



# Baw Baw Shire Flood Emergency Plan

A Sub-Plan of the  
Municipal Emergency Management Plan

For Baw Baw Shire Council  
and  
VICSES Unit(s) Erica & Warragul

Draft Version 1.2 April 2013

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## Distribution List

The Distribution List for this sub plan is the same as in the Municipal Emergency Management Plan.

## Document Transmittal Form / Amendment Certificate

This Municipal Flood Emergency Plan (MFEP) will be amended, maintained and distributed as required by VICSES in consultation with the Baw Baw Shire.

Suggestions for amendments to this Plan should be forwarded to:

VICSES East Regional Headquarters  
82a Moore Street  
MOE VIC 3825

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

Amendment Number	Date of Amendment	Amendment Entered By	Summary of Amendment

This Plan will be maintained on the Baw Baw Shire website [www.bawbawshire.vic.gov.au](http://www.bawbawshire.vic.gov.au)

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## List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan:

<u>AEP</u>	Annual Exceedance Probability
<u>AHD</u>	Australian Height Datum (the height of a location above mean sea level in metres)
<u>AIIMS</u>	Australasian Inter-service Incident Management System
<u>AoCC</u>	Area of Operations Control Centre / Command Centre
<u>ARI</u>	Average Recurrence Interval
<u>ARMCANZ</u>	Agricultural & Resource Management Council of Australia & New Zealand
<u>AV</u>	Ambulance Victoria
<u>BoM</u>	Bureau of Meteorology
<u>CEO</u>	Chief Executive Officer
<u>CERA</u>	Community Emergency Risk Assessment
<u>CERM</u>	Community Emergency Risk Management
<u>CFA</u>	Country Fire Authority
<u>CMA</u>	Catchment Management Authority
<u>RERC</u>	Regional Emergency Response Coordinator
<u>RERCC</u>	Regional Emergency Response Coordination Centre
<u>DHS</u>	Department of Human Services
<u>DH</u>	Department of Health
<u>DoI</u>	Department of Infrastructure
<u>DPI</u>	Department of Primary Industries
<u>DSE</u>	Department of Sustainability and Environment (successor body to DNRE)
<u>EMLO</u>	Emergency Management Liaison Officer
<u>EMMV</u>	Emergency Management Manual Victoria
<u>EMT</u>	Emergency Management Team
<u>EO</u>	Executive Officer
<u>FO</u>	Floodway Overlay
<u>FWS</u>	Flood Warning System
<u>FZ</u>	Floodway Zone
<u>IC</u>	Incident Controller
<u>ICC</u>	Incident Control Centre
<u>IMT</u>	Incident Management Team
<u>IMS</u>	Incident Management System
<u>LSIO</u>	Land Subject to Inundation Overlay
<u>MECC</u>	Municipal Emergency Coordination Centre
<u>MEMP</u>	Municipal Emergency Management Plan
<u>MEMPC</u>	Municipal Emergency Management Planning Committee
<u>MERC</u>	Municipal Emergency Response Coordinator
<u>MERO</u>	Municipal Emergency Resource Officer
<u>MFB</u>	Metropolitan Fire and Emergency Services Board
<u>MRM</u>	Municipal Recovery Manager
<u>PMF</u>	Probable Maximum Flood
<u>RCC</u>	Regional Control Centre
<u>RDO</u>	Regional Duty Officer
<u>SBO</u>	Special Building Overlay
<u>SCC</u>	State Control Centre
<u>SEWS</u>	Standard Emergency Warning System
<u>SHERP</u>	State Health Emergency Response Plan
<u>SOP</u>	Standard Operating Procedure
<u>VicPol</u>	Victoria Police
<u>VICSES</u>	Victoria State Emergency Service

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## Part 1. INTRODUCTION

### 1.1 Municipal Endorsement

The Baw Baw Shire Council is the custodian of this Municipal Flood Emergency Plan (MFEP), as a sub plan of the Baw Baw Shire Municipal Emergency Management Plan (MEMP).

This MFEP has been prepared by the Municipal Flood Planning Sub-Committee with the authority of the Municipal Emergency Management Committee (refer to section 1.6 endorsement of plan) pursuant to Section 20 of the Emergency Management Act 1986 (as amended).

The Baw Baw Shire Council has undertaken consultations with the communities of Baw Baw about the arrangements contained within this plan as detailed in Appendix H:

This MFEP is consistent with the Emergency Management Manual Victoria (EMMV) and the Victoria Flood Management Strategy (DNRE, 1998a), and takes into account the outcomes of the Community Emergency Risk Assessment (CERA) process undertaken by the Municipal Emergency Management Planning Committee (MEMPC).

This Plan links with the Flood Management Plan, prepared by Baw Baw Shire, to assist in the delivery of flood management responsibilities and the implementation of suitable measures to manage the risks associated with flooding.

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

This Municipal Flood Emergency Plan is a result of the cooperative efforts of the Baw Baw Shire Flood Planning Committee (MFPC) and its member agencies. The signatories below, on behalf of their respective agencies commit to the implementation of this plan as it applies to each agency.

**Helen Antsis**

Chief Executive Officer  
Baw Baw Shire

Date:

**Clint Saarinen**

Regional Manager  
VICSES East Region

Date:

**Ricky Ross APM**

Regional Emergency Management  
Inspector  
Victoria Police

Date:

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## 1.2 The Municipality Flood Risk Profile

The approximate population of Baw Baw Shire as at 2011 Census was 44,042. The Shire contains 14 townships and many small hamlets, with the largest population areas being Warragul, Drouin and Trafalgar.

Baw Baw Shire is located in West Gippsland, approximately 120 km east of Melbourne and 20 km west of the Latrobe Valley. The Shire is made up of over 100 localities spread over 3,855 square kilometres of rolling green hills, towns, mountains and top agricultural land.

Major rivers within the municipality are the Thomson, Tarago, Latrobe, Tyers and Moe plus numerous other creeks and water courses. More detailed risk is explained in Appendix A to this plan.

Flood is identified as a High risk within Baw Baw Shire, as detailed in the 2010 MEMP. This has been validated again in the 2012 CERM Review. Melbourne Water has produced a Floodplain Risk Management Plan (Flood Management Plan) to further assess detailed flooding risks in the municipality and detail flood mitigation infrastructure opportunities.

Detailed flood threats, information and response information for each river system and identified at risk community is provided in the attachments and appendices to this plan.

## 1.3 Purpose and Scope of this Flood Emergency Plan

The purpose of this MFEP is to detail arrangements agreed for the planning, preparedness/prevention, response and recovery from flood incidents within Baw Baw Shire.

As such, the scope of the Plan is to:

- Identify the Flood Risk to Baw Baw Shire;
- Support the implementation of measures to minimise the causes and impacts of flood incidents within the Baw Baw Shire;
- Detail Response and Recovery arrangements including preparedness, Incident Management, Command and Control and Co-ordination;
- 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 Baw Baw Shire Flood Planning Committee (MFPC) will comprise of the following representatives from the following agencies and organisations:

- Victoria Police (i.e. Municipal Emergency Response Co-ordinator) (MERC) (**Chair**),
- VICSES, Regional Officer – Emergency Management
- Baw Baw Shire, MERO
- Melbourne Water
- West Gippsland Catchment Management Authority,
- Other agencies and community representatives or consultants as required.

## 1.5 Responsibility for Planning, Review & Maintenance of this Plan

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

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

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The MFPC will meet at least once per year.

The plans should be reviewed:

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

## **1.6 Endorsement of the Plan**

The MFEP will be circulated to Municipal Flood Planning Sub-Committee members seeking acceptance of the draft plan.

Upon acceptance, the plan is forwarded to the MEMPC and Council for endorsement with the recommendation to include the MFEP as a sub-plan of the MEMPlan.

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## **Part 2. PREVENTION / PREPAREDNESS ARRANGEMENTS**

### **2.1 Community Awareness for all Types of Flooding**

Details of this MFEP will be released to the community through local media, the FloodSafe program, websites (VICSES and the Municipality) upon formal adoption by Baw Baw Shire. Current community groups will be utilised for town specific consultation and engagement.

VICSES will co-ordinate community education programs for flooding within the Council area, with the support of Baw Baw Shire, Melbourne Water and West Gippsland CMA, eg StormSafe / FloodSafe.

### **2.2 Structural Flood Mitigation Measures**

Subject to the provisions of the Baw Baw Planning Scheme, Baw Baw Shire encourages residents and business owners / operators in potentially flood prone areas to plan and put in place effective flood protection measures for their dwellings and business premises. This applies in particular to areas subject to flash flooding and overland flows.

The flood mitigation works that exist within the Council area are described in Appendix A to this plan.

### **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 and/or after a major flood event. 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 BoM website.

The BoM operates a flood warning system for the Latrobe River and its tributaries within Baw Baw Shire, ie Latrobe River, Moe River, Tanjil River and Thomson River.

Comments made on behalf of the Municipality relating to Council matters must be approved by the MERO or the Chief Executive Officer (CEO) or delegate with regard to response issues and by the Municipal Recovery manager (MRM) or the CEO or delegate with regard to recovery issues.

The method(s) used to disseminate information to communities, particularly recovery related information, will be decided at the time. Additional information on public information and warning and the methods that may be considered are detailed in the MEMP. This includes the details of appropriate media outlets.

#### **2.3.3 Flood Wardens**

No arrangements exist or are planned in Baw Baw Shire for Flood Wardens.

## **Part 3. RESPONSE ARRANGEMENTS**

### **3.1 Introduction**

#### **3.1.1 Activation of Response**

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

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The Incident Controller/RDO will activate agencies as required and as documented in the Region and 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 Baw Baw Shire. These agencies will be engaged through the EMT.

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

### **3.1.3 Municipal Emergency Coordination Centre (MECC)**

If a MECC is established for a flood event, VICSES will provide an EMLO.

The VICSES RDO / ICC will liaise with the MECC directly.

If an Incident EMT is established, the Municipality will maintain involvement in the Incident EMT.

The function, location, establishment and operation of the MECC is the responsibility of Baw Baw Shire and will be detailed in the Baw Baw Shire MEMP.

### **3.1.4 Escalation**

Most flood incidents are of local concern and an appropriate response can usually be coordinated using local resources. However, when these resources are exhausted, the State's arrangements provide for further resources to be made available, firstly from neighbouring Municipalities (on a regional basis) and then on a State-wide basis.

Resourcing and event escalation arrangements are described in the EMMV ('State Emergency Response Plan' – section 3.5).

The six Gippsland Municipalities have a resource sharing agreement in place for emergency events as detailed in the MEMP.

## **3.2 Strategic Control Priorities**

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

1. Protection and preservation of life is paramount - this includes:
  - a. Safety of emergency services and other agency personnel, and;
  - b. Safety of community members including vulnerable community members and visitors/tourist located within the incident area.
2. Issuing of community information and community warnings detailing incident information that is timely, relevant and tailored to assist community members make informed decisions about their safety.;
3. Protection of critical infrastructure and community assets that supports community resilience;
4. Protection of residential property as a place of primary residence;
5. Protection of assets supporting individual livelihoods and economic production that supports individual and community financial sustainability
6. Protection of environmental and conservation values that considers the cultural, biodiversity, and social values of the environment;

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

### 3.3 Command, Control & Coordination

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

The specific details of the Command, Control and Coordination arrangements for this plan are 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 DSE as the Control Agency responsible for “*dam safety, water and sewerage asset related incidents*” and other emergencies

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

#### 3.3.2 Incident Controller (IC)

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

#### 3.3.3 Incident Control Centre (ICC)

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

Pre-determined Incident Control Centre locations are

- **Level 1** – Local VICSES Unit (Warragul & Erica)
- **Level 2** - VICSES East Region Headquarters, 82a Moore St Moe or VICSES East Region Office, 130 Macleod Street, Bairnsdale
- **Level 3** – Multi Agency Control Facility, Franklin Street, Traralgon or VICSES East Region Office, 130 Macleod Street, Bairnsdale

#### 3.3.4 Divisions and Sectors

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

Divisions and Sectors may cover a geographic boundary outside of Baw Baw Shire (i.e. including parts of Latrobe City Council, Bass Coast Shire or Cardinia Shire depending on operational requirements. These will be established by the ICC during an event.

#### 3.3.5 Incident Management Team (IMT)

The Incident Controller will form an Incident Management Team (IMT). Refer to 3.5 of the EMMV for guidance on IMT's and Incident Management Systems (IMS's).

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### 3.3.6 Emergency Management Team (EMT)

The Incident Controller will establish a multi-agency Emergency Management Team (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 Incident Controller for consideration in developing incident management strategies.

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

Refer to 3.5 of the EMMV for guidance on EMTs.

### 3.3.7 On Receipt of a Flood Watch / Severe Weather Warning

**Baw Baw Shire Council** will operate as defined within their Standard Operating Procedures.

The **VICSES** Incident Controller/ RDO will:

- Ensure flood bulletins and community information are prepared and issued to the community;
- Notify and brief appropriate officers, this includes (if established) Regional Control Centre (RCC), State Control Centre (SCC), Council and other emergency services through the EMT;
- Assess ICC readiness (including staffing of IMT and EMT) and open if required;
- 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;
- Monitor watercourses and undertake reconnaissance of low-lying areas;
- Ensure flood mitigation works are being checked by owners.
- Develop and issue incident action plan(s); and
- Develop and issue situation report(s).

