 and C1-2.

The Bendigo Creek catchment upstream of the Bendigo Creek at Huntly stream gauge (located downstream of Huntly) has an area of around 203km². This includes the main stem of Bendigo Creek along with its many tributaries as well as the stormwater drainage systems within the many sub-catchments. The catchment area upstream of central Bendigo is approximately 62km².

The creek flows north from Kangaroo Flat, through the Bendigo Central Business District and on to Huntly after which it merges with Myers Creek and Mount Hope Creek. Mount Hope Creek then flows on to Kow Swamp. The outflow from Kow Swamp joins with Bullock Creek

APPENDIX C1 – BENDIGO

to become Pyramid Creek which enters the Loddon River immediately downstream from Kerang. Numerous tributaries flow into Bendigo Creek throughout the urban area of Bendigo.

There are fourteen (14) main tributary creeks comprising Long Gully Creek, Golden Creek, Spring Creek, Back Creek, Ironbark Creek, California Gully Creek, Jobs Creek, Shepherds Hut Gully, Tipperary Gully, Sunrise Gully, New Chum Gully, Grassy Flat Creek, Eaglehawk Creek and Racecourse Creek. There are also a number of channels and gullies, such as Dead Bullock Gully, that transfer runoff to the creek system but are not formal creeks.

There are five (5) minor water storages within the catchment:

- ◆ Crusoe Reservoir (owned and operated by the City of Greater Bendigo);
- ◆ No 7 Reservoir (owned and operated by the City of Greater Bendigo);
- ◆ Spring Gully Reservoir (owned and operated by Coliban Water);
- ◆ Sandhurst Reservoir (owned and operated by Coliban Water);
- ◆ Gateway Park Lake (owned and operated by the City of Greater Bendigo);
- ◆ Specimen Hill Reservoir;
- ◆ Grassy Park Reservoir No 1; and
- ◆ Jackass Flat Reservoir.

The first five storages listed above (with the exception of Crusoe) are considered to be off-line as they have catch drains that divert water from their upstream catchments around the reservoir and back into the water course. The catch drains at Crusoe have been modified so that the reservoir now receives an inflow from its catchment. Crusoe is also the largest storage in the catchment with a capacity of 890ML and a catchment of 320ha (3.2km²).

Whether these storages are full or empty at the start of a storm event has very little impact on downstream flooding. The storages do not have any noticeable impact on flows (i.e. attenuation) and thus on flooding.



Figure C1-3: Screen shot from video of the February 2011 flood in Bendigo Creek at Holdsworth Road Bridge around 1.5km downstream from the Bendigo Creek at Bendigo gauge while Creek is still rising (courtesy of Water Technology Pty Ltd, 2011)



Figure C1-4: Screen shot from video of the February 2011 flood taken from the Central City Caravan Park in Golden Square with floodwater just below top of bank (courtesy of Water Technology Pty Ltd, 2011)

2. Overview of Flooding Consequences

2.1 Overview

Large floods within the urban area of Bendigo typically occur after summer thunderstorms although they have also resulted from more general heavy rain events (see for example the history of flooding in Appendix A)⁷. The heavy rainfall causes a rapid rise in floodwaters which pass quickly through the hilly upper and middle parts of the creek catchments. Water is usually not very deep but moves very quickly and can be dangerous. Around Epsom and Huntly where the landscape is relatively flat, flood water spreads out more, is deeper and travels more slowly.

Flooding has been recorded from Kangaroo Flat, through central Bendigo / Golden Square and on through Epsom and Huntly. The Central Business District (CBD) is particularly vulnerable and there are numerous reports of Pall Mall and Charing Cross being under water with many business premises affected. Tannery Lane and Thomas Street are also susceptible to flooding. Many other roads have also been inundated, some by fast flowing water at a depth that represents a significant hazard. Roads considered hazardous during flood events can be seen on the hazard maps delivered by the Bendigo Urban Flood Study (Water Technology, 2014).

In general terms, high risk areas include:

- ◆ Spring Gully – Caroline Street to Whittaker Street.

⁷ Typically, short duration rain events (say from 30 minutes to 2 hours) delivering falls of 40mm or more (i.e. in excess of 20mm per hour) over the Bendigo creeks will result in flooding that affects properties (some over-floor) and roads.

- ◆ Quarry Hill – Williamson, Miller, Hallam and Houston streets.
- ◆ Kennington - Mundy Street and upstream of Mclvor Road.
- ◆ Long Gully – Eaglehawk Road.
- ◆ Emu Point – Finn Street.
- ◆ Strathdale - Victa Road.
- ◆ Kangaroo Flat –Crusoe Road to Alder Street.
- ◆ Golden Square – Alder Street to Maple Street.
- ◆ Central Bendigo – Short Street to Myrtle Street, Charing Cross and Arnold Street to Bridge Street.
- ◆ Central Bendigo – Bendigo Creek to Mclvor Road.
- ◆ White Hills – Grace Street area and Plumridge Street.
- ◆ The Epsom area including Scott Street, Adelaide Hills Street and Goynes Road.
- ◆ Huntly township including Sargeants Road to James Road.
- ◆ Ascot township.

2.2 Warning Times

Bendigo Creek and its tributaries have a history of flash flooding. Floodwaters flow and rise quickly. Debris can cause blockages which cause localised increases in flood depths.

The analyses undertaken in support of the Bendigo Urban Flood Study (Water Technology, 2014) suggest that typically, the time from the beginning of heavy rain on a wet catchment to the start of rises within the upper parts of the creek system is very short: generally less than an hour. In the vicinity of the CBD, time ranges from around 1 to 2 hours while at Huntly it ranges from around 2 hours in big floods to around 5 hours for small floods. Creek levels rise quickly with flooding / overbank flows likely to begin for a big flood within an hour or so of the initial rise⁸. Additional information on times to rise and travel times is provided in Appendix B.

2.3 Areas Affected

Maps produced by the Bendigo Urban Flood Study (Water Technology, 2014) provide guidance on where flooding is likely to occur. It should be noted however that local impacts, or impacts in excess of those indicated, may occur as a result of very localised stormwater runoff and drainage and / or be attributable to localised severe flooding emanating from tributary streams or piped systems. Similarly, local increases in flood levels and impacts may result from local factors such as blockages at bridges and culverts and from obstructions to overland flows such as caused by works, channels, fences, buildings and the like.

2.4 Properties Affected

2.3.1 Summary

The Bendigo Urban Flood Study (Water Technology, 2014) has estimated that around 15,000 properties (industrial, commercial and residential) would be affected in Bendigo by a large (i.e. 1% AEP) flood. This includes properties affected by stormwater and riverine / creek flooding and covers all catchments within the urban area. It is therefore an upper value and during an actual event would very probably be an over-estimate of the actual number of properties affected, unless the (severe) rain event covered the whole of the Bendigo urban area. The study estimated that if such a flood affected Bendigo Creek only, the number of properties impacted would reduce to around 2,437.

⁸ It is emphasised that these times are approximate only and are for heavy rain on a wet catchment. Lighter rain or rain on a drier catchment result in much slower response times. In addition, a multi-burst rain event that extends over a number of days will obscure response times: initial rain will wet up the catchment and later (heavy) rain will cause very quick and significant rises in creek levels with possible areas of flooding.

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In very broad terms:

- ◆ In areas upstream of around Golden Square, flow velocities can be quite high with flooding generally confined to fairly well contained corridors around watercourses and drainage lines and with some shallow flow along roads;
- ◆ Between Golden Square and a little upstream of Epsom (in the vicinity of White Hills and the Racecourse), flow velocities are marginally slower but still fast while the extent of flooding increases with a much wider corridor around watercourses and drainage lines and more, but still generally shallow, flow along roads;
- ◆ Around Epsom and downstream, flow velocities are much slower but the extent and depth of flooding is greater: much larger areas are affected by flooding but the water does not move quite as fast.

There was extensive flooding and 10 houses were affected from Bendigo East to Epsom on 26 December 1999 following 75mm of rain in 45 minutes. A further 5 properties were flooded in the Eaglehawk, Huntly, Kennington, Strathdale and Kangaroo Flat areas on 24 October 2000. In December 2000, a further 6 properties were flooded in Long Gully, Maiden Gully and Bendigo East. Many properties were affected and 10 flooded in Bendigo, Golden Square, Strathdale, Kennington, Maiden Gully and Strathfieldsaye on 18 May 2003 following 68mm of rain in 45 minutes.

AEP (%) ARI	50% 2-yr	20% 5-yr	10% 10-yr	5% 20-yr	2% 50-yr	1% 100-yr	0.5% 200-yr
Large buildings flooded (non-residential buildings larger than 1000m ²)	-	98	110	132	144	154	166
Properties flooded	-	4,494	6,272	8,908	12,101	14,846	17,830
Total properties flooded	-	4,592	6,382	9,040	12,245	15,000	17,996

Three caravan parks are affected by flooding in Bendigo:

- Dower Park Recreation Reserve Caravan Park, Station Street, Kangaroo Flat – during a severe (e.g. 1% AEP) flood, there will be areas of flooding as well as a flow path through part of the park with water 100 - 350mm deep.
- Ascot Holiday Park, Heinz Street, Ascot – during a severe (e.g. 1% AEP) flood, shallow flooding will affect part of the perimeter of the park, mainly along the table drains / gutters alongside the surrounding roads.
- Gold Nugget Tourist Park, Midland Highway, Epsom – during a severe (e.g. 1% AEP) flood, substantial areas of the park will be inundated by water up to 350mm deep.

2.3.2 Detailed List

A detailed list of properties affected by flooding within Bendigo is not available.

2.5 Isolation

The main access roads to / from Bendigo are the:

- ◆ Midland Highway to the north east towards Echuca;

- ◆ Calder Highway to the south to Castlemaine and Melbourne and also to the north west towards Wedderburn and Charlton;
- ◆ Loddon Valley Highway to the north west towards Kerang (north and south of Serpentine);
- ◆ Mclvor Highways to the east / south east to Heathcote.

The Midland Highway is the most likely major access route to be compromised by flooding. During a severe flood, access is likely to be compromised for up to 48 hours through Epsom and Huntly as well as a little further to the north (i.e. downstream). Alternative routes should be available but will necessitate detours.

Other major roads may also be compromised but for shorter periods.

2.6 Essential Infrastructure

Essential infrastructure affected by flooding at Bendigo includes:

- Major transport routes (e.g. Midland, Calder, Loddon Valley and Mclvor Highways);
- Other major roads that pass through the Bendigo urban area and over any of the creeks – see mapping;
- Railway lines (e.g. the Castlemaine - Bendigo line (the main rail link to Melbourne), the Bendigo - Echuca line, the Bendigo - Swan Hill line and the Bendigo - Bridgewater and places beyond line);
- The Bendigo Central Business District (e.g. shops and businesses).

Community facilities at Bendigo – significant disruption is likely particularly in the Central Business District. The Hospital and other essential facilities (e.g. health, electricity, telephone, internet / communications, water and sewer services, fire, police, ambulance, SES, Council) are expected to remain largely unaffected by floodwaters in the southern parts of the city but may suffer some interruptions in the general areas of White Hills, Epsom and Huntly. However, potable water supplies were affected during the November 2010 event and the Helen Jessen Maternal Health Centre was inundated during January 2011.

3. Flood Mitigation

3.1 General

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).

3.2 Flood Protection Levees

Levees currently exist on the east (right hand) bank of Bendigo Creek from Scott Street in White Hill to the Bendigo – Tennyson Road in Huntly, a distance of approximately 15km. These levees play an important role in protecting large areas of Epsom and Huntly from inundation during large flow events (Water Technology, 2014). A more detailed description of the levees is available in the 1986 levee audit report by Findlay Irrigation.

Water Technology (2014) demonstrated that if these levees fail or are overtopped, there would be additional inundation of a large area through Epsom and Huntly. While flood depths would be around 250mm or less, key flow paths would be deeper, for example adjacent to the Midland Highway and to the south of Leans Road. Further, much of the breakout flow would end up flowing into Back Creek at Epsom.

3.3 Drainage Works

There are currently no specific drainage works aimed at alleviating flooding within Bendigo other than retarding basins at key locations.

4. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

5. Command, Control and Coordination

The Command, Control and Coordination arrangements in this Municipal Flood Emergency Plan will be as detailed in the Emergency Management Manual Victoria.

All flood response activities within the City of Greater Bendigo will be under the Control of the VICSES Regional Officer / Incident Controller.

An Emergency Management Team (EMT) may be established by the Incident Controller in accordance with the Emergency Management Manual Victoria.

An **Incident Control Centre (ICC)** will be established by the Control Agency (i.e. VICSES) for its command and control functions in response to any flood event within the Municipality. It will be operated in accordance with VICSES arrangements.

The location of the ICC will be determined and advised to relevant stakeholders dependant on the extent and severity of the flood event.

The establishment and operation of the **Municipal Operations Centre (MOC)** will be in accordance with and as detailed within the MEMP.

6. Flood Intelligence, Action Table and Indicative Flood / No Flood Guidance Tool for Bendigo

6.1 Introduction

Flood impacts described in the following tables relate to a combination of stormwater and creek flooding. It should be noted that local impacts, or impacts in excess of those indicated, may occur. Similarly, local increases in flood levels and impacts may result from local factors such as blockages at bridges and from obstructions to overland flows such as works, channels, fences, buildings and the like.

Notes:

1. 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 intell 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 Emergency Management Manuals](#) Collection, in particular in Manual 20 “Flood Preparedness”.
2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience.

6.2 Flood Intelligence Card

Observed Rainfall (mm) (see graphs)	AEP of Observed Rainfall	Bendigo gauge height 407254 (m) not Telemetered	Huntly gauge height 407255 (m)	Bendigo Design Flows (MI/d) Water Tech 2013	Huntly Design Flows (MI/d) Water Tech 2013	Bendigo damages total number properties flooded	Consequence / Impact at Bendigo / Actions
Use as guidance for likelihood of stormwater / flash flooding							
Note that the flooding extents and depths shown on the flood maps and in the GIS layers (see Appendix F1) are for a rainfall event that affects the whole of the Bendigo Creek catchment. Thus the maps / layers are representative for the area directly affected by the storm but may over-estimate the extents and depths for downstream locations.							
	0.5% AEP (200-year ARI)			15,751	27,216	17,996	

Observed Rainfall (mm) (see graphs)	AEP of Observed Rainfall	Bendigo gauge height 407254 (m) not Telemetered	Huntly gauge height 407255 (m)	Bendigo Design Flows (MI/d) Water Tech 2013	Huntly Design Flows (MI/d) Water Tech 2013	Bendigo damages total number properties flooded	Consequence / Impact at Bendigo / Actions
Use as guidance for likelihood of stormwater / flash flooding							
Note that the flooding extents and depths shown on the flood maps and in the GIS layers (see Appendix F1) are for a rainfall event that affects the whole of the Bendigo Creek catchment. Thus the maps / layers are representative for the area directly affected by the storm but may over-estimate the extents and depths for downstream locations.							
~ 30mm in 20min To ~58mm in 2 hs	1% AEP (100-year ARI)			13,556	22,524	15,000	<p>Four Caravan Parks are impacted:</p> <ul style="list-style-type: none"> • Golden Nugget Tourist Park (Midland Highway, Epsom), • Ascot Holiday Park (Heinz Street, Ascot), • Central City Caravan Park (High Street, Golden Square), • Dower Park Recreation Reserve Caravan Park (Station Street, Kangaroo Flat). <p>Levees along right hand bank of Bendigo Creek (15Km long) from Scott street in White Hills to Tennyson Road in Huntly. Levee protection level, up to 100 year flood, however not well maintained.</p>
99mm over 48 hours	February 2011 50 year flood	2.71	3.48	7,119	19,215		<p>Water in the Bendigo Creek peaked just below bank level at the Central City Caravan Park in Golden Square; some shallow water did flow through the Caravan park.</p> <p>Buildings impacted by flooding:-</p> <ul style="list-style-type: none"> • Hargreaves Mall, • Killian's walk overflowed and poured into the Body Shop and Cotton On Kids stores, • Central Deborah Tourist Mine, • Bendigo Police Station, • Bath Lane Business, • Queen Elizabeth Oval Clubrooms, • Visitor Information Centre, • North Bendigo Social Rooms, • Units in Victoria Lane Eaglehawk.

Observed Rainfall (mm) (see graphs)	AEP of Observed Rainfall	Bendigo gauge height 407254 (m) not Telemetered	Huntly gauge height 407255 (m)	Bendigo Design Flows (ML/d) Water Tech 2013	Huntly Design Flows (ML/d) Water Tech 2013	Bendigo damages total number properties flooded	Consequence / Impact at Bendigo / Actions
Use as guidance for likelihood of stormwater / flash flooding							
Note that the flooding extents and depths shown on the flood maps and in the GIS layers (see Appendix F1) are for a rainfall event that affects the whole of the Bendigo Creek catchment. Thus the maps / layers are representative for the area directly affected by the storm but may over-estimate the extents and depths for downstream locations.							
~ 27mm in 20min to ~ 51mm in 2hs	2% AEP (50-year ARI)			11,465	18,135	12,245	
83.5mm over 28 hours	September 2010, March 2010 5 year flood	2.44	5.42	3,845	15,085		
~ 22mm in 20min to ~ 43mm in 2hs	5% AEP (20-year ARI)			8,778	12,787	9,040	
~ 19mm in 20min to ~ 37mm in 2hs	10% AEP (10-year ARI)			6,869	9,037	6,382	
~16mm in 20min to ~32mm in 2hs	20% AEP (5-year ARI)		3.31	5,469	6,549	4,592	
89 mm over 3 days	50March 2010	1.4	2.03	46	1,326		

6.3 Summary of Properties Flooded

AEP (%) ARI	50% 2-yr	20% 5-yr	10% 10-yr	5% 20-yr	2% 50-yr	1% 100-yr	0.5% 200-yr
Large buildings flooded (non-residential buildings larger than 1000m ²)	-	98	110	132	144	154	166
Properties flooded	-	4,494	6,272	8,908	12,101	14,846	17,830
Total properties flooded	-	4,592	6,382	9,040	12,245	15,000	17,996

6.4 Detailed List of Properties Flooded

Not available.

6.5 Using the Indicative Flood / No Flood Tool

Figure C1-1 should be used for rainfall bursts within a storm event and for short duration events (i.e. less than an hour or so) while **Figure C1-2** should be used for the whole rainfall event. If the rain event extends over more than 24 hours, a 24 hour moving window should be adopted so that only the last 24 hours of data is used with due regard for catchment wetness and appropriate adjustment for the curve used.

