Northern Grampians Shire Flood Emergency Plan

A Sub-Plan of the Municipal Emergency Management Plan

For Northern Grampians Shire Council
and
VICSES Stawell and St Arnaud Units

Version 9.3 – December 2016

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20	Operations Manager	CFA Grampians Region District 16 HQ - Ararat	
21		VicRoads, Western Region, Ballarat	
22		Department of Human Services, Horsham	
23		Department of Health	
24		Bureau of Meteorology (Flood Warning)	
25	Richard Scholten	Power supplier – Powercor, Ballarat	
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Document Transmittal Form / Amendment Certificate

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

Suggestions for amendments to this Plan should be forwarded to VICSES Grampians Regional Office, 352 Dowling Street, Wendouree, 3355 or by email to **midwest@ses.vic.gov.au**.

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

Amendment Number	Date of Amendment	Section	Page No.	Amendment Entered By	Summary of Amendment
V8	Jun 2008			MCA/WT	Final draft version. Includes available flood intel for Glenorchy and Halls Gap.
V9	Jan 2014			MCA/WBM	Changed document to new MFEP format. Added available flood intel for the Upper Wimmera catchment.
V9.1	May 2014			GJK	All
V9.2	July 2014			MCA/WBM	Added available flood intel for Mt William Creek.
V9.3	Aug 2014			MCA/WBM	Edit Mt William Ck intel

This Plan will be maintained on both the SES and the Northern Grampians Shire Council websites at:

www.ses.vic.gov.au www.ngshire.vic.gov.au

List of Abbreviations & Acronyms

The following abbreviations and acronyms are used in the Plan:

AEP	Annual Exceedance Probability
AHD	Australian Height Datum (the height of a location above mean sea level in metres)
AIIMS	Australasian Inter-service Incident Management System
AoCC	Area of Operations Control Centre / Command Centre
ARI	Average Recurrence Interval
ARMCANZ	Agricultural & Resource Management Council of Australia & New Zealand
AV	Ambulance Victoria
BoM	Bureau of Meteorology
CALD	Culturally and Linguistically Diverse (communities)
CEO	Chief Executive Officer
CEP	Community Education Plan
CERM	Community Emergency Risk Management
CFA	Country Fire Authority
CMA	Catchment Management Authority
DEPI	Department of Environment and Primary Industries (successor body to DSE and DPI)
DH	Department of Health
DHS	Department of Human Services
DNRE	Department of Natural Resources and Environment
DO	Duty Officer
DoI	Department of Infrastructure
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment (successor body to DNRE)
EAS	Emergency Alert System
EMA	Emergency Management Australia
EMLO	Emergency Management Liaison Officer
EMMV	Emergency Management Manual Victoria
EMT	Emergency Management Team
EO	Executive Officer
FO	Floodway Overlay
FWS	Flood Warning System
FSL	Full Supply Level (refers to a dam or reservoir)
FZ	Floodway Zone
GIS	Geographical Information System
GWMWater	Grampians Wimmera Mallee Water
HRCC	Horsham Rural City Council
HSC	Hindmarsh Shire Council
IAP	Incident Action Plan
IC	Incident Controller
ICC	Incident Control Centre
IFD	Intensity-Frequency-Duration (applies to rainfall data)
IMT	Incident Management Team
IMS	Incident Management System
LHQ	Local Headquarters
LSIO	Land Subject to Inundation Overlay
MECC	Municipal Emergency Coordination Centre
MEMP	Municipal Emergency Management Plan
MEMPC	Municipal Emergency Management Planning Committee
MERC	Municipal Emergency Response Coordinator

MERO	Municipal Emergency Resource Officer
MFB	Metropolitan Fire and Emergency Services Board
MFEP	Municipal Flood Emergency Plan (this plan)
MFEPC	Municipal Flood Emergency Planning Committee
MRM	Municipal Recovery Manager
NCCMA	North Central Catchment Management Authority
NGSC	Northern Grampians Shire Council
OIC	Officer in Charge
OSOM	One Source, One Message
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RCC	Regional Control Centre
RDO	Regional Duty Officer (VICSES)
REMI	Regional Emergency Management Inspector
RERC	Regional Emergency Response Coordinator
RERCC	Regional Emergency Response Coordination Centre
RFA	Request for Assistance
RIA	Rapid Impact Assessment
SBO	Special Building Overlay
SCC	State Control Centre
SEWS	Standard Emergency Warning System
SHERP	State Health Emergency Response Plan
SitRep	Situation Report
SOP	Standard Operating Procedure
VFD	Victorian Flood Database
VicPol	Victoria Police
VICSES	Victoria State Emergency Service
WCMA	Wimmera Catchment Management Authority
YSC	Yarriambiack Shire Council

Part 1. INTRODUCTION

1.1 Municipal Endorsement

This Municipal Flood Emergency Plan (MFEP) has been prepared in conjunction with the Northern Grampians Shire Municipal Flood Emergency Planning Committee (MFEPC) with the authority of the Northern Grampians Shire Municipal Emergency Management Planning Committee (MEMPC) pursuant to Section 20 of the Emergency Management Act 1986 (as amended).

In the development of this draft Plan, the MFEPC has incorporated recommendations and outcomes from the Glenorchy, Halls Gap and Upper Wimmera flood studies where such data is available.

This MFEP is a sub plan to the Northern Grampians Shire Municipal Emergency Management Plan (MEMP), 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 Management (CERM) process undertaken by the Municipal Emergency Management Planning Committee (MEMPC).

This Municipal Flood Emergency Plan is consistent with the VICSES Grampians Region Flood Emergency Plan and the State Flood Emergency Plan.

This Municipal Flood Emergency Plan is a result of the cooperative efforts of the Northern Grampians Shire Flood Emergency Planning Committee (MFEPC) and its member agencies.

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

This Plan is endorsed by the Northern Grampians Shire MEMPC as a sub-plan to the MEMP.

Endorsement

…… Date / /2014
TBA

Chair of the Municipal Emergency Management Planning Committee.

…… Date / /2014
Stephen Warren (Regional Manager VICSES)

1.2 The Municipality

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

1.3 Purpose and Scope of this Flood Emergency Plan

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

As such, the scope of the Plan is to:

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

1.4 Municipal Flood Emergency Planning Committee (MFEPC)

Membership of the Northern Grampians Shire Flood Emergency Planning Committee (MFEPC) will comprise of the following representatives from the following agencies and organisations:

- VICSES – Regional Officer – Emergency Management (Chair)
- VICSES Stawell Unit – Controller or Deputy Controllers
- VICSES St Arnaud Unit – Controller or Deputy Controllers
- Northern Grampians Shire – Manager Infrastructure
- Northern Grampians Shire – Municipal Emergency Resources Officer
- Northern Grampians Shire – Municipal Recovery Manager
- Northern Grampians Shire – Manager Operations
- Northern Grampians Shire – Emergency Management Coordinator
- Victoria Police (MERC)
- CFA Stawell Brigade
- CFA District 16
- Wimmera Catchment Management Authority (as required)
- North Central Catchment Management Authority (as required)
- Water Authorities (as required)
- Bureau of Meteorology (as required)
- Local community representatives and
- Other agencies 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 Emergency Planning Committee has responsibility for preparing, reviewing, maintaining and distributing this plan.

The MFEPC will meet at least twice per year.

This plan should be reviewed and where necessary, arrangements and information contained in it should be amended:

- Annually as per MEMPC Sub-Plan review schedule;
- Following any new flood study;
- Following a change in non-structural and / or structural flood mitigation measures; and
- After the occurrence of a significant flood event within the Municipality.

When a review is undertaken and minor amendments are made to the Plan, the amended Plan will be adopted by the MFEPC and the MEMPC and included into the website copy of the Plan. If significant amendments are made to the Plan at any time, the amended Plan must be passed to Council for adoption once the MFEPC and the MEMPC have endorsed the significant amendments.

1.6 Endorsement of the Plan

The MFEP will be circulated to MFEPC an MEMPC members to seek acceptance of the draft plan.

Upon acceptance, the plan will be forwarded to the MEMPC for endorsement with the recommendation to include the MFEP as a sub-plan of the MEMP.

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 the Northern Grampians Shire Council.

VICSES with the support of the Northern Grampians Shire and the Wimmera and North Central Catchment Management Authorities will coordinate community education programs for flooding within the MFEP area.

A Community Education Plan (CEP) to support this plan will be developed in conjunction with VICSES. This may include, for example, Flood Safe / Storm Safe and the distribution of local flood guides to at-risk communities.

2.2 Structural Flood Mitigation Measures

Refer to Appendices A and C for detailed information relating to structural flood mitigation measures within the Municipality.

2.3 Non-structural Flood Mitigation Measures

2.3.1 Exercising the Plan

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

2.3.2 Flood Warning

Arrangements for flood warning are contained within the State Flood Emergency Plan (see http://www.ses.vic.gov.au/prepare/em-planning/state-plans), Part 3.7 of the EMMV and on the Bureau of Meteorology (BoM) website (see http://www.bom.gov.au).

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

2.3.3 Flood Wardens

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

The data collected is used to determine / understand what has happened during / after a flood event where property or other assets may be affected by flood waters, determining where the flood waters came from and to assist with potential mitigation options and so on.

Flood Wardens have not been established within Northern Grampians Shire.

2.3.4 Other Measures

Refer to Appendices A and C for detailed information relating to other non-structural flood mitigation measures within the Municipality.

Part 3. RESPONSE ARRANGEMENTS

3.1 Introduction

3.1.1 Activation of Response

The Regional Duty Officer (RDO) VICSES Grampians Region or Incident Controller (IC) may activate flood response arrangements.

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

3.1.2 Responsibilities

There are a number of agencies with specific roles that will act in support of VICSES and provide support to the community in the event of a serious flood within Northern Grampians Shire. These agencies will be engaged through the Incident EMT.

The general roles and responsibilities of supporting agencies are as agreed within the Northern Grampians Shire MEMP, EMMV (Part 7 'Emergency Management Agency Roles'), the State Flood Emergency Plan and the VICSES Grampians Region Flood Emergency Plan (see http://www.ses.vic.gov.au/prepare/em-planning/regional-plans).

3.1.3 Escalation

Most flood incidents are of local concern and an appropriate response can usually be managed 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 Statewide basis.

Resourcing and event escalation arrangements are described in the EMMV ('State Emergency Response Plan' – Section 3.6).

3.2 Strategic Control Priorities

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

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

Circumstances may arise where the Incident Controller is required to vary these priorities, with the exception being that the protection of life should remain the highest priority. 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 3.3, 3.4, 3.5 & 3.6 of the EMMV.

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

3.3.1 Control

Functions 5(a), 5(b) 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 DEPI as the Control Agency responsible for dam safety as well as for water, sewerage and other emergencies / threats. A more detailed explanation of roles and responsibilities is provided in later sections of Part 7 of the EMMV.

All flood response activities within Northern Grampians Shire including those arising from a dam failure or retarding basin / levee 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

Incident Level	Location	ICC Location	Facility Owner	Key Contact
Regional Control Centre	Ballarat	19 Learmonth Rd, Wendouree, 3355	CFA	Phil Beasley Regional Commander, CFA
ICC Level 3	Ballarat	25 Vickers St, Sebastopol	DEPI	Jon Rofe, District Manager.
ICC Level 3	Horsham	110 Natimuk Rd, Horsham	DEPI	Russell Manning
ICC Level 2	Ballarat	352 Dowling St	SES	Stephen Warren Regional Manager
ICC Level 2	Horsham	19 McLachlan St, Horsham	CFA	Dale Russell

3.3.4 Divisions and Sectors

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

The following Divisions and Sectors may be established (but not limited to) to assist with the management of flooding within the Municipality:

Division (pre-determined Divisional Command locations)	**Sectors** (Pre-determined Sector Command locations)
Stawell VICSES	St Arnaud CFA
Ararat VICSES	

3.3.5 Incident Management Team (IMT)

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

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

3.3.6 Emergency Management Team (EMT)

The Incident Controller will establish a multi-agency 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 Northern Grampians Shire Council, 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 Section 3.5 of the EMMV for guidance on EMTs.

3.3.7 Coordination

The Municipal Emergency Response Coordinator (MERC) for the Northern Grampians Shire will ensure that the Coordination function is undertaken. The Incident Controller / RDO will ensure that communications are established with the MERC and that regular situational updates are provided. This may be undertaken through the Division / Sector Commander where appointed.

3.3.8 Municipal Emergency Coordination Centre (MECC)

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

The function, location, establishment and operation of the MECC are detailed in the Northern Grampians Shire MEMP.

3.3.9 VICSES actions on receipt of a Flood Watch / Severe Weather Warning

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

- Review flood intelligence to assess likely flood consequences
- Monitor weather and flood information / situation through the BoM website (www.bom.gov.au)
- Assess Command and Control requirements.
- Review local resources and consider needs for further resources regarding personnel, property protection, flood rescue and air support
- Notify and brief appropriate officers. This includes Regional Control Centre (RCC) (if established), State Control Centre (SCC) (if established), Council, other emergency services through the EMT.
- Assess ICC readiness (including staffing of IMT and EMT) and open if required
- Ensure flood bulletins and community information are prepared and issued to the community
- Monitor watercourses and undertake reconnaissance of low-lying areas
- Develop media and community information management strategy
- Ensure flood mitigation works are being checked by owners
- Develop and issue Incident Action Plan (IAP), if required
- Develop and issue Situation Report(s) (SitReps), if required

3.3.10 VICSES actions on receipt of the First and Subsequent Flood Warnings

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

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

3.4 Community Information and Warnings

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

Community information and warnings communication methods available but not necessarily relevant in Northern Grampians Shire include:

- Emergency Alert;
- Phone messages (including SMS);
- Radio and Television;
- Two-way radio;
- Mobile and fixed public address systems;
- Sirens;
- Verbal Messages (i.e. Doorknocking);
- Agency Websites;
- VICSES Flood Storm Information Line;
- Variable Message Signs (i.e. road signs);
- Community meetings;
- Newspapers;
- Email;
- Telephone trees;
- Community Flood Wardens;
- Fax Stream;
- Newsletters;
- Letter drops;
- Social media and / or social networking sites (i.e. twitter and / or facebook).

The release of flood bulletins and information with regard to response activities at the time of a flood event is the responsibility of VICSES, as the Control Agency. The EMT, if activated, and the MERC will be advised of any warnings issued when they occur.

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

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

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

DH will coordinate information regarding public health and safety precautions.

Refer to Appendices C and E for the specific details of how community information and warnings are to 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 VICSES RDO will manage all media communication.

Support agencies should consult with the IC / VICSES RDO prior to releasing information to the media, to ensure that consistent and accurate information is being provided to the community.

3.6 Rapid Impact Assessment

The purpose, function and conduct of RIAs are outlined in the State Flood Emergency Plan.

A rapid impact assessment (RIA) should 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 may then be used to provide the basis for further needs assessment and recovery planning by DHS and recovery agencies.

VicPol is responsible for coordinating the collection, collation and dissemination of RIA information on a whole-of government basis. The Incident Controller is responsible for activating VicPol to undertake this function.

3.7 Preliminary Deployments

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

3.8 Response to Flash Flooding

Emergency management response to flash flooding should be consistent with the guideline for the emergency management of flash flooding contained within the State Flood Emergency Plan.

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

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

During a flash flood, it will often be difficult, due the rapid development of flooding, to establish emergency relief centres ahead of actually triggering the evacuation, as is normal practice. Evacuation must still be considered as an option for ensuring the safety of people in at risk areas.

3.9 Evacuation

The decision to recommend or warn people to prepare to evacuate or to evacuate immediately rests with the Incident Controller in consultation with the MERC, MERO, DHS, Health Commander and other key agencies and expect advice (e.g. CMA and flood Intelligence specialists).

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

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

Refer to Section 3.8 and Part 8 and Appendix 9 of the EMMV (Evacuation Guidelines) for guidance on evacuations for flood emergencies.

Refer to the Northern Grampians Shire MEMP for guidance on evacuation arrangements for communities within the Northern Grampians Shire and to Appendix D of this MFEP for detailed evacuation arrangements in the event of flooding.

Refer also to the VicRoads website for road closures (http://alerts.vicroads.vic.gov.au)

3.10 Flood Rescue

Under Victoria's emergency management arrangements, rescue is considered separately from the relocation of people who are stranded or isolated by floodwaters. Where the waters are either fast or swift flowing and / or the people being assisted are facing actual or threatened danger of physical harm the response escalates from relocation to rescue.

Victoria Police, as the designated control agency for water rescue, coordinates rescues undertaken during flood events.

In order to activate water rescue services, VICSES, as Control Agency for overall flood response, will identify areas at risk of requiring rescue and notify the Officer in Charge of the Water Police Search and Rescue Squad to request pre-deployment of rescue resources to those areas.

In conducting rescues, VicPol may require the assistance of appropriately trained and equipped personnel. In these circumstances, appropriately trained and equipped VICSES units or other agencies that have appropriate training, equipment and support may carry out rescues.

VicPol coordinate with these agencies to ensure operational readiness for activation.

In significant flood events, VicPol will appoint a Flood Rescue Manager, who may be an officer from Victoria Police or one of the support agencies.

The primary responsibilities of the Flood Rescue Manager are to:

- Coordinate all rescue activities
- Identify and source required resources
- Deploy required police and support agency resources

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.

Resources available within Northern Grampians Shire to assist with rescue operations are as listed in the MEMP. VICSES specific resources to assist are located at all of the Units either within or adjacent to the Municipality, specifically, Rescue Boats are located at the Stawell. Ararat and Horsham Units. A number of other Rescue Boats are located across the Grampians Region. Further resources would be available dependent upon the size and impact of the event from across the state.

Note that:

- Aircraft may be available through VicPol for urgent rescue operations.
- VicPol and VICSES can access rescue boats, but there is a lead-time required to get them on-site within the Municipality.

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

3.11 Animal Welfare

Animal management guidelines are provided in the MEMP along with the location and contact details for appropriate animal welfare entities. See also Section 4.3 in Part 4 of this MFEP.

3.12 Aircraft Management

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

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

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

Suitable airbase facilities are located at:

- Stawell Aerodrome – large capacity aircraft, 50 pax size
- Ararat and Horsham Aerodromes

3.13 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. VICSES will work with the relief agencies to service communities that are isolated.

3.14 Essential Community Infrastructure and Property Protection

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

DEPI will work with VICSES to identify key energy assets (i.e. power, gas and liquid fuels) on floodplains. Providers of other essential services may need to be contacted in the event of concerns about service continuity.

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.

Property may be protected by:

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

Priorities for sandbags

The Incident Controller will determine the priorities related the use of VICSES sandbags, which will be consistent with the Strategic Control Priorities within the State Emergency Flood Plan and with VICSES Sandbag Policy. As a general rule, sandbags will be issued in priority order of protecting:

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

Any properties identified as being outside the potential flood area will be referred to an alternative source of sandbags (e.g. local hardware store or sandbag supplier).

Quantities

As a guide, 25 sandbags is a reasonable number to supply to residents to allow for coverage of doorways, blocking vents, drains and toilets. Additional sandbags may be provided on a case-by-case basis with due regard for individual issues and local priorities identified by the Incident Management Team.

The Northern Grampians Shire maintains a NIL stock of sandbags. Council cannot guarantee that sand will also be available, however the Shire will make all possible attempts to supply sand at required locations as requested at the time of the event. The Ararat, Stawell, Horsham, St Arnaud and Ballarat VICSES Units also maintain sandbag stocks. A small stock of bags is also located at the Glenorchy Golf Club. Additional supplies are available through the VICSES Regional Headquarters to supplement local stocks.

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.

Refer to Appendix C for further specific details of essential infrastructure requiring protection and the location of sandbag collection point(s).

3.15 Disruption to Services

Disruption to services other than essential community infrastructure and property can occur in flood events. Refer to Appendix C for specific details of likely disruption to services and proposed arrangements to respond to service disruptions in Northern Grampians Shire.

3.16 Road Closures

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

Road closures caused by flooding within the Municipality will be facilitated by the Northern Grampians Shire Council and VicRoads as part of their normal formal functions. This will include necessary observations and, if time permits, the placement of warning signs, road blocks, etc to local and regional roads, bridges, walking and bike trails, etc. Northern Grampians Shire Council staff may also liaise with and advise VicRoads as to the need or advisability of erecting warning signs and / or of closing roads and bridges under its jurisdiction.

VicRoads and the Northern Grampians Shire will communicate information regarding road closures to the ICC and the wider community.

Within Northern Grampians Shire, there are a significant number of roads that are impacted by floodwater. For details of the highways and arterial roads affected, see the Flood Intelligence Cards in Appendix C for each location.

3.17 Dam Failure

DEPI 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 no major dams with potential to cause structural and community damage within the Municipality. The Northern Grampians Shire has one only dam of consequence – Moonlight Dam.

3.18 Waste Water related Public Health Issues and Critical Sewerage Assets

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

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

It is the responsibility of the Northern Grampians Shire Council Environmental Health Officer to inspect and report to the ICC on any wastewater quality issues relating to flooding.

3.19 After Action Review

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

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

Part 4. EMERGENCY RELIEF AND RECOVERY ARRANGEMENTS

4.1 General

Arrangements for recovery from a flood incident within Northern Grampians Shire are detailed in the Northern Grampians Shire MEMP.

4.2 Emergency Relief

The Incident Controller should ensure that the MERC, the Regional Recovery Coordinator and the Municipal Recovery Manager are kept informed of arrangements for 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 Section 4.4 of the EMMV for details of the range of emergency relief services that may be provided.

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

Details of the relief arrangements are available in the MEMP.

4.3 Animal Welfare

Animal management guidelines are provided in the MEMP along with the location and contact details for appropriate animal welfare entities.

Matters relating to the welfare of livestock, companion animals and wildlife (including feeding and rescue) are to be referred to DEPI. This includes requests for emergency supply and / or delivery of fodder to stranded livestock or for livestock rescue.

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 and in the Northern Grampians Shire MEMP.

ACCURACY & CONFIDENTIALITY

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

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

APPENDIX A – FLOOD THREATS FOR NORTHERN GRAMPIANS SHIRE

1. General

The Northern Grampians Shire has a population of around 13,320 people and covers an area of 5,903 square kilometres. Centred on the town of Stawell, which has a population of around 7,000 people, the Municipality relies upon the local agricultural sector and tourism. Other towns include St Arnaud (3,000), Halls Gap (400 but swelling to 8,000 to 10,000 during peak holiday periods), Great Western (200), Navarre (200), Marnoo (150) and Glenorchy (150).

The Melbourne-Adelaide transport corridor traverses the Wimmera Region, placing Stawell within an important regional and national context.

Glenorchy, Navarre, Halls Gap and Great Western, as with many rural settlements in Australia, are positioned on a floodplain which in turn subjects much of their infrastructure to the damaging effects of periodic floods. Halls Gap is subject to flash flooding.

Adjacent Municipalities are the Loddon Shire to the east, Pyrenees Shire to the south east, Ararat Rural City to the south, Southern Grampians Shire to the south west, Horsham Rural City to the west, Yarriambiack Shire to the north west and Buloke Shire to the north.

2. Major Waterways

The principal waterway within the Municipality is the Wimmera River. Other major waterways are the Avon-Richardson and Avoca Rivers. Part of the headwaters of the Glenelg River is also within the Municipality.

A major part of the Wimmera catchment, upstream from a short distance upstream of the Horsham-Lubeck Road (upstream of the Yarriambiack Creek off-take) is within the Municipality. The river forms the boundary between Northern Grampians Shire and the Rural City of Horsham for approximately 18km.

Key waterways within the Municipality, some of which are tributaries of the Wimmera River, include Mt William Creek, Concongella Creek, Fyans Creek and Wattle Creek. Concongella Creek flows from Great Western and enters the Wimmera River upstream of Glenorchy. Mt William Creek drains Mt William south east of Halls Gap, flows past the south of Lake Lonsdale and enters the Wimmera River downstream from Glenorchy. Fyans Creek rises in the southern Grampians Ranges and flows through Halls Gap to Lake Lonsdale. Wattle Creek drains the Pyrenees Ranges, flows through Navarre and enters the Wimmera River downstream from Greens Creek.

Dunmunkle Creek is a major effluent watercourse of the Wimmera River from upstream of Glenorchy. Breakouts occur from the river to the creek during high flow events. The Creek flows in a northerly direction through Rupanyup and eventually becomes part of a channel system that terminates at Lake Tyrell, north of Sea Lake.

The Wimmera River also overflows into Swedes Creek, a tributary of the Richardson River, upstream of Glenorchy.

There are two major weirs controlling flow in the Wimmera River within the Shire.

- Glenorchy Weir is located downstream from Glenorchy on the Wimmera River. It is a low level, fixed crest concrete weir and is located across the Wimmera River just downstream from the inlet of the Lonsdale-Glenorchy channel downstream from the Glenorchy township. It can divert up to 350 ML/d into the Lonsdale-Glenorchy channel. The Weir allows water from this part of the river to be directed anywhere within the system except for the area supplied with the headworks south of Horsham
- Huddleston's Weir diverts all flows up to 1,600 ML/day into Pine and Taylors Lakes, off-stream storages operated by GWMWater within the Rural City of Horsham. Note that while the diversion works have a

significant impact on low to moderate flows, there is little change to the area inundated in major floods. The Weir is fully submerged at a flow of 4,000ML/day. Huddleston's Weir is located just downstream/within the Shire boundary.

The Wimmera River upstream of Glenorchy is relatively hilly with a well defined watercourse and floodplain. The floodplain downstream from Glenorchy to Horsham is a large and relatively flat alluvial area with a complex system of floodpaths. It is characterised by wetlands, the largest being Darlot and Dooen Swamps within the Rural City of Horsham. These areas (i.e. the natural storage of the floodplain) have a vital role in the natural mitigation of floods and help prevent flooding downstream from Glenorchy.

Note that the presence of GWMWater infrastructure across the Wimmera River floodplain downstream from Glenorchy has the potential to significantly alter the distribution of flood flows in this area.

The Horsham Floodplain Management Study (SRWSC, 1982) highlighted the significant role the floodplain upstream of Horsham plays in attenuating flood peaks. The study recommended that the natural floodplain upstream of Horsham be protected so that its flood storage and attenuation characteristics are retained.

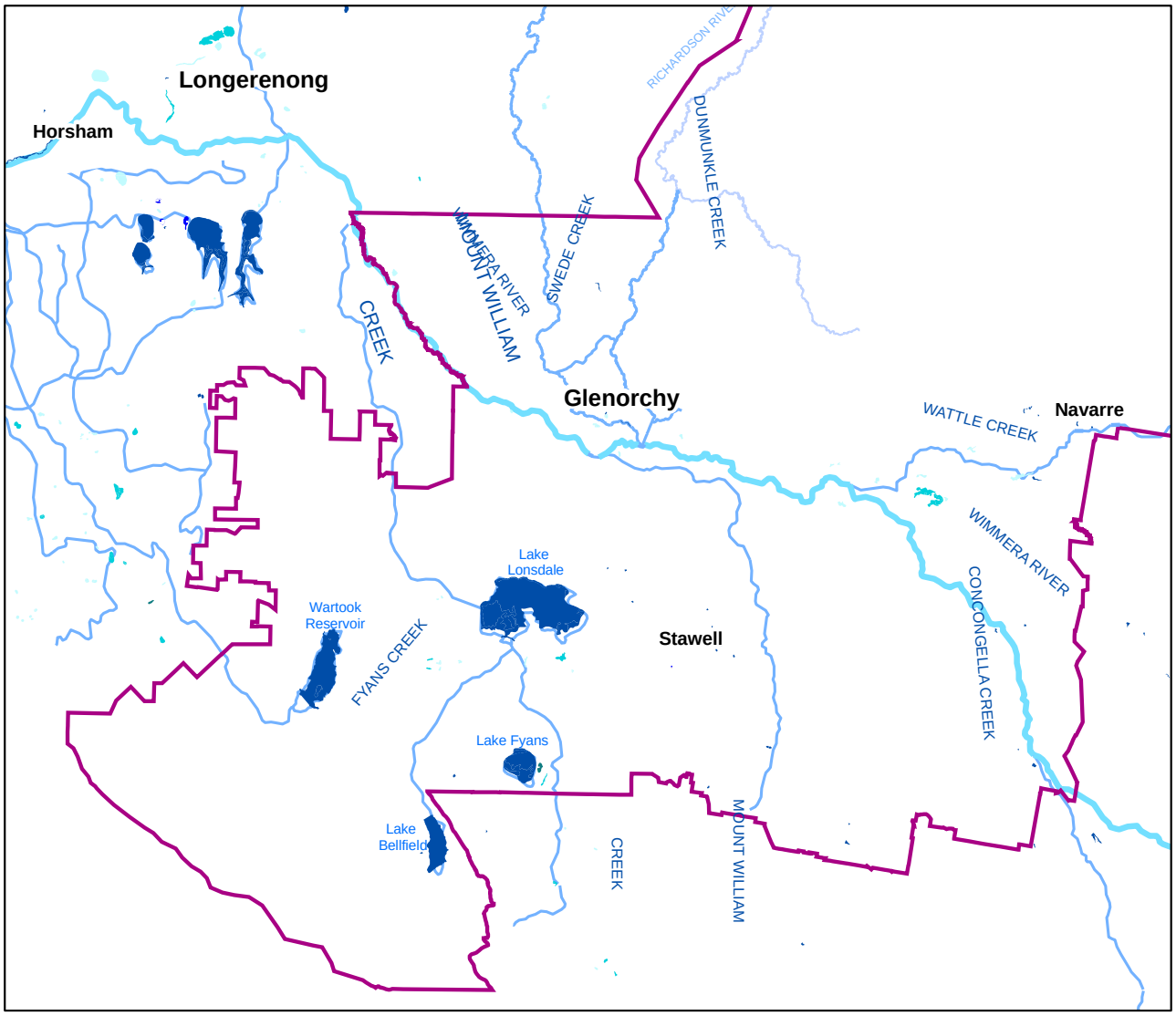

Figure A1: Waterways and storages in the Northern Grampians Shire.

Four (4) on-stream storages operated by GWMWater (Lake Lonsdale, Lake Fyans, Lake Wartook and Lake Bellfield) are located within the Municipality in the Wimmera catchment. Other than Lake Lonsdale (on Mount William Creek upstream of Dadswells Bridge and completed in 1902), these storages have little capacity to influence flood flows within the Wimmera River.

All of the Avon-Richardson River system upstream of Rich Avon is within the Municipality.

The west bank of the Avoca River from Natte Yallock to a few kilometres downstream from Yawong is within the Municipality.

3. Riverine Flooding

Antecedent conditions have a large influence on runoff and flood generation within the Municipality: big floods generally originate from a wet catchment. A period of rain is required to "wet up" the catchments and fill the natural floodplain storage before significant runoff is generated.

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

1 Moist warm airflow from northern or north western Australia (perhaps from a decaying tropical cyclone) bringing moderate to heavy rainfall over a period of 12 hours or more following a period of general rainfall. The period of general rainfall "wets up" the catchments and (partially) fills the natural floodplain storage. These combine to increase the runoff generated during the subsequent period of heavy rainfall.

2 Successive cold fronts, often during winter and spring, that bring periods of rain that wet up the catchments and prime them for flooding from a further front or complex low-pressure system that is perhaps slow moving and brings moderate to heavy rainfall.

Large floods on the Wimmera River through the Northern Grampians Shire generally occur as a result of moderate to heavy rainfall after a prolonged period of general rainfall. The period of general rainfall "wets up" the catchment and also partially fills the natural floodplain storage along the many tributary streams. These two effects combine to increase the runoff generated during the subsequent period of rainfall resulting in a large flood at Glenorchy and downstream. Apart from August 1981, September 1983 and January 2011 (although the subsequent rainfall was heavy and sustained during this event), this rainfall scenario has not occurred since the 1920's.

The following rainfalls and antecedent conditions are considered likely to lead to possible flooding along the Wimmera River but are provided as an indicative guide only.

- After a long dry spell such as occurs in summer – 75mm to 100mm over the catchment in less than 2 days;
- After an initial break but while still dry – 25mm to 50mm over the catchment in less than 1 day; and
- Under very wet conditions or very closely following a previous big flow event – 10 to 20mm in 12 hours or less.

High intensity rainfall such as associated with thunderstorms is likely to lead to flash flooding at Halls Gap.

4. Flash Flooding, Overland Flows and Stormwater Flooding

The flooding of floodplains within river and creek corridors is much easier to predict than flash flooding and overland flows, particularly in existing urban areas, when the local drainage system surcharges. The latter tends to be relatively localised, not necessarily in contiguous areas and occur when short duration, high intensity rainfall (usually associated with severe thunderstorms or small scale weather systems that are locally intense and slow moving) is concentrated in some part of or across a small catchment. Such events, which are mainly confined to the summer months, do not generally create widespread flooding since they only last for a short time and affect limited areas. Flooding from these storms occurs with little warning. Localised damage can be severe.

High intensity rainfall such as associated with thunderstorms giving average rainfall rates of typically more than 30 mm/hour sustained over a period of 30 minutes (i.e. 15mm of rain) or so is likely to lead to high flows in local

creeks (e.g. at Halls Gaps) and / or overland flows, even on a dry catchment. Flash flooding could also occur in the urbanised parts of the Municipality (e.g. in Stawell when the local drainage system surcharges). This amount of rain on a wet catchment will result in higher flows within waterways but the depth, extent and duration of any flooding will be determined by the volume of rain and the period over which it falls.

Other factors can significantly affect the extent and depth of inundation in a given area. For example, blocked drains; silted, blocked or insufficient number of side entry pits; no entry to drains from low points; undersized drains (insufficient capacity – both piped and table); inappropriate road and footpath cross-falls; footpaths not high enough to contain flow in roadway and / or roadside drainage not sufficiently sized; the extent of inspection and maintenance, etc. Fences and other obstructions can block overland flow paths resulting in flooding that may otherwise not have been expected. These factors can result in the inundation of properties by overland flows, even for storms of much less intensity than the 1% AEP or design event. As formalised overland flow paths have generally not been delineated across the Shire, properties in or close to local drainage lines may flood unexpectedly. The likely location of such flooding is hard to predict other than in cases where a drain has a past history of surcharging. Council maintenance records may provide some guidance in such cases.

5. Dam Failure Flood Risk

On-stream storages operated by GWMWater (Lake Lonsdale, Lake Fyans, Lake Wartook and Lake Bellfield) are located within the Municipality in the Wimmera catchment. Other than Lake Lonsdale (on Mount William Creek upstream of Dadswells Bridge and completed in 1902), these storages have little capacity to influence flood flows within the Wimmera River (see Table A1 below).

Dam Safety Management Plans[1] have been prepared and are routinely exercised by GWMWater for each of these storages.

While DEPI is the Control Agency for dam safety incidents, VICSES is the Control Agency for any flooding that may result.

There are a number of large private dams within the Municipality.

There are no stormwater retarding basins within the Municipality.

Water Storage	Capacity (ML)	Outflow arrangement	Operator	Comment
Bellfield	78,550	Fixed crest	GWM Water	On-stream storage upstream of Halls Gap and Dadswells Bridge via Lake Lonsdale
Fyans	21,090	No spillway	GWM Water	Off-stream storage upstream of Dadswells Bridge via Lake Lonsdale
Lonsdale	65,550	Fixed crest	GWM Water	On-stream storage upstream of Dadswells Bridge
Wartook	29,360	Fixed crest	GWM Water	

Table A1: Details of major storages within Northern Grampians Shire

[1] 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.

6. Health and Environmental Risks

There are many septic tanks (e.g. Glenorchy) and a number of sewerage pump stations (e.g. seven at Halls Gap) within the Shire that may be inundated by floodwaters. Further, chemicals and fuel may be stored in farm sheds and tanks on floodplains.

7. Properties at Risk

While information on property floor levels and the likelihood of over-floor flooding is available for Glenorchy (see Appendix C1 and Water Technology, 2006), the Upper Wimmera catchment (see Appendix C3 and BMT WBM, 2014) and Mount William Creek (see Appendix C4 and BMT WBM, 2014), similar information is not currently available for other locations within the Shire.

The table below is a breakdown of the number of properties impacted in a 1% AEP riverine flood event. These figures are **indicative only** and are based on a mixture of mapping and actual impacts during historical events that were less than the 1% event. Any revisions will **increase** the number of properties affected.

Waterway	Community	# properties flooded in 1% AEP				
		Residential	Business	Industrial	Rural	Total
	Glenorchy	27	11			38
	Halls Gap					71
Upper Wimmera		27				27
Mt William Creek		17	5	2		24
Total		**71**	**16**	**2**		**160**

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

The three (3) caravan parks / camping grounds at Halls Gap have been confirmed at risk of being flooded during events significantly small than a 1% AEP event.

Property flood charts (i.e. diagrams showing property floor level against flood depth) were delivered to individual property owners in Glenorchy during 2006 following completion of the Glenorchy flood study (Water Technology, 2006). It is important that these diagrams are revisited (and possibly updated and re-issued) after each major flood event that caused over-floor flooding in order to ensure that they remain generally representative of likely flood consequences. Refer also to Appendix C1

The Mount William Creek Flood Investigation (WBM, 2014) has shown that damage to other than roads (e.g. disruption and restrictions to regional access) and the agricultural sector (e.g. fences, pasture, etc) arising from floods less than the 1% AEP (100-year ARI) event is not large and comes from flooding of twenty-five (25) properties (eleven (11) of which also experience over-floor flooding). Seven (7) of the over-floor flooded buildings are in Dadswells Bridge (the motel, 2 x houses and 2 x shops) with three (3) in Stawell (2 x houses and a shop) and a shed at Lake Lonsdale

The three (3) buildings flooded over-floor in Stawell by the 1% AEP flood level are in Longfield Street. The shop is flooded over-floor from below the 5-year ARI event. The first house is flooded over-floor from a little below the 10-year ARI event and the second house is flooded from a little below the 100-year ARI event. The nursery in Ararat Road while not flooded even by the PMF is within 100mm of being flooded from below the 5-year ARI event.

Floods more severe than the 1% AEP event result in an increase in the number of buildings at-risk of over-floor flooding (up from 7 to 18 at the PMF with only 1 building not flooded over-floor) and additional disruption and restrictions to regional access due to flooded roads.

A summary and a detailed listing of the properties likely to be flooded and inundated over-floor is provided in Appendix C4.

8. Infrastructure at Risk

8.1 Overview

Major infrastructure within the Municipality includes major highways, the Victoria – South Australia rail link, and a range of other facilities. The following list applies to Northern Grampians Shire only.

8.2 Major Roads

Dependant on location and magnitude of the flood, the following roads may be inundated and closed:

- Western Highway at Great Western and / or at Dadswells Bridge
- Wimmera Highway between Henty Highway (Dooen) and St Arnaud and between the Logan - Wedderburn Road and St Arnaud
- Donald - Stawell Road between Donald and Stawell
- Murtoa - Glenorchy Road between Murtoa and Glenorchy
- Stawell - Warracknabeal Road between the Western Highway and Rupanyup
- Halls Gap – Grampians Road
- Grampians Road between Western Highway at Stawell and the Grampians Tourist Road in Halls Gap
- Silverband Falls Road near Halls Gap

Many minor roads in and around the Shire are also likely to be inundated. Refer to the lists in Appendix Cs.

8.3 Essential Infrastructure

There is no known essential infrastructure affected by flooding within the Mount William Creek catchment.

Community facilities:

8.4 Other Infrastructure

Mobile network telephone towers – none known.

Wastewater treatment plant – unlikely to be flooded.

Sewer pump stations – 3 of the 7 at Halls Gap, others not known.

Water treatment plant – not applicable.

Electrical power kiosks / zone sub-stations (cabinets) – none known.

Community facilities

- **Halls Gap** – 3 x caravan parks / camping grounds, oval, Parks Victoria offices, Police Station car park, shops, Boardwalk, motel.
- **Glenorchy** – 2 x churches, Telstra building, GWMWater pump station and water tower in Forest Street, CFA shed, Town Hall

- **Upper Wimmera – Navarre, Joel Joel, Greens Creek and Campbells Bridge** – none identified.
- **Mount William Creek** – none known although the motel at Dadswells Bridge was flooded in January 2011. The Dadswells Bridge Town Hall was also affected by the January 2011 flood but the floor has since been raised.
- **Other locations** - TBA

9. Flooding Hotspots

No flooding hotspots have been recorded other than the locations identified on the maps in Appendix F.

10. Flood Mitigation

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

There are no flood mitigation works or major levees recorded within the Shire.

Structural flood mitigation measures have not been proposed as part of the Upper Wimmera catchment flood study (BMT WBM, 2014) as flood damages could not be reduced effectively by any of the measures considered.

11. Impact of the Wimmera Mallee Pipeline

Piping of the Wimmera Mallee Stock and Domestic Supply System (i.e. the Wimmera Mallee Pipeline Project) has the potential to impact on flood behaviour in three ways:

- Alteration to the operating regime of existing storages;
- Alterations to floodplain conveyance characteristics; and
- Alterations to floodplain storage characteristics.

While no significant changes are proposed to Taylor's Lake outlet channel as part of the Wimmera Mallee Pipeline Project, it is possible that there may be some alteration to other channel embankments within the floodplain and potential for a redistribution of flood flows as well as a change in storage characteristics. The impact and consequences of such redistribution and change in storage characteristics will need to be observed and recorded in future flood events.

12. Historic Floods

12.1 Wimmera River

Flooding from the Wimmera River have been a regular feature of the area, with significant floods occurring in 1870, 1889, 1894, 1909, 1915, 1916, 1923, 1955, 1956, 1960, 1964, 1973, 1974, 1975, 1981, 1983, 1988, 1992, 1993, 1996, 2010 and 2011. Of these, the January 2011 event was the largest at Glenorchy at 5.03m on the gauge.

A number of large floods occurred along the Wimmera River prior to 1924 including events in 1889, 1894, 1909 and 1915. This is in contrast to the subsequent period (1924 to 2005) where only a few large floods have occurred, with the exception of the January 2011 event. Generally the community attribute the absence of large floods since 1923 to development within the catchment (e.g. land use change, construction of water storages, etc). However, recent studies (SRWSC, 1982: Water Technology, 2003) have concluded that development has had minimal impact on the magnitude of large floods within the catchment while conceding that total runoff (yield) from the catchment may have reduced.

A history of notable flood events within the Wimmera River catchment, derived in part from analyses contained in Water Technology (2003), is provided in the Table below.

12.2 Halls Gap

Halls Gap is subject to flash flooding[2]. Notable flash floods occurred in December 1992, May 2007 and January 2011. A smaller event occurred in January 2007.