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

**Baw Baw Shire Council** will operate as defined within their Standard Operating Procedures (to be developed)

The **VICSES** Incident Controller/ RDO will:

- Continue to review flood intelligence to assess likely flood consequences;
- Determine what the at-risk community need to know and do as the flood develops;
- Continue to warn the at-risk community including ensuring that an appropriate warning and community information strategy is implemented;
- Liaise with relevant asset owners as appropriate (i.e. water and power utilities);
- Implement response strategies as required based upon flood consequence assessment;
- Continue to monitor the flood situation – [www.bom.gov.au/vic/flood/](http://www.bom.gov.au/vic/flood/) and [www.bom.gov.au](http://www.melbournwater.com.au/content/rivers_and_creeks/rainfall_and_river_level_data/rainfall_and_river_level_data.asp), [http://www.melbournwater.com.au/content/rivers\\_and\\_creeks/rainfall\\_and\\_river\\_level\\_data/rainfall\\_and\\_river\\_level\\_data.asp](http://www.melbournwater.com.au/content/rivers_and_creeks/rainfall_and_river_level_data/rainfall_and_river_level_data.asp); and
- Continue to undertake reconnaissance of low-lying areas.

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### **3.4 Community Information and Warnings**

The Bureau of Meteorology has the responsibility for issuing Flood and Severe Weather Warnings.

VICSES, as the Control Agency, co-ordinates further community messaging.

Council has the responsibility to assist VICSES to warn individuals as required within the municipality.

Other agencies such as CFA, DSE and VICPOL may be requested to assist VICSES with the communication of community flood warnings.

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

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

Guidelines for the distribution of community information and warnings are contained in the State Flood Emergency Plan.

Community information and warnings will be targeted at local, regional and state wide needs and may include:

- Emergency Alert;
- Radio and Television;
- Verbal Messages (i.e. Doorknocking);
- Agency Websites;
- VICSES Flood Storm Information Line;
- Variable Message Signs (i.e. road signs);
- Community meetings & newsletters; and
- Social media.

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

### **3.5 Media Communication**

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

### **3.6 Rapid Impact Assessment**

Rapid Impact Assessment is the responsibility of Victoria Police.

Rapid impact assessment will be conducted in accordance with part 3 of the EMMV to assess and record the extent and nature of damage caused by flooding. This information will then be used to provide the basis for further needs assessment and recovery planning by DHS 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 Incident Controller will consult with relevant agencies to ensure that resources are in place if required to provide emergency response. These resources might include emergency service personnel, food items and non-food items such as medical supplies, shelter, assembly areas, relief centres etc.

### **3.8 Response to Flash Flooding**

Emergency management response to flash flooding should be consistent with the guidelines within the State Flood Emergency Plan.

Areas that are commonly affected by flash flooding are listed in the Attachments to this flood plan.

### **3.9 Evacuation**

VicPol is the control agency responsible for evacuations. The decision to recommend evacuation to VicPol rests with the Incident Controller.

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

VICSES is responsible for the development and communication of evacuation warnings.

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

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

### **3.10 Flood Rescue**

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

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

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

### **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 and approval of the Incident Controller.

A Helipad is located at West Gippsland Hospital, Landsborough Street, Warragul.

Light aircraft landing strips are located at Longwarry, Labertouche and Drouin South.

### **3.12 Resupply**

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

When predictions/intelligence indicates that communities, neighbourhoods and/or households may become isolated, VICSES will advise businesses and/or households that they should stock up on essential items.

After the impact, VICSES can support isolated communities through assisting with the transport of essential items to isolated communities and assisting with logistics functions.

Resupply operations are to be included as part of the emergency relief arrangements with VICSES working with the relief agencies to service communities that are isolated.

### **3.13 Essential Community Infrastructure and Property Protection**

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

Each SES Unit maintains a small stock of sandbags. Back-up supplies are available through the VICSES Regional Headquarters. The Incident Controller will determine the priorities related to the use of sandbags, which will be consistent with the strategic priorities and VICSES Sandbag Policy.

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

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

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

### **3.14 Disruption to Services**

Disruption to services other than essential community infrastructure and property can occur in flood events.

Refer to Appendix C for specific details of likely disruption to services.

### **3.15 Road Closures**

Baw Baw Shire and VicRoads will carry out their formal functions of road closures including observation and placement of warning signs, road blocks etc. to its designated local and regional roads, bridges, walking and bike trails.

Baw Baw Shire will advise VicRoads as to the need or advisability of erecting warning signs and / or of closing roads and bridges under its jurisdiction.

Baw Baw Shire will advise VicRoads of all road closures within Council's jurisdiction.

VicRoads are responsible for designated main roads and highways and Councils are responsible for the designated local and regional road network.

VicRoads will communicate community information regarding road closures.

Refer to Appendix A for specific details of likely road closures during flooding events.

### **3.16 Dam Failure**

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

There are four (4) main reservoirs in Baw Baw Shire with the potential to cause significant rural inundation and possible agricultural damage.

- Tarago Reservoir (Tarago River)
- Thomson Dam (Thomson River)
- Blue Rock Lake (Tanjil River)
- Moondarra Reservoir (Tyers River)

### **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, it is the responsibility of Melbourne Water (Longwarry) and Gippsland Water to undertake the following:

- Advise VICSES & Baw Baw Shire Council of the vulnerability of critical sewerage assets to assist preparedness and response activities in the event of flood;
- Maintain or reduce the vulnerability of critical sewerage assets;
- Check and correct where possible the operation of critical sewerage assets in times of flood;
- Advise the ICC in the event of inundation of critical sewerage assets.

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

### **3.18 After Action Review**

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

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

### **3.19 Recording of Flood Information**

During and immediately after a flood it is important that key aspects of the event are recorded for future reference.

Arrangements for the collection / recording of all flood related information is the responsibility of the Municipality with assistance from VICSES and Melbourne Water will assist. The MERO should ensure there is no duplication of data collection activities and efforts, in particular it should be integrated with post-impact assessment activities.

Data to be collected includes:

- The date / time on the reference river gauge when key infrastructure (eg. drains, roads, buildings, etc.) is first affected by rising flood waters;
- The extent and depth of the peak of the flood within the precinct(s) affected as well as at strategic locations within the Municipality (in conjunction with Melbourne Water);
- As part of and in preparation for the above, actively encourage residents to mark the flood peak with a permanent marker on a permanent structure within their property and to note the date / time of its occurrence; and
- Flood damage – in both qualitative and quantitative terms.

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## **Part 4. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS**

### **4.1 General**

Relief and recovery arrangements within Baw Baw Shire are detailed in the Baw Baw Shire MEMP and/or the Relief and Recovery Sub-plan.

### **4.2 Emergency Relief**

The decision to recommend the opening of an emergency relief centre rests with the Incident Controller. Incident Controllers are responsible for ensuring that relief arrangements have been considered and implemented where required under the State Emergency Relief and Recovery Plan (Part 4 of the EMMV).

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

Details of the relief arrangements are available in the MEMP / Relief and Recovery Plan.

### **4.3 Animal Welfare**

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

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

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

### **4.4 Transition from Response to Recovery**

VICSES as the Control Agency is responsible for ensuring effective transition from response to recovery. This transition will be conducted in accordance with existing arrangements as detailed in Part 3 Section 3.10 of the EMMV.

This may include a formal transition agreement from response to recovery, signed by local, regional and state representatives.

APPENDICES A-F



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## ASSOCIATED REPORTS

- | Flood Management Plan for Baw Baw Shire Council, Melbourne Water and West Gippsland CMA, 2013
- | Strategic Flood Intelligence Report – Latrobe Basin, Water Technology for VICSES, 2011
- | Flood Warning Data Collection Network Map – Latrobe Basin, Bureau of Meteorology
- | Warragul Urban Drainage Strategy, for WGCMA & GCB by SKM, 2008
- | Hazel & Spring Creeks Hydrology and Hydraulics Review, for BBSC by Earth Tech, February 2004
- | Warragul Flood Study & Modelling Project Report, for BBSC by Water Technology, December 2012
- | Warragul Waterways Flood Mapping Project, for WGMA by Water Technology, December 2012
- | Report on Land Use Determination in the Tarago River Catchment, Soil Conservation Authority, Land Conservation Council, March 1973
- | Department of Primary Industries, Inland Angling Guide, Bunyip River Catchment  
<http://www.dpi.vic.gov.au/fisheries/recreational-fishing/inland-angling-guide>
- | Environment Victoria, <http://environmentvictoria.org.au/content/latrobe-river>
- | Flood Class Level Review - Latrobe Basin, Thiess Services for Department of Sustainability & Environment, 2012

## ACCURACY & CONFIDENTIALITY

Use this information as a guide to the possible effects of a flood. This card is based on estimates of flood behaviour and particular effects may occur at heights different from those indicated here. They may also occur at slightly different heights in different floods. This card may contain sensitive information about the effects of flooding on private property. Specific reference to private addresses or businesses must be made directly to owners or other emergency services but not via broadcast or print media.

# APPENDIX A – FLOOD THREATS

## OVERVIEW OF RIVER SYSTEM

### GENERAL

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Baw Baw Shire is a large rural municipality with an area of approximately 4,030 km<sup>2</sup> and a population of approximately 44,000 (2011 Census). It is on the edge of Melbourne's south east growth corridor with the Latrobe Valley to its east.

Major towns in Baw Baw Shire are: Warragul, Drouin, Yarragon, Longwarry, Trafalgar and Walhalla, most of which have a flood risk profile.

### DESCRIPTION OF MAJOR WATERWAYS AND DRAINS

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There are several major waterways within Baw Baw Shire that flow generally eastwards into the Gippsland Lakes and into Bass Strait near Leaks Entrance. These include the Latrobe, Moe, Tanjil and Thomson Rivers and Narracan Creek.

The Tarago, Bunyip and Lang Lang Rivers rise at the western end of the Shire and flow to the west into Westernport Bay.

The main waterways in the Shire are:

#### | BUNYIP RIVER BASIN

- **Bunyip River**
- **Tarago River** (Tarago Reservoir)
- **Lang Lang River** (O'Mahoney Creek)

#### | LATROBE RIVER BASIN

- **Latrobe River** – from 1km upstream of its confluence with the Moe River and including Pioneer Creek, Ada River, Benny Creek, Loch River, Toorong River & Hawthorn Creek.
- **Moe River** - from 1km upstream of its confluence with the Latrobe River and including Hazel, Spring, Shady, Red Hill & Bear Creeks and the Moe Drain.
- **Narracan Creek** – upstream of Coalville.
- **Tanjil River** - from 3km upstream of its confluence with the Latrobe River and including Icy Creek, Tanjil River West Branch, Tanjil River East Branch and Serpentine Creek.
- **Tyers River** – most of the river and including Tyers River West Branch, Christmas Creek and Tyers River East Branch.
- **Rintoul Creek East Branch**
- **Eaglehawk Creek**
- **Thomson River** - from upstream of the Old Walhalla-Cowwarr Road and including the Jordan River, Aberfeldy River, Donnelly Creek, Fulton Creek and Stringers Creek.

There are also four large reservoirs in the Shire which are discussed later in the plan.

| **Thomson Dam** (Thomson River)

| **Moondarra Reservoir** (Tyers River)

| **Blue Rock Lake** (Tanjil River)

| **Tarago Reservoir** (Tarago River)

## BUNYIP BASIN (Bunyip River, Tarago River, Lang Lang River)

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### BUNYIP RIVER

The **Bunyip River** rises in forested hills near **Tonimbuk** flowing south towards the **Princes Highway**. In the upper reaches the stream is 3-5 m wide and contains a Melbourne Water diversion weir. Approximately 8km north of the Princes Highway the land becomes flatter and has been cleared for farming. The river continues to flow south to the Princes Highway at **Longwarry North** where it is joined from the west by **Cannibal Creek** and then **Labertouche Creek** to the east just prior to crossing the Princes Highway near **Longwarry North**. Downstream from the Princes Highway the river has been formed into a drainage channel known as the Main Drain which is 10-12m in width. The drain continues in a south westerly direction, out of Baw Baw Shire, through **Koo Wee Rup**, across the **South Gippsland Highway** and into **Westernport Bay**.

### TARAGO RIVER

The **Tarago River** is in the Bunyip River catchment and has an on-stream reservoir called **Tarago Reservoir** (37,500ML) immediately west of the township of **Neerim South**. The catchment extends to the north to the township of **Mayook** and westwards to the ridge which forms the common boundary between this catchment and the main Bunyip River catchment. Above Tarago Reservoir the river flows through steep forest, below the Reservoir the river flows through open hilly country, is wider (8-10m) and has low banks and good riparian vegetation. It first flows east then south to the reservoir then south and south west to **Tarago** and west to **Drouin West** and out of Baw Baw Shire.

### LANG LANG RIVER

The **Lang Lang River** rises in open, moderately hilly country around the **Warragul-Korumburra Rd** and **Ross & Witherdons Rd** intersection as a shallow stream becoming progressively wider (6m) as it flows towards **Heath Hill**. The catchment is highly modified, with the stream channelised in some areas.

The River travels east and then north to **Poowong East** and then joins with **O'Mahoneys Creek** north east of **Athlone**. It then travels west with **Pheasant Creek** joining from the south after passing through **North Poowong**. The river then continues to travel west to **Heath Hill**. Below Heath Hill, the river has been straightened and partly channelised with steep banks. It then travels west and south west out of Baw Baw Shire, through **Lang Lang** and to **Westernport Bay**.

