



# Municipal Flood Emergency Plan

# 2019

A Sub-Plan of the Municipal Emergency Management Plan





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## Distribution List

Copy No.	Issue to:		Date
	Name	Organisation	
Original		MEMP Committee Executive Officer Emergency Management Coordinator	
1		Council Office Copy	
2		MEMP Committee Chairman	
3		MERO	
4		MRM	
5		MERC Wodonga Police Station	
6		RERC	
7		Wodonga Police Station	
8		Albury Police Station	
9		VICSES Hume RHQ	
10		VICSES Wodonga unit	
11		North East Catchment Management Authority	
12		Bureau of Meteorology (Flood Warning)	
13		DELWP Wodonga	
14		Parks Victoria	
15		Ambulance Victoria Wodonga	
16		CFA (Wodonga Brigade)	
17		CFA (District 24 Region Headquarters, Wodonga)	
18		VicRoads Wodonga	
19		Department of Health and Human Services Wodonga	
20		Albury Wodonga Health	
21		Ausnet Services	
22		Goulburn Murray Water	
23		North East Water	
26		NSWSES – Murray Region	
27		NSWSES – Albury Unit	

## Document Transmittal Form / Amendment Certificate

This Municipal Flood Emergency Plan (MFEP) will be amended, maintained and distributed as required by Victoria State Emergency Service (VICSES) in consultation with Wodonga City Council (the council).

Suggestions for amendments to this Plan should be forwarded to VICSES Hume Regional Office 64 Sydney Road, Benalla, Victoria 3672.

Amendments listed below have been included in this Plan and promulgated to all registered copy-holders.

Amendment number	Date of amendment	Amendment entered by	Summary of amendment
0.1	Jan 2016	S.Schneider	Initial draft based on discussions with the council and NECMA
0.2	July 2016	P.Leddy	Update details for the council
0.3	January 2017	C.Sexton	Input VICSES Information
0.4	January 2018	T.Loffler/ C.Sexton	Input Flood intelligence and Flood study data. Albury (union Bridge gauge and Doctors Point gauge comparison data for flood impacts – Gateway Island
0.5	May 2018	P.Leddy	Updates from Julian Skipworth Water Technology and COW
0.6	Oct 2018	C.Sexton	Final draft and Wodonga Unit input to operations
0.7	May 2019	C. Sexton	Inclusion of specific actions, flash flood information and May 2019 Flash flood
0.8	August	P.Leddy/ C.Sexton	SES Amendments

This Plan will be maintained on the VICSES and council websites.

VICSES: [ses.vic.gov.au/get-ready/your-local-flood-information/wodonga-city-council](https://ses.vic.gov.au/get-ready/your-local-flood-information/wodonga-city-council)

Wodonga council: [wodonga.vic.gov.au/about-us/emergency-management/prepare-emergency.asp#flood](https://wodonga.vic.gov.au/about-us/emergency-management/prepare-emergency.asp#flood)

## 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
ARI	Average Recurrence Interval
AV	Ambulance Victoria
BoM	Bureau of Meteorology
CEO	Chief Executive Officer
CERA	Community Emergency Risk Assessment
CFA	Country Fire Authority
CMA	Catchment Management Authority
RERC	Regional Emergency Response Coordinator
RERCC	Regional Emergency Response Coordination Centre
DHHS	Department of Health and Human Services
DH	Department of Health
DJPR	Department of Jobs, Precincts and Regions
DELWP	Department Environment, Land, Water and Planning
EMMV	Emergency Management Manual Victoria
EMT	Emergency Management Team
EO	Executive Officer
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
MECC	Municipal Emergency Coordination Centre
MEMP	Municipal Emergency Management Plan
MEMPC	Municipal Emergency Management Planning Committee
MERC	Municipal Emergency Response Coordinator
MERO	Municipal Emergency Resource Officer
MFEP	Municipal Flood Emergency Plan
MFPC	Municipal Flood Planning Committee
MFB	Metropolitan Fire and Emergency Services Board
MRM	Municipal Recovery Manager
NECMA	North East Catchment Management Authority
PMF	Probable Maximum Flood
RCC	Regional Control Centre
RDO	Regional Duty Officer
SBO	Special Building Overlay
SCC	State Control Centre
SEWS	Standard Emergency Warning System
SHERP	State Health Emergency Response Plan
SOP	Standard Operating Procedure
VicPol	Victoria Police
VICSES	Victoria State Emergency Service

# 1. INTRODUCTION

## 1.1. Municipal Endorsement

This Municipal Flood Emergency Plan (MFEP) has been prepared by the City of Wodonga Municipal Flood Planning Committee (MFPC) and with the authority of the City of Wodonga Municipal Emergency Management Planning Committee (MEMPC) – (refer to page 2 of endorsement of plan) pursuant to Section 20 (1) of the Emergency Management Act 1986.

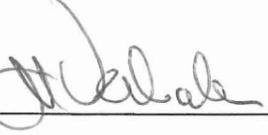
The MFPC has undertaken the following consultations with the City of Wodonga community about the arrangements contained within this plan:

This Municipal Flood Emergency Plan is a result of the cooperative efforts of the City of Wodonga Municipal Flood Planning sub-committee (MFPC) and its member agencies. Particular acknowledgment should be afforded to staff from both the State Emergency Service (SES) and the North East Catchment Management Authority (NECMA) for their specific, expert input.

The MFEP is consistent with the Regional Flood Emergency Plan and the State Flood Emergency Plan.

This Plan is endorsed by the City of Wodonga MEMPC as a sub-plan to the MEMP. This Plan is approved by the VICSES Regional Manager.

This Plan was considered and adopted by the council at the ordinary meeting of council on:

	Approval	Endorsement
Date: <u>4/9/19</u>	Date: <u>9/8/19</u>	Date: <u>9/9/2019</u>
Name: <u>Mark Dixon</u>	Name: <u>Keith O'Brien</u>	Name: <u>Mark Verbarken</u>
Signature: 	Signature: 	Signature: 
Mark Dixon Chief Executive Officer Wodonga City Council	Keith O'Brien North East Region VICSES Regional Manager	Mark Verbarken Chair – Municipal Emergency Management Planning Committee

## 1.2. The Municipality

An outline of the city of Wodonga in terms of its location, demography and other general matters is provided in the Municipal Emergency Management Plan (MEMP). An outline of the flood threat is provided in Appendix A of the MEMP.

## 1.3. Purpose and Scope of this Flood Emergency Plan

The purpose of this MFEP is to document agreed planning, preparedness/prevention, response and recovery arrangements for flood incidents within the city of Wodonga.

As such, the scope of the Plan is to:

- Identify the Flood Risk to the city of Wodonga;
- Support the implementation of measures to minimise the causes and impacts of flood incidents within the city of Wodonga;
- Detail Response and Recovery arrangements including preparedness, Incident Management, Command and Control; and,
- Identify linkages with Local, Regional and State emergency and wider planning arrangements with specific emphasis on those relevant to flood.

## 1.4. Municipal Flood Planning Committee (MFPC)

Membership of the City of Wodonga MFPC comprises of the following representatives from the following agencies and organisations:

- VICSES (such as Wodonga Unit Controller or representative and Regional Officer – Emergency Management);
- Wodonga Council;
- Victoria Police (such as Municipal Emergency Response Co-ordinator MERC) as required;
- North East Catchment Management Authority (NECMA);
- Goulburn Murray Water (GMW) as required;
- North East Water as required;
- Local community representatives; and,
- Other agencies as required.

## 1.5. Responsibility for Planning, Review and Maintenance of this Plan

This MFEP must be maintained in order to remain effective.

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

The MFPC will meet during the three year review period and as below:

The plans should be reviewed:

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

## 1.6. Endorsement of the Plan

The draft MFEP has been circulated to the MEMPC who have recommended the adoption of the plan by the council to be included as a sub-plan of the Municipal Emergency Management Plan (MEMP).

# 2. PREVENTION / PREPAREDNESS ARRANGEMENTS

## 2.1. Community Awareness for All Types of Flooding

Upon formal adoption by the council, the details of this MFEP, excluding contact details will be released to the community through local media, will be uploaded to the VICSES and council websites, and will be referenced during future the FloodSafe programs. VICSES, with the support of the council and NECMA, will continue to co-ordinate community education programs for flooding within the council area.

## 2.2. Structural Flood Mitigation Measures

The following structural flood mitigation measures exist within the council area:

- Sanctuary Boulevard Levee adjacent House Creek downstream of Yarralumla Drive - This is an earth levee providing flood protection to one per cent AEP level (+freeboard) to low-lying land and associated houses (approximately 26 properties). The levee is owned and maintained by the council. Refer to Appendix F - Maps.
- Retention and re-use ponds constructed within Wodonga Racecourse in 2008/2009 provide some flood storage to mitigate peak flows from the White Box Rise development in the 145 ha upstream catchment of Jack in the Box Creek. The storage mitigates post-development two year ARI flow to pre-development level. Flows larger than five year ARI bypass the storage ponds. The Bandiana railway embankment downstream of the racecourse also serves as a de-facto retarding basin.
- Lake Hume on the Murray River upstream of Albury-Wodonga stores water for irrigation purposes. While the storage alters the seasonality of downstream flows and may impact on the passage of small, frequent floods, it is not principally operated to mitigate downstream flooding and large floods are only partially regulated. Lake Hume can store incoming floodwaters when the lake is at a low level; however, when the storage is full or near full, flood inflows must be passed downstream with little attenuation.

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

## 2.3. Non-structural Flood Mitigation Measures

### 2.3.1. Exercising the Plan

Arrangements for exercising this Plan will be at the discretion of the MEMPC. This Plan should be regularly exercised, preferably on an annual basis. Refer to section 4.7 of the EMMV for guidance.

### 2.3.2. Flood Warning

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

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

### 2.3.3. Flood Observers

The VICSES Local Knowledge Policy outlines the strategies and principles for ensuring the incorporation of local knowledge in decision making before, during and after incidents.

As at this version of the plan, no specific details of arrangements to capture local knowledge exist and are not provided in Appendix G, as in other plans.



## 3. RESPONSE ARRANGEMENTS

### 3.1. Introduction

#### 3.1.1. Activation of Response

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

The Incident Controller/RDO 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 serious flood within the city of Wodonga. These agencies will be engaged through the EMT.

The general roles and responsibilities of supporting agencies are as agreed within the City of Wodonga MEMP and EMMV (Part 7 'Emergency Management Agency Roles'), State Flood Emergency Plan and Regional Flood Emergency Plan available at [ses.vic.gov.au](http://ses.vic.gov.au).

#### 3.1.3. Escalation

Most flood incidents are of local concern and an appropriate response can usually be co-ordinated using local resources; However, when these resources are exhausted, the State Government'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 and event escalation arrangements are described in the EMMV ('State Emergency Response Plan' - section 3.5).

### 3.2. State Emergency Management 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; and,
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 (IC) is required to vary these priorities, with the exception being that the protection of life should remain the highest. This shall be done in consultation with the State Controller and relevant stakeholders based on sound incident predictions and risk assessments.

### 3.3. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP must be consistent with those detailed in State and Regional Flood Emergency Plans. For further information, refer to sections 3.4, 3.5 and 3.6 of the EMMV.

The specific details of the Command, Control and Co-ordination arrangements for this plan are to be provided in Appendix C.

#### 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 Department Environment, Land, Water and Planning (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 Wodonga, including those arising from a dam failure or retarding basin/levee bank failure incident, will therefore be under the control of the appointed IC, or his/her delegated representative.

### 3.3.2. Incident Controller (IC)

An IC will be appointed by the VICSES (as the Control Agency) to command and control available resources in response to a flood event on the advice of the BoM (or other reliable source) that a flood event will occur or is occurring. The IC responsibilities are as defined in Part 3.5 of the EMMV.

### 3.3.3. Incident Control Centre (ICC)

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

Pre-determined ICC locations are:

- VICSES Hume Regional Office, 64 Sydney Road, Benalla
- CFA District 24 Headquarters ICC, 55 Moorefield Park Drive, Wodonga
- CFA District 23 Headquarters ICC, 1 Ely Street, Wangaratta

### 3.3.4. Divisions and Sectors

To ensure that effective Command and Control are in place, the IC may establish Divisions and Sectors, depending on the complexity of the event and resource capacities. VICSES Hume Region Flood Response Plan provides a list of designated Division Command Point's (DCPs) and Sector Command Points (SCPs).

The following Divisions and Sectors may be established to assist with the management of flooding within the Municipality:

Division	Sector
SES Wodonga LHQ – 172 Victoria Cross Parade, Wodonga	SES Wodonga LHQ – 172 Victoria Cross Parade, Wodonga

VICSES Field Operations Vehicles (FOVs) are also available for deployment where appropriate and can assist in fulfilling the requirement of a DCP/SCP in the field.

### 3.3.5. Incident Management Team (IMT)

The IC will form an IMT.

Refer to 3.5 of the EMMV for guidance on IMTs and Incident Management Systems (IMSS).

### 3.3.6. Emergency Management Team (EMT)

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

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

Refer to 3.5 of the EMMV for guidance on EMTs.

### 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 IC/VICSES RDO will be as follows:

- Review flood intelligence to assess likely flood consequences;
- Monitor weather and flood information – [www.bom.gov.au](http://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), the council, and other emergency services through the EMT;
- Assess ICC readiness (including staffing of IMT and EMT) and open if required;
- Ensure flood warnings 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; and,
- Develop and issue situation report, if required.

### 3.3.8. On Receipt of the First and Subsequent Flood Warnings

The IC (or VICSES RDO until an IC is appointed) will undertake actions as defined within the flood intelligence cards (appendix C). General considerations by the IC/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:
  - o What areas may be at risk of inundation;
  - o What areas may be at risk of isolation;
  - o 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; and,
  - o 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:
  - o The current flood situation;
  - o Flood predictions;
  - o What the consequences of predicted levels may be;
  - o Public safety advice;
  - o Who to contact for further information; and,
  - o Who to contact for emergency assistance.;
- Liaise with relevant asset owners as appropriate (such as 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](http://www.bom.gov.au/vic/flood); and,
- 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:

- Emergency Alert;
- VicEmergency Website and app
- Phone messages (including SMS);
- Radio and television;
- Two-way radio;
- Mobile and fixed public address systems;
- Sirens;
- Verbal messages (such as door-knocking);
- Agency websites;
- VicEmergency Hotline - 1800 226 226;
- Variable message signs (such as road signs);
- Community meetings;
- Newspapers;
- Email;
- Telephone trees;
- Community Flood Wardens;
- Fax stream;
- Newsletters;
- Letter drops; and
- Social media and/or social networking sites such as Twitter and Facebook).

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

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

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

Other agencies such as Country Fire Authority (CFA), DWELP and Victoria Police (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 IC may consider the use of the Emergency Alert System and Standard Emergency Warning System (SEWS).

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

### 3.5. Media Communication

The IC through the Public Information 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

An initial impact assessment can be conducted in accordance with part three of the EMMV to assess and record the extent and nature of damage caused by flooding. This information may then be used to provide the basis for further needs assessment and recovery planning by the Department of Health and Human Services (DHHS) and recovery agencies.

### 3.7. Preliminary Deployments

When flooding is expected to be severe enough to cut access to towns, suburbs and/or communities, the IC 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

An 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 in the order as given:

1. Determine if there are barriers to evacuation by considering warning time, safe routes, resources available etc.;
2. If evacuation is possible, 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 Triple Zero (000) if they require rescue. This advice needs to be provided even when evacuation may be possible, due to the likelihood that not all community members will evacuate;

4. For buildings known to be structurally unsuitable, an earlier evacuation trigger will need to be established (return to step one of this cycle); and,
5. If an earlier evacuation is not possible, 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, due to the rapid development of flooding, it will often be difficult 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 IC.

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 the Australian Red Cross will take on the responsibility of registering people affected by a flood emergency, including those who have been evacuated.

Refer to section 3.8 of the EMMV and the Evacuation Guidelines for guidance of evacuations for flood emergencies.

The council has a Gateway Island Evacuation Plan that is available by request to the council.

Refer to Appendix D of this Plan for detailed evacuation arrangements for the council.

### 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.

### 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 IC.

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

Suitable airbase facilities are located at:

- Albury Airport

## Albury Airport



Overview of the airport from the south-east

IATA: ABX · ICAO: YMAY

Summary			
<b>Airport type</b>	Public		
<b>Operator</b>	Albury City Council		
<b>Serves</b>	Albury, New South Wales, Wodonga, Victoria		
<b>Elevation AMSL</b>	539 ft / 164 m		
<b>Coordinates</b>	36°04'06"S 146°57'30"E		
<b>Website</b>	<a href="#">Official website</a>		

### Map



Location in New South Wales

Runways			
Direction	Length		Surface
	m	ft	
07/25	1,900	6,234	Asphalt

### 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 (such as residences, businesses, roads, power supply etc.) may be affected in the event of a flood.

The council maintains a small stock of approximately 4000 sandbags, at the council depot, and back-up supplies are available through the VICSES Regional Headquarters. The IC 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, priority will be given to protection of Essential Community Infrastructure. Other high priorities may include the protection of historical buildings, for example

Property may be protected by:

- Sandbagging to minimise entry of water into buildings;
- Encouraging businesses and households to lift or move contents;
- Construction of temporary levees in consultation with the Catchment Management Authority (CMA), Local Government Area (LGA) and VICPOL, and within appropriate approval frameworks.

The IC 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 specific details of essential infrastructure requiring protection and location of sandbag collection point(s).

Refer to Appendix H - Victoria State Emergency Service Statewide Guideline - Sandbags. This document outlines guidelines for the procurement, storage, distribution, use and disposal of sandbags during flood emergencies.

### 3.14. Disruption to Services

Disruption to services other than essential community infrastructure and property can occur in flood events. Refer to appendix D for specific details of likely disruption to services and proposed arrangements to respond to service disruptions in the city of Wodonga.

### 3.15. Road Closures

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

VicRoads and the council will communicate community information regarding road closures.

For known local road impacts, refer to Appendix C of this plan.

### 3.16. Dam Failure

DWELP is the Control Agency for dam safety incidents (such as breach, failure or potential breach/failure of a dam); however, VICSES is the Control Agency for any flooding that may result.

### 3.17. Waste Water Related Public Health Issues and Critical Sewerage Assets

Inundation of critical sewerage assets including septic tanks and sewerage pump stations may result in water quality problems within the municipality. Where this is likely to occur or has occurred, the responsible agency 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; and,
- Advise the ICC in the event of inundation of critical sewerage assets.

If required, North East Water Emergency Management Coordinator should be contacted in the event of an emergency.

It is the responsibility of the council's Environmental Health Officer to inspect and report to the MERO and the ICC on any water quality issues relating to flooding.

#### 3.17.1. Public Health Issues and Critical Sewerage Assets

Inundation of sewerage assets including sewerage pump stations during surface flooding may result in water quality problems within the municipality. Where this is likely to or has occurred, the relevant Water Corporation will be responsible for:

- Identification and monitoring critical assets to assist preparedness and response activities in the event of flooding
- Advising VICSES/ICC of any potential or current service delivery continuity threats to critical sewerage infrastructure
- Developing action plan(s) in consultation with the Incident Controller to protect critical sewerage infrastructure assets

Inundation of septic tank systems may also result in similar water quality problems. In the event of flood waters contaminated by septic tank systems, the City of Wodonga Environmental Health Officer is to advise the ICC and relevant Water Corporation. Assessment and actions are detailed above.

North East Water on-call Duty Officer or Duty Manager support can be made via the MEMPlan contact list.

### 3.17.2. Preventing Illness from Contaminated Water

Drinking water (potable reticulated water supply systems) have the capacity to deal with flood situations due to protective barriers such as positive pressure and chlorine unless there is damage to key infrastructure or the system experiences a mains failure during the flood event. The relevant Water Corporation will be responsible for:

- Monitoring the performance and capacity of their respective potable water supply system
- Providing advice to the Incident Controller (IC) of any potential threat to supply or critical infrastructure
- Advising the IC whether town water (potable) supply is at risk, in consultation with the Incident Controller and Department of Health and Human Services will notify consumers and the community if the water is not safe to drink, including issuing the necessary advice (e.g. Boil Water Advisory Notice)
- Developing an action plan in consultation with the IC to protect critical water supply assets

The Municipal Environmental Health Officer will provide oversight and assistance for private domestic systems and support the relevant Water Corporation as needed.

The Incident Controller will develop drinking water warnings in consultation with the relevant Water Corporation(s) (e.g. North East Water for urban supplies and Goulburn-Murray Water for non-town water users for stock and domestic), Municipal Environmental Health Officer and Health Commander.

### 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.

### 3.19. Access to Technical Specialists.

VICSES manages contracts with private technical specialists who can provide technical assistance in the event of flood operations or geotechnical expertise. Refer to VICSES SOP061 for the procedure to engage these specialists

70 Island Road,  
Bonegilla Island, October, 2016



## 4. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS

### 4.1. General

Arrangements for recovery from a flood incident within the city of Wodonga is detailed in the City of Wodonga MEMP Recovery Sub-plan.