12.3 Mount William Creek

Damaging floods inundated Dadswells Bridge in 1909, 1975, 1981, 1992 and January 2011. It is assumed that there same floods also affected the catchment upstream of Lake Lonsdale.

12.4 Avon-Richardson River

To be completed by NGSC in conjunction with North Central CMA.

12.5 Avoca River

To be completed by NGSC in conjunction with North Central CMA.

12.6 Glenelg River

Flooding within the headwaters of the Glenelg River is not considered sufficient to warrant consideration within this MFEP.

Specific Storm Events by Date

- **The August 1909 Flood**

Anecdotal evidence points to the August 1909 flood as being the largest major flood for which detailed records exist. About 82 mm of rain fell over the Wimmera catchment during the 19 hours ending 6pm 19 August 1909, causing widespread flooding.

At Elmhurst, in the upper reaches of the catchment, the flood was estimated to be at least 0.6 m higher than the 1870 flood. At Glenorchy all but 6 houses were flooded.

Information about the 1909 event along the Yarriambiack Creek is limited and relates only to flooding north of the Municipality.

Along Dunmunkle Creek, the August 1909 event was also a major flood. At Rupanyup on the 21st August, the floodwater was said to have been 1.4m deep over the whole township and flowing in a stream 5.3km wide.

- **The flood of 14 January 2011**

Significant widespread rainfall affected the majority of the State in January 2011. It was the wettest January on record. The event was significant enough for the Bureau of Meteorology to publish Special Climate Statement 26 to describe the synoptic conditions associated with the event. In summary, the extreme rainfall recorded was generated by the passing of complex and persistent low-pressure systems. A broad slow moving trough centred over western Victoria and a ridge of high pressure to the south of Tasmania were the main drivers for the rainfall that started to fall on 9th January. The two systems created exceptionally humid conditions and an unstable easterly flow across Victoria. The trough strengthened on the 12th and developed into a low-pressure system over eastern South Australia on Thursday the 13th as a high-pressure system moved into the Tasman Sea. The low-pressure system cleared the State on the Friday evening (the 14th) after adding an additional 50 to 100mm of rain.

The level of flooding and the flood related damage exceeded that experienced in September 2010, with significant above floor and infrastructure damage recorded in communities across the Municipality. Additional information on

[2] Flash flooding is defined as flooding which occur within 6 hours of rain. It is usually the result of intense local rain and is characterised by rapid rise in water levels.

the characteristics and impact of this flood event are available from the Wimmera and North Central CMAs and NGSC.

At Glenorchy:

- The impacts of this event was felt at the residential level, due to the amount of houses physically built low to the ground, and the terrain effect as well
-

At Halls Gap:

- The impacts where most apparent within the main CBD area, with both businesses in the lower lying areas being the most effected. Additionally roads were either cut or damaged, in instances both.
-

Upper Wimmera catchment

This event was the largest in the Upper Wimmera River catchment and was influenced by antecedent conditions. Heavy rain (144mm over two days in the Pyrenees) combined with an already wet catchment led to significant flooding in all Upper Wimmera watercourses. The stream gauges at Eversley, Glynwylln and Navarre were damaged with record flooding. Navarre, Landsborough, Eversley, Crowlands, Joel Joel, Greens Creek and Campbells Bridge all experienced flooding. The level of flooding and the flood related damage exceeded that experienced in September 2010, with significant above floor and infrastructure damage recorded.

Mount William Creek catchment

The most serious flood occurred in January 2011 when record rainfall (267mm in 3 days at Mt William and 161mm at Dadswells Bridge over the 10-12 January: 11mm, 75mm & 75mm respectively) in the catchment resulted in the largest flood in memory along Mount William Creek.

At the start of the event, Lake Lonsdale was at 93.8% capacity (49,986ML). During the event it is estimated to have peaked at 70,205ML (131.7% capacity). GWMW estimated the peak flow at the tail gauge was approximately 38,527ML/d, marginally below the estimated 1% AEP flood flow of 44,200ML/d (see photograph below). The previous highest flood recorded at the tail gauge (27,300ML/d) occurred in 1909.

The 2014 flood caused widespread damage to property along the length of the creek and resulted in the inundation of a number of homes and buildings in Dadswells Bridge. Dadswells Bridge, Pomonal, Moyston and surrounding areas were isolated as were many rural dwellings due to flood damage to rural roads.

Lake Lonsdale spilling approximately 30,000ML/d in January 2011 (source: Wimmera CMA)

SUMMARY OF FLOODS FOR THE WIMMERA RIVER							
Month/Year of Flood	Gauging Station Location and Number						
	Eversley 415207	Crowlands 415245	Navarre 415238	Glynwylln 415206	Glenorchy 415201	Walmer 415200	Comments
Oct. 1894					No records	3.71m gauge 30,400 ML/day 2.3% AEP	Major flood along the Wimmera River. Townships of Horsham, Glenorchy, Dimboola & Jeparit affected
Aug. 1909					No records	3.86m gauge 42,400 ML/day 0.5% AEP	Widespread flooding along the Wimmera River and Dunmunkle and Yarriambiack Creeks. Townships of Horsham, Glenorchy, Warracknabeal, Dimboola, Jeparit and Rupanyup affected.
Feb 1911					No records	3.40m gauge 15,600 ML/day 14.7% AEP	
Sept 1915					No records	3.69m gauge 29,100 ML/day 2.7% AEP	Major flood along Wimmera River and Yarriambiack Creek. Townships of Horsham, Glenorchy Warracknabeal, Dimboola & Jeparit affected.
Sept 1916					No records	3.44m gauge 17,100 ML/day 12.2% AEP	Major flood along Wimmera River. Townships of Horsham and Glenorchy affected.
Aug 1923					No records	3.50m gauge 19,350 ML/day 9.1% AEP	
Oct 1973					4.94m gauge 22,800 ML/day 6.4% AEP	3.36m gauge 14,500 ML/day 16.8% AEP	
May 1974					17,500ML/d	18,000ML/day	
Oct 1975					4.91m gauge 20,100 ML/day 9.4% AEP	3.43m gauge 16,700 ML/day 12.9% AEP	
Aug 1980					4.72m gauge	2.97m gauge	

SUMMARY OF FLOODS FOR THE WIMMERA RIVER							
Month/Year of Flood	Gauging Station Location and Number						
	Eversley 415207	Crowlands 415245	Navarre 415238	Glynwylln 415206	Glenorchy 415201	Walmer 415200	Comments
					13,500 ML/day 23% AEP	8,250 ML/day 35% AEP	
Aug 1981					4.85m gauge 17,200 ML/day 14% AEP	3.63m gauge 24,800 ML/day 4.7% AEP	Significant flooding along Wimmera River & Yarriambiack Creek. Horsham, Warracknabeal, Dimboola & Jeparit may have been affected to some degree.
Sept 1983					4.86m gauge 17,700 ML/day 13% AEP	3.77m gauge 35,000 ML/day 1.3% AEP	
Sept 1988	3.52				4.97m gauge 25,200 ML/day 4.3% AEP	3.55m gauge 21,004 ML/day 7.5% AEP	
Oct 1992					4.79m gauge 15,000 ML/day 19% AEP	3.33m gauge 13,500 ML/day 18.9% AEP	
Oct 1996	3.75				4.78m gauge 14,800 ML/day 19.5% AEP	3.50m gauge 19,214 ML/day 9.3% AEP	Flood along Wimmera River. Township of Dimboola affected.
Sept 2010	4.74	2.64	4.64	8.31			
Jan 2011	5.84	3.44	4.77 (est)	8.80	5.03m gauge ~1% AEP	4.27m gauge 33,049 ML/day	Record flooding in the Upper Wimmera. Similar to 1909 at Glenorchy and downstream. Level at Horsham elevated by backwater from McKenzie Creek and other tributaries.

NOTES: The Walmer gauge is located about 3.7km downstream from the Horsham Weir.

AEPs of historic events are approximate only.

13. Flood Inundation Mapping

The 2006 Glenorchy Flood Study (Water Technology, 2006) delivered a series of detailed flood inundation maps for Glenorchy (see Appendix F1). These maps show the expected extent and depth of inundation for events ranging from the 20% AEP (5-year ARI) flood event up to the 0.5% AEP (200-year ARI) flood event. The maps also identify houses and other buildings likely to be flooded above floor level by each event. Surveyed floor levels have been compared to predicted flood heights. A red dot is used to show each floor level lower than the expected flood height (i.e. over-floor flooding is likely). A list of affected properties with corresponding river levels and likely flood depths is provided at Appendix C1.

A series of detailed flood inundation maps were delivered for Halls Gap (see Appendix F2) as part of the 2008 Halls Gap Flood Study (Water Technology, 2008). These maps show the expected extent and depth of inundation for events ranging from the 10% AEP (10-year ARI) flood event up to the 0.5% AEP (200-year ARI) flood event. Details of properties affected are provided in Appendix C2.

Flood inundation maps have also been produced by BMT WBM (2014) for the Upper Wimmera catchment to Glynwylln for the 5, 10, 20, 50, 100 and 200-year ARI flood events and the PMF event. A subset of those maps is included in this MFEP at Appendix F3. The study also delivered a list of properties within the upper catchment likely to experience below and above-floor inundation for each of these events. That information is included in Appendix C3.

Flood inundation maps have been produced by BMT WBM (2014) for the Mount William Creek catchment for the 5, 10, 20, 50, 100 and 200-year ARI flood events and the PMF event. A subset of those maps is included in this MFEP at Appendix F4. The study also delivered a list of properties within the catchment likely to experience below and above-floor inundation for each of these events. That information is included in Appendix C4.

For areas of the Municipality not covered by detailed flood maps, the Northern Grampians Planning Scheme shows areas along the waterways within the Shire likely to be inundated by a 1% AEP (100-year ARI) flood event as LSIO (Land Subject to Inundation Overlay). While it is not practical to reproduce the overlay as an attachment to this Plan, hard copies are available from the NGSC and Wimmera CMA. They are also available in hard copy form and as PDF digital copies at the NGSC MECC and in digital form at the DSE website www.doi.vic.gov.au/planningschemes.

Within Glenorchy itself, the Planning Scheme refers to designated 1% AEP flood levels. These are the 1% AEP flood levels across land designated as subject to inundation within the Planning Scheme.

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

14. Digital Flood Extent Datasets and Flood Photography

14.1 Wimmera Catchment

The Victorian Flood Data (VFD) datasets (available from the Wimmera and / or North Central CMA) contain a significant quantity of flood information for the Upper Wimmera catchment in GIS format. For example:

- Historic flood levels for the 1909, 1956, 1973, 1981, 1983, 1988, 1996 and 2011 flood events;
- Historic flood extents taken from an orthophotographic compilation of floods from 1909 to 1985 and March 1988 (Concongella, Wattle and Salt creeks) as well as aerial and other photography of the August 1981, September 1983, September 1988 and January 2011 events; and
- 1% AEP (100 year ARI) flood extent and levels at Glenorch.

The WCMA has 15cm visual and near-infrared aerial photography for selected streams within the Wimmera catchment flown in January 2011 during the flood event.

There is also 15cm aerial photography of selected streams flown in December 2009.

The original aerial flood photography mentioned above is also available from Wimmera CMA (see Table below). All aerial photography is available as ECW format.

Wimmera Catchment Information	Area	Events
Statistical and Historic Flood Levels	Northern Grampians Shire (Wimmera River)	Flood levels for 1909, 1956, 1973, 1981, 1983, 1988, 1996 & 2011
Flood Photography	Northern Grampians Shire	1909 to 1988 (orthophoto) Aug 1981 (vertical photography) Sep 1983 (video & oblique photography) Mar 1988 (orthophoto – Concongella, Wattle & Salt Ck) Sep 1988 (oblique photography) Jan 2011

14.2 Mount William Creek

The Mount William Creek catchment is covered by 10m pixel Spot VNIR 2001 satellite imagery.

Various sub-catchments are covered by 1:46,000 digital orthorectified colour aerial photography, with pixel resolution of 1m (flown 2002).

The entire catchment is covered by 1:40,000 digital orthorectified colour aerial photography, with pixel resolution of 0.6m (flown 2011). 50cm 2010 orthorectified true colour aerial photography is also available.

14.3 Avoca River

The VFD (available from Wimmera and / or North Central CMA) contains flood information for the Avoca River catchment in GIS format. For example:

- Historic flood extents taken from aerial photography of the September 1988 event.

The original aerial flood photography mentioned above is also available from the NCCMA. Other relevant information is also available (see Table below).

Avoca River Information	Area	Events
Statistical and Historic Flood Levels	Northern Grampians Shire (Avoca River)	
Flood Photography	Northern Grampians Shire	Sept 1988 (oblique photography)

14.4 Avon-Richardson River

The VFD (available from Wimmera and / or North Central CMA) contains flood information for the Avon-Richardson River catchment in GIS format. For example:

- Historic flood extents taken from aerial photography of the September 1988 event; and
- 1909 flood extents.

The original aerial flood photography mentioned above is also available from Wimmera CMA. Other relevant

information is also available (see Table below).

Avon-Richardson River Information	Area	Events
Statistical and Historic Flood Levels	Northern Grampians Shire (Avon-Richardson River)	
Flood Photography	Northern Grampians Shire	Sept 1988 (oblique photography)

14.5 Other Datasets

WCMA has a catchment-wide Airborne Laser Scanning derived Digital Elevation Model (DEM).

The Wimmera and North Central CMAs hold a variety of other datasets that include:

- Contour and survey information, including LiDAR data.
- Drainage and road infrastructure data.
- Digital cadastral information.
- Flood and non-flood aerial photography.

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

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

Definitive information on the time it takes flash flooding (i.e. resulting from heavy rainfall associated with severe weather or thunderstorm activity) to develop (i.e. to arrive at a location) following the start of heavy rain and the time it takes for the maximum water depth / extent to be reached is not available for any locations within the Municipality. **Timing is however likely to be short: less than 6 hours and maybe as short as 30 minutes.**

Upper Wimmera Catchment

Note: The BoM does not issue flood warnings for the Upper Wimmera catchment.

Location From	Location To	Typical Travel Time	Comments
Start of heavy rain on a wet catchment	Eversley	1 - 2 hours	Begin to rise from normal levels
Start of heavy rain on a wet catchment	Crowlands	2 - 4 hours	Begin to rise from normal levels
Start of heavy rain on a wet catchment	Navarre	3 – 6 hours	Begin to rise from normal levels
Start of heavy rain on a wet catchment	Glynwylln	6 - 12 hours	Begin to rise from normal levels
Rates of rise are quite rapid (can be 1m/hour or more at Navarre and 500mm/hour or more at other locations) on a wet catchment with flooding / overbank flows likely to begin within 1 to 4 hours of the initial rise. Peaks last for a few hours at most and recessions are about half the rate of rise. It is emphasised that these times are approximate only and are for heavy rain on a wet catchment. Lighter rain or rain on a drier catchment result in much slower response times. For example, in January 2011 the time from start of rain to the start of flooding was of order 50 hours or more. Initial rain wetted up the catchment and the heavy rain that followed caused very quick and significant rises in stream levels with attendant record flooding. A second flood will travel faster than a flood on a "dry" watercourse and a big flood will in general travel faster than a small flood.			
Start of rain on the Upper catchment	Glenorchy	24 – 30 hours	Begin to rise from normal levels
Start of rise to peak	Glenorchy	30 to 36 hours	From start of rise to peak level
Time between peaks - need to look at hydrograph to determine time at which critical levels will be exceeded			
Eversley	Glynwylln	7 to 19 hours	January 2011 = 9.5 hours September 2010 = 19 hours
Eversley	Glenorchy	18 to 30 hours	January 2011 = 22.5 hours September 2010 = 30 hours
Glynwylln	Glenorchy	11 to 13 hours	January 2011 = 13 hours September 2010 = 11 hours
Glynwylln	Horsham (Walmer)	87 to 103 hours	January 2011 = 90 hours September 2010 = 103 hours
Glenorchy	Horsham (Walmer)	77 to 92 hours	January 2011 = 77 hours September 2010 = 92 hours

Mount William Creek

Note: The BoM does not issue flood warnings for Mount William Creek.

Location From	Location To	Typical Travel Time	Comments
Start of rainfall	Moyston, Pomonal	6 hours or so	On a wet catchment with heavy rain
	Lake Lonsdale	1 – 2 days	Depends on catchment wetness – quicker on a wet catchment
	Dadswells Bridge	2 – 5 days	Highly dependent on rainfall totals and the level of Lake Lonsdale prior to the event
Lake Lonsdale Spillway	Dadswells Bridge	8 – 12 hours	With Lake Lonsdale spilling

APPENDIX C1 – GLENORCHY COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview of Issues and Flood Behaviour

Large Wimmera River floods generally occur as a result of moderate to heavy rainfall in the upstream parts of the catchment after a prolonged period of general rainfall. The incidence of major flows along the Wimmera River and through Glenorchy is therefore very much dependent on catchment wetness (i.e. antecedent rainfall).

In addition to flooding within Glenorchy, large areas of flat rural land flood and access to properties along the Wimmera River, particularly downstream from Glenorchy, are affected for extended periods during major flood events.

Flooding through the Glenorchy township is a result of both direct inundation by the Wimmera River, and breakout flow from upstream areas flowing through the town. The breakout flows cross the Glenorchy – Campbell Bridge Road, continue through the culverts under the railway line and enter the town along the Cameron and Boyd Street drains.

Between 2 & 3km upstream of Glenorchy, Dunmunkle Creek and the Swedes Cut (a high level cut diverting water to Swedes Creek) divert floodwaters to the north. Flow into Dunmunkle Creek is controlled by the regulator and the Glenorchy – Campbell Bridge Road. If the regulator is assumed to be closed, the flow in Dunmunkle Creek varies between about 1,470ML/d for the 10-year ARI Wimmera River flood to around 2,750ML/d for the 200-year ARI event.

While there is a natural narrowing of the floodplain in the vicinity of Glenorchy, there are also significant embankments associated with roads, the railway line and channels in the area that have the potential to substantially modify flow patterns. These include the significant embankments of the Stawell – Warracknabeal Road Bridge over the Wimmera River that intrude into the floodplain and appear to prevent floodwaters flowing back to the river. The embankments associated with the previous bridge crossing are still present upstream of the existing crossing.

The passage of flood flows through Glenorchy has been highly altered over time. The principal drainage works consist of two channels running along Boyd and Cameron Streets, joining downstream from the town. In addition, there have been numerous private bund / levee systems constructed over time by individual landowners in order to protect their residences. These are generally poorly constructed.

Localised rural flooding is experienced as the river approaches 4.0m on the Glenorchy gauge (minor flood level). As flood waters rise, the extent of rural land inundated increases and roads become progressively more flood affected. Glenorchy remains relatively unaffected until the river approaches 4.85m on the town gauge. As the river rises towards the 10% AEP (10 year ARI) flood level (4.9m), water begins to breakout through the town anabranch and inundate properties. Extensive inundation occurs through Glenorchy in moderate and larger flood events.

During large floods, overflows may occur into Swedes Creek and thus into the Avon-Richardson river system from upstream of Campbells Bridge down to the cut channel approximately mid-way between Campbells Bridge and Glenorchy, a distance of about 10km.

2. Overview of Flooding Consequences

2.1 Warning Times

The flood warning time for Glenorchy is generally around 12 hours or more - see Appendix B.

2.2 General Comments

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

2.3 Roads Affected

The first roads within the Glenorchy township will begin to be affected from below the 10-year ARI event. All roads within the town will be wetted by around the 20-year ARI event. The Stawell – Warracknabeal Road is unlikely to be inundated at Glenorchy by a 100-year ARI event but is likely to be inundated to the south and north.

2.4 Isolation

Isolation can occur if the Stawell – Warracknabeal Road and / or other major roads in the area are inundated.

2.5 Properties Affected

2.5.1 Summary

The first floor is flooded between the 5-year and 10-year ARI event.

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

The Glenorchy floodplain management plan (Water Technology, 2006) delivered flood inundation and extent maps for the town and immediate surrounding area. See Appendix F1. The maps also show the location of all properties within the town affected by below and above-floor inundation for a range of floods up to the 0.5% AEP (200 year ARI) event.

2.5.2 Detailed List

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground flooding and the likely depth of over-floor inundation is provided in Section 7.4 of this Appendix. It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix F1).

It should be noted that properties in addition to those listed may also be flooded from time to time depending on the severity of the event

2.5.3 Update of List of Properties Likely to be Flooded

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

2.6 Areas Affected

Maps at Appendix F1 provide guidance on where flooding is likely to occur within Glenorchy and the immediate area for flood events ranging from the 10-year ARI event up to the 200-year ARI event.

2.7 Essential Infrastructure

There is no known essential infrastructure affected by flooding at Glenorchy, other than the:

- GWMWater pump at the end of Forest Street;
- The CFA shed in Forest Street;
- The Town Hall in Forest Street.

3. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

4. Flood Mitigation

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

5. Design Peak Flood Estimates

ARI (years)	Level at the Glenorchy gauge	
	(m)	(mAHD)
10	4.90	168.65
20	4.96	168.71
50	5.01	168.76
100	5.03	168.78
200	5.05	168.80

6. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Northern Grampians Shire Council will be under the Control of the VICSES Regional Duty Officer /or an appointed Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

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

The ICC for the Northern Grampians Shire and any Divisional or Sector Commands will be located as detailed in the VICSES Grampians Region Flood Emergency Plan.

7. Flood Intelligence Card and Property Inundation List

7.1 Introduction

The BoM currently provides flood forecasts for Glenorchy. It anticipates being able to provide a minimum of 24 hours warning lead time of flooding at Glenorchy in most situations. An absolute minimum of 8 to 10 hours is anticipated in the unlikely event of failure of most rain gauges in the upper parts of the catchment.

Hourly rainfall data is available from a gauge at the Mt Emu Creek at Mena Park and the Hopkins River at Ararat stream gauge sites and from the BoM operated Westmere AWS, Mt William AWS and Ben Nevis AWS as well as (at 9am) from the BoM daily read stations at Beaufort – see BoM website.

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 "Flood Preparedness".
2. All levels, impacts and actions listed in the following flood intelligence card may need to be adjusted to better reflect experience.

7.2 Flood Intelligence Card

WIMMERA RIVER at GLENORCHY				
River Height (m)	**River Flow (ML/d)**	**Consequence / Impact within the Municipality Refer to property list below and maps at Appendix F1**	**Action[3] Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible**	**Comments**
1.82m	2,000ML/d	**Within the Shire:** Water flows into Dooen Swamp with a river flow of about 2,000ML/d.	Advise landholders so that stock can be moved from Dooen Swamp.	80% AEP (1.3 year ARI) event
4.00m	7,000ML/d	**Within the Shire:** Localised minor flooding of rural land adjacent to the Wimmera River.	Advise landholders so that stock can be moved from low lying areas along the river.	Minor Flood Level 50% AEP (2 year ARI)

[3] All references to unsafe driving depths have been extracted from Appendix J of *Floodplain Management in Australia, Best Practice Principles and Guidelines* (ARMCANZ, 2000)

WIMMERA RIVER at GLENORCHY				
River Height (m)	**River Flow (ML/d)**	**Consequence / Impact within the Municipality Refer to property list below and maps at Appendix F1**	**Action[3] Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible**	**Comments**
4.50m	10,075ML/d	**Within the Shire:** Extent of rural land inundated increasing and roads becoming progressively more flood affected.	Erect "Water Over Road" signs as appropriate. Advise property owners in the urban and rural areas of the Shire of the likelihood of road and property flooding in excess of 300mm. Advise that driving in water more than 300mm deep is highly dangerous and may result in loss of life.	
4.72m	13,500ML/d			August 1980 event 23% AEP (4.4 year ARI)
4.75m	14,200ML/d			Moderate Flood Level 21% AEP (4.7 year ARI)
4.77m	14,600ML/d			20% AEP (5 year ARI) event
4.78m	14,800ML/d			October 1996 event 19.5% AEP (5.1 year ARI)
4.79m	15,000ML/d			October 1992 event 19% AEP (5.3 year ARI)
4.85m	17,200ML/d	**At Glenorchy:** Glenorchy township affected by floodwaters. Water in the town anabranch is more than 0.25m deep and properties in Carfrae Street are beginning to be inundated. Old shop in Bunbury Street about to be flooded.	Advise property owners in Glenorchy of the likelihood of road and property flooding (refer to list below and flood inundation maps at Appendix F1).	August 1981 event 14% AEP (7 year ARI)
4.86m	17,700ML/d	**At Glenorchy:**	Consider relocating CFA equipment and	September 1983 event

WIMMERA RIVER at GLENORCHY				
River Height (m)	**River Flow (ML/d)**	**Consequence / Impact within the Municipality Refer to property list below and maps at Appendix F1**	**Action[3] Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible**	**Comments**
		Shallow flooding in Arapiles, Bunbury, Boyd, Cameron, Carfrae, Dry, Forest, Green and Wills Street.	operations with regard for likely property flooding and road closures.	13% AEP (7.7 year ARI)
4.90m	19,300ML/d	**At Glenorchy:** Old shop in Bunbury Street and house in Boyd Street flooded above floor. 1 other property flooded below floor level. Part of Arapiles, Bunbury, Boyd, Cameron, Carfrae, Dry, Forest, Green and Wills Street flooded to depth of 0.25m and properties beginning to flood. Flooding up to 0.25m deep along Dunmunkle and Swedes creeks.	Door knock, sandbag or evacuate houses identified as subject to over floor flooding (see list below and flood inundation maps at Appendix F1). Erect "Water Over Road" and "Road Closed" signs as appropriate. Advise that driving in water more than 300mm deep is highly dangerous and may result in loss of life.	Major Flood Level 10% AEP (10 year ARI)
4.91m	20,100ML/d			October 1975 event 9.4% AEP (11 year ARI)
4.92m	21,040ML/d	**At Glenorchy:** Shallow flooding of properties in Edwards, Forest and Marl Street. Access to CFA shed and Town Hall likely to be difficult.	If not done, consider relocating CFA equipment and operations with regard for likely property flooding and road closures.	
			Advise rural property owners that they may be isolated for some days.	
4.94m	22,800ML/d			October 1973 event 6.4% AEP (16 year ARI)
4.95m	23,650ML/d	**At Glenorchy:** House in Marl Street flooded above floor.	Door knock, sandbag or evacuate houses identified as subject to over floor flooding (see list below and flood inundation maps at	

WIMMERA RIVER at GLENORCHY				
River Height (m)	**River Flow (ML/d)**	**Consequence / Impact within the Municipality Refer to property list below and maps at Appendix F1**	**Action[3] Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible**	**Comments**
			Appendix F1).	
4.96m	24,320ML/d	**At Glenorchy:** Above floor flooding of 3 houses and below floor flooding of a further 9. Flooding up to 0.5m deep in the vicinity of Cameron and Forest Street. All other roads within town flooded to a depth of less than 0.25m.	Erect "Water Over Road" and "Road Closed" signs as appropriate. Advise that driving in water more than 300mm deep is highly dangerous and may result in loss of life.	5% AEP (20 year ARI) event
4.97m	25,200ML/d	**At Glenorchy:** Shallow flooding of properties in Cameron and Green Street.		September 1988 event 4.3% AEP (23 year ARI)
5.00m	28,000ML/d	**At Glenorchy:** House in Carfrae Street flooded above floor.	Door knock, sandbag or evacuate houses identified as subject to over floor flooding (see list below and flood inundation maps at Appendix F1).	
5.01m	29,730ML/d	**At Glenorchy:** Above floor flooding of 4 houses and below floor flooding of a further 11. Shallow flooding of properties in Wills Street. Flooding of more than 1.0m deep in the vicinity of the intersection of Cameron and Forest Street. All other roads within town flooded to a depth of at least 0.25m.		2% AEP(50 year ARI) event
5.02m	31,200ML/d	**At Glenorchy:** Houses in Cameron and Wills Street flooded above floor. CFA shed in Forest Street flooded above floor. GWMWater pump shed at end of Forest Street flooded above floor. Access to town likely to be difficult for anything less than truck and / or 4WD.	Door knock, sandbag or evacuate houses identified as subject to over floor flooding (see list below and flood inundation maps at Appendix F1). Consider evacuating the town.	

WIMMERA RIVER at GLENORCHY				
River Height (m)	**River Flow (ML/d)**	**Consequence / Impact within the Municipality Refer to property list below and maps at Appendix F1**	**Action[3] Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible**	**Comments**
5.03m	33,350ML/d	**At Glenorchy:** Above floor flooding of 6 houses, the CFA shed and 1 shed as well as below floor flooding of a further 28 properties within Glenorchy. Most of Glenorchy flooded with depths ranging from shallow to almost 2m. Access to town likely to be severely affected if water rises much further. **Within the Shire:** Many Shire roads and low level bridges flooded.	Consider evacuating the town. Driving in a normal car likely to be dangerous. Ensure all low level bridges and river crossings are closed.	1% AEP (100 year ARI) event
5.04m				January 2011 event
			Consider need to evacuate or resupply rural properties.	
5.05m	36,600ML/d			0.5% AEP (200 year ARI) event
		No information other than more damaging than the 200 year ARI event.		Probable Maximum Flood (PMF)

The flows, gauge heights, AEPs and ARIs quoted in the above table have been extracted from the analyses documented in Water Technology (2006 & 2003).

Flood impacts described in the above table relate primarily to mainstream flooding from the Wimmera River. It should be noted that local impacts, or impacts in excess of those indicated may occur as a result of local stormwater runoff and drainage and / or be attributable to flooding emanating from tributary streams. Similarly, local increases in flood levels and impacts may result from local factors such as culvert and other blockages and from obstructions to overland flows such as earthworks, channels, fences, buildings and the like.

7.3 Summary of Properties Flooded

Summary of number of flood affected properties in Glenorchy						
	Level on the Glenorchy gauge					
	4.90m	4.96m	5.01m	5.03m		
Numbers of properties flooded above floor	2	4	5	10		
Number of properties flooded below floor only	3	10	12	28		
Total number of flooded properties	**5**	**14**	**17**	**38**		

7.4 Detailed List of Properties Likely to be Flooded

7.4.1 Introduction

The following is a list of properties expected to experience flooding (and the depth of that flooding) at various heights on the Walmer river gauge along with an indication of the likely depth of over floor flooding**. It is strongly recommended that the following list be used in conjunction with the flood inundation maps (see Appendix F1)** where a red dot has been used to show each floor level lower than the expected flood height (i.e. where over floor flooding is likely).

7.4.2 Update of List of Properties Likely to be Flooded

The list of properties likely to be flooded (with corresponding river level and indication of over floor flood depth) should be updated within five (5) weeks of a flood peak with information collected as part of post-flood information recording activities and as may be collected as a consequence of the event debrief (see Part 3 Section 8) as well as from the collective experience of the Flood Emergency Management Team. Procedures detailed in Part 4 Section 7 of this Flood Response Plan should be followed to ensure a comprehensive and coordinated approach to update.

GLENORCHY – any changes need to be reflected in property flood charts delivered to individual property owners in Glenorchy during 2006									
Location of House (Street Name & Number)	**Depth of flooding at property for selected river heights on the Glenorchy gauge.**				**Depth of over floor flooding at property for selected river heights on the Glenorchy gauge.**				**Comments**
	4.90m	**4.96m**	**5.01m**	**5.03m**	**4.90m**	**4.96m**	**5.01m**	**5.03m**	
Arapiles Street	---	---	---	0.05m					Shed on block bounded by Arapiles, Gleeson & Bunbury Street

GLENORCHY – any changes need to be reflected in property flood charts delivered to individual property owners in Glenorchy during 2006									
Location of House (Street Name & Number)	Depth of flooding at property for selected river heights on the Glenorchy gauge.				Depth of over floor flooding at property for selected river heights on the Glenorchy gauge.				Comments
	4.90m	4.96m	5.01m	5.03m	4.90m	4.96m	5.01m	5.03m	
Arapiles Street	---	0.06m	0.14m	0.34m					Old church on north west corner of Arapiles & Bunbury Street
Arapiles Street	---	---	---	0.18m					House on north east corner of Arapiles & Green Street
Bunbury Street	---	---	---	0.19m					House on north east corner of Bunbury & Arapiles Street
Bunbury Street	---	---	---	0.18m					House on south side of Bunbury St midway between Forest & Dry St
Bunbury Street	---	---	---	0.07m					House next door to the east (upstream)
Bunbury Street	---	---	---	0.04m					House next door to the east (upstream) – next to house on the corner
Bunbury Street	---	---	---	0.07m					House on south west corner of Bunbury & Forest Street
Bunbury Street	---	---	---	0.15m					1st house on north side of Bunbury Street west of corner with Forest Street
Bunbury Street	---	---	---	0.19m					House on north west corner of Bunbury & Forest Street
Bunbury Street	0.33m	0.36m	0.49m	0.65m	0.17m	0.20m	0.33m	0.49m	Old shop on south east corner of Forest & Bunbury Street
Bunbury Street	---	0.04m	0.14m	0.29m					House next door to the east (upstream)
Bunbury Street	---	---	---	0.11m					House on north side of Bunbury St midway between Forest St and Telstra
Bunbury Street	---	0.07m	0.12m	0.32m					Telstra installation
Boyd Street	---	0.09m	0.19m	0.27m		0.09	0.19m	0.27m	1st house on south side of Boyd Street west of corner with Forest Street
Cameron Street	---	---	0.04m	0.29m				0.23m	3rd house on north side of Cameroon Street west of Forest Street
Carfrae Street	0.23m	0.26m	0.36m	0.49m					House on south east corner of Forest & Carfrae Street next to church
Carfrae Street	0.17m	0.20m	0.32m	0.45m			0.02m	0.15m	Church

GLENORCHY – any changes need to be reflected in property flood charts delivered to individual property owners in Glenorchy during 2006									
Location of House (Street Name & Number)	Depth of flooding at property for selected river heights on the Glenorchy gauge.				Depth of over floor flooding at property for selected river heights on the Glenorchy gauge.				Comments
	4.90m	4.96m	5.01m	5.03m	4.90m	4.96m	5.01m	5.03m	
Edwards Street	---	0.07m	0.13m	0.16m					Old Bakery
Edwards Street	---	0.11m	0.11m	0.16m					House next door to Old Bakery to the north east
Edwards Street	---	---	---	0.03m					Post Office
Edwards Street	---	---	0.12m	0.20m					Post Office residence
Edwards Street	---	---	---	0.19m					Church on south east corner of Edwards & Wills Street
Forest Street	3.69m	3.72m	3.85m	3.99m				0.09m	GWMWater pump shed at end of Forest Street
Forest Street	0.67m	0.70m	0.82m	0.96m	0.30m	0.33m	0.48m	0.59m	Concrete Water Tower
Forest Street	---	---	---	0.26m				0.14m	CFA shed
Forest Street	---	0.08m	0.15m	0.32m				0.31m	Town Hall
Forest Street	---	---	---	0.05m					2nd house on west side of Forest Street north of corner with Boyd Street
Forest Street	---	---	---	0.18m					3rd house on west side of Forest Street north of corner with Boyd Street
Green Street	---	---	---	0.10m					House on north side of Green St midway between Dry & Arapiles St
Green Street	---	---	0.16m	0.37m					House on north west corner of Green & Dry Street
Marl Street	---	0.02m	0.11m	0.19m		0.02m	0.11m	0.19m	House on corner of Marl & Boyd Street
Marl Street	---	0.17m	0.25m	0.35m					House on east side of Marl Street opposite Clark Street
Marl Street	---	---	---	0.07m					House on east side of Marl Street immediately north of the railway line
Wills Street	---	---	---	0.09m					2nd house on south side of Wills Street west of corner with Forest Street

GLENORCHY – any changes need to be reflected in property flood charts delivered to individual property owners in Glenorchy during 2006									
Location of House (Street Name & Number)	**Depth of flooding at property for selected river heights on the Glenorchy gauge.**				**Depth of over floor flooding at property for selected river heights on the Glenorchy gauge.**				**Comments**
	4.90m	**4.96m**	**5.01m**	**5.03m**	**4.90m**	**4.96m**	**5.01m**	**5.03m**	
Wills Street	---	---	---	0.11m					1st house on east side of church at corner of Edwards & Wills Street
Wills Street	---	---	---	0.17m				0.03m	2nd house on east side of church on corner of Edwards & Wills Street
Wills Street	---	---	---	0.12m					3rd house on east side of church on corner of Edwards & Wills Street

APPENDIX C2 – HALLS GAP
COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Halls Gap is subject to flash flooding[4]. It usually occurs following intense short duration rainfall, typically associated with thunderstorms. Warning times are very short.

Halls Gap is located along the base of a valley between two steep ranges - the Mount William Range to the east and the Mount Difficult Range to the west.

Numerous well-defined gullies (i.e. drainage lines) drain the Mount Difficult Range (i.e. western ridge) and flow from west to east through the township. Stony Creek is the largest of these gullies. Intense rainfall generates flows in Stony Creek and down the gullies with breakouts creating large areas of very fast moving overland sheet flow down the steep hill slopes. Sheet flow can be up to 250mm deep while flow in gullies is deeper. Several gullies drain through residential areas and breakouts from Stony Creek flood the camping ground and the shops / boardwalk. The overland flow in particular gives rise to considerable hazard to landowners and to campers at the three caravan parks as it has significant velocity. Damage can be substantial.

Notable flash floods occurred in December 1992 and May 2007. A smaller event occurred in January 2007. Other events have occurred over the years causing damages, but more of a minimal disruption.

2. The Gullies and Fyans Creek

Fyans Creek rises in the southern Grampians Ranges, flows through Halls Gap and into Lake Lonsdale. Halls Gap is located some 2–3km downstream from Lake Bellfield in the valley formed by the Mount William Range to the east and the Mount Difficult Range to the west. Numerous well-defined gullies (i.e. drainage lines) drain the Mount Difficult Range (i.e. western ridge) and flow from west to east through the township. Stony Creek is the largest of these.

The Fyans Creek channel between Lake Bellfield and Delley's Bridge is sufficiently large to carry the 1 in 200 year ARI (0.5% AEP) flood event without inundating adjacent land. Downstream from the bridge, the channel capacity reduces and limited inundation of adjacent land occurs.

As indicated in Section 1 above, it is the fast flowing overland flows that develop very quickly and that emanate from Stony Creek and the gullies draining the Mount Difficult Range following heavy rainfall flows (i.e. flash floods) which cause problems for Halls Gap. High flows in Fyans Creek are generally not a problem for Halls Gap other than in relation to access if the Creek wets Grampians Road on the Stawell (downstream) side of town. With significant development occurring along the base of the Mount Difficult Range and within the Halls Gap valley floor area, a major flash flood event is likely to cause significant damage. In such an event, warning times will be very short (minutes rather than hours) and risk high. Compounding the risk is the fact that many property owners live away from Halls Gap and that, from time to time, a significant number of tourists frequent the town. Many of the latter are likely to be campers and would be exposed to flooding in the camping grounds.

The terrain is generally steep on the western side of Halls Gap township at the base of the Mount Difficult Range. Development has occurred in this area and it is noted that a number of building platforms have been formed by a "cut and fill" operation. These platforms are particularly susceptible to flooding by the relatively shallow but very fast moving overland flows that are generated in the gullies and creeks that drain the Range.

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[4] Flash flooding is defined as flooding which occur within 6 hours of rain. It is usually the result of intense local rain and is characterised by rapid rise in water levels.

Lake Bellfield is located a short distance upstream of the township.

3. Dam Break – Lake Bellfield

Dam break studies indicate that ?????? – *to be completed when available with information from work being undertaken for GWMWater.*

4. Flood Behaviour

4.1 General

Flooding that emanates from the gullies and creeks that discharge from the Mount Difficult Range into the Halls Gap township is generally shallow (up to around 300mm or so but flowing very fast) but flow paths are quite wide. The speed of the water poses a serious risk to life and makes driving through flooded area extremely hazardous.

4.2 South of Pinnacle Road

Some nine significant gullies drain the Mount Difficult Range to the south of Pinnacle Road. Generally shallow (up to 250mm deep but very fast) sheet flow flooding occurs along these gullies. Some ponding occurs along the western (up slope) side of Grampians Road. Extensive shallow overland flows occur along Sundial Avenue. This overland flow path continues towards Fyans Creek through the Halls Gap Lakeside Caravan Park immediately downstream from Lake Bellfield. To the east (downs slope side) of Grampians Road, the overland flow continues across the valley floor into Fyans Creek. Some additional areas of ponding occur where there are local depressions in the valley floor. The sewer pump station at the corner of Sundial and Tymna Drive may be inundated.

4.3 Pinnacle Road to Silver Springs / Tandara Road

Residential development has occurred between Pinnacle Road and Silver Springs Road on the western (up slope) side of Grampians Road. Several gullies including Stony Creek drain through this residential area. Significant overland flow occurs along gullies adjacent to Pinnacle Road, Wattletree Road, Young Road and Silver Springs Road. Flows are generally shallow (less than 250mm) but wide and very fast. Properties in this area that are constructed on a "cut and fill" pad are considered particularly susceptible to flooding.

Overland flows adjacent to Pinnacle Road cross Grampians Road and are directed through the constructed wetlands at the Parks Victoria Centre. The remaining overland flows cross Grampians Road to join overflows from the Parks Victoria wetlands and continue north along the valley floor towards Tandara Road. The valley floor provides flood storage and thereby attenuates peak flows into Fyans Creek.

Note that during the January 2007 event, the Parks Victoria Centre was flooded. It is likely that flooding will reoccur during future heavy rainfall events unless some local adjustments are made to flow paths in the immediate vicinity of the Centre.

4.4 Silver Springs / Tandara Road to Rosea Street / Hemley Court

Significant and very fast overland sheet flows occur along Silver Springs Road due to its alignment up the hill slope. This flow crosses Grampians Road at the Silver Springs / Tandara / Grampians Road intersection. Velocities will be high. This intersection is likely to be very dangerous.

Extensive shallow ponding also occurs on the eastern (down slope) side of Grampians Road at Tandara Road with overland flow from south of Tandara Road contributing to it. The sewer pump station adjacent to No 5 Tandara Road may be inundated, particularly if water ponds at the bottom end of Tandara Road.

Several high velocity flow paths cross Ellis Street to the north of Hill Street. Properties in this area that are constructed on a "cut and fill" pad are considered particularly susceptible to flooding.

Further to the north of the Tandara Road / Grampians Road intersection, extensive, wide and fast flowing overland

flows cross Grampians Road. Allotments on the eastern (down slope) side of Grampians Road will be inundated by shallow (up to 300mm deep) water.

To the east of Grampians Road, the overland flow continues across the valley floor into Fyans Creek. Some additional areas of ponding occur where there are local depressions in the valley floor. This ponding provides some flood storage and will act to attenuate peak flows into Fyans Creek.