It is suggested that **local rainfall data** (i.e. data from the area receiving the heaviest falls) determined from local reports or from an **interpretation of BoM weather radar images** is used to determine an appropriate rainfall depth for use in the indicative (flash) Flood / No Flood guidance tool at Figure C1. Data reported from the **Bendigo AWS** (located at the airport and available from the BoM website at 30 minute intervals and occasionally more frequently) will provide a basis for calibration of radar imagery. In the absence of any local rainfall data and BoM weather radar imagery, the data reported by the Bendigo AWS could be used to drive the indicative tool. However, as flooding at Bendigo is generally caused by locally intense rainfalls such as from thunderstorms, it is very likely that the rainfall recorded at the Bendigo AWS will not be representative of the rain that causes the flooding (i.e. it will be lower and in some instances very much lower). The telemetered rain gauge at **Strathfieldsaye** may also provide useful guidance but data from this site is only available from the BoM website at around 3-hourly intervals.

Each flood event should be added to the indicative tool as a dot along with the date. It is also suggested that information about the area over which the rainfall occurred and the consequences should be added to the "Rainfall and Consequence Table" that follows the tool.

FIGURE C1-1 Indicative guidance for likelihood of flash flooding in Bendigo based on rainfall

This guide assumes that rainfall affects the whole catchment and is not localised. If localised, the guide will over-estimate the likelihood of flooding in areas not affected by the heavy rainfall. If the catchment is very wet, move up one level. EG: if rainfall is on 10-year curve and catchment very wet, refer to 20-year map and consequences.

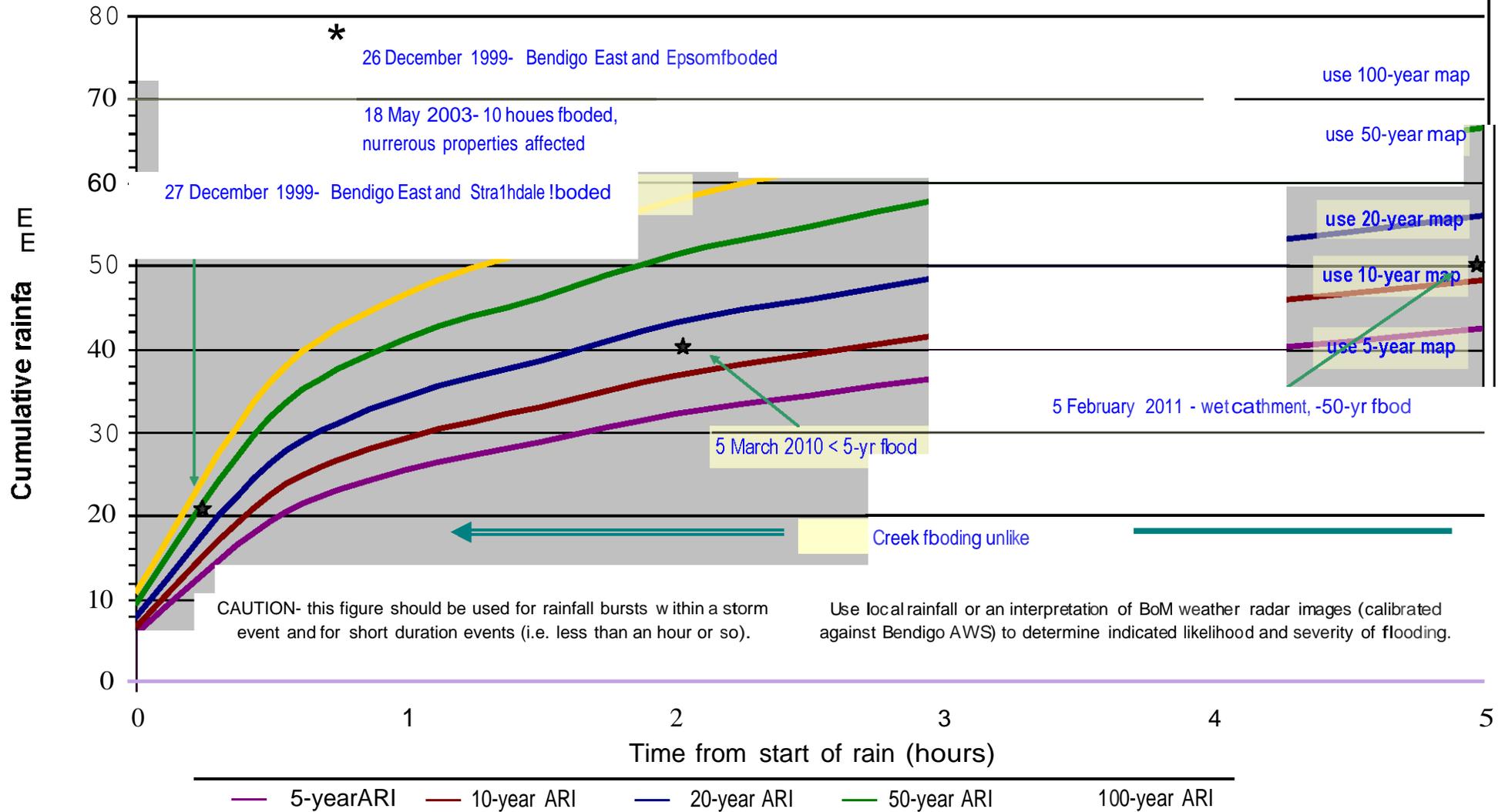
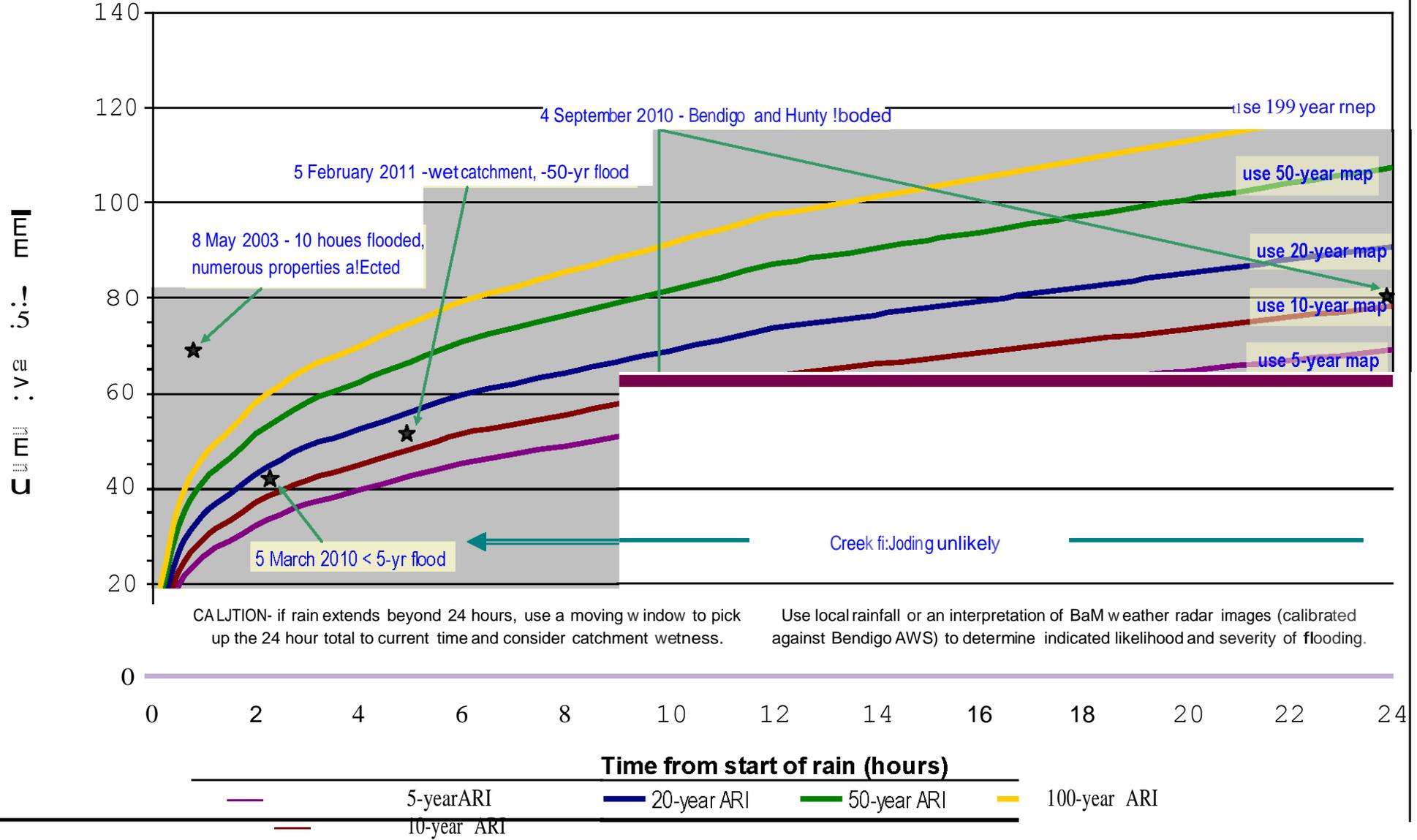


FIGURE C1-2 Indicative guidance for likelihood of flash flooding in Bendigo based on rainfall

This guide assumes that rainfall affects the whole catchment and is not localised. If localised, the guide will over-estimate the likelihood of flooding in areas not affected by the heavy rainfall. If the catchment is very wet, move up one level. EG: if rainfall is on 10-year curve and catchment very wet, refer to 20-year map and consequences.



CAUTION- if rain extends beyond 24 hours, use a moving window to pick up the 24 hour total to current time and consider catchment wetness.

Use local rainfall or an interpretation of BaM weather radar images (calibrated against Bendigo AWS) to determine indicated likelihood and severity of flooding.

6.6 Rainfall and Consequence table

Date	Rainfall			Area affected by heavy rain	Consequences	ARI of flooding
	m m	Durati on	ARI			
26/12/1999	75	45 mins	>100-yr		Extensive flooding and 10 houses were affected from Bendigo East to Epsom	
18/05/2003	68	45 mins	>100-yr		Many properties were affected and 10 flooded in Bendigo, Golden Square, Strathdale, Kennington, Maiden Gully and Strathfieldsaye	
5/03/2010	89 40	3 days 2 hours	~15-yr		Flooding at Bendigo and Huntly	<5-yr
4/09/2010	80 40	1 day 10 hours	<20-yr		Flooding at Bendigo and Huntly	~5-yr
10/01/2011	159 64	5 days 1 day	<5-yr		Flooding at Bendigo and Huntly	~20-yr
5/02/2011	99 50	48 hours 5 hours	~12-yr ~15-yr		Flooding at Bendigo and Huntly and across municipality	~50-yr
13/09/2016	77 44	3 days 1 day	<5-yr		Flooding at Bendigo and Huntly	~5-yr

APPENDIX C2 – HEATHCOTE COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Heathcote is situated on the Northern Highway approximately 40km south-east of Bendigo and 110km north of Melbourne, within the City of Greater Bendigo. The town straddles Mclvor Creek and was settled around 1852. It has a population of around 4,073 (ref 2011 census).

Mclvor Creek is within the Campaspe catchment and is a tributary to Lake Eppalock. It joins with Mt Ida Creek downstream from Heathcote and upstream of the Mt Ida Creek stream gauge at Derrinal. It originates in the mountainous areas of The Great Dividing Range to the south of Tooborac (approximately 17km south of Heathcote) and flows in a generally northerly direction towards Heathcote. See catchment map at Appendix F2-1.

The Mclvor Creek catchment is around 158km² in size and is relatively steep with numerous well defined flow paths. The majority of the catchment is used for agricultural purposes, predominately grazing. There are a number of tributaries feeding from the local gullies, including Long Gully, Whites Gully, Caledonia Gully, Possum Gully, Golden Gully, Parsons Gully, Peter's Gully, Wattle Gully and Dead Horse Gully. In addition to a number of small informal farm dams, there are two relatively small storages upstream of Heathcote, both of which have virtually no upstream catchments.

- Caledonia Gully Reservoir is operated by Coliban Water and supplies water to Heathcote and Tooborac. It is located around 5km south of the town near the intersection of Dairy Flat Road and Hedleys Dam Track; and
- Hedleys Dam is located at the head of Argyle Gully around 500m north west of Caledonia Gully Reservoir (nearer Heathcote) along Hedleys Dam Track. Ownership details are not readily available.

The largest flood in recent memory (assessed as being around a 30-year ARI event) occurred at Heathcote in May 1974. The January 2011 event (assessed as being around a 7-year ARI event) is the second largest in recent years. Other larger events occurred in September 1870, September 1906 and April 1939. The latter two events have been assessed as being in excess of the 100-year ARI flood.

Floods generally occur at Heathcote during the spring and summer months as a result of local heavy rain. Rises within Mclvor Creek usually begin between 3 and 6 hours from the start of rain but can be delayed by up to 10 hours. Rises are rapid with the peak generally occurring between 10 and 12 hours after the start of rise. The size of the flood does not appear to drive the rate of rise but a second flood on a wet catchment does rise a little quicker. Timing can be as short as 8 hours from start of rise to peak.

Locally heavy rain in and around Heathcote and particularly on the hills on the south (Redesdale) side of the town will cause very rapid rises in the gullies running down to Mclvor Creek resulting in flooding of the streets that run down to High Street (e.g. Herriot, Chauncey and Pohlman streets). Properties along High Street (e.g. in the vicinity of the intersection of these streets and High Street) may also flood.

2. Flooding Consequences

2.1 Overview

At Heathcote, there are a good number of residential and commercial properties located on the well-defined floodplain of Mclvor Creek. While flooding from the creek is extensive in many of the developed areas of the town, it is generally shallow. Velocities are highest in the main

stream channel (more than 2m/sec) and somewhat lower (between about 0.5m/sec and 2m/sec) along the main flow paths and roads. Flow velocity through properties is typically low at less than 0.5m/s. Hazard is low away from the main flow paths.

High flows in Mclvor Creek close the Barrack Street and Robinson Street fords in Heathcote. The road closures can isolate properties on the northern side of the creek.

Runoff from the hills on the southern (Redesdale) side of town can cause the gullies that run to Mclvor Creek to rise quickly and flood and inundate the roads that run towards High Street as well as some of the properties along High Street. The Herriot – High Street, Chauncey - High Street and Pohlman – High Street intersections and adjacent properties appear to be particularly vulnerable.

2.2 Warning Times

Floods develop and rise quickly in the Mclvor Creek catchment, more so when the area is wet. Warning times are short.

At Heathcote, the creek typically will start to rise 3 to 6 hours after the start of heavy rain with the peak 8 to 12 hours later.

A local rule of thumb is that if water goes over the road at Tooborac Bridge, Heathcote will experience flooding an hour and a half (1½ hours) later.

2.3 Areas Affected and Isolation

During a 5-year ARI (20% AEP) event, the Northern Highway (High Street) is wetted to a depth of around 250mm to the north west (towards Bendigo) of Mitchell Street (see Figure C2-1) from creek breakouts near Clouston Court and opposite Boomerang Place. The initial section of the Mclvor Highway is also wetted to a similar depth.

As flood severity increases, breakout flooding occurs along Beauchamp Street, upstream of Chauncey Street and downstream to Mitchell Street.

The fords at Barrack Street (see Figure C2-2) and Robinson Street are inundated quite frequently with a depth of 1.2m and 1.6m likely respectively during the 5-year ARI (20% AEP) event. During larger floods, access to the properties on the northern side of the creek becomes difficult as:

- The Northern Highway (High Street) is wetted to a depth of around 250mm to the north west of Mitchell Street during a 5-year ARI (20% AEP) event (as is the initial part of the Mclvor Highway) and is likely to be impassable from around or a little above the 10-year ARI event;
- Chauncey Street is likely to be impassable from between the 20 and 50-year ARI events; and
- While access via the Heathcote - Nagambie Road and then Forest Drive may be possible up to somewhere between the 50 and 100-year ARI event; and via fire tracks through reserve land up to and including the 200-year ARI event, local drainage may make local roads and tracks impassable.

Flooding across the Northern and Mclvor Highways to the north west of Mitchell Street is more established and deeper during a 10-year ARI (10% AEP) event with the result that both would probably need to be closed due to excessive depth (see Figure C2-1). Travel to the north west (e.g. Bendigo) and north (e.g. Elmore) would still be possible but would need to be initially via the Heathcote – Kyneton Road and the Heathcote – Nagambie Road respectively.

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The Northern Highway has been flooded in the past near the intersection with Warrowitue-Forest Road to the south east of town (i.e. towards Tooborac). It is not clear what caused the flooding – local runoff or water from the creek.

While flood water does sit alongside the northern edge of the Northern Highway from near the town side of the Heathcote – Nagambie Road intersection (i.e. on the south eastern side of town) from a little below the 50-year ARI event, for all events up to and including the 200-year ARI event, flood water only crosses the Highway to the north west (towards Bendigo) of Mitchell Street.

While there are a number of creek crossings, the study has shown that partial blockage of culverts and bridge openings (up to 50%) generally have little impact on adjacent flood levels. For example, partially blocking the Northern Highway Bridge increases upstream levels by up to about 120mm whereas blocking the Chauncey Street Bridge increases upstream levels by up to around 200mm across the reserve and at a number of nearby properties.



Figure C2-1: The Northern Highway at Heathcote north west of Mitchell Street on 14 January 2011

(courtesy of G Spears)



Figure C2-2: The Barrack Street ford and pedestrian bridge in Heathcote on 8 September 1983

(courtesy of G Spears)

2.4 Properties Affected

In Heathcote, 14 properties are flooded close to the buildings by the 10-year ARI (10% AEP) event with the first property flooded in Thomas Street. There are also 3 houses within 100mm of flooding over-floor: 2 in Thomas Street and 1 in Pohlman Street. The stockyards are surrounded and the tennis courts are partially flooded – occurred in November 2000 and again in January 2011.

The VICSES depot is within 100mm of being flooded during a 50-year ARI (2% AEP) event.

In the 100-year ARI (1% AEP) event, most of the area downstream (to the north west) of Barrack Street between Wright Street (initially and then High Street) and Mclvor Creek is flooded. There are 109 properties, including the VICSES depot site, that are flooded in this area. Of these 109 properties, 24 are flooded over-floor and a further 17 floors are within 100mm of being wetted.

A detailed list of properties affected by flooding within Heathcote is provided in Section 7.3 of this Appendix.

2.5 Essential Infrastructure

Essential community infrastructure, such as the Mclvor Medical Centre, the CFA, Ambulance and Police stations, Council offices, the Water Treatment Plant, the Heathcote Water

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Reclamation Plant⁹, the Community Centre and the Primary School are not affected by flooding up to at least the 200-year ARI event. While the swimming pool is similarly not affected, facilities at the Tennis, Bowls, Angling and Football clubs are impacted from around the 50-year ARI event.

Reticulated water standpipes are located in Herriot Street near the O’Keefe Rail Trail and in High Street near the Victoria Hill Road intersection. Neither location is affected by flooding from Mclvor Creek up to at least the 200-year ARI event.