### 4.2. Emergency Relief

The decision to recommend the opening of an emergency relief centre rests with the IC. ICs 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 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 detailed in Appendix K of the MEMP.

Details of the relief arrangements are available in the MEMP refer to Appendix K with details shown below.

#### Appendix K from MEMP - Emergency Relief/Recovery Centres

The following facilities have been assessed and found to be potentially suitable for use in times of emergency as relief and/or recovery centres. Careful consideration must be given to the prevailing circumstances and number of people needing assistance when selecting a site or sites to be used to operate an emergency relief and/or recovery centre. The MERO and MRM will liaise and based on the nature and scale of the emergency will decide on the number of centres and location/s to be activated. The MRM will activate the centres in accordance with the Recovery Action Plan.

**\*\*Note:** If the Wodonga Sports and Leisure Centre (WSLC) is being used by the council's Business Recovery Committee, then the WSLC will not be available for use as an Emergency Relief Centre.

	Name of facility and address
1	The Cube Wodonga, Hovell Street, Wodonga
2	Wodonga Sports and Leisure Centre, Hedgerow Court, Wodonga
3	Birallee Park Club Rooms, Marshall Street
4	Birallee Park change rooms, Marshall Street
5	Baranduda Community Centre, 3 Sage Court, Baranduda
6	Felltimber Community Centre, Cnr Melrose Drive and Felltimber Creek Road
7	Martin Park Clubrooms, Gordon Street or Vermont Street (two entrances)
8	Martin Park players rooms, Gordon Street or Vermont Street (two entrances)
9	Nell Wilson Pavilion (open land areas at the showgrounds and racecourse) with access and egress roads. Hamilton Smith Drive

### 4.3. Animal Welfare

Matters relating to the welfare of livestock, companion animals and wildlife (including feeding and rescue) are to be referred to the Department of Jobs, Precincts and Regions (DJPR).

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

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

Details for matters relating to animals can be accessed in the City of Wodonga Municipal Emergency Animal Welfare Plan.

Refer to Appendix K in the MEMP for animal shelter compound locations.

### 4.4. Transition from Response to Recovery

As the Control Agency, VICSES 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 3.10 of the EMMV.



Killara, along Murray Valley Hwy  
October, 2016

## Appendix A - Flood threats for the City of Wodonga

### General

The city of Wodonga is a major urban centre situated on the Murray River adjacent to what is referred to as the Twin City of Albury, New South Wales. Wodonga is strategically placed between Melbourne and Sydney on the Hume Highway in North East Victoria.

The municipality is 434km<sup>2</sup> with the main population centre being Wodonga and adjacent developing urban areas of Killara and Baranduda, and the Bonegilla and Bandiana Military Areas. The Wodonga LGA is primarily urban development with a small fringe area of rural development. The surrounding land use is agricultural.

Wodonga has an annual rainfall of approximately 700mm. The climate experiences extremes of heat in summer and cold temperatures in winter (-20C to 40C range).

Wodonga is located to the south of the Murray River floodplain approximately 20km downstream of Hume Dam. The Wodonga LGA includes the Murray River floodplain from Lake Hume to Barnawartha North - a distance of approximately 35km (river length approximately 60km). The majority of the urban area is located outside of the Murray River floodplain; however, Gateway Island (limited commercial and industrial development) is located within the floodplain and bounded by Wodonga Creek to the south and the Murray River to the north.

The Wodonga LGA also includes the following waterway reaches flowing through predominantly rural areas with limited development:

- The lower reaches of the Kiewa River (extending 24km from the southern boundary of the LGA to the confluence with the Murray River);
- The lower reaches of Yackandandah Creek (extending 7km from the boundary of the LGA to the confluence with the Kiewa River); and,

- The entire length of Middle Creek (approximately 20km length), which enters the Kiewa River a short distance upstream of Killara.

Within the urban area local flood impacts are associated with tributaries of the Murray River:

- Felltimber Creek – with a catchment of approximately 15km<sup>2</sup> above the Hume Freeway. Approximately two thirds of the catchment is undeveloped lying to the south and west of the urban area. Within the urban area, Felltimber Creek flows primarily through a golf course and reserves and parks. Felltimber Creek passes beneath the Hume Freeway north of Wodonga TAFE to enter the Murray River floodplain near Sheathers Road.
- House Creek and tributary stream, Huon Creek – with a catchment area of approximately 70km<sup>2</sup> extending to the south of the urban area. The upper catchment (approximately 55km<sup>2</sup> above the urban area) is steep and rocky. House Creek flows primarily through parks and reserves within the urban area, but impacts on dwellings at Cypress Court and Park Lane (between Brockley Street and Melbourne Road). House Creek passes beneath the Hume Freeway at Sumsion Gardens entering Wodonga Creek downstream of the Lincoln Causeway.
- Jack in the Box Creek – drains a small catchment (industrial and military land) south of Bandiana. Creekside reserves are narrow and some flood impacts on private property occur around and downstream of Thomas Mitchell Drive. Downstream of Lawrence Street, industrial land closely abuts the creek and flooding can impact industrial land. Jack in the Box Creek passes beneath the Hume Freeway near the Bandiana Link interchange to enter Wodonga Creek immediately upstream of the Lincoln Causeway.

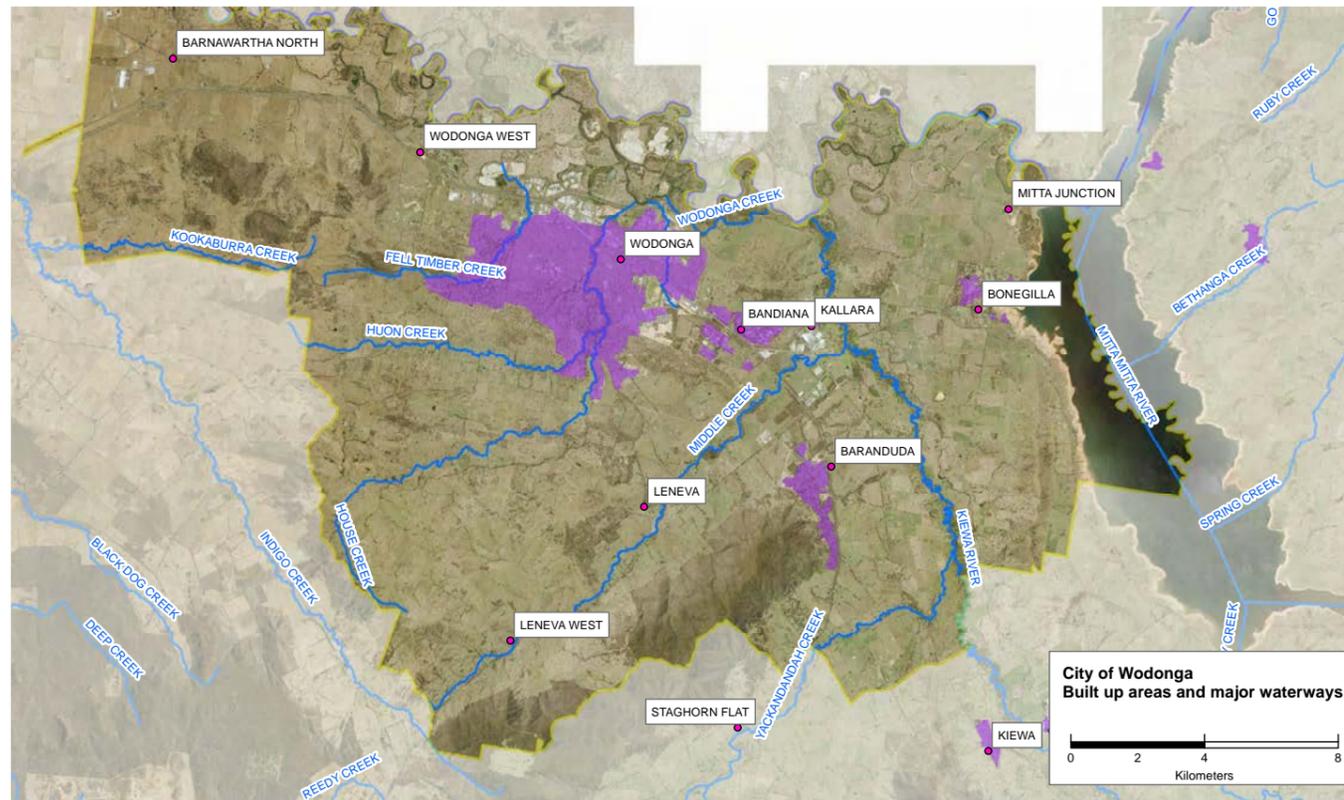


Figure 1 – City of Wodonga LGA and major waterways (built up areas in purple)



Figure 2 – Murray River floodplain (one per cent AEP extent) at Wodonga

## Historic Floods

The following historic flood events of significance are identified from the *Wodonga Municipal Emergency Management Plan (2015)* and other sources (flood studies and historic records):

- May 2019 – Flash flood event at Wodonga and Baranduda. A severe weather event that resulted in heavy rainfall with Baranduda receiving 93 mm with a precipitation rate of 19mm/hr at its peak intensity. Flash flooding at Baranduda affected 37 properties from fencing damage and drive ways washed away to mud through houses. Seven homes were impacted with 1 uninhabitable. These homes were in the Barton Court and Platypus Place area of Baranduda which is situated at the foot of the Baranduda Ranges. The terrain close to the homes was steep and had been the subject of recent fuel reduction burns which had cleared the vegetation fuel 90 to 95 %.
- October 2016 – Largest Murray River flood since 1992. Moderate flood level (Union Bridge gauge) resulting from releases from Lake Hume along with moderate flooding in the Kiewa River. Approximate 10 per cent AEP resulting in flooding over the majority of the width of the Murray River floodplain adjacent Wodonga and isolation of rural properties and local road closures. Sandbagging undertaken to north of Gateway Island buildings. Resulted in pit instability issues for sand and gravel quarry at Sheathers Road, Wodonga. Flood photography available.
- March 2012 – Significant local event for Wodonga urban waterways (118mm in 30 hours – approximately 20-50 year ARI rainfall, but lower ARI for critical short duration intensity, 247mm total rainfall over seven days).
- December 2010 – Major rainfall in surrounding hills causing flooding of local creeks/urban waterways, including Middle Creek which overtopped the Kiewa Valley Highway and was estimated (GHD 2013) to be around 50 year ARI in Middle Creek. Murray River flood levels highest since 2000 (at Albury). Record flood levels in Yackandandah Creek.
- September 1998 – Flooding in Kiewa River (nominal 40 year ARI event – GHD 2000 FDTP) and Yackandandah Creek.
- October 1996 – Murray River flooding resulting from releases from Lake Hume to enable repair. Flood photography available.
- September 1979 – Middle Creek flood event resulting from rainfall of 92mm over 16 hour period, approximately 20 year ARI rainfall intensity, but dry catchment conditions reduced flood magnitude (GHD 2013 – Middle Creek flood study).
- September/October 1975 – Flooding on Middle Creek, Kiewa River and Murray River. October 1975 event in the Murray River approximate 50 year ARI (GHD 2012).
- May and October 1974 – Flooding on Murray River approximately 30 year ARI in October (GHD 2012), surveyed historic flood marks on Kiewa River. Flood photography available for May event.
- June 1931 – Sixth largest flood on record for the Murray River at Albury.
- October 1917 (following large floods in June/July) – Second largest flood on record with peak level at Albury same or just below 1870 level (GHD 2012). Also resulted in flooding on the Kiewa River (refer Lower Kiewa Floodplain Management Plan. Hydraulic modelling of this event (GHD 1984) forms basis for declared Murray River one per cent AEP flood levels.
- 1870 – Thought to be the largest Murray River flood on record based on very limited available records, estimated 130 year ARI (GHD 2012).
- 1867 – Approximately third largest flood on record at Albury (GHD 2012).

Available flood magnitude and recurrence intervals are summarised in Table 1 and Table 2.

**Table 1: Murray River historic flood events**

Stream	Event	Flow (Union Bridge / Doctors Point)	Gauge level (Doctors Point)	Gauge level (Albury, Union Bridge)	ARI	Source
Murray River	1870	268,000 ML/D	-	5.89	130 years	GHD 2012
Murray River	Oct 1917	241,000 ML/D	-	5.83	95 years	GHD 2012
Murray River	1867	225,000 ML/D	-	5.79	70 years	GHD 2012
Murray River	Oct 1975	200,000 ML/D	7.05	5.66	50 years	GHD 2012
Murray River	Oct 1974	170,000 ML/D	6.93	5.59	30 years	GHD 2012
Murray River	Oct 1992	126,000 ML/D	6.61	5.4	12 years	GHD 2012
Murray River	Oct 2016	117,000 ML/D	6.52	5.39	10 years	Event records
Murray River	Oct 1996	108,000 ML/D	6.44	5.31	9 years	GHD 2012

**Table 2 - Kiewa River historic flood events**

Stream	Event	Flow Bandiana	Gauge level (Bandiana)	ARI	Source
Kiewa River	Sep 1998	61,540 ML/D	3.58	45 years	
Kiewa River	May 1974	45,200 ML/D	3.42	18 years	
Kiewa River	Jul 1978	36,100 ML/D	3.32	10 years	
Kiewa River	Dec 2010	35,300 ML/D	3.32	10 years	
Kiewa River	Dec 2010		3.33		
Kiewa River	Sep 1975		3.30		
Kiewa River	Oct 2016 / Sep 2010		3.29		
Middle Creek	Dec 2010		No Other Data		

## Dam Failure

All major dams are subject to rigorous dam safety management programs implemented by the managing entity and are subject to Individual Dam Safety Emergency Management Plans (DSEPs). DSEPs identify possible dam safety scenarios and provide intelligence and inundation extents to assist in community information, notifications and warnings. DEWLP is the control agency for dam incidents in Victoria, while VICSES is the control agency for the flooding that may result.

The major dams that may impact the municipality are Lake Hume and Lake Dartmouth. Smaller storages in the upper reaches Kiewa River system may also have localised impacts downstream.

**Table 3: Major dams upstream of City of Wodonga**

Location	Owner	Dam Height	Dam Capacity	Comments
Lake Hume	MDBA (State Water operator)	41.5 m (to FSL)	3,005 GL	Significant impact through Wodonga in the event of dam failure.
Lake Dartmouth	MDBA (GMW operator)	180 m	3,856 GL	Discharges to upper reaches of Lake Hume.
Rocky Valley	AGL Hydro	30.5 m	29.1 GL	Located in upstream reaches of Kiewa River which enters the Murray River around 5km upstream of Wodonga. Significant attenuation expected upstream of Wodonga LGA.
Pretty Valley	AGL Hydro	8.2 m	350 ML	
Junction Dam (Lake Guy)	AGL Hydro	26 m	1,640 ML	
Clover Dam	AGL Hydro	20 m	250 ML	
Mt Beauty Regulating Storage	AGL Hydro	6.1 m	900 ML	



## Appendix B - Typical flood peak travel times

Location From	Location To	Typical Travel Time	Comments
Mt Beauty	Kiewa	12 hours	
Kiewa	Bandiana	5 hours	
Heywoods	Doctors Point	12 hours	
Doctors Point	Albury	4 hours	

# Appendix C1 – Lower Kiewa, Yackandandah Creek and Middle Creek Flood Emergency Plan

## Overview

### Kiewa River

The Kiewa catchment (approximately 1655km<sup>2</sup>) extends approximately 100km from the Great Dividing Range around Falls Creek to the Murray River. The Kiewa Hydroelectric Scheme is located in the upper part of the Kiewa catchment, but commands only a small part of the catchment above Wodonga and has little influence on flood magnitudes in the lower reaches of the Kiewa River around Wodonga.

The Kiewa River enters the Murray River at Doctors Point, approximately 16km downstream of Hume Dam and 5km upstream of Wodonga. The lower 24km length of the Kiewa River (approximately 14km floodplain length) is located within the Wodonga LGA.

### Yackandandah Creek

Yackandandah Creek is a left bank tributary of the Kiewa River, entering the Kiewa River near the southern limit of the Wodonga LGA. The majority of the catchment and waterway length is located within the Indigo LGA with a length of only approximately 7km lying within the Wodonga LGA. Flood impact from Yackandandah Creek within the Wodonga LGA is therefore restricted to a small length of rural floodplain upstream and downstream of the Kiewa Valley Highway.

### Middle Creek

Middle Creek is a left bank tributary of the Kiewa River, entering the Kiewa River approximately 1.5km upstream of the Murray Valley Highway. The entirety of Middle Creek (approximately 20km length) and the entire catchment (approximately 87km<sup>2</sup>) lies within the Wodonga LGA.

## Overview of Flooding Consequences

### Kiewa River

The Kiewa River floodplain extends for approximately 14km through the Wodonga LGA. The floodplain within this reach is rural farming land, with only a small area of residential development abutting the floodplain around Killara (upstream and downstream of the Murray Valley Highway crossing). There are no known dwellings within the one per cent AEP extent with the exception of two dwellings at the Murray Valley Highway:

- 3718 Murray Valley Highway – near the eastern side of the Kiewa floodplain. A low lying cottage subject to flooding and isolation;
  - o This cottage requires sandbagging due to water entering property.
- 3829 Murray Valley Highway – immediately east of the Kiewa River. An elevated structure (above

one per cent AEP level) but subject to isolation; and,

- A house off Conisbee Lane isolated by flood water.

The Murray Valley Highway at Bandiana was flooded in September 1998 but no other road closures resulting from the Kiewa River are known within the Wodonga LGA (although numerous private access tracks within the floodplain are extensively flooded).

Development adjacent the Kiewa River at Killara (immediately upstream and downstream of the MVH) is restricted to high ground and no impact on dwellings is known (up to events of September 1998 magnitude or approximate one per cent AEP); however, there may be limited flooding of property backyards for houses on the south side of the Murray Valley Highway.

The Cudgewa-Wodonga Rail Trail crosses the Kiewa River floodplain approximately one kilometre south of the Murray Valley Highway and is substantially flood prone in events approaching moderate flood level at Bandiana.

The Kiewa River at Bandiana gauge has a minimum flood class level of 2.8m. The gauge will often maintain a level at or above this for an extended period through winter and spring with no known flood impacts beyond flooding of some grazing land; therefore requiring no emergency management actions.

### Yackandandah Creek

Within the short reach of Yackandandah Creek within the Wodonga LGA the floodplain width is around 400-600m, but increases significantly near the confluence with the Kiewa River. There are no known flood exposures excluding flooding of grazing properties.

The Kiewa Valley Highway is the only crossing of Yackandandah Creek within the Wodonga LGA. The road is well elevated above historic flood levels; however, piers were undermined and damaged in the December 2010 flood event (largest event on record for Yackandandah Creek) and the bridge was subsequently replaced in 2011. Lindsay Road, which crosses the Yackandandah Creek floodplain at the boundary of the Wodonga LGA, is prone to frequent flooding.

### Middle Creek

The area upstream of Leneva the Middle Creek floodplain is predominantly rural with limited assets exposed to flood risk. Upstream of the Wodonga-Beechworth Road, Middle Creek is incised and the floodplain width is limited; however, there are a number of houses to the north of the creek which rely on low level access routes crossing the creek which may be cut. Further downstream as Middle Creek enters the future urban growth area of Leneva, the floodplain

width increases to an average 200m. The dwelling at 188 Frederic Street Road is on isolated high ground (approximate one per cent AEP level), but is potentially isolated due to flooding over Frederic Street Road and the access driveway to the dwelling.

Whytes Road, the Kiewa Valley Highway and Frederic Street Road are all subject to closure as a result of flooding from Middle Creek. The Whytes Road crossing is a concrete causeway with a threshold for overtopping < two year ARI. Hazardous conditions exist for vehicles crossing the flooded causeway. Flood depths of approximately two metres are expected in the one per cent AEP event.

A bypass for the Whytes Road crossing is available via the Kiewa Valley Highway, which is estimated to overtop in events >20 year ARI (five per cent AEP - (assuming no debris blockage). The most recent overtopping was in December 2010. The Baranduda Boulevard bridge crossing has capacity >one per cent AEP. Frederic Street Road (a local road servicing only a few properties) is subject to flooding in events around five year ARI (20 per cent AEP).

Capacity and overtopping information is provided below (Table 4 from the Middle Creek Flood Study, GHD 2014).

The Wodonga Terminal Station (electricity) is on Whytes Road adjacent (south of) Middle Creek; however, it is elevated above one per cent AEP flood level for both the Kiewa River and Middle Creek. A high voltage transmission line crosses Middle Creek downstream of Whytes Road. One tower is located close to the creek and is subject to flood depth around 0.9m in the one per cent AEP event.

Design flow information for Middle Creek is shown in Table 5.