Extensive shallow but fast overland sheet flows occur between Hemley Court / Rosea Street and Stony Creek. Flows along Rosea Street affect several properties adjacent to Grampians Road.

To the north, along Mackeys Peak Road, overland flows pond alongside Grampians Road near the beginning of the commercial / retail area. Ponded water can threaten existing shops along Grampians Road. Drainage infrastructure enables flows to continue east across Heath Street and onto the valley floor.

The existing bund (or levee) along the western (up slope) boundary of the Halls Gap Caravan Park directs the overland sheet flows that occur to the north of Mackeys Peak Road towards Stony Creek. However, some overland flow occurs to the east of the bund and across Mackeys Peak Road resulting in some shallow (up to about 250mm deep) but very fast flowing water through the Caravan Park. This presents a significant risk to campers.

4.5 Stony Creek

Fast flowing breakouts occur from Stony Creek upstream of Halls Gap School Road. These breakouts result in flooding of that part of the Halls Gap Caravan Park located between the Halls Gap Primary School and Grampians Road. As velocities are high, the risk to campers is substantial. Downstream (to the east) of Grampians Road, Stony Creek is confined to the channel. However, significant flooding occurs at the shops / boardwalk. This flooding may affect adjacent properties as well as the Police Station (as a minimum the car park area will be flooded).

4.6 North of Mount Victory Road

Flows along Mount Victory Road inundate the eastern corner of the recreation reserve (larger floods encroach on the reserve – see maps at Appendix H) with significant ponding along Warren Road. Access and egress will be difficult due to velocity and / or depth of water. Additional fast flowing overland flows from the hill slope to the west of Warren Road contribute to this ponding. Flows continue to the north beyond Bucker Road and then enter Fyans Creek.

4.7 Grampians Road East to Delley's Bridge

Several overland flow paths exist from the Mount William Range across Grampians Road to the east of Fyans Creek. These flow paths continue across the land to the north of Grampians Road and into Fyans Creek.

The Parkgate Resort Caravan Park to the north of Grampians Road is also likely to be affected by overland flows.

5. Overview of Flooding Consequences

5.1 Warning Times and Need for a Locally Driven Response

As outlined above, Halls Gap is subject to flash flooding from very fast flowing overland flows emanating from Stony Creek and the gullies draining the Mount Difficult Range as a direct consequence of heavy rainfall. The flooding occurs very quickly with little warning. An effective response by VICSES and NGSC to such flooding is not possible: time is too short and access to Halls Gap along Grampians Road can be quickly prevented by fast flowing water. This water can also prevent people leaving Halls Gap. Response therefore has to be initiated and managed by the people who will be impacted.

5.2 Local Signage, Flood Response Plans and Related Material

5.2.1 Signage

With assistance from NGSC, Wimmera CMA propose to prepare material showing the extent of flooding through Halls Gap for a range of possible flooding scenarios for permanent display at (location to be determined by NGSC) in Halls Gap. The display will also include advice on what to do in the event of heavy rainfall considered likely to lead to flash flooding. Maintenance of the display will be a joint responsibility of Agencies involved.

NGSC will, in consultation with the Halls Gap tourist industry, give consideration to the development, installation and long term maintenance of appropriate signage aimed at raising visitor and community awareness of the potential for flooding and other hazards within Halls Gap.

5.2.2 Flood Response Plans

In recognition of the high risk from flash flooding at Halls Gap, Wimmera CMA with assistance from NGSC and VICSES will assist business owners and / or operators as well as residents likely to be affected by flash flooding to develop a local flood response plan aimed at ensuring the safety of individuals. The resulting plans will address the need for Caravan and Camping sites operators to advise all owners and occupiers that the area is subject to flash flooding and what they should do to facilitate evacuation when flooding occurs and, in the event of a flood, ensure that occupiers are informed as flooding develops.

An individual business and residential flood response plan template and guideline, aimed at assisting prior thought on what to do when a flood occurs and at driving an increase in flood awareness within the permanent and visitor populations at Halls Gap, will be provided by Wimmera CMA and NGSC.

5.2.3 Flood Awareness

NGSC in consultation with Wimmera CMA will, on an annual basis:

- Remind all owners and / or operators of residential and business premises in Halls Gap identified in this Appendix that individual flood response plans should be maintained and up-to-date and that procedures described in them should remain valid and implementable; and
- Check the condition of all flood related signage and display material and, with assistance from NGSC and VICSES, arrange for replacement and / or upgrade as considered appropriate.

Responsibility for maintenance of Plans rests with individuals.

5.3 Areas Affected

In summary, most of the area on the down slope side of Grampians Road through Halls Gap and around the Boardwalk is most affected by flooding along with all the streets that run up / down slope and buildings that are built on the hillside in gullies. Refer to the inundation maps in Appendix F2 and

5.4 Roads Affected

All roads in Halls Gap are affected.

5.5 Properties Affected

5.5.1 Summary

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor can be derived from the table at Section 10.2 of this Appendix and the inundation maps at Appendix F2.

5.5.2 Detailed List

The properties likely to be flooded for a range of floods are listed in Section 10.2 of this Appendix. **It is strongly recommended that this list is used in conjunction with the flood inundation maps at Appendix F2.**

5.5.3 Update of List of Properties Likely to be Flooded

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

5.6 Isolation

Grampians Road is flooded at a number of locations within Halls Gap and on the downstream (Halls Gap) side. Depths vary but velocities are high which presents a significant hazard to most vehicles.

5.7 Essential Infrastructure

There is no known essential infrastructure affected by flooding at Halls Gap other than:

- 3 of the 7 sewer pump stations;
- 3 x caravan parks / camping grounds (i.e. Halls Gap Lakeside Caravan Park, Halls Gap Caravan Park, Parkgate Resort Caravan Park);
- The oval;
- Parks Victoria offices;
- The Police Station car park (and perhaps the building in a large flood);
- Shops and the Boardwalk;
- Motel.

6. Flood Mitigation

6.1 General

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

6.2 Flood Protection Levees

There are no formal flood mitigation works in place at Halls Gap.

6.3 Drainage Works

There are no specific drainage works in Halls Gap that impact on flooding or vice versa.

7. Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

Note that users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Halls Gap and use that to assess the likelihood of flooding in the area.

8. Gauge Information

While there are no telemetered stream level gauges upstream of Halls Gap, the Fyans Creek gauge (415250) is located a short distance downstream.

9. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Northern Grampians Shire Council will be under the Control of the VICSES Regional Duty Officer /or an appointed Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

An ICC will be established by the Control (i.e. VICSES) for the command and control functions in response to flood events within the Municipality. It will be operated in accordance with VICSES arrangements.

The ICC for the Northern Grampians Shire and any Divisional or Sector Commands will be located as detailed in the VICSES Grampians Region Flood Emergency Plan.

10. Flood Intelligence Card, Property Inundation List and Flood / No Flood Guidance Tool

10.1 Introduction

The BoM does not currently provide flood forecasts for Fyans Creek or for Halls Gap. All actions must therefore be driven by rainfall and / or creek level observations.

While there are no telemetered stream level gauges upstream of Halls Gap, the Fyans Creek gauge (415250) is located a short distance downstream.

The BoM collects and records rainfall at a number of locations close to Halls Gap and the Fyans Creek catchment. Data from a number of these sites are available from the BoM website at intervals ranging from around 30-minutes to daily. Rainfall data is available at around 30 minute intervals from the AWS rain gauges at Mt William and Stawell.

Users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of Halls Gap and across the upper catchment (if available) in order to gain a better appreciation of the likely severity of flooding and its impacts in the town.

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 “Flood Preparedness”.
2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience

10.2 Detailed List of Properties Likely to be Flooded

HALLS GAP		
Location / Description of Property	**Approx ARI at which Flooding will Begin**	**Comments and Notes**
The Halls Gap Lakeside Caravan Park, located immediately downstream from Lake Bellfield.	10 year ARI (10% AEP) and bigger.	Overland flows extending from Sundial Avenue likely to cause considerable hazard for campers and other Park occupiers. More severe floods result in faster flowing but not necessarily deeper flooding. Risk and damage will increase with velocity.
The Halls Gap Caravan Park located on the	10 year ARI (10% AEP) and bigger.	Fast moving overland sheet flows crossing Mackeys Peak Road will cause shallow but fast

western (up slope) side of Grampians Road near the commercial area of town.		moving flooding through the Park. This presents a significant hazard to campers. Shallow but fast flowing breakouts from Stony Creek from upstream of Halls Gap School Road also represent a substantial hazard to campers in that part of the Park adjacent to the Creek. More severe floods result in faster flowing but not necessarily deeper flooding. Risk and damage will increase with velocity.
The Parkgate Resort Caravan Park located off Grampians Road at the northern end of the town.	10 year ARI (10% AEP) and bigger.	Some flooding is likely across parts of this Caravan Park. More severe floods result in faster flowing but not necessarily deeper flooding. Risk and damage will increase with velocity.
Town Oval	10 year ARI (10% AEP) and bigger	The oval is quickly surrounded by fast flowing water at least 250mm deep even though the centre of the reserve appears to remain dry even in large events. Not a good assembly location in times of flash flooding as access / egress quickly becomes difficult and dangerous.
Residential properties located on the western (up slope) side of Grampians Road as well as in Warren Street. The Kookaburra, The Grand, the shops along Grampians Road and the Parks Victoria Centre have all flooded in the past. The Police Station car park (and perhaps the building itself.	Refer to maps at Appendix F2	Houses and garages constructed on 'cut and fill' pads are most likely to be at risk of flooding from shallow (up to 250mm deep) but very fast moving sheet flows that break out from the numerous gullies that carry runoff to the valley floor. Those properties located near a gully and that have the main entrance or a substantial area of glass on the up hill side without any flow deflecting measures in place are considered to be most at risk. However, as debris loads in gullies and blockages in culverts under roads that run parallel to Grampians Road will contribute to flood risk and the incidence of flooding, it is not feasible to identify particular at-risk properties.
Properties in Tandara Road and Hemley Court..	Refer to maps at Appendix F2	
GWMWater sewer pump stations:		There are 7 sewer pump stations in Halls Gap. It is considered likely that a large flood will inundate the following pump stations: ➢ At the junction of Sundial Avenue and Tymna Drive ➢ Adjacent to No 5 Tandara Road ➢ At the Halls Gap Hotel (2262 Grampians Road)

APPENDIX C3 – UPPER WIMMERA CATCHMENT COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1 Overview

The Upper Wimmera catchment has an area of around 1,500km^2 and is considered, for the purposes of this MFEP, to comprise all of the area and watercourses upstream of Glynwylln. These include the Wimmera River and its tributaries, the major ones being Mount Cole Creek, Wattle Creek (also known as Heifer Station Creek), Howard Creek and Seven Mile Creek.

The upper parts of the catchment include the northern slopes of the Great Dividing Range and the Pyrenees. It is hilly and relatively steep here with numerous well defined flow paths. In the lower parts, the topography flattens to form a wide and relatively undefined floodplain.

The main watercourse is the Wimmera River which originates south of Elmhurst in the Mount Cole State Forest. It flows in a generally westerly direction past the townships of Elmhurst, Eversley and Crowlands before its confluence with Mount Cole Creek, just downstream from Crowlands. From here, the river flows in a generally northerly direction through Joel Joel before its confluence with Wattle Creek approximately halfway between Greens Creek and Glynwylln. Due to the relatively flat nature of the floodplain in this area, cross catchment flows occur between the creek systems well before the confluence. It then flows on past Glynwylln towards Glenorchy. Beyond Glenorchy, the river flows past Horsham, Dimboola and Jeparit and continues on into Lake Hindmarsh.

There are several townships within the catchment including Navarre, Landsborough, Elmhurst, Eversley, Warrak, Crowlands, Joel Joel, Greens Creek and Campbells Bridge (see Figure C3-1). Navarre, Joel Joel, Greens Creek and Campbells Bridge are all within Northern Grampians Shire. Landsborough and Crowlands are located within Pyrenees Shire while Elmhurst, Eversley and Warrak are located within the Rural City of Ararat.

Navarre is located towards the north of the Upper Wimmera catchment, approximately 35km north east of Stawell, on the bank of Wattle Creek (aka Heifer Station Creek) one of the Wimmera's main tributaries. Blind Creek, a small tributary anabranch just north of the township, carries flows from the north of the catchment as well as breakaway flows from Wattle Creek. Joel Joel is located on the main stem of the Wimmera River north of Stawell while Greens Creek is located further to the north west near where Greens Creek joins the Wimmera River. Campbells Bridge is approximately midway between Greens Creek and Glenorchy, immediately downstream of the Concongella Creek and Wimmera River confluence, on the Donald – Stawell Road.

2 Flood Behaviour

The analyses undertaken in support of the Upper Wimmera Flood Investigation (WBM, 2014) suggest that typically, the time from the beginning of heavy rain on a wet catchment to the start of stream rises range from around 1 to 2 hours at Eversley, 2 to 4 hours at Crowlands, 3 to 6 hours at Navarre and 6 to 9 (possibly up to 12) hours at Glynwylln. Rates of rise are quite rapid (can be 1m/hour or more at Navarre and 500mm/hour or more at other locations) on a wet catchment with flooding / overbank flows likely to begin within 1 to 4 hours of the initial rise.

It is emphasised that these times are approximate only and are for heavy rain on a wet catchment. Lighter rain or rain on a drier catchment result in much slower response times. For example, in January 2011 the time from start of rain to the start of flooding was of order 50 hours or more. Initial rain wetted up the catchment and the heavy rain that followed caused very quick and significant rises in stream levels with attendant record flooding.

As the majority of the Upper Wimmera catchment is used for grazing (there is some cropping in the lower parts) it is unlikely that the time of year or crop status will influence the spread of floodwaters or the rate at which they rise and fall. However, antecedent conditions do have a large impact on flood development and character.

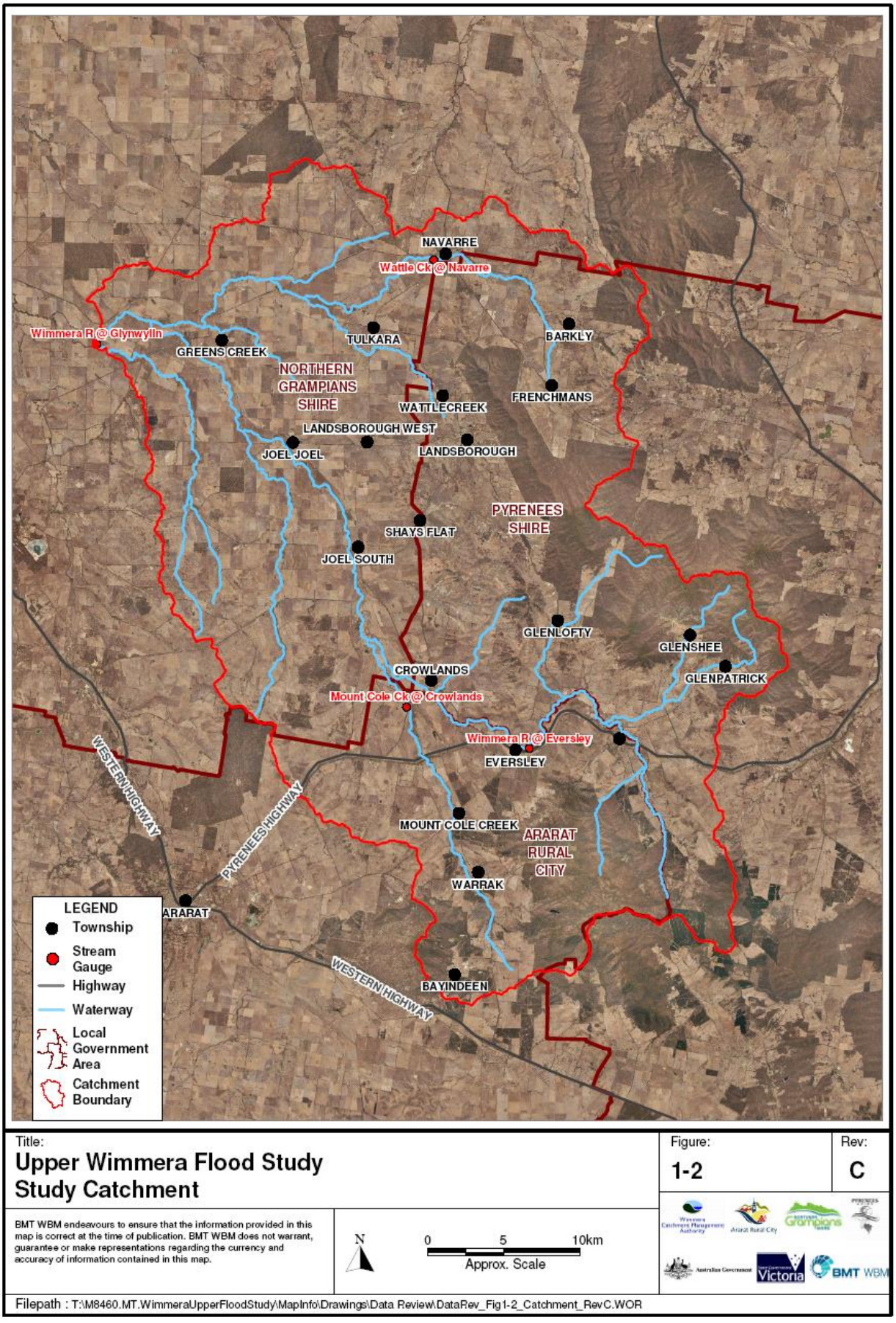


Figure C3-1 Upper Wimmera Catchment with Townships and Stream Gauging Sites

Big floods in the Upper Wimmera generally require a wet catchment (e.g. January 2011).

Rainfall and stream flow are recorded at a number of locations within or close to the Upper Wimmera catchment. Data from most of the telemetered sites are available from the BoM website at intervals ranging from around 30 minutes to daily (around 9am) with most data updated every 3 hours or more frequently during a flood event.

3 Overview of Flooding Consequences

3.1 Warning Times

Floods develop and rise quickly in the Upper Wimmera catchment when the area is wet: catchment response times are generally less than 6 hours (see Appendix B). This places the catchment in the flash flood category.

3.2 Areas Affected

Damage to other than roads and the agricultural sector (e.g. fences, pasture, etc) arising from floods less than the 2% AEP (50-year ARI) event is minimal and is associated with over-floor flooding of only two buildings (both buildings begin to be flooded over-floor between the 20-year and 50-year ARI events – one each in Warrak and Wattle Creek) and restrictions to regional access due to roads being flooded. Floods more severe than the 2% AEP event result in an increase in the number of buildings at-risk of over-floor flooding (4 at the 1% AEP event and 8 at the 0.5% AEP event) and further restrictions to regional access due to flooded roads.

The damage assessment undertaken by BMT WBM (WBM, 2014) suggests that during a 1% AEP (100-year ARI) event, building damage would account for approximately 1% of the total damage (minus indirect damages) incurred while damage to agricultural land and road infrastructure would account for around 77% and 22% respectively. The percentage for more frequent floods would be even smaller.

Local feedback received during the course of the Upper Wimmera Flood Investigation (WBM, 2014) indicated that most residents did not see flooding as a major problem.

3.3 Roads Affected

Many roads in the Municipality (and the adjacent Pyrenees Shire and Rural City of Ararat) are affected by flooding in the Upper Wimmera catchment. The more significant of these include:

- Stawell – Avoca Road at Navarre and to the west of the town as well as to the east and west of Greens Creek;
- Ararat – St Arnaud Road north (and also south) of Navarre
- Callawadda – Navarre Road west of Navarre – in 5 locations
- Greens Creek – Joel Joel Road
- Landsborough Road near Joel Joel – to the east and west
- Landsborough Road near its intersection with the Stawell – Joel South Road
- Joel Joel – Crowlands Road near and to the south of Joel Joel
- Bulgana Road near the Wimmera River bridge
- Crowlands – Eversley Road
- Shays Flat Road / Stawell - Joel South Road
- Campbells Bridge Road
- Landsborough West – Tulkara Railway Road initially south of Tulkara and around Landsborough West
- Landsborough – North Woodlands Road
- Donald - Stawell Road between Donald and Stawell

3.4 Properties Affected

3.4.1 Summary

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor is provided in Section 9.3 of this Appendix.

3.4.2 Detailed List

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground flooding and the likely depth of over-floor inundation is provided in Section 9.4 of this Appendix**.** Properties within 100mm of over-floor flooding are also identified. **It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix F3) and the indicative flood guidance tool provided in Section 9.5.**

3.4.3 Update of List of Properties Likely to be Flooded

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

3.5 Isolation

Isolation is not generally a major issue for the Upper Wimmera catchment. While many roads do get flooded from reasonably low levels, depths are usually not excessive and roads generally become trafficable within a couple of days.

3.6 Essential Infrastructure

There is no known essential infrastructure affected by flooding within the Upper Wimmera catchment.

4 Design Peak Flood Level and Flow Estimates

Gauge location	Peak flood level (mAHD)						
	5-yr ARI flood level	10-yr ARI flood level	20-yr ARI flood level	50-yr ARI flood level	100-yr ARI flood level	200-yr ARI flood level	PMF flood level
Navarre	226.8	227.7	227.9	228.0	228.0	228.1	228.4
Crowlands	245.8	246.3	246.5	246.7	246.8	247.0	248.8
Eversley	263.1	264.0	264.8	265.7	266.3	266.7	273.3
Glynwylln	190.9	192.4	192.9	194.3	195.0	195.3	198.1

Gauge location	Peak flow (m^3/sec)						
	5-yr ARI flood level	10-yr ARI flood level	20-yr ARI flood level	50-yr ARI flood level	100-yr ARI flood level	200-yr ARI flood level	500-yr ARI flood level
Navarre	27	42	57	84	113	153	216
Crowlands	23	37	47	73	99	137	195
Eversley	57	89	121	180	249	330	463
Glynwylln	156	249	351	551	748	959	1290

5 Gauge Information

There are four (4) stream gauges in the Upper Wimmera catchment (at Navarre, Crowlands, Eversley and Glynwylln) and a number of rain gauges. A summary of these gauges is provided in the table below.

Rainfall stations			River level / flow stations		
Location	**Telemetry type**	**BoM website**	**Location**	**Telemetry type**	**BoM website**
Avoca	TBRG -phone	√	Crowlands	ERTS	√
Pyrenees (Ben Nevis)	TBRG - ERTS	√	Eversley[1]	ERTS	√
Eversley	TBRG - ERTS	√	Glenorchy	ERTS	√
Navarre	TBRG- ERTS	√	Glynwylln[1]	ERTS	√
Moyston	AWS	√	Navarre[1]	ERTS	√
Stawell	TBRG - ERTS	√	Stawell	ERTS	√
Stawell Aerodrome	AWS	√			
Mt William	AWS	√			
Wimmera Highway[2]	TBRG - phone				
Other gauges outside the Upper Wimmera catchment[3]		√			

[1] The river gauges at Glynwylln, Eversley and Navarre were damaged during the January 2011 flood. Repairs have been completed and the gauges are again fully operational.

[2] Rainfall data from this rain gauge is not routinely available from the BoM website.

[3] Data from other gauges outside the Upper Wimmera catchment (e.g. Ararat) are available from the BoM website and assists in the development of a more complete appreciation of areal rainfalls and of likely stream responses across the region.

6 Flood Mitigation

6.1 General

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

6.2 Flood Protection Levees

There are no formal flood mitigation works in place within the Upper Wimmera catchment although some roads do act to some extent as informal levees.

6.3 Drainage Works

There are no specific drainage works within the Upper Wimmera catchment identified as having an impact on flooding or vice versa.

7 Flood Impacts and Required Actions

Refer to the following Flood Intelligence Card.

Note that users of the flood intelligence card should consider rainfall depth and rates across the Upper Wimmera catchment and use the indicative tool at Section 9.5 in order to better appreciate the likely severity of flooding and its impacts in the area. Local data and / or data from the BoM website (http://www.bom.gov.au/) should be used. It is suggested that the following sites, available from the BoM website, will provide useful indicative rainfall data:

- Navarre
- Eversley
- Pyrenees (Ben Nevis)
- Ararat

8 Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Northern Grampians Shire Council will be under the Control of the VICSES Regional Duty Officer /or an appointed Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

An ICC will be established by the Control (i.e. VICSES) for the command and control functions in response to flood events within the Municipality. It will be operated in accordance with VICSES arrangements.

The ICC for the Northern Grampians Shire and any Divisional or Sector Commands will be located as detailed in the VICSES Grampians Region Flood Emergency Plan.

9 Flood Intelligence Card, Property Inundation List and Flood / No Flood Guidance Tool

9.1 Introduction

The BoM does not currently provide flood forecasts for the Upper Wimmera River catchment. All flood response actions must therefore be driven by rainfall and / or river level observations.

The BoM collects and records rainfall and streamflow from a number of locations within or close to the Upper Wimmera River catchment. Data from al streamflow sites and some of the rainfall sites are available from the BoM website at intervals ranging from around 30 minutes to daily. Rainfall data is available at around 30 minute intervals from the AWS's at Pyrenees (Ben Nevis) and Ararat. Similar data is generally available at 3-hourly intervals during heavy rain events from the rain gauges at the Navarre and Eversley sites.

Users of the flood intelligence card should consider rainfall depth and rates at locations in the vicinity of the Upper Wimmera catchment and use the indicative Flood / No Flood guidance tool at Section 9.5 in order to better appreciate the likely severity of flooding and its impacts across the area. Instructions for use of the tool are also provided in Section 9.5.

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intel detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 "Flood Preparedness".
2. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience

9.2 Flood Intelligence Card

Observed Rainfall (see graph)	AEP of flood	Water level / flow at (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at the Northern Grampians Shire.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Wimmera catchment watercourses will begin to rise within an hour or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B. At Navarre, the creek can rise very quickly (1m/hour or more) while at other locations, water levels can rise at up to 500mm/hour or more.				
Heavy rain on wet catchment			Likely to result in strong runoff and rapid rises throughout the catchment. If period of rain is short, local flooding likely. If period of rain is prolonged, significant riverine flooding likely.	◦ Check antecedent conditions - is catchment wet? ◦ Monitor rainfall and water levels. The AWS's can be checked every 30 minutes or so on BoM website. ◦ Use the indicative flood / no flood tool to develop an appreciation of the likely scale of the flood event.
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~60mm in 12 hours ~75mm in 24 hours ~90mm in 48 hours	20% AEP (5-yr ARI)		1 building at Glenpatrick within 100mm of flooding over-floor but not likely to happen until flooding greater than 1% AEP. No buildings likely to flood over-floor until above 5% AEP event. Water beginning to accumulate along the sides of roads, and on the upstream side of larger roads. A number of the smaller local roads will be flooded but most are likely to remain passable.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging building at Glenpatrick. ◦ Deploy “water over road” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~70mm in 12 hours ~85mm in 24 hours ~100mm in 48 hours	10% AEP (10-yr ARI)		1 building at Glenpatrick within 100mm of flooding over-floor but not likely to happen until flooding greater than 1% AEP. No buildings likely to flood over-floor until above 5% AEP event. Water becoming deeper along the sides of roads, and on the upstream side of larger roads. Flooding on the smaller local roads getting more extensive and a little deeper. Some roads will need to be closed due to depth considerations.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging building at Glenpatrick. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

Observed Rainfall (see graph)	AEP of flood	Water level / flow at (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at the Northern Grampians Shire.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Wimmera catchment watercourses will begin to rise within an hour or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B. At Navarre, the creek can rise very quickly (1m/hour or more) while at other locations, water levels can rise at up to 500mm/hour or more.				
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~80mm in 12 hours ~100mm in 24 hours ~120mm in 48 hours	5% AEP (20-yr ARI)		1 building at Glenpatrick and 2 at Wattle Creek within 100mm of flooding over-floor. 2 buildings soon to be flooded over-floor: at Wattle Creek and Warrak Water becoming deeper along the sides of roads, and on the upstream side of larger roads. Flooding on the smaller local roads getting more extensive and deeper. Some roads will need to be closed due to depth and velocity considerations. Larger roads likely to be wetted now - see list above.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging building at Glenpatrick, Wattle Creek and Warrak – see list below. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~95mm in 12 hours ~120mm in 24 hours ~140mm in 48 hours	2% AEP (50-yr ARI)		2 buildings flooded over-floor: at Wattle Creek and Warrak. 3 buildings within 100mm of flooding over-floor: at Glenpatrick, Wattle Creek and Bayindeen. 2 buildings soon to be flooded over-floor: at Navarre & Nowhere Creek. Water deeper along the sides of roads. Flooding on the smaller local roads getting more extensive and deeper. Some roads will need to be closed due to depth and velocity considerations. Larger roads likely to be wetted now (see list above) and some will need to be closed.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging building at Glenpatrick, Wattle Creek, Warrak and Bayindeen – see list below. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

Observed Rainfall (see graph)	AEP of flood	Water level / flow at (mAHD / m^3/s)	Consequence / Impact	Action Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and MERO at the Northern Grampians Shire.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Wimmera catchment watercourses will begin to rise within an hour or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B. At Navarre, the creek can rise very quickly (1m/hour or more) while at other locations, water levels can rise at up to 500mm/hour or more.				
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~110mm in 12 hours ~130mm in 24 hours ~160mm in 48 hours	1% AEP (100-yr ARI)		4 buildings flooded over-floor: at Wattle Creek, Navarre, Nowhere Creek and Warrak. 4 buildings within 100mm of flooding over-floor: at Glenpatrick, Wattle Creek, Tulkara and Bayindeen. 8 buildings soon to be flooded over-floor: 3 at Navarre, 2 at Wattle Creek and 1 each at Tulkara, Nowhere Creek and Warrak. Water deeper along the sides of roads. Flooding on the smaller local roads getting more extensive and deeper. Some roads will need to be closed due to depth and velocity considerations. Larger roads will be wetted now (see list above) and some will need to be closed.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging building at Glenpatrick, Wattle Creek, Tulkara, Navarre, Nowhere Creek, Warrak and Bayindeen – see list below. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

9.3 Summary of Properties Flooded

Summary of number of flood affected properties in Upper Wimmera (ref WBM, 2014) EXISTING CONDITIONS							
	Design Flood AEP (%)						
	20%	10%	5%	2%	1%	0.5%	PMF
Level at reference gauge							
Number of properties flooded above floor	0	0	0	2	4	8	38
Number of properties flooded below floor only	2	7	9	13	23	28	13
Total number of flooded properties	**2**	**7**	**9**	**15**	**27**	**36**	**51**
Number of properties within 100mm of flooding over-floor	1	1	3	3	4	4	4

9.4 Detailed List of Properties Flooded

Upper Wimmera River Catchment – EXISTING CONDITIONS (ref WBM, 2014) It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for the Upper Wimmera															
LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	**Depth of flooding near building for each ARI**							**Depth of over-floor flooding at property for each ARI**							**Comments**
	5yr	**10yr**	**20yr**	**50yr**	**100yr**	**200yr**	**PMF**	**5yr**	**10yr**	**20yr**	**50yr**	**100yr**	**200yr**	**PMF**	
Bayindeen															
725 Buangor-Ben Nevis Road							0.40								
239 Ords Orchad Road				0.23	0.23	0.23	0.24								

Upper Wimmera River Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for the Upper Wimmera

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
Elmhurst															
2587 Pyrenees Highway					0.06	0.23	1.26							0.67	
Glenpatrick															
14 Ackers Lane	0.09	0.10	0.10	0.10	0.10	0.10	0.22							0.09	
Green Creek															
1476 Stawell-Avoca Road							1.22							0.93	
2371 Stawell-Avoca Road		0.04	0.06	0.11	0.16	0.21	0.98							0.54	
Joel Joel															
41 Perry Road							2.12							1.98	
Landsborough															
2418 Ararat-St Arnaud Road							0.16							0.16	Shed - earth floor
2425 Ararat-St Arnaud Road							0.63							0.63	House
2565 Ararat-St Arnaud Road			0.04	0.06	0.07	0.08	0.11								
2709 Ararat-St Arnaud Road					0.09	0.10	0.25							0.01	
2781 Ararat-St Arnaud Road		0.04	0.09	0.09	0.09	0.09	0.09								

Upper Wimmera River Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for the Upper Wimmera

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
Landsborough West															
23 Copeland Road							0.36								
73 School Loop Road	0.19	0.22	0.22	0.23	0.23	0.26	0.49							0.04	
Navarre															
1 Airey Street					0.01	0.04	0.34							0.10	House
19 Airey Street						0.08	0.56							0.37	House
20 Airey Street				0.14	0.17	0.25	0.67								CFA shed
21 Airey Street						0.10	0.59							0.21	House
821 Barkly-Navarre Road				0.07	0.28	0.53	1.96							0.55	
14 Cambridge Street							0.48							0.09	House
5 Escort Street					0.02	0.13	0.62							0.08	House
6 High Street				0.05	0.18	0.28	0.75							0.44	House
9 High Street					0.01	0.17	0.68							0.10	House
10 High Street					0.13	0.21	0.68							0.16	House
17 High Street						0.13	0.65							0.27	House
18 High Street						0.23	0.72							0.13	House

Upper Wimmera River Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for the Upper Wimmera

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
22 High Street					0.08	0.19	0.68					0.08	0.19	0.68	Shed - earth floor
23 High Street						0.11	0.61							0.13	House
25 High Street						0.07	0.56						0.05	0.54	House
26 High Street							0.46								Primary School
30 High Street					0.05	0.13	0.62							0.18	House
32 High Street					0.15	0.27	0.75								Shearing shed
33 High Street						0.07	0.62							0.22	House
36 High Street					0.04	0.14	0.68							0.22	House
39 High Street						0.04	0.66						0.03	0.61	General store
40 High Street					0.20	0.35	0.91							0.36	House
42 High Street				0.16	0.36	0.51	1.06							0.50	House
48 High Street					0.13	0.21	0.79							0.28	House
40 Macs Lane		0.07	0.07	0.07	0.09	0.12	0.55								
19 Ramsey Street						0.12	0.66							0.21	House
Nowhere Creek															
620 Nowhere Creek Road		0.13	0.14	0.21	0.31	0.41	1.20					0.14	0.22	1.04	

Upper Wimmera River Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for the Upper Wimmera

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
Tulkara															
74 Radley's Road							0.32							0.01	
863 Tulkara Railway Road			0.06	0.14	0.18	0.26	0.59						0.01	0.22	
931 Tulkara Railway Road							0.29								
Warrak															
1085 Buangor-Ben Nevis Road				0.20	0.21	0.21	0.23				0.20	0.21	0.21	0.21	
1179 Buangor-Ben Nevis Road							0.10								
Wattle Creek															
2861 Ararat-St Arnaud Road		0.09	0.12	0.15	0.17	0.20	0.41						0.02	0.18	
281 Wattle Creek Road											0.13	0.19	0.27	0.66	
Other															
32 Burke Street							0.03								Church
60 Burke Street							0.01								House
Howitt Street - south end							0.23								Shearing shed
54 McKinley Street							0.22							0.08	House

9.5 Indicative Flood / No flood Guidance Tool for the Upper Wimmera River catchment

9.5.1 Introduction

The BoM does not currently provide flood forecasts for the Upper Wimmera River catchment. All flood response actions must therefore be driven by rainfall and / or river level observations.

9.5.2 Indicative Flood Behaviours

Typically, the time from the beginning of heavy rain on a wet catchment to the start of stream rises range from around 1 to 2 hours at Eversley, 2 to 4 hours at Crowlands, 3 to 6 hours at Navarre and 6 to 9 (possibly up to 12) hours at Glynwylln. Rates of rise are quite rapid (can be 500mm/hour or more) on a wet catchment with flooding / overbank flows likely to begin within 1 to 4 hours of the initial rise. Big floods generally come from a wet catchment.

9.5.3 Using the Indicative Flood / No flood Guidance Tool

In the lead up to a flood event

An average of the rainfall recorded at the rain gauges at Navarre, Eversley, Pyrenees (Ben Nevis) and Ararat (AWS) (or if the catchment is wet and one gauge is consistently higher, the average of that gauge and the next highest) should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below, unless data from alternative locations closer to areas considered likely to experience the heaviest rainfall is available. Care should be exercised however, as it must be remembered that runoff from headwater as well as low land areas contribute to flooding.

Note however that:

- If the depth of rain recorded at the Ararat AWS is less than the depth recorded at Eversley, the Ararat depth should not be included.
- If an indication of flood severity is required at less than 3-hourly intervals, a very rough idea could be obtained by using the average of the rainfall recorded at Pyrenees (Ben Nevis) and Ararat (AWS).

If the catchment is very wet, it would be appropriate to step up one level.

If the catchment is dry and / or rain extended over more than 24 hours, this tool will tend to over-estimate the likelihood of flooding.

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

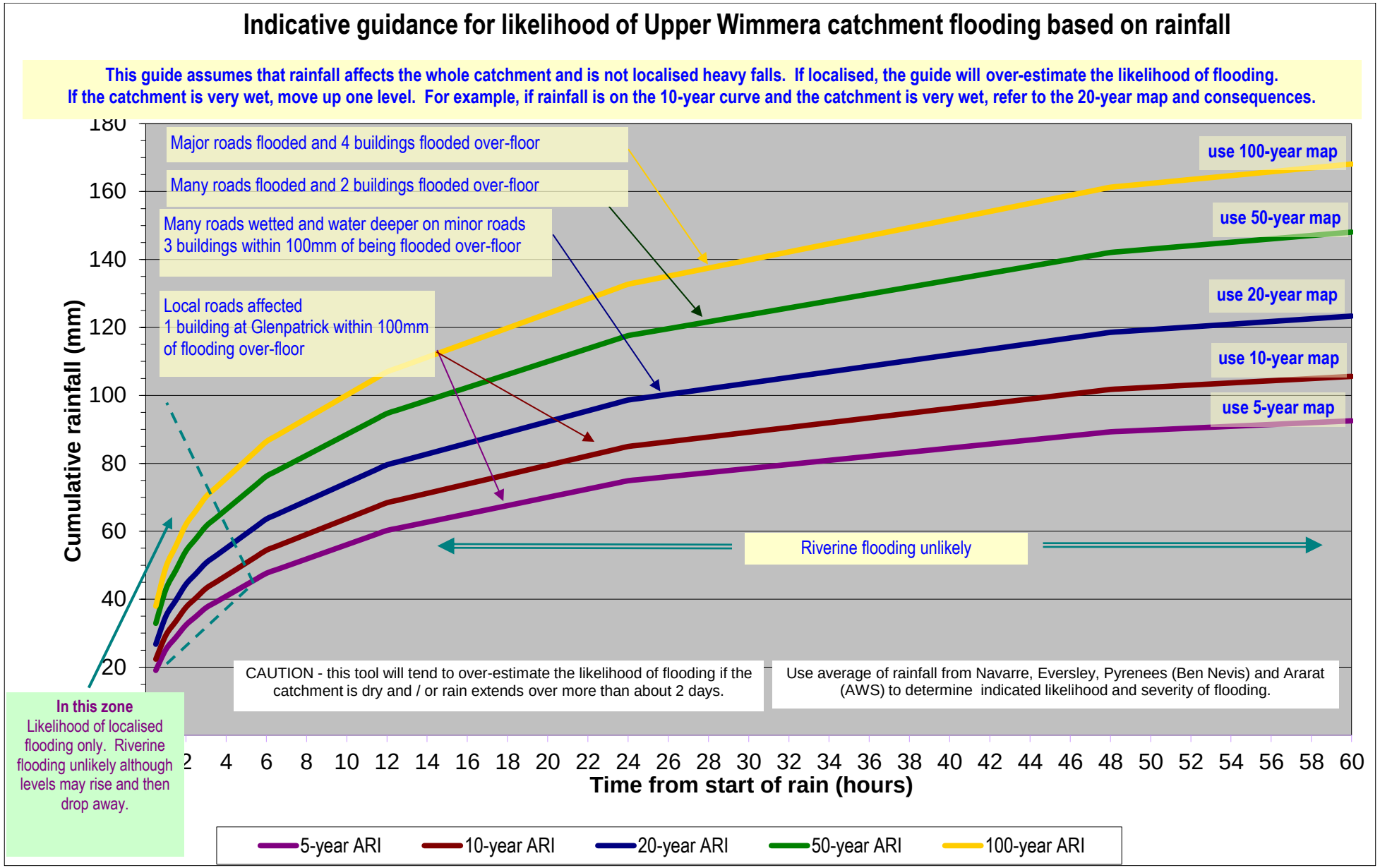
Approach 1: Using the total rainfall depth obtained from the start of the event (discount early drizzle or very light rain), plot the rainfall depth against elapsed time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding of around that severity is likely.

Approach 2: Discount the early lighter rain from consideration (i.e. begin calculating rainfall depth from start of heavy rain) and plot rainfall depth against time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding is likely.

CAUTION. While a strength of the tool is that it does provide a quick ball-park answer to questions such as "will we flood" and "how bad will it be", it is based on a number of gross assumptions and generalisations. It is therefore indicative only. It is not property specific and does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or specific likely consequences. Further, it will not always indicate the expected severity of flooding correctly although it will usually give a heads-up to severe flooding and thus of likely consequences. Note also that the tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than 24 hours. On the other hand, it will tend to underestimate the likelihood of flooding if the catchment is wet. In such circumstances, it would be appropriate to step up one curve.

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. Relevant information should also be added to Appendix C3.


Indicative guidance for likelihood of Upper Wimmera catchment flooding 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.
If the catchment is very wet, move up one level. For example, if rainfall is on the 10-year curve and the catchment is very wet, refer to the 20-year map and consequences.
Major roads flooded and 4 buildings flooded over-floor
Many roads flooded and 2 buildings flooded over-floor
Many roads wetted and water deeper on minor roads
3 buildings within 100mm of being flooded over-floor
Local roads affected
1 building at Glenpatrick within 100mm
of flooding over-floor
use 100-year map
use 50-year map
use 20-year map
use 10-year map
use 5-year map
Riverine flooding unlikely
CAUTION - this tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than about 2 days.
Use average of rainfall from Navarre, Eversley, Pyrenees (Ben Nevis) and Ararat (AWS) to determine indicated likelihood and severity of flooding.
In this zone
Likelihood of localised flooding only. Riverine flooding unlikely although levels may rise and then drop away.
Cumulative rainfall (mm)
180
160
140
120
100
80
60
40
20
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
Time from start of rain (hours)
5-year ARI
10-year ARI
20-year ARI
50-year ARI
100-year ARI

APPENDIX C4 – MOUNT WILLIAM CREEK COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

1. Overview

Mount William Creek has a catchment area of approximately 1,300km^2 and is a tributary to the Wimmera River. It rises in the Rural City of Ararat to the south of Jullukar and to the south west of Barton in the mountainous regions of The Grampians and the West Victorian Uplands and drains the eastern flank of the Mt William Mountain Range and the north eastern side of the Grampians. From there, the creek and its tributaries flow in a generally northerly direction through Lake Lonsdale and Dadswells Bridge to Lubeck and the Wimmera River, 18km downstream from Dadswells Bridge and some distance downstream from Glenorchy.