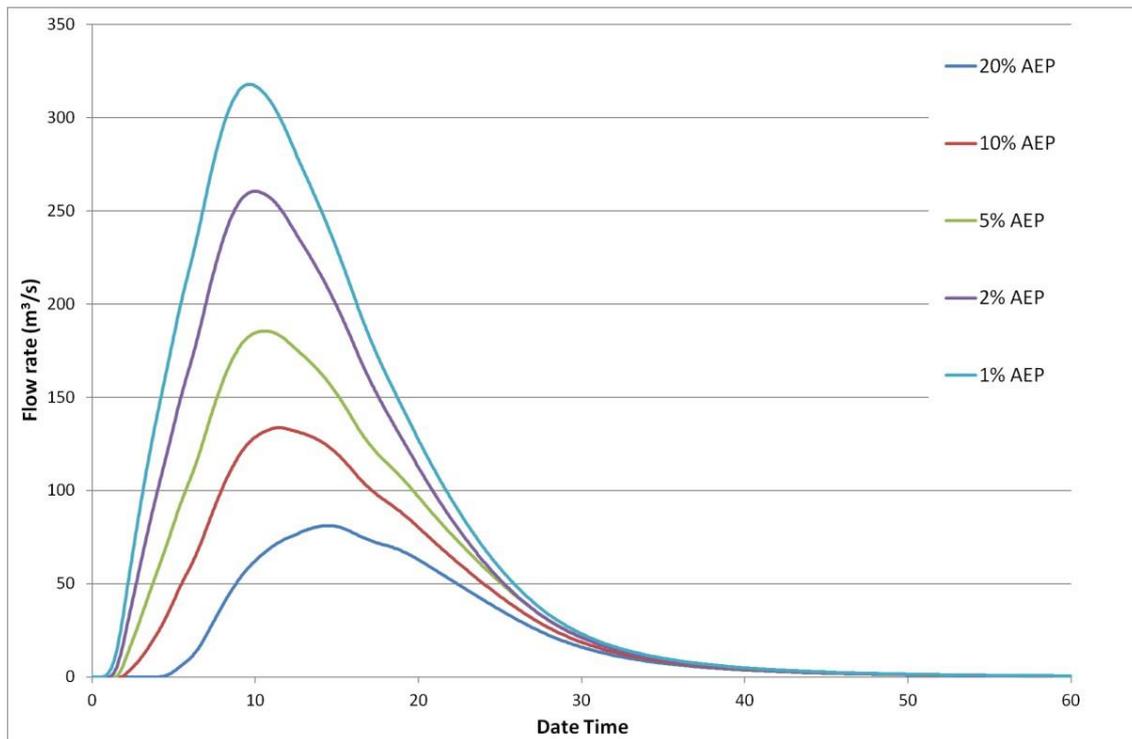
Parts of the Queens Meadow Caravan Park (Barrack Street and Ambers Drive) are inundated from a little above the 10-year ARI event. In the 20-year ARI (5% AEP) event, there is a breakaway flow through the park towards the potable cabins on Barrack Street with approximately half the site inundated to some extent in the 50-year ARI (2% AEP) event with one property flooded over-floor. Additional over-floor flooding occurs as flood severity increases.

3. Design Floods

In the absence of a gauge on Mclvor Creek, the design flood event flows and hydrographs as determined as part of the Heathcote Flood Study (WBM, 2015A) are provided below. It is suggested that they could be used to gain some guidance on the likely severity of expected flooding when compared against flows determined in real-time from recorded rainfall.

Design peak flow values (m ³ /s) and levels									
AEP	20%	10%	5%	2%	1%	0.5%	0.2%	0.1%	PMF
Peak flow (m³/s)	81	134	186	260	318	395	472	535	3901
Level at the Barrack Street ford									
(mAHD)	231.14	231.69	231.98	232.21	232.35	232.49			
Level at the Robinson Street ford									
(mAHD)	226.05	226.44	226.68	226.94	227.11	227.30			

⁹ The Heathcote Water Reclamation Plant is located 3km south-west of the town. Wastewater is collected via 2 x pump stations, 20km of gravity mains and 3km of rising mains. Sewage is treated through a 2Ha lagoon system and is then kept in a storage lagoon before being used to irrigate the Heathcote Golf Course.



4. Flood Mitigation

The Heathcote Flood Study (WBM, 2015A) considered a number of structural options for reducing the extent and depth of flooding from Mclvor Creek at Heathcote: levees close to the creek in the vicinity of Thomas Street and from around Herriot Street to Pohlman Street, raising the Northern Highway to the north west of Mitchell Street, raising Chauncey Street and replacing the ford with a bridge, and clearing vegetation from the creek channel and banks. As at the date of this document, none of the works had been implemented.

5. Town Flooding, Drainage and Risks

Local stormwater runoff poses a significant risk to property within the Heathcote township. 730 properties are exposed to inundation (i.e. where more than 10% of the property is wetted) during a 10% AEP local rain event. The number rises to 942 during a 1% AEP local rain event (WBM, 2015B).

There are a number of areas within Heathcote subject to substantial flood risk from local catchment runoff – refer to maps at Appendix F2-2. These areas include;

- High Street and Playne Street between the Northern Highway and Chauncey Street;
- Overflow from Golden Gully between Herriot Street and Mclvor Creek; and
- Breakout flow from Mountain Creek between the Heathcote - North Costerfield Road and the Heathcote Golf Course.

The main hazardous areas are located along the banks of the Mclvor Creek and along a number of channels and gullies in and around Heathcote. In particular:

- The High Street and Playne Street flow path shows an area of high hazard predominately towards its north western end;
- The Golden Gully shows high hazard along the drain parallel to Miller Street;
- The Mountain Creek flow path shows high hazard along Shakespeare Street, Wattle Drive and through the rear of a number of private lots on those streets as well as on Patterson Street.

6. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

7. Command, Control and Coordination

The Command, Control and Coordination arrangements in this Municipal Flood Emergency Plan will be as detailed in the Emergency Management Manual Victoria.

All flood response activities within the City of Greater Bendigo will be under the Control of the VICSES Regional Officer / Incident Controller.

An Emergency Management Team (EMT) may be established by the Incident Controller in accordance with the Emergency Management Manual Victoria.

An **Incident Control Centre (ICC)** will be established by the Control Agency (i.e. VICSES) for its command and control functions in response to any flood event within the Municipality. It will be operated in accordance with VICSES arrangements.

The location of the ICC will be determined and advised to relevant stakeholders dependant on the extent and severity of the flood event.

The establishment and operation of the **Municipal Operations Centre (MOC)** will be in accordance with and as detailed within the MEMP.

8. Flood Intelligence, Action Table and Indicative Flood / No Flood Guidance Tool for Heathcote

8.1 Introduction

Flood impacts described in the following tables relate primarily to creek flooding. It should be noted that local impacts, or impacts in excess of those indicated, may occur, especially in the event of locally heavy rain in and around Heathcote and particularly on the hills on the south (Redesdale) side of the town. In the event of the latter, the gullies running down to Mclvor Creek will rise quickly and flood. Streets running down to High Street (e.g. Herriot, Chauncey and Pohlman streets) as well as properties along High Street (e.g. in the vicinity of the intersection of these streets and High Street) may also flood. Similarly, local increases in flood levels and impacts may result from local factors such as blockages at bridges and culverts and from obstructions to overland flows such as works, channels, fences, buildings and the like.

Notes:

1. 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 intell 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. Additional details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at <http://www.ema.gov.au> and in particular in Manual 20 “Flood Preparedness”.
2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience.

8.2 Flood Intelligence Card

McIVOR CREEK at HEATHCOTE				
Observed Rainfall (see graphs)	Creek level at Heathcote (mAHD)	Event AEP (%) ARI	Consequence / Impact at Heathcote Refer to maps and lists at Appendix F	Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
		Frequent	Higher than “normal” flows in Mclvor Creek inundate the Barrack Street ford and the Robinson Street ford in Heathcote.	Deploy “road closed” signs on both sides of both fords.
34mm in 2hrs to 57mm in 12hrs	Barrack St 231.14 Robinson St 226.05	20% 5 year	The fords at Barrack Street and Robinson Street are inundated to a depth of 1.2m and 1.6m respectively. The Northern Highway (High Street) is wetted to a depth of up to 250mm to the north west (towards Bendigo) of Mitchell Street as a result of breakouts from near Clouston Court and opposite Boomerang Place. The inundation extends to the Mclvor Highway – Northern Highway intersection and includes the initial section of the Mclvor Highway. Small breakouts are occurring on the northern floodplain and water is backing up gullies	If not already done, deploy “road closed” signs on both sides of both fords. Consider closing the Northern and Mclvor Highways if water is expected to become deeper. Prepare to deploy “water over road” signs on Thomas Street and Beauchamp Street with attention to the intersections as flooding is likely to be little more pronounced in those areas.

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McIVOR CREEK at HEATHCOTE				
Observed Rainfall (see graphs)	Creek level at Heathcote (mAHD)	Event AEP (%) ARI	Consequence / Impact at Heathcote Refer to maps and lists at Appendix F	Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
			<p>on the southern (High Street) side of the creek.</p> <p>As flood severity increases:</p> <ul style="list-style-type: none"> > Breakout flooding occurs along Beauchamp Street. > Up to 14 properties will be flooded, the first in Thomas Street. 	
40mm in 2hrs to 66mm in 12hrs	Barrack St 231.69 Robinson St 226.44	10% 10 year	<p>The Northern Highway (High Street) north west of Mitchell Street is wetted to a depth of more than 250mm in the low points with water extending to the McIvor Highway – Northern Highway intersection and over the initial section of the McIvor Highway. Floodwaters will get progressively deeper as flood severity increases.</p> <p>Thomas Street and Beauchamp Street are wet as are the creek ends of Mitchell, Pohlman and Chauncey streets as well as the eastern end of Wright Street.</p> <p>14 properties are flooded (the first of these is in Thomas Street) and 3 houses are within 100mm of being flooded over-floor (2 in Thomas Street and 1 in Pohlman Street).</p> <p>The stockyards are surrounded and the tennis courts are partially flooded.</p> <p>Parts of the Queens Meadow Caravan Park (Barrack Street and Ambers Drive) are about to inundated.</p>	<p>Close the Northern and McIvor Highways if not already done, particularly if water is still rising.</p> <p>Assist properties about to be flooded over-floor –consider lifting / relocating chattels, sandbagging and relocating occupants.</p>
45mm in 2hrs to 75mm in 12hrs	Barrack St 231.98 Robinson St 226.68	5% 20 year	<p>The deepest areas of flooding across the Northern and McIvor Highways are 500mm deep or more.</p> <p>Both ends of Wright Street as well as the end of Herriot Street are now wet.</p> <p>Depths are increasing along flooded roads and Chauncey Street will soon become impassable. Isolation / access is a developing issue for the northern side of town.</p> <p>9 buildings are flooded over-floor with a further 5 within 100mm of being inundated.</p> <p>A further 28 properties are flooded with another 5 close to being flooded.</p> <p>A breakaway flow is established through the Queens Meadow Caravan Park towards the portable cabins on Barrack Street.</p>	<p>Consider protecting or relocating chattels at the Tennis, Bowls, Angling and Football club premises.</p> <p>Consider closing Chauncey Street if water is expected to become deeper.</p> <p>Plan for isolation and implement work-arounds.</p>
55mm in 2hrs to 87mm in 12hrs	Barrack St 232.21 Robinson St 226.94	2% 50 year	<p>Flood water is now present alongside the northern edge of the Northern Highway from near the town side of the Heathcote – Nagambie Road intersection (i.e. on the south eastern side of town). However, unless there has been strong local rainfall, the paved surface of this part of the Highway is unlikely to be wetted.</p>	<p>Consider relocating VICSES operations.</p>

APPENDIX C2 – HEATHCOTE

McIVOR CREEK at HEATHCOTE				
Observed Rainfall (see graphs)	Creek level at Heathcote (mAHD)	Event AEP (%) ARI	Consequence / Impact at Heathcote Refer to maps and lists at Appendix F	Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
			<p>Chauncey Street is impassable as are other streets close to the creek.</p> <p>Access via the Heathcote - Nagambie Road and then Forest Drive may still be possible.</p> <p>12 buildings are flooded over-floor with a further 7 within 100mm of being inundated.</p> <p>A further 58 properties are flooded with another 6 close to being flooded.</p> <p>The VICSES depot is within 100mm of being flooded over-floor.</p> <p>Facilities at the Tennis, Bowls, Angling and Football clubs are impacted.</p> <p>Approximately half the Queens Meadow Caravan Park is inundated to some extent with one building flooded over-floor. Additional over-floor flooding occurs as flood severity increases.</p>	
62mm in 2hrs to 95mm in 12hrs	Barrack St 232.35 Robinson St 227.11	1% 100 year	<p>Isolation for large parts of the town is likely to be an issue.</p> <p>Most of the area downstream (to the north west) of Barrack Street between Wright Street (initially and then High Street) and McIvor Creek is flooded.</p> <p>Water is close to High Street between Barrack Street and Herriot Street.</p> <p>Access via the Heathcote - Nagambie Road and then Forest Drive may not be possible, particularly if there has been heavy local rain.</p> <p>Depending on local and surrounding rain and runoff, access to Heathcote may still be possible from the south via the Heathcote – Kyneton Road.</p> <p>There are 109 properties flooded in this area. Within these 109 properties, 24 buildings are flooded over-floor and a further 17 floors are within 100mm of being wetted. Another 6 properties are close to being flooded.</p> <p>The VICSES depot is flooded over-floor.</p>	
	Barrack St 232.49 Robinson St 227.30	0.5% 200 year	<p>Access via the Heathcote-Nagambie Rd and then fire tracks through reserve land may be possible although heavy local ran and resulting local runoff may flood the road.</p> <p>Depending on local and surrounding rain and runoff, access to Heathcote may still be possible from the south via the Heathcote – Kyneton Road.</p> <p>49 buildings are flooded over-floor with a further 12 within 100mm of being inundated.</p> <p>A further 80 properties are flooded with another 3 close to being flooded.</p>	

8.3 Properties Likely to be Flooded at Heathcote

Summary of number of properties in Heathcote affected by Mclvor Creek Flooding (ref WBM, 2015A)						
EXISTING CONDITIONS						
	Design Flood ARI (years)					
	5	10	20	50	100	200
Number of properties flooded over-floor	0	0	6	12	24	49
Number of floors within 100mm of being inundated	0	3	5	7	17	12
Number of properties flooded below floor only	0	14	28	58	85	80
Number of properties within 100mm of being inundated near the building	0	3	5	6	6	3
Total number of flooded properties	0	14	34	70	109	129

Note that local stormwater runoff also poses a significant risk to property within the Heathcote township. **730 properties** are exposed to inundation (i.e. where more than 10% of the property is wetted) during a 10% AEP local rain event. The number **rises to 942** during a 1% AEP local rain event (WBM, 2015B). Information on the number of properties flooded over-floor is not available.

The following is a list of properties expected to experience inundation (and the depth of that inundation) as a result of flooding from Mclvor Creek, along with an indication of the likely depth of over-floor inundation. **It is strongly recommended that the following list is used in conjunction with the flood inundation maps (see Appendix F).**

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 with information collected as part of post-flood information recording activities as well as may be collected as a consequence of the event debrief and from the collective experience of the IMT.

8.4 Using the Indicative Flood / No Flood Tool

As the BoM does not currently provide flood forecasts for Heathcote or Mclvor Creek (there is no formal flood warning system), all actions must be driven by rain and / or creek level observations. However, there are no gauges upstream of Heathcote to provide an indication of the onset of flooding or to provide historic data that will enable a comparison of past flood events.

It is suggested that the [indicative quick look ‘flood / no-flood’ tool](#) developed for Heathcote (see below) will provide an initial heads-up of the likelihood and scale of possible flooding. **Local rainfall data** (i.e. data from the area receiving the heaviest falls) determined from local reports or from an **interpretation of BoM weather radar images** can be used to determine an appropriate rainfall depth for use in the tool. Rainfall reported from the **Redesdale AWS** (available from the BoM website at 30 minute intervals and occasionally more frequently) will

APPENDIX C2 – HEATHCOTE

provide a basis for calibration of radar imagery. In the absence of any local rainfall data and BoM weather radar imagery, the data reported by the **Redesdale AWS** could be used to drive the tool. The telemetered rain gauge at **Strathfieldsaye** may also provide useful guidance but data from this site is only available from the BoM website at around 3-hourly intervals.

It should be noted that the tool does not provide a prediction of expected flood height. It provides indicative guidance only that can then be related to the flood inundation maps (and GIS datasets) produced by WBM (2015A & 2015B), a sub-set of which is provided in Appendices F2-1 and F2-2.

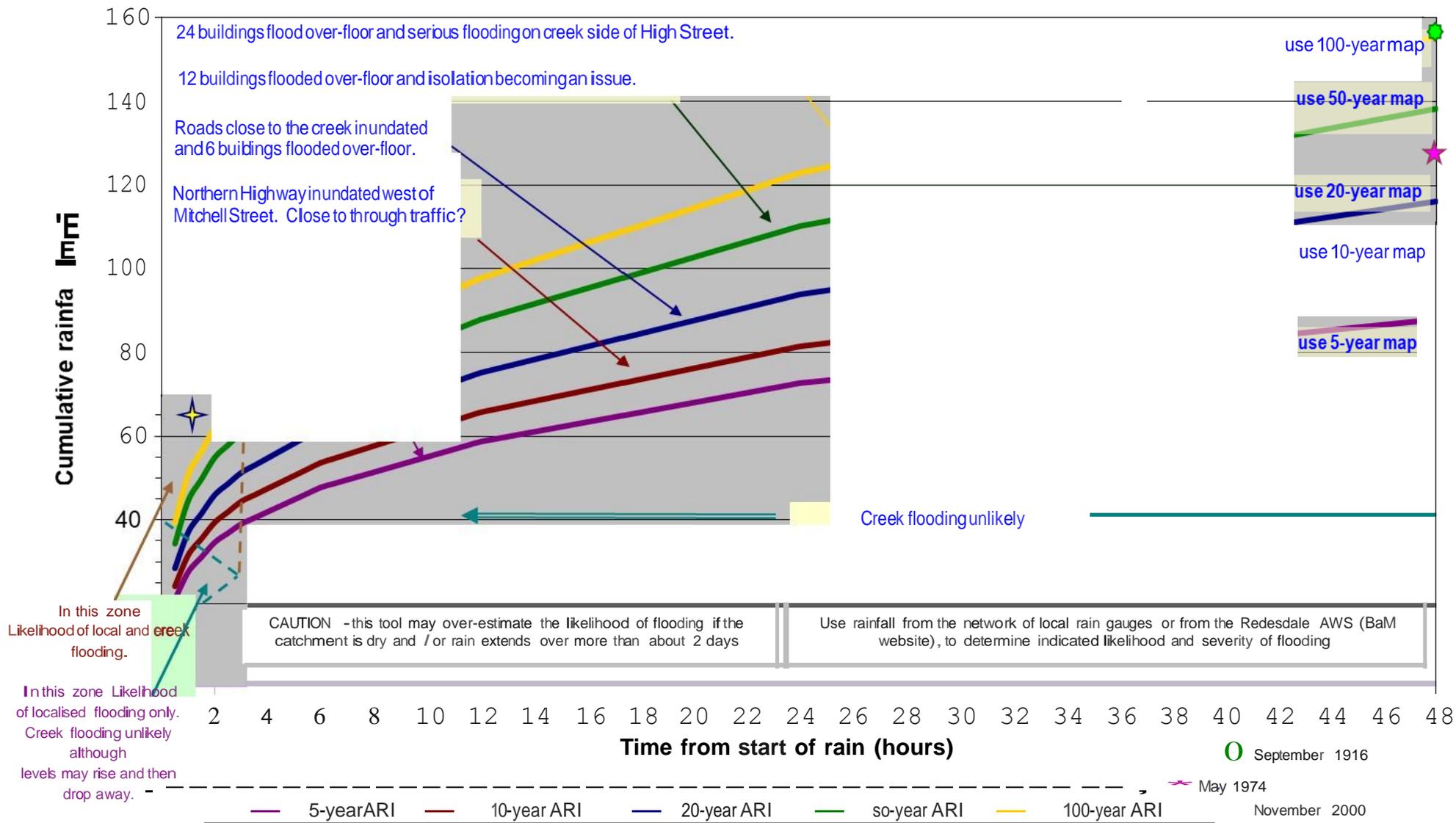
In addition to providing initial indications of the likely scale of flooding in and around Heathcote, the tool can be used to initiate installation of the PALS at the locations detailed below.