## LATROBE BASIN (Latrobe, Moe, Tanjil, Tyers & Thomson Rivers and Narracan Ck)

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The **Latrobe River** begins its journey on the southern slopes of the Great Dividing Range, flowing through Baw Baw Shire, Latrobe City and Wellington Shire and into the Gippsland Lakes at Lake Wellington, joining Bass Strait at Lakes Entrance.

The basin extends south to north from the **Strzelecki Ranges** to the **Great Dividing Range**. It consists of an elongated central area of flat cleared farmland plus a larger northern and smaller southern area of forested, steep mountain and/or hills. The **Latrobe River** originates as a number of tributaries in several high rainfall areas resulting in a very reliable flow regime and a large waterway downstream.

**Only those tributaries that are in the Baw Baw Shire are described here.**

### LATROBE RIVER

**Tributaries:** Pioneer Ck, Ada River, Benny Ck, Loch River, Toorong River, Hawthorn Ck

The main stream rises south east of **Powelltown** near Piedmont flowing first north to the confluence with a small stream called **Pioneer Creek**, then east to the confluence with **Ada River**, **Benny Creek** and then **Loch River** at **Noojee** where the *Latrobe River @ Noojee* BoM flood gauge is located.

The river continues east to the confluence with the **Toorong River**, then south and east to the confluence with **Hawthorn Creek** then south east to near **Willowgrove** where the *Latrobe River @ Willowgrove* BoM flood gauge

is located. This gauge is predominantly surrounded by farmland and has never gone above the minor flood class level. The highest recorded level was 4.1m on 5 June 2012.

The River continues in a south easterly direction through open farmland until it flows out of the Baw Baw Shire into Latrobe City just before the confluence with the **Moe River**, a major tributary. This is closely followed by the confluence with the **Tanjil River**, another major tributary. The river passes through **Lake Narracan** immediately to the north of **Moe** before continuing its journey eastwards to the **Gippsland Lakes**.

## MOE RIVER

**Tributaries: Hazel & Spring Cks, Shade Ck, Red Hill Ck, Bear Ck, Moe Drain, Rintouls Ck, Eaglehawk Ck**

The **Moe River** starts to the south of **Warragul** and travels in a northerly and north westerly direction to the confluence with **Hazel Creek** (Spring Ck) which joins it from the north after travelling through farmland and the town of **Warragul**. The river is then joined by a small, deep, narrow tributary called **Bear Creek** just south of the Princes Highway near **Darnum** where the *Moe River @ Darnum* BoM flood gauge is located. This gauge is in the upper catchment where the river is reasonably well contained and surrounded by farmland. Once the river breaks its banks here, it will spread out over a wide flat flood plain. Between 2000 and 2013, there have been 5 events above the minor flood level. The Darnum gauge provides early warning for impacts on the Moe River Flats from upper catchment flows. Localised heavy rain over the Shady Creek and other lower catchments can cause flooding on the Flats without any appreciable rises at Darnum.

The river then flows in a north easterly direction and crosses the Princes Highway near Yarragon. From a short distance downstream from the Highway, the river has been channelised to form the **Moe Drain**. **Shady Creek** joins the river between the Yarragon-Shady Creek Rd and the Willow Grove Rd. The Moe Drain runs through the **Moe River Flats** (a natural wetlands area situated between **Yarragon** and **Moe** and to the north of **Trafalgar** where the *Moe River @ Trafalgar East* BoM flood gauge is located. The current course of the Moe River is now a 19km long drain 10-15m wide which was constructed around 1887 and progressively enlarged between the 1890's and 1940. The Canal flows through flat farmland and is straddled by two roads, North Canal Rd and South Canal Rd. Lack of maintenance on the canal has led to channel erosion and undermining of the roads.

The Moe Drain then continues to flow east, out of Baw Baw Shire to join the Latrobe River and Narracan Creek a short distance upstream of Lake Narracan.

The catchment area to Darnum is 225km<sup>2</sup> and to the Latrobe River, 620km<sup>2</sup>. The Shady Creek catchment is 193km<sup>2</sup>.

The straightening of the main river channel means that the **Moe Drain** is now not necessarily located in the lowest part of the floodplain. Further, embankments that extend above the natural surface have been added to the channel to increase its carrying capacity resulting in a situation where the water level in the drain can be higher than the surrounding land. Breakouts occur from time to time, especially when flows exceed channel capacity and flooding becomes reasonably widespread. Flood waters are not able to return (or drain) easily to the main channel due to the embankments and low lying areas and tend to remain longer than perhaps would normally be expected. This is not a major issue in the floodplain adjacent to the Moe township as the banks are generally lower than the natural surface.

There is also a drain referred to as the **Contour Drain** between Trafalgar and the Moe Drain that causes considerable flooding.

## NARRACAN CREEK

Narracan Creek rises in hilly farmland near **Thorpdale** where the *Narracan Creek @ Thorpdale* BoM flood gauge is situated, then flows in a north easterly direction through cleared or lightly forested river flats (a well-defined and reasonably broad floodplain) to the Princes Freeway at Moe within the **City of Latrobe**. The Creek passes through Moe to join the Latrobe River and Moe Drain a short distance upstream of **Lake Narracan**. The catchment has been modified by agriculture and there is no urban development on the floodplain within Baw Baw Shire. There is a waterfall on the creek 4km downstream of **Thorpdale**.

## TANJIL RIVER

**Tributaries: Icy Ck, Tanjil River West, Tanjil River East, Blue Rock Lake, Serpentine Ck**

The **Tanjil River West Branch, Icy Creek** and **Tanjil River East Branch** all rise in the steep forested mountains to the west and south of **Mt Baw Baw**. All of them flow south with Icy Creek and the West Branch joining first and flowing south east to the confluence with East Branch and then through **Tanjil Junction** where the *Tanjil River @ Tanjil Junction* BoM flood gauge is situated. This gauge is surrounded by bush, where the river is reasonably well contained and provides early warning of volumes entering Blue Rock Lake (Dam). There is a minor road upstream that may be inundated during higher flow events. There have been 22 minor and 2 major events at this site since January 2000.

The River then flows south to **Blue Rock Lake**, a 208,000ML reservoir north of Moe. Below Blue Rock Lake the river flows through **Tanjil South** where the *Tanjil River @ Tanjil South* BoM flood gauge is located. At this gauge site the river is well contained with high gently sloped banks. Farm equipment and roads will be inundated at low levels. The levels at this site have not gone above 2.24m (Minor level is 2.5m) since the dam was constructed.

The River continuous south through mostly flat farmland to the **Latrobe River** confluence (just outside of Baw Baw Shire).

## SERPENTINE CREEK

Serpentine Creek is located between the Tanjil River East Branch and the Tyers River West Branch, to the east of Mount Tanjil. It rises at an elevation of 364m and flows for its 14km length almost entirely within State forest. It joins the Tanjil River around 7km upstream of its confluence with the Latrobe River a short distance upstream of Lake Narracan.

## TYERS RIVER

**Tributaries: Tyers River West, Christmas Ck, Tyers River East, Moondarra Reservoir**

**Tyers River West Branch** is a small stream flowing in forested mountains that rises in the Great Dividing Range to the south east of **Mt Baw Baw** and travels south west then east to the confluence with **Christmas Creek** and then generally south east until the confluence with the **Tanjil River East Branch**. The river then becomes a fast flowing stream running through flat farmland adjacent to steep forested country until it reaches **Moondarra Reservoir**. The Moondarra Reservoir is a 30,300ML domestic water storage on the Tyers River. Below the Reservoir the river is wide and shallow. It flows through steep forest heading south east towards **Tyers** and the boundary of the Baw Baw Shire before reaching the confluence with the **Latrobe River** to the north of **Morwell**.

## RINTOULS CREEK

**Rintouls Creek** is a small creek rising in the forested hills below **Rawson** and **Walhalla**, flowing south across the Shire boundary into **Latrobe City**, where it crosses the **Moe-Glengarry Rd** before joining the **Latrobe River** just west of Traralgon.

## EAGLEHAWK CREEK

**Eaglehawk Creek** is a small creek rising in the forested hills below **Walhalla**, flowing south across the Shire boundary into **Latrobe City**, where it crosses the **Traralgon-Maffra Rd** and **Cairnbrook Rd** to the west of **Glengarry** and then joining the **Latrobe River** to the south of **Glengarry**.

## THOMSON RIVER

**Tributaries: Jordan River, Thomson Dam, Aberfeldy River, Donnelly Ck, Fulton Ck**

The **Thomson River** rises in the forested mountains near **Mt Gregory** where the western edge of the Thomson River catchment borders the **Yarra River** catchment. It flows in an easterly direction to the **Thomson Reservoir**. A large tributary, the **Jordan River**, rises in the hills north of where the Thomson rises and near where the north western border of the catchment borders the **Goulburn River** catchment. The Jordan River

flows in an easterly direction until the township of **Jericho** and then south east until it flows into the Thomson Reservoir.

The Thomson Reservoir is operated by Melbourne Water and generally contains the runoff generated from the area above the dam, although it has filled and spilled on three occasions: 1992, 1993 and 1996. Further detail on the Thomson Reservoir is in the **Flood Risk** section of this plan below.

The Thomson River continues below the reservoir in a southerly direction (the *Thomson River @ The Narrows* BoM flood gauge is located just below the reservoir) to the confluence with the **Aberfeldy River**. The Aberfeldy River is a wide mountain stream running through steep forest where the *Thomson River @ Beardmore* BoM flood gauge is located and then further south where it receives waters from **Donnelly Creek** and then **Fulton Creek** before flowing into the Thomson River. The Thomson continues to flow south through heavily forested mountains until it reaches **Coopers Creek**, a small settlement where the *Thomson River @ Coopers Ck* BoM flood gauge is located.

The Thomson continues to flow south, then east, then north through forested hills around **Walhalla** where Stringers Creek joins the river after passing through the township of Walhalla where approximately 45 special use properties are at risk of flood in a 1% AEP event.

**Lammers Creek** and **Deep Creek** join the river as it turns eastwards and then southwards through forested hills until it crosses the Shire boundary into **Wellington Shire** and breaks out into open grassy farmland just above **Cowwarr Weir**.

A listing of the Melbourne Water named waterways within the municipality, taken from the Flood Management Plan, is below. Waterways in the West Gippsland CMA area have not been provided.

## MELBOURNE WATER WATERWAYS

Bellbird Creek	Lang Lang River (Middle)	Red Jacket Creek
Black Butt Creek	Lang Lang River (Upper)	Robertson Creek
Brandy Creek	Lawson Creek	Ryson Creek
Bullock Creek	Minnieburn Creek	Sardine Creek
Bunyip River (Lower)	Minnieburn Creek Nth. Branch	Scalp Creek
Bunyip River (Middle)	Mosquito Creek	Seven Acres Creek
Bunyip River (Upper)	Mt View Creek	Sisters Creek
Crystal Creek	Mt View Creek Sth Branch	Spion Kopje Creek
Eliza Creek	Muddy Creek East	Tarago River East Branch
Gum Scrub Creek East	Musk Creek	Tea Tree Creek East
Gypsy Creek	Nine Mile Creek	Telegraph Creek
Harold Creek	O'Mahoneys Creek	Thompsons Drain
Heifer Creek	Pheasant Creek	Tin Creek
Ironside Creek	Pilgrim Creek	Two Mile Creek East
Kelvin Track Creek	Quarry Rd Creek	Wattle Creek
Labertouche Creek	Quartz Creek	Whiskey Creek

## MELBOURNE WATER MAIN DRAINS

Eacotts main drain	King Parrot Creek main drain
Gum Scrub Creek East main drain	Tarago River (Lower) main drain
Gypsy Creek main drain	Thompsons Drain main drain

# FLOOD RISKS

**Most of the flood risk in the shire is within the Latrobe River catchment.**

Baw Baw Shire experiences both riverine and flash flooding events in, mainly in Warragul, Trafalgar, Walhalla and on the Moe River Flats between Yarragon and Moe. Most residential flooding occurs in townships along the Princes Freeway (Highway) corridor, i.e. Warragul, Drouin, Drouin South, Trafalgar and Yarragon, a small proportion above floor level. A number of properties are also flooded in Walhalla by Stringers Creek.

Many roadways are also impacted by flood waters causing isolation and transport disruption, details of which are listed later in this document.

## RIVERINE FLOODING

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Riverine floods within the Shire generally occur as a result of:

- | Moist warm airflow from northern Australia bringing moderate to heavy rainfall over a period of 12 hours or more following a prolonged period of general rainfall. The period of general rainfall “wets up” the catchments and (partially) fills both the on-stream dams and the natural floodplain storage. These combine to increase the runoff generated during the subsequent period of heavy rainfall.
- | Successive cold fronts that bringing periods of rain that wet up the catchments and prime them for flooding from a further front or complex low pressure system that is perhaps slower moving and / or brings heavier rainfall.
- | A low pressure system (often intense and known as an ‘east coast low’) that develops within eastern Bass Strait or over the Tasman Sea and directs moist air for a period of 12 hours or more onto the Gippsland coast. The lifting that occurs as it travels inland results in heavy rain and possible flooding. A south easterly air flow associated with an east coast low can be particularly damaging for the Latrobe Valley streams.

Most riverine flooding risk is from the Bunyip River at Longwarry North and on the Moe River (Drain) on the Moe Flats between Yarragon and Moe and to the north of Trafalgar. There is some risk in and around Warragul and Walhalla from the local creeks although both fall within the flash flooding category due to the short response time.