The Mount William Creek catchment includes a number of waterways in addition to Mount William Creek: Salt Creek, Fyans Creek (has the potential to contribute a significant amount of water to Mount William Creek during a flood), Pleasant Creek, Sheepwash Creek and Golton Creek along with their tributaries.

There are three major storages in the catchment: Lake Bellfield and Lake Fyans on Fyans Creek and Lake Lonsdale on Mount William Creek. There are also a number of channels that connect with these storages as well as with the wider GWMW system.

Flows from Mt William Creek are normal highly regulated due to Lake Lonsdale. Lake Lonsdale was built in 1902 and is a 55.5GL on-stream storage within the Shire of Northern Grampians upstream (to the south) of Dadswells Bridge. It is operated by GWMW. The Lake can significantly reduce flood peaks, depending on the levels in the Lake at the start of a flood and the magnitude of the event.

The upper (south western) parts of the catchment are extremely steep with numerous well defined flow paths. Further through the catchment (i.e. to the north), the topography flattens to form a wide floodplain with many incised creeks and streams including Mount William Creek, Nine Mile Creek, Pentland Creek and Sugarloaf Creek.

The southern and south-western sides of the catchment have undergone significant land use change over the past 20 years or so with a significant number of dwellings and tourism developments on rural lifestyle blocks along the Grampians fringe.

The majority of the catchment is used for agricultural purposes, predominately grazing.

There are several townships within the catchment including Pomonal, Moyston, Stawell, Dadswells Bridge and Halls Gap.

The town of Moyston is located towards the southern end of the catchment, approximately 15km west of Ararat, and is within the Rural City of Ararat. Salt Creek, a tributary to Mount William Creek is located approximately 1.5km north of the main town centre.

The town of Pomonal is located in the central west of the catchment, approximately 20km south west of Stawell, and is also within the Rural City of Ararat. The town is situated on the banks of Millers Creek, a tributary to Mount William Creek.

Dadswells Bridge is within the Rural City of Horsham.

Stawell is not included in the current Appendices as the current consideration did not extend beyond the Western Highway (i.e. it did not include any part of the town to the north and east of the Western Highway).

It is noted that while Halls Gap is within the Mount William Creek catchment[5], it is addressed through specific Appendices within the Northern Grampians MFEP. A flood study was completed for the town in 2008 (Water Technology, 2008).

Within the Northern Grampians Shire, there are two locations subject to extensive flooding: upstream of Lake Lonsdale and downstream from Lake Lonsdale at Ledcourt on the Shire boundary where the creek channel is ill defined.

2. Flood Behaviour

2.1 Warning Times

Flooding in the Mount William Creek catchment is generally caused by significant rainfall over the catchment upstream of Lake Lonsdale. This usually results from a large regional event. Locally intense rainfall can lead to flash flooding in the upper reaches around Moyston and Pomonal but flooding downstream of Lake Lonsdale and around Dadswells Bridge would not be expected unless Lake Lonsdale was spilling.

In general terms, response time for the upper parts of the catchment is much shorter than for the catchment below Lake Lonsdale. It is generally considered to be of order 1 - 2 days, while response in the lower catchment is considered to be of order of 2 - 5 days and highly dependent on the available storage within Lake Lonsdale.

Floods develop and rise quickly in the upper parts of the catchment around Moyston and Pomonal, particularly when the area is wet. Response times on a wet catchment would be expected to be generally less than 6 hours but could be a day or longer when the area is dry, provided that rainfall was not intense.

The situation at Dadswells Bridge is different. Response time (i.e. the time from the beginning of rain to initial stream rises) is very much longer and heavily influenced by the level of Lake Lonsdale and whether it is spilling.

Travel time from Lake Lonsdale (when it is spilling) to Dadswells Bridge ranges from around 8 to 12 hours, depending on the size of the flood.

2.2 Areas Affected

The Mount William Creek Flood Investigation (WBM, 2014) has shown that damage to other than roads (e.g. disruption and restrictions to regional access) and the agricultural sector (e.g. fences, pasture, etc) arising from floods less than the 1% AEP (100-year ARI) event is not large and comes from flooding of twenty-five (25) properties (eleven (11) of which also experience over-floor flooding). Seven (7) of the over-floor flooded buildings are in Dadswells Bridge (the motel, 2 x houses and 2 x shops) with three (3) in Stawell (2 x houses and a shop) and a shed at Lake Lonsdale

Floods more severe than the 1% AEP event result in an increase in the number of buildings at-risk of over-floor flooding (up from 7 to 18 at the PMF with only 1 building not flooded over-floor) and additional disruption and restrictions to regional access due to flooded roads.

The flood inundation maps at Appendix F4 provide guidance on the likely extent and depth of flooding.

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[5] Halls Gap is subject to flash flooding, where flash flooding is defined as flooding which occurs within 6 hours of rain (BoM, 1996), and is therefore usually the result of intense local rain and is characterised by rapid rise in water levels.

Halls Gap is located along the base of a valley between two steep ranges - the Mount William Range to the east and the Mount Difficult Range to the west. Numerous well-defined gullies (i.e. drainage lines) drain the Mount Difficult Range (i.e. western ridge) and flow from west to east through the town. Stony Creek is the largest of these. Stony Creek is a tributary to Fyans Creek.

2.3 Properties Affected

2.3.1 Summary

A summary of the number of properties likely to be flooded and the number likely to be inundated over-floor is provided in Section 5.3 of this Appendix.

2.3.2 Detailed List

A list of properties likely to be flooded for a range of floods along with the expected depth of over-ground flooding and the likely depth of over-floor inundation is provided in Section 5.4 of this Appendix**.** Properties within 100mm of over-floor flooding are also identified. **It is strongly recommended that the list is used in conjunction with the flood inundation maps (see Appendix F3) and the indicative flood guidance tool provided in Section 5.5.**

2.3.3 Update of List of Properties Likely to be Flooded

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

2.4 Infrastructure at Risk

2.4.1 Overview

Major infrastructure within the Mount William Creek catchment includes the Victoria – South Australia rail link, while downstream from Lake Lonsdale and at Dadswells Bridge there is the Western Highway (the main Adelaide – Melbourne road link).

2.4.2 Major Roads and Isolation

The Western Highway at Dadswells Bridge is inundated by floods from between the 20-year and 50-year ARI level which effectively isolated the town from both Stawell and Horsham. During a large flood the Western Highway is likely to remain impassable for 2 to 3 days.

Most of the smaller roads in the Mount William Creek floodplain are inundated progressively by floods from between the 10 and 20 year ARI level which isolates rural properties and severely restricts movement around the district.

2.4.3 Essential Infrastructure

There is no known essential infrastructure affected by flooding within the Mount William Creek catchment, other than the Western Highway at Dadswells Bridge.

2.4.4 Other Infrastructure

Mobile network telephone towers – none known.

Wastewater treatment plant – not applicable.

Sewer pump stations – none known.

Water treatment plant – not applicable.

Electrical power kiosks / zone sub-stations (cabinets) – none known.

Community facilities:
At Dadswells Bridge – Motel (affected by January 2011 flood). Note also that the Town Hall was affected during the January 2011 flood but the floor has since been raised.

3. Flood Mitigation

Other than the levee adjacent to Mount William Creek at Dadswells Bridge, there are no known flood mitigation works within the catchment.

4. Command, Control and Coordination

The Command, Control and Coordination arrangements in this MFEP will be as detailed in the EMMV.

All flood response activities within the Ararat Rural City will be under the Control of the VICSES Regional Duty Officer / Incident Controller.

An EMT may be established by the Incident Controller in accordance with the EMMV.

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

The ICC for the Ararat Rural City and any Divisional or Sector Commands will be located as detailed in the VICSES Mid-West Region Flood Emergency Plan.

5. Flood Intelligence Card, Property Inundation List and Indicative Flood Tool

5.1 Introduction

The BoM does not currently provide flood forecasts for any part of the Mount William Creek catchment. All actions must therefore be driven by rainfall and / or river level observations.

The Bureau of Meteorology (BoM) collects and records rainfall at a number of locations within or close to the Mount William Creek catchment. However, data from only three of these sites are available from the BoM website at a sub-daily interval. Rainfall data from the Mt William AWS and the Stawell Aerodrome AWS are available at 30-minute intervals (more frequently during very heavy rain events) while data from the Stawell ERTS at the Concongella gauging site is available at hourly intervals, although the site provides data to BoM in near real-time (i.e. as it is recorded). Data from all three sites is available through the rainfall and river height data (by catchment) map and in table format.

Stream level data is available from the BoM website for two locations within the Mount William Creek catchment:

- Fyans Creek at Fyans Creek (415250); and
- Mt William Creek at Lake Lonsdale tail gauge (415203).

There are additional water monitoring sites, operated primarily for water and catchment management purposes, at:

- Fyans Creek at Lake Bellfield (415214);
- Fyans Creek at Grampians Road Bridge (415217) upstream of Lake Bellfield;
- Mount William Creek at Mokepilly (415252); and
- Lake Lonsdale Head Gauge (415227)

Notes:

1. While flood intelligence cards provide guidance on the relationship between flood magnitude and flood consequences, flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, will have identical impacts. Further, the hydrologic and hydraulic modelling that underpins much of the intell detailed below is informed by a number of assumptions and approximations that are unlikely to be replicated exactly during a flood event. Actual impacts under similar rainfall conditions are therefore expected to be similar but may not be exactly the same: there are likely to be some differences. More details about flood intelligence and its use can be found in the Australian Emergency Management Manuals flood series at http://www.ema.gov.au and in particular in Manual 20 “Flood Preparedness”.
2. It should be noted that local impacts, or impacts in excess of those indicated, may occur. Similarly, local increases in flood levels and impacts may result from local factors such as blockages at bridges and from obstructions to overland flows such as works, channels, fences, buildings and the like.
3. All levels, impacts and actions listed in the following flood intelligence card and graph may need to be adjusted to better reflect experience.

5.2 Flood Intelligence Card

Observed Rainfall (see graph)	AEP of flood	Lake Lonsdale tail gauge (mAHD)	Consequence / Impact	Action (to be completed) Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and the MERO at the Ararat Rural City.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Mount William Creek catchment watercourses will begin to rise within a few hours or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B.				
Heavy rain on wet catchment			◦ Likely to result in strong runoff and rapid rises throughout the catchment. ◦ If period of rain is short, local flooding likely. ◦ If period of rain is prolonged, significant riverine flooding likely.	◦ Check antecedent conditions - is catchment wet? ◦ Monitor rainfall and water levels. The AWS's can be checked every 30 minutes or so on BoM website. ◦ Use the indicative flood / no flood tool to develop an appreciation of the likely scale of the flood event.
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~40mm in 6 hours ~50mm in 12 hours ~65mm in 24 hours	20% AEP (5-yr ARI)	181.49	◦ A shop in Longfield Road in Stawell flooded over-floor and 2 x houses within 100mm of flooding over-floor. ◦ Water beginning to accumulate along the sides of roads, and on the upstream side of larger roads. ◦ A number of the smaller local roads will be flooded but most are likely to remain passable.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging buildings at Stawell. ◦ Deploy “water over road” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~50mm in 6 hours ~60mm in 12 hours ~75mm in 24 hours	10% AEP (10-yr ARI)	182.22	◦ A shop and a house in Longfield Road in Stawell flooded over-floor and another house within 100mm of flooding over-floor. ◦ Water becoming deeper along the sides of roads, and on the upstream side of larger roads. ◦ Flooding on the smaller local roads getting more extensive and a little deeper. Some roads will need to be closed due to depth considerations.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging buildings at Stawell. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

Observed Rainfall (see graph)	AEP of flood	Lake Lonsdale tail gauge (mAHD)	Consequence / Impact	Action (to be completed) Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and the MERO at the Ararat Rural City.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Mount William Creek catchment watercourses will begin to rise within a few hours or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B.				
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~60mm in 6 hours ~75mm in 12 hours ~90mm in 24 hours	5% AEP (20-yr ARI)	183.95	◦ A shop and a house in Longfield Road in Stawell flooded over-floor and another house within 100mm of flooding over-floor. ◦ Water becoming deeper along the sides of roads, and on the upstream side of larger roads. ◦ Flooding on the local roads getting more extensive and deeper. Some roads will need to be closed due to depth and velocity considerations. ◦ Larger roads likely to be wetted now - see list above.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging buildings at Stawell. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~70mm in 6 hours ~90mm in 12 hours ~110mm in 24 hours	2% AEP (50-yr ARI)	184.36	◦ A shop and a house in Longfield Road in Stawell flooded over-floor and another house within 100mm of flooding over-floor. ◦ Water deeper along the sides of roads. ◦ Flooding on the local roads getting more extensive and deeper. Some roads will need to be closed due to depth and velocity considerations.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging buildings at Stawell. ◦ Deploy “water over road”, “road closed” and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

Observed Rainfall (see graph)	AEP of flood	Lake Lonsdale tail gauge (mAHD)	Consequence / Impact	Action (to be completed) Actions may include (but not limited to) evacuation, closure of roads, sandbagging, issue of warnings and who is responsible
USING THIS INTELLIGENCE CARD. Obtain rainfall data and use the indicative flood guidance tool to determine the approximate flood severity. Consider the appropriate flood inundation map. Review all consequences and actions in this table, from the first row down to the approximate expected severity of flooding. Initiate all actions in a logical sequence. Note that that some actions may need to be initiated in an order that is different from their relative placement in this table.				
If response has been initiated locally, the first action should be a call to VICSES, followed by a call to the MERC and the MERO at the Ararat Rural City.				
It is important that any decision to Evacuate is made early based on available intelligence and that, in general, sandbagging is reserved for non-weatherboard buildings.				
Upper Mount William Creek catchment watercourses will begin to rise within a few hours or so of the start of heavy rain if the catchment is wet. Rises will be later and slower on a drier catchment. See Appendix B.				
Indicative only - will depend on antecedent conditions and spatial and temporal distribution of the rain ~85mm in 6 hours ~105mm in 12 hours ~125mm in 24 hours	1% AEP (100-yr ARI)	184.54	◦ 3 buildings flooded over-floor in Stawell. ◦ A shed flooded over-floor on Mt Dryden Road in Lake Lonsdale. ◦ Flooding on the local roads getting more extensive and deeper.	◦ Implement appropriate response actions and secure necessary resourcing. ◦ Consider sandbagging buildings at Stawell. ◦ Deploy "water over road", "road closed" and other signs. ◦ Continue to monitor rainfall and water levels. ◦ Maintain the plot on the indicative flood / no flood tool in order to further develop appreciation of the likely scale of the flood event. ◦ Refer to indicated maps and impacts.

5.3 Indicative Flood / No flood Guidance Tool for Mount William Creek upstream of Lake Lonsdale

5.3.1 Introduction

The BoM does not currently provide flood forecasts for any part of the Mount William Creek catchment. All actions must therefore be driven by rainfall and / or river level observations.

5.3.2 Using the Indicative Flood / No flood Guidance Tool

In the lead up to a flood event

An average of the rainfall recorded at the AWS rain gauges at Mt William and Stawell Aerodrome should be used to determine an appropriate rainfall depth for use in the Indicative Flood / No Flood guidance tool provided below, unless data from alternative locations closer to areas considered likely to experience the heaviest rainfall is available. Care should be exercised however, as it must be remembered that runoff from headwater as well as low land areas contribute to flooding.

If the catchment is very wet, it would be appropriate to step up one level.

If the catchment is dry and / or rain extended over more than 24 hours, this tool will tend to over-estimate the likelihood of flooding.

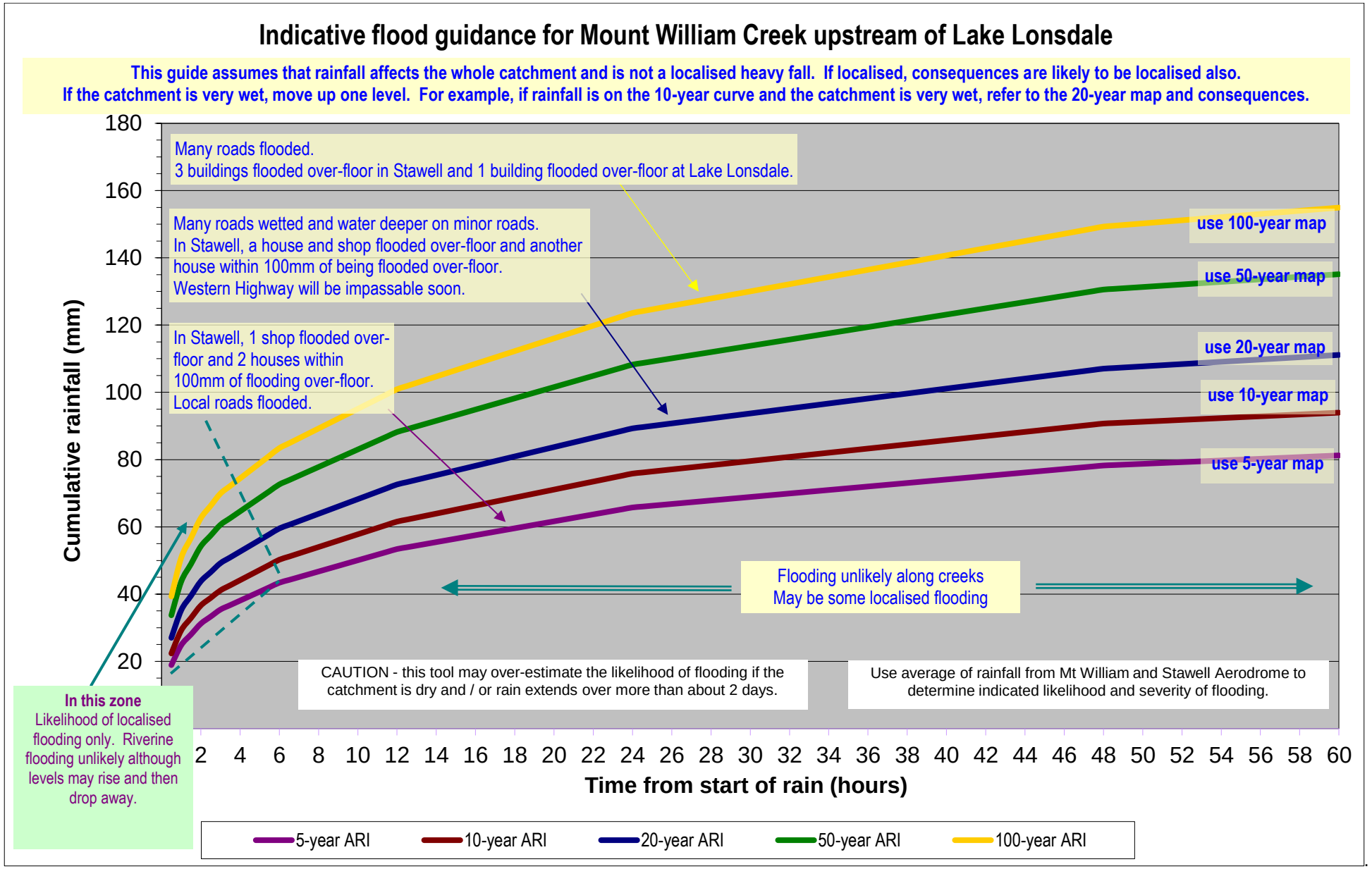
Using the total rainfall depth obtained from the start of the event (discount early drizzle or very light rain), plot the rainfall depth against elapsed time on a copy of the tool. A new plot should be started on receipt of data for each new time step and existing plots should be extended using the new data. Assess the likelihood and expected severity of flooding from the curves with due regard for included notes. A crossing of the curves by any of the plots indicates that flooding of around that severity is likely.

Unless there are unusual circumstances, actions as per the Flood Intelligence Card should be initiated as soon as the tool suggests flooding is likely. Response can be escalated if the tool indicates an increase in the expected severity of flooding.

CAUTION. While a strength of the tool is that it does provide a quick ball-park answer to questions such as "will we flood" and "how bad will it be", it is based on a number of gross assumptions and generalisations. It is therefore indicative only. It is not property specific and does not enable accurate predictions of expected flooding, peak flood heights, the time of flood peak, the severity of expected flooding or specific likely consequences. Further, it will not always indicate the expected severity of flooding correctly although it will usually give a heads-up to severe flooding and thus of likely consequences. Note also that the tool will tend to over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than 24 hours. On the other hand, it will tend to underestimate the likelihood of flooding if the catchment is wet. In such circumstances, it would be appropriate to step up one curve.

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. Relevant information should also be added to Appendix C4.


Indicative flood guidance for Mount William Creek upstream of Lake Lonsdale
This guide assumes that rainfall affects the whole catchment and is not a localised heavy fall. If localised, consequences are likely to be localised also.
If the catchment is very wet, move up one level. For example, if rainfall is on the 10-year curve and the catchment is very wet, refer to the 20-year map and consequences.
Many roads flooded.
3 buildings flooded over-floor in Stawell and 1 building flooded over-floor at Lake Lonsdale.
Many roads wetted and water deeper on minor roads.
In Stawell, a house and shop flooded over-floor and another house within 100mm of being flooded over-floor.
Western Highway will be impassable soon.
In Stawell, 1 shop flooded over-floor and 2 houses within 100mm of flooding over-floor.
Local roads flooded.
use 100-year map
use 50-year map
use 20-year map
use 10-year map
use 5-year map
Flooding unlikely along creeks
May be some localised flooding
CAUTION - this tool may over-estimate the likelihood of flooding if the catchment is dry and / or rain extends over more than about 2 days.
Use average of rainfall from Mt William and Stawell Aerodrome to determine indicated likelihood and severity of flooding.
In this zone
Likelihood of localised flooding only. Riverine flooding unlikely although levels may rise and then drop away.
Cumulative rainfall (mm)
180
160
140
120
100
80
60
40
20
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
Time from start of rain (hours)
5-year ARI
10-year ARI
20-year ARI
50-year ARI
100-year ARI

5.4 Summary of Properties Flooded

Summary of number of flood affected properties in Mt William Creek catchment (ref WBM, 2014) EXISTING CONDITIONS							
	Design Flood AEP (%)						
	20%	10%	5%	2%	1%	0.5%	PMF
Level at reference gauge							
Number of properties flooded above floor	1	2	6	9	11	12	34
Number of properties flooded below floor only	3	2	7	10	13	16	7
Total number of flooded properties	**4**	**4**	**13**	**19**	**24**	**28**	**41**
Number of properties within 100mm of flooding over-floor	3	2	2	3	4	4	5

Summary of number of flood affected properties in Mt William Creek catchment within the NORTHERN GRAMPIANS SHIRE (ref WBM, 2014) EXISTING CONDITIONS							
	Design Flood AEP (%)						
	20%	10%	5%	2%	1%	0.5%	PMF
Level at reference gauge							
Number of properties flooded above floor	1	2	2	2	4	5	11
Number of properties flooded below floor only	3	2	2	5	5	6	6
Total number of flooded properties	**4**	**4**	**4**	**7**	**9**	**11**	**17**
Number of properties within 100mm of flooding over-floor	3	2	2	2	1	1	5

5.5 Detailed List of Properties Flooded

Mount William Creek Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Mount William Creek

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
FYANS CREEK															
14 Cool Waters Road				0.42	0.61	0.78	2.14							1.18	House
1676 Grampians Road							0.16								House
1852 Grampians Road				0.26	0.25	0.27	0.43								House
LAKE LONSDALE															
Mt Dryden Road					0.07	0.20	1.71					0.05	0.18	1.69	Shed
Mt Dryden Road						0.25	1.76						0.17	1.68	Shed
LEDCOURT															
445 Roses Gap Road							1.82							1.43	House
STAWELL															
25 Ararat Road															Nursery
36 Ararat Road	0.01	0.02	0.02	0.03	0.02	0.05	0.18								House
52 Ararat Road							0.32							0.32	House
54 Ararat Road							0.22							0.04	Shed

Mount William Creek Catchment – EXISTING CONDITIONS (ref WBM, 2014)

It is suggested that this table is used in conjunction with the flood inundation maps and flood intelligence card for Mount William Creek

LEGEND		Within ~100mm of flooding over-floor							Depth of over-floor flooding							
Location (Number & Street)	Depth of flooding near building for each ARI							Depth of over-floor flooding at property for each ARI							Comments
	5yr	10yr	20yr	50yr	100yr	200yr	PMF	5yr	10yr	20yr	50yr	100yr	200yr	PMF	
2 Black Range Road						0.22	0.61								House
3 Black Range Road					0.12	0.28	0.64							0.06	House
7 Black Range Road							0.37							0.29	House
2 Burgh Street							0.44								Shop
1-7 Holloway Road															Vet Clinic
2 Longfield Street	0.16	0.17	0.18	0.18	0.20	0.21	0.26					0.00	0.01	0.06	House
4-10 Longfield Street	0.14	0.16	0.18	0.21	0.25	0.27	0.43	0.14	0.16	0.18	0.21	0.25	0.27	0.43	Shop
12 Longfield Street	0.27	0.31	0.32	0.36	0.38	0.41	0.56		0.03	0.04	0.08	0.10	0.13	0.28	House
66 Pickering Road				0.06	0.10	0.12	0.38								House

APPENDIX C5 – AVOCA RIVER CATCHMENT COMMUNITY FLOOD EMERGENCY MANAGEMENT PLAN

To be completed at a later date

Avoca River

- 1893 (30yr ARI) – Impact unknown
- 1909 (?? ARI) - Impact unknown
- September 1983 (25yr ARI) - Impact unknown
- June 1995 (25 ARI) - Impact unknown
- October 1996 (20yr ARI) - Impact unknown
- September 2010 (?? ARI) - Impact unknown
- January 2011 (?? ARI) - Houses with over floor flooding in the Natte Yallock, Archdale Junction and Archdale areas. Road and bridge infrastructure damage, arterial and local roads closed for several days/weeks. Large areas of rural land flooded, with some kilometres of fencing destroyed. Stock losses unknown

APPENDIX D1 – FLOOD EVACUATION ARRANGEMENTS FOR GLENORCHY

1 Phase 1 - Decision to Evacuate

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

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

- When life and safety are at risk;
- Properties are likely to become inundated;
- Properties are likely to become isolated and occupants are not suitable for isolated conditions;
- Public health is at threat as a consequence of flooding and evacuation is considered the most effective risk treatment. This is the role of the Health Commander of the incident to assess and manage. Refer to the State Health Emergency Response Plan (SHERP) for details);
- Buildings have been made uninhabitable;
- Essential services have been damaged and are not available to a community and evacuation is considered the most effective risk treatment.

The following should be considered when planning for evacuation:

- Anticipated flood consequences and their timing and reliability of predictions;
- Size and location of the community to be evacuated;
- Likely duration of evacuation;
- Forecast weather;
- Flood models;
- Predicted timing of flood consequences;
- Time required to conduct the evacuation;
- Time available to conduct the evacuation;
- Evacuation priorities and evacuation planning arrangements;
- Access and egress routes available and their potential flood liability;
- Current and likely future status of essential infrastructure;
- Resources required to conduct the evacuation;
- Resources available to conduct the evacuation;
- Shelter including Emergency Relief Centres, Assembly Areas etc.;
- Vulnerable people and facilities;
- Transportation;
- Registration;
- People of CALD background and transient populations;
- Safety of emergency service personnel;
- Different stages of an evacuation process.

The decision to evacuate should be made in consultation with the MERO, MERC, DHS, Health Commander and other key agencies and expert advice (e.g. Wimmera CMA, Flood Intelligence specialists) unless time constraints prevent this consultation.

The following **Evacuation Checklist** can be used as a guide when evaluating the need for evacuation in a particular area as a result of flooding.

Key Questions	Answers
Are there any existing Flood Evacuation Plans for the Municipality?	
Name of area(s) at risk.	
How many people are at risk (including special needs groups)?	
When and where are access routes likely to be disrupted?	
Is the area a flood island, accessible by road, accessible overland or land locked?	
How much time is available to warn the area? Where Flash Flooding risks exist adopt the strategy detailed in Section 3.8 of this MFEP.	
Under what circumstances and in what areas is shelter in place and not evacuation the best option?	
Where are Flood Relief Centres located?	
What are the triggers for evacuation? (i.e. a particular area at a specified gauge height?) – refer to Appendix C of this MFEP.	
How will evacuation warning messages be communicated to people? (i.e. OSOM, Emergency Alert, etc.)	
Have standard evacuation messages been developed for predicted or likely flood scenarios?	
What forms of transport are needed to assist with evacuation?	
Where are airbase facilities located?	
Where are animal shelter compounds located? Any other arrangements for management and accommodation of pets / animals?	
What are the local command and control arrangements for evacuation?	
Other Confirmations and Clarifications:	
Clarify and confirm local arrangements and responsibilities for evacuation at the local level. This includes: ➢ Confirming and facilitating local awareness of responsibilities for the decision to evacuate (i.e. Incident Controller), the management of evacuation (i.e. VicPol) and the tasks to be undertaken for evacuation (i.e. development and communication of evacuation warnings). ➢ The role of agencies at the local level involved in evacuation (i.e. VicPol, VICSES, Australian Red Cross, etc.) Local arrangements must be consistent with arrangements as set out in Section 3.8 of the EMMV and the Evacuation Guidelines.	

The table below details triggers for evacuation. If these circumstances are predicted or are likely to occur, evacuation should be considered.

Sector	Gauge	Trigger

The table below details time required to evacuate established areas.

Sector	Likely time required for evacuation (including resource assumptions)

2 Phase 2 – Warning or Recommendation

Messages to the community will comprise either a warning to affected people that they prepare to evacuate or a recommendation that they evacuate immediately.

Evacuation messages can be disseminated via methods listed in Part 3 of this plan.

Evacuation messages will be developed and issued by the Incident Controller in consultation with the MERO, MERC, DHS and other key agencies and expert advice (e.g. Wimmera CMA, Flood Intelligence specialists).

The Incident Controller is responsible for authorising and issuing evacuation messages.

3 Phase 3 – Withdrawal

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

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

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

VICPOL will control security of evacuated areas.

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

Possible evacuation routes to be used are as detailed in the MEMP:

Sector	Evacuation Route	Evacuation route closure point or circumstances

Landing zones for helicopters are located at:

- Pre established at aerodromes
- Various locations, dependent upon safety requirments.

Special needs groups and vulnerable residents likely to need help may be identified via the Home and Community Care (HACC) database, via Council's 'residents at risk' register or through community network organisations. Refer to the MEMP.

4 Phase 4 – Shelter

Relief Centres and / or assembly areas which cater for people's basic needs may be established to meet the immediate needs of people affected by flooding. Flood Emergency Relief / Recovery Centres and / or Assembly Areas are listed in the MEMP.

The Northern Grampians Shire Council is responsible for the provision of emergency shelter and for managing emergency relief centres.

The Incident Controller is responsible for activating emergency relief services.

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

Animal Shelter

Animal management guidelines are provided in the MEMP along with the location and contact details for appropriate animal welfare entities.

Matters relating to the welfare of livestock, companion animals and wildlife (including feeding and rescue) are to be referred to DPI. This includes requests for emergency supply and / or delivery of fodder to stranded livestock or for livestock rescue.

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

5 Phase 5 – Return

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

The Incident Controller in consultation with VicPol and other relevant agencies will determine when it is safe for evacuees to return to the affected area / their properties and will arrange for the notification of the community.

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

Considerations for deciding whether to evacuate may return to the affected area include:

- Current flood situation;
- Status of flood mitigation systems;
- Size and location of the community;
- Access and egress routes available and their status;
- Resources required to coordinate the return;
- Special needs groups;
- Forecast weather;
- Transportation particularly for people without access to transport.

6 Disruption to Services

Disruption to a range of services can occur in the event of a flood. This may include road closures affecting school bus routes, damage to water treatment plant affecting potable water supplies, etc. [List facilities, trigger point for action and strategy to be employed]

Service	Impact	Trigger point for action	Strategy / Temporary Measures

7 Essential Community Infrastructure and Property Protection

Essential Community Infrastructure and properties (e.g. residences, businesses, roads, power supply, etc) that require protection are as follows: [List facilities, trigger point for action and strategy to be employed]

Facility	Impact	Trigger Point for action	Strategy / Temporary Measures

8 Rescue

Resources available within Northern Grampians Shire to assist with rescue operations are as listed in the MEMP.

While there are no formal resource sharing arrangements establishing by the Northern Grampians Shire Council with other Municipalities (apart from the MAV Resource Sharing MOU) and / or other agencies, Victorian incident management arrangements established for flood facilitate such sharing.

Known high-risk areas / communities (i.e. low-lying islands) where rescues might be required include are being developed.

APPENDIX D2 –
FLOOD EVACUATION ARRANGEMENTS FOR Other Locations

Any other areas that requires evacuation arrangements not already detailed herein, will be developed as a matter of priority.

APPENDIX E – FLOOD WARNING SYSTEMS

1 Flood Warning

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

2 Severe Thunderstorm and Severe Weather Warnings

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

The BoM issues warnings of flash flooding when it becomes apparent that an event has commenced which may lead to flash flooding or when flash flooding has commenced.

3 Flood Watches

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

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

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

4 Flood Warnings

4.1 Overview

Flood Warnings are firm predictions of flooding based on actual rainfall and river height information. They are produced by the application of a range of models that include simple relationships between upstream and downstream water levels through to complex stream flow based models of catchment behaviour that take account of antecedent conditions (i.e. the 'wetness' of the catchment, storage levels within dams, etc) and likely future rainfall. Releases from dams are an essential input to such models.

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

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

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

- **Key locations:** may be a forecast location and the real-time data collected at site are critical to the provision of a flood forecasting service to a downstream site.
- **Secondary locations:** data from these sites are used to support hydrological modelling and flood prediction activities although their loss during an event is considered unlikely to affect BoM ability to provide a flood forecasting service.

Flood forecasts provided by the BoM are categorised as either:

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

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

Flood warnings usually include:

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

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

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

Additional information (e.g. weather radar and satellite images as well as updated rain and river level information) can also be obtained from the Bureau's website (www.bom.gov.au/hydro/flood/vic) or for the cost of a local call on ☎ 1300 659 217.

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

4.2 Wimmera River Catchment

A data collection system to support flood warning for Glenorchy and downstream has been implemented within the Municipality. During 2007, Wimmera CMA in conjunction with GWMWater, VICSES, Horsham Rural City Council (HRCC), Hindmarsh Shire Council (HSC) and Yarriambiack Shire Council (YSC) installed a number of radio telemetered rainfall and stream gauges across the Wimmera catchment as part of an upgrade of the Wimmera

River flood warning system. These stations provide accurate real time information about rainfall and changes to river levels as they occur via radio directly to the BoM and GWMWater.

4.3 Upper Wimmera River Catchment

There are currently no flood warning systems or arrangements in place for the Upper Wimmera River catchment or for any of the upper catchment townships. The tool provided in Section 9.5 of Appendix C2 does however provide indicative guidance on the likelihood and expected severity of flooding across the upper catchment based on consideration of rainfall.

4.4 Mt William Creek

There are currently no flood warning systems or arrangements in place for Mount William Creek or for any of the catchment townships. The tool provided in Section 5.3 of Appendix C3 does however provide indicative guidance on the likelihood and expected severity of flooding across the upper and middle catchment based on consideration of rainfall..

4.5 Avoca River

To be completed later.

4.6 Other Watercourses

To be completed later.

5 Flood Bulletins

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

The relevant VICSES Region Headquarters or the established ICC will normally be responsible for drafting, authorizing and issuing Flood Bulletins, using the One Source, One Message (OSOM) system.

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

Flood Bulletins should follow the following structure:

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

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

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

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

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

6 Local Flood Warning System Arrangements

There are no specific local flood warning systems or arrangements currently in place within the Municipality.

7 Flood Class Levels

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

It is emphasised that the flood class levels quoted in the table below refer to that part of the watercourse where the flood effects can be related to the reading from the actual or proposed gauge.

It is important to remember that flood impact is dependent on more than the peak height or flow. The rate of rise, duration, extent and season of flooding are also important. For this reason, flood class levels can only be considered as a guide to flood severity.

Preliminary flood class levels have been proposed for the areas around Navarre, Eversley, Crowlands and Glynwylln in the Upper Wimmera catchment as follows (add values to local datum when available):

Navarre:

Minor flood level	227.700 m AHD
Moderate flood level	227.900 m AHD
Major flood level	227.950 m AHD

Eversley:

Minor flood level	264.000 m AHD
Moderate flood level	264.900 m AHD
Major flood level	265.250 m AHD

Crowlands:

Minor flood level	246.300 m AHD
Moderate flood level	246.500 m AHD
Major flood level	246.600 m AHD

Glynwylln:

Minor flood level	192.400 m AHD
Moderate flood level	193.000 m AHD
Major flood level	193.600 m AHD

8 Flash Flooding

The BoM's policy on the provision of flash flood warning services is set out in a document dated May 1996 (Bureau of Meteorology, 1996). Following a definition of flash flooding ("flooding occurring within about 6 hours of rain, usually the result of intense local rain and characterised by rapid rises in water levels"), the document describes the policy framework which underpins the flash flood warning service provided by the BoM. The 1987 working arrangements (Bureau of Meteorology, 1987) also refer to the provision of flash flood warning services and make it clear that the BoM does not have an exclusive role.

.

9 Details of relevant gauges

Station No	River / Creek	Station	Flood Class Levels (m)			Gauge Zero (m AHD)	Comments
			Minor	Moderate	Major		
415238	Wattle Creek	Navarre	---	---	---		
415245	Mt Cole Creek	Crowlands	---	---	---		
415207	Wimmera River	Eversley	---	---	---	259.865	
415206	Wimmera River	Glynwylln	---	---	---	186.228	Built higher after January 2011 flood.
415237	Concongella Ck	Stawell	---	---	---		
	Wimmera River	Glenorchy	4.00	4.75	4.90	163.750	
	Wimmera River	Walmer (d/s Horsham)	---	---	---		Located approx 3.7km downstream from the Horsham Weir. Can be influenced by MacKenzie River and other tributary inflows.
415250	Fyans Creek	Fyans Creek	---	---	---		
415203	Mt William Creek	Lake Lonsdale TG	---	---	---		
415220	Avon River	Wimmera Highway	---	---	---		
415260	Richardson River	U/S Rich Avon Weir	---	---	---		
	Richardson River	Carrs Plains					
408206	Avoca River	Archdale Junction	---	---	---		Located approximately 3 km upstream of the Cherry Tree Creek junction.
408200	Avoca River	Yawong Weir	3.00	4.30	5.00		
To be completed for other catchments							

APPENDIX F1 – MAPS for GLENORCHY

1 Overview

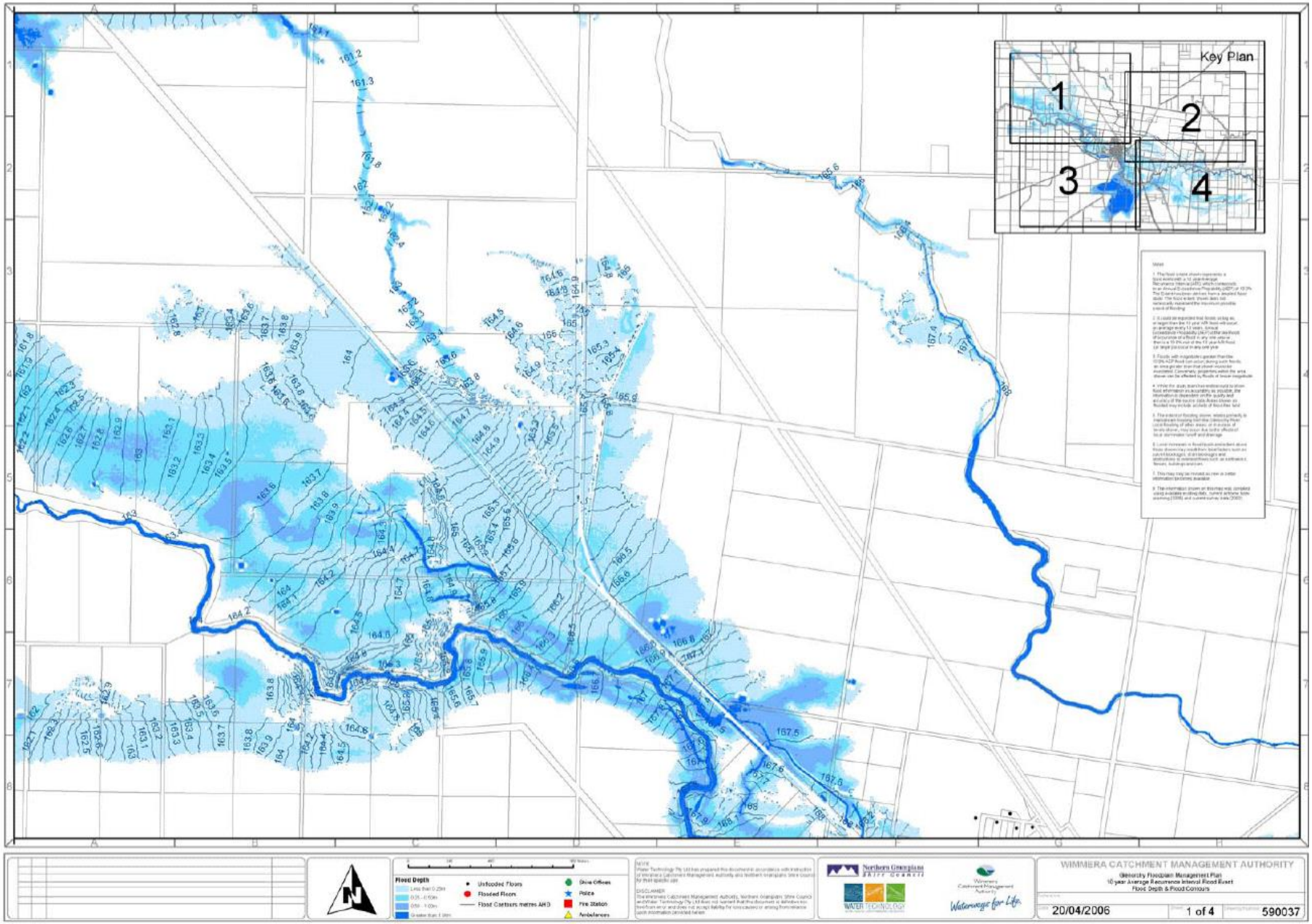
Maps considered useful to flood response at Glenorchy are included in this Appendix. They comprise:

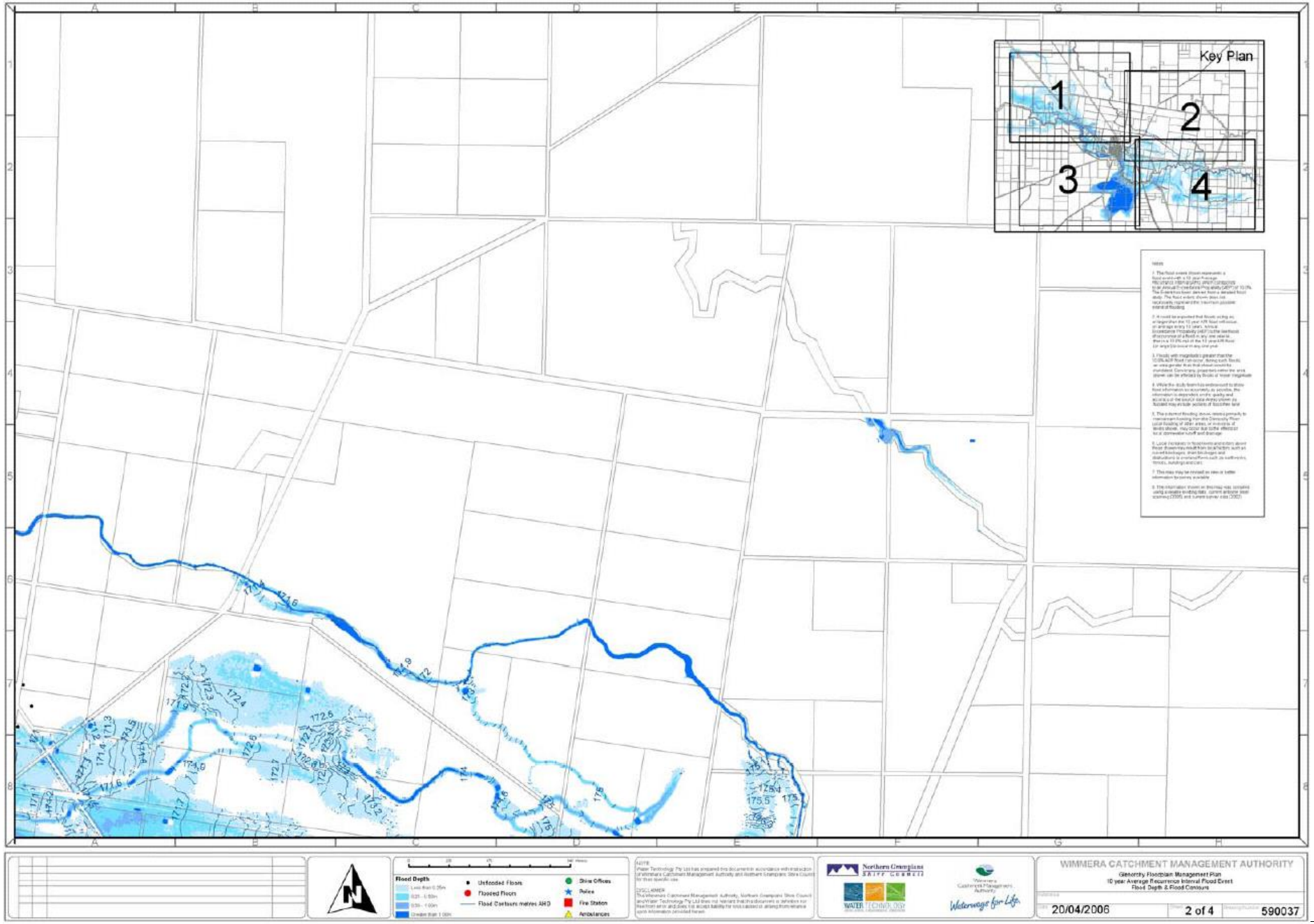
- A set of maps showing flood extents and depths for the design flood events considered (i.e. 10, 20, 50, 100 and 200 year ARI) by Water Technology when delivering the Glenorchy Flood Study (Water Technology, 2006). The maps also identify houses and other buildings likely to be flooded above floor level by each event. Surveyed floor levels have been compared to predicted flood heights. A red dot is used to show each floor level lower than the expected flood height (i.e. that over-floor flooding is likely).
- A set of maps, prepared by Water Technology, showing flood extent and depths along the Wimmera River downstream from Glenorchy for the 10, 20 and 50-yearARI flood events.