The rainfall that produced each new flood event should be added to the indicative tool as a dot along with the date. It is also suggested that information about the area over which the rainfall occurred and the consequences should be added to the "Rainfall and Consequence Table" that follows the tool.

APPENDIX C2- HEATHCOTE

Indicative guidance for likelihood of flooding at Heathcote based on rainfall

This guide assumes that rainfall affects the whole catchment and is not localised heavy falls. If localised, the guide may over-estimate the likelihood of flooding. If the catchment is very wet, move up one level. For example, if rainfall is on the 10-year curve and the catchment is very wet, refer to the 20-year map and consequences.



APPENDIX C2 – HEATHCOTE

1.1 Rainfall and Consequence Table

Date	Rainfall			Area affected by heavy rain	Consequences	ARI of flooding
	mm	Duration	ARI			
25/09/1916	158	2 days			Large flood through Heathcote	
20/10/1916	72				Smaller flood	
10/05/1930	69	2 days				
10/12/1930	120				Creek running a banker	
15/12/1930	66	12 hours			Big flood	
15/02/1934	43	12 hours			Big flood	
7/04/1939	91 37	90 minutes			Worst flood in 20 years	>100 yr
24/09/1955	84	12 hours			Biggest flood since 1939	
14/05/1974	127	2 days			Largest flood through Heathcote in recent memory	~ 30 year
14/11/2000	65 82	1 hour 3 hours			Flash flooding at Heathcote – a lot of water came down Peter's Gully	
Jan 2011	73	2 days				~ 10 year

8.5 Locations for a PALS Gauge at Heathcote

A site upstream of the Barrack Street ford (2 sites have been identified – see Table C2-1) or perhaps on the upstream side of the Robinson Street ford¹⁰ has been identified for installation of either permanent creek level monitoring equipment or Portable Automated Logger System (PALS) equipment (see below and Appendix F) to assist flood forecasting and warning activities at Heathcote. The location has been selected on the basis of ease of access during the early stages of a flood, the lead time that would be available during an event for flooding at Heathcote, the ‘representativeness’ in terms of flood severity, and the ability to relate levels at those sites to flood inundation mapping delivered as part of the Heathcote Flood Study (WBM, 2015A).

It is not suggested that the site must be instrumented during a future flood, although if it was, the data collected would greatly assist local flood response and use of the intelligence contained in this MFEP, and post-event, inform update of this MFEP.

The table below provides location details for the PAL sites as well as the existing gauge on Mt Ida Creek at Derrinal while the **red dot** on the accompanying maps provide a visual description of that location.

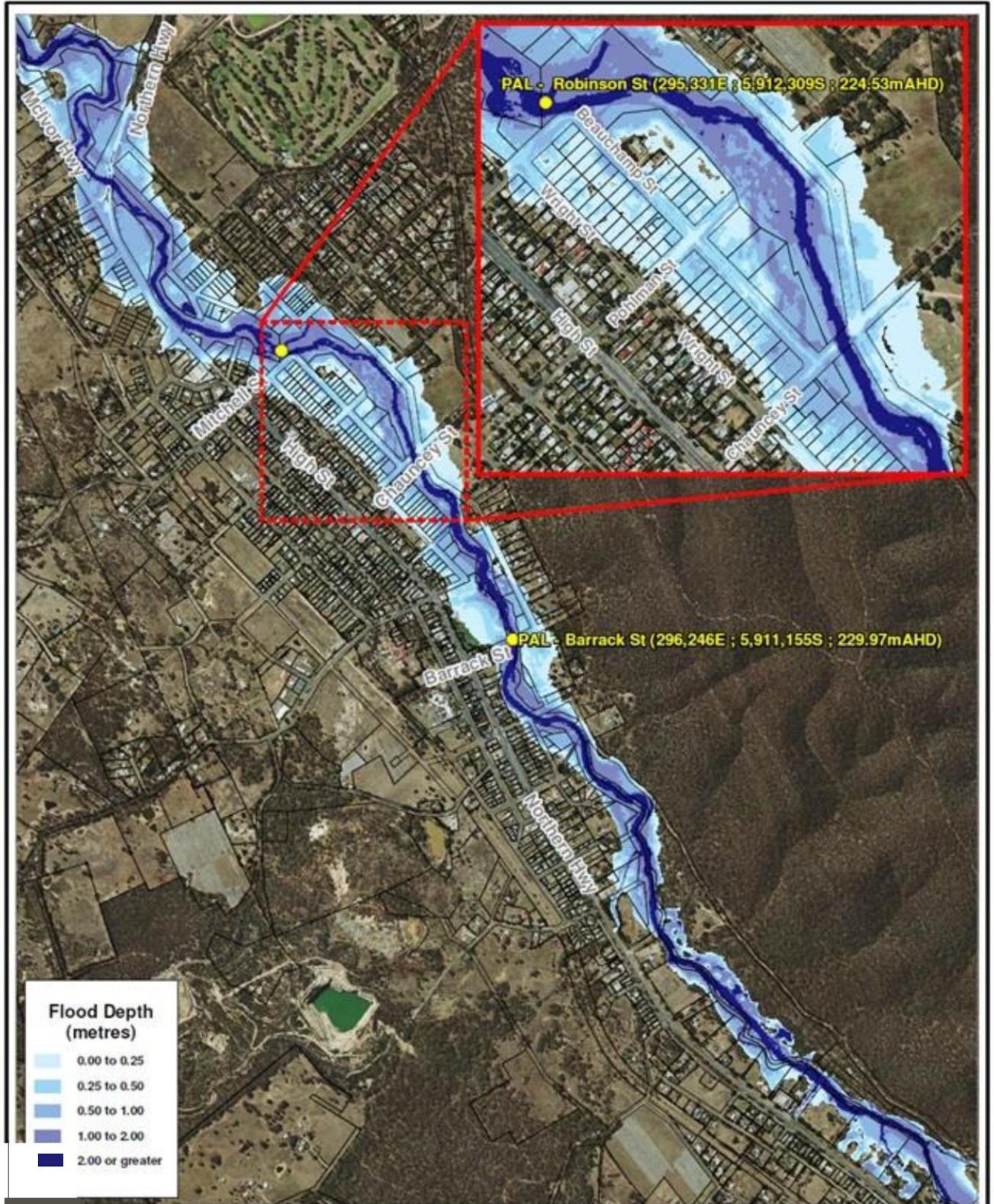
Table C2-1 Potential PALS location, gauge zero and applicable design flood levels

Location						
Gauge zero for PALS unit (mAHD)	20% AEP (mAHD)	10% AEP (mAHD)	5% AEP (mAHD)	2% AEP (mAHD)	1% AEP (mAHD)	0.5% AEP (mAHD)
290725E 5915815S	Derrinal gauge on Mt Ida Creek downstream from Heathcote					
198.31	200.63	201.48	202.34	202.63	202.73	202.88
296246E 5911155S	Mclvor Creek at the Barrack Street ford in Heathcote (2 possible sites)					
229.97	231.14	231.69	231.98	232.21	232.35	203.49
228.63	231.14	231.69	231.98	232.21	232.35	203.49
295331E 5912309S	Mclvor Creek at the Robinson Street ford in Heathcote					
224.53	226.05	226.44	226.68	226.94	227.11	227.30

¹⁰ An alternative site would be on the upstream side of the Chauncey Street Bridge or, but less desirable, on the upstream side of the Northern Highway Bridge at the downstream (Bendigo) end of town

APPENDIX C2- HEATHCOTE

8.6 Overview of proposed PALS locations at Heathcote



Tldt
Heathcote Flood Study

Figure: **1** | Rev: **A**

0'KI-H...tcISIITW loI-... ..

0 375 750m
IWTWIM..

Approx Scale

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1% AEP Flood Depth and PAllocations

APPENDIX C3 – Campaspe River

Community Flood Emergency Management plan

1. Overview

The Campaspe River around Redesdale flows within a deep valley causes little risk to residences. There is inundation of low-lying farm land and potential for some road closures.

Further information will be gathered as an outcome of the Regional Floodplain Management Strategy.

APPENDIX D – FLOOD EVACUATION ARRANGEMENTS

There are five stages in the evacuation process: decision, warning, withdrawal, shelter and return.

1 Phase 1 - Decision to Evacuate

The Incident Controller may make the decision to evacuate an at-risk community under the following circumstances:

Properties are likely to become inundated;

Properties are likely to become isolated and occupants are not suitable for isolated conditions;

Public health is at threat as a consequence of flooding and evacuation is considered the most effective risk treatment. This is the role of the Health Commander of the incident to assess and manage. Refer to the State Health Emergency Response Plan (SHERP) for details);

Essential services have been damaged and are not available to a community and evacuation is considered the most effective risk treatment.

The following should be considered when planning for evacuation:

Anticipated flood consequences and their timing and reliability of predictions;

Size and location of the community to be evacuated;

Likely duration of evacuation;

Forecast weather;

Flood Models;

Predicted timing of flood consequences;

Time required to conduct the evacuation;

Time available to conduct the evacuation;

Evacuation priorities and evacuation planning arrangements;

Access and egress routes available and their potential flood liability;

Current and likely future status of essential infrastructure;

Resources required to conduct the evacuation;

Resources available to conduct the evacuation;

Shelter including Emergency Relief Centres, Assembly Areas etc;

Vulnerable people and facilities;

Transportation;

Registration

People of CALD background and transient populations;

Safety of emergency service personnel;

Different stages of an evacuation process.

The decision to evacuate is to be made in consultation with relevant stakeholders such as; the MERO, MERC, DHHS, Health Commander and other key agencies and expert advice (CMA's and Flood Intelligence specialists).

Triggers for evacuation will be considered by the Incident Controller in consultation with the EMT

2 Phase 2 – Warning

Warnings may include a warning to prepare to evacuate and a warning to evacuate immediately. Once the decision to evacuate has been made, the at-risk community will be warned to evacuate. Evacuation warnings can be disseminated via methods listed in Part 3 of this Plan.

Evacuation warning messages will be developed and issued by VICSES in consultation with the MERO, MERC, DHHS and other key agencies and expert advice (e.g. North Central CMA and Flood Intelligence specialists).

3 Phase 3 – Withdrawal

Withdrawal will be controlled by the VICPOL Evacuation Manager. The Evacuation Manager is responsible for managing the withdrawal which will include developing an evacuation plan which clearly identifies activities and timelines as well as the roles and responsibilities of any agencies involved.

VICSES will provide advice regarding the most appropriate evacuation routes and locations for at-risk communities to evacuate to, etc.

VICSES, CFA, AV and Local Government will provide resources where available to support VICPOL / VICROADS with route control and may assist VICPOL in arranging evacuation transportation.

VICPOL will control security of evacuated areas.

Evacuees will be encouraged to move using their own transport where possible. Transport for those without vehicles or other means will be arranged.

4 Phase 4 – Shelter

Emergency Relief Centres and/or assembly areas which cater for people's basic needs for floods may be established to meet the immediate needs of people affected by flooding.

Emergency Relief Centres are listed in the MEMP VICPOL in consultation with VICSES will liaise with Local Government and DHHS (where regional coordination is required) via the relevant control centre to plan for the opening and operation of relief centres. This can best be achieved through the Emergency Management Team (EMT).

5 Phase 5 – Return

The Incident Controller in consultation with VICPOL will determine when it is safe for evacuees to return to their properties and will arrange for the notification of the community.

VicPol will manage the return of evacuated people with the assistance of other agencies as required.

Considerations for deciding whether to evacuate include:

- Current flood situation;
- Status of flood mitigation systems;
- Size and location of the community;
- Access and egress routes available and their status;
- Resources required to coordinate the return;
- Special needs groups;
- Forecast weather;

Transportation particularly for people without access to transport

6 Disruption to Services

Disruption to a range of services can occur in the event of a flood. This may include road closures affecting school bus routes, damage to water treatment plant affecting potable water supplies, etc.

7 Essential Community Infrastructure and Property Protection

Essential Community Infrastructure and properties (e.g. residences, businesses, roads, power supply, etc) that require protection are as follows:

The City of Greater Bendigo in conjunction with VICSES will establish sandbag collection points if and as required.

8 Rescue

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

- ◆ Aircraft available through the State Aircraft Unit.
- ◆ Boats available through VICSES RDO.
- ◆ VICPOL resources available via RERC.

APPENDIX E – FLOOD WARNING SYSTEMS

1 Flood Warning Products

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

The 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.

The BoM issues warnings of 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 the 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, the 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 within an area covered by the formal flood forecast and warning service, the Flood Watch would be upgraded to a Flood Warning.

4 Flood Warnings

4.1 Overview

Flood Warnings are firm predictions of flooding based on actual rainfall and river height information. They are produced by the application of a range of models that include simple relationships between upstream and downstream water levels through to complex 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.

To assist the description of the service it provides, BoM are in the process of categorising the locations where river height data is obtained into three types as follows.

- ◆ **Forecast locations:** BoM provides a forecast of future water level as the class of predicted flooding ('minor', 'moderate' or 'major' - see BoM website for an explanation of these terms and current flood class levels) or as a predicted level and associated class of flooding for these locations.
- ◆ **Information locations:** BoM does not provide a forecast for these locations but as flood class levels are defined, does provide current water levels and trends (i.e. a now-cast).
- ◆ **Data locations:** BoM only provides data for these locations: no forecasts and no indication of the class (or severity) of flooding.

These locations will be further designated as either "key" or "secondary" in relation to flood forecasting activities.

- ◆ **Key locations:** may be a forecast location and the real-time data collected at site are critical to the provision

of a flood forecasting service to a downstream site.

- ◆ **Secondary locations:** data from these sites are used to support hydrological modelling and flood prediction activities although their loss during an event is considered unlikely to affect BoM ability to provide a flood forecasting service.

Flood forecasts provided by the BoM are categorised as either:

- ◆ **Qualitative:** the forecast includes information about the expected class of flooding ('minor', 'moderate' or 'major' - see BoM website for an explanation of these terms and current flood class levels) and the timing of expected flooding at the location. The forecast may also include information about the expected class of flooding during the peak.
- ◆ **Quantitative:** the forecast includes the expected class of flooding ('minor', 'moderate' or 'major' - see BoM website for an explanation of these terms and current flood class levels) together with more specific information about the height and time of future water levels at the location.
- ◆ **Generalised:** the forecast comprises generalised statements advising that flooding is expected and are usually issued for areas where no locations exist for which quantitative or qualitative forecasts are provided, in the developing stages of a flood and / or when there is insufficient data available to make a specific prediction.

Generally flood warnings are issued by the BoM to the media, VICSES, Council and other stakeholder agencies and organisations. VICSES promptly alerts and disseminates such warnings to other agencies and organisations. Stakeholder agencies and organisations, including Council, are responsible for onward dissemination of the warning details.

Flood warnings usually include:

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

Note 1: The term "local flooding" and "flash 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 from the Bureau's website (www.bom.gov.au/hydro/flood/vic) or for the cost of a local call on ☎ 1300 659 217.

On receipt of an Initial or Urgent Flood Warning, the VICSES Regional Office at Bendigo (or the after hours Regional Duty Officer) will forward the warning via email to nominated representatives of stakeholder organisations. In most cases this person will also receive an SMS message advising of the warning being issued. Subsequent warnings are forwarded by email only.

4.2 Bendigo Creek

There are currently no specific flood warning systems or arrangements in place for the Bendigo Creek catchment.

There are two stream gauges within the catchment within the City of Greater Bendigo:

- ◆ Bendigo Creek at Bendigo (407254); and
- ◆ Bendigo Creek at Huntly (407255)

The Huntly site is instrumented with a logger and 3G telemetry but data is not available through the BoM website.

The only rain gauge within the general vicinity of Bendigo (it is also within the Bendigo Creek catchment) that reports in time increments that could be considered useful for a flash flood warning system is the BoM operated Automatic Weather Station (AWS) at Bendigo Airport (81123). This station routinely reports incremental rainfall totals every 30 minutes and more frequently during significant events. Data from the station is available in near real-time from the BoM website.

4.3 Campaspe River

The BoM currently provide flood warning services for the Campaspe River at Redesdale.

4.4 Mt Ida / Mclvor Creeks

There are currently no specific flood warning systems or arrangements in place for the Mt Ida and Mclvor Creek catchments.

4.5 Other Streams / Locations

Local Knowledge or when Information becomes available

5 Flood Bulletins

VICSES distributes flood emergency information to the media through “Flood Bulletins”. Flood Bulletins provide BoM Flood Warning information as well as information regarding possible flood consequences and safety advice, not contained in BoM Flood Warning products. VICSES uses the title Flood Bulletin to ensure emphasis is placed upon BoM Flood Warning product titles.

The relevant VICSES Region Headquarters or the established ICC will normally be responsible for drafting, authorizing and issuing Flood Bulletins.

Flood Bulletins should refer to the warning title within the Bulletin header.

Flood Bulletins should follow the following structure:

- What is the current flood situation;
- What is the predicted flood situation;
- What are the likely flood consequences;
- What should the community do in response to flood warnings;
- Where to seek further information;
- Who to call if emergency assistance is required.

It is important that the description of the predicted flood situation is consistent with and reflects the relevant BoM Flood Warning.

Flood Bulletins should be focused on specific gauge (or in the absence of gauges, catchment) reference areas, that is the area in which flood consequences specifically relate to the relevant flood gauge.

Flood Bulletins should be prepared and issued after receipt of each Flood Watch and Flood Warning from the BoM, or after Severe Weather or Thunderstorm Warnings indicating potential for severe flash flooding.

To ensure Flood Bulletins are released in a timely manner, standardised Flood Bulletins may be drafted based on different scenarios, prior to events occurring. The standardised Flood Bulletins can then be adapted to the specifics of the event occurring or predicted to occur.