**Table 4: Middle Creek – Roadway overtopping information (from GHD 2012)**

Structure	Type/Description	Discharge capacity		Maximum depth 100 Year ARI Road Overflows (m)	100 Year ARI Afflux (m)
		Flow (m <sup>3</sup> /s)	Equivalent ARI (years)		
Whytes Road	Culvert/causeway. Twin 750mm diameter culverts.	2	<2	2.00	<0.1
Kiewa Valley Highway	Bridge. Span 27m, waterway opening area 35m <sup>2</sup>	90	20	0.62	0.9
Cycleway/ Pedestrian Bridge	Bridge. Span 15m, waterway opening 20m <sup>2</sup>	5	<2	2.00	0.0
Baranduda Boulevard	Bridge. Span 23m, waterway area 62m <sup>2</sup>	>155	>100	Not overtopped	0.8
Private bridge	Bridge. Span 18m, waterway area 71m <sup>2</sup>	>153	>100	Not overtopped	0.7
Frederic Street Road	Bridge. Span 21m, waterway area 37m <sup>2</sup>	30	<5	1.04	<0.1
Beechworth Wodonga Road	Bridge. Span 20m, waterway area 39m <sup>2</sup>	125	100	Not overtopped	0.6

Notes: 1. Discharge capacity is the modelled discharge when the road is on the verge of overtopping  
2. Results in Table 4 assume zero waterway structure blockage.

**Table 5: Middle Creek – Design flows (from GHD 2012)**

Middle Creek location (refer Figure 1)	Catchment area (km <sup>2</sup> )	Peak design flow (m <sup>3</sup> /s)				
		5yr ARI	10yr ARI	20yr ARI	50yr ARI	100yr ARI
Beechworth Wodonga Rd	42.6	27	42	65	96	125
Frederic Street Road	56.8	35	52	80	114	146
Baranduda Boulevard	61.3	37	55	84	119	155
Kiewa valley Highway	72.9	42	62	94	133	172
Whytes Road	74.5	43	63	95	135	174

## Flood Mitigation

There is no flood mitigation infrastructure in this reach of the Kiewa River. Kiewa Hydro storages in the upper Kiewa (above Mt Beauty) are considered to have no impact on flood magnitudes in the lower Kiewa.

## Flood Impacts and Required Actions

- House off Conisbee Lane isolated by flood water. Consider engaging the landowner prior.
- During Flash Flood events, where impacts are confirmed, Units will need to notify the NEDO for appropriate warning to the community.

### Gauge Location: Kiewa River at Bandiana

River Height (m) And or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions - may include (but not limited to) Evacuation, closure of road, sandbagging, issue warning and who is responsible
2.8m (4,100 ML/D)	Minor Flood Level (<2 year ARI)	No known impacts of significance – local flooding around gauge site and low lying farmland.	BOM will issue flood warning. VICSES to publish Minor Flood warning to community
3.1m (13,400 ML/D)	Moderate Flood Level (2 year ARI)		BOM will issue Flood warning. VICSES to publish Moderate Flood warning to community
3.15		August 2016 – Shallow flooding over significant areas of low lying farmland and local access routes.	

# Appendix C2 – Murray River and Gateway Island Flood Emergency Plan

## Overview

### Murray River

The Murray River floodplain within the Wodonga LGA extends for approximately 32km with a river channel length of approximately 63km. The average flood profile gradient measured in relation to the floodplain is approximately one in 2000.

The Murray River floodplain lies to the north of the Hume Freeway and Bandiana Link Road which together generally mark the northern perimeter of the Wodonga urban/industrial area. The Moloney Drive industrial area (which lies to the north of the Hume Freeway) is also outside of the Murray floodplain. Lincoln Causeway, the Hume Freeway and the Sydney-Wodonga Railway all cross the Murray River floodplain in proximity to Wodonga.

The passage of floodwaters from the Upper Murray catchment (approximately 15,300km<sup>2</sup> upstream of Lake Hume, including the Dartmouth River catchment (3560km<sup>2</sup>)) is influenced by the Lake Hume storage located approximately 20km upstream of Wodonga. Hume Dam's primary function is water storage to secure water availability for downstream demands during wet periods. When the storage level is low flood events may be largely or completely captured within Hume Dam, but at higher storage levels floodwaters from upstream will be passed through with little significant attenuation, and thus the storage should not be assumed to protect downstream communities from flooding. In addition to the passage of floodwaters via Hume Dam, the Kiewa River (1650km<sup>2</sup>) enters the Murray River between Hume Dam and Wodonga, and thus flooding around Wodonga results from both the Upper Murray River catchment and the Kiewa River.

The Murray River in the reach adjacent Wodonga is described as a laterally migrating, anabranching floodplain river featuring an incised meandering river channel and multiple anabranch channels carrying a variable proportion of flows as flows increase (refer Earth Tech 2005). Flows are generally confined to the main river channel and anabranch channels until the total floodplain flow exceeds 25,000 ML/Day, although floodplain pockets may be inundated at this level. This coincides with approximately high summer flow (irrigation release) conditions.

The dominant anabranch near Wodonga is Wodonga Creek, which follows the southern edge of the floodplain near. The area of land bounded by Wodonga Creek and Flanagans Creek to the south and the Murray River to the north (refer to Figure 3) is known as Gateway Island, and includes sediment extraction industries, limited commercial development and a small number of dwellings. Gateway Island is subject to isolation and flooding in large events and is the most developed part of Wodonga with the greatest exposure to flooding from the Murray River.

Other anabranches include Ryans Creek upstream of Wodonga, and Dights Creek Downstream of Albury.

River Height (m) And or River Flow (ML/d)	Annual Exceedance Probability	Consequence / Impact	Actions - may include (but not limited to) Evacuation, closure of road, sandbagging, issue warning and who is responsible
3.2 (27,500 ML/D)	5 year ARI	Access to 217 Conisbee Lane floods off Murray valley Hwy, isolating single dwelling at the end of the road.  Access to properties on following roads may become isolated from this height: <ul style="list-style-type: none"> <li>Gullifer Lane</li> <li>Smith Rd</li> <li>Pollards Rd</li> <li>McIntosh Rd</li> </ul>	Wodonga Council to monitor and inspect Conisbee Lane to determine road closure.  SES to engage land holder of potential isolation.  Wodonga council to monitor and inspect roads to determine road closures.  SES to engage with land holders of potential isolation.
3.24		Oct 1993	
3.29		Oct 2016 and Sep 2010 – Extensive floodplain inundation, local road closures.	
3.3m (32,760 ML/D)	Major Flood Level (7 year ARI)		BOM will issue Flood warning.  VICSES to publish Major Flood warning to community
3.326	10 years	Dec 2010	
3.34 (38,200 ML/D)	10 year ARI		
3.424	18 years	May 1974	
3.50 (52,900 ML/D)	4% AEP (25 year ARI)		
3.576	45 year ARI	Sep 1998 – Extensive and deep flooding of farmland in the floodplain. Closure of south end of Pollards Road and numerous private access tracks within the floodplain. Kiewa Valley Highway flooded.	
3.60 (64,600 ML/D)	2% AEP (50 year ARI)		
3.69 (76,700 ML/D)	1% AEP (100 year ARI)		

Note: 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 cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series.

The ford at Whytes Road, Middle Creek Baranduda may become impassable after heavy rain fall.

As Middle Creek is an ungauged waterway with rapid catchment response times (< 4 hours?) it is not possible to generate reliable intel in a timely manner to predict imminent overtopping of the causeway.

The only way to infer overtopping potential is based on the information from the flood study (overtopping < 2 yr ARI) and intensity-frequency-duration information in Table 10 of the MFEP which would suggest that 3-6 hour rainfall totals of around 30 mm or more would likely result in overtopping. Given that there is no local pluviograph (rain gauge with sub-daily data) able to identify local storm intensity in the small catchment even this information is insufficient to enable warning of impact.

In order to address this the Regional Flood Plain Management Strategy (North East Catchment Management Authority) identifies this as a year 2 (2019-2020) priority to review road closure practices and consider warning options.

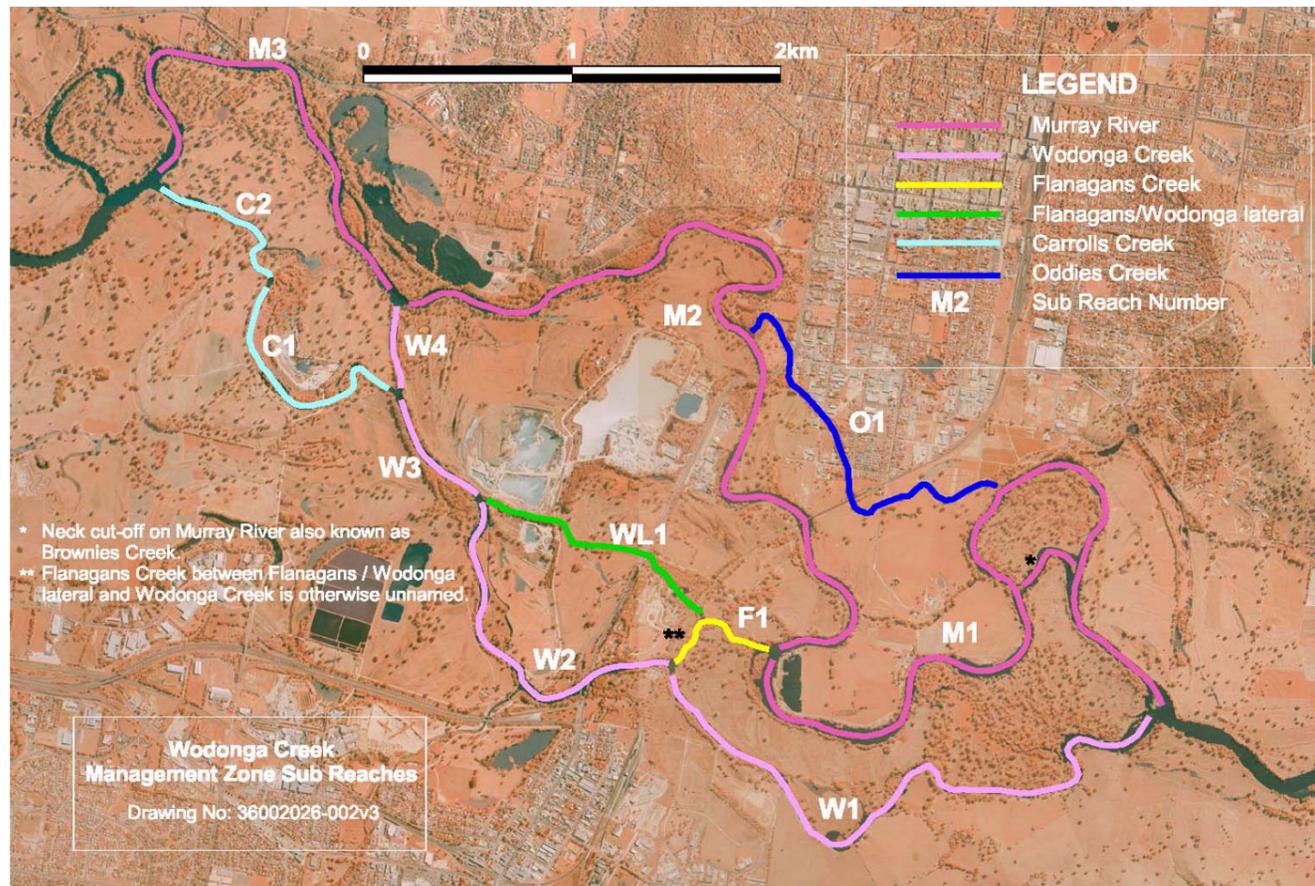


Figure 3 - Murray River floodplain waterway features adjacent Wodonga (from NSW River Management Plan or the Wodonga Reach Management Zone)

### Gauges

Gauge locations for the Murray River downstream of Lake Hume are shown in Figure 4. Details of the flood warning service associated with these gauges are summarised in Table 6. Flood warnings are issued by BoM for the Kiewa River at Bandiana and the Murray River at Albury.

### Murray River at Albury

The Murray River at Albury (Union Bridge, located on Lincoln Causeway) is a Quantitative forecast location, which includes expected flood class (minor, moderate or major) with more specific information on the height and time of water levels.

- For example, the Murray River at Albury will exceed Minor Flood Level (4.3m) around 3pm Saturday evening. The Murray River at Albury is expected to peak near 5.6 metres (Major Flood Level 5.5 metres) around 6pm on Sunday.

### Kiewa River at Bandiana

The Kiewa River at Bandiana is a Qualitative forecast location, which includes expected flood class (minor, moderate or major) and timing of flooding. The timing is indicated in blocks of six, 12 or 24 hours, such as early morning, afternoon or overnight

- For example, minor flooding is expected in the Kiewa River at Bandiana during Saturday afternoon. The Kiewa River at Bandiana is expected to peak above the Major Flood Level (3.m) during Sunday evening.

### Murray River at Heywoods

The Murray River at Heywoods (releases from Lake Hume) and Murray River at Doctors Point (releases from Lake Hume and Kiewa River flows) are data sites only, thus there is no forecasting of levels.

Table 6: Murray River and Lower Kiewa River gauge details

Gauge #	Gauge Location	Years of operation	Prediction type	Target warning lead time	Trigger height (beyond which warnings issued)	70% of peak forecasts within	Min	Mod	Maj
409016	Murray River at Heywoods	1969 onward	River data location (no forecast)	NA	NA	NA			
402205	Kiewa River at Bandiana	1965 onward	Qualitative	3 hrs	> 2.8m	n/a	2.8	3.1	3.3
409017	Murray River at Doctors Point	1929 onward	River data location (no forecast)	NA	NA	NA			
409001	Murray River at Albury	1867 onward	Quantitative	12 hrs	>5.5m	+/- 0.3m	4.3	4.9	5.5



Figure 4 - Murray River gauge locations

### Forecasting Impact at Albury Gauge using Doctors Point Gauge (Gateway Island Impacts)

- Available flood inundation mapping in the Murray River downstream of Lake Hume is presented based on total flow downstream of the Kiewa River confluence (such as releases from Lake Hume and Kiewa River flows).
- The Doctors Point and Albury gauges are both located downstream of the Kiewa River confluence.
- Analysis of flows from the period before 1992 during which there was flow gauging at Albury shows a linear (and close to 1:1 relationship) between flow at Doctors Point and Albury, reflecting the fact that there are no significant tributary inflows and relatively little flow attenuation between Doctors Point and Albury (refer Figure 5).

### Doctors Pt - Union Br flow (pre 1992)

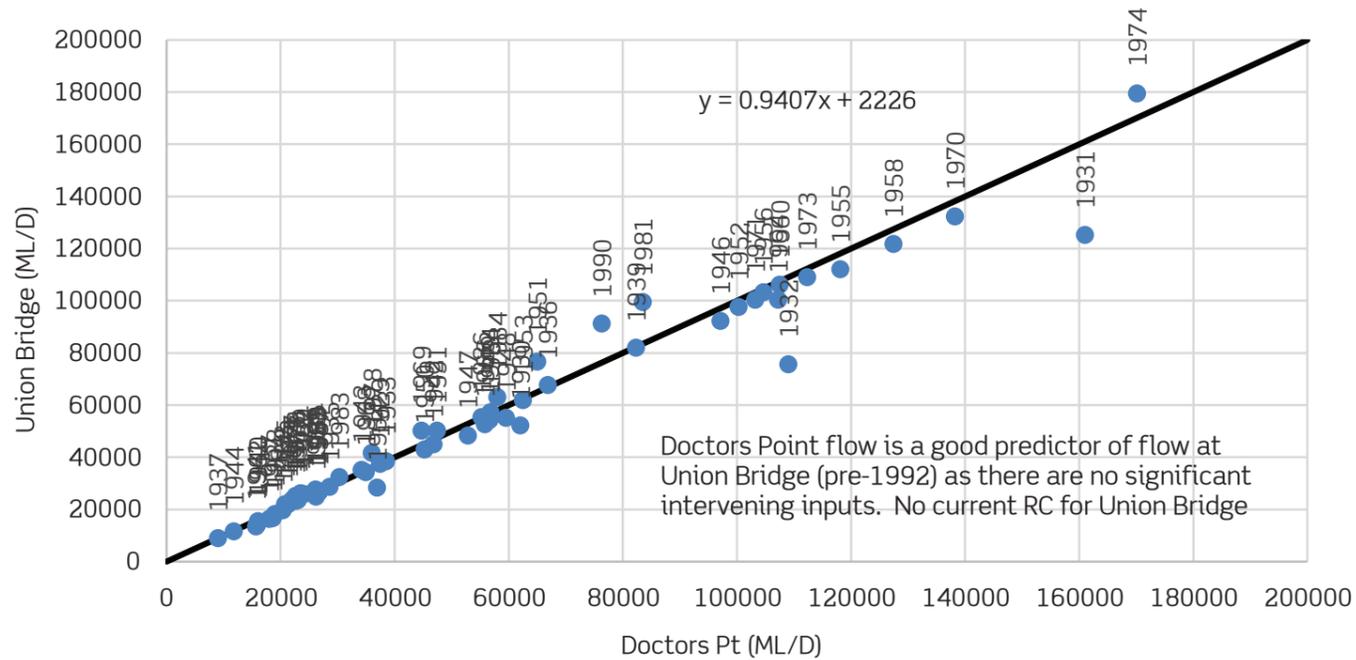
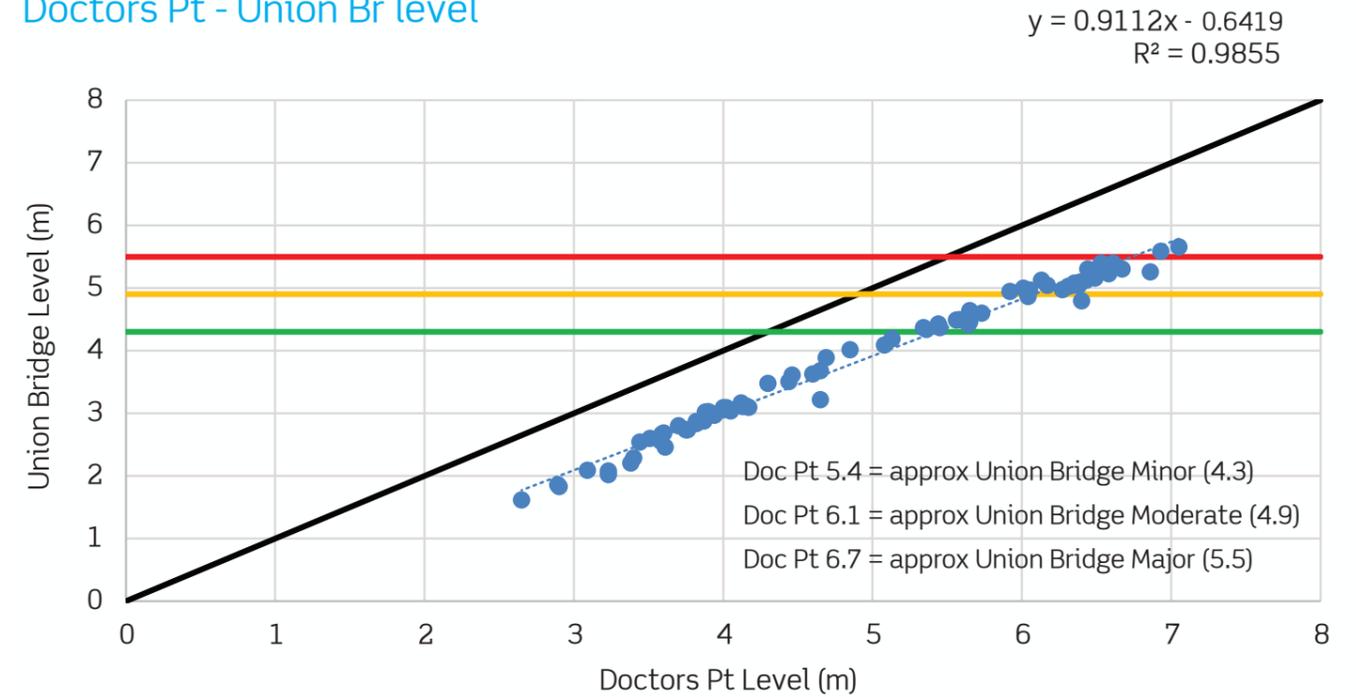


Figure 5 - Relationship between flow at Doctors Point and Union Bridge

#### Background

- The Albury gauge (for which forecast levels are issued by BoM) does not have a current rating curve and forecast levels can't be converted to a flow at Albury; thus it is difficult to establish which flood inundation map to refer to.
- To get around this, the relationship between Albury gauge level and Doctors Point level has been assessed and it is found that Albury gauge level provides a good indication of Doctors Point gauge level (Figure 6).
  - o Doctors Point level = (Union Bridge level + 0.6419) / 0.9112
- This relationship tends to over-estimate Doctors Point level by approximately 200mm for Union Bridge levels below approximate 5.1m (low Moderate flood), but is typically within 100mm for larger floods.
- Adopting this relationship allows forecast Union Bridge (Albury) level to be converted to Doctors Point level and then using the Doctors Point rating curve, the total Murray River flow (downstream of the Kiewa confluence) is established.