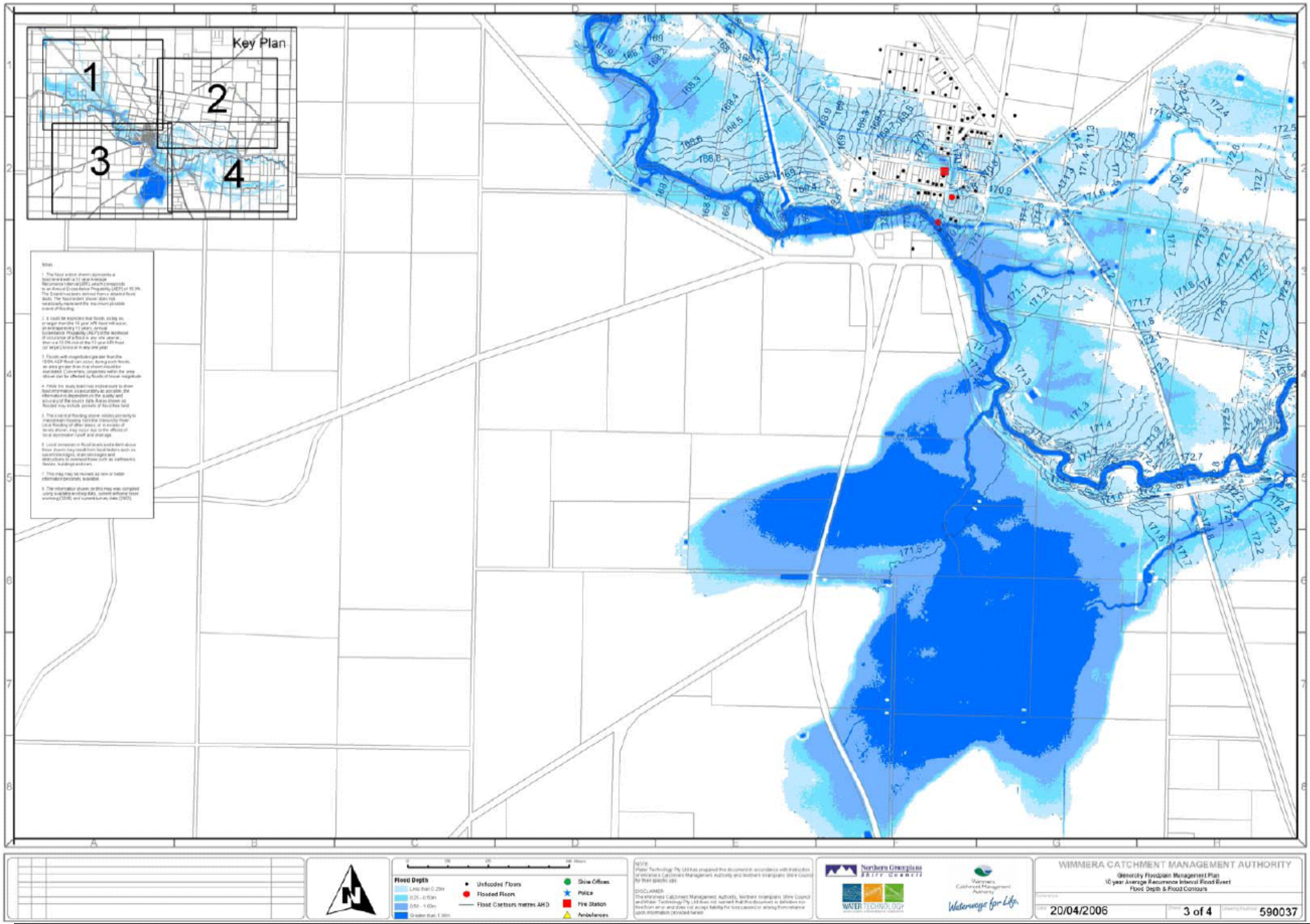
Note that:

- These maps are available in hard copy form from NGSC and / or Wimmera CMA.
- Maps showing 100-year ARI (1% AEP) flood extent and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website (see the list of references in Appendix G).
- Within Glenorchy itself, the Planning Scheme refers to designated 1% AEP flood levels. These are the 1% AEP flood levels across land designated as subject to inundation within the Planning Scheme.

Set of 4 x flood extent and depths for the 10% AEP (10 year ARI) event




Key Plan
1
2
3
4
Flood Depth
Unflooded Floors
Flooded Floors
Flood Contours metres AHD
Shire Offices
Police
Fire Station
Ambulances
Northern Grampians
SHIRE COUNCIL
WATER TECHNOLOGY
Waterways for Life
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
10 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
2 of 4
590037


Key Plan
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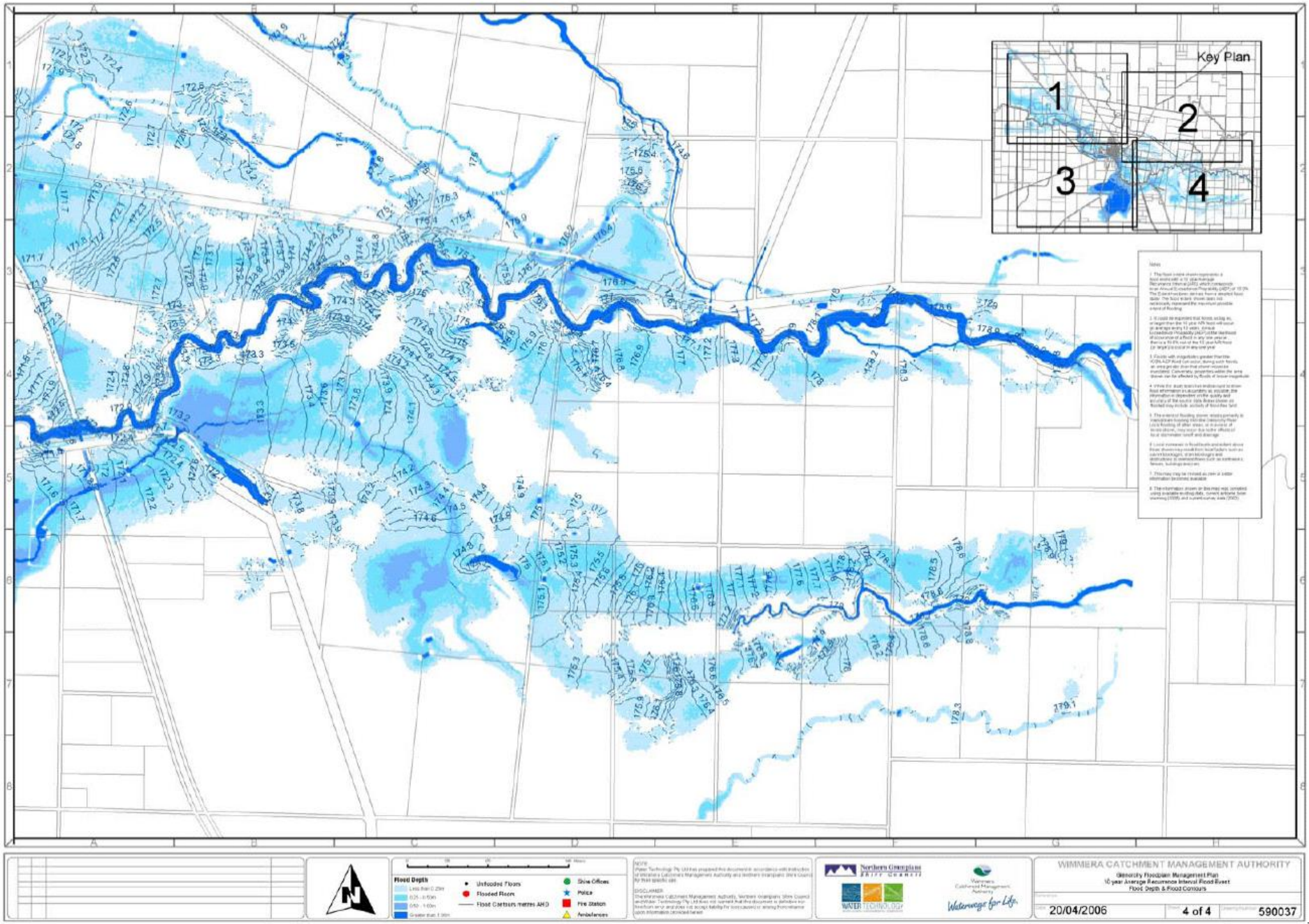
Flood Depth
Unfooded Floors
Flooded Floors
Flood Contours metres AHD
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
10 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
3 of 4
590037


Key Plan
1
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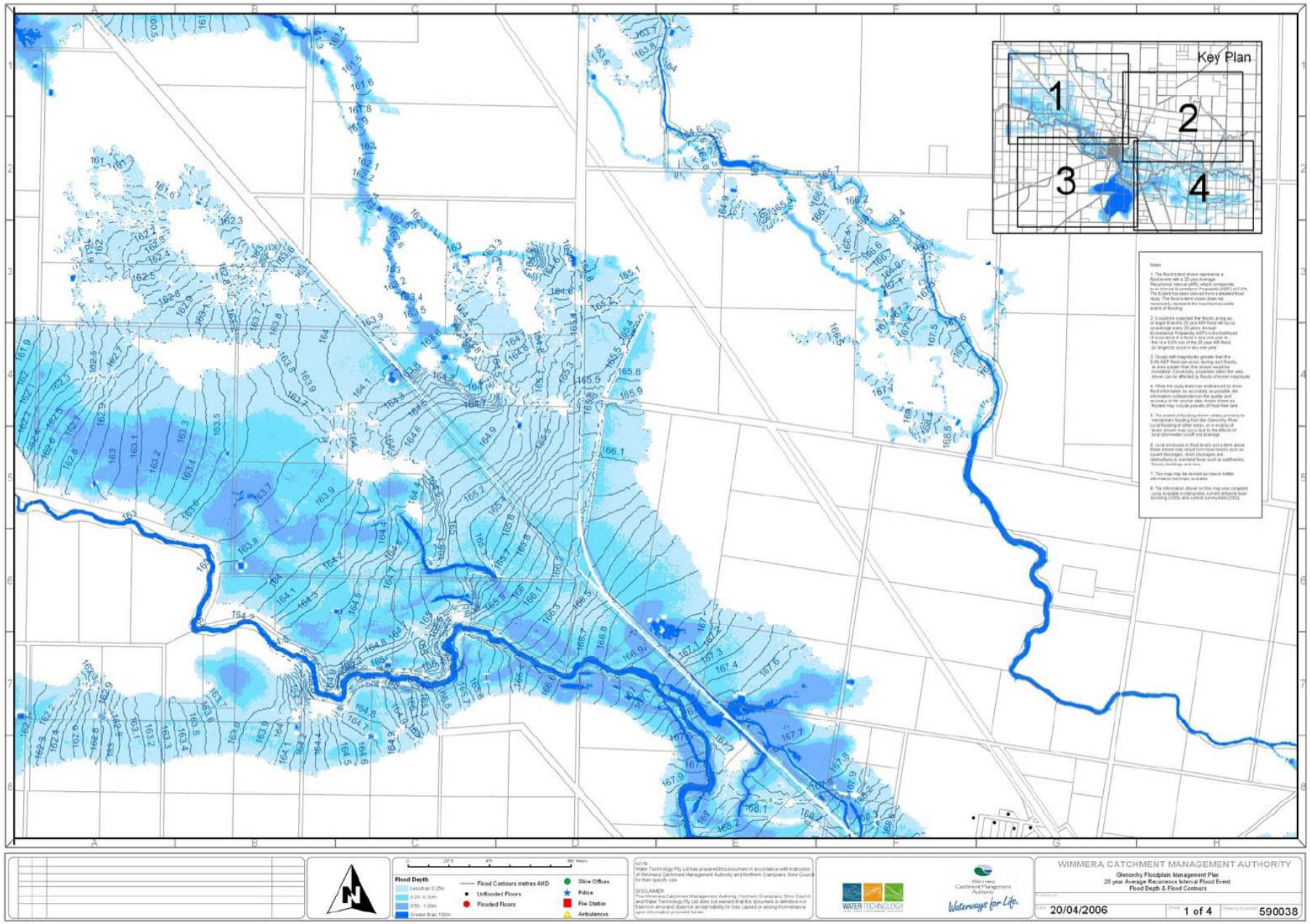
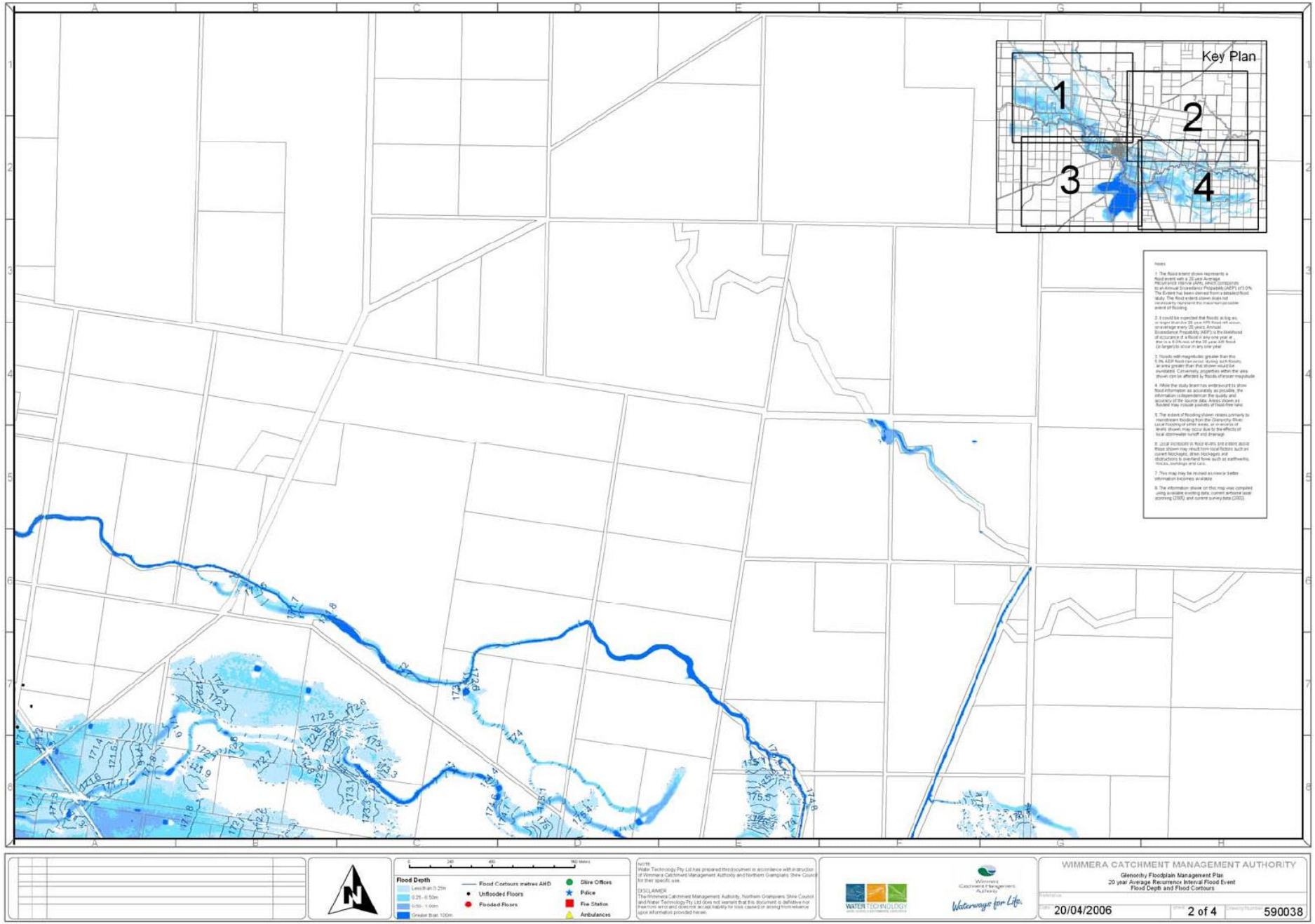
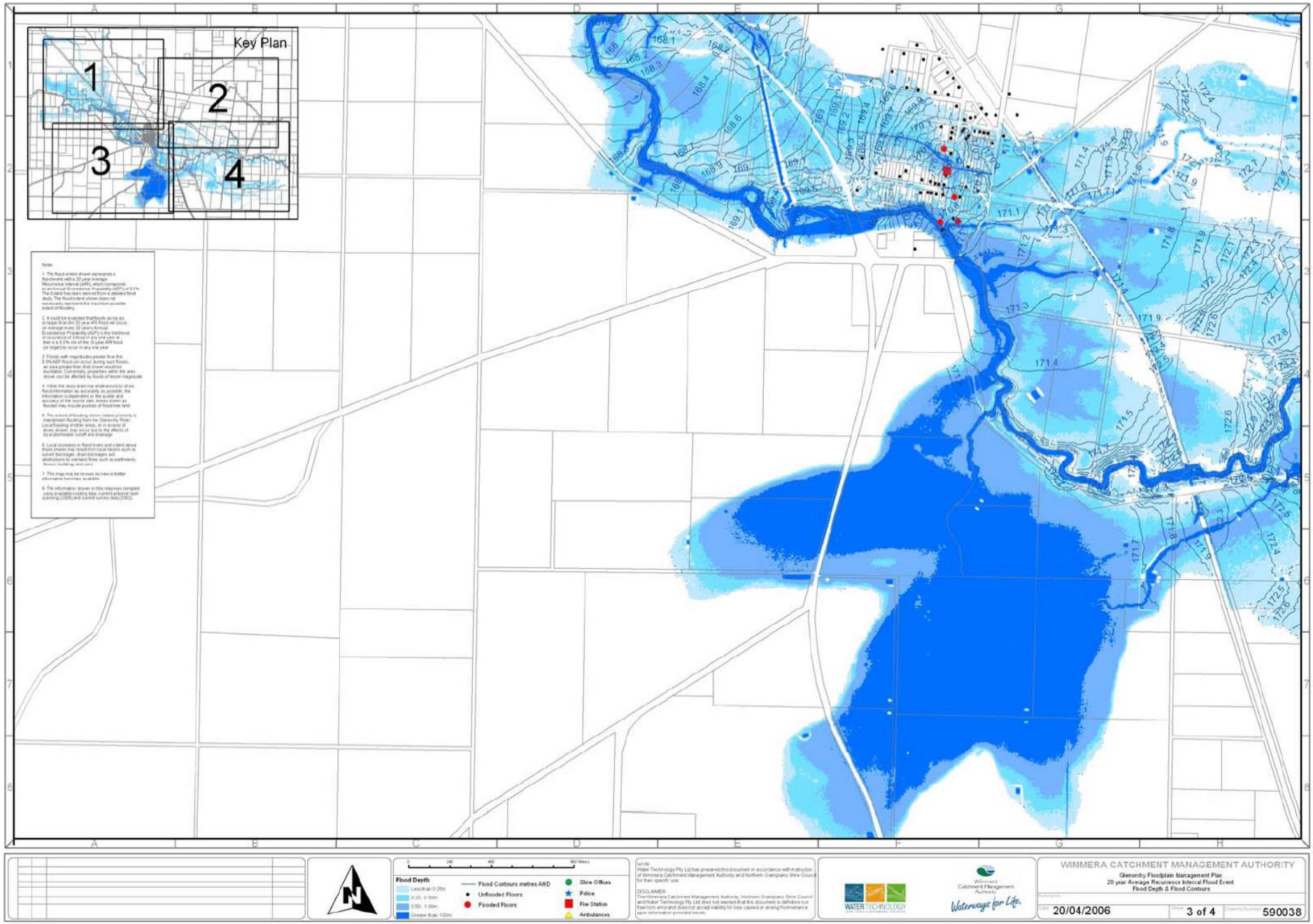
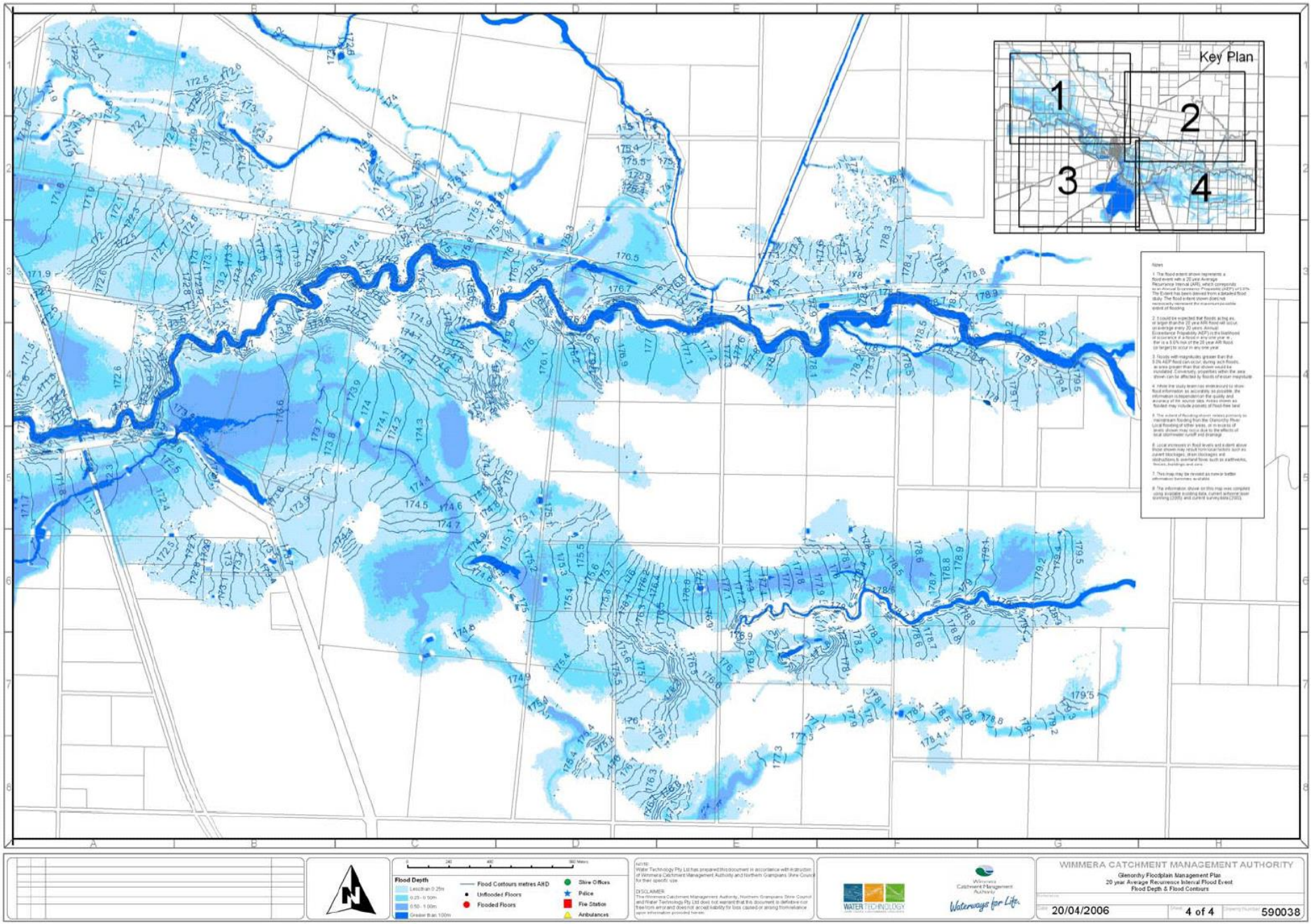
Flood Depth
Unfloodes Floors
Flooded Floors
Flood Contours metres AHD
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
10 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
4 of 4
590037

Set of 4 x flood extent and depths for the 5% AEP (20 year ARI) event

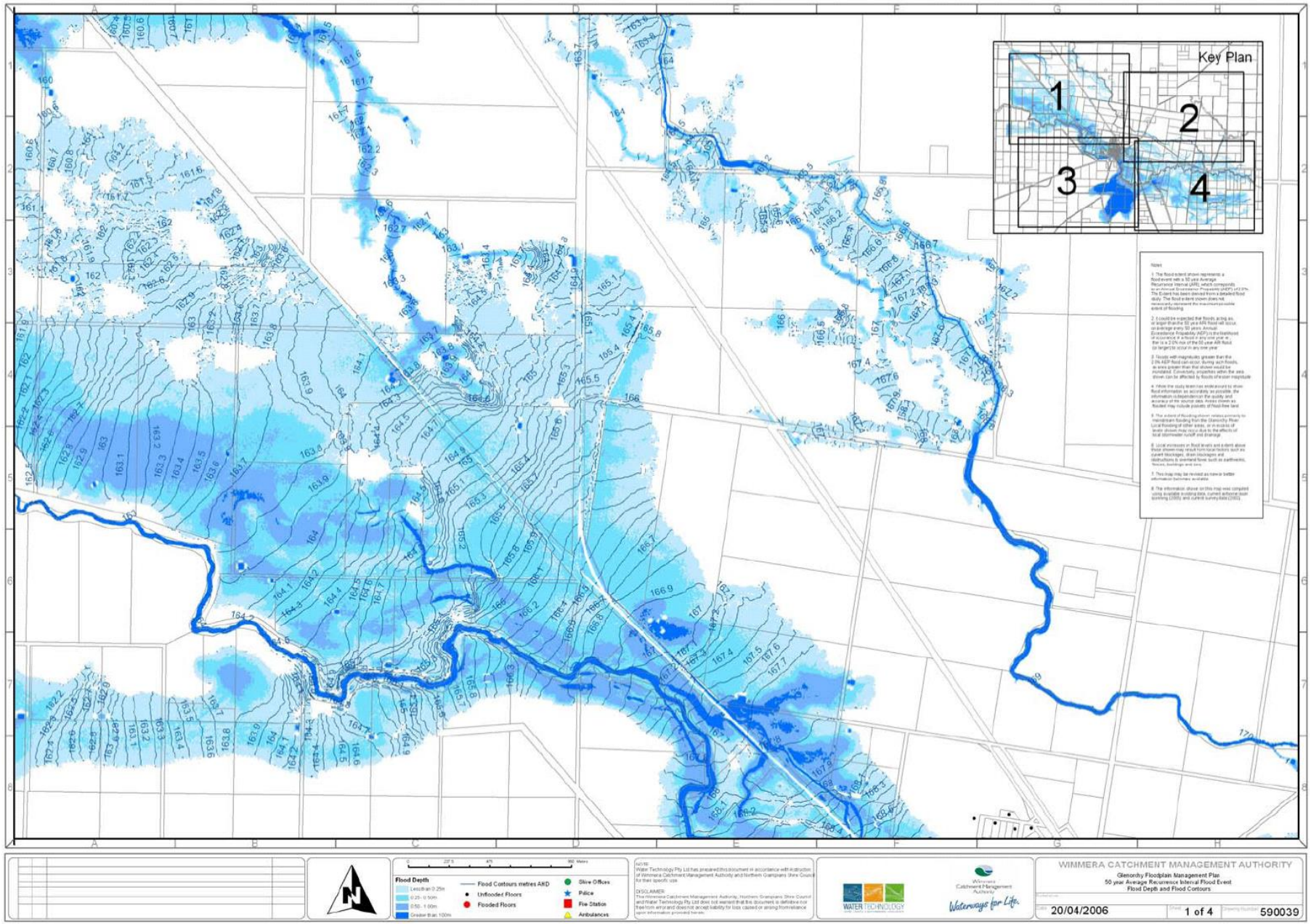


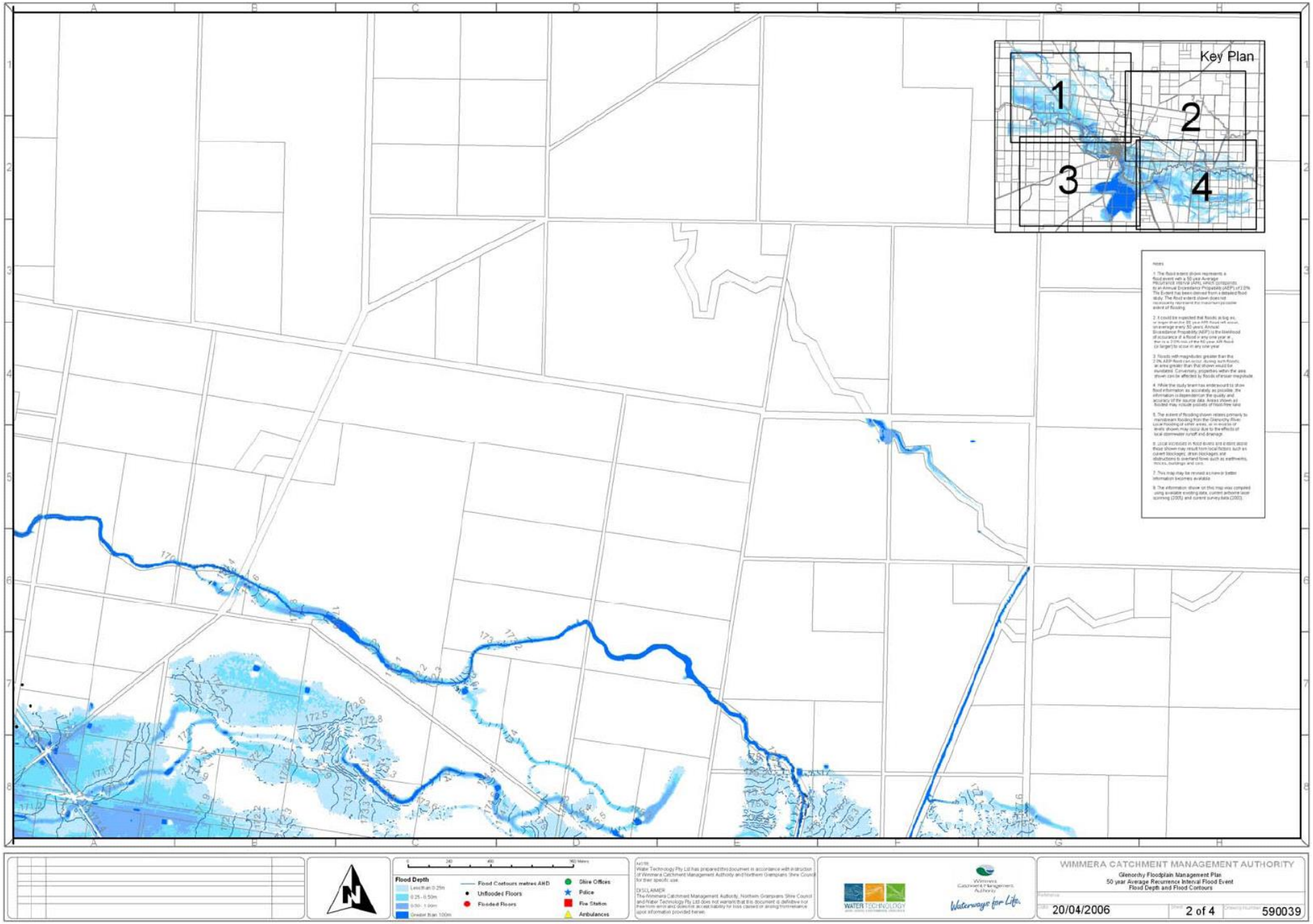

Key Plan
1
2
3
4
Flood Depth
Less than 0.25m
0.25 - 0.50m
0.50 - 1.00m
Greater than 100m
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
20 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
2 of 4
590038

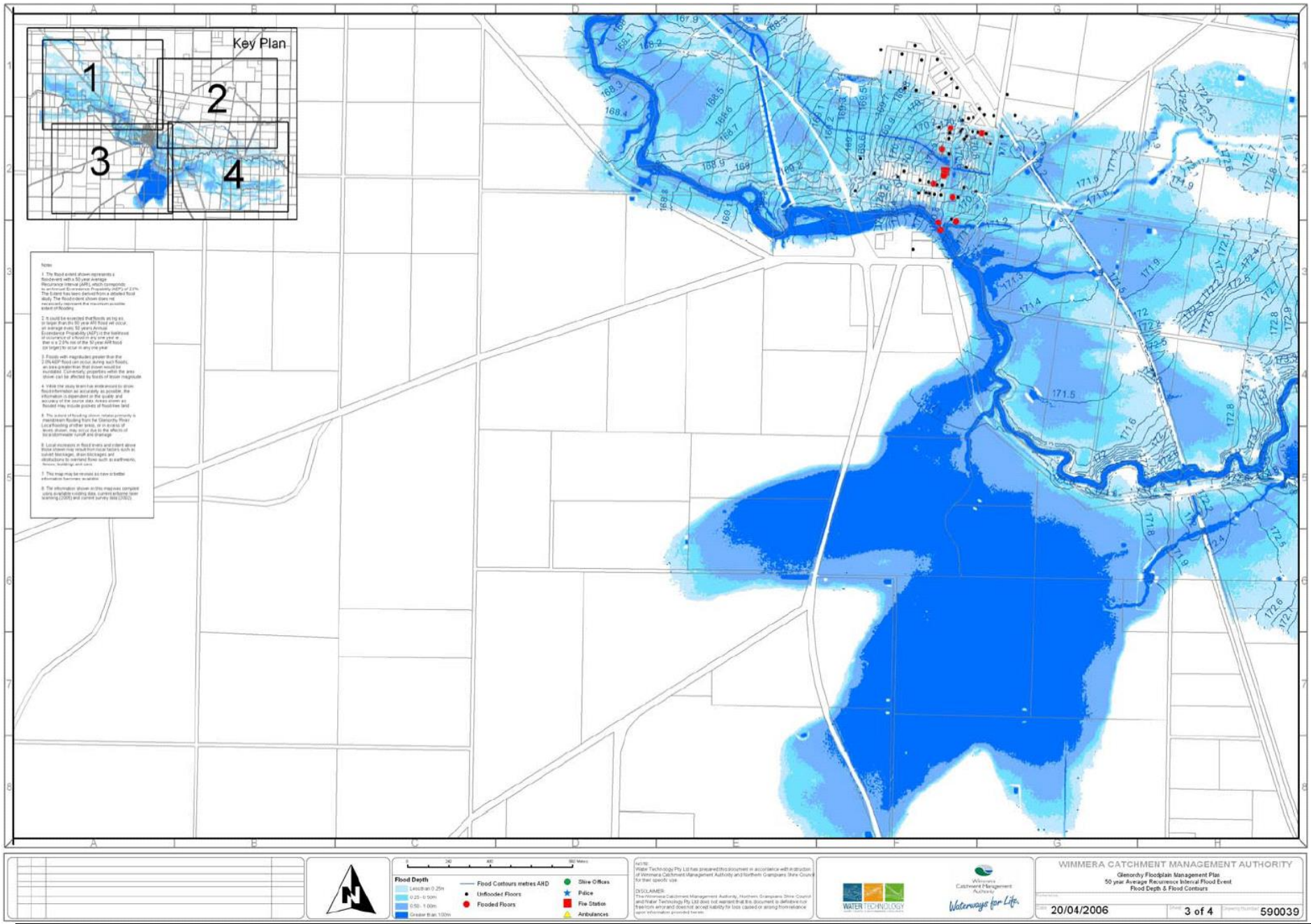

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
20 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
3 of 4
590038

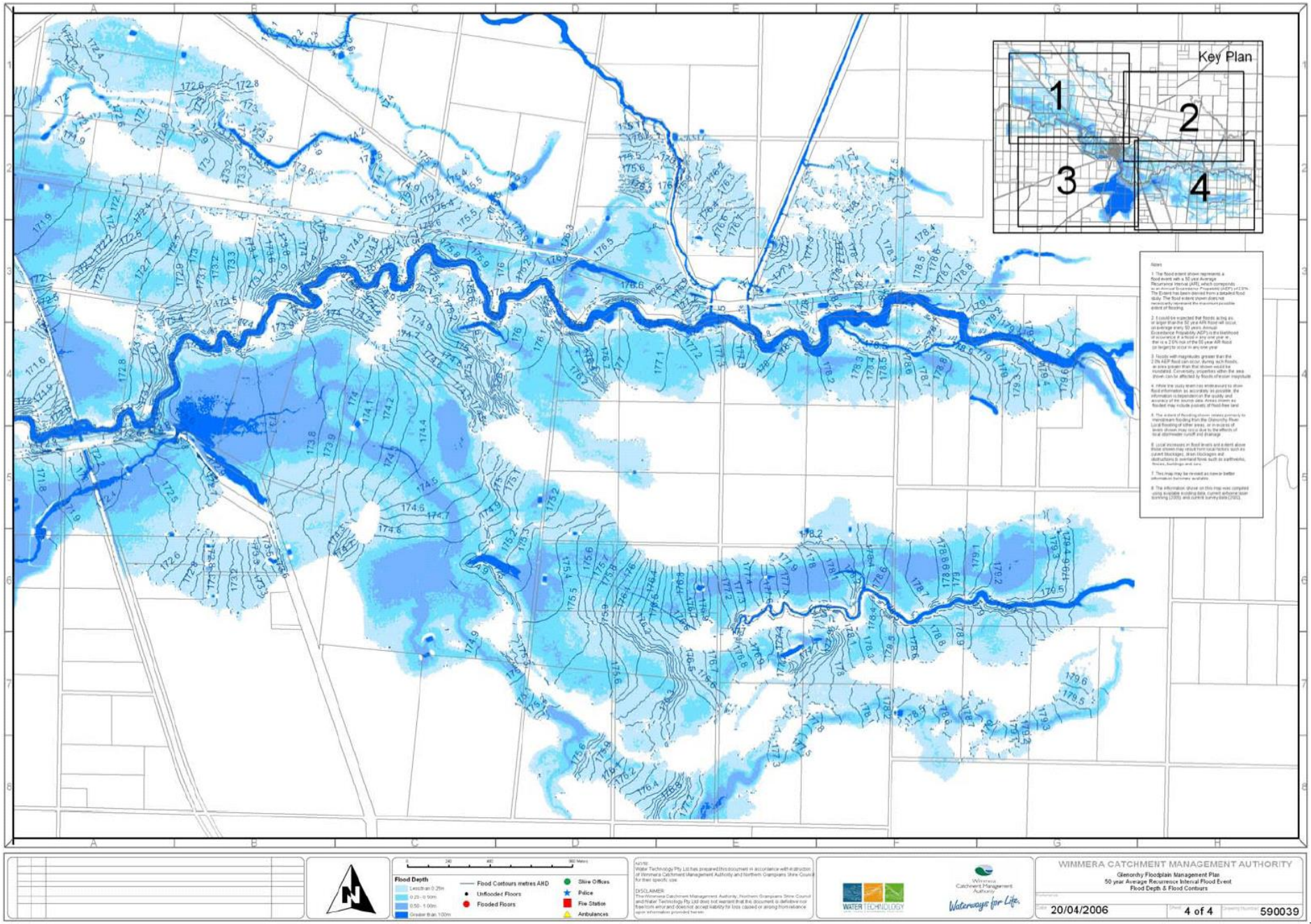

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
20 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
4 of 4
590038