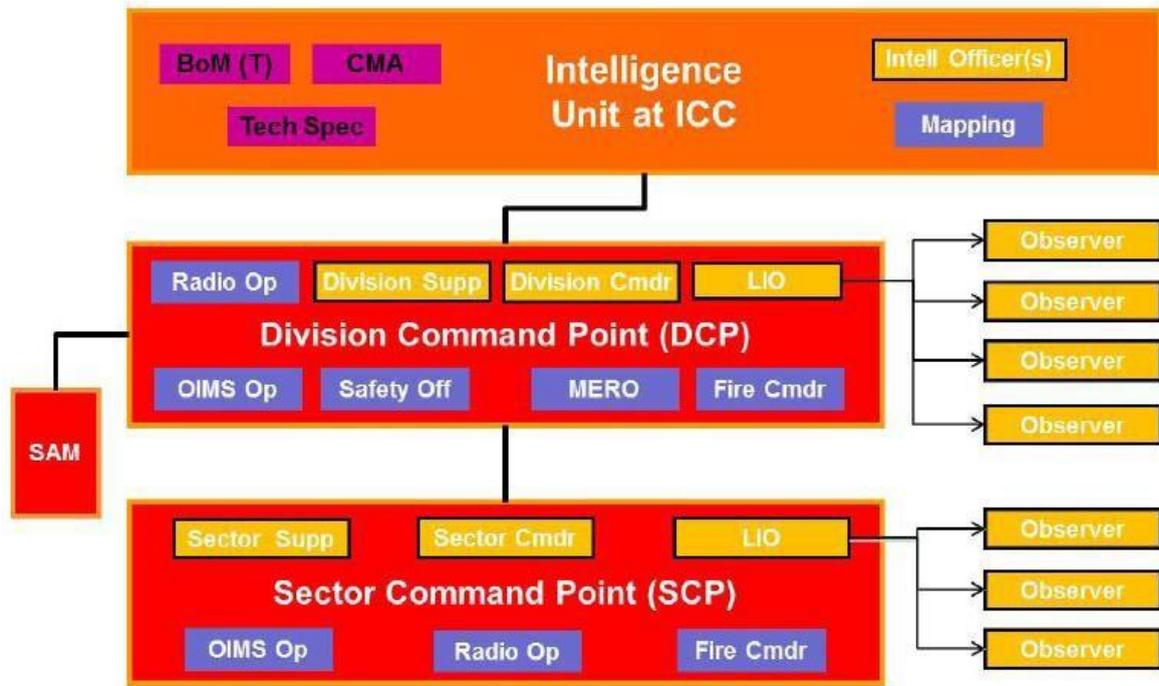


Figure E-1: Intelligence Unit Information Flow

6 Local Flood Warning System Arrangements

None exist as at the date of this MFEP.

7 Flood Class Levels

Not all sites for which flood class levels exist will automatically be provided with a quantitative flood forecast by the BoM in the future. It is understood that sites will be classified on the basis of flood risk and consequence. The lower rated sites will receive a quantitative warning service only. For these sites, BoM will issue warnings that advise only of the exceedance (or likely exceedance) of flood class levels along with the class of flooding expected: a detailed flood forecast will not be provided.

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.

It is emphasised that the flood class levels refer to that part of the watercourse where the flood effects can be related to the gauge reading.

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.

APPENDIX E – FLOOD WARNING SYSTEMS

8 Details of relevant gauges

Station No	River / Creek	Station	Flood Class Levels (m)			Gauge Zero AHD (m)	Comments
			Minor	Moderate	Major		
406213	Campaspe River	Redesdale	2.0	4.0	5.7	213.053	Gauge is ~60m downstream of Kyneton Heathcote Road bridge
406207	Campaspe River	Lake Eppalock DS	158.4	160.4	162.4	0.000	
406201	Campaspe River	Barnadown	3.8	4.4	5.0	132.489	Gauge is located ~2.5 km downstream of the Bendigo Road bridge
406218	Campaspe River	Campaspe Weir HG	121.2	121.4	121.6	0.000	
406262	Axe Creek	Strathfieldsaye	N/A	N/	N/A		
406235	Wild Duck Creek	U/S of Heathcote at Mia Mia Road					BoM report rainfall and creek level on the bulletins but the site is not classified as a forecast location, information location (no FCLs) or a data location in the SLS.
406224	Mt Pleasant Creek	Runnymede				129.990	

APPENDIX F1 – MAPS for BENDIGO

1 Overview

1% AEP flood mapping is included for the following areas:

Bendigo/Eaglehawk/Epsom/Jackass Flat/White Hills areas
 Big Hill/Kangaroo Flat areas
 California Gully/Long Gully/Maiden Gully areas (x2)
 Central Bendigo
 East Huntly
 Strathfieldsaye/Junortoun
 West Huntly

The Bendigo Urban Flood Study (Water Technology, 2014) delivered, for the 5, 10, 20, 50, 100 and 200-year ARI design events map sets showing:

- > Flood extents and depths;
- > Flow velocities;
- > Flood Hazard.

The study also delivered equivalent GIS layers.

There are no maps included in this Appendix from the Bendigo Flood Study. There are three main reasons for this:

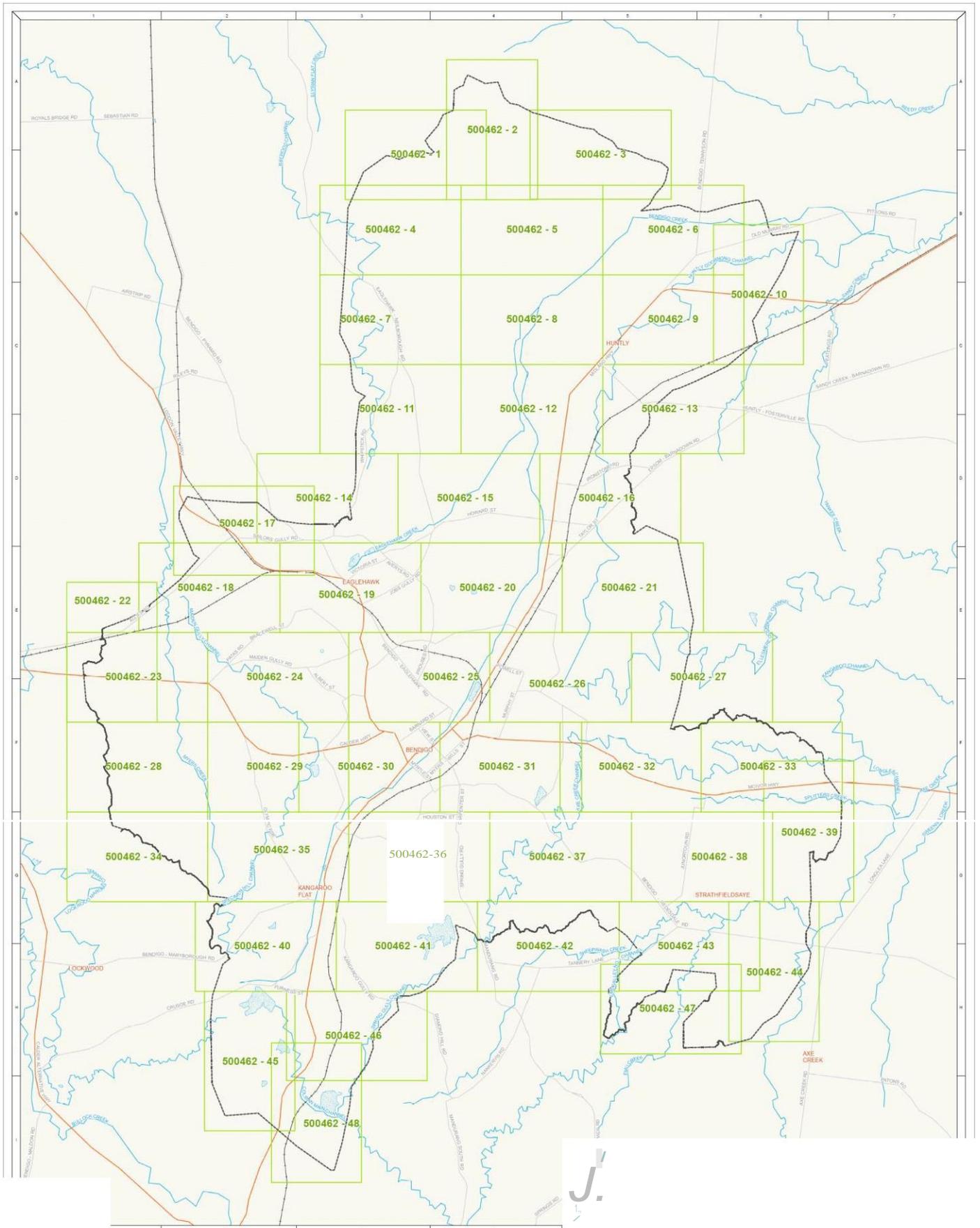
- > The number of maps - there are 48 maps for each design event and 48 hazard maps;
- > The scale – at A4 size it is a significant challenge to pick out features and discriminate between what is flooded to depth and what is only wetted, particularly as every overland flow path and wetted area across the entire catchment has been picked up; and
- > Interrogation of the mapping in relation to flood extents, depths, hazard, etc is better done through the GIS datasets rather than from a small hardcopy of the map.

The key diagram for map selection is provided on the following page.

It should be noted that the following schema was used to determine hazard:

Flood Risk	Depth (m)	Velocity x Depth (m ² /s)
Low	Below 0.4	Below 0.4
Medium	0.4 – 08	0.4 - 0.8
High	Above 0.8	Above 0.8

APPENDIX F2- MAPS FOR GREATER BENDIGO (1% AEP)



— Highway
— Major Road
 Map Sheet Extents
 Model Extent
 Major Lake/Swamp


BENDIGO URBAN FLOOD STUDY
OVERVIEW MAP
 City of Greater Bendigo



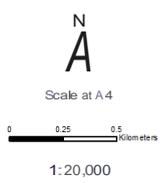
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City of Greater Bendigo

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

ASCOT/EPSOM



- | | |
|---------------------------|-----------------------|
| III Ambulance station | — Road |
| 11 Depot/Municipal Office | — Rail Trail |
| Church | — River/Creek |
| ⋮ Camp Ground | — Creek/Stream |
| ⋮ Retirement/Aged Care | — Levee |
| ⋮ Hospital | — Township boundaries |
| ⋮ Fire Station | — Cadastre |
| ⋮ Police Station | 1% AEP Flood |
| ⋮ School/Child Care | |
| ⋮ SES Unit | |

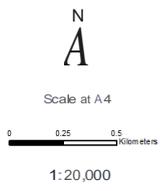
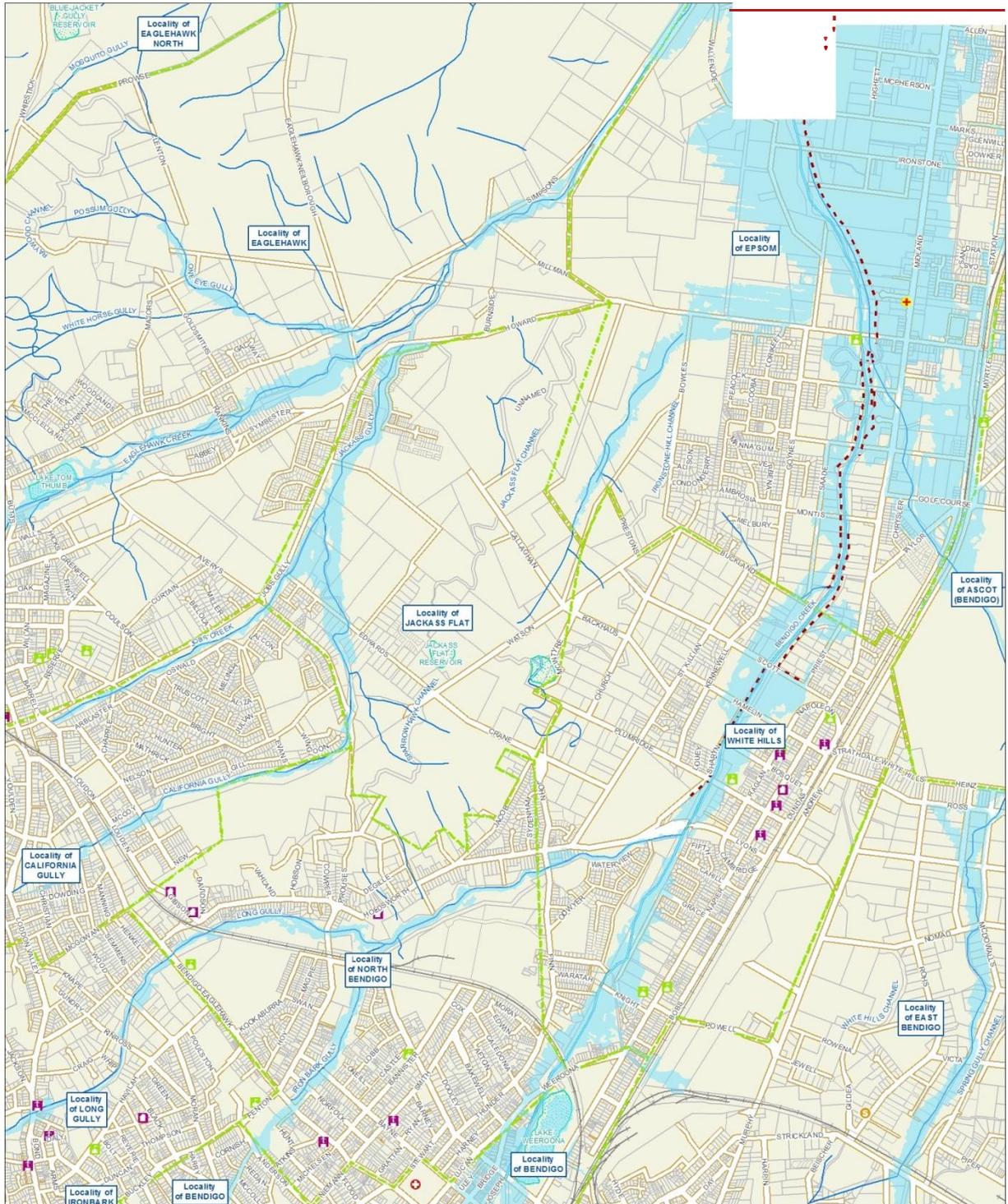


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

BENDIGO/EAGLEHAWK/EPSOM/JACKASS FLAT/WHITE HILLS



- Ambulance/ambulance
- Depot/Municipal Office
- Church
- Camp Ground
- Retirement/Aged Care
- Hospital
- Fire Station
- Police Station
- School/Child Care
- SES Unit
- Road
- Rail Trail
- River/Creek
- Creek/Stream
- Levee
- Township boundaries
- Cadastre
- 1% AEP Flood



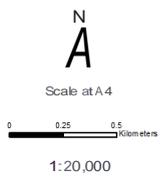
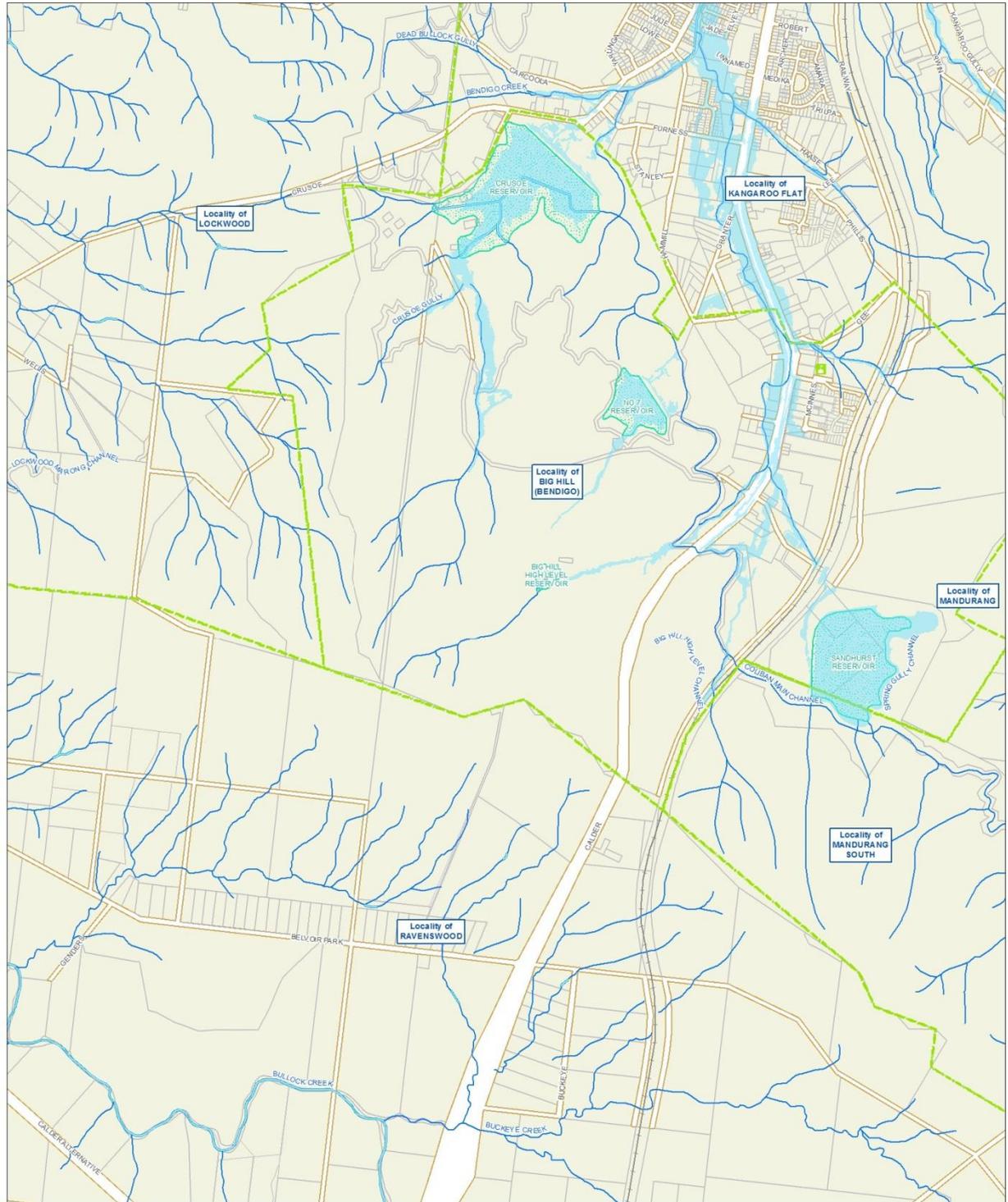
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Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

BIG HILL/KANGAROO FLAT



- | | |
|------------------------|----------------------|
| Ambulance station | Road |
| Depot/Municipal Office | Rail |
| Church | River/Creek |
| Camp Ground | Creek/Stream |
| Retirement/Aged Care | Levee |
| Hospital | Extent of Flood Data |
| Fire Station | Downslope boundaries |
| Police Station | Cadastre |
| School/Child Care | 1% AEP Flood |
| SES Unit | |