### Doctors Pt - Union Br level



Doctors Point level is a good indicator of level at Union Bridge (for pre-1992 flows) as there is no significant change in flow and rating curves have similar grade above around 60000 ML/D (say Doc Pt 6.0m). Union Bridge typically 0.8-1.2m below Doctors Point.

Figure 6 - Relationship between Doctors Point and Union Bridge gauge levels

Table 7A: Conversion table: Flood levels at Doctors Point to Union Bridge Gauge, Albury.

The level is seen at Doctors Point (column A in the table below) can be used to estimate what expected level will be seen at the Union Bridge gauge (column B in the table below) to help determine response actions and evacuation of gateway island.

Doctors Point (m)	Union Bridge (m)	Flood class level	Doctors Point (m)	Union Bridge (m)	Flood class level
5.09	4		6.19	5	
5.20	4.1		6.30	5.1	
5.31	4.2		6.41	5.2	
5.42	4.3	Minor	6.52	5.3	
5.53	4.4		6.63	5.4	
5.64	4.5		6.74	5.5	Major
5.75	4.6		6.85	5.6	
5.86	4.7		6.96	5.7	
5.97	4.8		7.07	5.8	
6.08	4.9	Moderate	7.18	5.9	
			7.29	6	

Flood inundation maps are available in GHD 2012 for five year ARI (approximately Moderate flood level at Albury gauge) to 500 year ARI (600mm above Major flood level at Albury gauge -refer to Table 7).

**Table 7: Available flood inundation mapping for the Murray River near Wodonga**

ARI	ML/D	Doctors Point level (based on RC)	Union Bridge level (based on DocPt-UnionBr relationship)	
2	40,000	4.9	3.8	No modelling available
Minor (Union Bridge)	48,400	5.4	4.3	No specific modelling available – adopt five year, but recognise this overestimates impact
Moderate (Union Bridge)	72,600	6.1	4.9	No specific modelling available – adopt 5 year
5	75,000	6.15	4.965	
10	110,000	6.62	5.39	
Major (Union Bridge)	130,000	6.74	5.5	No specific modelling available – adopt 10 year
20	145,000	6.82	5.57	
50	205,000	7.08	5.81	
100	250,000	7.2	5.92	
200	330,000	7.35	6.06	
500	440,000	7.49	6.16	

The flood inundation mapping is considered to over-estimate impacts on the Murray River between Lake Hume and the Kiewa River confluence as the flow adopted in modelling of this reach over-estimates the percentage of total Albury flows typically released from Lake Hume (modelling assumes only 10 per cent of total flow is derived from the Kiewa River).

### Overview of Flooding Consequences

The width of the Murray River floodplain inundated in the one per cent AEP flood varies from approximately one kilometre to 4.5km. Much of the floodplain is characterised by a relatively steep floodplain edge. This results in a modest increase in the area inundated when comparing moderate flood events (such as 5-10 year ARI or 20 per cent-10 per cent AEP events) with major flood events ( 20-100 year ARI or five per cent-one per cent AEP events).

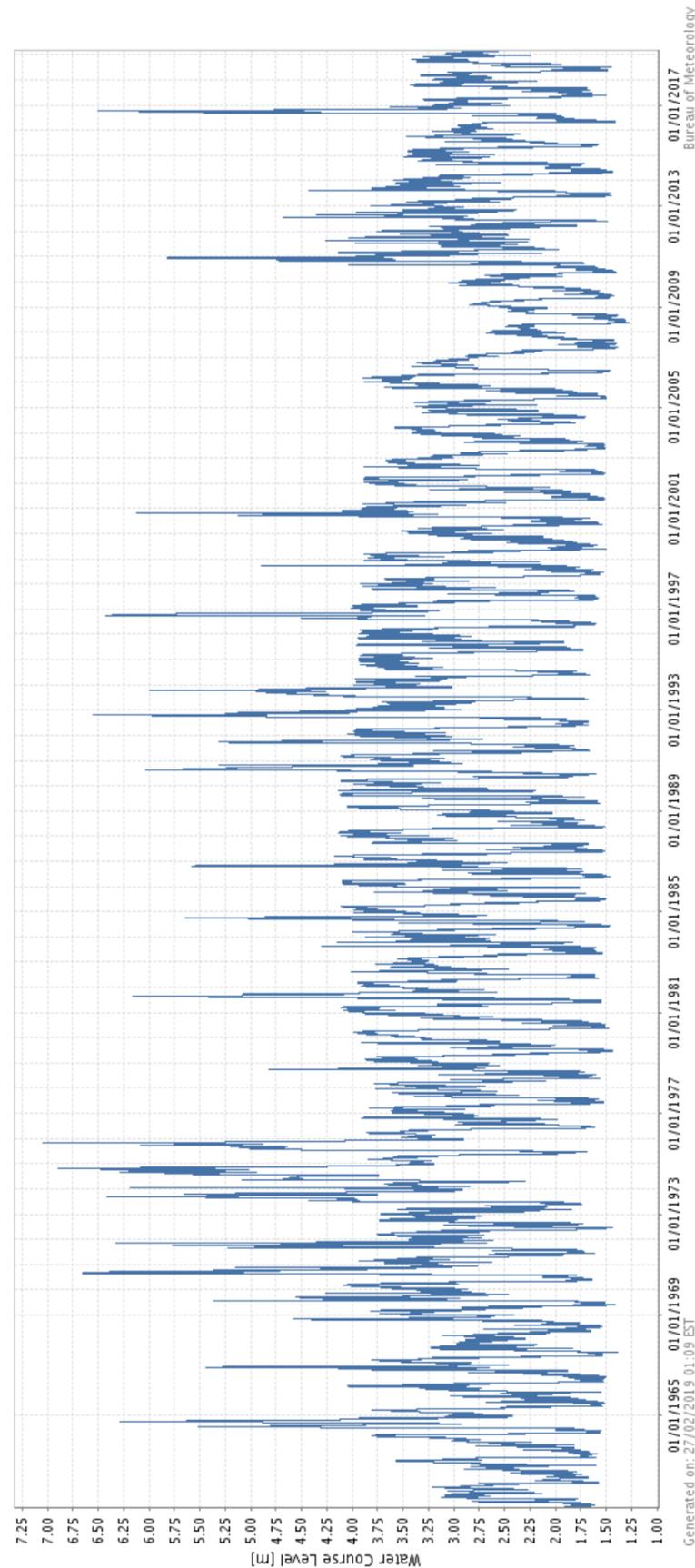
### Historic Gauge Levels

The largest flows on record are summarised in Table 8.

**Table 8: Murray River flood record**

Historic Gauge levels: Doctors Point	Doctors Point gauge level (m)	Flow (GHD 2012)	ARI (GHD 2012)
1870		268,000	130
Oct 1917		241,000	95
1867		225,000	70
Oct 1975	7.05	200,000	50
Oct 1974	6.928	170,000	30
Aug 1970	6.672	138,000	18
Oct 1992	6.61		
Oct 2016	6.53		10
Sep 1970	6.435		
Oct 1996	6.442		
Sep 1973	6.435		
Nov 1971	6.34		
Oct 1964	6.382		
Sep 1974	6.294		

The period from the mid-1990s onwards has seen relatively few significant flood events (in comparison to previous years as seen in Figure 7).



**Figure 7 - Historic gauge levels for Murray River at Doctors Point**

The most significant flood events in recent years include:

- October 1996 – Releases from Lake Hume to lower water levels to manage dam safety risks. No significant inflows from the Kiewa River;
- October 2000;
- December 2010 – First flood release from Lake Hume after the extended low flow period from 2001-2010 during which releases did not exceed approximately 25,000 ML/D (approximate bank full flow); and,
- October 2016 – Highest river level since 1996 (approximately same magnitude). Flooding over the majority of the floodplain width, peripheral impacts on Gateway Island commercial area, impacts on stability of quarries within the floodplain.

### Impacts and Required Actions (Read in conjunction with Intelligence Card)

#### Roads and bridges

- Hume Freeway – The Hume Freeway crossing of the Murray River floodplain between Wodonga and Albury is well elevated, approximately two metres above one per cent AEP levels and based on GHD 2012 remains above 0.2 per cent AEP (500 year ARI) level (>7.5m on Doctors Point gauge).
- Lincoln Causeway – Lincoln Causeway is at a lower level than the Hume Freeway bypass which replaced it in 2007, but remains above one per cent AEP level. The threshold for overtopping is estimated as 400 year ARI (Doctors Point 7.4m).
- Sydney-Melbourne Railway – The rail bypass is well elevated and remains above 500 year ARI level (>7.5m on Doctors Point gauge). The old alignment (currently proposed for conversion to a pedestrian path/rail trail) is also above one per cent AEP level.
- Heywoods Bridge/Bonegilla Road – With a deck level RL 162.8m AHD, the bridge is perched above one per cent AEP level; however approach roads, most significantly on the southern (Bonegilla) side are subject to flooding in lesser events, approximately 15 year ARI (Doctors Point).
- Providing access across the Murray River from Albury (Waterworks Road) to Island Road (Victoria). The Bridge is high; however, Island Road to the south of the bridge is inundated in events greater than approximate five year ARI event (Doctors Point 6.0m).

- Stock Route bridge – The old timber structure (no longer in service) has been replaced by a high level suspension bridge. The bridge is above one per cent AEP flood level; however, both approaches are flooded in the five year ARI event.
- South Albury levee – The majority of the levee (protecting South Albury) has approximately 0.5m freeboard above one per cent AEP levels; however, localised sections have lesser freeboard (upgrade under consideration by Albury City Council).

#### Gateway Island

- Gateway Island is described in GHD 2012 as experiencing flooding in events >145,000 ML/D (20 year ARI, Doctors Point gauge 6.7m) but the depth and extent of overtopping varies across the Island.
- Land around the commercial developments (such as Three Monkeys Tavern) is identified as experiencing flooding in events of 20 year ARI (Doctors Point 6.7m). Peripheral inundation occurred adjacent to buildings in the Northern Part of the commercial area (such as La Maison) in October 2016 (Doctors Point 6.53m). This area was sandbagged in October 2016 (although floodwaters would not have impacted buildings in the absence of sandbagging).
- Harris Road, which extends to the east of Lincoln Causeway, is subject to flooding in events of five year ARI magnitude. Diamond Park (train track, motorbike track etc) were extensively flooded in October 2016.
- Lemke Road to the west of Lincoln Causeway is subject to flooding in events of five year ARI magnitude and experienced flooding in October 2016. The greatest flooding is on the western side of Gateway Lakes impacting the rowing clubs etc. in this area. Shallow flooding occurred around dwellings at 68 and 84 Lemke Road in October 2016 without above floor flooding.

#### Bonegilla

There are approximately 20 rural residences on the Murray River/Kiewa River floodplain between Lake Hume and the Lincoln Causeway. Most are located on relatively high ground within the floodplain but can be isolated. Available modelling (GHD 2012) indicates that flooding of access roads occurs in events > five year ARI however the model tends to over-estimate flood extents in this area (dependent on relative flow magnitudes from the Murray and Kiewa Rivers). In October 2016 (approximate 10 year ARI at Doctors Point), flooding was restricted to low lying floodplain features with the only known road closure impacts



River Height (m)	Flood Level (m) AHD	Flow (m <sup>3</sup> /s)	Flood Class & Annual Exceedance Probability	Consequence / Impact	Action
5.39			10% AEP	<p>Oct 2016 Flood Height.</p> <p>Island Rd, Bonegilla, accessed via NSW, experiences road local low lying flooding. Many residents have boat access due to isolation.</p> <ul style="list-style-type: none"> <li>All properties on Island Road, all experience access issues from this height.</li> <li>During 2016 residents at 132 and 147 remained with boat access.</li> <li>70 Island Road was surrounded by water. See Intelligence photo on page 12 of this plan.</li> </ul> <p>Diamond Park, Gateway Island (train track, motorbike track extensively flooded in Oct 2016</p> <p>Black Duck Café/Gypsy Gardens, 9 Weight Road Gateway Island had sandbags and sand on site in 2016 in preparation for further flooding.</p> <p>Wodonga Quarries is located on the Murray River Floodplain Adjacent to Edwards Rd, Hume Fwy and the Sydney - Melbourne Railway to the South and Sheathers Rd to the East. Feltrimber Creek approaches the site from the South East as it enters the floodplain. The site has the main gas supply line running north/south through an easement between the two pits at the site and has high voltage power lines running East/West at the North of the quarry approximately 50M from the site. The north of the site is exposed to the floodplain and receives water there from a 10% AEP Flood.</p> <p>Baxter Property Holdings quarry site is approximately 200M south of the Murray River and is also impacted by water from a 10% AEP Flood.</p> <p>Gateway Village located on the east side of Lincoln Causeway has a businesses and buildings within the precinct.</p> <p>VICSES sandbagged the north end of the Carpark at La Maison Café in the 2016 flood to prevent further flood impacts. The buildings to the north experience flooding back up the storm water system and into their basements in a 10% AEP flood.</p>	<p>Council to monitor and determine when to close Island Road</p> <p>VICSES to engage residents in Harris Road about access issues and flooding predictions.</p> <p>Council to close access to Diamond Park</p> <p>VICSES to engage with business and discuss potential impacts and appropriate plan</p> <p>IC to engage Earth Resources section within the Dept. of Jobs, Precincts and Regions to ensure they form part of EMT</p>

River Height (m)	Flood Level (m) AHD	Flow (m <sup>3</sup> /s)	Flood Class & Annual Exceedance Probability	Consequence / Impact	Action
5.39 (cont.)			10% AEP (cont.)	<p>Access to properties on following roads may become isolated from this height:</p> <ul style="list-style-type: none"> <li>52 Goynes's Rd, Wodonga (house above 1% AEP Flood)</li> <li>32 and 22 Goynes's Rd, Wodonga</li> <li>51 Bidstrup Rd, Wodonga West</li> <li>102 and 60 Sheathers Rd, Wodonga</li> <li>89 Carroll's Lane Wodonga</li> <li>1 and 6 Stock Route Rd, Gateway Island</li> <li>9 Wright Rd, Gateway Island</li> <li>17 Trabants Rd, Bonegilla</li> <li>231, 359 and 409 Snowdens Rd, Bonegilla</li> <li>26 and 35 Reids Rd, Bonegilla</li> <li>138 Ryans Rd, Bonegilla</li> </ul> <p>McIntosh's Rd maybe inundated by flood water restricting access to Rapseys Rd, Bonegilla.</p>	<p>VICSES to engage businesses and council about requirement for sandbagging carpark and or storm water system from 10%AEP</p> <p>Council to monitor and determine when to close impacted roads.</p> <p>VICSES to engage residents in roads/properties listed about access issues and flooding predictions.</p>
5.5	152.935	~140	Major Flood Level	Harris & Lemke Roads inundated	BOM will issue Flood warning. VICSES to publish Major Flood warning to community Consider Evacuation of Gateway Island business park
5.8					Evacuation by road to the north past the height of 5,865 metres on the Albury Gauge will not be possible safely.
6.065	153.5	~2,893	1% AEP		
7.1					Evacuation by road to the south past the height of 7,365 metres on the Albury Gauge will not be possible safely.
Catastrophic Floods (Definitions below)					
8.665	156.1	14,897	Dam Crest Flood		
8.965	156.4	20,286	Probable Maximum Flood (PMF)	Depth over floor: 2.8m Warning time: ~8 hours	
17.565	165.0	87,172	Sunny Day Failure	Depth over floor: 11.4m Warning time: ~2 hours	Lincoln Causeway and all properties inundated at these levels.
19.465	166.9	177,532	Dam Crest Flood with Failure	Depth over floor: 13.3m Warning time: ~12 hours	
19.835	167.27	180,248	PMF - Dambreak	Depth over floor: 13.7m Warning time: ~8 hours	
21.395	168.83	243,061	Cascade Failure	Depth over floor: 15.2m Warning time: ~8 hours	

Note: 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 cards detail the relationship between flood magnitude and flood consequences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series.



# Appendix C3 – Wodonga Urban Waterways Flood Emergency Plan

## House Creek and Huon Creek

House Creek is a tributary of Wodonga Creek (which is itself an anabranch of the Murray River), entering Wodonga Creek adjacent the Hume Freeway. The upper catchment of House Creek is rural/farming land, with the creek running north of, and approximately parallel to, Castle Creek Road upstream of the urban interface, approximately 1.5km upstream of Yarralumla Drive.

The major tributary of House Creek is Huon Creek. Huon Creek runs parallel to Huon Creek Road through rural/farming land, before entering the urban area approximately 1.3km upstream of Yarralumla Drive. Huon Creek enters House Creek approximately 1km downstream of Yarralumla Drive.

The total catchment area upstream of the Wodonga Creek confluence is approximately 69.4km<sup>2</sup> (6940 ha) (Cardno Willing 2002).

## Overview of Flooding Consequences

### Significant flood exposures and mitigation

The majority of the urban reach of House Creek is contained within parkland/reserves with limited flood impact on private assets (beyond flooding of the lower parts of some lots backing onto the creek reserve). Exceptions to this include three residential areas:

- Sanctuary Boulevard – levee protection provided to 25 houses which would otherwise be subject to above floor flooding in events exceeding 20 year ARI.
- Cypress Court and Park Lane contain a small number of houses (approximately 10 in total) exposed external or above floor flooding. Two houses flood above floor in the one per cent AEP event on Cypress Court. Levees are proposed for future implementation in these areas.

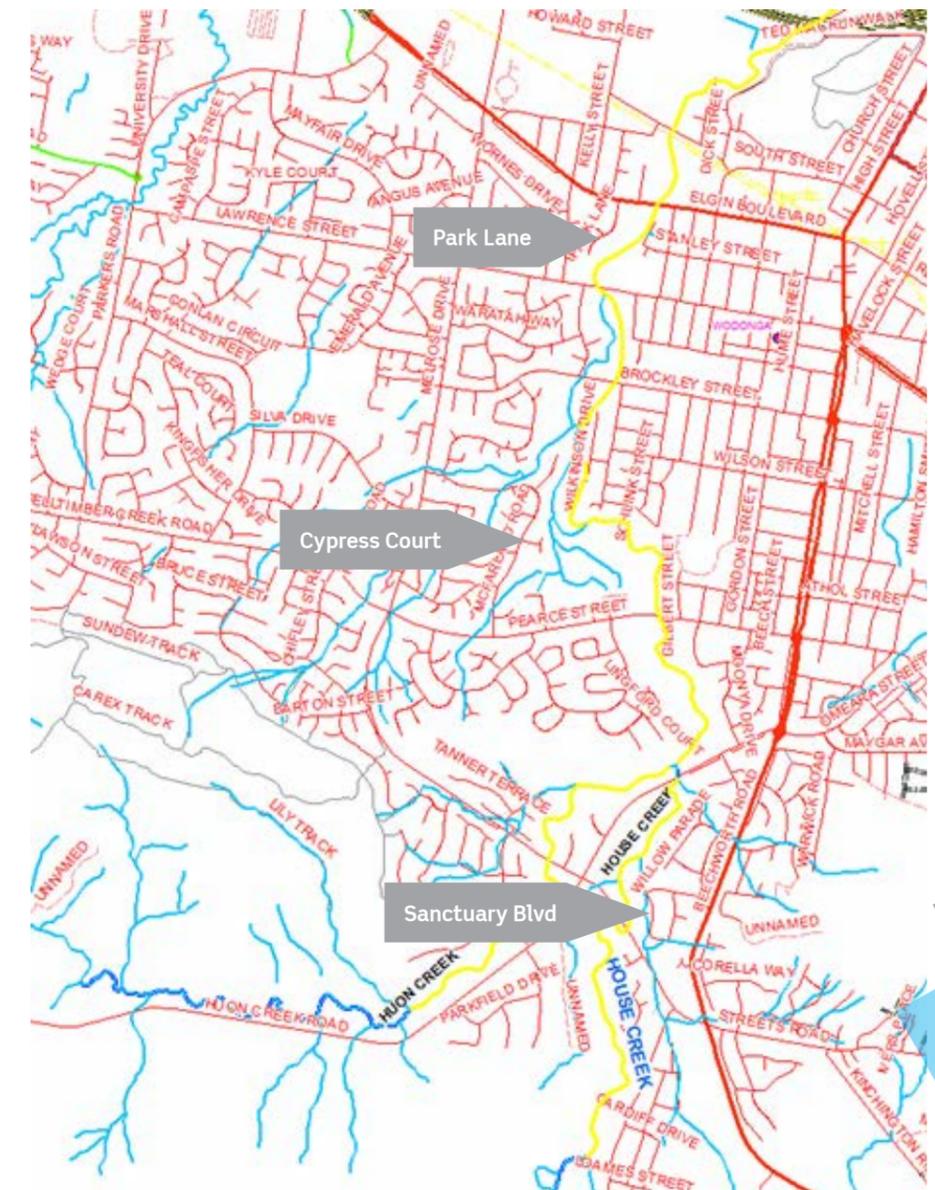


Figure 8 - House Creek and Huon Creek in the Wodonga urban area

## Available flood data

The most recent flood investigation for the House Creek/Huon Creek catchment was undertaken in 2018 (Water Technology). The investigation included a hydraulic analysis of the broader catchment and 2D hydrolic modelling, which provided a range of detailed flood mapping for five, 10, 20, 50, 100 and 200 year ARI events. There is no long-term established stream gauge on House Creek but a short term gauge operated downstream of Brockley St from August 2000 to 2002 (W&P 2002 Section 4.3.3). Historic flood levels at road crossings are tabulated below, from W&P with modelled flood levels from Water Technology 2018 also provided.