## STORMWATER FLOODING, FLASH FLOODING & OVERLAND FLOWS

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Short duration, high intensity rainfall (usually associated with thunderstorms) can also cause flash flooding and overland flows within the Shire. Runoff from such events can exceed the capacity of stormwater drainage systems and cause local creeks to flood. These events, which usually occur during summer, do not generally create widespread flooding since they only last for a short time and affect limited areas. Flooding from these storms occurs with little warning and localised damage can be severe.

Townships considered most at risk from flash flooding include Warragul, Trafalgar, Yarragon and Walhalla with Warragul the highest risk.

Typically, average rainfall rates of more than about 35mm/hour for 30 minutes or more (ie. 17mm or so in 30 minutes) is likely to lead to flash flooding and / or overland flows, across the urbanised parts of the Shire.

At Warragul:

- | Levels rise and fall very quickly with:
  - o urban stormwater flooding likely within about 30 minutes of heavy rainfall; and
  - o initial rises in Hazel and Spring Creeks occurring within 6 hours of heavy rain.
- | The period of inundation from Hazel and Spring Creek is likely to be 4 to 6 hours;
- | Roads that cross the Hazel and Spring Creek corridors within Warragul are likely to be drowned out from quite low flows and experience both high velocities and substantial depths during severe events;
- | At Warragul, three (3) retarding basins have been constructed with the aim of reducing flood impacts arising from high flows in Hazel and Spring Creeks;
- | The Warragul Flood Modelling by Water Technology in 2012 indicates there are some residential properties subject to flooding in a 100yr ARI event;

| A number of commercial / industrial buildings are subject to over-floor flooding at less than a 20 year ARI event; and

| A number of commercial / industrial buildings are subject to over-floor flooding in a 100 year ARI event.

Changes in rainfall patterns associated with climate change are likely to lead to less frequent (but possibly larger) riverine floods but, because of more frequent localised severe storm activity, more frequent flash flooding and overland flow events.

## RURAL FLOOD RISK

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There are a number of areas that have significant rural flood risk. Though these areas are not highly populated, rural properties are susceptible to isolation or inundation and a significant number of roads are affected during large floods.

Low lying areas around -

| **Bunyip River** – Longwarry North

| **Moe River** – on the flats between Yarragon and Moe and to the north of Trafalgar

| **Hazel & Spring Cks** – Warragul, Nilma

| **Thomson River** – downstream of Coopers Creek

| **Aberfeldy River** – Toombon, Aberfeldy Bridge

| **Tanjil River** – Tanjil Bren, Fumina South, Tanjil Junction

## DAM FAILURE FLOOD RISK

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There are four significant reservoirs in Baw Baw Shire:

| **Thomson Dam** (Thomson River)

| **Moondarra Reservoir** (Tyers River)

| **Blue Rock Lake** (Tanjil River)

| **Tarago Reservoir** (Tarago River)

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

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

## HEALTH & ENVIRONMENTAL RISKS

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There are many septic tanks in the rural areas that may be inundated by floodwaters and farm chemicals stored in farm sheds on the floodplain. According to the FMP, Gippsland Water's sewer system in both Yarragon and Trafalgar are frequently overloaded due to flooding from overland flow.

## PROPERTIES AT RISK

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Melbourne Water and West Gippsland CMA have identified approximately 1,043 that are impacted in the following townships:

| Stringers Creek – Walhalla

| Overland flows & flash flooding – Trafalgar, Warragul, Yarragon

| Flash flooding from Hazel & Spring Cks and local rainfall – Warragul

Community	Location	Impact	Riverine Flooding	Flash Flooding
Warragul	Burke St	Burke Street Caravan Park		X
Nilma	End of Queen St extension	Residential & farming area		X
Drouin	Subway at train station Berry Farm, Garfield			X
Yarragon	Yarragon Flats	residential area		X
Trafalgar	7 Mile Road & Trafalgar Flats	Residential & farming area – houses flooded and isolated	X	
Tarago		Glencomrie Caravan Park	X	
Longwarry	Cook Street	Residential area	X	

## HISTORICAL FLOODS

Below is a table of historical flood heights and graphs showing the annual maximum gauge height at particular locations. Below these is a description of historically significant flood events that have occurred in Baw Baw Shire.

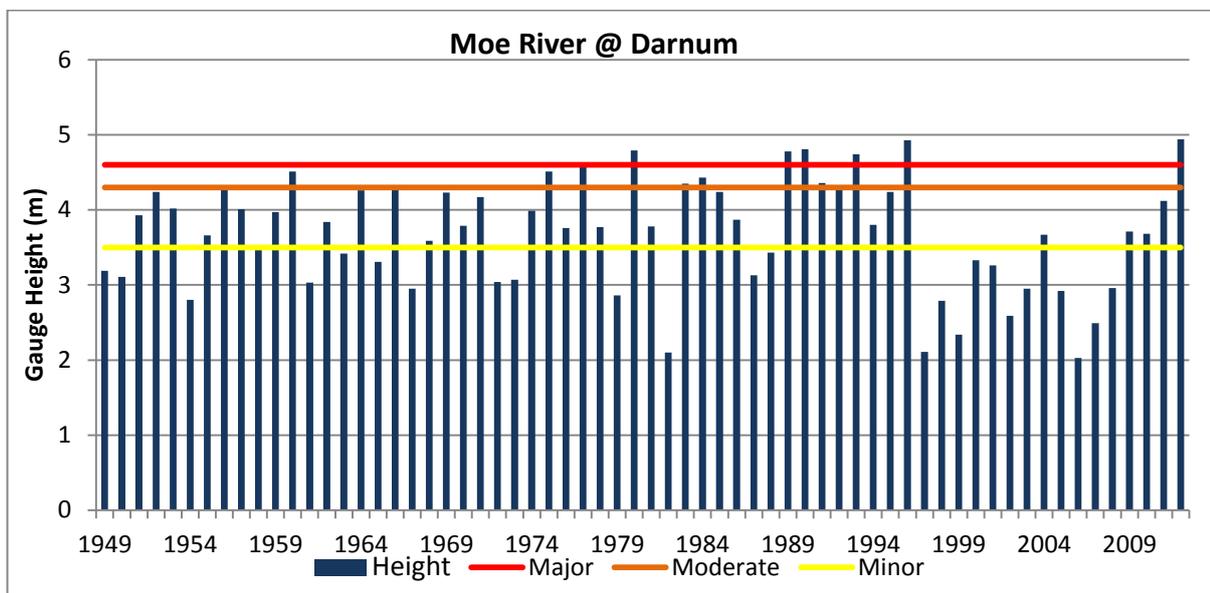
### LATROBE RIVER

EVENT	Latrobe R @ u/s Ada River Junction	Loch R @ Noojee	Latrobe R @ Noojee	Latrobe @ Willowgrove	Tanjil R @ Tanjil Junction	Tanjil R @ Tanjil South
1969 Jun	-	1.09	2.13	3.36	3.03	2.27
1971 Nov	1.42	1.99	2.95	3.61	4.40	3.33
1978 Jun	0.61	1.03	1.90	3.32	3.56	2.68
1993 Sep	1.11	1.25	3.01	3.69	4.45	2.22
1995 Nov	0.64	-	1.72	3.51	3.63	2.24
2005 Feb	1.30	0.94	2.44	4.30	4.21	1.58
2007 Jun	1.10	0.95	2.54	3.82	3.91	1.22
2011 Feb	0.78	0.66	2.22	4.06	1.65	1.54
2011 Aug	0.52	0.60	1.72	2.80	2.10	1.86
2012 Jun	0.66	0.77	2.35	4.17	3.75	2.31
Major				-	3.50	3.50
Moderate				-	2.50	3.00
Minor				5.50	1.50	2.50

### MOE RIVER

EVENT	Moe R @ Darnum	Moe R @ Trafalgar East	Narracan Ck @ Thorpdale	Narracan Ck @ Moe
1960 May	4.51	5.09	1.69	-
1975 Aug	4.51	4.95	1.02	-
1975 Nov	4.48	5.16	1.23	-
1977 Jul	4.61	5.63	1.52	-
1980 Jul	4.79	4.82	1.06	-
1983 Sep	4.35	5.05	1.26	-
1989 Oct	4.78	4.99	1.72	-
1990 Oct	4.81	5.58	1.86	-
1993 Sep	4.74	5.08	2.16	-
1995 Nov	3.40	5.14	1.65	-
1996 Jul	4.93	4.41	1.35	0.81
1996 Sep	3.78	4.48	1.73	2.19
2011 Feb	3.87	4.72	1.17	1.22
2011 Mar	2.08	4.44	1.90	2.53
2012 May	4.94	5.19	1.40	1.53
2012 Jun	4.70	5.20	1.42	1.18
Major	4.60			
Moderate	4.30			
Minor	3.50			





## HISTORICAL EVENTS

### NOVEMBER 1934

One of the most prominent recorded historical floods in the region occurred on the 29th of November 1934. Across the Port Phillip and South Gippsland regions, 350 mm was recorded over a 48-hour period, resulting in landslides, road closures and evacuations. The floods caused 36 deaths across south-east Melbourne, left 6,000 homeless and are noted as the region's most destructive on record (Southern Ocean Exploration 2005). The damage to buildings, roads and infrastructure as a result of the flooding and subsequent landslips was unparalleled. This resulted in one of the largest floods to occur along the Moe Drain.

At Warragul, anecdotal evidence suggests that the 1934 flood is the largest flood experienced in Hazel Creek at Warragul with media at the time reporting 261mm falling during a 33 hour period: an average of around 7.9mm / hour over the entire period. This significantly exceeds the 100yr ARI 33hr rainfall intensity of 5.4mm/hour suggesting it was an extreme event (ref EarthTech, 2004).

### MAY & JUNE 2012

May and June 2012 also saw widespread floods throughout Gippsland. The May event recorded the equal highest level on the Moe River at Darnum (4.9m recorded in July 1996 and also the major flood level) and the June event the 7<sup>th</sup> highest on record. Both events caused significant flooding along the Moe River Drainage Canal. A number of roads were closed and properties isolated.

## MAJOR WATER STORAGEES

Name	Location	Authority Responsible	Dam Capacity @ FSL (ML)	Type
Blue Rock Lake	Tanjil River	Southern Rural Water	208,000	Fixed Crest
Moondarra Reservoir	Tyers River	Gippsland Water	30,300	Fixed Crest
Tarago Reservoir	Tarago River	Melbourne Water	37,580	Fixed Crest
Thomson Dam	Thomson River	Melbourne Water	1,068,000	Fixed Crest

Current storage levels and volumes can be accessed via:-

- | For Melbourne Water dams:  
[http://www.melbournewater.com.au/content/water\\_storagees/water\\_report/water\\_report.asp](http://www.melbournewater.com.au/content/water_storagees/water_report/water_report.asp)
- | For Southern Rural Water dams:  
[http://www.srw.com.au/page/page.asp?page\\_id=110](http://www.srw.com.au/page/page.asp?page_id=110)
- | For Gippsland Water dams:  
<http://www.gippswater.com.au/ProjectsServices/StorageLevels.aspx>

## FLOOD MITIGATION SYSTEMS

At Warragul, three (3) retarding basins have been constructed with the aim of reducing flood impacts arising from high flows in Hazel and Spring Creeks. They do reduce high flows and thus the extent and depth of inundation but do not prevent flooding (see flood risk section above). The retarding basins are located at:

- Tarwin Street – west of the intersection of Tarwin Street, Pharaohs Road and Sutton Street;
- Landsborough Road – south west of the corner of Landsborough Road and Butlers Track; and
- Sutton Street – located in Brooker Park north of Sutton Street and bounded by Charles Street (east) and Bowen Street (west).