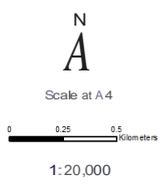
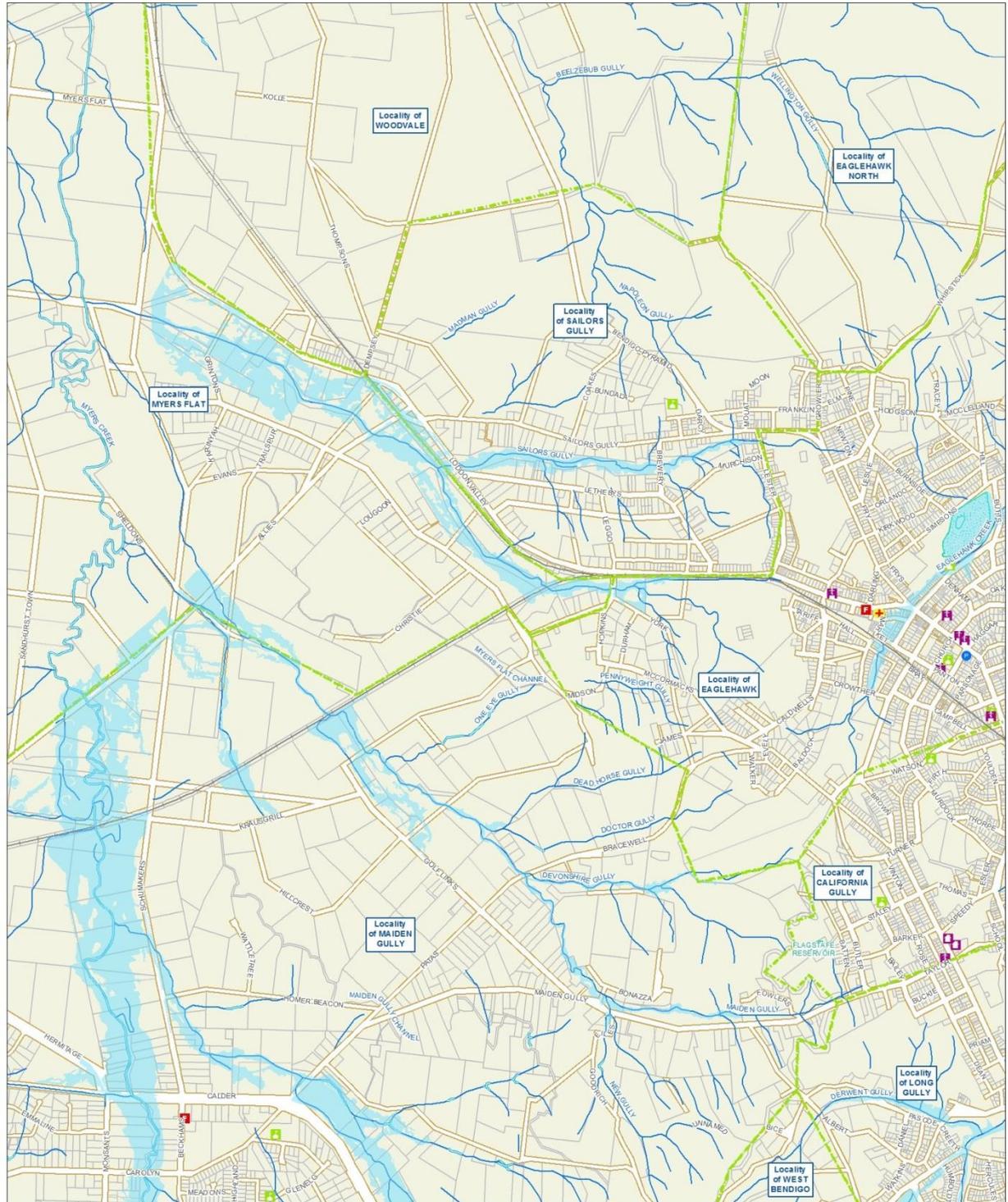


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

CALIFORNIA GULLY/EAGLEHAWK/LONG GULLY/MAIDEN GULLY



- Ambulance/first aid
- Depot/Municipal Office
- Church
- Camp Ground
- Retirement/Aged Care
- Hospital
- Fire Station
- Police Station
- School/Child Care
- SES Unit
- Road
- Rail Trail
- River/Creek
- Creek/Stream
- Levee
- Township boundaries
- Cadastre
- 1% AEP Flood

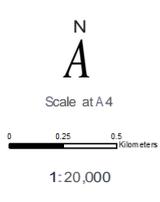
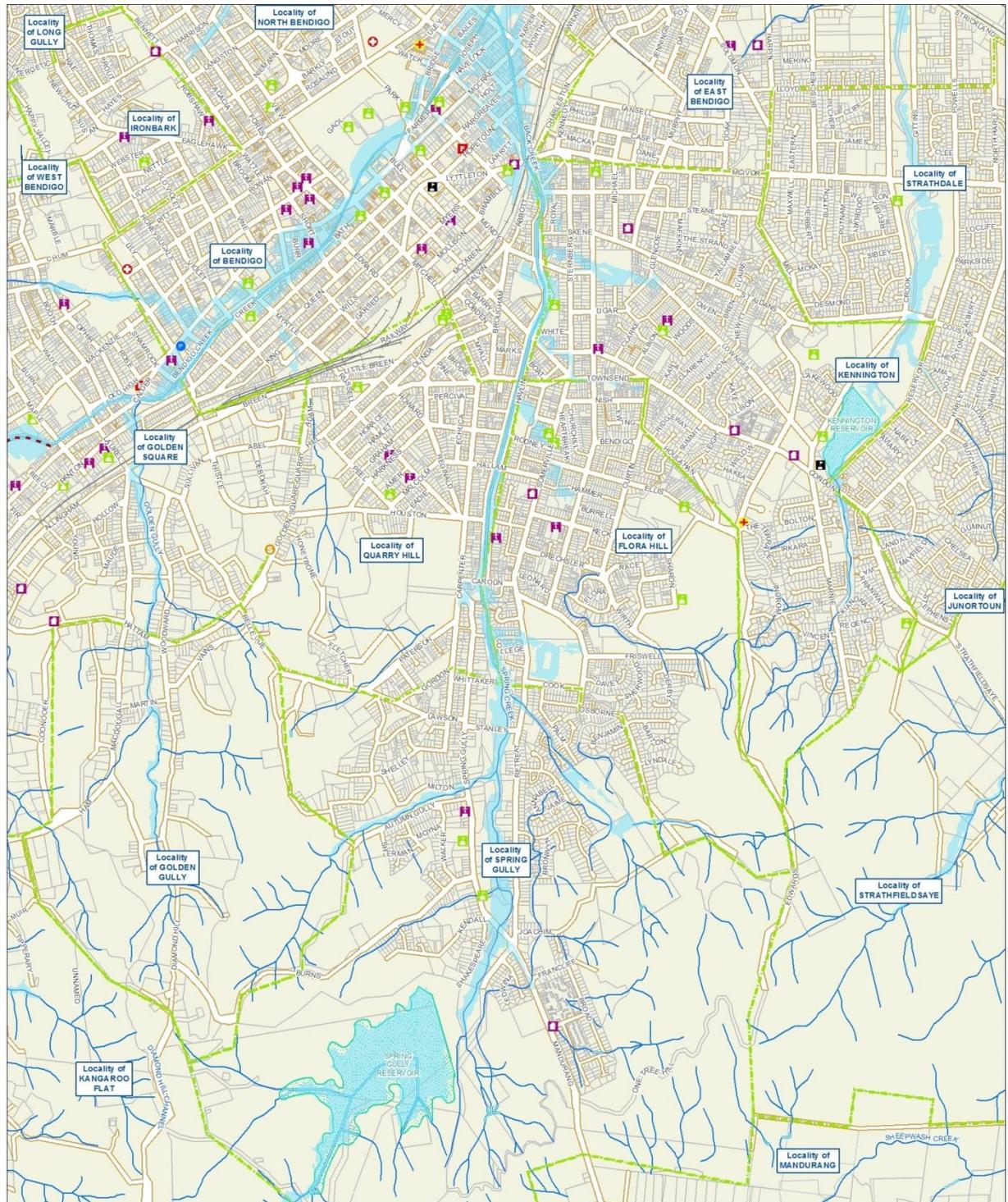


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

CENTRAL BENDIGO



- Ambulance/first aid
- Depot/Municipal Office
- Church
- Camp Ground
- Retirement/Aged Care
- Hospital
- Fire Station
- Police Station
- School/Child Care
- SES Unit
- Road
- Rail Trail
- River/Creek
- Creek/Stream
- Levee
- Township boundaries
- Cadastre
- 1% AEP Flood

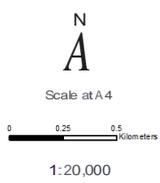
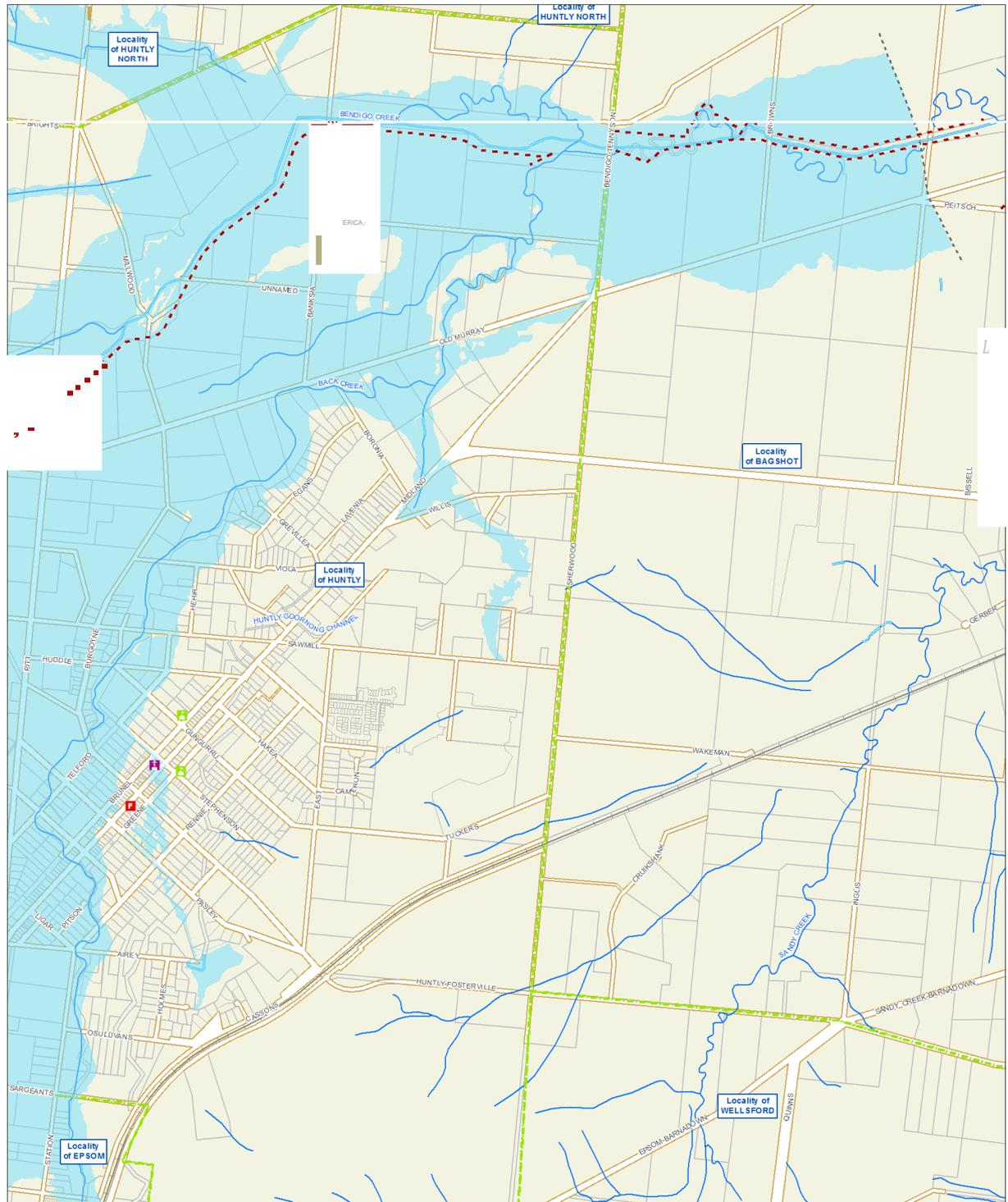


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

EAST HUNTLY



- | | |
|------------------------|----------------------|
| Ambulance station | Road |
| Depot/Municipal Office | Rail Trail |
| Church | River/Creek |
| Camp Ground | Creek/Stream |
| Retirement/Aged Care | Levee |
| Hospital | Extent of Flood Data |
| Fire Station | Downslope boundaries |
| Police Station | Cadastre |
| School/Child Care | 1% AEP Flood |
| SES Unit | |

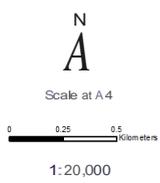
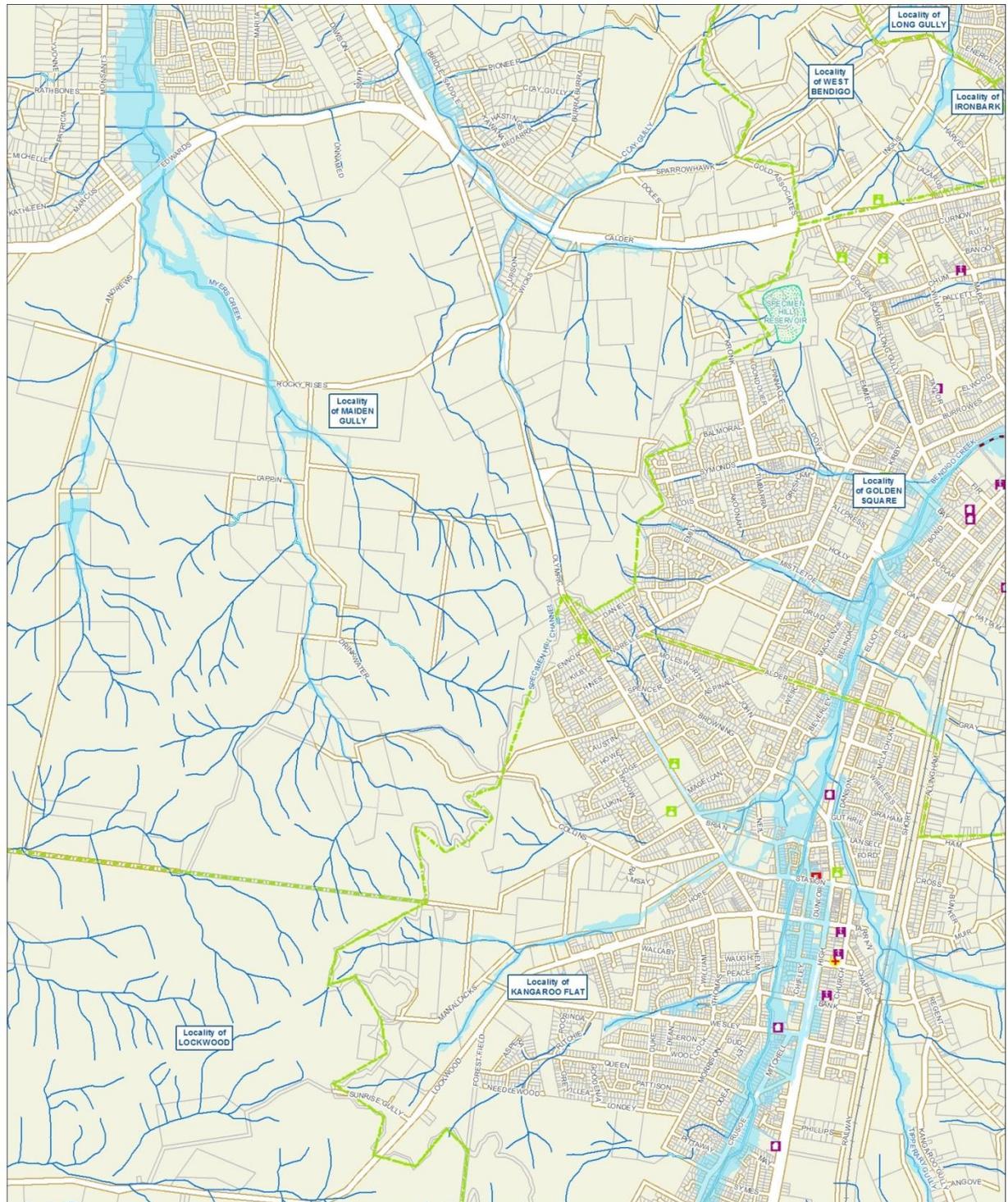


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

CALIFORNIA GULLY/EAGLEHAWK/ILONG GULLY/MAIDEN GULLY



- | | |
|---------------------------|-----------------------|
| III Ambulance/Station | — Road |
| 11 Depot/Municipal Office | — Rail Trail |
| Church | — River/Creek |
| ⋮ Camp Ground | — Creek/Stream |
| ⊖ Retirement/Aged Care | — Levee |
| H Hospital | — Township boundaries |
| III Fire Station | — Cadastre |
| ⊖ Police Station | 1% AEP Flood |
| ⊖ School/Child Care | |
| ⊖ SES Unit | |