## Historic events

**Table 1: Historic flood levels – House Creek and Huon Creek**

Location	August 1970	September 1973	January 1974	August 1983	February 1993	Modelled 20 yr ARI	Modelled 100 yr ARI
Reuss St Bridge		152.57				153.35	153.43
Hume Highway						153.31	153.34
Railway Line	155.52					155.82	156.34
Forest Mars Bridge			155.77			155.46	156.78
Melbourne Road	157.08		157.4	158	158.7	157.58	158.30
Suspension Bridge						157.52	158.23
Lawrence Street	158.23		158.56	159.17	159.88	159.45	160.03
Woodland Bridge						159.96	160.32
Brockley Street			160.43			160.92	161.50
Pearce Street		164.82		165.7		166.45	167.15
Huon Ck Road		169.44				168.93	169.10
Yarralumla Drive						173.12	174.71
Huon Creek Footbridge (near Cambourne Ct)						175.66	175.91
Sanctuary Boulevard (upstream end)						172.88	173.33

## Overlays

Existing planning scheme overlays (FO) reflect the results of the previous flood study (2002). The results of the current study (Water Technology 2018) have not yet been adopted in the planning scheme.

Critical storm duration from six to 12 hours for the one per cent AEP event (Water Technology 2018).

## Historic events

- W&P 2002 identifies the largest flood event (prior to the study) as occurring in 1993, resulting in overtopping of Lawrence Street and overtopping of the Sanctuary Blvd levee.

**Table 2: Summary of Flooding Consequences – House and Huon Creeks**

Flooding Event and Indicative Rainfall	Flood Characteristics	Private Property Inundation	Key roadways inundated – Access and Egress	Actions - may include (but not limited to) Evacuation, closure of road, sandbagging, issue warning and who is responsible
<p><b>20% AEP Indicative Rainfall - 44mm in 6 hours, 56mm in 12 hours, 70mm in 24 hours</b></p>	<ul style="list-style-type: none"> <li>Flood waters break out to public parks and reserves</li> <li>A number of private properties that extend on to the lower floodplain are impacted by flood waters however there is minimal impact to private infrastructure</li> <li>A number of bike and walking tracks inundated</li> </ul>	<p>Residential property impacted at:</p> <ul style="list-style-type: none"> <li>58-62 – 136 Huon Creek Road</li> <li>32 – 58 Clarendon Avenue</li> <li>1 – 3 Cambourne Court</li> <li>3-7 Como Drive</li> <li>32, 34, 36A, 36B, 40 Huon Creek Road</li> <li>3-7 Kirribilli Court</li> <li>2 Uralla Court</li> <li>47 Jarrah Street</li> <li>23-27 and 11-13 Moonya Drive</li> <li>Church Street</li> </ul> <p>Out buildings impacted at:</p> <ul style="list-style-type: none"> <li>Pool at 118 Huon Creek Road.</li> </ul> <p>Dwellings impacted at:</p> <ul style="list-style-type: none"> <li>No dwellings impacted.</li> </ul>	<p>0.5 to 1 metre inundation depth</p> <ul style="list-style-type: none"> <li>No roads inundated to this depth</li> </ul> <p>0.3 to 0.5 metres inundation depth</p> <ul style="list-style-type: none"> <li>Sangster Street</li> </ul> <p>Below 0.3 metres inundation depth</p> <ul style="list-style-type: none"> <li>Forrest Mars Drive</li> </ul>	<p>Council to monitor and determine if bike/walking paths and road need to be closed due to flood water</p> <p>Council to monitor and determine when roads need to be closed due to flood water at:</p> <ul style="list-style-type: none"> <li>Sangsters Rd</li> <li>Forrest Mars Drive</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions.</p>

Flooding Event and Indicative Rainfall	Flood Characteristics	Private Property Inundation	Key roadways inundated – Access and Egress	Actions - may include (but not limited to) Evacuation, closure of road, sandbagging, issue warning and who is responsible
<b>10% AEP Indicative Rainfall - 51mm in 6 hours, 64mm in 12 hours, 82mm in 24 hours</b>	<ul style="list-style-type: none"> <li>The flood depths generally increase by approximately 100mm-200mm</li> <li>Flood waters are mainly confined to public parks and reserves along the creeks</li> </ul>	<p>Additional residential property impacted at:</p> <ul style="list-style-type: none"> <li>15 to 21 Moonya Drive</li> <li>39 Huon Creek Road</li> <li>1 to 5 Hereford Street</li> <li>6 Cypress Court</li> </ul> <p>Out buildings impacted at:</p> <ul style="list-style-type: none"> <li>3 and 5 Hereford Street</li> <li>116 Huon Creek Road</li> </ul> <p>Dwellings impacted at:</p> <ul style="list-style-type: none"> <li>100 Huon Creek Road.</li> </ul>	<p>0.5 to 1 metre inundation depth:</p> <ul style="list-style-type: none"> <li>Sangster Street</li> </ul> <p>0.3 to 0.5 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Forrest Mars Drive</li> </ul> <p>Below 0.3 metres inundation depth:</p> <ul style="list-style-type: none"> <li>None</li> </ul>	<p>Council to monitor and determine if further bike/walking paths and road need to be closed due to flood water</p> <p>Council to monitor and determine if roads need to be closed further due to flood water at:</p> <ul style="list-style-type: none"> <li>Sangsters Rd</li> <li>Forrest Mars Drive</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions at:</p> <ul style="list-style-type: none"> <li>Huon Creek Rd</li> <li>Hereford St</li> </ul> <p>VICSES to consider flash flood warning if properties are confirmed as impacted</p>
<b>5% AEP Indicative Rainfall - 58mm in 6 hours, 73mm in 12 hours, 93mm in 24 hours</b>	<ul style="list-style-type: none"> <li>The flood depths generally increase by approximately 200mm-300mm</li> </ul>	<p>Additional residential property impacted at:</p> <ul style="list-style-type: none"> <li>2 Peterkin Lane</li> <li>5 and 7 Cypress Court</li> </ul> <p>Out buildings impacted at:</p> <ul style="list-style-type: none"> <li>128, 116, 96, 94, 64 Huon Creek Road</li> <li>47 Jarrah Street</li> <li>1 to 5 Hereford Street</li> <li>5 to 7 Cypress Court</li> </ul> <p>Dwellings impacted at:</p> <ul style="list-style-type: none"> <li>96 Huon Creek Road</li> <li>6 Cypress Court</li> </ul>	<p>0.5 to 1 metre inundation depth:</p> <ul style="list-style-type: none"> <li>Sangster Street</li> <li>Access to 142 Castle Creek Road</li> </ul> <p>0.3 to 0.5 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Forrest Mars Drive</li> </ul> <p>Below 0.3 metres depth:</p> <ul style="list-style-type: none"> <li>Lawrence Street</li> </ul>	<p>Council to monitor and determine if roads need to be closed further due to flood water at:</p> <ul style="list-style-type: none"> <li>Lawrence St</li> <li>Huon Creek Road</li> <li>Cypress Court</li> <li>Heatherly Court</li> <li>Forrest Mars Drive</li> <li>Cambourne Court</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions at:</p> <ul style="list-style-type: none"> <li>Huon Creek Rd</li> <li>Cypress Court</li> <li>Access to 142 Castle Creek Rd</li> </ul> <p>VICSES to consider flash flood warning if properties are confirmed as impacted</p>
<b>2% AEP Indicative Rainfall - 68mm in 6 hours, 85mm in 12 hours, 109mm in 24 hours</b>	<ul style="list-style-type: none"> <li>The flood depths generally increase by approximately 100mm-200mm</li> </ul>	<p>Additional residential property impacted at:</p> <ul style="list-style-type: none"> <li>4 Peterkin Lane</li> </ul> <p>Dwellings impacted at:</p> <ul style="list-style-type: none"> <li>5 to 7 and 3 Cypress Court</li> </ul>	<p>0.5 to 1 metre inundation depth:</p> <ul style="list-style-type: none"> <li>Sangster Street</li> </ul> <p>0.3 to 0.5 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Lawrence Street</li> <li>Heatherly Court</li> <li>Forrest Mars Drive</li> </ul> <p>Below 0.3 inundation metres depth:</p> <ul style="list-style-type: none"> <li>Huon Creek Road</li> <li>Cypress Court</li> </ul>	<p>Council to monitor and determine if roads need to be closed further due to flood water at:</p> <ul style="list-style-type: none"> <li>Lawrence St</li> <li>Huon Creek Road</li> <li>Cypress Court</li> <li>Heatherly Court</li> <li>Forrest Mars Drive</li> <li>Cambourne Court</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions at:</p> <ul style="list-style-type: none"> <li>Cypress Court</li> </ul> <p>VICSES to consider flash flood warning if properties are confirmed as impacted</p>

Flooding Event and Indicative Rainfall	Flood Characteristics	Private Property Inundation	Key roadways inundated – Access and Egress	Actions - may include (but not limited to) Evacuation, closure of road, sandbagging, issue warning and who is responsible
<b>1% AEP Indicative Rainfall - 75mm in 6 hours, 94mm in 12 hours, 122mm in 24 hours</b>	<ul style="list-style-type: none"> <li>The flood depths generally increase by approximately 100mm-200mm</li> </ul>	<p>Additional residential property impacted at:</p> <ul style="list-style-type: none"> <li>142 Castle Creek Road</li> <li>7 Hereford Street</li> <li>135 Brockley Street</li> <li>2 Cypress Court</li> <li>3 to 9 Park Lane</li> </ul> <p>Out buildings impacted at:</p> <ul style="list-style-type: none"> <li>142 Castle Creek Road</li> <li>4 Peterkin Lane</li> <li>34 Clarendon Avenue</li> <li>7 Hereford Street</li> </ul> <p>Dwellings impacted at:</p> <ul style="list-style-type: none"> <li>2 Cambourne Court</li> <li>135 Brockley Street</li> <li>1 and 3 Hereford Street</li> <li>2 and 4 Cypress Court</li> <li>3 to 7 Park Lane</li> </ul>	<p>0.5 to 1 metre inundation depth:</p> <ul style="list-style-type: none"> <li>Heatherly Court</li> <li>Sangster Street</li> </ul> <p>0.3 to 0.5 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Lawrence Street</li> <li>Forrest Mars Drive</li> <li>Cambourne Court</li> </ul> <p>Below 0.3 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Huon Creek Road</li> <li>Cypress Court</li> </ul>	<p>Council to monitor and determine if roads need to be closed further due to flood water at:</p> <ul style="list-style-type: none"> <li>Lawrence St</li> <li>Huon Creek Road</li> <li>Cypress Court</li> <li>Heatherly Court</li> <li>Forrest Mars Drive</li> <li>Cambourne Court</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions at:</p> <ul style="list-style-type: none"> <li>Cypress Court</li> <li>Cambourne Court</li> <li>Brockley Street</li> <li>Hereford Street</li> <li>Cypress Court</li> <li>Park Lane</li> </ul> <p>VICSES to consider flash flood warning if properties are confirmed as impacted</p>
<b>0.5% AEP Indicative Rainfall - 82mm in 6 hours, 103mm in 12 hours, 134mm in 24 hours</b>	<ul style="list-style-type: none"> <li>The flood depths generally increase by approximately 100mm-200mm</li> </ul>	<p>Out buildings impacted at:</p> <ul style="list-style-type: none"> <li>3 Cambourne Court</li> </ul>	<p>0.5 to 1 metre inundation depth:</p> <ul style="list-style-type: none"> <li>Heatherly Court</li> <li>Lawrence Street</li> <li>Sangster Street</li> <li>Forrest Mars Drive</li> </ul> <p>0.3 to 0.5 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Cambourne Court</li> <li>Huon Creek Road</li> <li>Cypress Court</li> </ul> <p>Below 0.3 metres inundation depth:</p> <ul style="list-style-type: none"> <li>Pearce Street</li> </ul>	<p>Council to monitor and determine if roads need to be closed further due to flood water at:</p> <ul style="list-style-type: none"> <li>Lawrence St</li> <li>Huon Creek Road</li> <li>Cypress Court</li> <li>Heatherly Court</li> <li>Forrest Mars Drive</li> <li>Cambourne Court</li> <li>Pearce St</li> </ul> <p>VICSES to engage residents about access issues and flooding predictions at:</p> <ul style="list-style-type: none"> <li>Cambourne Court</li> </ul> <p>VICSES to consider flash flood warning if properties are confirmed as impacted</p>

**Table 3: Waterway crossings – House Creek and Huon Creek**

Waterway	Crossing	Flood impact	Actions	Source of information
Huon Creek	Gilberts Road	In rural area, providing access from Huon Creek Road to four dwellings. No information on incidence of overtopping of road/culverts.	Council to monitor and determine if roads need to be closed	
	Wilsons Road	In rural area, providing access from Huon Creek Road to one dwelling. Overtopped by 0.1m in 1% AEP event	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Yarralumla Drive	No overtopping in 0.5% AEP event and below		Water Tech (2018)
House Creek	Unnamed track near Elligate Lane (top end of Castle Creek Road)	In rural area, providing access from Castle Creek Road to one dwelling. No information on incidence of overtopping of road/culverts	Council to monitor and determine if roads need to be closed	
	Unnamed (private access track) 300m upstream of Loames Street	In rural area, providing access from Castle Creek Road to one dwelling. Overtopped by 0.15m in 2% AEP event	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Yarralumla Drive	No overtopping in 0.5% AEP event and below		Water Tech (2018)
	Huon Creek Road	Overtopped by 0.5-0.1m in 2% AEP event, and by 0.1-0.15m in 1% AEP event. Overtop first occurs 190m west of main bridge	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Pearce Street	Overtopped by 0.5-0.1m in 0.5% AEP event	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Brockley Street	No overtopping in 0.5% AEP event and below		Water Tech (2018)
	Lawrence Street	Overtopped by <0.05m in 5% AEP event, and by 0.56m in 1% AEP event	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Melbourne Road/Elgin Boulevard	No overtopping in 0.5% AEP event and below		Water Tech (2018)
	Forest Mars Avenue	Overtopped by 0.15m-0.2m in 20% AEP event (from flow along Sangsters Road), and by 0.50m in 1% AEP event	Council to monitor and determine if roads need to be closed	Water Tech (2018)
	Reuss Road/Sumsion Gardens			
Hume Freeway	No overtopping in 0.5% AEP event and below			Water Tech (2018)

**Table 9: Significant flood exposures – House Creek and Huon Creek**

Waterway	Asset / location	Flood impact	Actions	Source of information
Huon Creek	None known	None known		None known
House Creek	Sanctuary Boulevard	Over floor flooding likely in 5% AEP event (in the absence of the levee)	VICSES to engage residents about access issues and flooding predictions	W & P (2002)
	Cypress Court	Over floor flooding of two houses (Lots 36 and 37) in 1% AEP event.	VICSES to engage residents about access issues and flooding predictions	Water Technology (2018)
	Park Lane	Over floor flooding of one house in 0.5% AEP event (Lot 4), external flooding to several properties in 1% AEP event.	VICSES to engage residents about access issues and flooding predictions	Water Technology (2018)

## Felltimber Creek

Felltimber Creek is a tributary of the Murray River, entering the Murray River floodplain a short distance downstream from the Hume Freeway. The catchment area upstream of the freeway is approximately 1500 ha (Cardno Willing 2004). The catchment area, which extends approximately four kilometres west of the Wodonga urban area, is predominantly rural with steep, cleared farmland and conservation areas, transitioning to Low Density Residential land above Felltimber Creek Road. Between Felltimber Creek Road and Parkers Road/Lawrence Street, the creek flows through Wodonga Golf Course with residential development set back from the waterway. From Parkers Road/Lawrence Street to Moorefield Park Drive the waterway and floodplain lie within public park land; however, there may be areas of potential impact on adjacent residential land. Between Moorefield Park Drive and the Hume Freeway, Felltimber Creek passes through the educational precinct (Latrobe University and former Wodonga TAFE land).

The most recent flood investigation for Felltimber Creek is the Felltimber Creek Flood Study (Cardno Willing 2004). The assessment includes modelled water surface profiles for 20 year, 50 year and 100 year ARI flood events, but no mapping of flood extents. There is no established stream gauge on Felltimber Creek and no known reliable historic flood levels to allow calibration of models.

There are no flood related planning scheme overlays in place along Felltimber Creek.

Figure 5 - Felltimber Creek in Wodonga urban area



Table 4: Waterway crossings - Felltimber Creek

Waterway	Crossing	Flood impact	Source of information
Felltimber Creek	Felltimber Creek Road (two crossings upstream of urban area)	Unknown	
	Felltimber Creek Road (in urban area)		
	Parkers Road		
	Moorefield Park Drive		
	McKoy Street		
	Hume Freeway		
	Railway line		
	Sheathers Road		

Table 5: Significant flood exposures - Felltimber Creek

Waterway	Asset / location	Flood impact	Source of information
Felltimber Creek	Golf course		

## Jack in the Box Creek

Jack in the Box Creek is a tributary of Wodonga Creek (which is itself an anabranch of the Murray River) entering Wodonga Creek adjacent the Hume Freeway. The catchment (930 ha) is predominantly urbanised.

Reach	Description	Comment	Actions
Upstream of Victoria Cross Parade	Bandiana Military Area	Upper catchment location, no known flood impacts	
Victoria Cross Parade to Thomas Mitchell Drive	Industrial area and Wodonga Racecourse	Retardation provided within Wodonga Racecourse. Known flood impacts include Child Care Centre on Thomas Mitchell Drive	VICSES to engage and check Bumble Bee Child Care Centre at 71 Thomas Mitchell Drive for flood inundation around playground area and with Police and predictions determine potential evacuation
Thomas Mitchell Drive to Lawrence Street	Residential area but waterway and majority of likely flood impacts within public park reserve		

Lawrence Street to Wigg Street	Residential area on west bank, industrial area on right bank	Very confined waterway reach. Flood impacts on businesses upstream of Osburn Street	VICSES to seek intelligence on potential impacts of businesses on the waterways in the following locations to determine and record impacts: <ul style="list-style-type: none"> <li>• 59 to 65 and 6 to 8 Wigg St</li> <li>• 11 to 13 Osburn St</li> <li>• 1 to 15 Michael Drive</li> <li>• Properties at rear of Conway Crt</li> <li>• 3 to 25 Sanyo Dr</li> </ul>
Wigg Street to Hume Freeway	Industrial area	Very confined waterway reach. Known flood impacts on industrial land	VICSES to seek intelligence on potential impacts of businesses on the waterways in the following locations to determine and record impacts: <ul style="list-style-type: none"> <li>• 8-14 Kendell St</li> <li>• 2-3 Whytes Crt</li> <li>• 1 Bradford St</li> </ul>

The most recent flood investigation for Jack in the Box Creek is the Jack in the Box Creek Flood Study (Cardno Willing 2006). This investigation provides flood level and extent information for five, 20, 50 and 100 year ARI flood events.

A further hydrologic review was undertaken for the city of Wodonga in 2012 (GHD 2012) to consider the impacts of upstream development and options for stormwater detention.

Land Subject to Inundation Overlay (LSIO) applies along the length of Jack in the Box Creek downstream of Victoria Cross Parade (based on Cardno Willing 2006), but there are known inaccuracies in the flood extent as represented by the overlays.

**Table 6: Waterway crossings - Jack in the Box Creek**

Waterway	Crossing	Flood impact	Source of information
Jack in the Box Creek	Victoria Cross Parade		
	Chapple Street		
	Thomas Mitchell Drive	Flooded in all events exceeding 20 year ARI	Cardno Willing 2004 Section 6.1
	Lawrence Street		
	Wigg Street		
	Osburn Street		
	Kendall Street		
	Hume Freeway		

**Table 7: Significant flood exposures - Jack in the Box Creek**

Waterway	Asset / location	Flood impact	Action	Source of information
Jack in the Box Creek	Bumble Bee Childcare Centre (71 Thomas Mitchell Drive)	Existing floor level 6cm above 1% AEP flood level (based on Cardno Willing 2004 assessment), but playground area is located within the waterway and needs to be evacuated	VICSES to engage and check Bumble Bee Child Care Centre at 71 Thomas Mitchell Drive for flood inundation around playground area and with Police and predictions determine potential evacuation	Planning application for extension of development (2006)
	Parkside Produce (13 Osburn Street)		VICSES to engage with Parkside Produce about access issues and flooding predictions	Exposure/damage in 2010 flood events
	Kendall Street (north of 7 Kendall Street)	Shallow flooding over roadways and into industrial lots.	VICSES to seek intelligence on potential impacts of businesses on the waterways in the following locations to determine and record impacts: <ul style="list-style-type: none"> <li>• Kendall St</li> </ul>	March 2012 flood event.