## LEVEES

Retarding Basin	Drain / Waterway	Operator
Moe Drain Levee, north and south – from near Yarragon to downstream of Trafalgar East	Moe River	WGCM/ BBSC

## MAJOR ROAD CLOSURES

Riverine Flooding	Flash Flooding
<b>Princes Freeway</b> - parts between Yarragon & Trafalgar East	<b>Princes Freeway</b> - parts between Yarragon & Trafalgar East

## RURAL ROAD CLOSURES

Riverine Flooding	Flash Flooding
<b>North Yannanthan Rd</b> , Modella Most of the roads on the Moe River Flats between Yarragon, Trafalgar East and Moe	
<b>TRAFALGAR</b>	
Contour Rd Malady Ln North Canal Rd Seven Mile Rd South Canal Rd	
<b>YARRAGON</b>	
Hazeldean Rd Little Moe River Rd Loch St Scanlon Rd Trickeys Rd	
<b>DROUIN</b>	
Bellbird Pk Settlement Rd	
<b>LONGWARRY</b>	
<b>Cook Rd underpass @ Bunyip River Gardner &amp; Edgar Rds intersection</b>	
<b>WARRAGUL</b>	<b>Ryans Crt</b> (and adjacent waterway) Warragul Other roads

## GAUGE LOCATIONS

Gauge Name	Location	Gauge Zero m AHD	No.
<b>LATROBE RIVER BASIN</b>			
Latrobe R u/s Ada River Junction			226222
Loch R @ Noojee			226220
Latrobe R @ Noojee	@ the Noojee-Vesper Rd bridge	207.651	226205
Latrobe R @ Willowgrove	On the road bridge SW of Willow Grove		226204
Moe R @ Darnum	20m u/s of the Darnum-Cloverlea Rd Bridge	79.598	226209
Moe R @ Trafalgar East	5.8km u/s of the Latrobe River junction		226402
Tanjil R @ Tanjil Junction	800m d/s junction of East & West branches		226226
Tanjil R @ Tanjil Sth		69.245	226216
Narracan Ck @ Thorpdale			226218
Narracan Ck @ Moe			226021
Tyers R @ Morgans Mill			226008
Tyers R @ Junction			226235
Tyers R @ Browns			226007
Jacobs Creek @ O'Tooles			226017
Tyers R @ The Pumphouse			226028
Thomson R @ The Narrows			
Thomson R @ Coopers Creek			
<b>BUNYIP RIVER BASIN</b>			
Bunyip River @ d/s Cannibal Ck	Longwarry North		228255
Bunyip River @ Headworks			228207
Tarago River @ Drouin West			228201
Tarago River @ Neerim South			228219

## DISRUPTION TO SERVICES

- | Large dairy processing plant, Darnum
- | Organic food processing plant, Drouin
- | Tourist Railway, Walhalla
- | V Line Rail Service, Trafalgar – Longwarry (Melbourne – Bairnsdale rail line)
- | Dairy and Forestry Industry transport
- | High-tension electricity transmission lines (from power stations in the Latrobe Valley to Melbourne)
- | High voltage electricity sub stations – Warragul & Drouin (map of electricity transmission lines throughout the Shire is available from the MERO)
- | Gas and Oil pumping stations – Westbury & Tanjil South (map of these is available from the MERO)

## GAUGE LEVEL INFORMATION

Gauge Name	Event	Gauge Height (m)	Flow (ML/d)	ARI (1 in X years)
<b>Latrobe R u/s Ada River Junction</b>	2005 Feb	4.21		
	2007 Jun	3.91		
	2004 Nov	2.23		
	2007 Nov	2.17		
	2008 Nov	2.10		
	2011 Aug	2.10		
	2011 Nov	2.02		
	2011 Mar	1.95		

Gauge Name	Event	Gauge Height (m)	Flow (ML/d)	ARI (1 in X years)
Loch R @ Noojee	1971 Nov	1.99		
	1959 Sep	1.59		
	1960 Nov	1.38		
	1993 Sep	1.25		
	1960 May	1.16		
	1970 Apr	1.13		
	1969 Jun	1.09		
	1971 Sep	1.06		
Latrobe R @ Noojee	1993 Sep	3.01		
	1971 Nov	2.95		
	2007 Jun	2.54		
	2005 Feb	2.44		
	1960 Nov	2.43		
	2012 Jun	2.35		
	1980 Jun	2.30		
	1996 Sep	2.27		
Latrobe R @ Willowgrove	<b>Major</b>	<b>5.50</b>		
	2005 Feb	4.30		
	2012 Jun	4.17		
	2011 Feb	4.06		
	2007 Jun	3.82		
	1993 Feb	3.69		
	1934 Nov	3.63		
	1971 Nov	3.61		
	1995 Nov	3.51		
	Moe R @ Darnum	2012 May	4.94	
1996 Jul		4.93		
1990 Oct		4.81		
1980 Jul		4.79		
1989 Oct		4.78		
1993 Sep		4.74		
2012 Jun		4.70		
1977 Jul		4.61		
<b>Major</b>		<b>4.60</b>	<b>4,200</b>	<b>8</b>
1930 May		4.51		
1975 Aug	4.51			
<b>Moderate</b>	<b>4.30</b>	<b>3,480</b>	<b>4</b>	
<b>Minor</b>	<b>3.50</b>	<b>2,050</b>	<b>&lt;2</b>	
Moe R @ Trafalgar East	1977 Jul	5.63		
	1990 Oct	5.58		
	2012 Jun	5.20		
	2012 May	5.19		
	1975 Nov	5.16		
	1995 Nov	5.14		
	1960 May	5.09		
	1993 Sep	5.08		
	1970 May	5.05		
	1983 Sep	5.05		
Tanjil R @ Tanjil Junction	1993 Sep	4.45		
	1971 Nov	4.40		
	2005 Feb	4.21		
	2007 Jun	3.91		
	2012 Jun	3.75		
	1999 Nov	3.63		
	1978 Jun	3.56		
	<b>Major</b>	<b>3.50</b>		
	1984 Jul	3.36		

Gauge Name	Event	Gauge Height (m)	Flow (ML/d)	ARI (1 in X years)
<b>Moderate</b>		<b>2.50</b>		
	<b>Minor</b>	<b>1.50</b>		
<b>Tanjil R @ Tanjil Sth</b>	<b>Major</b>	3.50		
		1971 Nov	3.33	
	<b>Moderate</b>	3.00		
		1978 Jun	2.68	
	<b>Minor</b>	2.50		
		2012 Jun	2.31	
		1969 Jun	2.27	
		1959 Sep	2.26	
		1995 Nov	2.24	
		1993 Sep	2.22	
	1990 Oct	2.18		
<b>Narracan Ck @ Thorpdale</b>		1993 Sep	2.16	
		2011 Mar	1.90	
		1990 Oct	1.86	
		1991 Sep	1.73	
		1996 Sep	1.72	
		1989 Oct	1.69	
		1960 May	1.68	
		2011 Jul	1.65	
<b>Narracan Ck @ Moe</b>		2011 Mar	2.53	
		1996 Sep	2.19	
		1996 Aug	1.81	
		2011 Apr	1.73	
		2012 May	1.53	
		2003 Feb	1.47	
		2011 Jul	1.42	
		1996 Oct	1.35	
<b>Tyers R @ Morgans Mill</b>		1969 Apr	3.14	
		2005 Feb	3.10	
		1960 Nov	2.74	
		2007 Jun	2.74	
		1969 Jun	2.71	
		1969 May	2.39	
		1968 Oct	2.27	
		1962 May	2.23	
<b>Tyers R @ Junction</b>		2005 Feb	5.77	
		2007 Jun	3.16	
		2005 Aug	3.10	
		2012 Jun	3.00	
		2004 Dec	2.77	
		2007 Nov	2.54	
		2011 Nov	2.45	
		2008 Nov	2.44	
<b>Tyers R @ Browns</b>		1978 Jun	6.62	
		2005 Feb	4.95	
		1976 Oct	4.39	
		1990 Apr	4.30	
		1993 Sep	4.26	
		1971 Nov	4.18	
		2007 Jun	4.17	
		1970 Jan	4.15	
<b>Jacobs Creek @ O'Tooles</b>		2005 Feb	2.45	
		2012 Jun	1.98	
		1980 Dec	1.92	
		1976 Oct	1.89	

Gauge Name	Event	Gauge Height (m)	Flow (ML/d)	ARI (1 in X years)
	1978 May 2007 Nov 2007 Jun 2011 Aug	1.79 1.58 1.52 1.46		
<b>Tyers R @ The Pumphouse</b>	1993 Sep 1995 Nov 1995 Oct 1992 Dec 1990 Oct 1992 Oct 1992 Sep 1995 Dec	3.45 3.24 2.52 2.14 2.13 1.46 1.45 1.41		
<b>Thomson R @ The Narrows</b>	1978 Jun 1960 Jul 1953 Oct 1959 Sep 1959 Oct 1956 Jan 1971 Nov 1958 Aug	3.51 3.41 3.24 3.08 2.76 2.70 2.60 2.59		
<b>Aberfeldy R @ Beardmore</b>	2007 Jun 1978 Jun 1990 Apr 2012 Jun 1993 Sep 1976 Oct 2007 Nov 2011 Aug	6.34 5.65 4.95 4.76 4.27 3.74 3.50 3.50		
<b>Thomson R @ Coopers Creek</b>	1978 Jun 1990 Apr 1993 Sep 1976 May 1995 Jun 1978 May 1975 Jun 1974 Aug	6.40 4.72 4.22 4.02 3.18 2.92 2.86 2.63		

## APPENDIX B – FLOOD PEAK TRAVEL TIMES

Travel times are calculated as the time the peak of the event takes to move from one gauge to the next. Note the onset of flooding can occur before the peak water level occurs.

It is possible for flooding to commence at downstream locations prior to peak heights being reached in the upper parts of the catchment due to both locally heavy rainfall and the backwater effects mentioned earlier.

Due to the high level of variability in antecedent catchment conditions, flood travel times can vary significantly, as demonstrated in previous floods.

Travel times listed here are **INDICATIVE ONLY** and are **HIGHLY VARIABLE**

Gauge Name	June 2007	April 1990	Jan 1978
Moe R @ Darnum	0	0	0
Moe R @ Trafalgar East	10.5hrs	31hrs	6.5hrs
Gauge Name	Oct 1995	Sept 1993	Nov 1971
Tanjil R @ Tanjil South	0	0	0
Tanjil R @ Tanjil Junction	12.5hrs	26hrs	7.5hrs



There are no Flood Class Levels for Warragul

## LOCATION

Warragul township is situated approximately 100km east of Melbourne and covers a diverse topographical area but generally moderately sloping and consisting of residential, industrial, commercial and cleared pastoral areas. It is in the Hazel Creek catchment, a tributary of Moe River which is itself a tributary of the Latrobe River that flows eastwards to the Gippsland Lakes and Bass Strait at Lakes Entrance.

## FLOOD BEHAVIOUR

### OVERVIEW

It is apparent that flooding which impacts on the populated areas of Warragul arises from two mechanisms:

- | Stormwater flooding resulting from intense rainfall falling over the highly impervious areas of the town; and
- | Riverine flooding of the Hazel and Spring Creek floodplains and lower lying developed areas within and around Warragul as a result of rain over the creeks' catchments.

### FLASH FLOODING FROM HAZEL & SPRING CREEKS

The most significant waterway running through Warragul is **Hazel Creek** which has a catchment of approximately 47km<sup>2</sup>. Hazel Creek runs south and then in an easterly direction to the south of the CBD where **Spring Creek** (142km<sup>2</sup>) discharges into Hazel Creek in the low lying areas of the floodplain just downstream of the **Howitt St** bridge, north of the **Princes Freeway**. Hazel Creek then continues to flow east through **Nilma** and then south east to the confluence with the **Moe River**.

Warragul sits high in the catchment and there are no flood gauges in either Hazel or Spring Creeks. There is no real record of flood flows or of flooding although some anecdotal evidence of previous floods does exist.

Anecdotal evidence would suggest that the 1934 flood is the largest Hazel Creek flood experienced with media at the time reporting 261mm falling during a 33hr period: an average of around 7.9mm / hour over the entire period. This significantly exceeds the 100yr ARI 33hr rainfall intensity of 5.4mm/hour suggesting it was an extreme event (EarthTech, 2004).

The Hazel and Spring Creek system is considered to be a flashy catchment with travel times between a significant rain event in the upper catchment and the flooding which impacts Warragul township being very short. Levels rise and fall very quickly with initial rises occurring within about 6 hours of heavy rain although this does vary depending on how wet the catchments are. The period of inundation is likely to be 4-6 hours.

### **FLASH FLOODING FROM URBAN STORMWATER**

Although Warragul is impacted by flooding from Hazel and Spring Creeks, the major risk is flash flooding and overland flows from urban stormwater.

Drainage in the town follows the natural topography and generally moves water from the higher reaches in the north through the township to the south with most of the townships floodplain located between the railway line and the Princess Freeway.

There is significant overland flow in Warragul in the following areas:

- ▷ from the residential area north of the CBD through the Civic Park precinct between Smith and Kent Streets;
- ▷ through the industrial area between Mason Street and Gladstone Road;
- ▷ Normandy Street toward the outlet at the intersection of Queen and Normandy Streets;
- ▷ Downstream of Brooker Park Retarding Basin (upstream and downstream of Sutton Street); and
- ▷ Downstream of Churchill Street.
- ▷ Industrial area between Albert Rd & Queen St
- ▷ Upstream of Stoddarts Rd & Ellen Cl

## **FLOOD MITIGATION SYSTEMS**

At Warragul, three (3) retarding basins have been constructed with the aim of reducing flood impacts arising from high flows in Hazel and Spring Creeks. They do reduce high flows and thus the extent and depth of inundation but do not prevent flooding (see flood risk section above). The retarding basins are located at:

- Tarwin Street – west of the intersection of Tarwin Street, Pharaohs Road and Sutton Street;
- Landsborough Road – south west of the corner of Landsborough Road and Butlers Track; and
- Sutton Street – located in Brooker Park north of Sutton Street and bounded by Charles Street (east) and Bowen Street (west).

A further four (4) retarding basins have been proposed within Warragul and are aimed at reducing the likelihood of flooding from stormwater within the town. Proposed sites are: in the CBD between Gladstone and Mason Streets, Civic Park (at the northern end of Civic Place), at the western end of Eisenhower Court and in Valleyview Park west of the intersection between Normanby Street and Ellen Close. At the date of this Plan, Council had not committed to building any of these basins.

## **FLOOD WARNINGS**

There is no flood warning system for Warragul.

## ROAD CLOSURES

Roads that cross the Creek's corridors within Warragul are likely to be drowned out from quite low flows and experience both high velocities and substantial depths during severe events.

The following roads are subject to inundation and/or closure. Note that many minor roads may also be inundated.