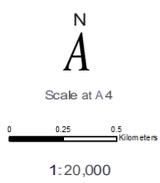
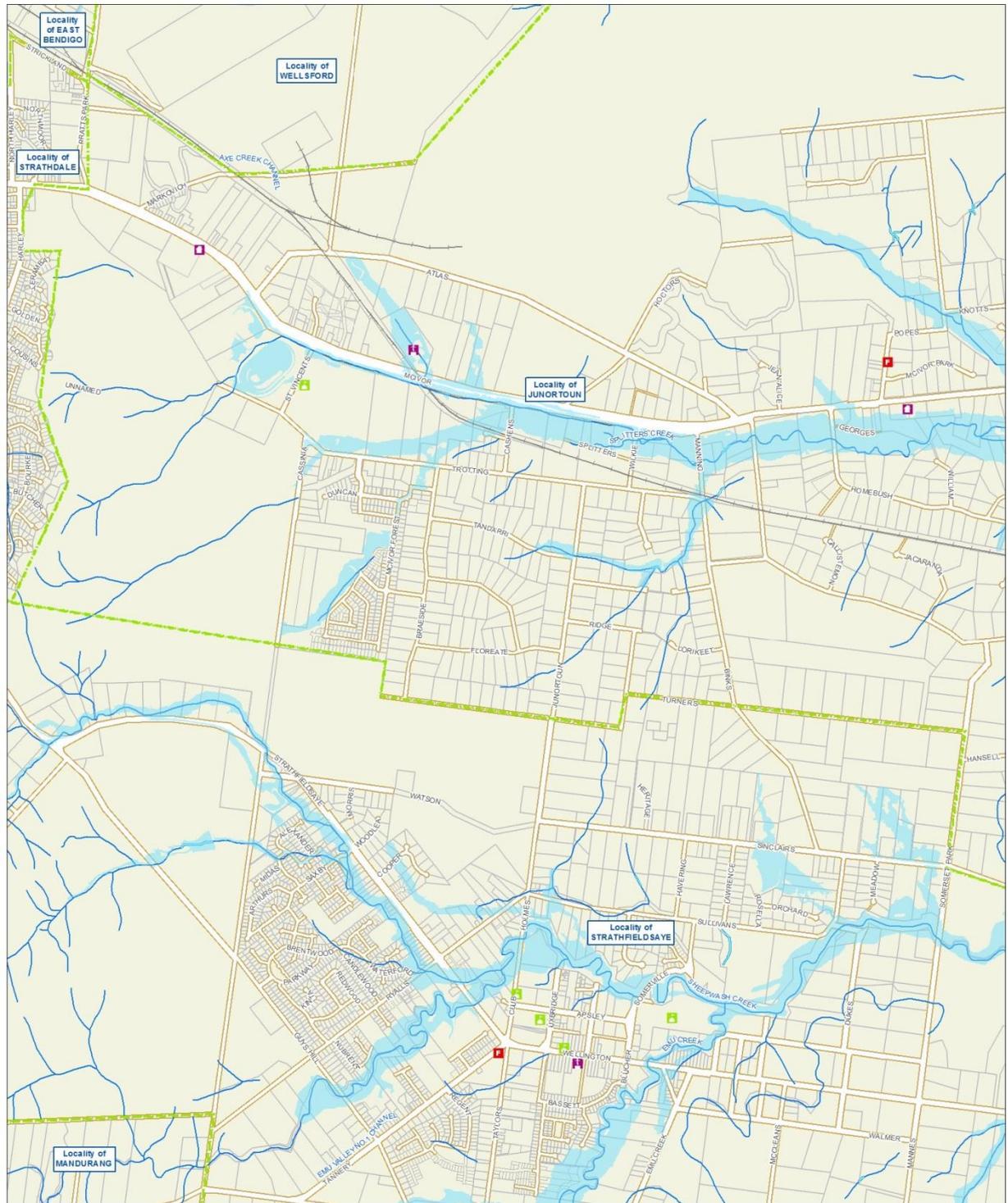


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APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

STRATHFIELDSAYE/JUNORTON



- | | |
|---------------------------|-----------------------|
| III Ambulance/retattoo | — Road |
| 11 Depot/Municipal Office | — Rail Trail |
| Church | — River/Creek |
| ⊞ Camp Ground | — Creek/Stream |
| ⊞ Retirement/Aged Care | — Levee |
| ⊞ Hospital | — Township boundaries |
| ⊞ Fire Station | — Cadastre |
| ⊞ Police Station | 1% AEP Flood |
| ⊞ School/Child Care | |
| ⊞ SES Unit | |

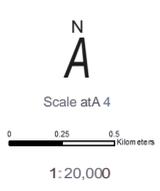
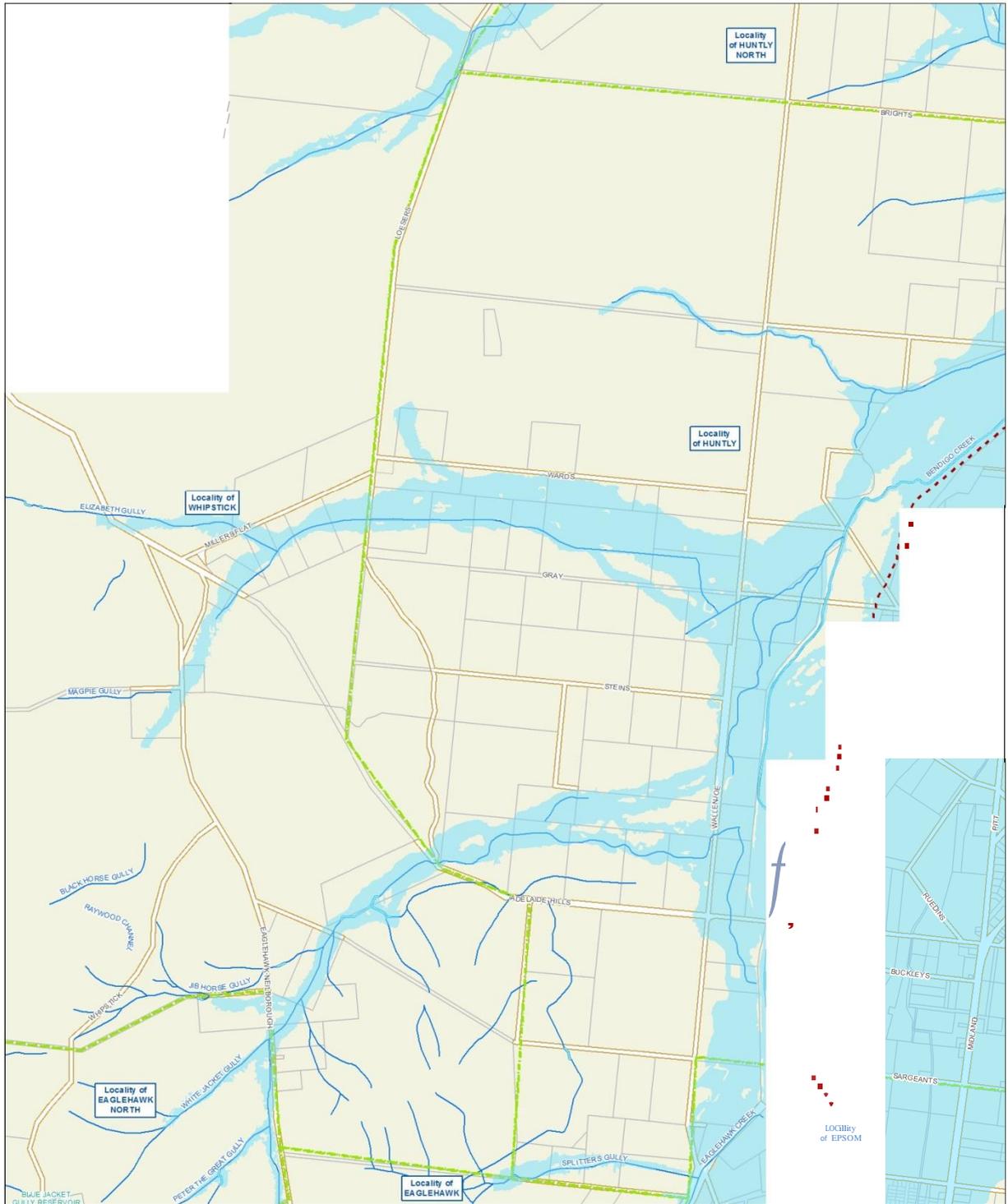


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 Map Produced: 23 June 2015

APPENDIX F2 MAPS FOR GREATER BENDIGO (1% AEP)

CITY OF GREATER BENDIGO

WEST HUNTLY



- Ambulance Station
- Depot/Municipal Office
- Church
- Camp Ground
- Retirement/Aged Care
- Hospital
- Fire Station
- Police Station
- School/Child Care
- SES Unit
- Road
- Rail Trail
- River/Creek
- Creek/Stream
- Levee
- Township boundaries
- Cadastre
- 1% AEP Flood



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 Map Produced: 23 June 2015

APPENDIX F2-1 – MAPS for HEATHCOTE – Mclvor Creek

1 Overview

The Heathcote Flood Study (WBM, 2015A) delivered map sets for the 5, 10, 20, 50, 100 and 200-year ARI design events showing:

- > Flood extents and depths;
- > Flood Hazard.

Inundation depth and extent maps were also delivered for the May 1974 and January 2011 events.

The study delivered equivalent GIS layers.

Selected maps are included in this Appendix. Users are however encouraged to use the GIS datasets as these will provide a more accurate and better resolution response to any interrogation.

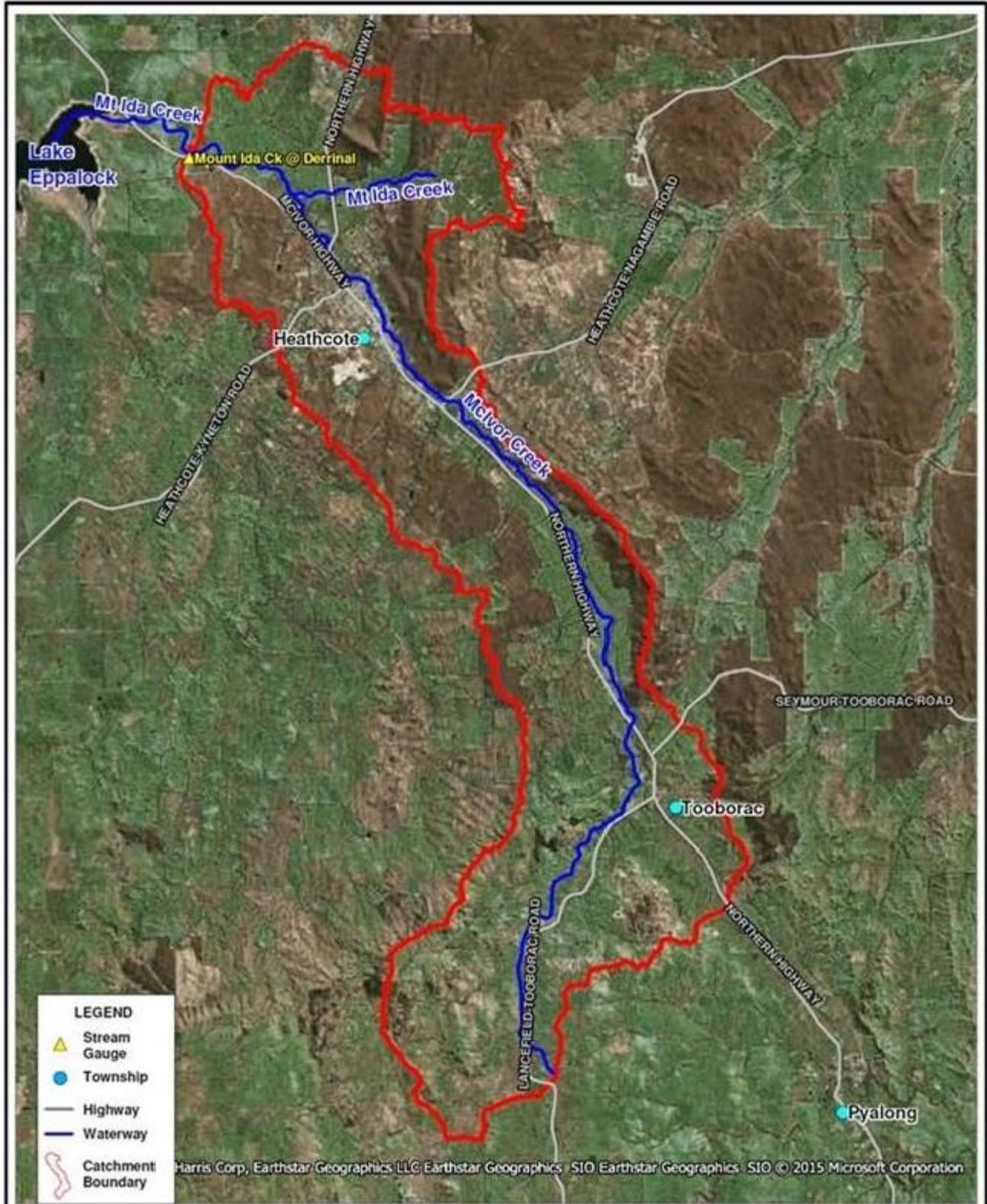
Flood hazard maps have not been included here as in general, hazard is low away from the main channel of the creek. Flood hazard is extreme within the main creek channel.

It should be noted that the following schema was used to determine hazard:

Flood Hazard	Depth (mm)	Velocity x Depth (m ² /s)
Safe		0.0
Low		Less than 0.4
Significant		0.4 - 0.6
Extreme	More than 500	More than 0.6

APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)

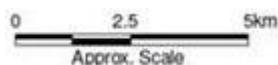
Catchment map-Mcivor Creek



rme:
Heathcote Flood Study
Study Catchment

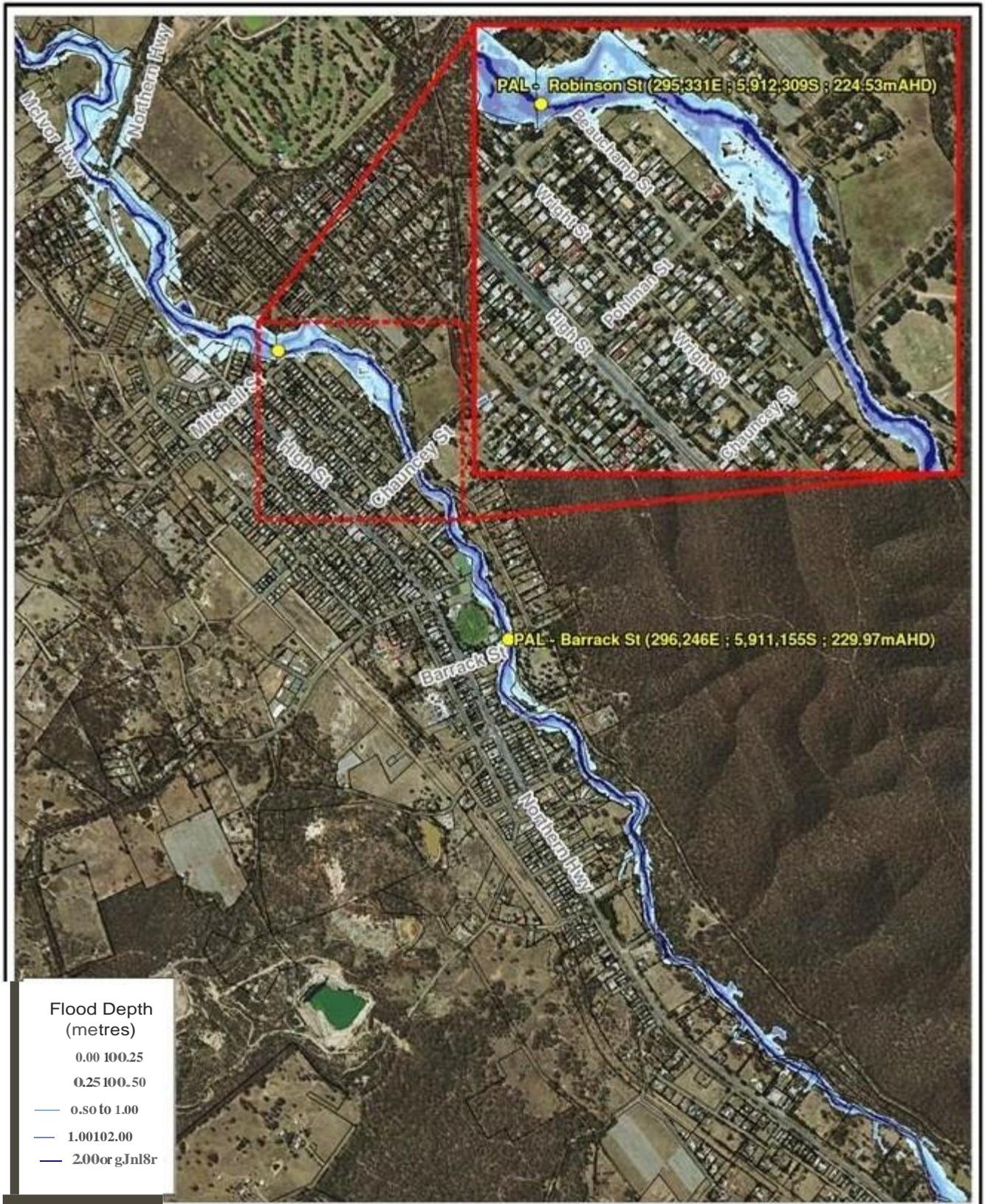
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APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)



File No:
Heathcote Flood Study
20% AEP Flood Depth

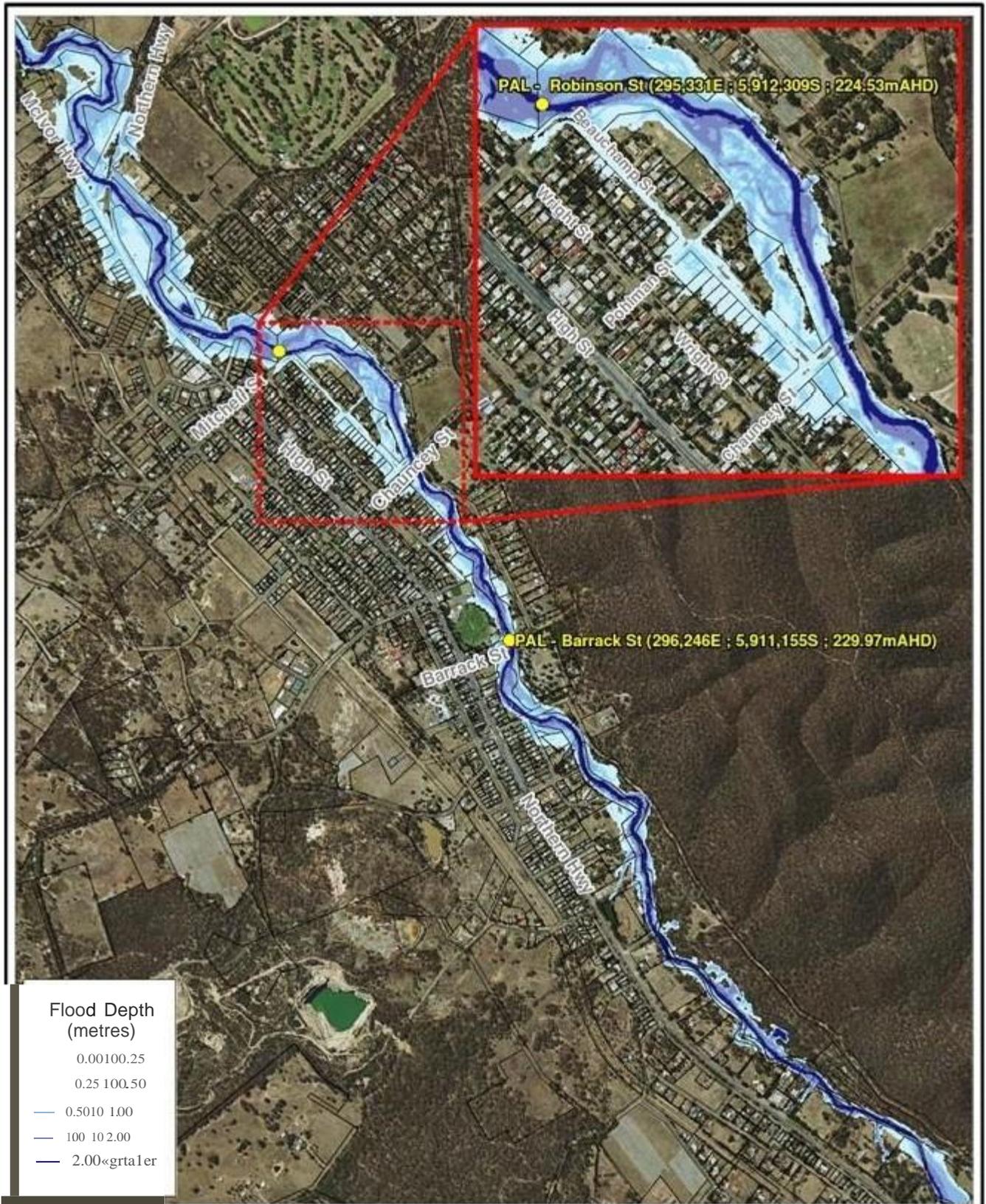
Figure: 8-1
 Rev: A

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APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)