Set of 4 x flood extent and depths for the 2% AEP (50 year ARI) event

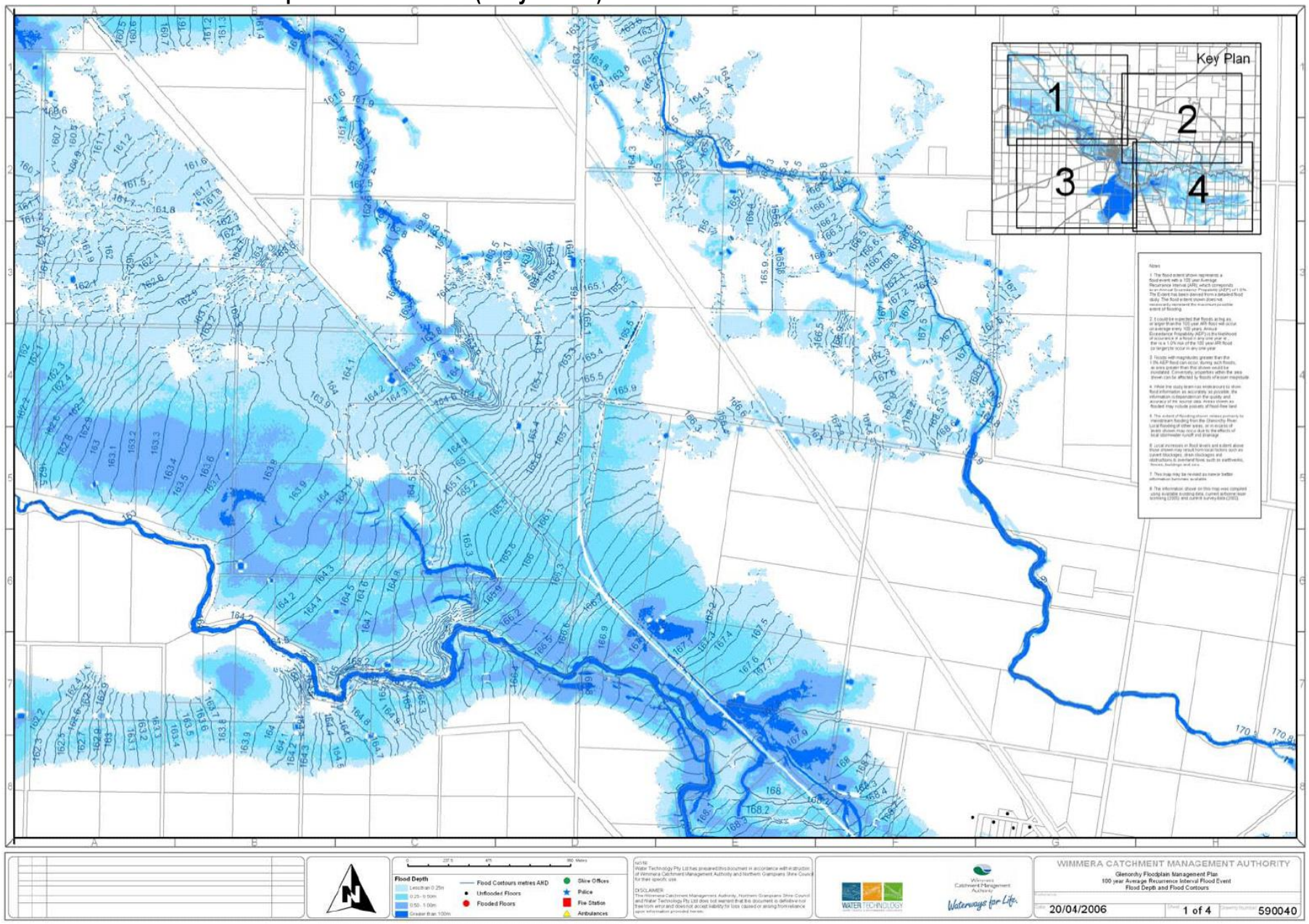


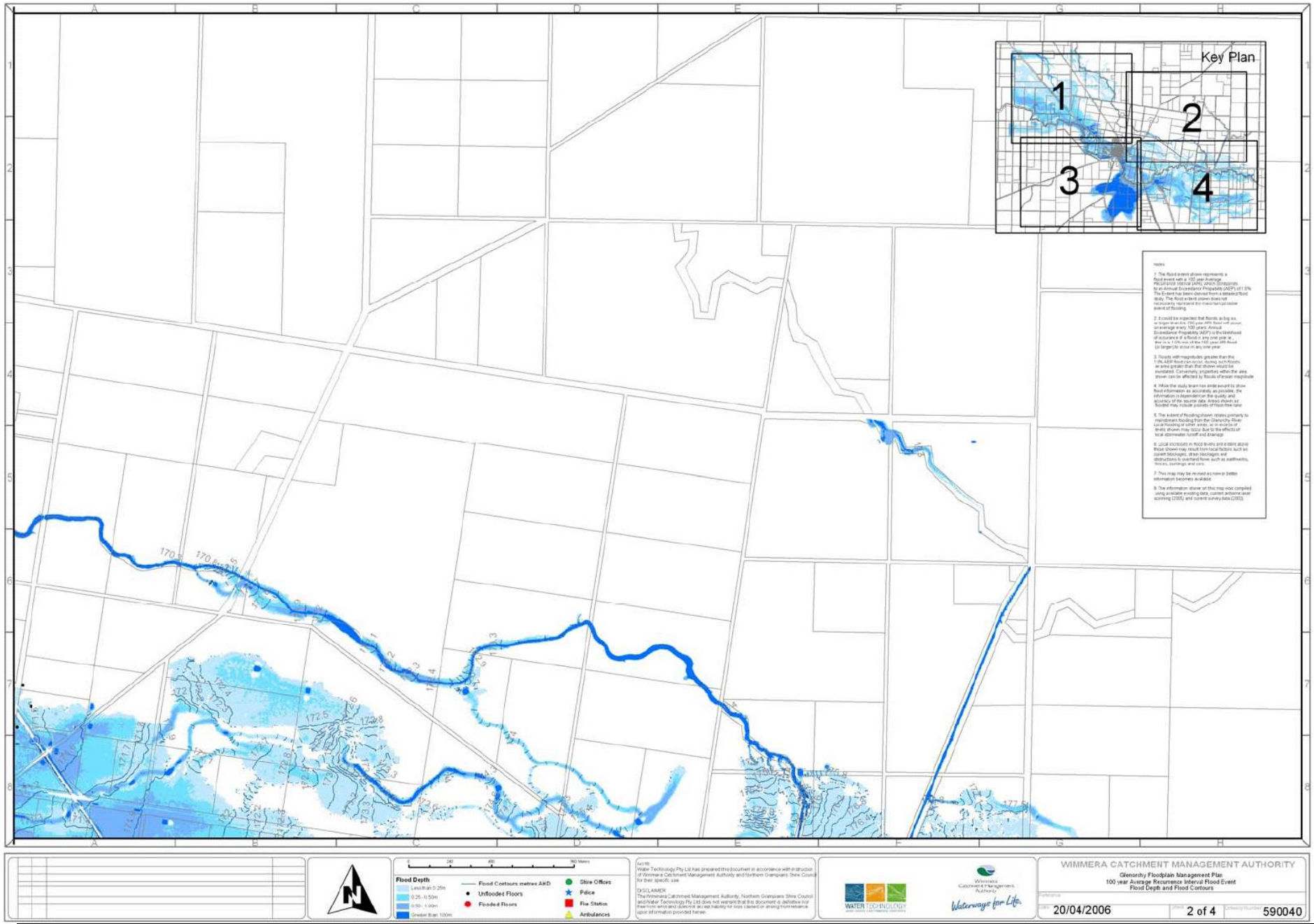

Key Plan
1
2
3
4
Flood Depth
Less than 0.25m
0.25 - 0.50m
0.50 - 1.00m
Greater than 100m
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WATERTECHNOLOGY
Waterways for Life
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
50 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
2 of 4
590039

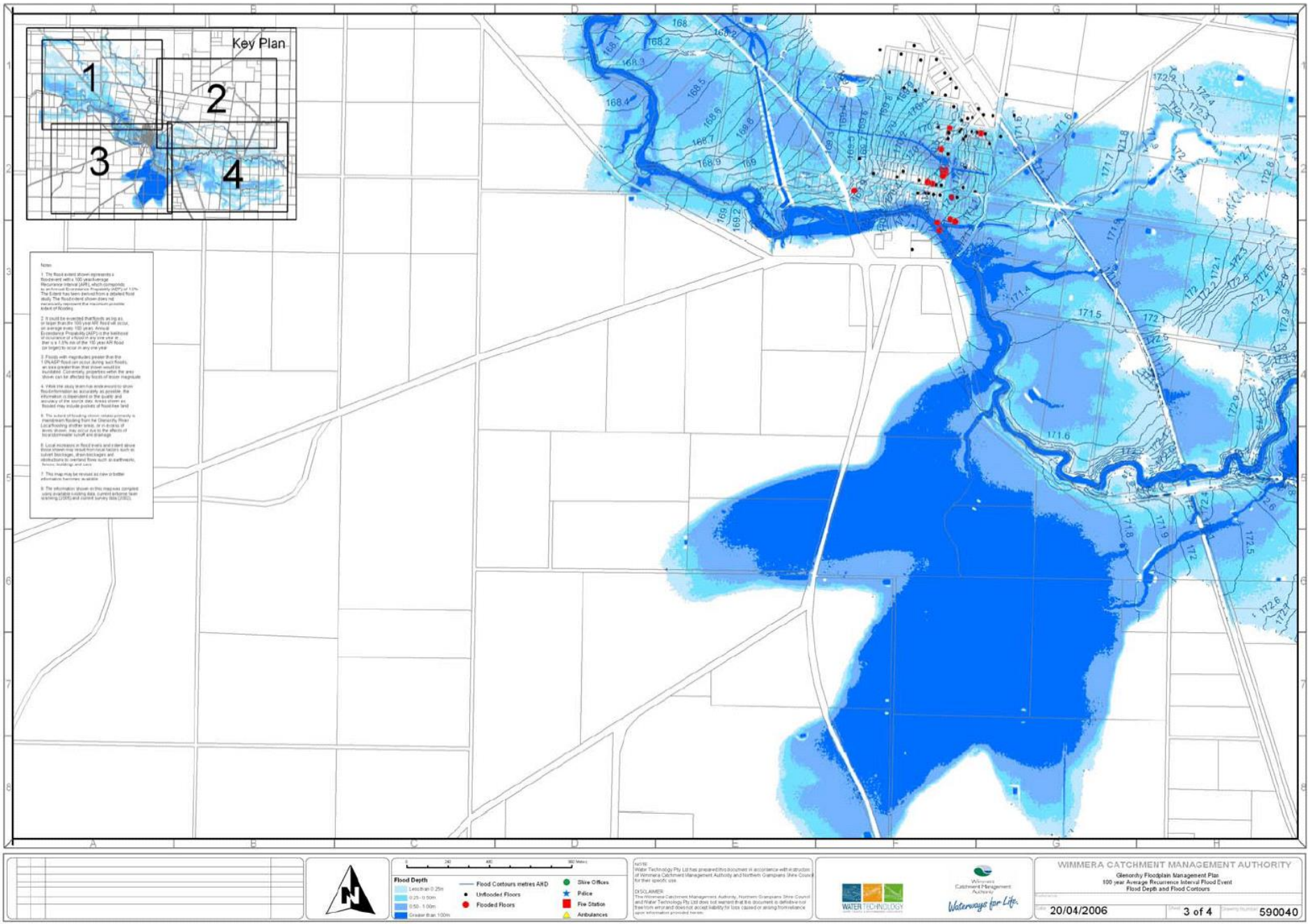

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
50 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
3 of 4
590039

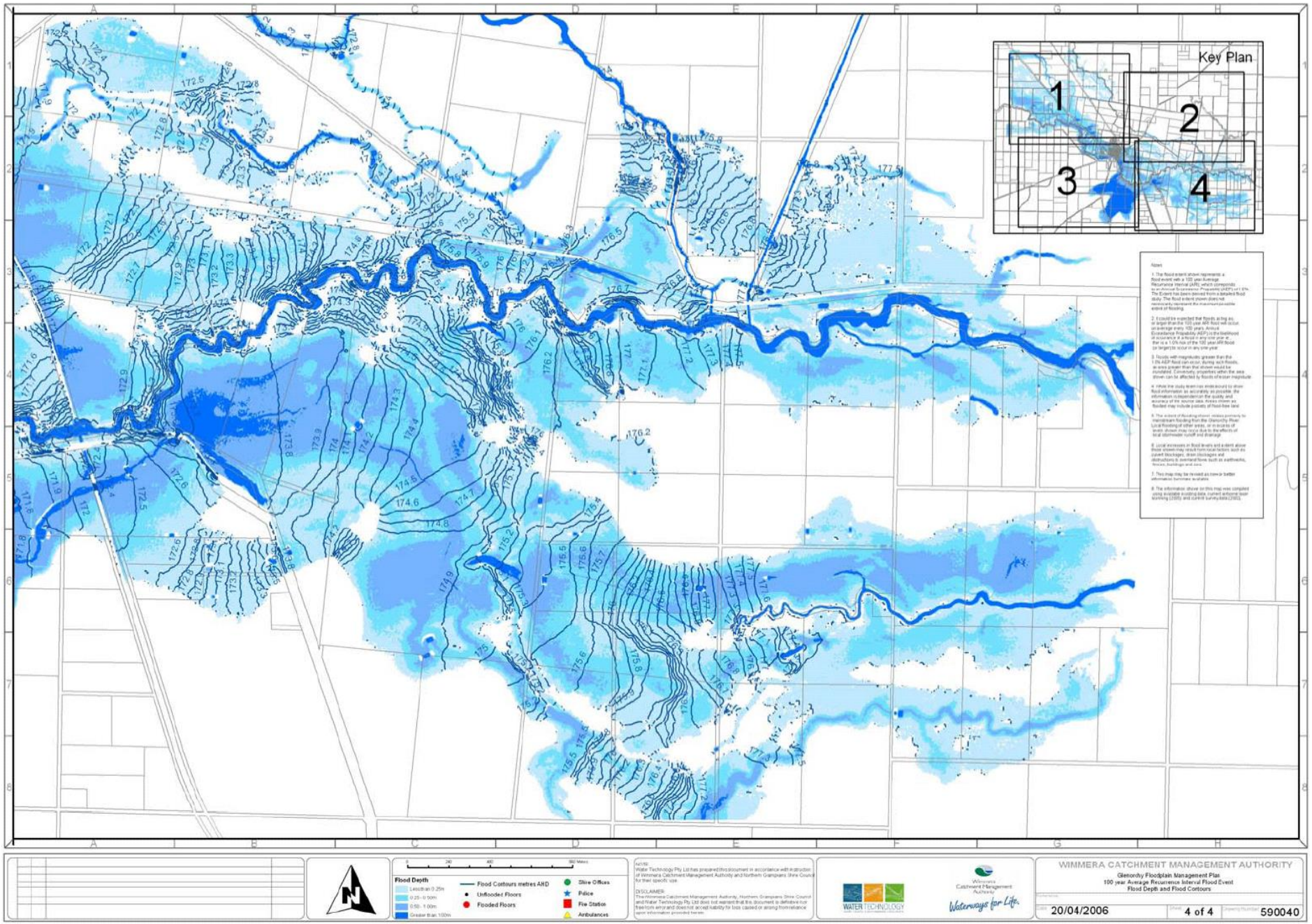

Key Plan
1
2
3
4
Flood Depth
Less than 0.25m
0.25 - 0.50m
0.50 - 1.00m
Greater than 1.00m
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
50 year Average Recurrence Interval Flood Event
Flood Depth & Flood Contours
20/04/2006
4 of 4
590039

Set of 4 x flood extent and depths for the 1% AEP (100 year ARI) event

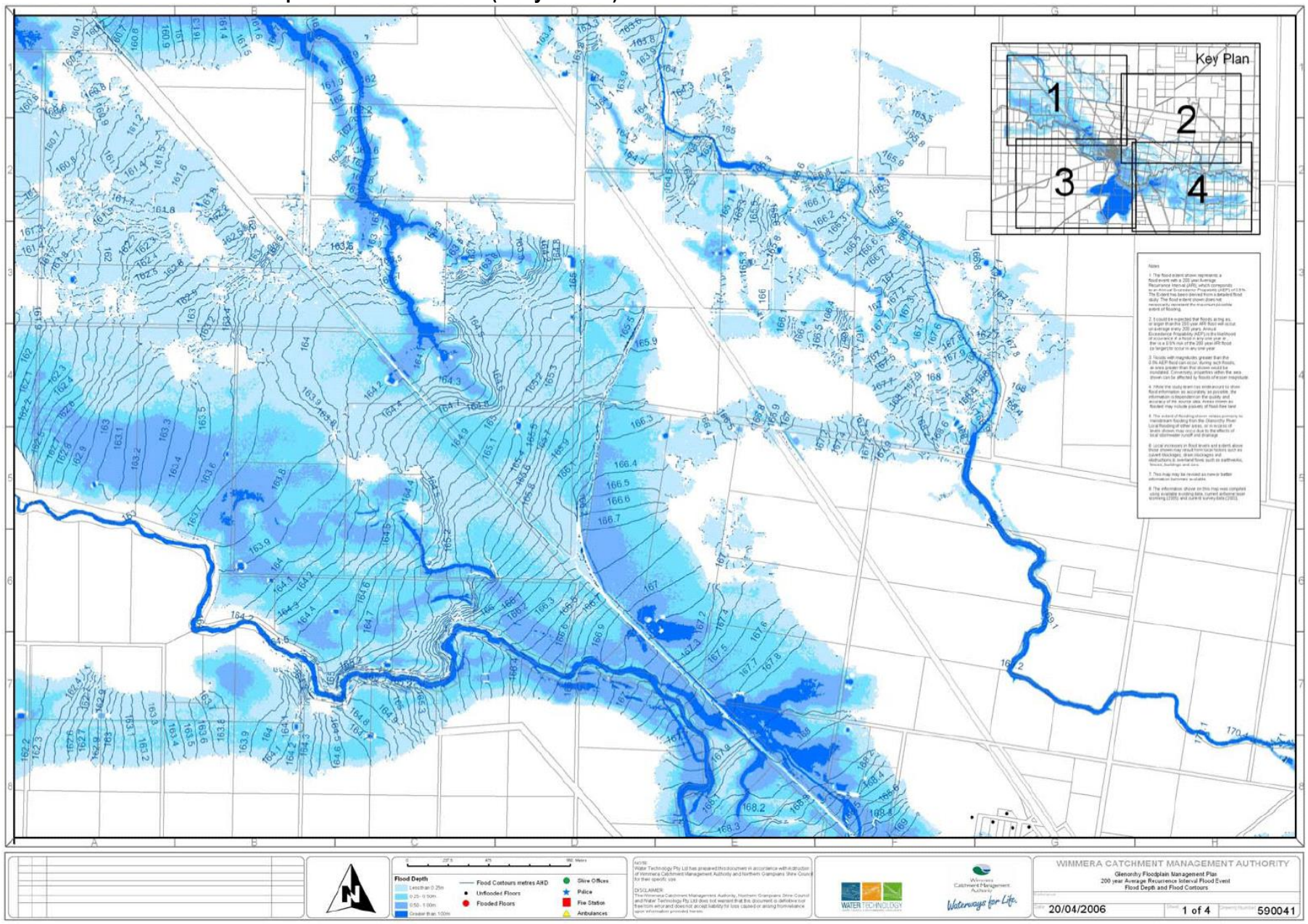


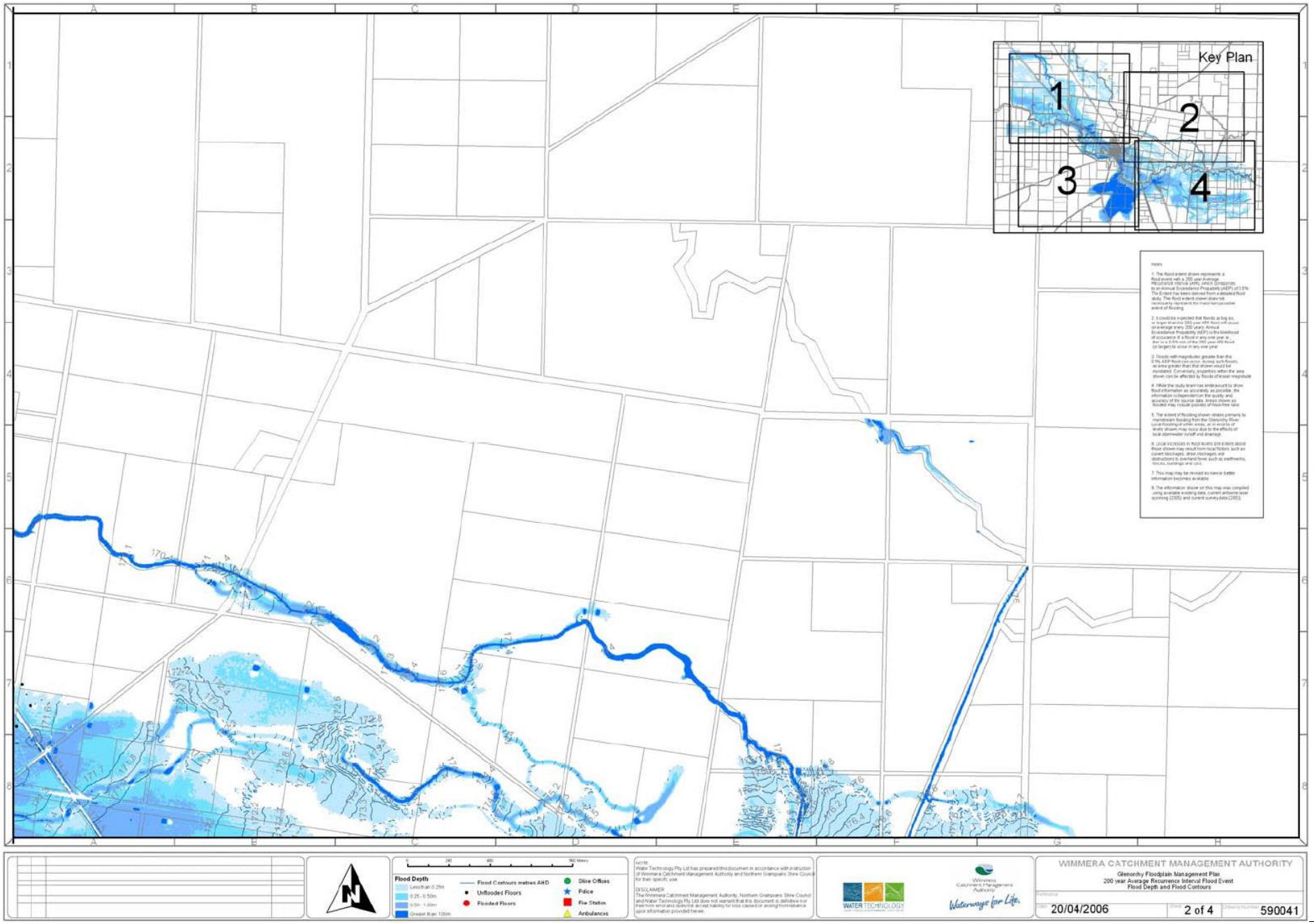

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
100 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
2 of 4
590040

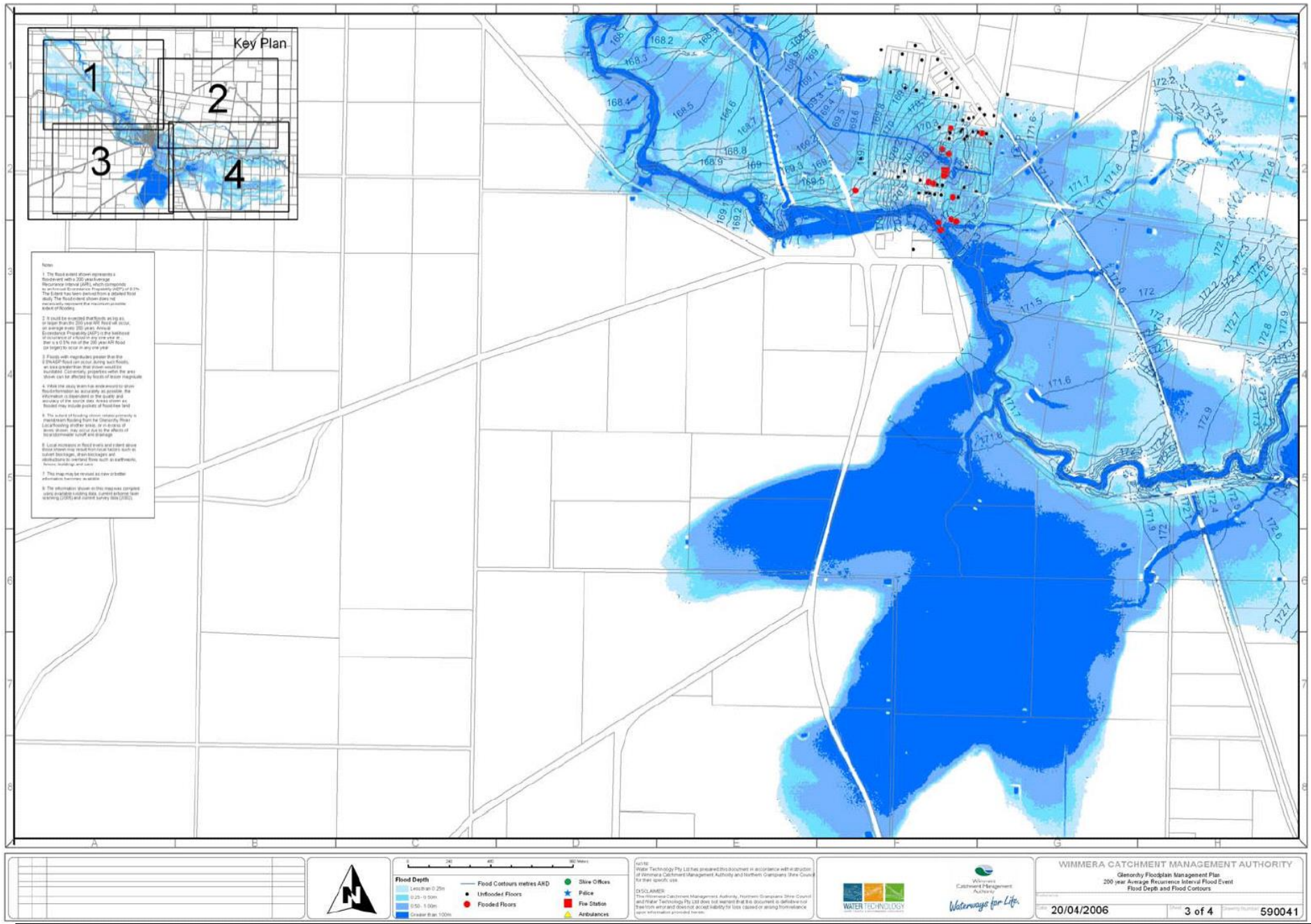

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
100 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
3 of 4
590040

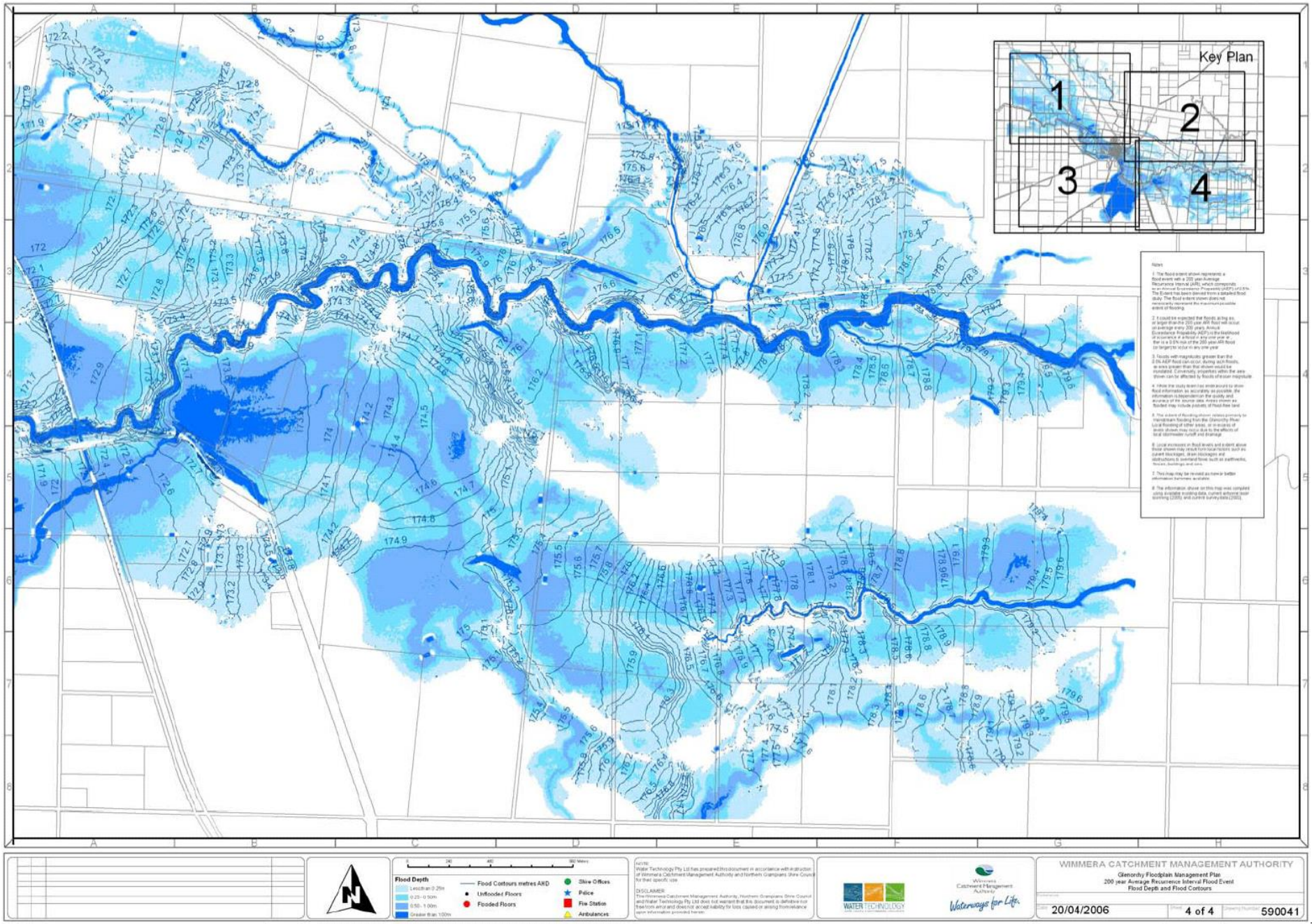

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
100 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
4 of 4
590040

Set of 4 x flood extent and depths for the 0.5% AEP (200 year ARI) event

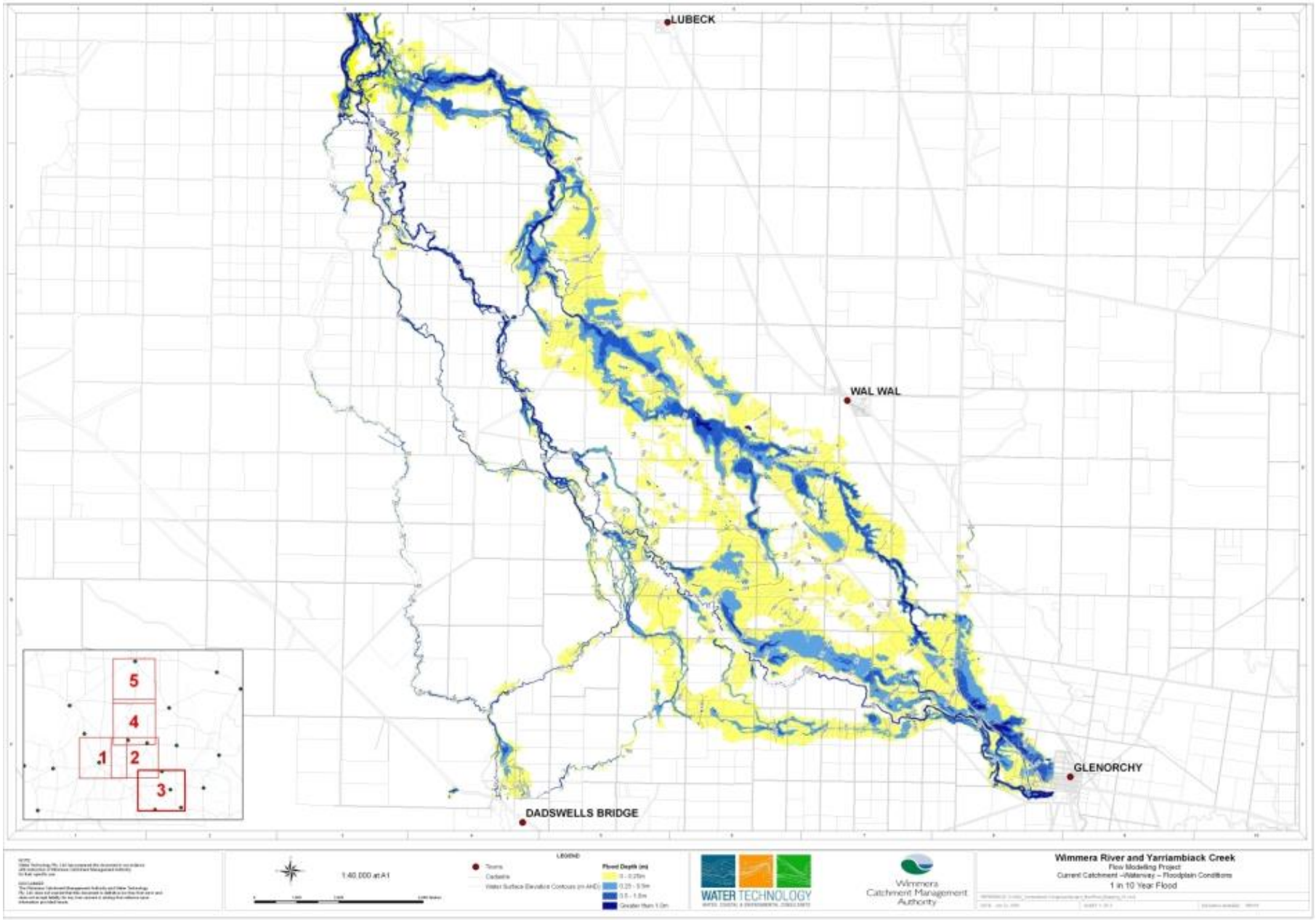



Key Plan
1
2
3
4
Flood Depth
Less than 0.25m
0.25 - 0.50m
0.50 - 1.00m
Greater than 1.00m
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
200 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
2 of 4
590041

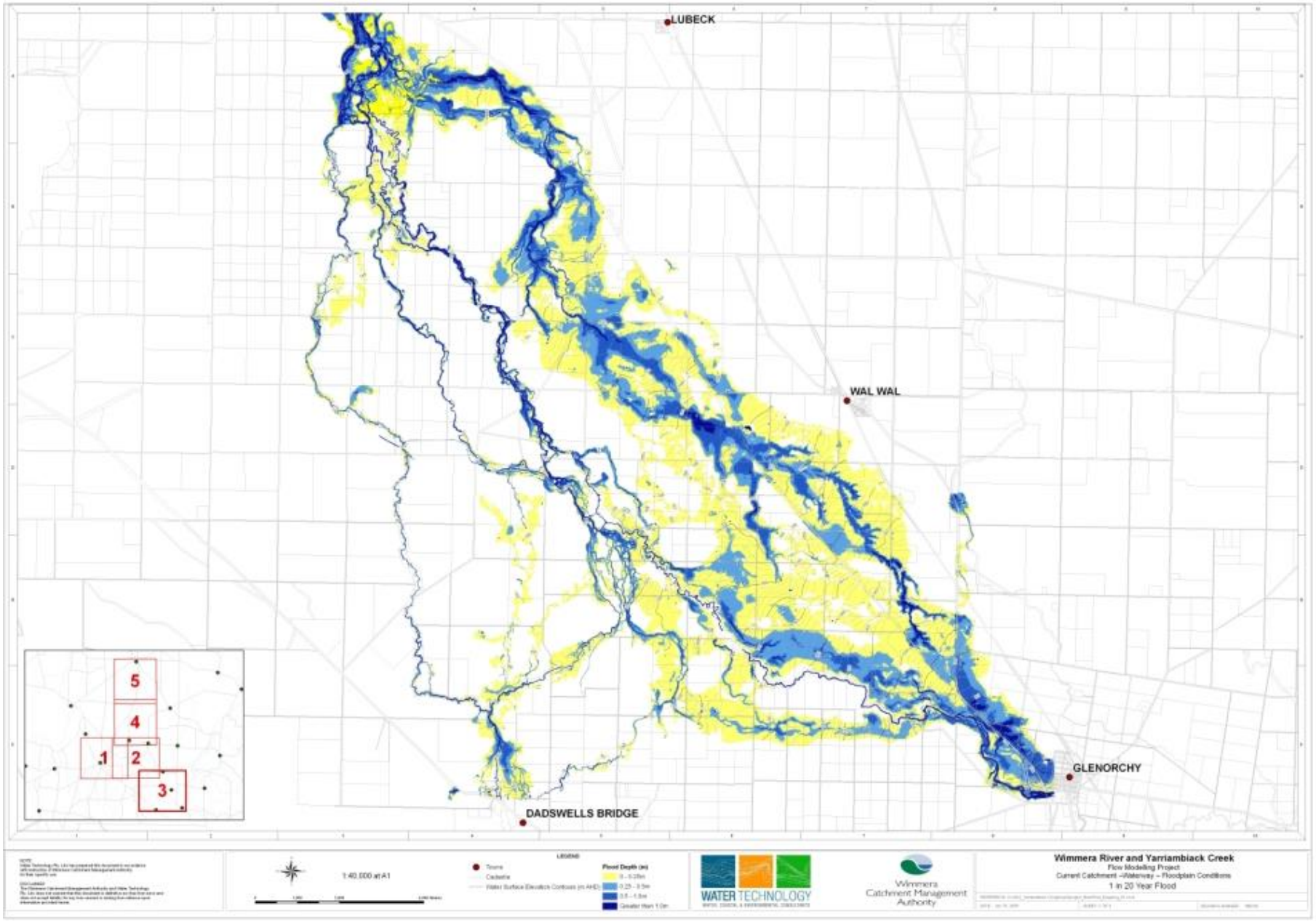

Key Plan
1
2
3
4
Flood Depth
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
200 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
3 of 4
590041


Key Plan
1
2
3
4
Flood Depth
Less than 0.25m
0.25 - 0.50m
0.50 - 1.00m
Greater than 1.00m
Flood Contours metres AHD
Unflooded Floors
Flooded Floors
Shire Offices
Police
Fire Station
Ambulances
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
Glenorchy Floodplain Management Plan
200 year Average Recurrence Interval Flood Event
Flood Depth and Flood Contours
20/04/2006
4 of 4
590041

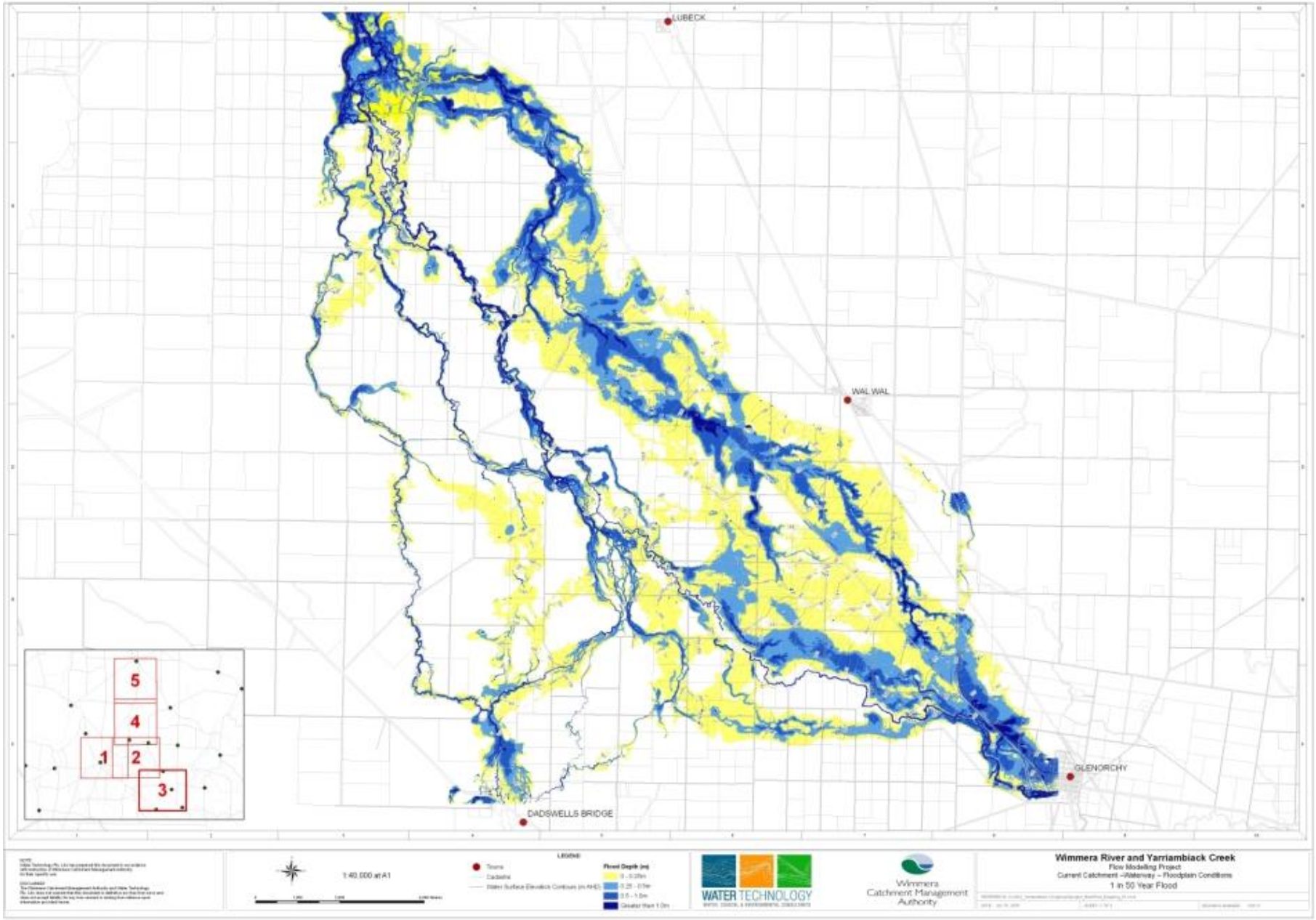
Wimmera River flood extent and depths for the 10% AEP (10 year ARI) event downstream from Glenorchy