ROAD	LOCATION	ROAD	LOCATION
Albert Rd		Mason St	
Alexander St		McMillan Dve	
Anderson St		Melanie Dve	
Barkly St		Mills Rd	
Albert Rd		Mitchell Crt	
Alexander St		Munro St	@ McMillan Drive
Anderson St		Normanby St	between Queen St & Albert Rd
Barkly St		North Rd	nth of Queen St
Baw Baw Dve		Peace Ave	
Bowen St	between Hibiscus Crt & Waratah Dve	Pearse St	
Brandy Creek Rd / Warringa Crt		Pharaohs Dve	
Burke St	between Spring St & Howitt Sth Rd	Phoenix St	
Cadby Ct		Queen St	Between Normanby St & North Rd
Cambridge Dve		Rebecca Crt	
Canawindi Dve		Ryan Crt	
Copelands Rd	nth of Queen St	Smith St	
Cunningham Crt		Spring St	Wills St
Eisenhower St		Stoddarts Rd	Normanby St & Sutton St
Ellen Crt		Stoffers St	
Eyre Place		Sutton St	@ Stoddarts Rd
George Stt		Tarwin St	
Gladstone St	@ Vermont Ave	Thomas Crt	
June Crt		Tobruk St	
Helen Crt		Waratah Dve	
King St	between McMillan Dve & Warraview Cls	Western Park Dve	near Pioneer St
Kent St		Wills St	near King St
Latrobe St		Windhaven Dve	

## CONSEQUENCES & IMPACTS SUMMARY

A map showing all parcels of land within Warragul inundated by more than 100mm during a 1% AEP flood event is provided in Appendix F. In the absence of floor level information, this map provides guidance on the numbers and locations of properties likely to be affected by flooding during a severe event in Warragul.

A map showing flood hazard across Warragul is also provided in Appendix F.

## CRITICAL INFRASTRUCTURE

None known to be at risk.

## GAUGE LEVEL INFORMATION

There are no river gauges in the vicinity of Warragul. With flash flooding providing the greatest risk factor, it is more appropriate to consider rainfall. The nearest rain gauge to Warragul available from the Bureau of Meteorology website at less than daily intervals is at Darnum. Other more local rainfall information may be available from residents and other contacts. The flood guidance tools at the end of this Appendix, together with the maps at Appendix F, provide a means of using data from the Darnum rain gauge (or from more local rain gauges) to give an indication of the likely scale and consequence of possible flooding.

# DETAILED CONSEQUENCES & IMPACTS – FLOOD INTELLIGENCE CARD

Gauge	Location	Datum Type
NO GAUGE	WARRAGUL	

## FLASH RIVERINE AND STORMWATER FLOODING

ARI	Consequences	Operational Considerations
20yr	<p><b>SUMMARY</b></p> <ul style="list-style-type: none"> <li>▶ See 20-year ARI flood extent and depth map in Appendix F.</li> </ul> <hr/> <p><b>PROPERTIES</b></p> <ul style="list-style-type: none"> <li>▶ Approximately 11 commercial / industrial buildings are subject to over floor flooding at &lt; 20yr ARI</li> </ul> <hr/> <p><b>ROADS</b></p> <ul style="list-style-type: none"> <li>▶ Many roads in Warragul will be covered by water as per listing above</li> </ul>	▶ .....
50yr	<p><b>SUMMARY</b></p> <ul style="list-style-type: none"> <li>▶ See 50-year ARI flood extent and depth map in Appendix F.</li> </ul> <hr/> <p><b>PROPERTIES</b></p> <ul style="list-style-type: none"> <li>▶ A map showing parcels of land inundated by more than 100mm during a 50yr ARI flood event is provided in Appendix F.</li> </ul> <hr/> <p><b>ROADS</b></p> <ul style="list-style-type: none"> <li>▶ Many roads in Warragul will be covered by water as per listing above</li> </ul>	▶
100yr	<p><b>SUMMARY</b></p> <p>Flooding occurs in the following areas:</p> <ul style="list-style-type: none"> <li>▶ Industrial area between Albert Rd &amp; Queen St (significant)</li> <li>▶ Cnr Gladstone St &amp; Vermont Ave (significant)</li> <li>▶ Queen St between Normanby St &amp; North Rd (Phoenix &amp; Pearse Sts )</li> <li>▶ Western Point Dve (near Pioneer St)</li> <li>▶ Between Waratah Dv &amp; Brooker Park Basin</li> <li>▶ Upstream of Stoddarts Rd &amp; Ellen Cl</li> </ul> <hr/> <p><b>PROPERTIES</b></p> <ul style="list-style-type: none"> <li>▶ The Secondary and Special Schools and the local SES Unit HQ are on the edge of the flood extent.</li> </ul>	

- ▷ Over floor flooding :
  - Nil - Residential
  - 39 - Commercial/Industrial
    - 11 upstream of Latrobe St
    - 4 between Howitt St & upstream railway bridge
    - 20 between Howitt St & downstream railway bridge
    - 4 between Queens St East & upstream railway bridge
- ▷ A map showing parcels of land inundated by more than 100mm during a 100yr ARI P flood event is provided in Appendix F.

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**ROADS**

- ▷ Many roads in Warragul will be covered by water as per listing above

# FLOOD GUIDANCE TOOLS

## INTRODUCTION

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The BoM does not currently provide flood forecasts for Warragul. All flood response actions must therefore be driven by local rainfall and / or river level observations.

Rainfall data is available from the BoM's website for Darnum at 3-hourly intervals during most rain events. This may not include thunderstorm events.

The two flood guidance tools provided herein (a critical duration map and an indicative flood / no flood tool) can be used with both forecast and recorded rainfall. They can be used to guide planning for flood response following a severe weather warning, flood advice or other advice from the BoM regarding expected rainfall, or to guide operational response and likely resourcing needs during a heavy rainfall event. They could also be used to provide advice to VICSES, Council and residents of expected likely flooding before or during a heavy rainfall event.

## INDICATIVE FLOOD BEHAVIOURS

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Urban stormwater flooding will occur quickly following heavy rainfall – typically within 30 minutes or so of rainfall that exceeds about 17mm in 30 minutes or is sustained at around 35mm/hour for 30 minutes or so.

Flash flooding emanating from Hazel and Spring Creeks develops a little slower and requires heavier and more sustained rainfall. Flooding usually occurs within about 6 hours of start of heavy rainfall and lasts for 4 to 6 hours.

## USING THE CRITICAL DURATION MAP

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The Critical Duration Map in Appendix F provides an indication of the areas likely to experience flooding within Warragul based on rainfall depth and duration (ref Water Technology 2012). Data provided is for a 100 year ARI event but can be used in an indicative way for more frequent events. For example:

- | If 30mm or so of rain fell over the Warragul area in a 30 minute period, flooding is likely to occur in all areas shaded blue through to green. Other (downstream) areas within the 100-year ARI flood extent may experience less severe flooding.
- | If 20mm or so of rain fell over the Warragul area in a 30 minute period, there may be some flooding in areas shaded blue through to green.
- | If 80mm or so of rain fell over the Warragul area in a 5 to 6 hour period, flooding is likely to occur in all areas shaded blue through to red. Other (downstream) areas within the 100-year ARI flood extent may experience less severe flooding.

The table embedded in the figure shows the maximum 100-year ARI rainfall depths for each duration.

## USING THE INDICATIVE FLOOD/ NO FLOOD GUIDANCE TOOL

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### DURING AN EVENT

It is suggested that rainfall data from the Darnum site (or alternative location closer to Warragul if the source and data are both reliable and timely – this is especially important in thunderstorm situations) should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below.

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

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

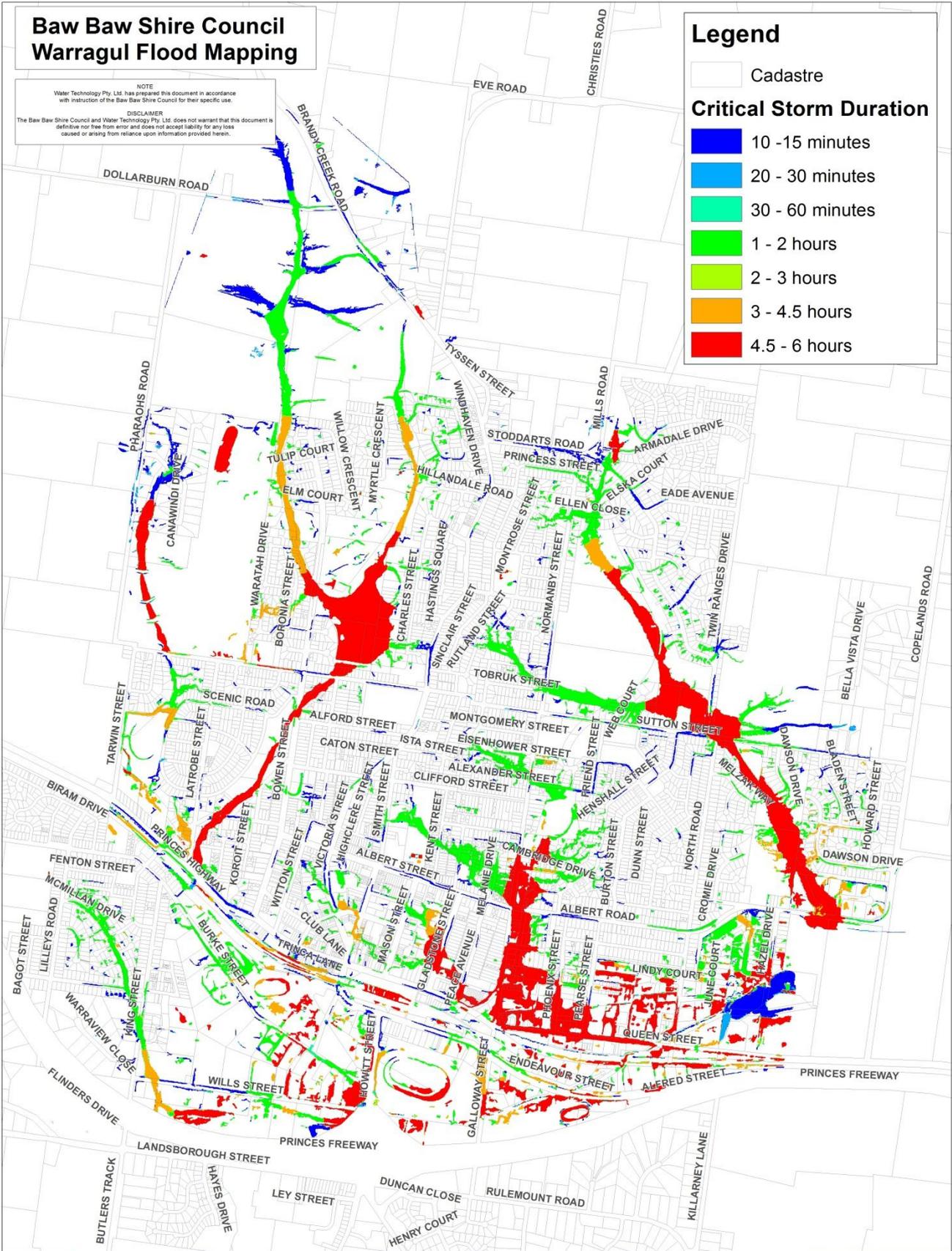
| **Approach 2:** Discount the early lighter rain from consideration (i.e. begin calculating rainfall depth from start of heavy rain) and plot depth against time on a copy of the tool. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes.

**CAUTION.** The tool is based on a number of gross assumptions and generalisations. It is indicative only and while it will not always indicate flooding / no flooding correctly, it will give a heads up to severe flooding. The tool does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or the likely consequences.

## **AFTER A FLOOD EVENT**

After a flood event, plot the event rainfall depth (with date) on the tool and include an overview of the event, including antecedent conditions, in Appendix A of this MFEP.

# CRITICAL DURATION MAP FOR WARRAGUL



## Baw Baw Shire Council Warragul Flood Mapping

**NOTE**  
Water Technology Pty Ltd. has prepared this document in accordance with instruction of the Baw Baw Shire Council for their specific use.

**DISCLAIMER**  
The Baw Baw Shire Council and Water Technology Pty Ltd. does not warrant that this document is definitive nor free from error and does not accept liability for any loss caused or arising from reliance upon information provided herein.