Note - In Flash Flood areas without gauges, it will only be possible to provide a general description of likely flood impacts.



## Gauge Location/Rainfall Intensity

There are no active stream gauges in the House Creek, Huon Creek, Felltimber Creek or Jack in the Box Creek systems. All are small catchments with limited warning time. Rapid onset flash flooding (<six hours) is likely to occur as a result of high intensity rainfall events in the local catchment (extending approximately 15km south of Wodonga). In the absence of stream gauges, rainfall intensity/frequency/duration (IFD) data provides the best indication of event magnitude, but stream response will be heavily dependent on rainfall location, duration (relative to critical duration for catchment) and precedent conditions.

IFD data for Wodonga (Table 10 and Figure 9) has been extracted from: [www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016](http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016), described as 2016 IFDs which (relative to the earlier ARR 1987 IFDs) are:

- Based on a more extensive data base, with more than 30 years of additional rainfall data and data from extra rainfall stations;
- More accurate estimates, combining contemporary statistical analysis and techniques with an expanded rainfall database;
- Better estimates of the two per cent and one per cent annual exceedance probability IFDs than the interim 2013 IFDs, and,
- By combining contemporary statistical analyses and techniques with an expanded database, the new 2016 IFDs provide more accurate design rainfall estimates for Australia.

Note: The 2016 IFDs replace both the ARR87 IFDs and the interim 2013 IFDs.

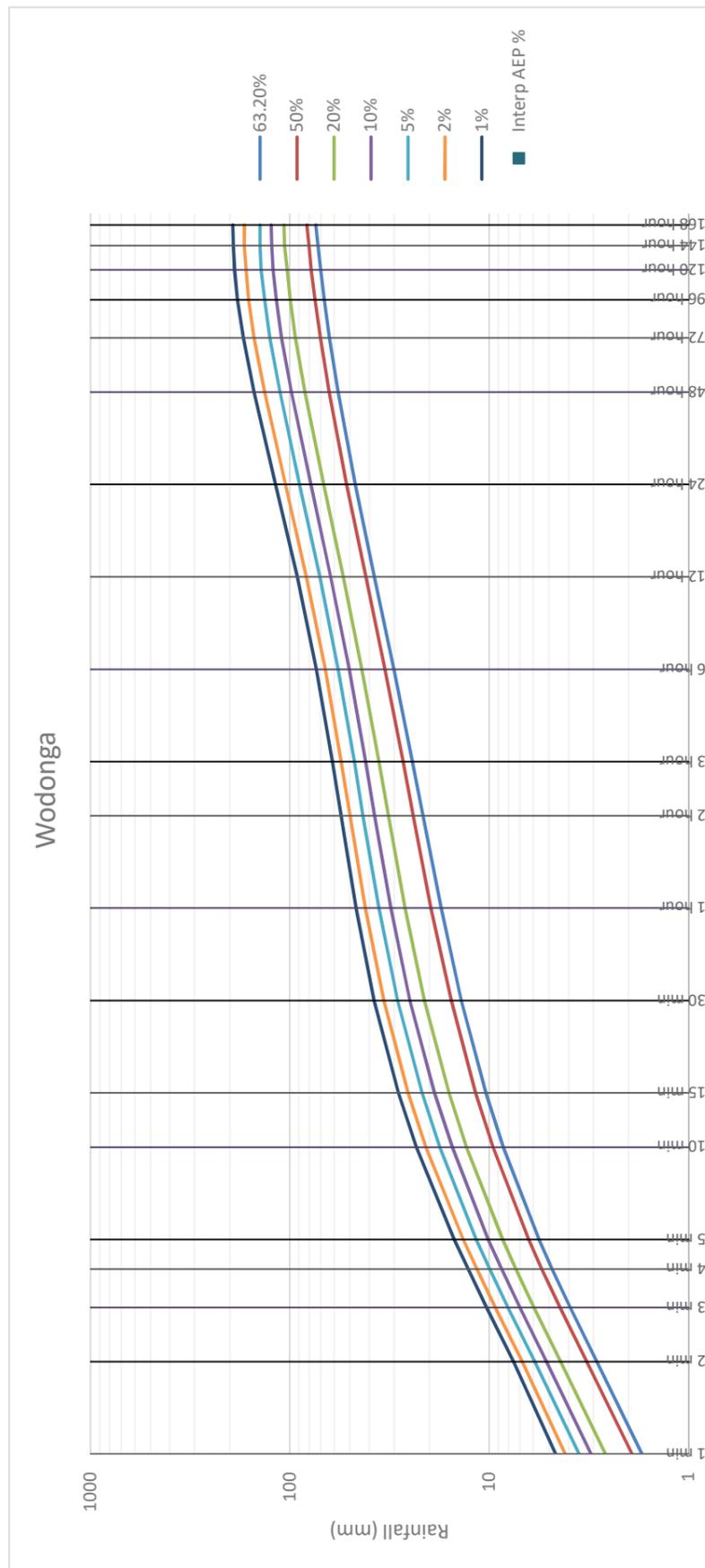
**Table 10: BOM IFD 2016 for Wodonga**

Location								
Label: <b>Wodonga</b>								
Requester	Easting	488000	Northing	6002000	Zone	55		
Nearest ga	Latitude	36.1375(S)		Longitude		146.8625(E)		
Annual Exceedance Probability (AEP)								
Duration	Duration							
	in min	63.20%	50%	20%	10%	5%	2%	1%
1 min	1	1.71	1.92	2.61	3.08	3.54	4.16	4.63
2 min	2	2.88	3.24	4.38	5.16	5.91	6.83	7.53
3 min	3	3.92	4.41	5.96	7.01	8.04	9.31	10.3
4 min	4	4.82	5.43	7.34	8.64	9.91	11.5	12.7
5 min	5	5.61	6.32	8.55	10.1	11.6	13.5	15
10 min	10	8.48	9.57	13	15.3	17.7	20.8	23.2
15 min	15	10.4	11.7	15.9	18.8	21.7	25.5	28.5
30 min	30	13.8	15.5	21.1	25	28.8	33.8	37.8
1 hour	60	17.4	19.6	26.4	31.1	35.7	41.8	46.5
2 hour	120	21.5	24	32	37.5	42.9	49.9	55.3
3 hour	180	24.3	27	35.7	41.7	47.5	55.2	61.1
6 hour	360	30.1	33.3	43.5	50.4	57.2	66.5	73.6
12 hour	720	37.6	41.5	53.9	62.3	70.7	82.5	91.7
24 hour	1440	46.9	51.8	67.5	78.4	89.3	105	118
48 hour	2880	57.2	63.5	83.9	98.2	112	134	151
72 hour	4320	63.2	70.3	93.5	110	126	151	171
96 hour	5760	67.1	74.8	99.5	117	134	161	183
120 hour	7200	70	78	103	121	139	166	189
144 hour	8640	72.2	80.3	106	123	141	169	192
168 hour	10080	74	82.1	107	124	141	169	193

## Appendix C References

1. Cardno Willing (2004). *Felltimber Creek Flood Study – Final Report (Version 1.1)*. Report to Wodonga Rural City Council. Cardno Willing Pty Ltd, Gordon, NSW, September 2004. (Consultant Ref. Project No. W3484-1, Ver1.1).
2. Cardno Willing (2006). *Jack in the Box Creek Flood Study (Version 4.0)*. Report to Wodonga Rural City Council. Cardno Willing Pty Ltd, NSW, January 2006.
3. WBM (2005). *Lower Kiewa Flood Study and Floodplain Management Plan – Final Report*. Report to North East Catchment Management Authority. WBM Pty Ltd, Melbourne, Victoria, August 2005. (Consultant Ref R.M6661.004.00.LowerKiewaRiverFloodStudyandFMP.doc Rev0)
4. Willing and Partners (2002). *House Creek and Huon Creek Flood Study (Version 3.3)*. Report to City of Wodonga. Willing and Partners Pty Ltd, NSW, April 2002
5. GHD (2012). *Albury City to Greater Hume – Murray River Flood Study – Final Report*. Report to Albury City Council and Greater Hume Shire Council. GHD, Wodonga, Victoria, March 2012. (Consultant Ref. 31/26963/5874, Rev 0).
6. Earth Tech 2005. *River Management Plan – Wodonga Reach Management Zone* (for NSW Dept of Infrastructure, Planning and Natural Resources).

Figure 9 – BOM IFD 2016 for Wodonga



## Appendix D - Flood Evacuation Arrangements

### Phase 1 - Decision to Evacuate

The IC 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); or,
- Essential services have been damaged and aren't available to a community; therefore 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; and,
- Different stages of an evacuation process.

The decision to evacuate is to be made in consultation with the MERO, MERC, DHS, Health Commander and other key agencies and expert advice (CMAs and Flood Intelligence specialists).

The table on the following page details triggers for evacuation, if these heights are predicted or are likely to occur evacuation should be considered.



Location	Evacuation Trigger	Action
Murray River – Albury Gauge – Gateway Island	4.9M (Moderate Flood Warning Level)	66 Harris Road may require evacuation due to access/egress issues. Investigation required.
	5.39M	All properties on Island Road, Bonegilla (Access from NSW) all experience access issues from this height. Some have boats for access however, Evacuation of other residents may be required. Access to all properties listed in Murray River Intelligence Card in Appendix C2 have access issues, Evacuation maybe required, investigations required.
	5.5M (Major Flood Warning Level)	Consider evacuation of Gateway Island business park.
	5.8M	Evacuation by road to the north past the height of 5.865 metres on the Albury Gauge will not be possible safely.
	7.1M	Evacuation by road to the south past the height of 7.365 metres on the Albury Gauge will not be possible safely.
Jack in the Box Creek, Wodonga	1% AEP	Visual inspection of Bee Child Care Centre at 71 Thomas Mitchell Drive for flood inundation from Jack in the Box Creek. Property 6CM above 1%AEP. Playground located in waterway.
Wodonga Municipality		Flash Flooding Impacts homes and business – Multiple rescue persons events.

## 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 (CMAs and Flood Intelligence specialists).

## Phase 3 – Withdrawal

Withdrawal will be controlled by VicPol. VICSES will provide advice regarding 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. Refer to Part 9 of the MEMP.

Landing zones for helicopters are located at:

- Albury Airport

Special needs groups will be/are identified in the council's 'residents at risk' register. This can be done through community network organisations. Further information on the council's 'residents at risk' register can be obtained from Vulnerable Persons Register in Crisisworks Datalink system.

## Phase 4 – Shelter

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. The flood relief centres and/or Assembly Areas are listed in the City of Wodonga MEMP in Appendix K.

VicPol, in consultation with VICSES, will liaise with Local Government and DHS (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 EMT.

### Animal Shelter

Animal shelter compounds will be established for domestic pets and companion animals of evacuees. These facilities may be located at locations detailed in Appendix K of the City of Wodonga MEMP.

### Caravans

Caravans maybe evacuated to the following locations:

Sector	Caravan evacuation location (include address)	Comments
Wodonga	Wodonga Show grounds	

## Phase 5 – Return

Return will be consistent with the Strategic Plan for the Return of Community

The IC 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; and,
- Transportation particularly for people without access to transport.

## 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, water treatment plant affecting potable water supplies etc.

Service	Impact	Trigger Point for action	Strategy/Temporary Measures
NIL			

## Essential Community Infrastructure and Property Protection

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

Facility	Impact	Trigger Point for action	Strategy/Temporary Measures
NIL			

The council will establish a sandbag collection point at

- Wodonga Council Depot

The following resources are available within Albury City Council to assist with rescue operations:

- Albury & Border Rescue Squad
- NSWSES Albury Unit

Known high-risk areas/communities (such as low-lying islands) where rescues might be required include:

- Bonegilla Island, Island Road, off Water Works Road, East Albury
- Diamond Park Motorcycle track Clubhouse

## Appendix E - Flood Warning Systems

### Flood Warning

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.

Flood Warnings

VICSES distributes flood emergency information to the media through Flood Warnings. Flood Warnings 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 Warning' 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, authorising and issuing Flood Warnings, using the 'One Source, One Message' system.

Flood Warnings should refer to the warning title within the warning header, for example 'Flood Warning for Major Flood Warning on Yarra River'.

Flood Warnings 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; and,
- Who to call if emergency assistance is required.

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

Flood Warnings 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.

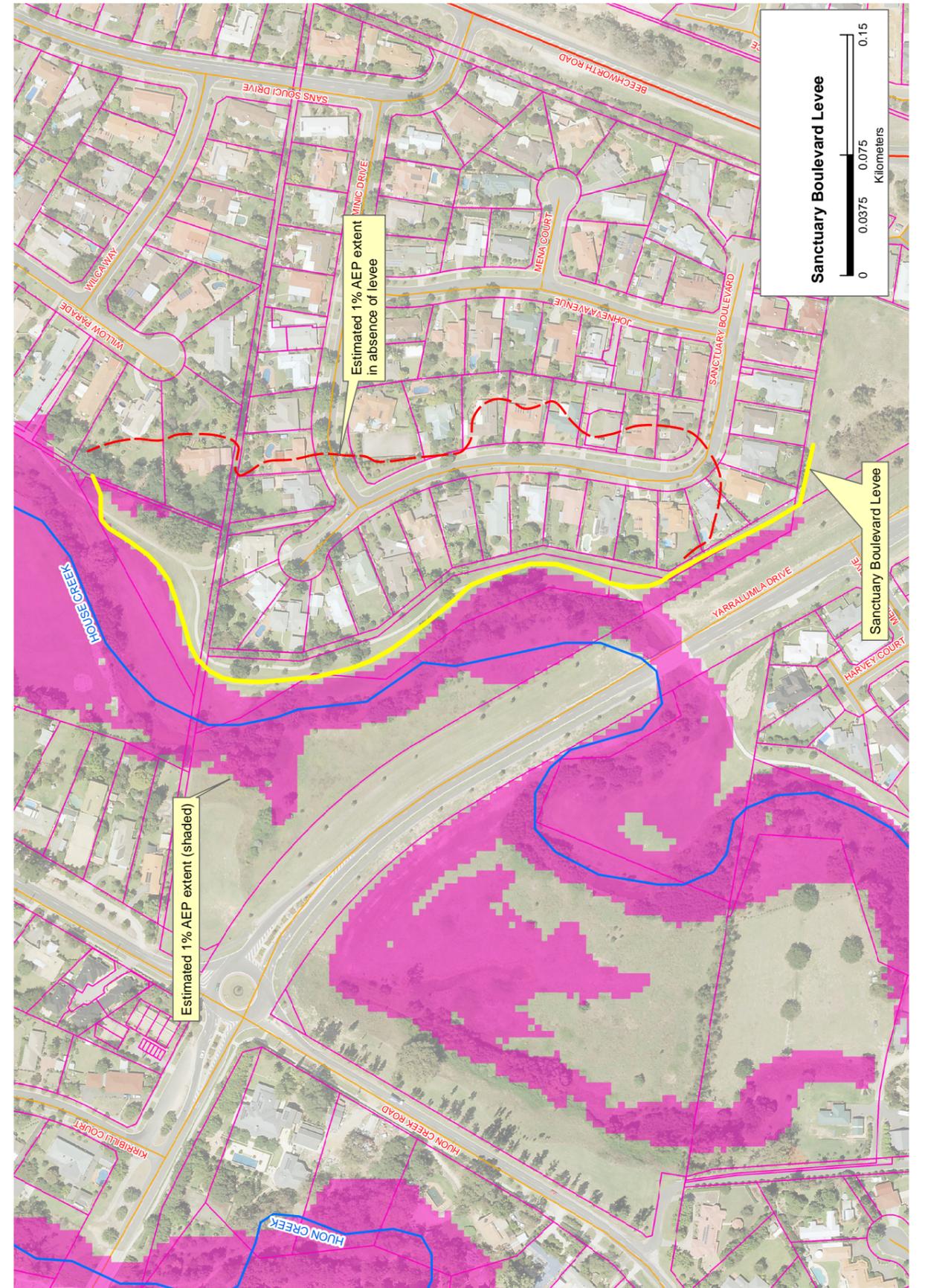
Flood Warnings should be prepared and issued after receipt of each Flood Watch and Flood Warning from the BoM, or after Severe Weather or Thunderstorm Warnings indicating potential for severe flash flooding.

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

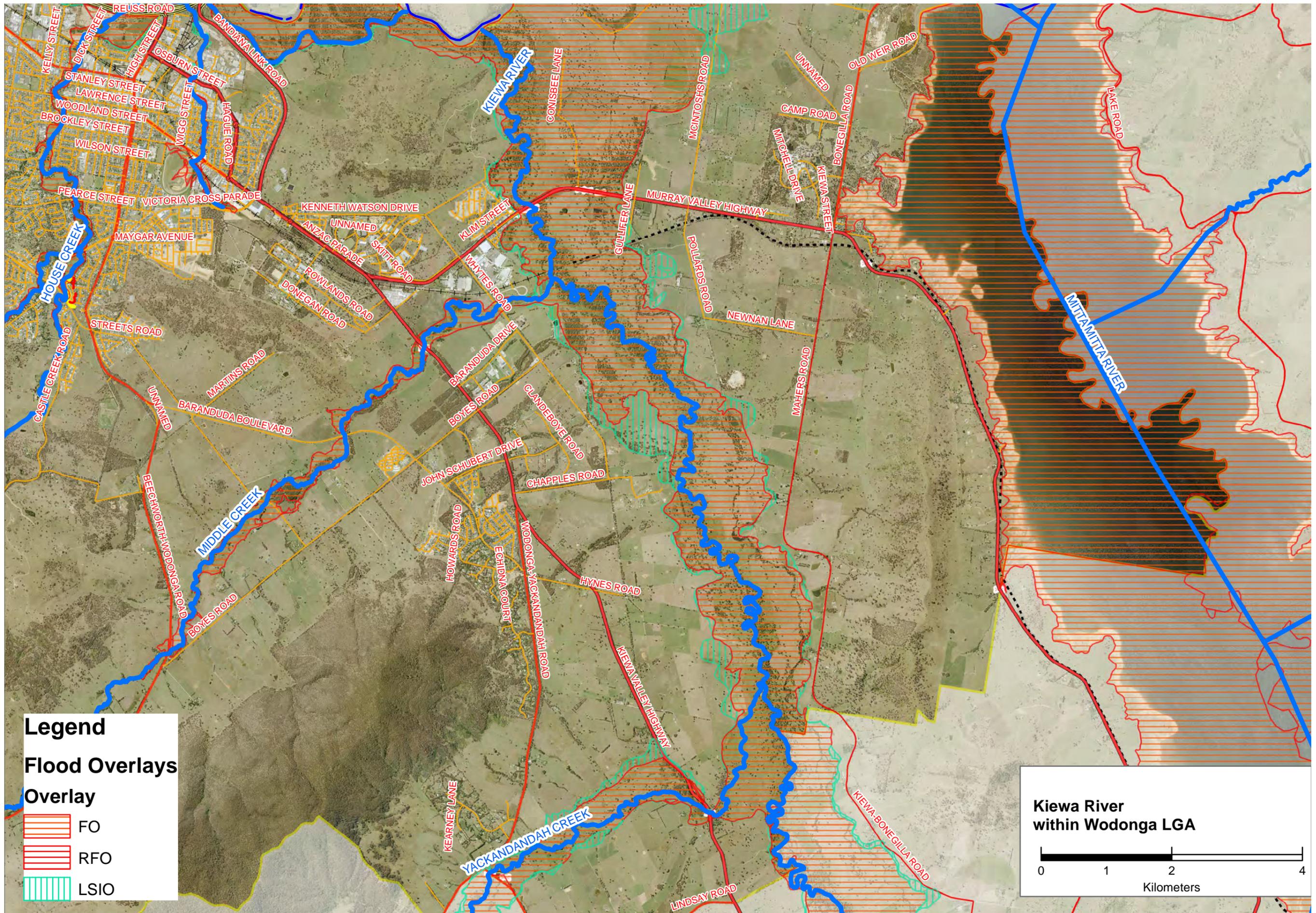
Sumsion Gardens, Belvoir Park Lake  
October, 2016