Wimmera River flood extent and depths for the 5% AEP (20 year ARI) event downstream from Glenorchy



Wimmera River flood extent and depths for the 2% AEP (50 year ARI) event downstream from Glenorchy



APPENDIX F2 – MAPS for HALLS GAP

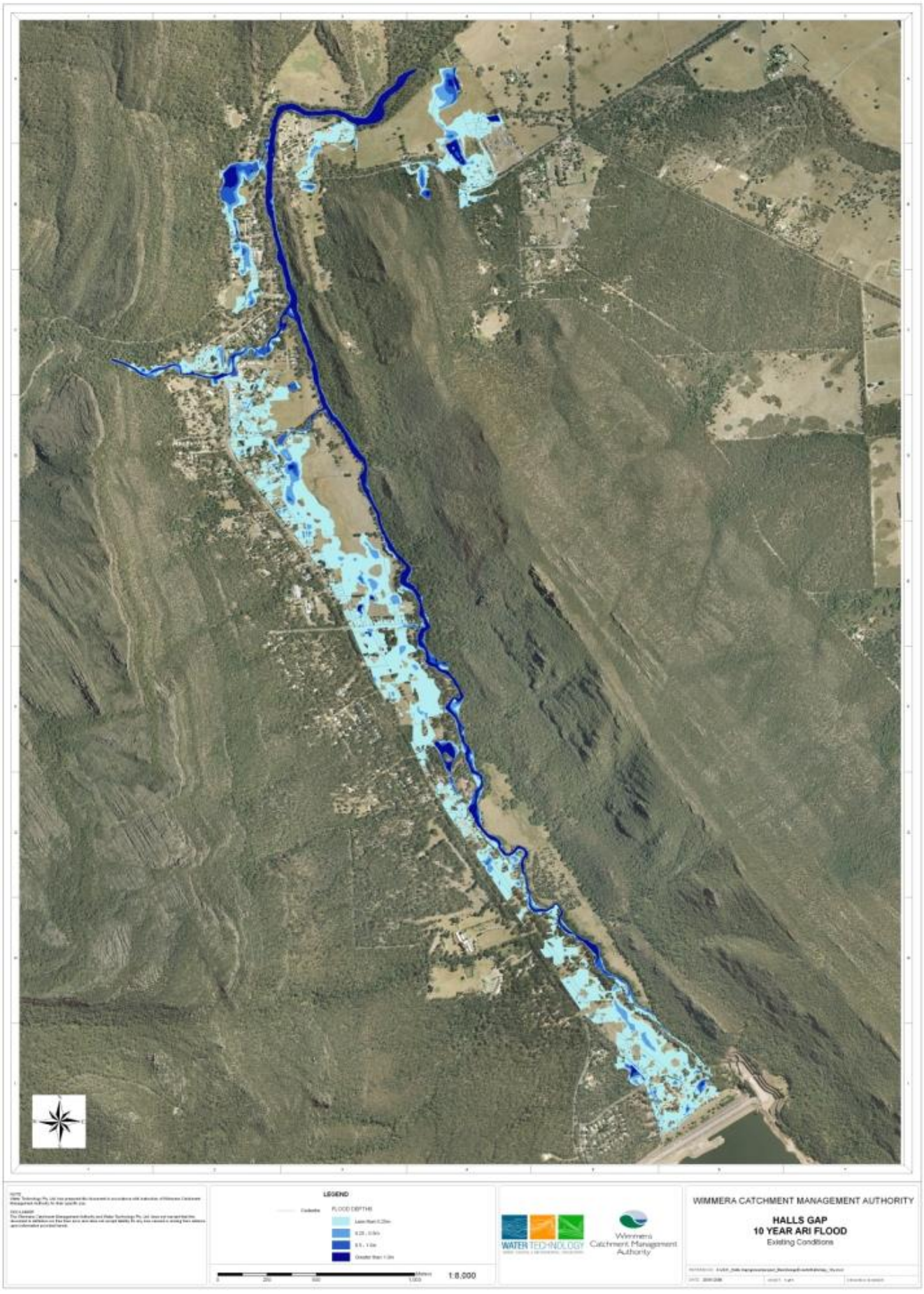
1 Overview

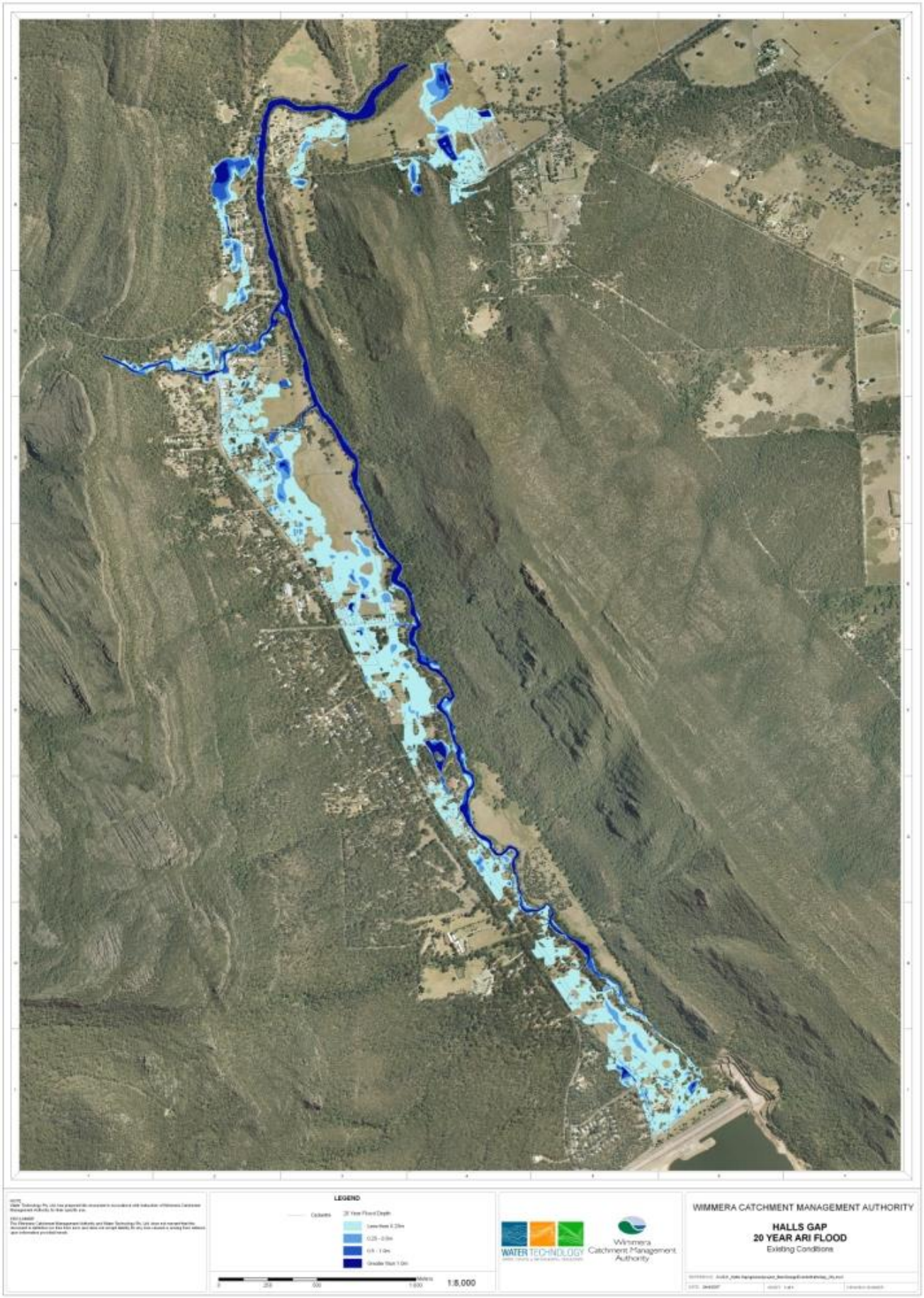
The flood inundation maps prepared as a part of the Halls Gap Flood Study (Water Technology, 2008) are included in this Appendix. They comprise:

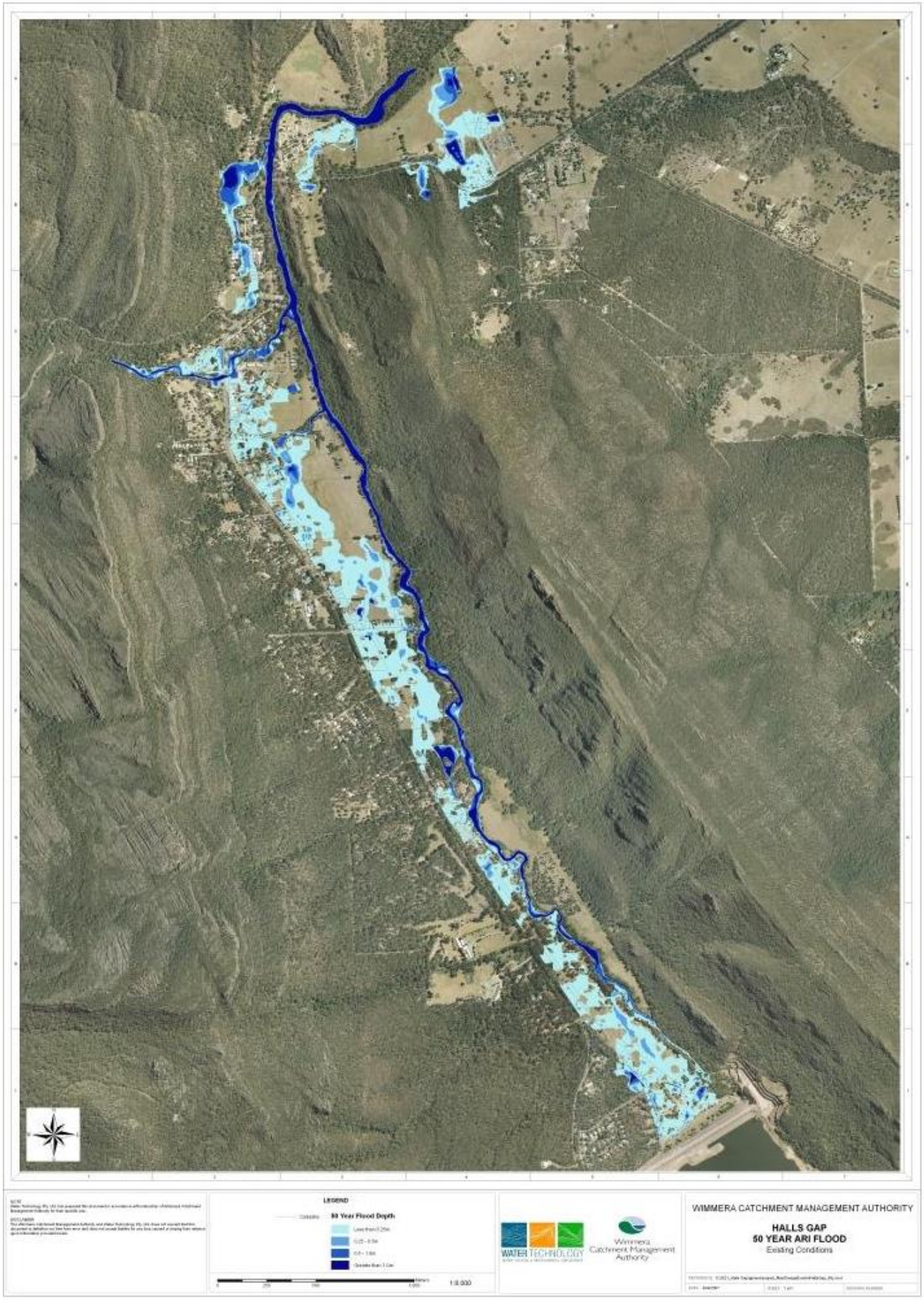
- A set of maps showing flood extents and depths for the design flood events considered (i.e. 10, 20, 50, and 100 year ARI) by Water Technology when delivering the Halls Gap Study (Water Technology, 2008). Note that the 200-year ARI flood inundation map has not been included in this document but is available from NGSC and / or the Wimmera CMA.

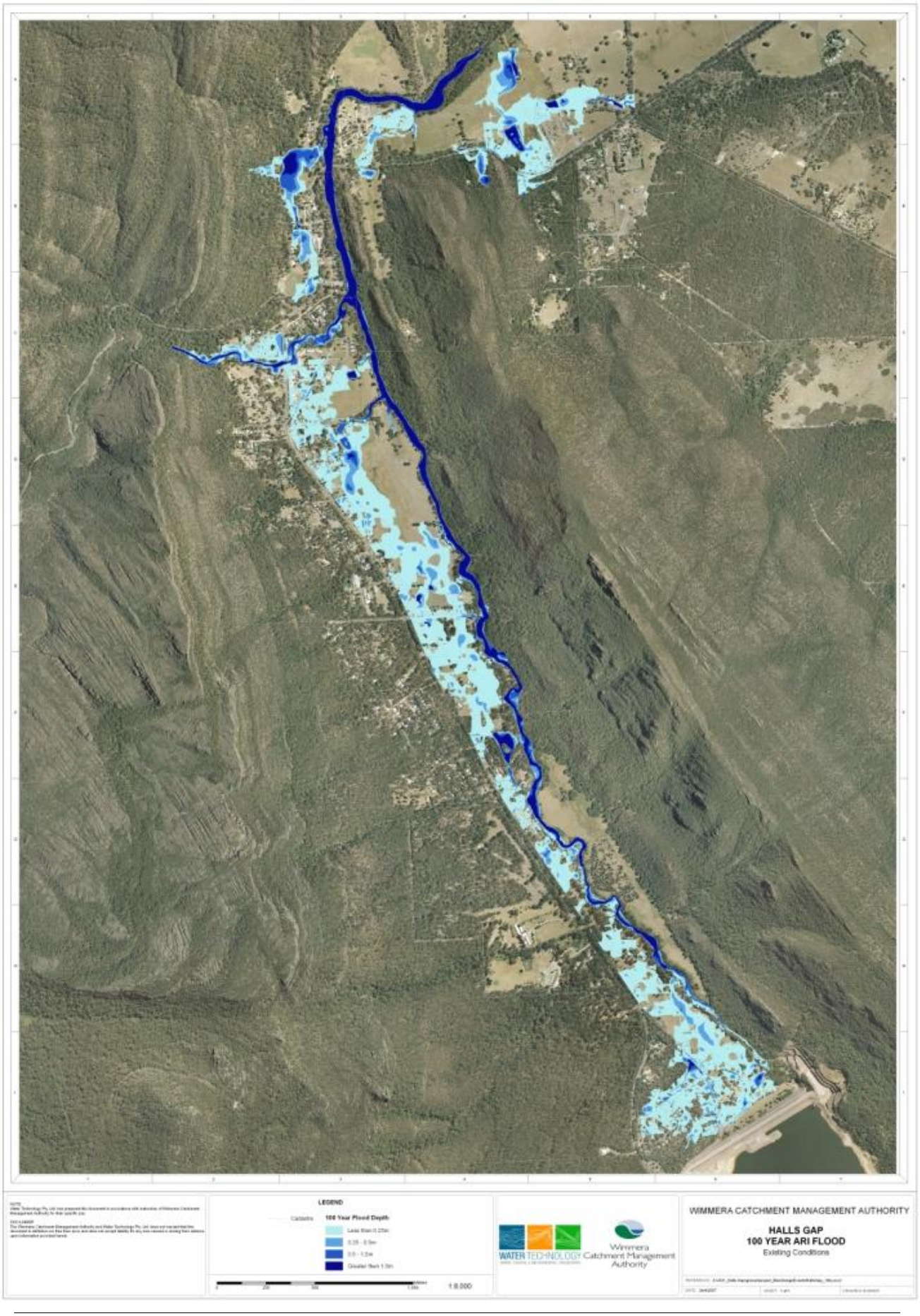
Note that:

- These maps are available in hard copy form from NGSC and / or Wimmera CMA.
- Maps showing 100-year ARI (1% AEP) flood extent and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website (see the list of references in Appendix G).


LEGEND
FLOOD DEPTHS
1:8,000
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
HALLS GAP
10 YEAR ARI FLOOD
Existing Conditions


LEGEND
1:8,000
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
HALLS GAP
20 YEAR ARI FLOOD
Existing Conditions


LEGEND
50 Year Flood Depth
WATER TECHNOLOGY
Wimmera Catchment Management Authority
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
HALLS GAP
50 YEAR ARI FLOOD
Existing Conditions


LEGEND
100 Year Flood Depth
1:8,000
WATER TECHNOLOGY
Wimmera Catchment Management Authority
WIMMERA CATCHMENT MANAGEMENT AUTHORITY
HALLS GAP
100 YEAR ARI FLOOD
Existing Conditions

APPENDIX F3 – MAPS for UPPER WIMMERA CATCHMENT

1 Overview

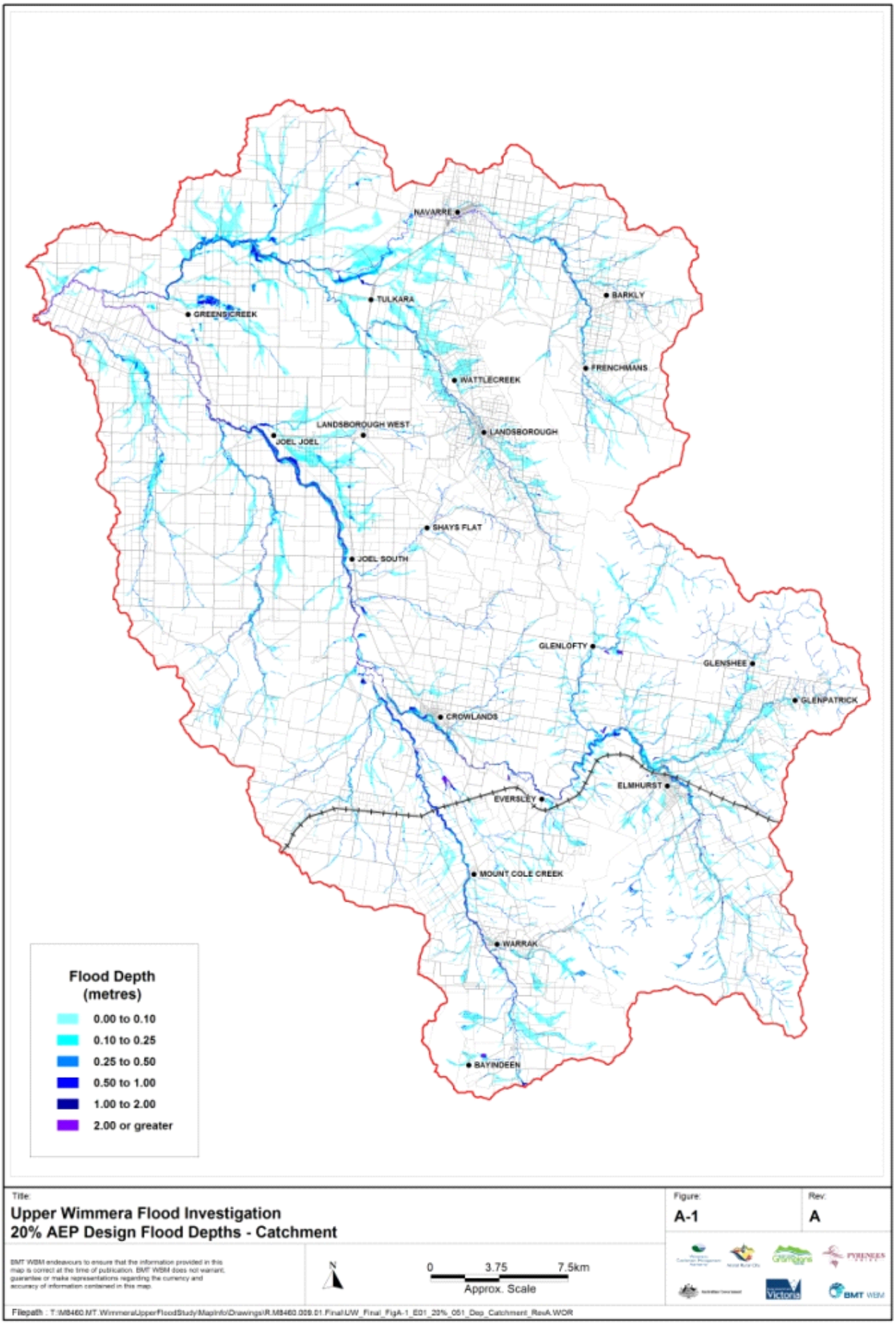
Maps considered useful to flood response through the Upper Wimmera catchment are included in this Appendix. They comprise:

- A set of maps showing flood extents and depths for the design flood events considered by BMT WBM (i.e. the 5, 10, 20, 50, 100, 200-year ARI and PMF events) when delivering the Upper Wimmera Catchment Flood Investigation (WBM, 2014).
- 1% AEP flood extent and depth maps for Navarre, Landsborough and Elmhurst (WBM, 2014);
- A map showing the approximate extent and depth of the September 2010 event at Navarre and Landsborough (WBM, 2014);
- Two maps showing the approximate extent and depth of the January 2011 event at Navarre (WBM, 2014);
- The 1% AEP flood hazard map (based on consideration of depth and velocity – see note below) for the Upper Wimmera catchment (WBM, 2014).

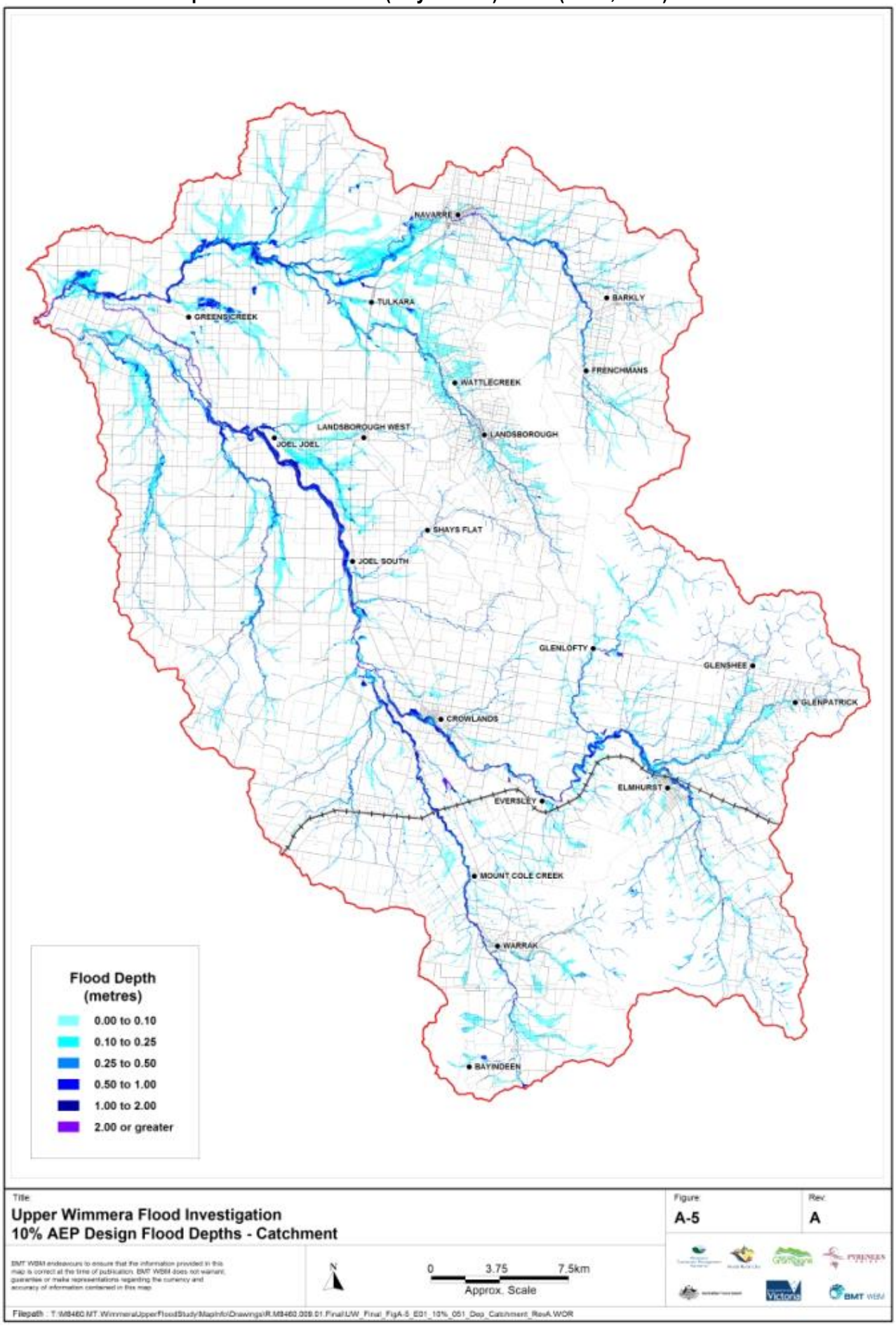
Note that:

- These maps are available in hard copy form from NGSC and / or Wimmera CMA.
- Maps showing 100-year ARI (1% AEP) flood extent and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website (see the list of references in Appendix G).
- Flood hazard categorised have been defined for this study as:
  - Low hazard – depth less than 400mm and / or velocity x depth less than 0.4m^2/s;
  - Moderate hazard – depth less than 800mm and / or velocity x depth less than 0.8m^2/s;
  - High hazard – depth greater than 800mm and / or velocity x depth greater than 0.8m^2/s;

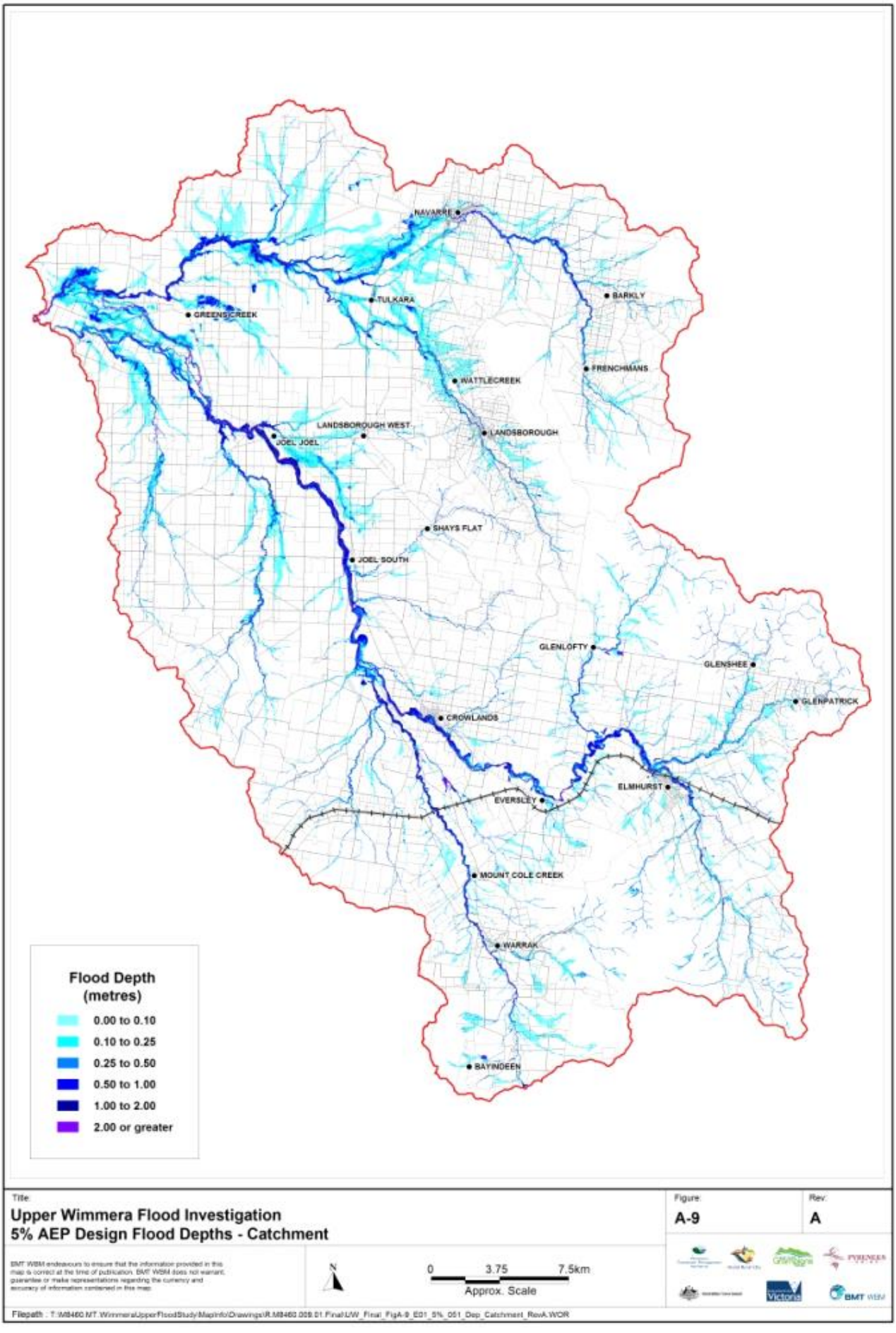
Flood extent and depths for the 20% AEP (5 year ARI) event (WBM, 2014)



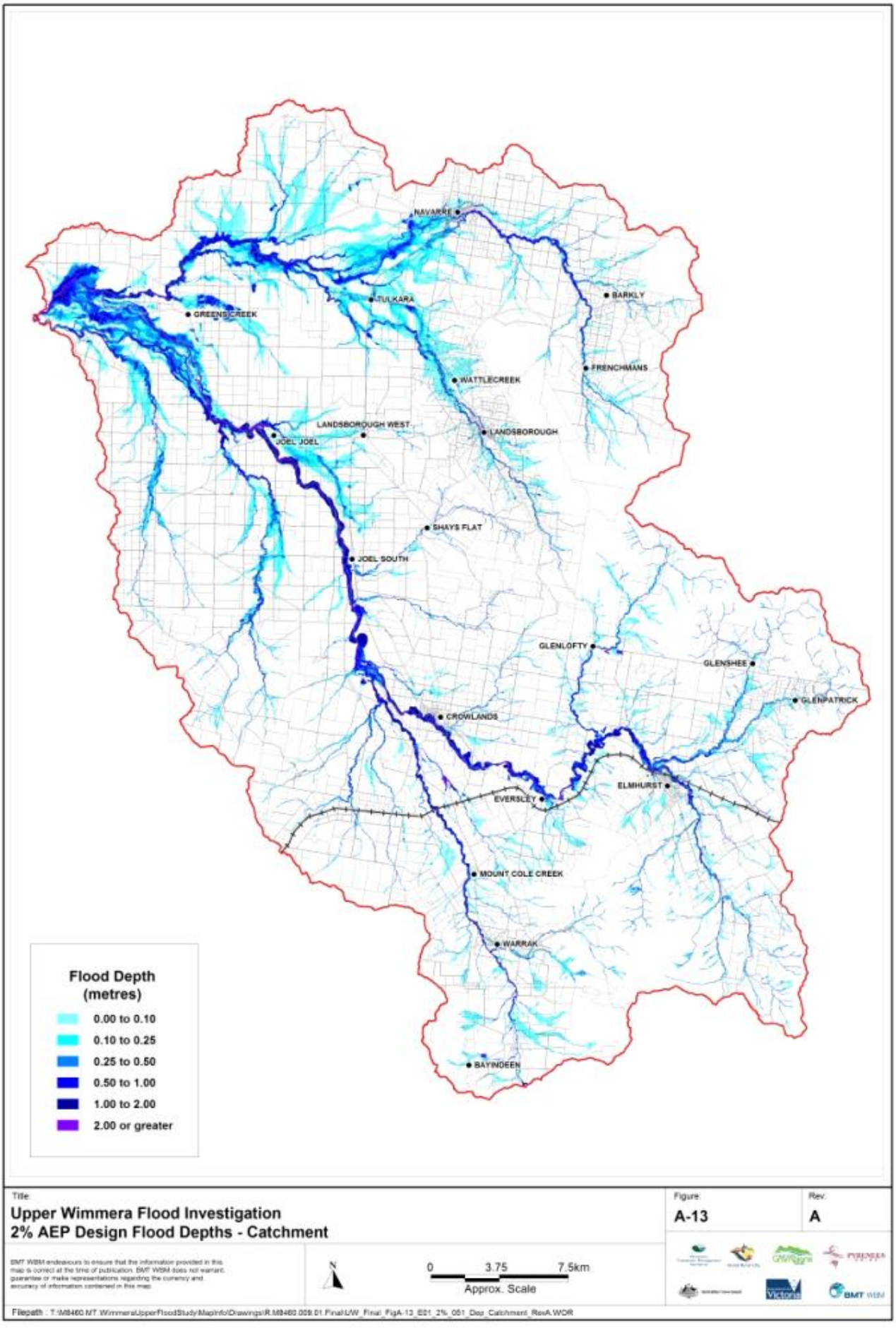
Flood extent and depths for the 10% AEP (10 year ARI) event (WBM, 2014)



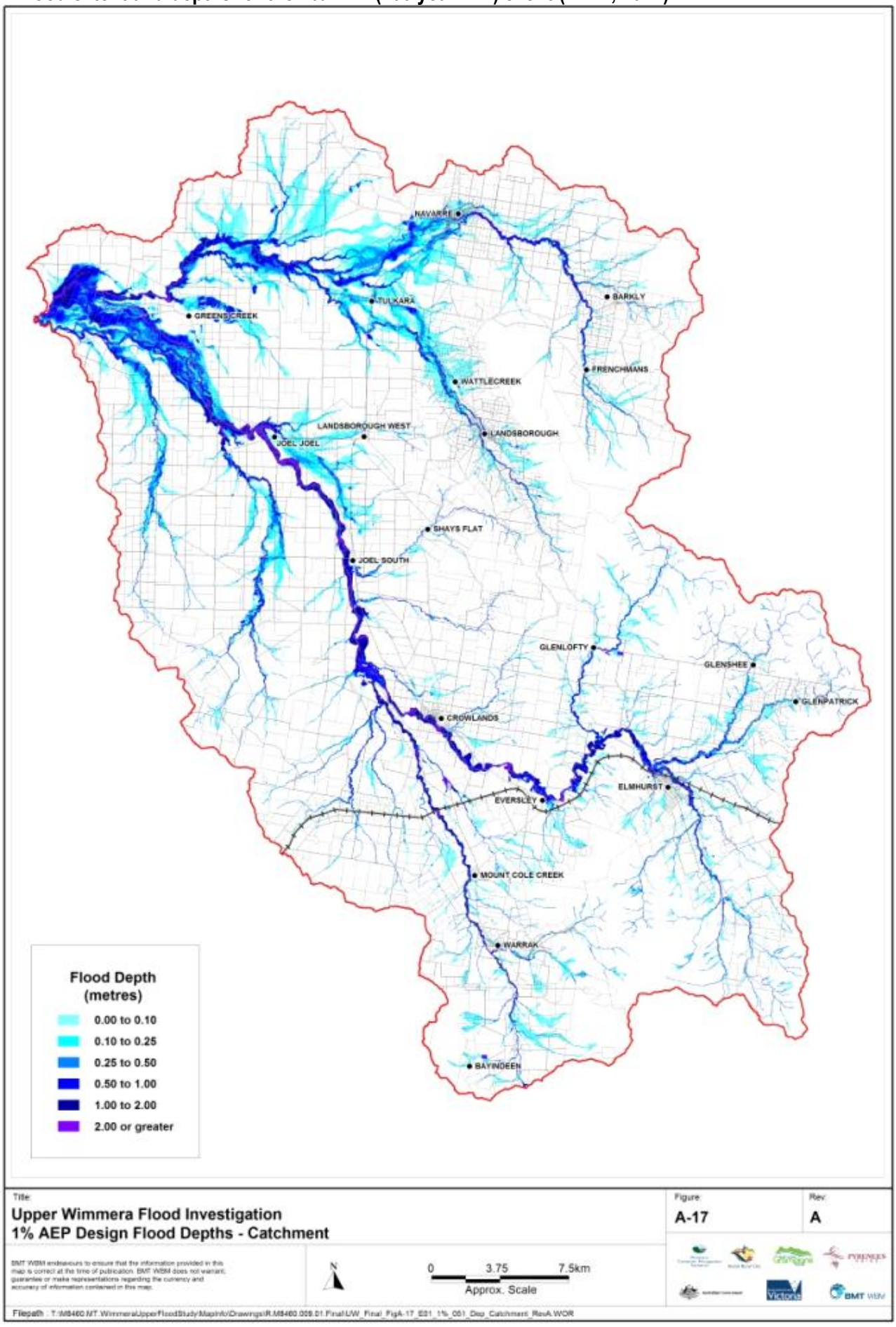
Flood extent and depths for the 5% AEP (20 year ARI) event (WBM, 2014)



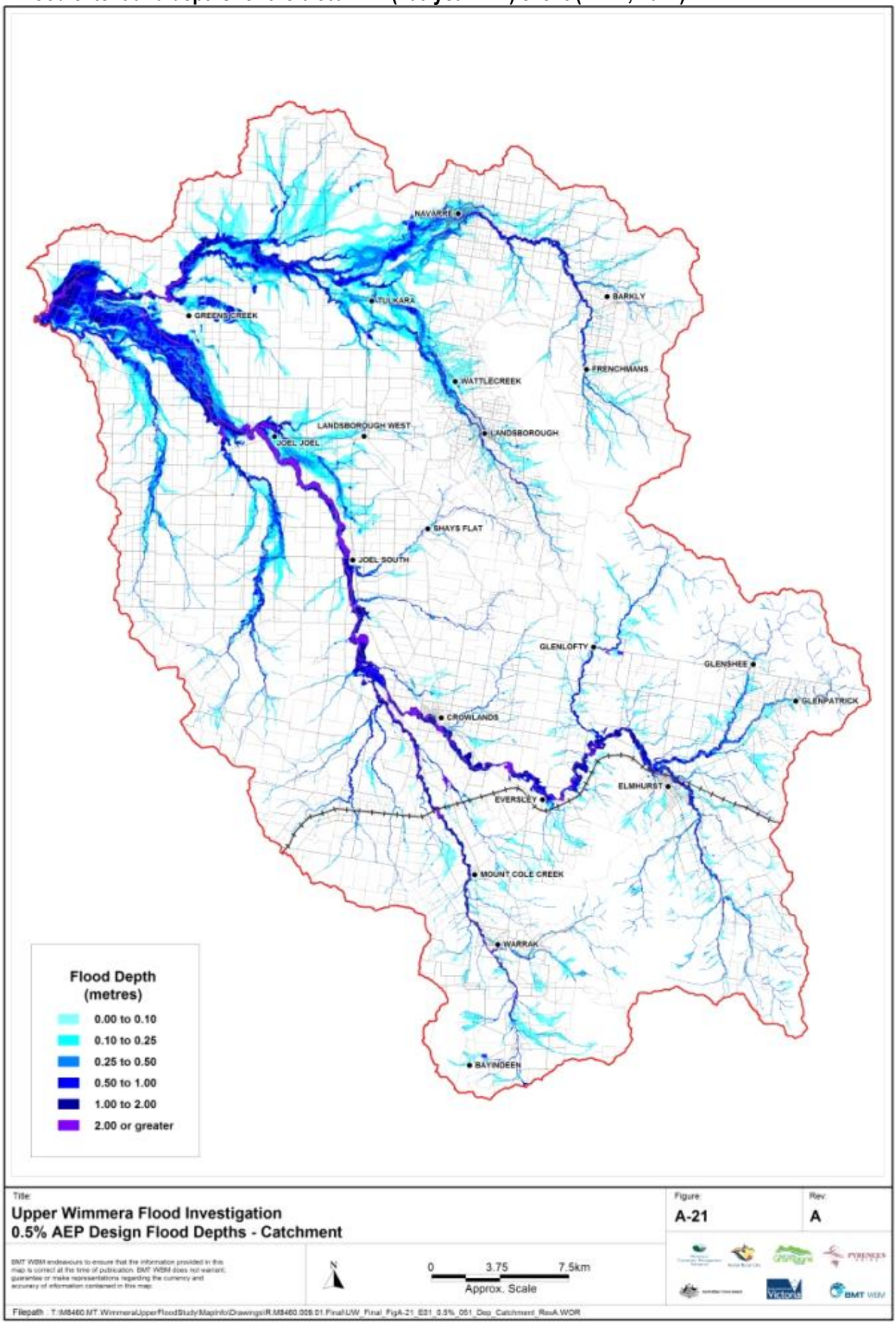
Flood extent and depths for the 2% AEP (50 year ARI) event (WBM, 2014)