**Legend**

□ Cadastre

**Critical Storm Duration**

- 10 - 15 minutes
- 20 - 30 minutes
- 30 - 60 minutes
- 1 - 2 hours
- 2 - 3 hours
- 3 - 4.5 hours
- 4.5 - 6 hours



**Critical Storm Duration 100 Year ARI**  
Data sources : Baw Baw Shire Council TUFLOW  
Warragul Flood Study

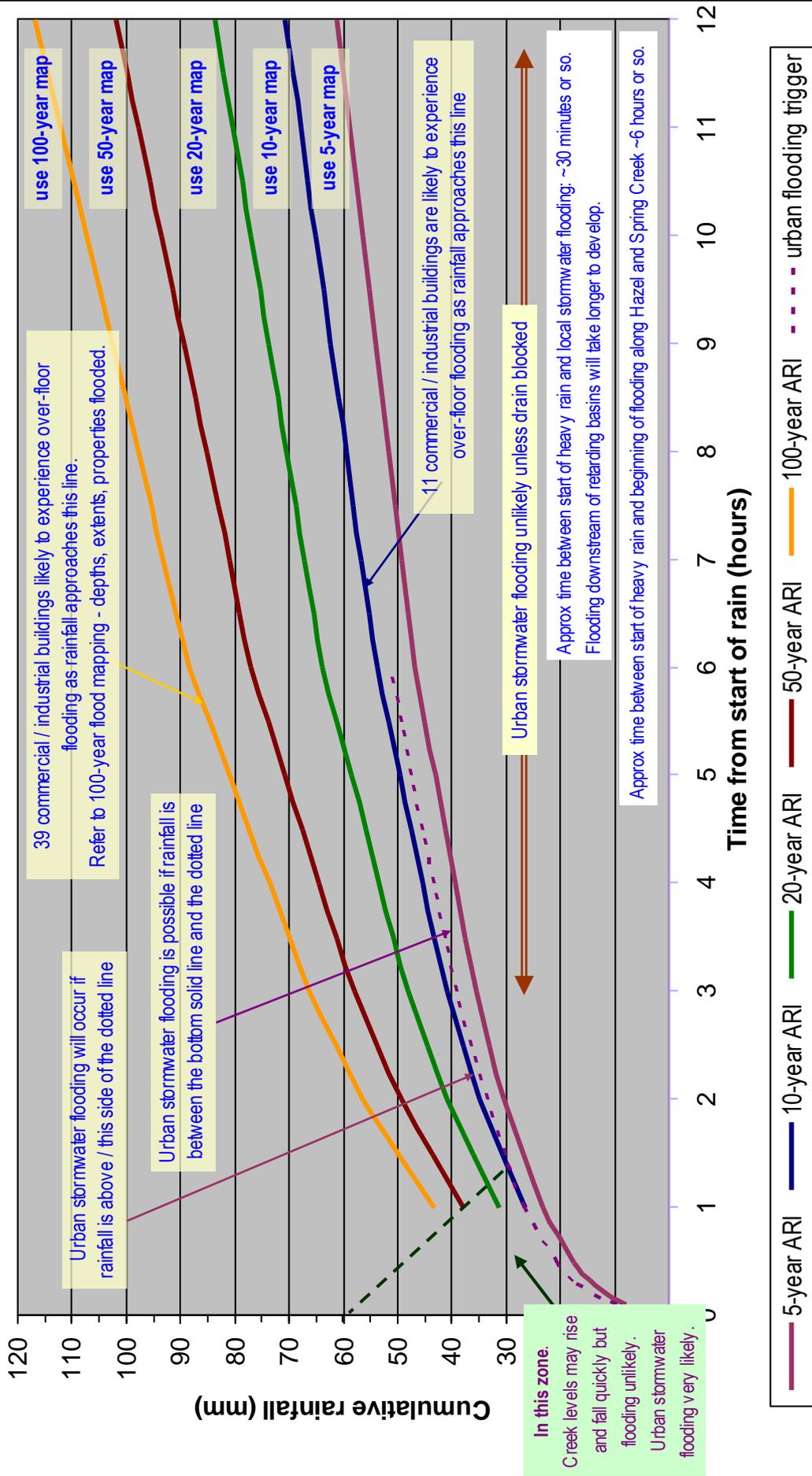


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04/06/2012

## Indicative guidance for likelihood of flooding in Warragul based on rainfall

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



# MOE RIVER FLATS



Minor 3.50

Moderate 4.30

Major 4.60

Moe River @ Darnum

## LOCATION

The Moe River crosses the Princes Highway near Yarragon. From a short distance downstream from the Highway, the river has been channelised to form the **Moe Drain**. Shady Creek joins the river between the Yarragon – Shady Creek Road and the Willow Grove Road.

The Moe Drain runs through the **Moe River Flats** (a natural wetlands area situated between **Yarragon** and **Moe** and to the north of **Trafalgar**) where the *Moe River @ Trafalgar East* BoM flood gauge is located. It is a large drain 10-15m wide and 19km long. It passes through what is now a wide floodplain of open pasture and farmland. The drain is straddled by two roads, North Canal Rd and South Canal Rd. Lack of maintenance on the canal has led to channel erosion and undermining of the roads.

The Moe Drain flow east, out of Baw Baw Shire to join the Latrobe River and Narracan Creek a short distance upstream of Lake Narracan.

The **Moe Contour Drain** is located on the southern edge of the Moe River floodplain at the base of the dip from higher ground onto the floodplain, and acts as a catch drain for feeding runoff and ponded floodwater back into the Moe River / Drain. The contour drain joins the Moe River at Walhalla Road, on the northwest side of Moe.

The *Moe River @ Darnum* BoM flood gauge is located near **Darnum** south of the Princes Highway. This gauge is in the upper catchment where the river is reasonably well contained and surrounded by farmland. It provides early warning for impacts on the Moe River Flats.

## FLOOD BEHAVIOUR

The straightening of the main Moe River channel means that the Moe Drain is now not necessarily located in the lowest part of the floodplain. Further, embankments that extend above the natural surface have been added to the channel to increase its carrying capacity resulting in a situation where the water level in the drain can be higher than the surrounding land. Breakouts occur from time to time, especially when flows exceed channel capacity and flooding becomes reasonably widespread. Flood waters are unable to return (or drain) easily to the main channel due to the embankments and low lying areas and tend to remain longer than perhaps would normally be expected. This is not a major issue in the floodplain adjacent to the Moe township as the banks are generally lower than the natural surface.

The Moe Contour Drain has also been identified as currently prone to exceeding capacity, spilling and then flooding adjacent properties. In recent years, it is understood that capacity has been significantly reduced due to weed growth and tree limbs blocking the open drain

It is estimated that the Moe Drain has overtopped its banks in the vicinity of the Princes Highway and downstream, 53 times in 30 years of record. This suggests that the Moe Drain experiences flooding on an approximately annual basis. This flooding is often a result of heavy rainfall across the flats compounded by high flows from further up the Moe catchment as well as from Shady Creek. High flows and levels in the Latrobe River slow Moe Drain flows which causes levels to rise with more flooding on the flats. During floods, water spills from the drain across farmland and roadways causing property access problems on the flats. Larger floods cause damage to farms and road crossings. The Princes Highway can also be affected between about Yarragon and Trafalgar by runoff from the hills to the south exceeding the capacity of culverted drainage lines.

## FLOOD MITIGATION SYSTEMS

The levees along the Moe Drain provide a degree of protection to adjacent farmland from smaller floods

## FLOOD WARNINGS

The Bureau of Meteorology provides qualitative flood forecasts (in terms of the class of flooding only) along with current river levels for the Moe River at Darnum. The Bureau also provides river levels for the Moe Drain at Trafalgar East.

Flood class levels have not been established for the area around the Moe Drain at Trafalgar East. There are a number of reasons for this, primary being that the flood profile along the floodplain has a saw-toothed shape caused by the roads and other banks across the floodplain that cause floodwaters to bank up. The Bureau does not therefore provide river level forecasts for the Moe River Flats or for the Moe Drain. It should be noted that hydrologic modelling will not deliver accurate forecasts for the Moe flats: hydraulic modelling is required.

## ROAD CLOSURES

The following roads are subject to inundation and/or closure. Note that many minor roads may also be inundated.

RIVERINE	
Factory Road – main access road for some properties	Duggans Rd
Yarragon-Shady Ck Rd	Willowgrove Rd
North Canal Rd	Lochs Creek Rd
Mahoneys Rd	Telephone Rd
Nine Mile Rd	Cummins Rd
South Canal Rd	Mitchells Rd
Eight Mile Rd	

## CRITICAL INFRASTRUCTURE

Apart from the roads outlined below, all other essential infrastructure and services around the Moe Drain are expected to remain dry during a severe flood event. Note that the Princes Highway between Yarragon and Trafalgar can become flooded when runoff arising from very heavy rain / severe storms on the hills to the south of the Highway exceeds the capacity of culverted drainage lines.

# GAUGE LEVEL INFORMATION

Flood Event	Flood Class (Darnum)	Moe R @ Darnum	Moe R @ Trafalgar East
2012 May		4.94	5.19
1996 Jul		4.93	4.70
1990 Oct		4.81	5.58
1980 Jul		4.79	4.82
1989 Oct		4.78	4.99
1993 Sep		4.74	5.08
2012 Jun		4.70	5.20
1977 Jul		4.61	5.63
	<b>Major</b>	<b>4.60</b>	-
1930 May		4.51	-
1975 Aug		4.51	4.95
	<b>Moderate</b>	<b>4.30</b>	-
	<b>Minor</b>	<b>3.50</b>	-

## DETAILED CONSEQUENCES & IMPACTS – FLOOD INTELLIGENCE CARD

This Flood Intelligence Card will be populated once the Latrobe Flood Study has been completed. This study is due for completion by June 2013 by the West Gippsland Catchment Management Authority.

Gauge	Location	Datum Type
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**NB** Depths quoted are above ground level. Properties are considered isolated when 20cm of water is across the road

Gauge Height (m)	Consequences	Operational Considerations
<b>SUMMARY</b> ▶ .....		
<b>PROPERTIES</b> ▶ .....		
<b>ROADS</b> ▶ .....		
<b>SUMMARY</b> ▶ .....		.....
<b>PROPERTIES</b> ▶ Low lying agricultural land beside the river		
<b>ROADS</b> ▶ .....		

## APPENDIX D – EVACUATION ARRANGEMENTS

The Incident Controller may make the decision to evacuate an at-risk community. Evacuation is the responsibility of VICPOL and will be conducted as per the EMMV and the MEMP.

## APPENDIX E - FLOOD WARNING SYSTEM

The Bureau of Meteorology provides a flood warning system for the Latrobe River and its tributaries. There are however several areas (e.g. Warragul) that are subject either to flash flooding or are too high in the catchment and are therefore not covered by the current formal flood warning system.

The indicative quick look flood / no flood tool for Warragul provided at Appendix C1 of this Plan assists in the identification of developing flood situations. Such tools can be developed for other locations and linked to likely flood impacts provided that either flood mapping is available or the consequences of previous floods have been documented.

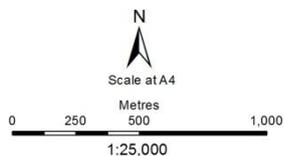
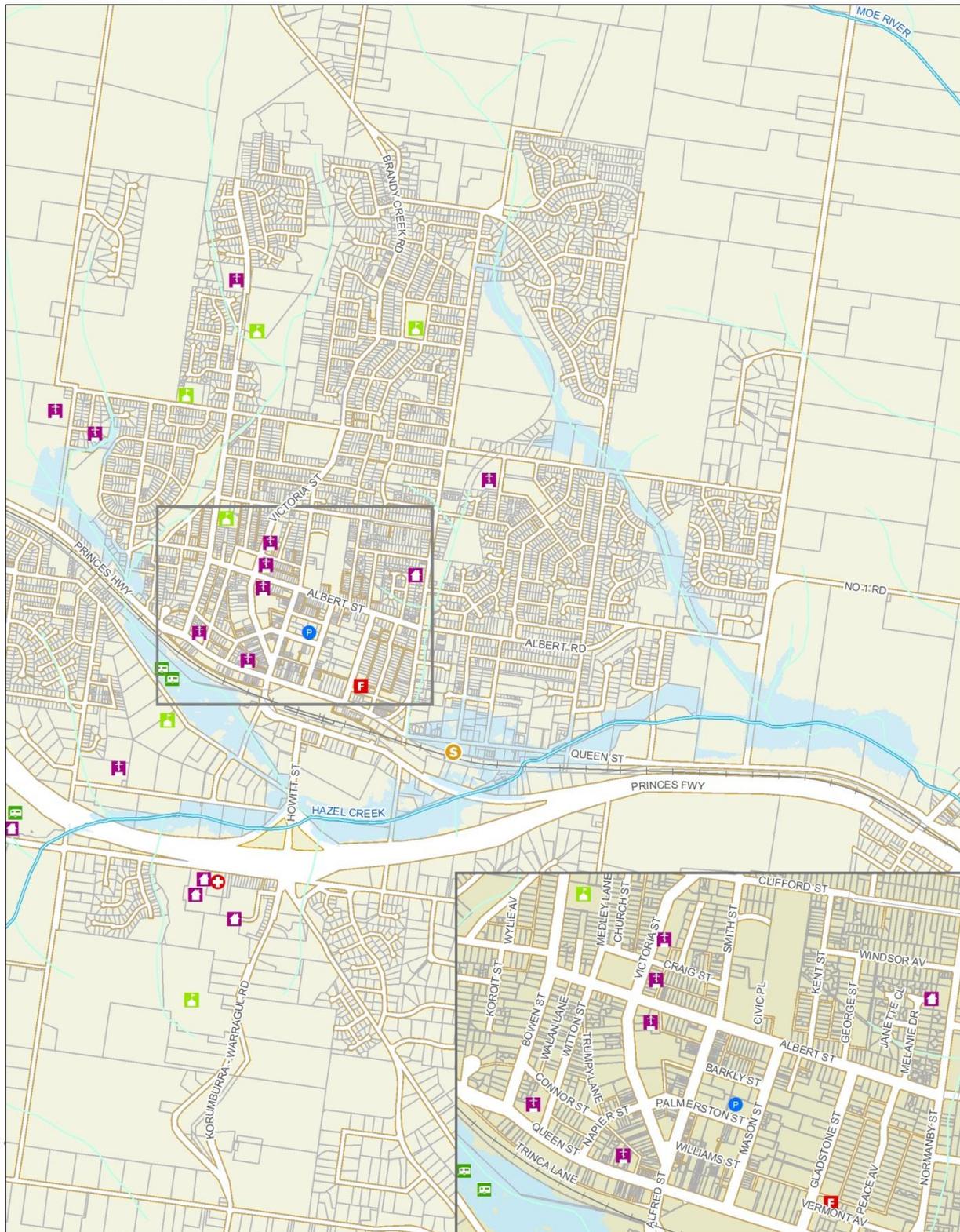
## APPENDIX F – MAPS