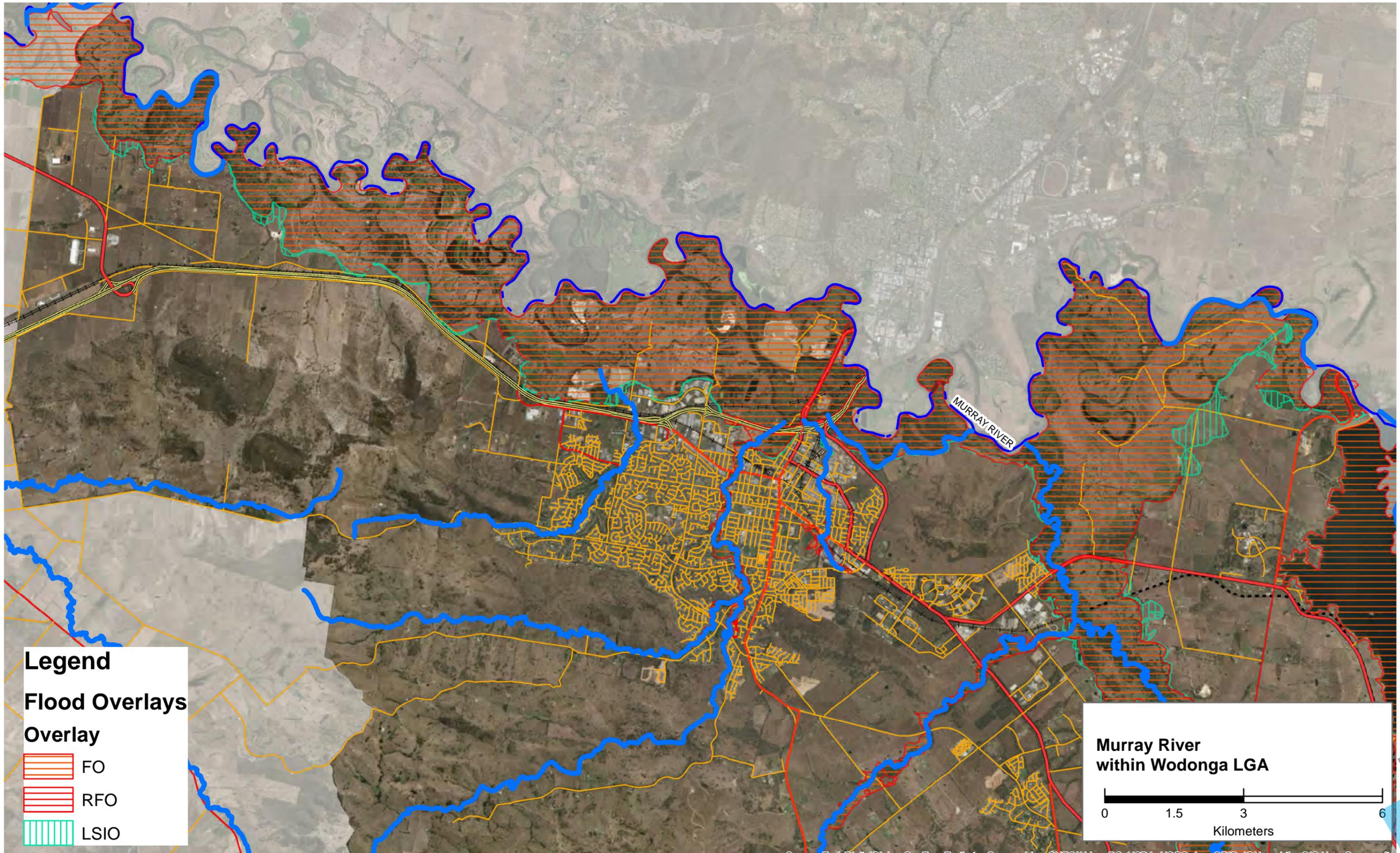
## Appendix F – Maps



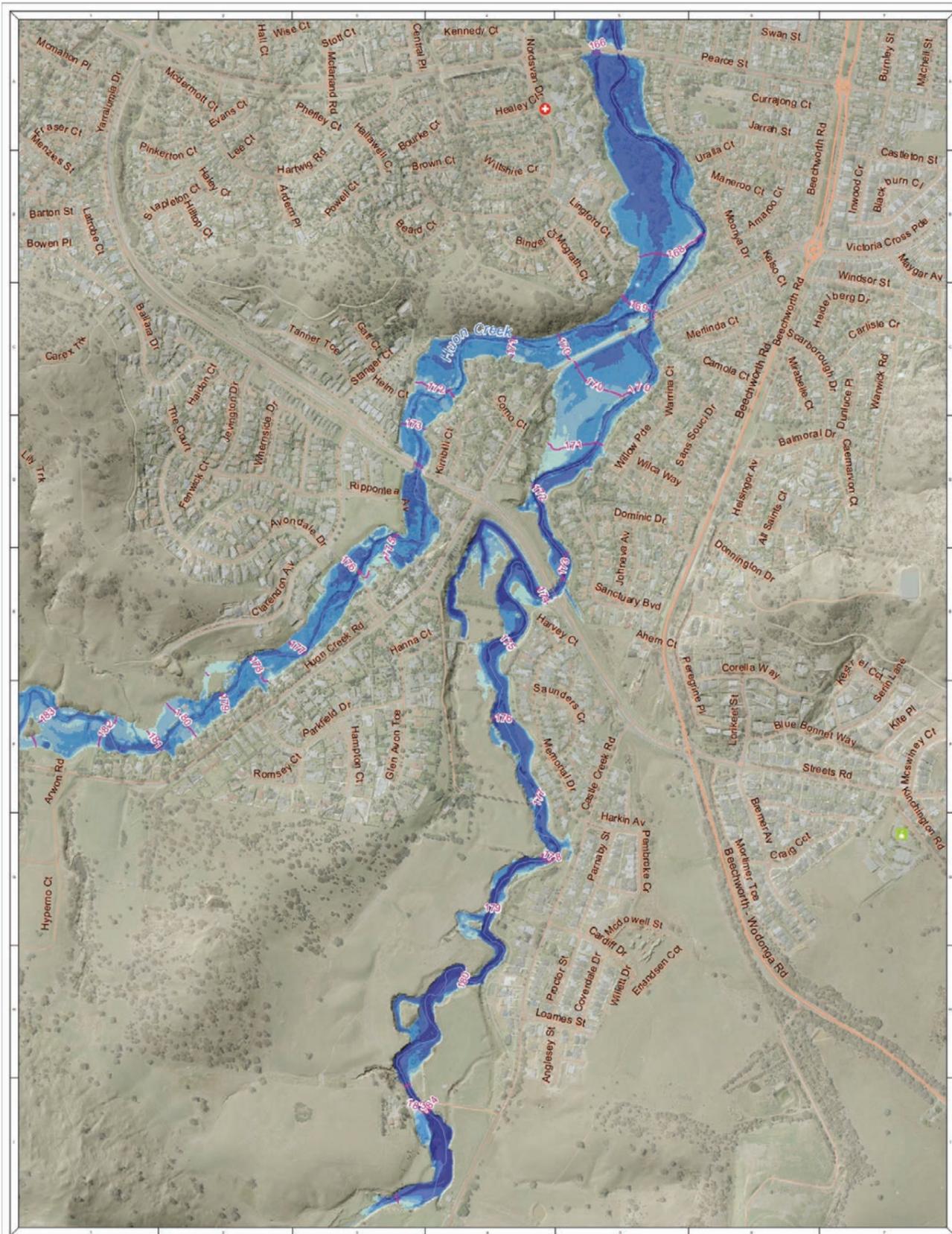
Map 1 - Sanctuary Boulevard levee



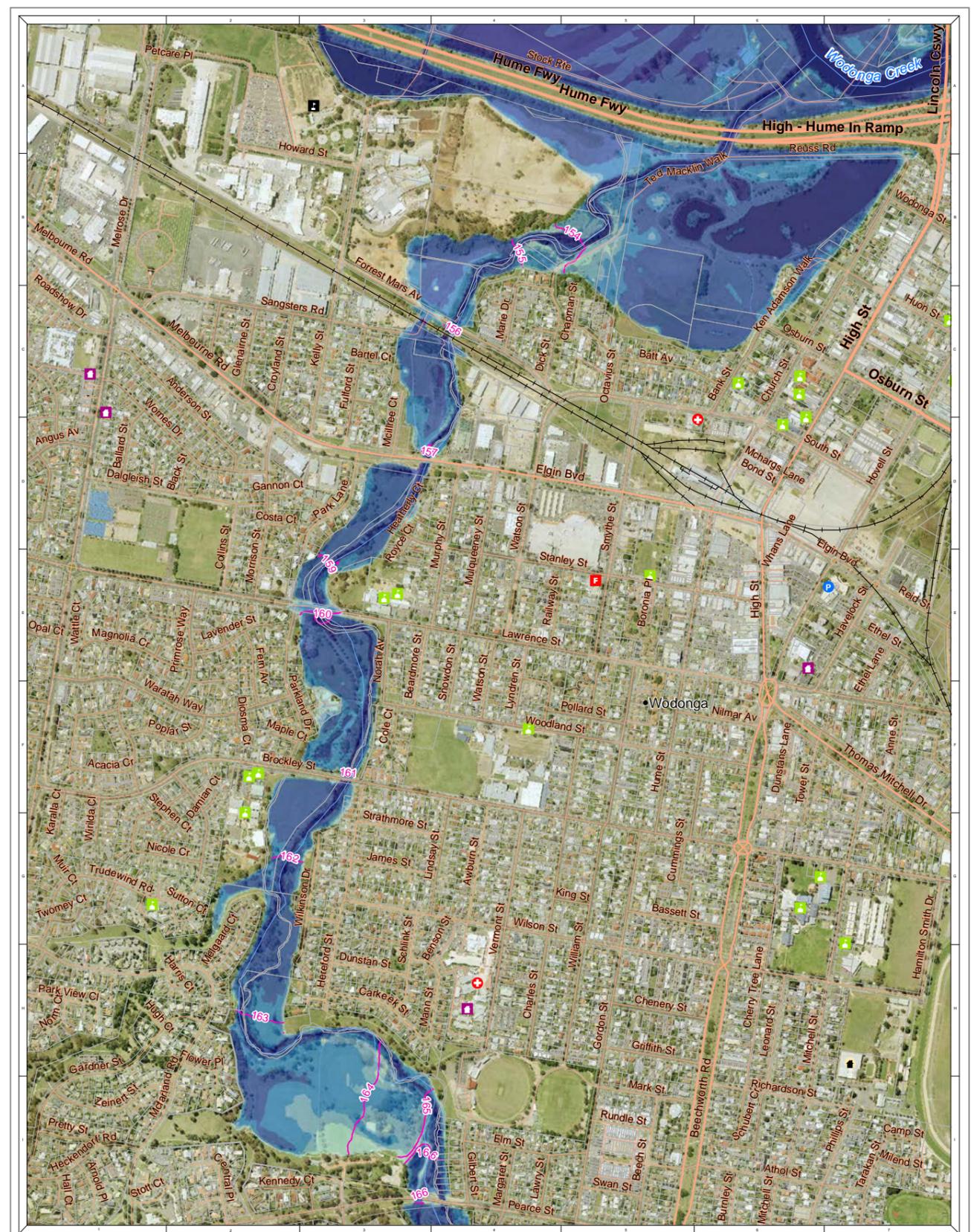
Map 2 - Kiewa River within the Wodonga LGA



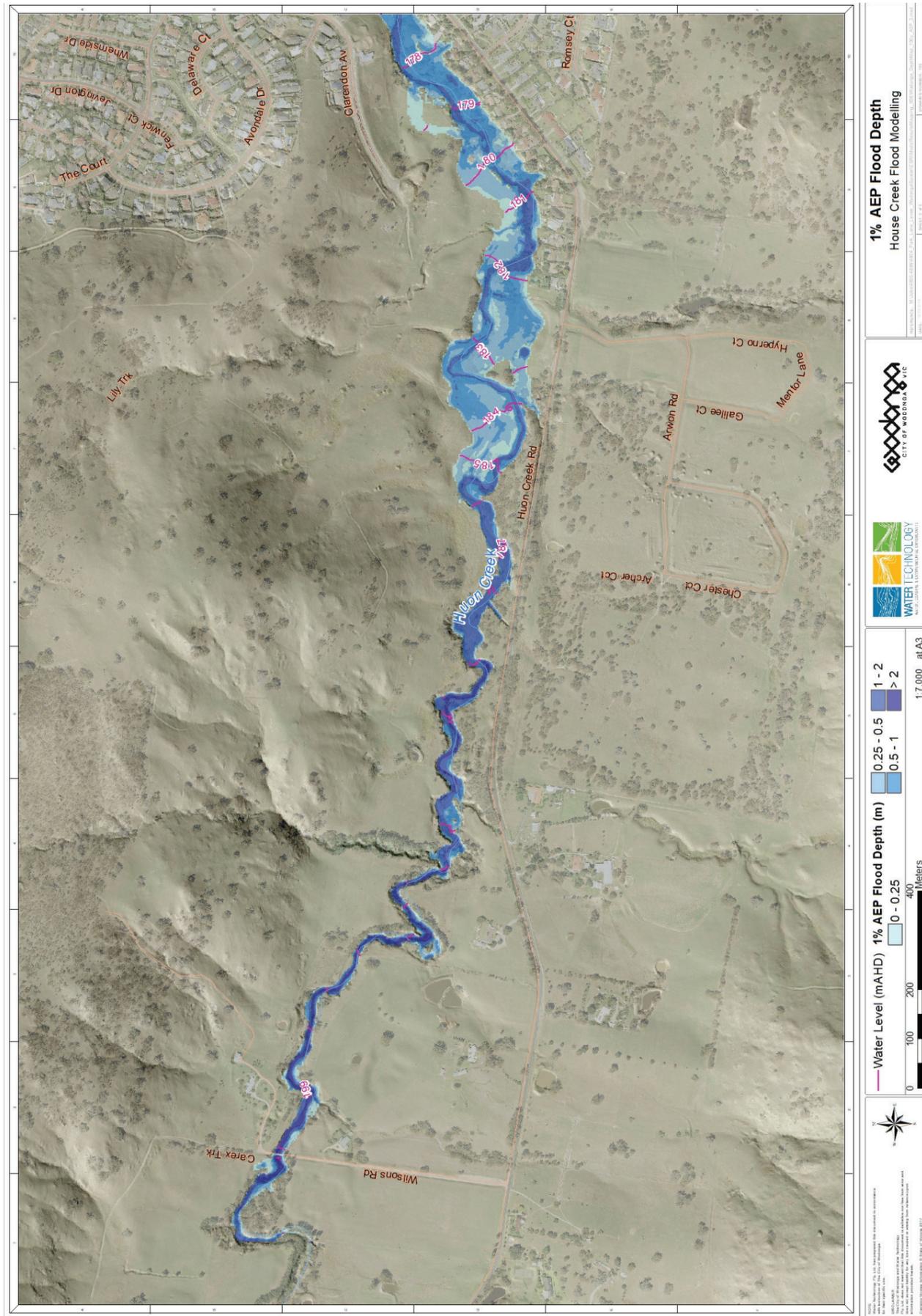
Map 3 - Murray River floodplain within the Wodonga LGA



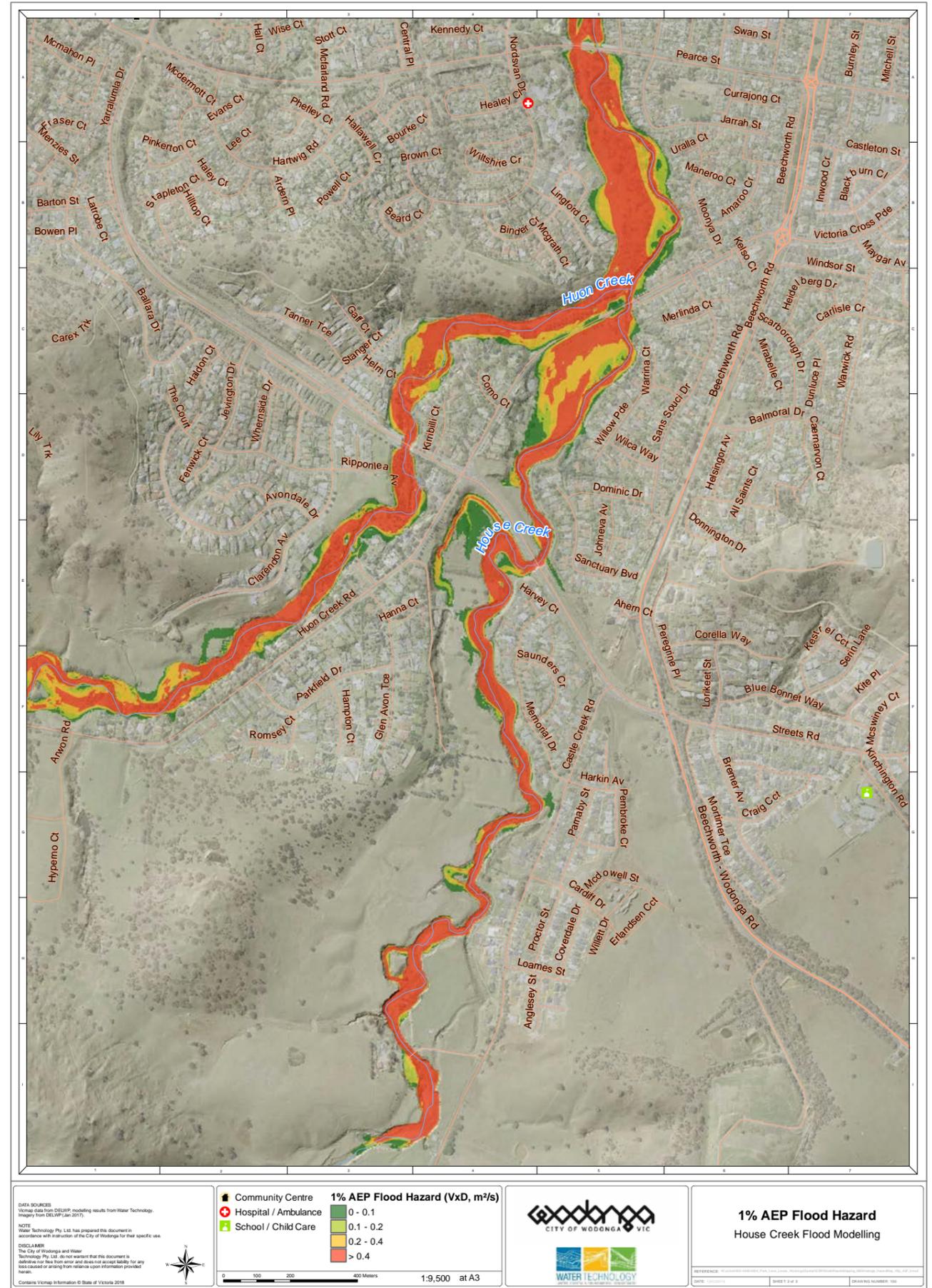
Map 4 - House Creek (upper) one per cent AEP Inundation Map



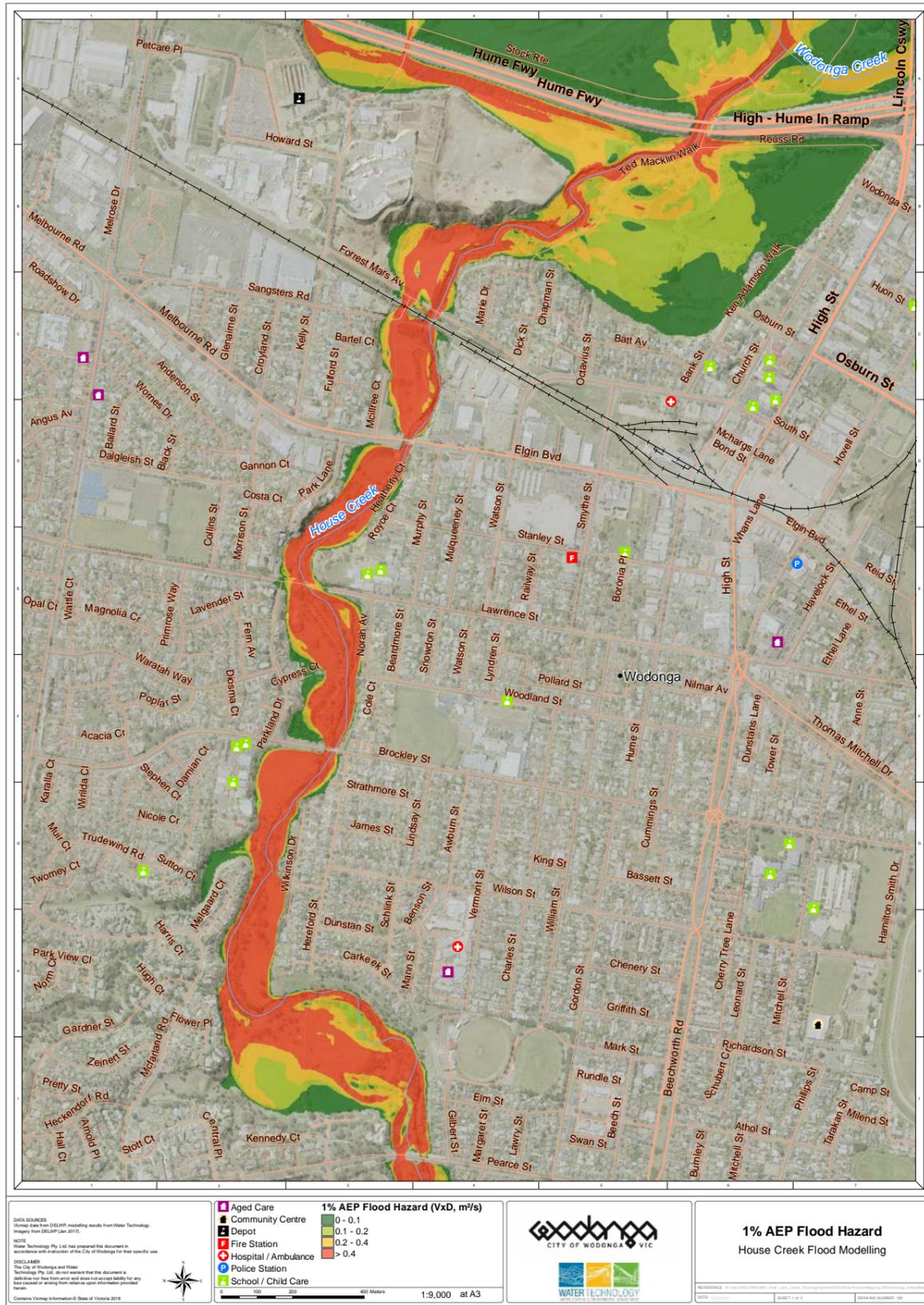
Map 5 - House Creek (lower) one per cent AEP Inundation Map