**Flood Depth
(metres)**

- 0.00100.25
- 0.25 100.50
- 0.5010 1.00
- 100 102.00
- 2.00
1er

Title:
Heathcote Flood Study
10% AEP Flood Depth

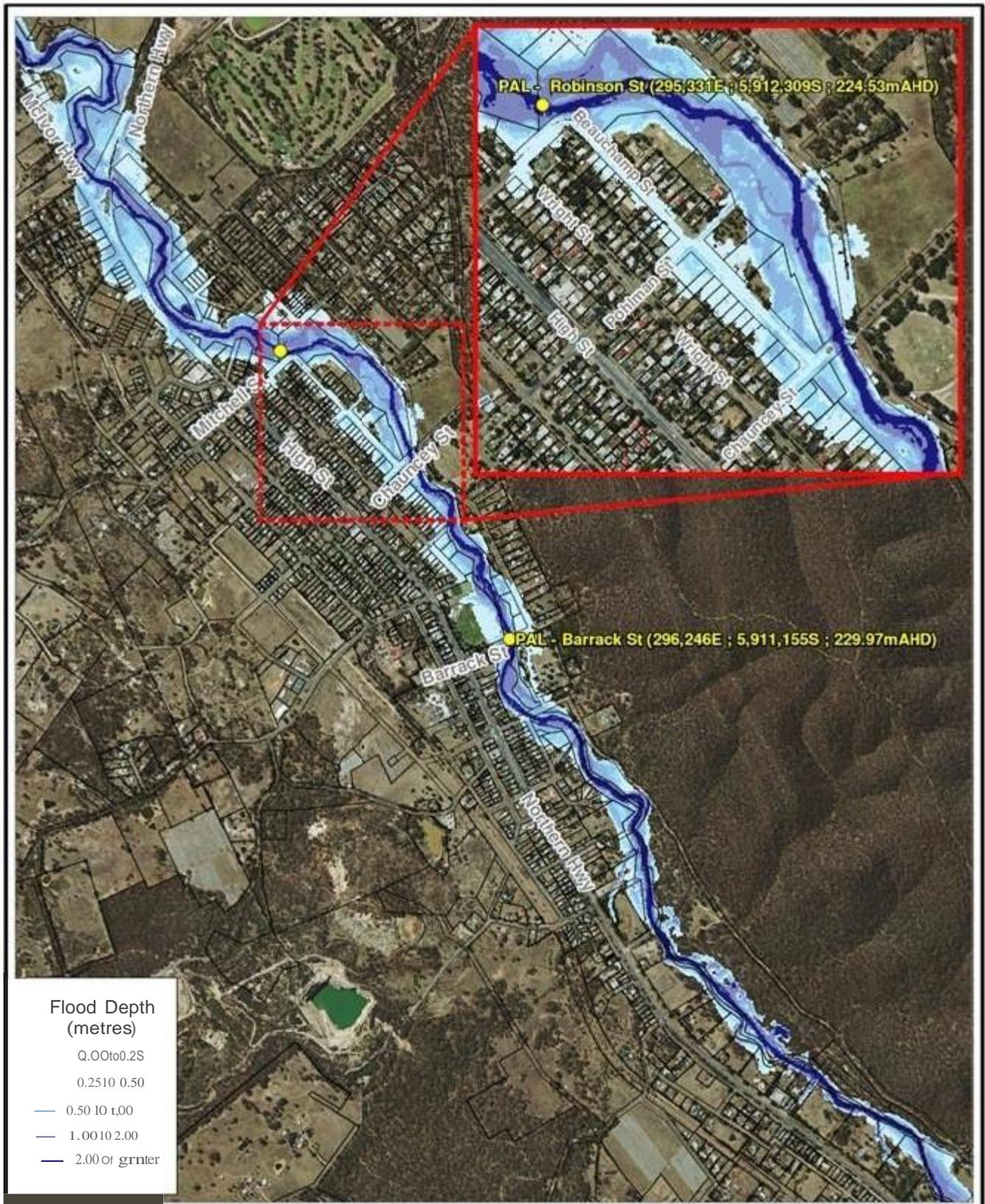
Figure: **8-2** | Rev: **A**

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APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)



Flood Depth (metres)

- Q.00 to 0.25
- 0.25 to 0.50
- 0.50 to 1.00
- 1.00 to 2.00
- 2.00 or greater

Title: Heathcote Flood Study 5% AEP Flood Depth		Figure: 8-3	Rev: A
0 375 750111 Approx. Scale		 www.bmtwbm.com.au	
Filepath : T:\M20448.PP.HeathcoteFloodStudy\MapInfo\Drawings\R.M20448.008.00.Final\HC_Final_Fig8-3_20y_dMax_RevA.WOR			

APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)



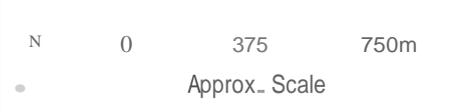
Flood Depth (metres)

- 0.00 to 0.25
- 0.25 to 1.00
- 1.00 to 2.00
- 2.00 or greater

Title:
Heathcote Flood Study
2% AEP Flood Depth

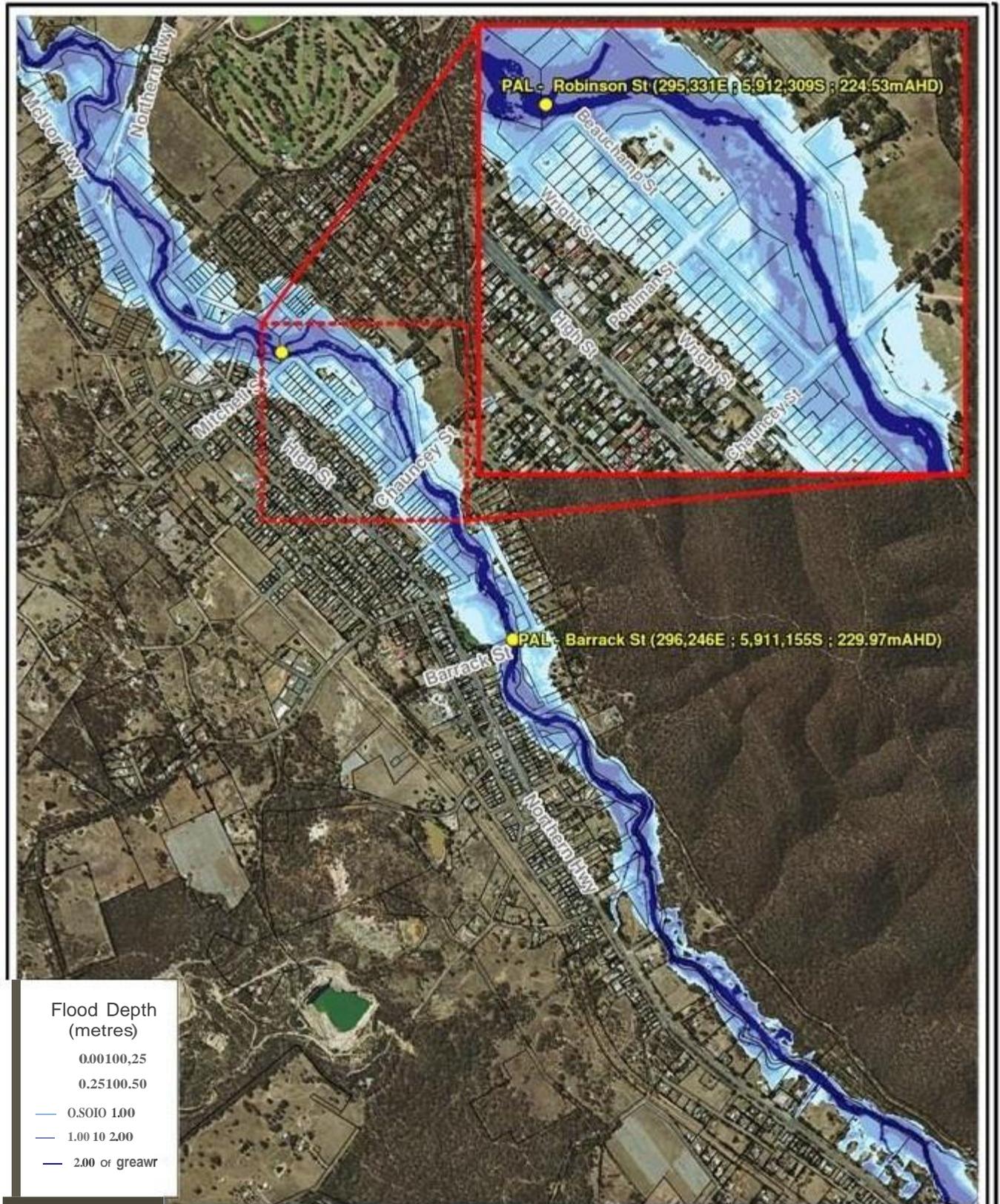
Figure: 8-4
 Rev: A

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APPENDIX F2- MAPS FOR HEATHCOTE(1% AEP)



Flood Depth (metres)	
0.00	0.25
0.25	1.00
1.00	2.00
2.00	or greater

Title:
Heathcote Flood Study
1% AEP Flood Depth

Figure: 8-5
 Rev: A

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APPENDIX G – SANDBAGS

This applies to the procurement, storage, distribution, use and disposal of sandbags during flood emergencies, primarily Riverine flood events. Flash Flood events, due to their quick nature, will be directed by the local VICSES Unit.

1. Use of sandbags

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 Flood Emergency 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 and operational staff in the flood affected community will assess the overall risk to communities and allocate sandbag resources based on risk.

2. Responsibilities

VICSES responsibilities include:

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

Council responsibilities include:

- Supporting VICSES in developing the MFEP
- Providing a support role during flood response
- Identifying Community Critical Facilities at a municipal level
- Procuring sandbags to protect council owned facilities including Community Critical Facilities managed by council
- Providing locations, plant and equipment, where available and capable, to support sandbagging operations as agreed in the MFEP
- Coordinating the clean-up and community recovery arrangements

Community Critical Facility owners' responsibilities include:

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

Other 'Response' agencies responsibilities include:

- Supporting VICSES in their response role.

Residential and commercial property owners' responsibilities include:

- 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 their local 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 (see www.ses.vic.gov.au/prepare/floodsafe).

VICSES will use the existing community education tools and programs (such as the Local Flood Guides and the FloodSafe program) to promote:

Practical information on:

- The purpose, use and disposal of sandbags (see www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide)
- Obtaining sandbags
- Safety considerations e.g. OHS, manual handling, safe use and disposal
- Alternative flood mitigation strategies to sandbagging
- Where to get information – Phone 1300 842 737 for the VICSES Information Line
- The responsibilities of critical infrastructure owners, businesses and private individuals to understand their flood risk and develop a flood plan

Key messages:

- 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 of sandbags

VICSES

VICSES will maintain a supply of sandbags to support the effective readiness and response to flood emergencies as identified in this MFEP.

The number of sandbags required at a State and regional level will be determined from information provided through the MFEP 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 cross-border and mutual aid arrangements for flood emergencies. VICSES will also work with local councils to access the 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 and sand may be obtained (purchased) from hardware suppliers (Bunnings/Mitre 10 etc.)

5. Storage of sandbags

VICSES

Sandbags will be stored by VICSES in appropriate locations across the municipality. VICSES will monitor the condition of all its sandbags for deterioration.

VICSES sandbags storage locations and initial quantities are as follows:

Bendigo VICSES Local Headquarters (LHQ)	4000 bags (minimum)
Marong VICSES Local Headquarters (LHQ)	4000 bags (minimum)
Heathcote VICSES Local Headquarters (LHQ)	4000 bags (minimum)
Other locations to be determined as required	

Additional sandbag supplies are held at the North West (Loddon Mallee) VICSES Regional Offices, located in Bendigo & Swan Hill. 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.

Council

Sandbags will be stored at appropriate Council locations across the municipality. Council will monitor the condition of all its sandbags for deterioration.

Council sandbags are currently stored at the Maryborough Works Depot

6. Distribution of sandbags

Priorities

The Incident Controller may make sandbags and sand available for flood mitigation activities during declared flood emergencies.

Sandbags will be issued consistent with the Strategic Control Priorities within the State Flood Emergency Plan, in the following order of priority to protect:

1. Critical Infrastructure and Community Critical facilities identified:
 - (a) in the MFEP 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.

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) by VICSES.

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:

*additional/alternate points can be nominated by the Incident Controller

Bendigo & surrounds

Bendigo SES Headquarters, Adam St (smaller events)

Bendigo Showgrounds, Holmes Rd (larger events - under cover available)

Heathcote

Barrack Reserve, Barrack St

Marong

Malone Park Recreation Reserve, Malone Park Rd

The Floodsafe Sandbag Quick Reference Guide

(<https://www.ses.vic.gov.au/documents/112015/136923/sandbag%20guide.pdf/8fb25a6f-dab1-2ef9-944b-9f5007c66b39>) provides details to community members about the indicative number of sandbags required for residential property protection and guidance on the safe use, for the filling and laying of sandbags.

As part of the response arrangements, the Incident Controller will track the distribution of sandbags through the Incident Management Team (IMT). This information will be provided to the recovery team as part of the transition from response to recovery.

Provision of sand

VICSES

VICSES will have plans in place to acquire sand through its own supply arrangements and where necessary through the emergency management arrangements. These arrangements will be identified in the MFEP. Sand suppliers may be identified in the MFEP.

Council

Council will have plans in place to acquire sand through its own supply arrangements

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 Incident Control Centre

7. 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 as outlined in the Emergency Management Manual Victoria. 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 H – REFERENCES AND INTEL SOURCES

The following studies maybe useful in understanding the nature of flooding within the City of Greater Bendigo.

- Water Technology (2014): *Bendigo Urban Flood Study*. Final report. A report to the North Central Catchment Management Authority and the City of Greater Bendigo. June 2014.
- BMT WBM (2016): *Heathcote Flood Study: Final Report*. A report to the North Central Catchment

Management Authority and the City of Greater Bendigo. March 2016

- *Strathfieldsaye Flood Study*, October 1984
- State Rivers & Water Supply Commission (1984): *Bendigo Flood Study*. Final Report. Volumes 1 & 2 (covered Bendigo Creek, Back Creek, Racecourse Creek and Long Gully Creek).
- Rural Water Commission (1985): *Huntly to Goornong History of Flooding*. December 1985
- Findlay Irrigation Design Services (1986): *Bendigo Flood Mitigation Scheme Levee Audit*. For the Department of Conservation and Natural Resources (covers Bendigo Creek and Spring Creek).
- Camp Scott Furphy (1994): *Huntly to Goornong Flood Study*. March 1994
- Department of Natural Resources & Environment (1996): *Maiden Gully Development Flood Study*. January 1996
- EarthTech: *Cecil Street Development Flooding and Stormwater Study*
- North Central Catchment Management Authority: *Cecil Street South*
- EarthTech: *Bendigo Creek Tributary at Furness. Creek Flood Study*
- Ian Drummond and Associates (2000): *Splitters Creek Flood Study*. Final report. A report for the North Central Catchment Management Authority. December 2000.
- SKM (2004): Bendigo Bank Headquarters Flood Investigation. For Gallagher Jeffs.
- EarthTech (2007): *Back Creek Flood Study*. For the City of Greater Bendigo
- GHD (2008): *Marnie Road Catchment Report*. September 2008
- Cardno (2009): *Chinese Gardens Report*

Other sources of information of direct relevance to the Municipality include:

- ◆ <http://www.nccma.vic.gov.au>
North Central Catchment Management Authority for various references
- ◆ <http://www.dtpli.vic.gov.au/>
Department of Transport, Planning and Local Infrastructure for planning scheme flood maps
- ◆ <http://data.water.vic.gov.au/monitoring.htm>
for historical data on water quality, river heights and flows
- ◆ <http://www.bom.gov.au>
Bureau of Meteorology for river gauge readings and flood warnings
- ◆ <http://www.floodvictoria.vic.gov.au>
for information on historic floods in Victoria – VERY USEFUL
- ◆ <http://www.ses.vic.gov.au>
Victoria State Emergency Service

<https://www.water.vic.gov.au/managing-floodplains/floodplain-management>
Department of Environment, Land, Water & Planning.

- ◆ COUNCIL, NCCMA 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.

Relevant but more general references include:

- ◆ Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), Standing Committee on Agriculture and Resource Management (SCARM) Report No 73: *Floodplain Management in Australia, Best Practice Principles and Guidelines*.

APPENDIX H – REFERENCES AND INTEL SOURCES

- ◆ Bureau of Meteorology (1996): *Bureau of Meteorology Policy on the Provision of the Flash Flood Warning Service*. May 1996.
- ◆ Department of Natural Resources and Environment (DNRE) (2000): *Flood Data Transfer Project – – Flood Data and Flood Planning Maps as well as Flood Mapping and River Basin Reports*.
- ◆ Department of Sustainability and Environment (DSE) (2008): *Victoria Caravan Parks Flood Emergency Management Plan Template and Guidelines*. (Two documents) March 2008.
- ◆ Victorian Flood Management Strategy 1997-2007
- ◆ Emergency Management Act 1986
- ◆ Emergency Management Manual Victoria, 1997 Edition
- ◆ <https://knowledge.aidr.org.au/resources/manual-series/>
Emergency Management in Australia
 - ◆ Managing the Floodplain, Manual 19, EMA 2009
 - ◆ [Flood Preparedness, Manual 20, EMA 2009](#)
 - ◆ [Flood Warning, Manual 21, EMA 2009](#)
 - ◆ [Flood Response, Manual 22, EMA 2009](#)
 - ◆ [Emergency Management Planning for Flood Affected by Dams, Manual 23, EMA 2009](#)
- ◆ City of Greater Bendigo Municipal Emergency Management Plan
- ◆ Water Act 1989
- ◆ Flood Warning Station Information Manual - February 1999