- | Warragul Township Map
- | Warragul Township Short Duration Flood Map
- | Latrobe River Catchment Map
- | Tarago River Catchment Map
- | Moe River Catchment Map
- | Tanjil River Catchment Map
- | 20yr ARI Flood Extent and Depth Map
- | 50yr ARI Flood Extent and Depth Map

# WARRAGUL TOWNSHIP MAP

BAW BAW SHIRE COUNCIL

Warragul



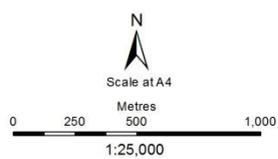
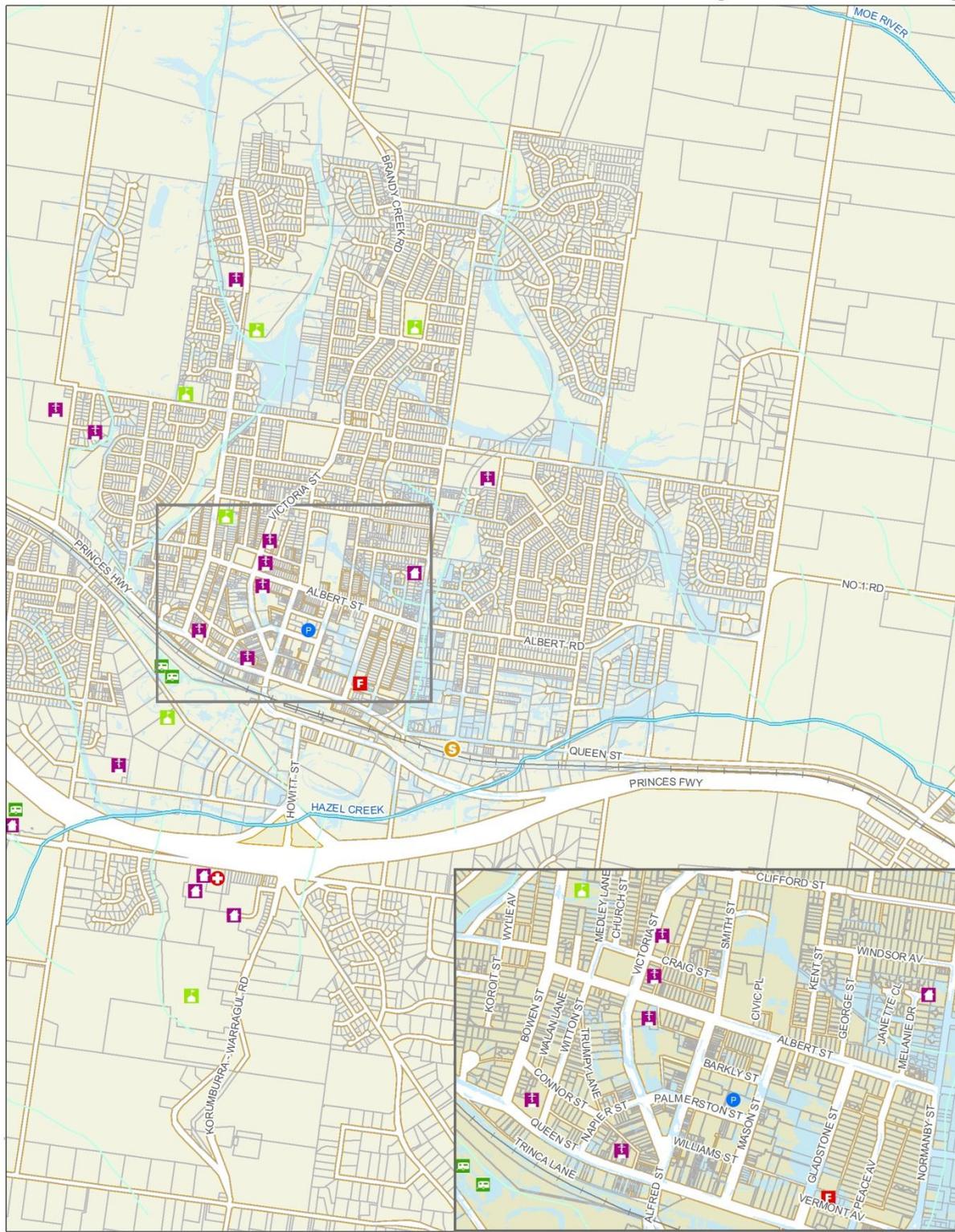
- Fire Station
- Hospital
- Police Station
- SES Unit
- School
- Nursing Home
- Church
- Camp Ground
- Rail Line
- Road
- River/Creek
- Creek/Stream
- 1% AEP Flood
- Cadastre

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# WARRAGUL TOWNSHIP SHORT DURATION FLOOD MAP

BAW BAW SHIRE COUNCIL

Warragul - Short Duration Flooding



- F Fire Station
- C Church
- + Hospital
- S Camp Ground
- P Police Station
- S SES Unit
- S School
- N Nursing Home
- 1% AEP Flood
- Cadastre
- Rail Line
- Road
- River/Creek
- Creek/Stream



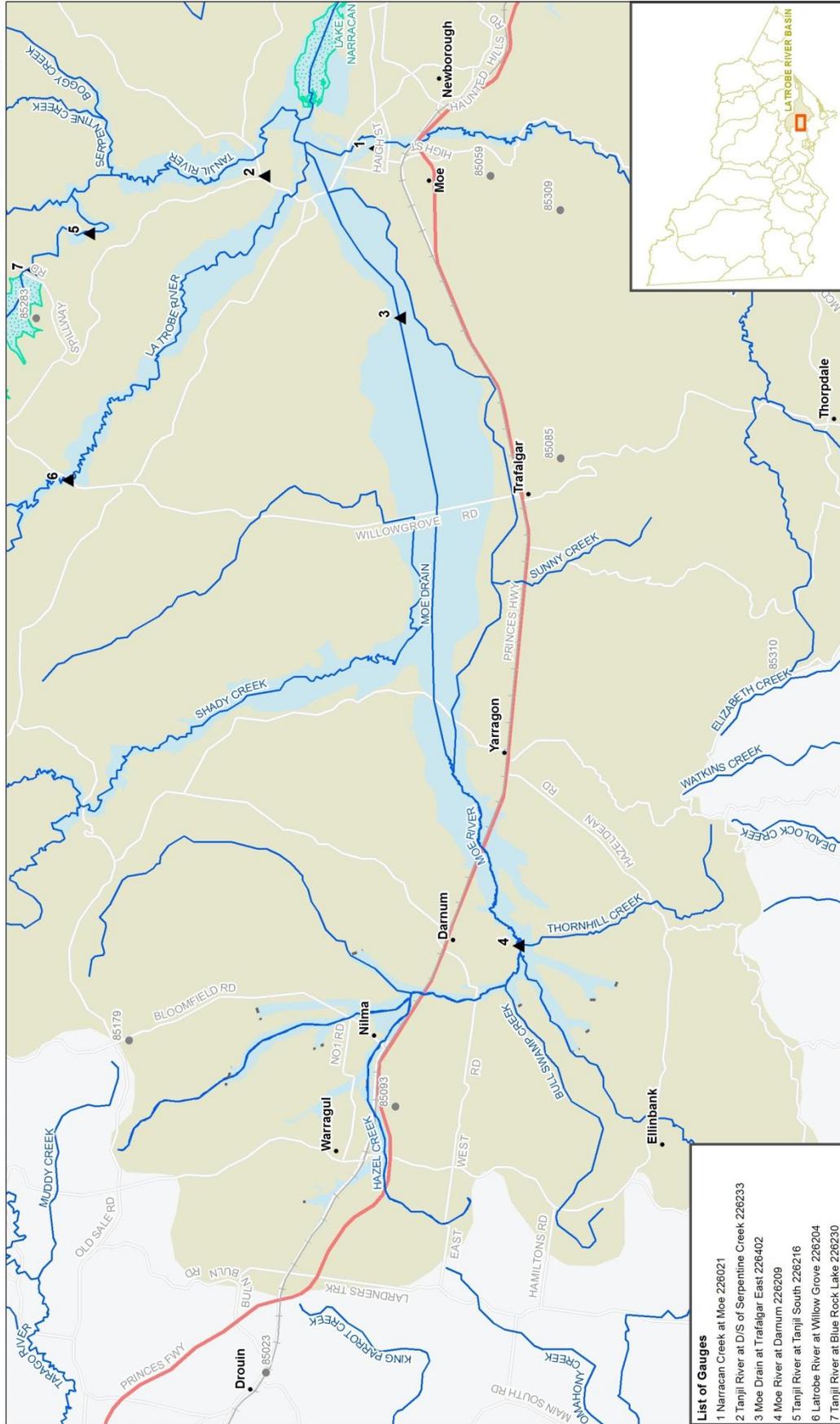
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# MOE RIVER CATCHMENT MAP

## Moe River Catchment



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1% AEP Flood  
Latrobe River Basin

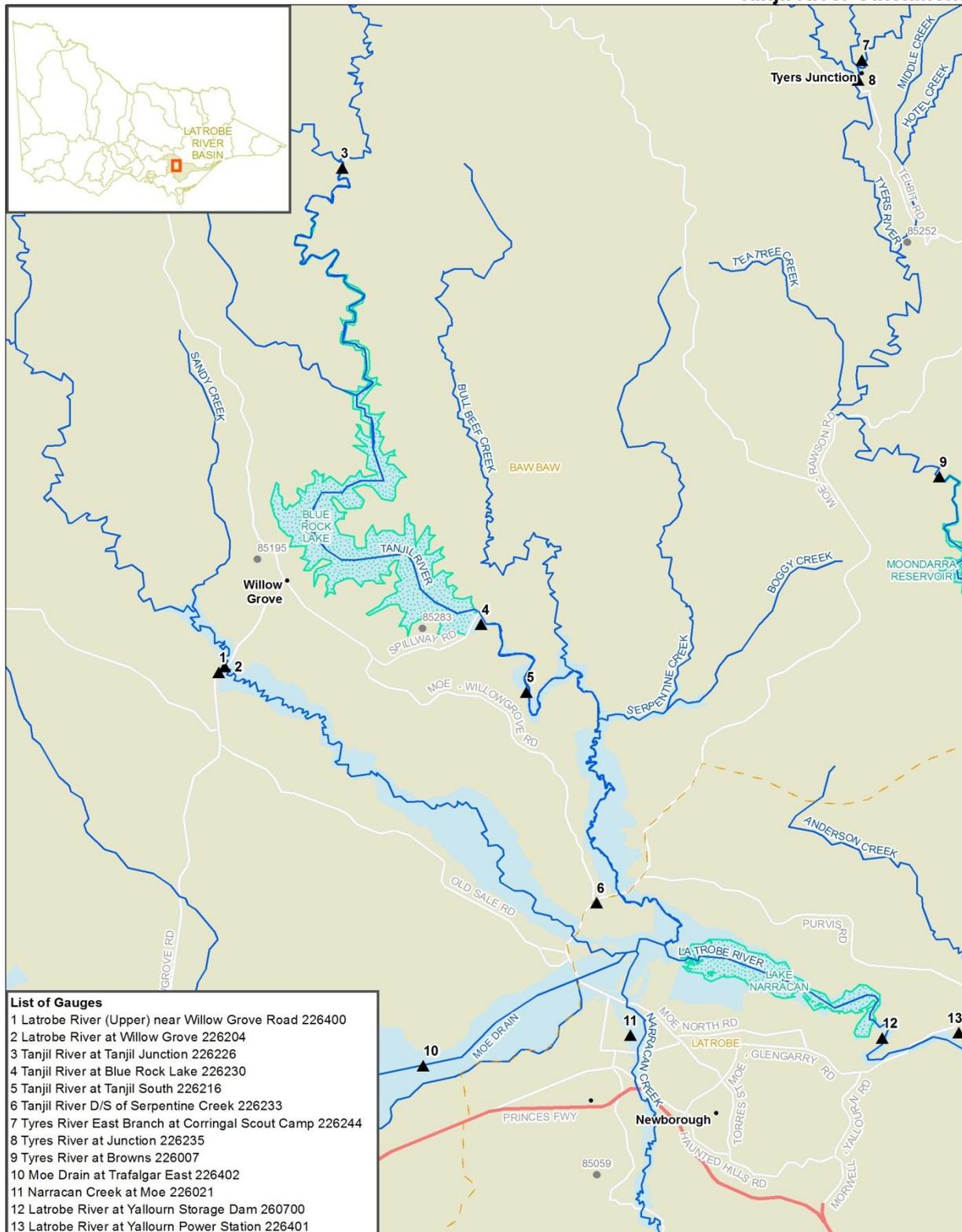
Rail Line  
Major Road  
Secondary Road  
Extent of Flood Data  
River/Creek



0 1.5 3 6 Kilometers  
Scale at A4 1:150,000

# TANJIL RIVER CATCHMENT MAP

## Tanjil River Catchment



## **WARRAGUL 20YR ARI FLOOD EXTENT AND DEPTH MAP**

To be provided

## **WARRAGUL 50YR ARI FLOOD EXTENT AND DEPTH MAP**

To be provided

## **WARRAGUL 100YR ARI FLOOD EXTENT AND DEPTH MAP**

To be provided