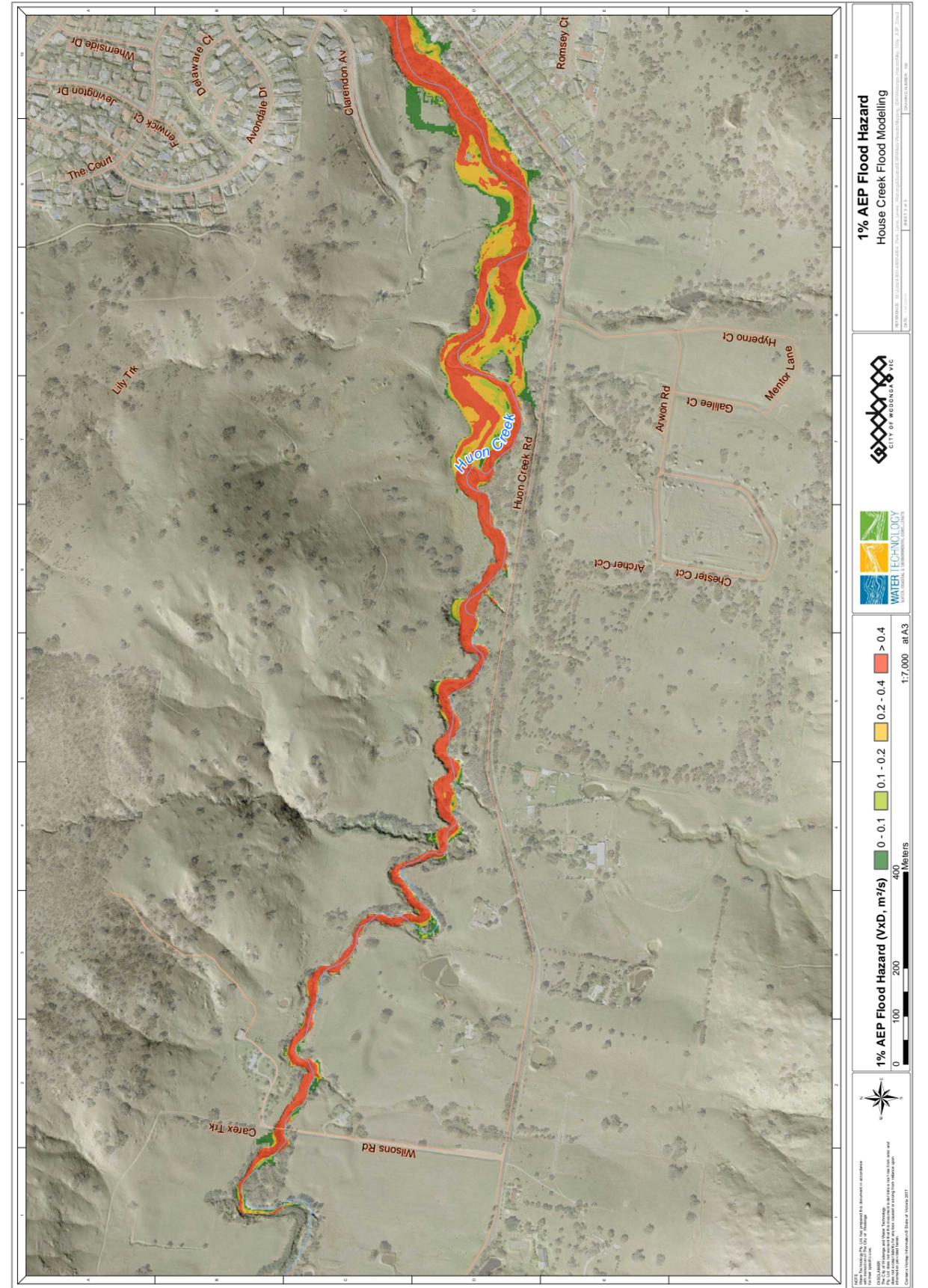
Map 6 - Huon Creek one per cent AEP Inundation Map



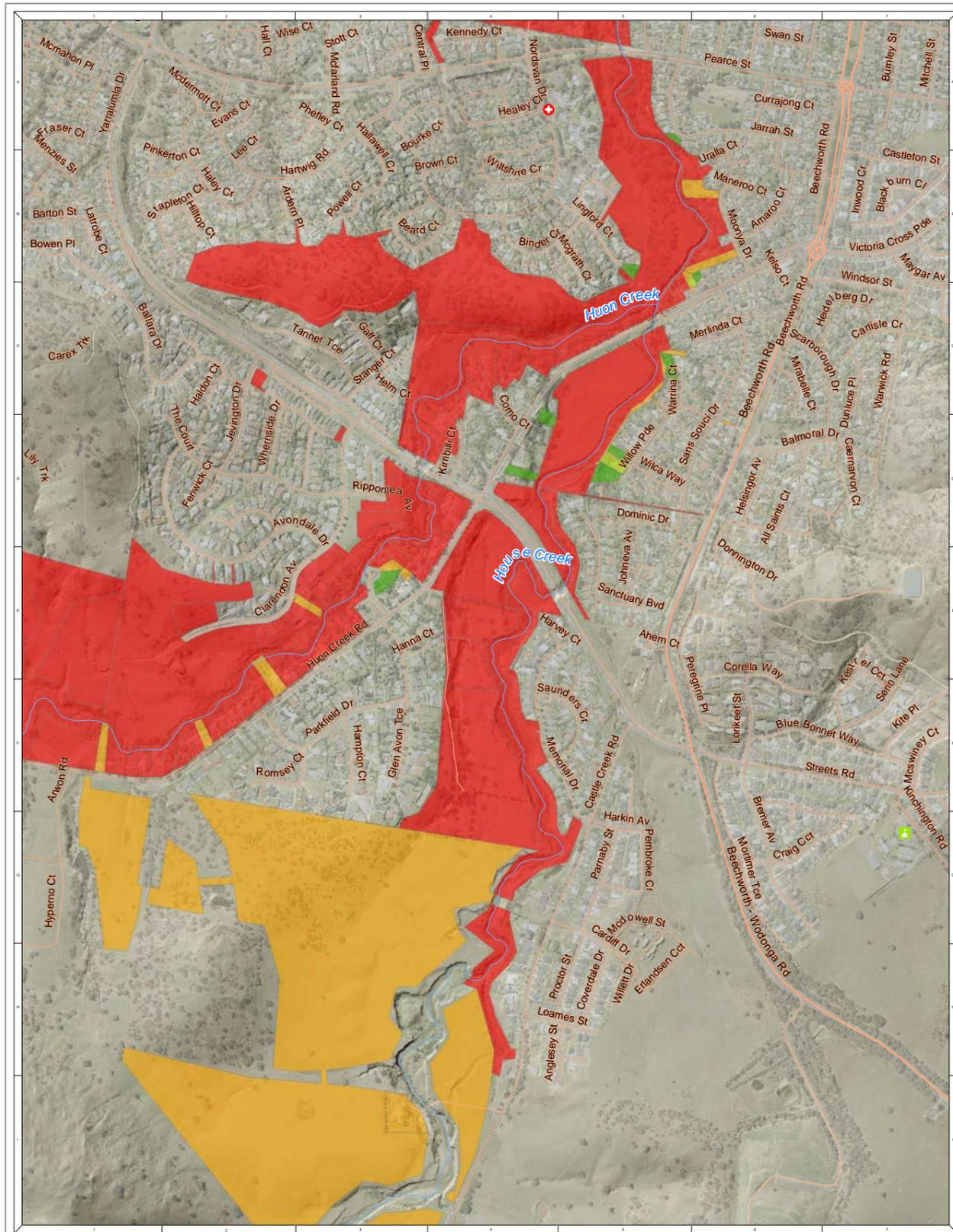
Map 7 - House Creek (upper) one per cent AEP Hazard Map



Map 8 - House Creek (lower) one per cent AEP Hazard Map



Map 9 - Huon Creek one per cent AEP Hazard Map



DATA SOURCES: Vicmap data from DEWPR, modelling results from Water Technology, imagery from DEWPR (Jan 2017).

NOTE: Water Technology Pty Ltd has prepared this document in accordance with instruction of the City of Wodonga for their specific use.

DISCLAIMER: The City of Wodonga and Water Technology Pty Ltd do not warrant that this document is suitable for use from other than the intended user. We are not liable for any loss or damage arising from reliance upon information provided herein.

City of Wodonga VIC

**1% AEP Property Inundation**  
House Creek Flood Modelling

Max Inundation (m)

- 0.0 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 4.0

Community Centre  
Hospital / Ambulance  
School / Child Care

1:9,500 at A3

WATER TECHNOLOGY

REFERENCE: 1% AEP Property Inundation House Creek Flood Modelling

DATE: 10/01/2018 SHEET 2 of 3 DRAWING NUMBER: 100



DATA SOURCES: Vicmap data from DEWPR, modelling results from Water Technology, imagery from DEWPR (Jan 2017).

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City of Wodonga VIC

**1% AEP Property Inundation**  
House Creek Flood Modelling

Max Inundation (m)

- 0.0 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 4.0

Aged Care  
Community Centre  
Depot  
Fire Station  
Hospital / Ambulance  
Police Station  
School / Child Care

1:9,000 at A3

WATER TECHNOLOGY

REFERENCE: 1% AEP Property Inundation House Creek Flood Modelling

DATE: 10/01/2018 SHEET 1 of 3 DRAWING NUMBER: 100

Map 10 - House Creek (upper) one per cent AEP Property Inundation Map

Map 11 - House Creek (lower) one per cent AEP Property Inundation Map

# Appendix H – Victoria State Emergency Service Statewide Guideline – Sandbags

This document outlines guidelines for the procurement, storage, distribution, use and disposal of sandbags during flood emergencies.

## 1. Introduction

The Victoria State Emergency Service (VICSES) is the control agency for flood emergencies. VICSES' responsibilities include the management of the state-wide procurement and storage of sandbags for flood emergencies. This includes providing sandbags to local areas for distribution based on the requirements identified in the Municipal Flood Emergency Plan (MFEP).

The final report of the 2010/2011 Victorian Flood Review observed that during the floods there was inadequate access to sandbags and a lack of knowledge about the filling and use of sandbags. VICSES also noted similar problems during the 2012 North East floods.

Prior to the development of this guideline, sandbag management was not regulated and there was no formal arrangement in place to define the roles and responsibilities for funding the procurement, storage, use and distribution of sandbags.

VICSES, in conjunction with Municipal Association of Victoria (MAV) and local councils, has developed this guideline to assist emergency managers and the community to plan for effective use of sandbags during flood emergencies.

Emergency managers are guided by the state strategic control priorities for flood emergencies. Incident Controllers will apply the strategic control priorities when considering the supply and distribution of sandbags to the community in preparation for and during flood emergencies (Refer to Section 8).

## 2. Purpose

The guideline will assist in ensuring that a consistent approach to the procurement, storage, distribution, safe use and disposal of sandbags is applied at a state level. Further, it is intended to assist in the development of regional and local sandbag guidelines and agreements.

## 3. Use of sandbags for flood emergencies

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 a 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. 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. Sandbags have also been used as temporary levees through the construction of sandbag walls.

**This guideline does not address the use of sandbags in the construction of temporary levees.**

## 4. Partnership arrangements

The success of this guideline is dependent on establishing strong partnerships at the regional and local level between local councils, CFA, MFB and DEPI to support the sandbag management arrangements. Local councils have a key role to assist VICSES through the flood emergency planning process and their ability to support operations.

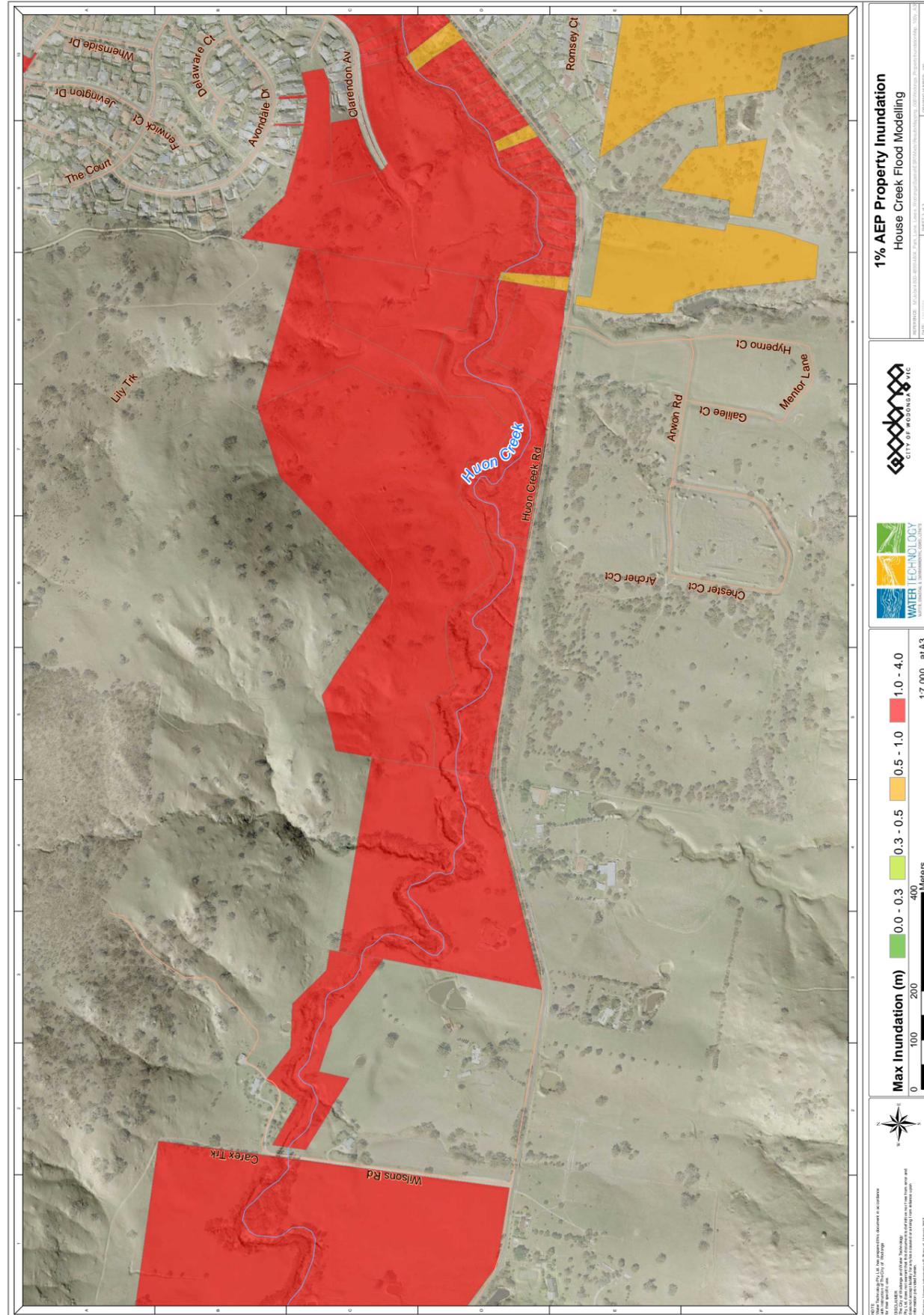
Operational arrangements for the procurement, storage and distribution of sandbags at the local and regional level will be included as an appendix in the MFEP, VICSES is responsible for leading the development of the MFEP.

## 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:



Map 12 – Huon Creek one per cent AEP Property Inundation Map

- 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 (refer to Section 9).

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 for to protect their property
- Following advice from their local council regarding the removal of sandbags from their property, as part of the community recovery.

## 5. Community and business education about sandbags

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](http://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:
  - o The purpose, use and disposal of sandbags (see [www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide](http://www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide))

- o Obtaining sandbags
- o Safety considerations e.g. OHS, manual handling, safe use and disposal
- o Alternative flood mitigation strategies to sandbagging
- o 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:
  - o Emergency response agencies will not always have the capacity to provide sandbags due to other competing priorities
  - o Businesses and individuals need to understand the flood risk to their property and, where appropriate, develop a Flood Emergency Plan
  - o 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.

## 6. Procurement of sandbags

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

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.

## 7. Storage of sandbags

Sandbags will be stored by VICSES in appropriate locations across Victoria. Through the application of risk based assessments, VICSES will work with councils to identify the quantities of sandbags required. This process will be aligned to the MFEP review cycle.

Sandbags will normally be located in a VICSES facility.

Arrangements to store sandbags in other facilities will be identified as part of the local MFEP planning process.

VICSES will monitor the condition of all its sandbags for deterioration.

## 8. Distribution of sandbags

### Priorities for sandbags during flood emergencies

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. These locations and local arrangements will be identified in the MFEP.

The Floodsafe Sandbag Quick Reference Guide (see [www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide](http://www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide)) 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 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.

## 9. 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.

## 10. Transitioning to this guideline

Successful implementation of this guideline may take several years and progress will be reviewed periodically. VICSES will introduce a process for including the local area arrangements for sandbag management in the MFEP. This process will then be rolled out as each MFEP is reviewed.

## 11. Floodsafe weblinks

- FloodSafe homepage: [www.ses.vic.gov.au/prepare/floodsafe](http://www.ses.vic.gov.au/prepare/floodsafe)
- VICSES guidelines on the safe use, for filling and laying of sandbags: [www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide](http://www.ses.vic.gov.au/prepare/floodsafe/floodsafe-resources/sandbag-reference-guide)

## 12. Further information

Contact:

Victoria State Emergency Service  
Victorian Head Office  
168 Sturt Street, Southbank, Victoria 3006

Telephone: (03) 9256 9000  
Email: [vicces@ses.vic.gov.au](mailto:vicces@ses.vic.gov.au)

## SES Regional Sandbag Resource

The VICSES North East Region also holds strategic reserves of sandbags at the following locations. In addition, VICSES maintains small community sandbag caches listed in the relevant MFEPs. The figures below refer to nominal amounts stored subject to refurbishment after an event.

Unit name	Primary contact person	Quantities (refers to individual sandbags)
Alexandra	VICSES Regional Duty Officer	2,500
Beechworth	VICSES Regional Duty Officer	3,000
Benalla	VICSES Regional Duty Officer	9,000
Bright	VICSES Regional Duty Officer	5,000
Chiltern	VICSES Regional Duty Officer	350
Cobram	VICSES Regional Duty Officer	1,500
Corryong	VICSES Regional Duty Officer	100
Euroa	VICSES Regional Duty Officer	8,000
Falls Creek	VICSES Regional Duty Officer	100
Kilmore	VICSES Regional Duty Officer	2,000
Kinglake	VICSES Regional Duty Officer	500
Mansfield	VICSES Regional Duty Officer	1,000
Marysville	VICSES Regional Duty Officer	500
Mitta Mitta	VICSES Regional Duty Officer	50
Murchison	VICSES Regional Duty Officer	2,000
Myrtleford	VICSES Regional Duty Officer	10,000
Numurkah	VICSES Regional Duty Officer	10,000
Rutherglen	VICSES Regional Duty Officer	3,000
Seymour	VICSES Regional Duty Officer	15,000
Shepp SAR	VICSES Regional Duty Officer	5,000
Tallangatta	VICSES Regional Duty Officer	2,500
Tatura	VICSES Regional Duty Officer	2,500
Wangaratta	VICSES Regional Duty Officer	6,000
Wodonga	VICSES Regional Duty Officer	8,000
Yackandandah	VICSES Regional Duty Officer	2,000
Yarrowonga	VICSES Regional Duty Officer	8,000
Wodonga CFA ICC	CFA Duty Officer	32,000
Nathalia Council Works Depot	Moira Shire MERO	10,000
NE RHQ	VICSES Regional Duty Officer	80,000