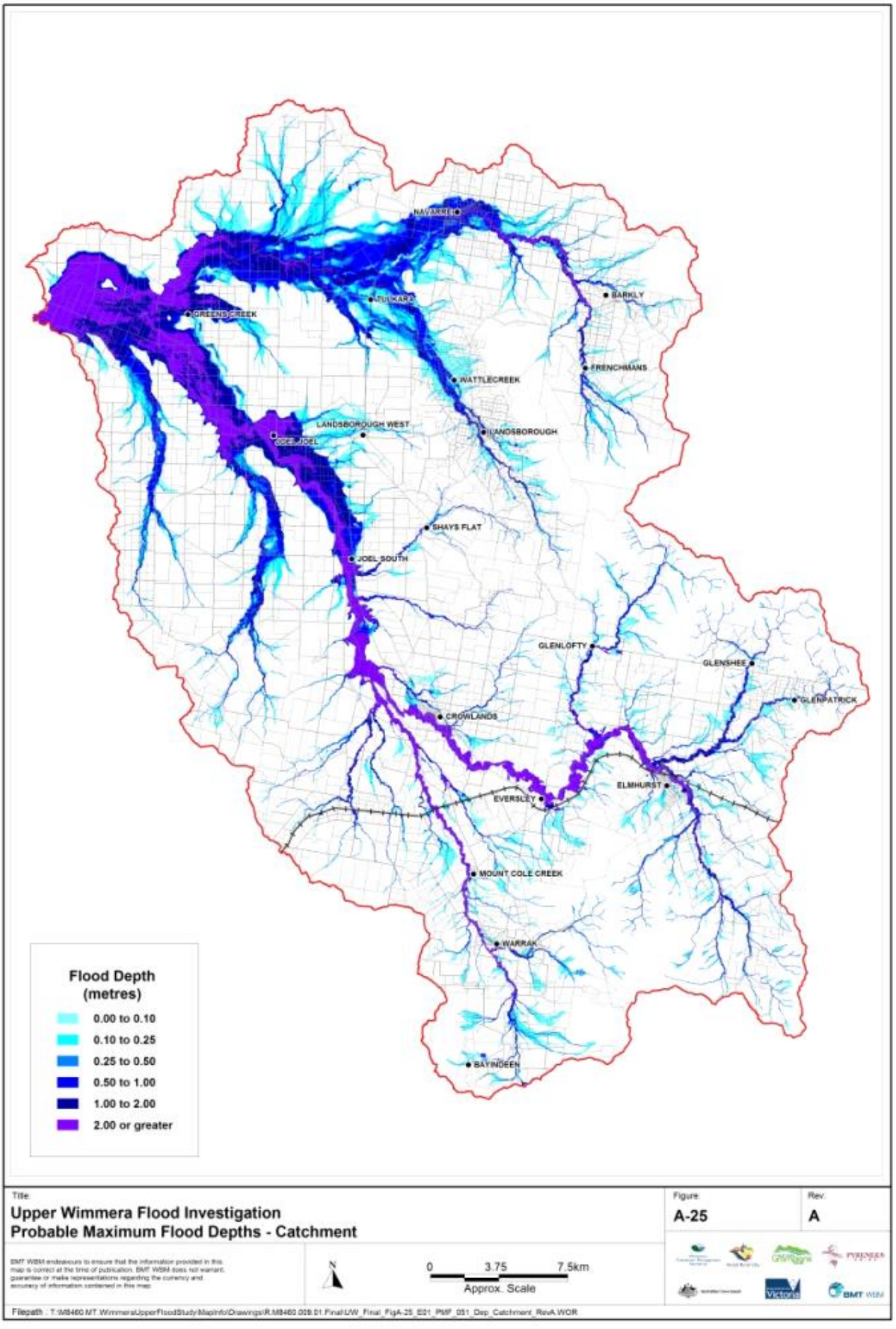
Flood extent and depths for the 1% AEP (100 year ARI) event (WBM, 2014)



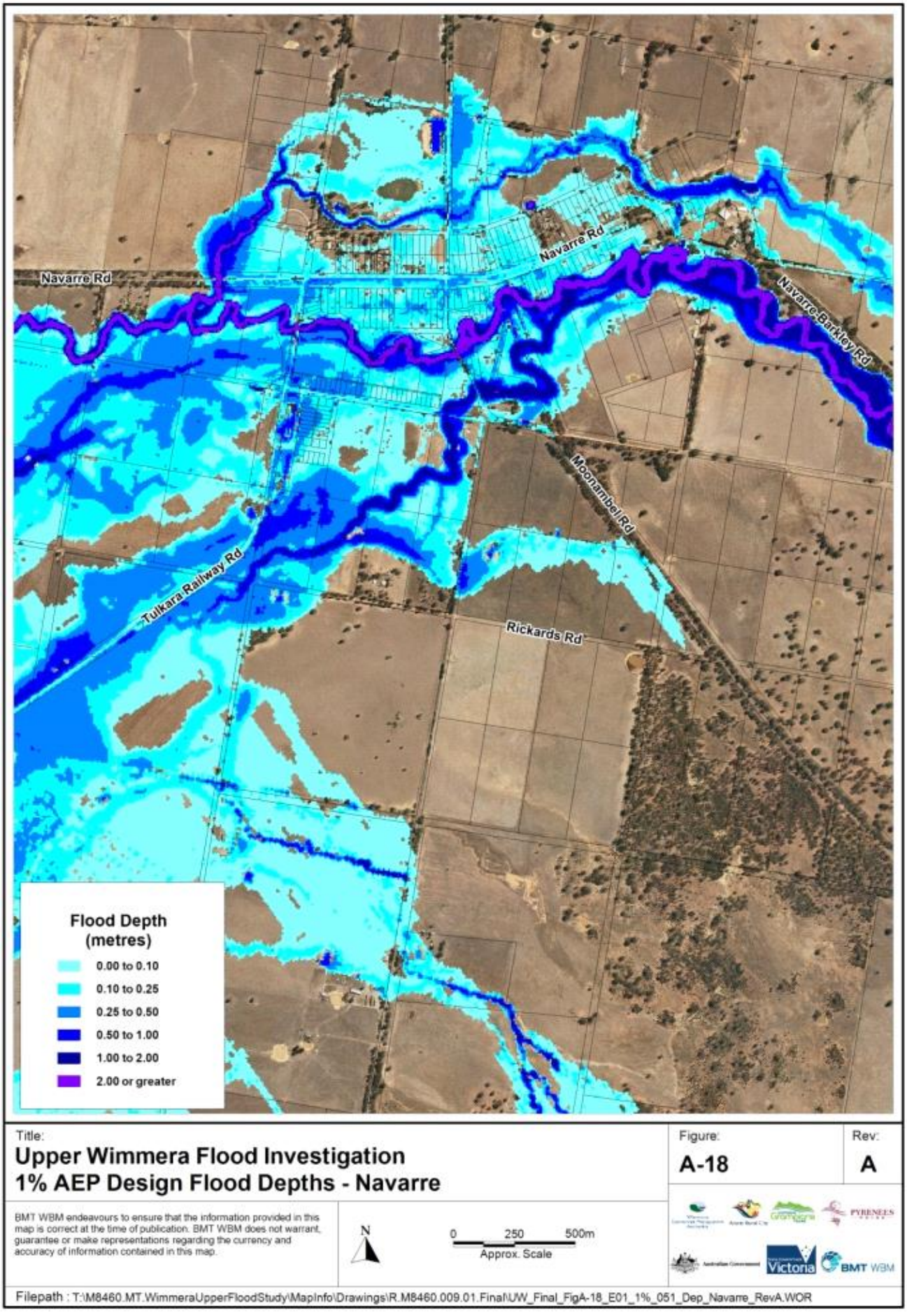
Flood extent and depths for the 0.5% AEP (200 year ARI) event (WBM, 2014)



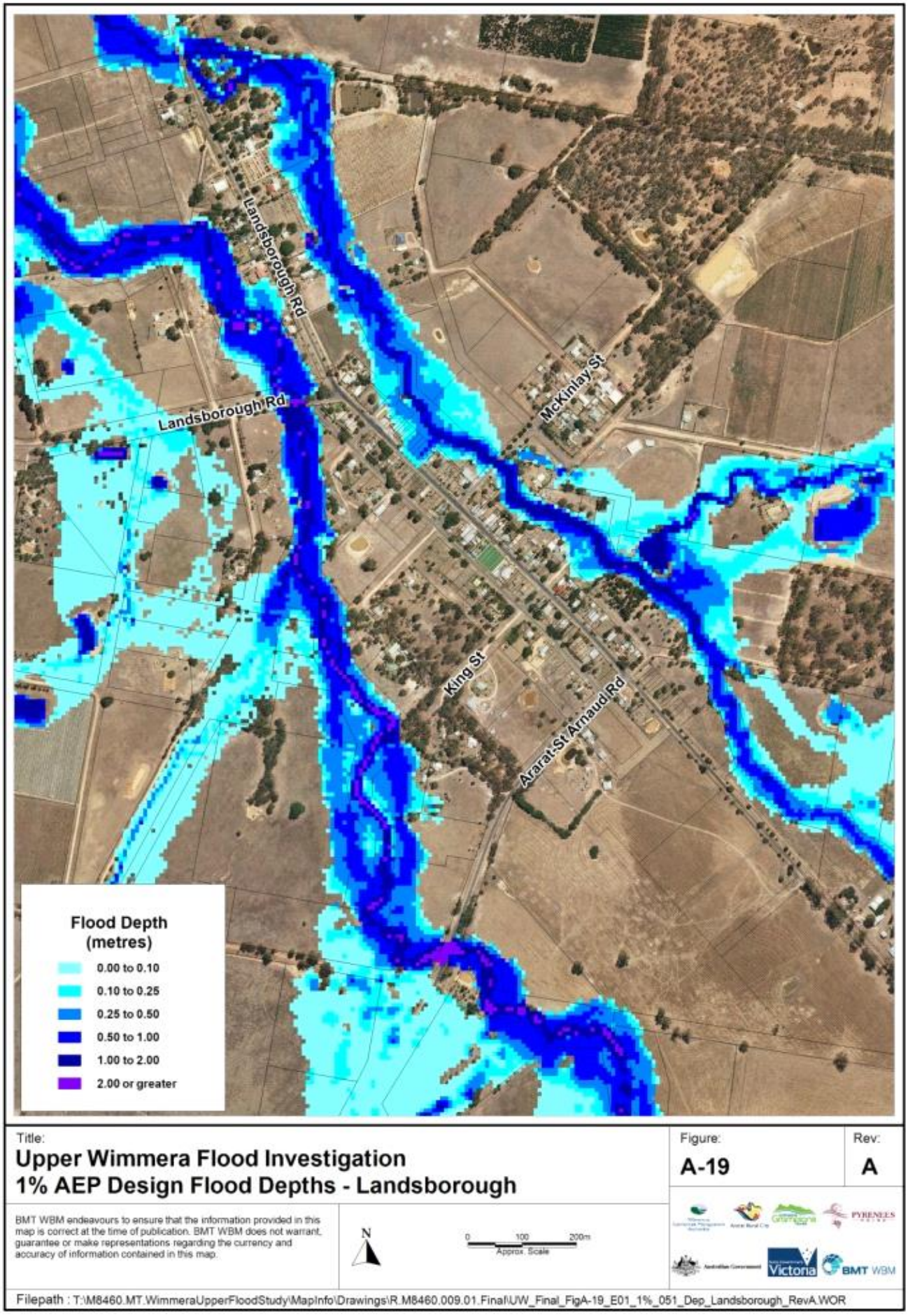
Flood extent and depths for the PMF event (WBM, 2014)



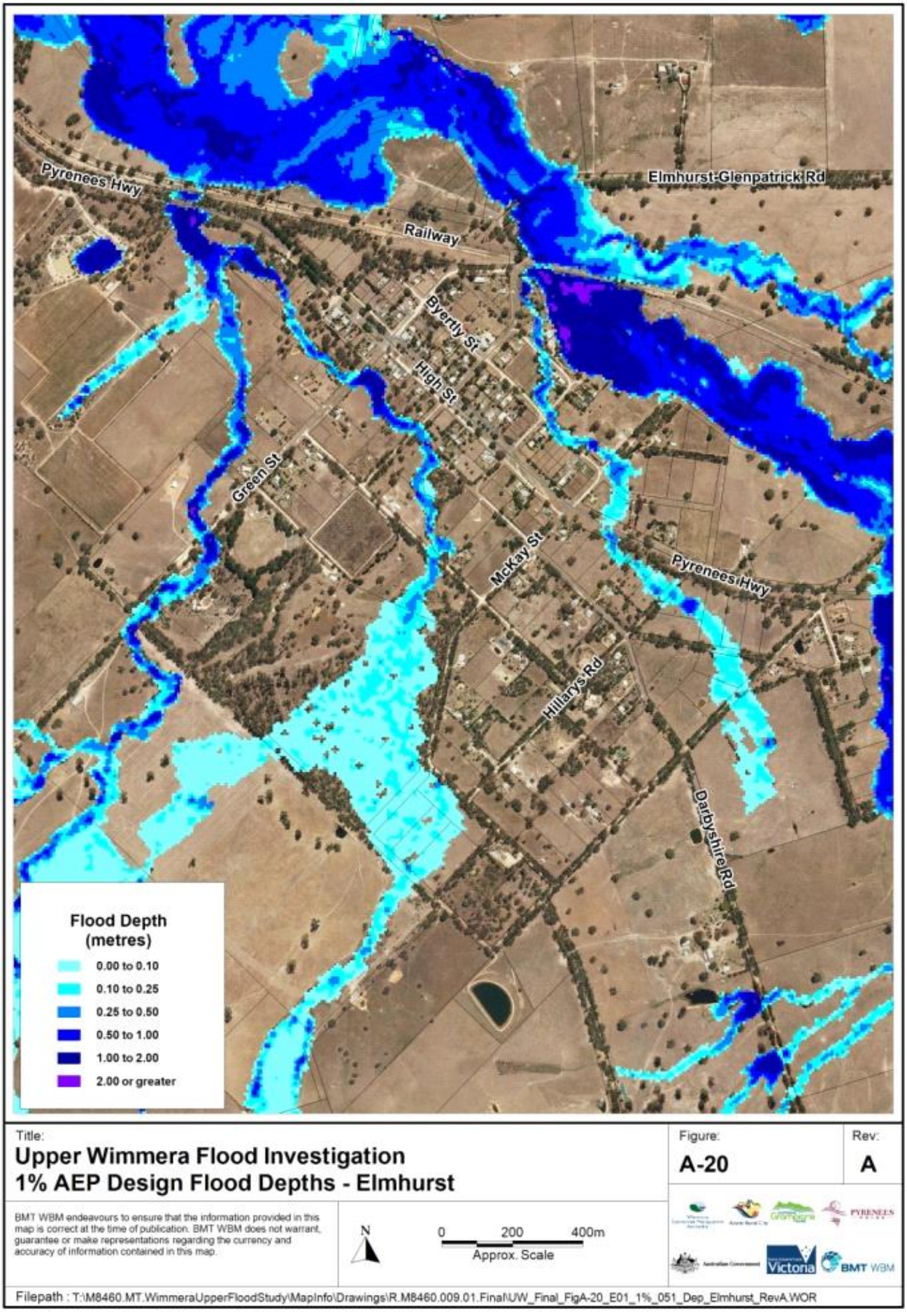
1% AEP flood depths and extents at Navarra (WBM, 2014)



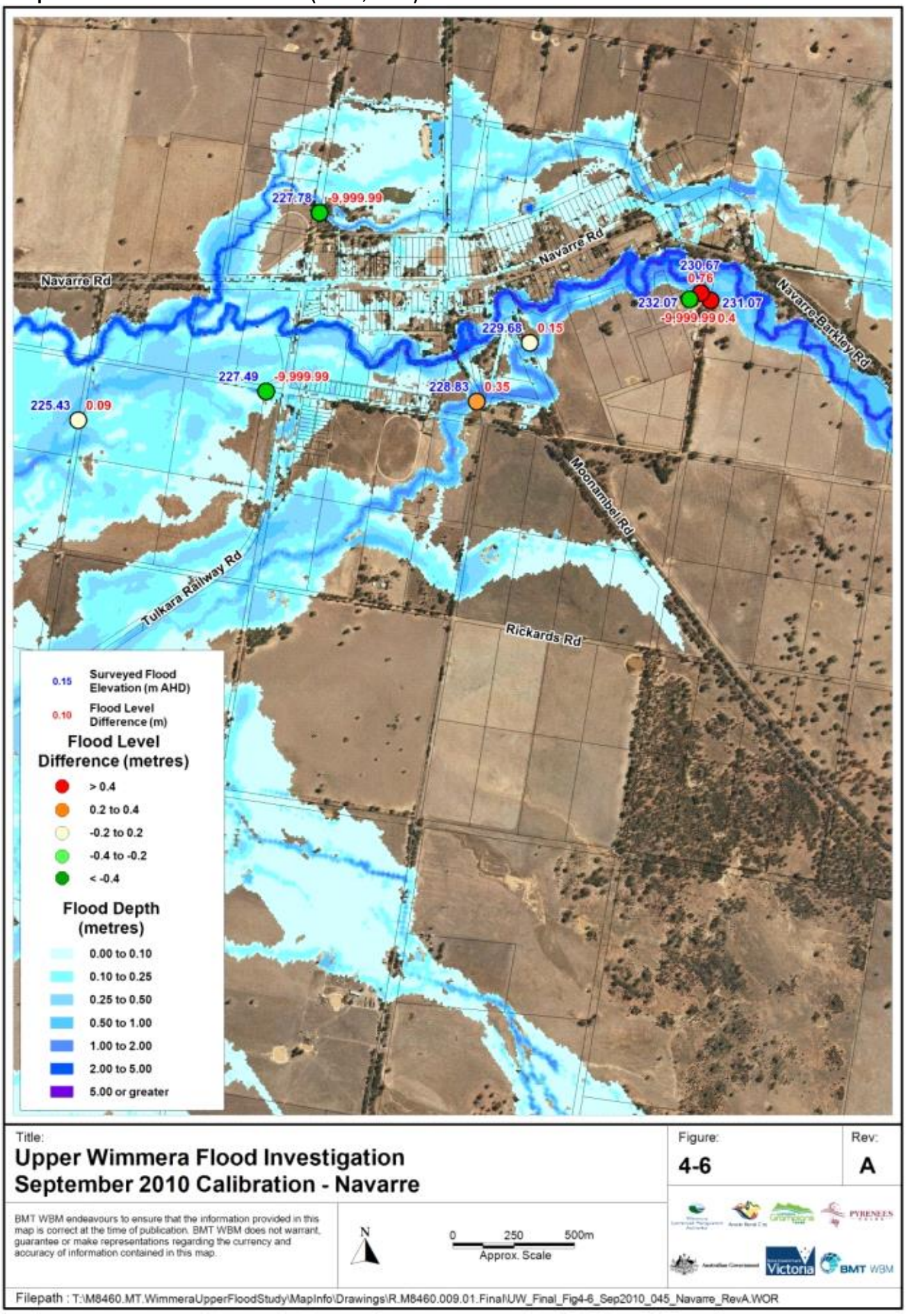
1% AEP flood depths and extents at Landsborough (WBM, 2014)



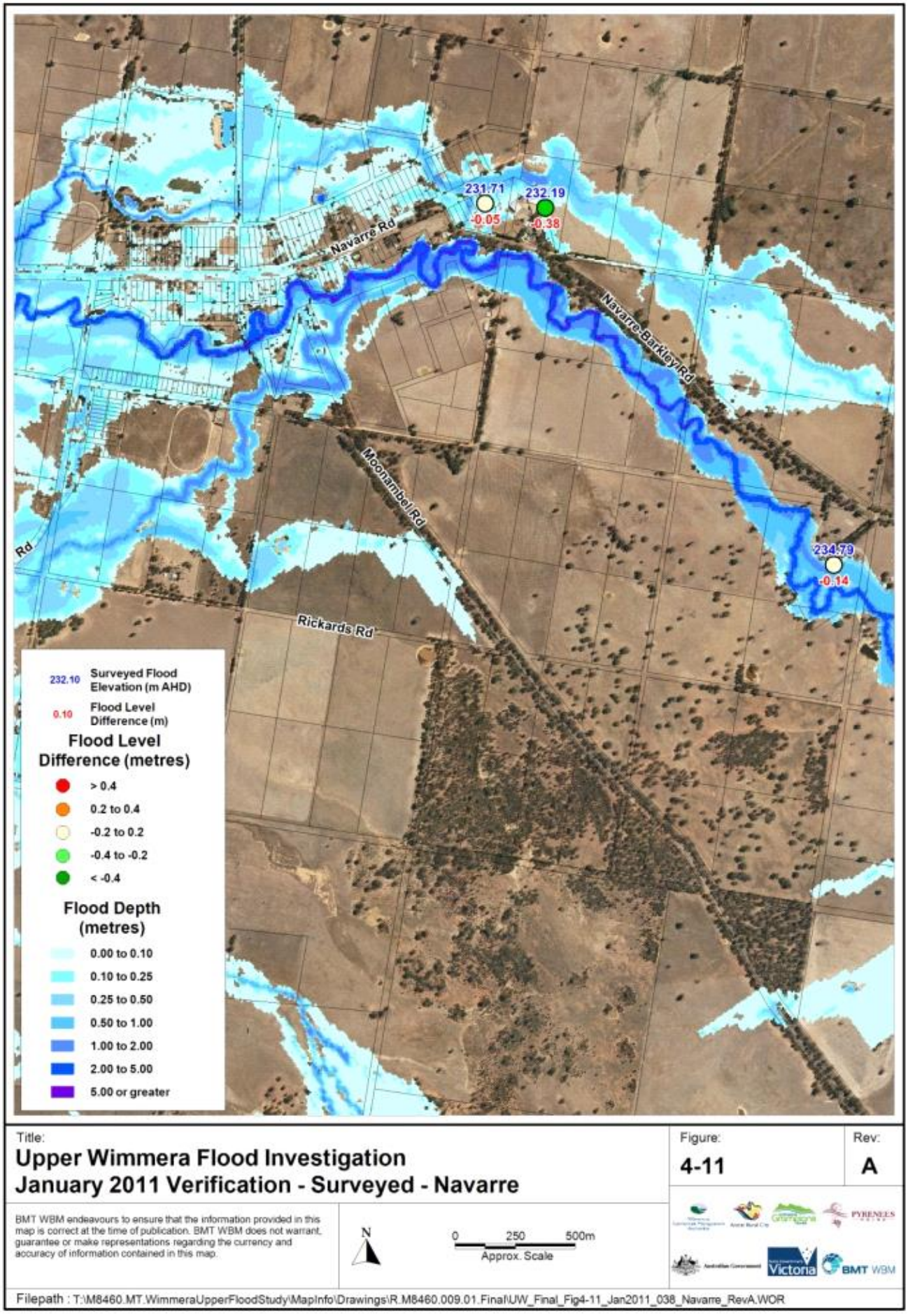
1% AEP flood depths and extents at Elmhurst (WBM, 2014)



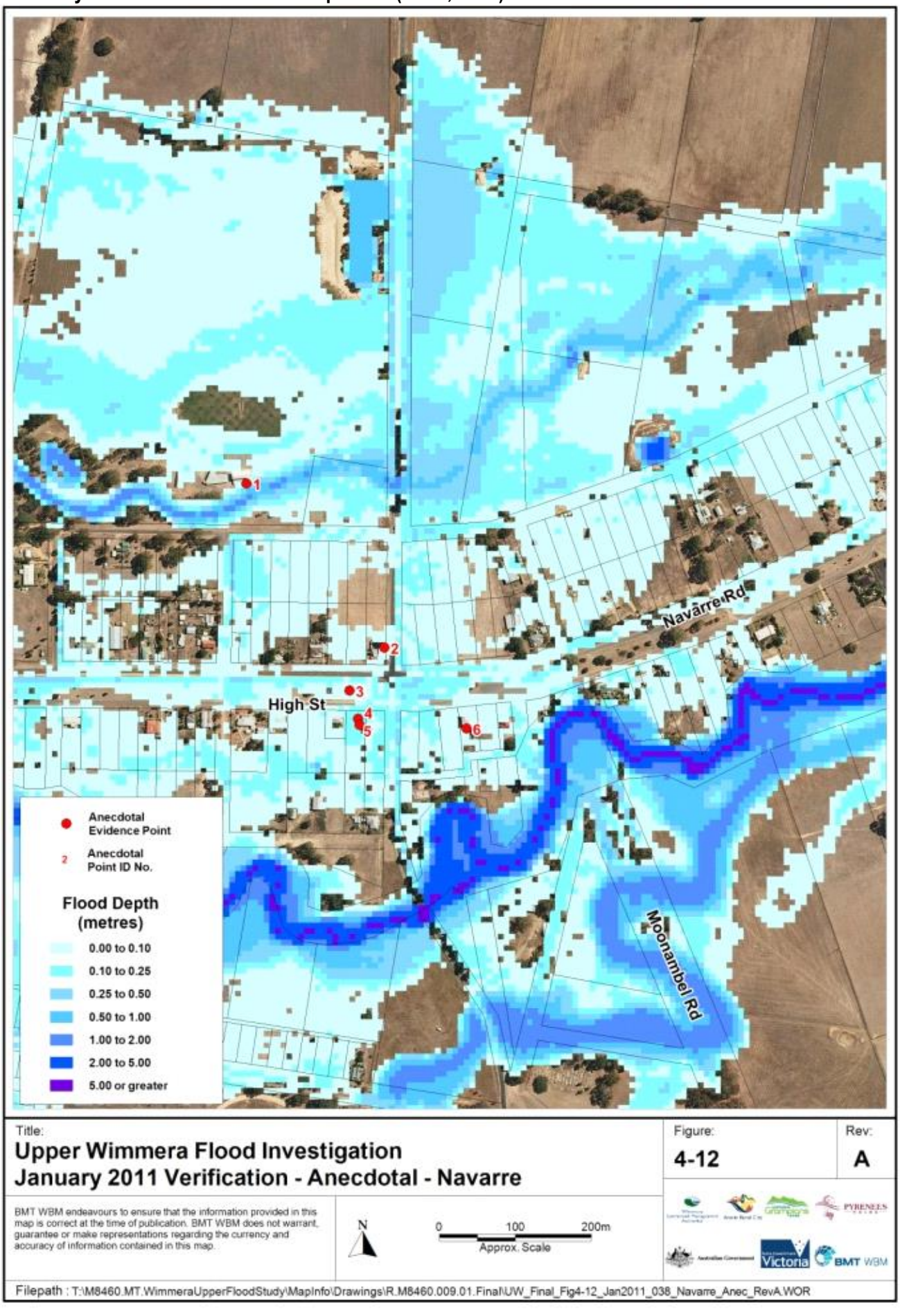
September 2010 event at Navarre (WBM, 2014)



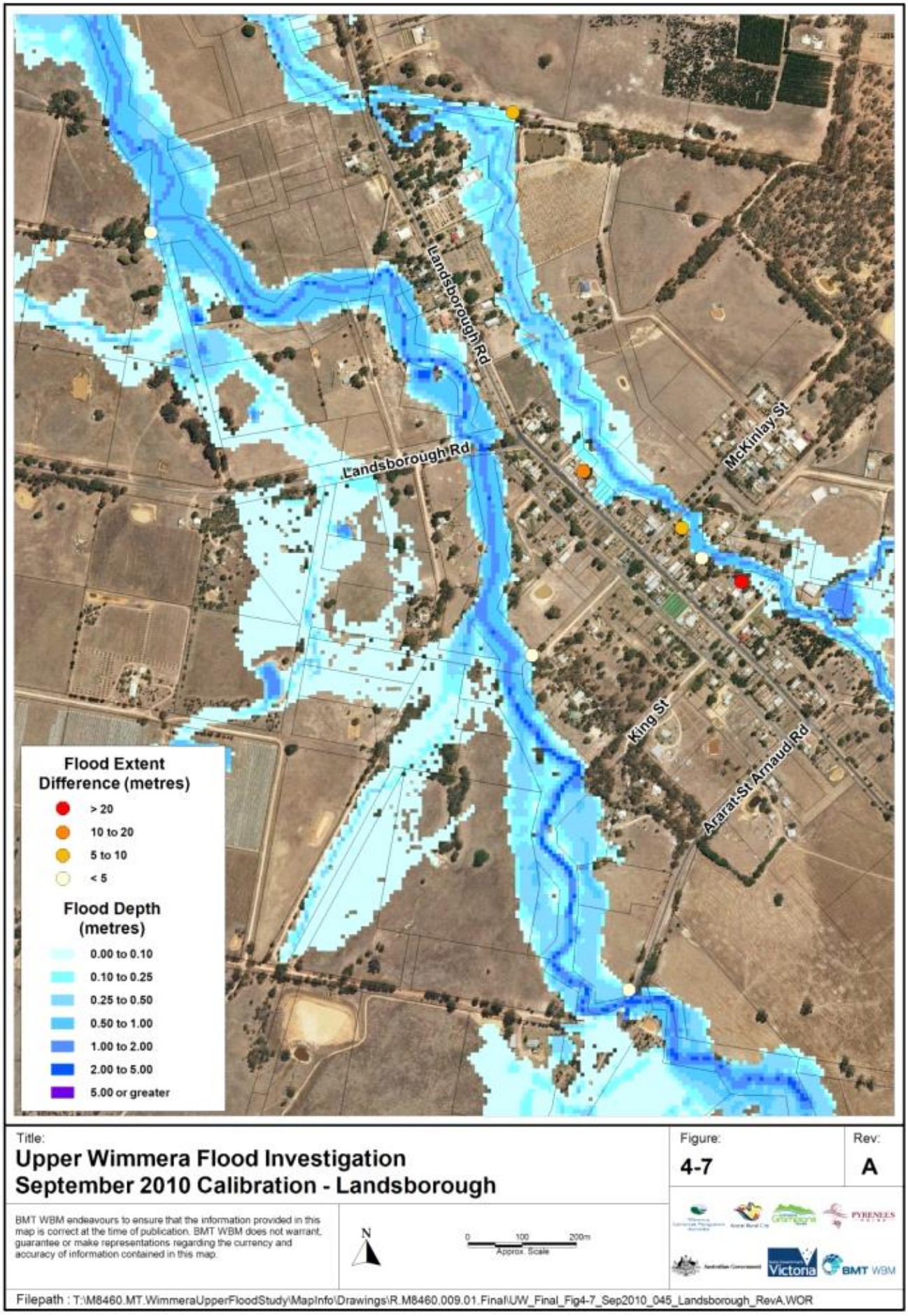
January 2011 event at Navarre – map 1 of 2 (WBM, 2014)



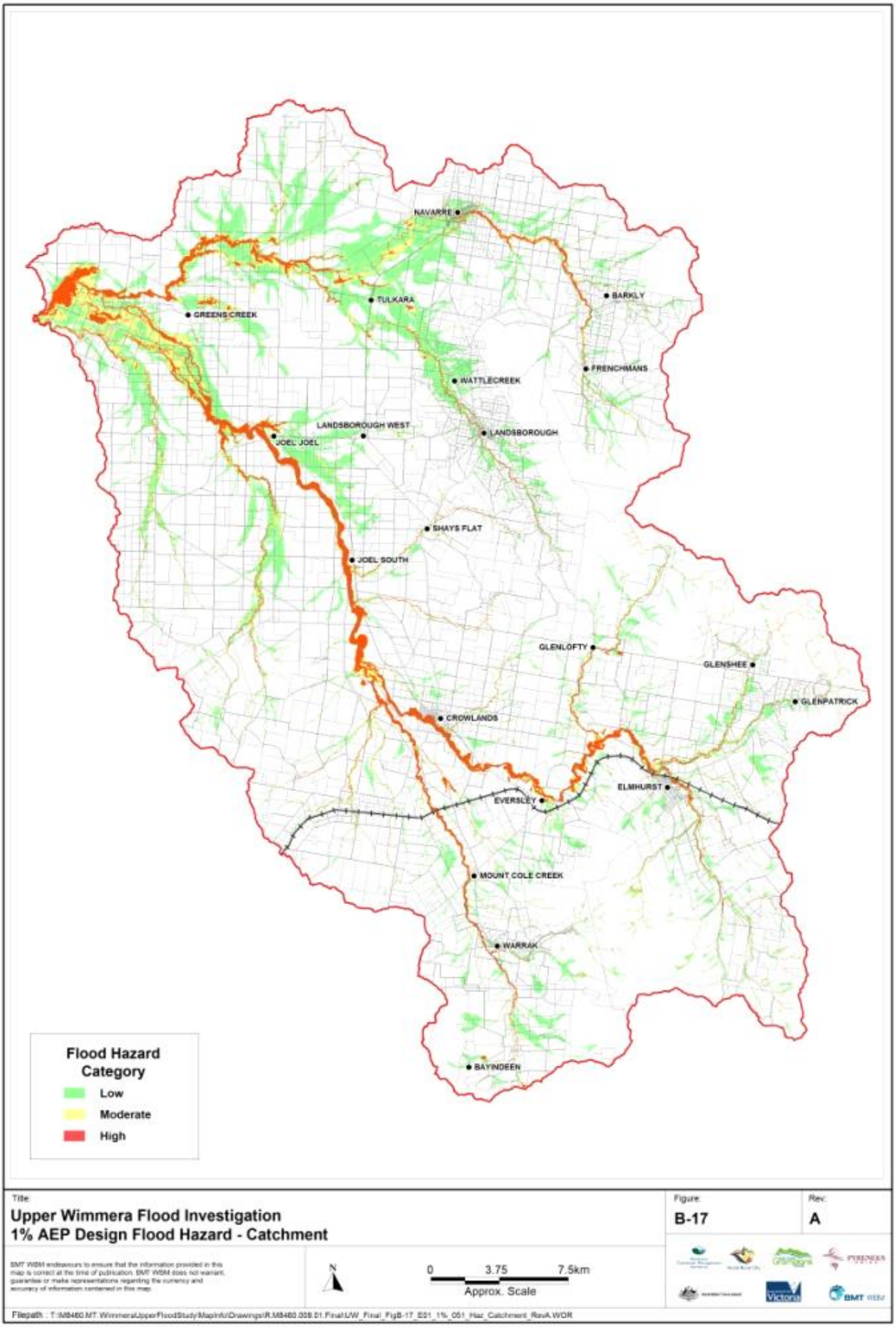
January 2011 event at Navarre – map 2 of 2 (WBM, 2014)



September 2010 event at Landsborough (WBM, 2014)



1% AEP flood hazard map for the Upper Wimmera catchment



APPENDIX F4 – MAPS for MOUNT WILLIAM CREEK

1 Overview

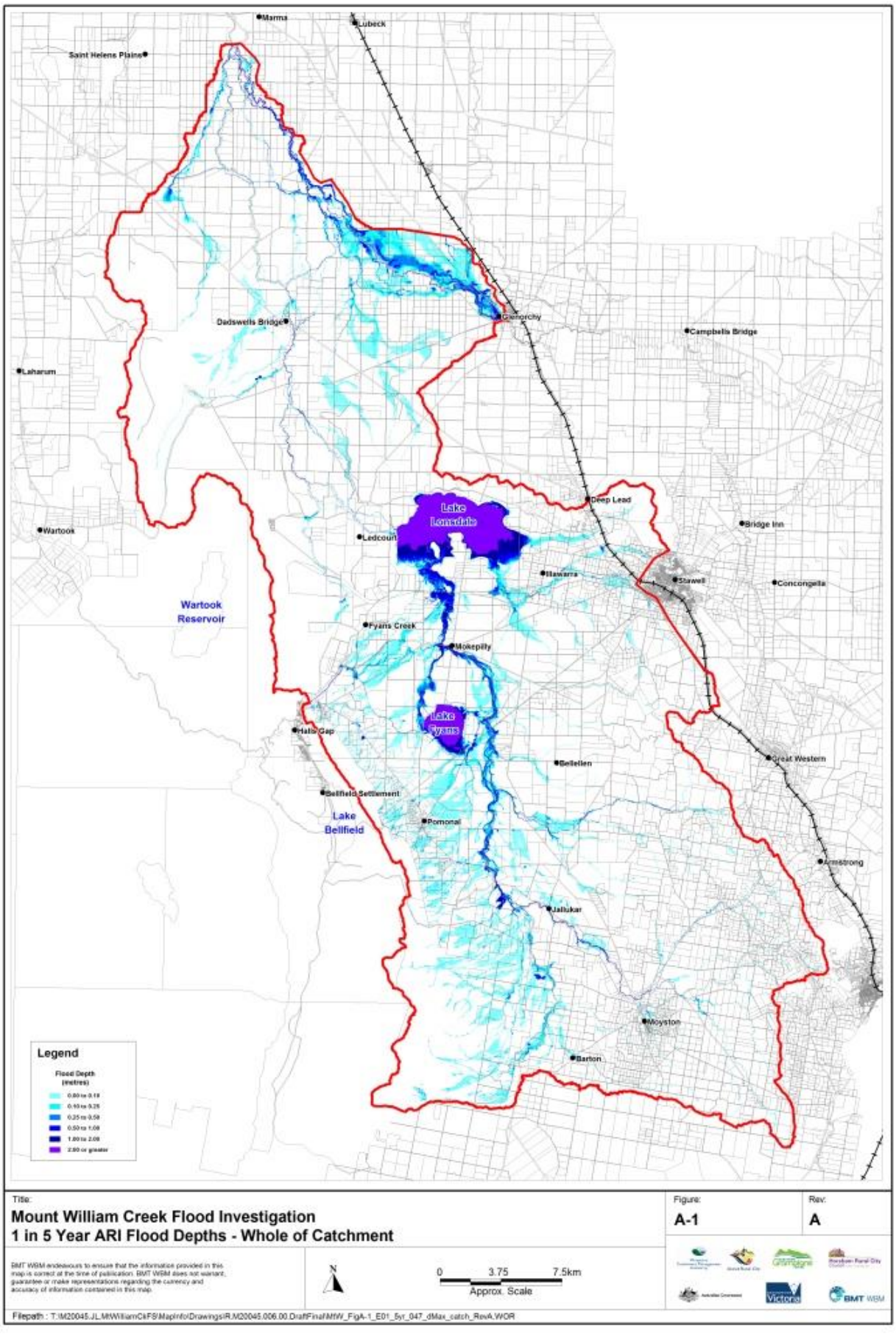
Maps considered useful to flood response through the Mount William Creek catchment are included in this Appendix. They comprise:

- A set of maps showing flood extents and depths across the whole catchment for the design flood events considered by BMT WBM (i.e. the 5, 10, 20, 50, 100, 200-year ARI and PMF events) when delivering the Mount William Creek Flood Investigation (WBM, 2014):
- The 1% AEP flood hazard maps (based on consideration of depth and velocity – see note below) for the Mount William Creek catchment (WBM, 2014).

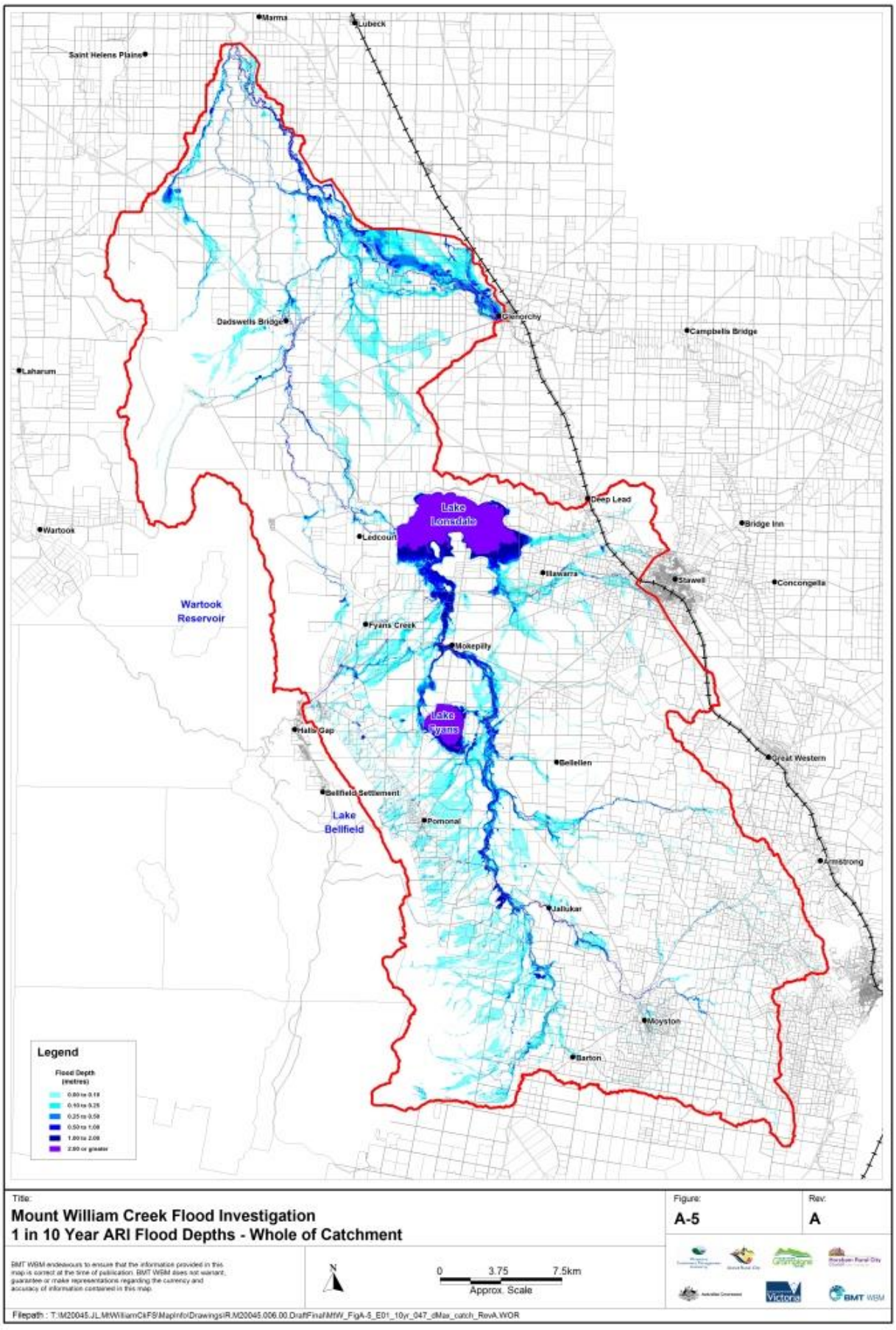
Note that:

- These maps are available in hard copy form from the Northern Grampians Shire and / or Wimmera CMA.
- Maps showing 100-year ARI (1% AEP) flood extent and floodways (together with volume, height and water quality data) are shown at the Victorian Water Resources website
- Flood hazard categorised have been defined for this study as:
  - Low hazard – depth less than 400mm and / or velocity x depth less than 0.4m^2/s;
  - Moderate hazard – depth less than 800mm and / or velocity x depth less than 0.8m^2/s;
  - High hazard – depth greater than 800mm and / or velocity x depth greater than 0.8m^2/s.
- A full set of flood hazard maps was delivered by WBM but have not been included in this MFEP.

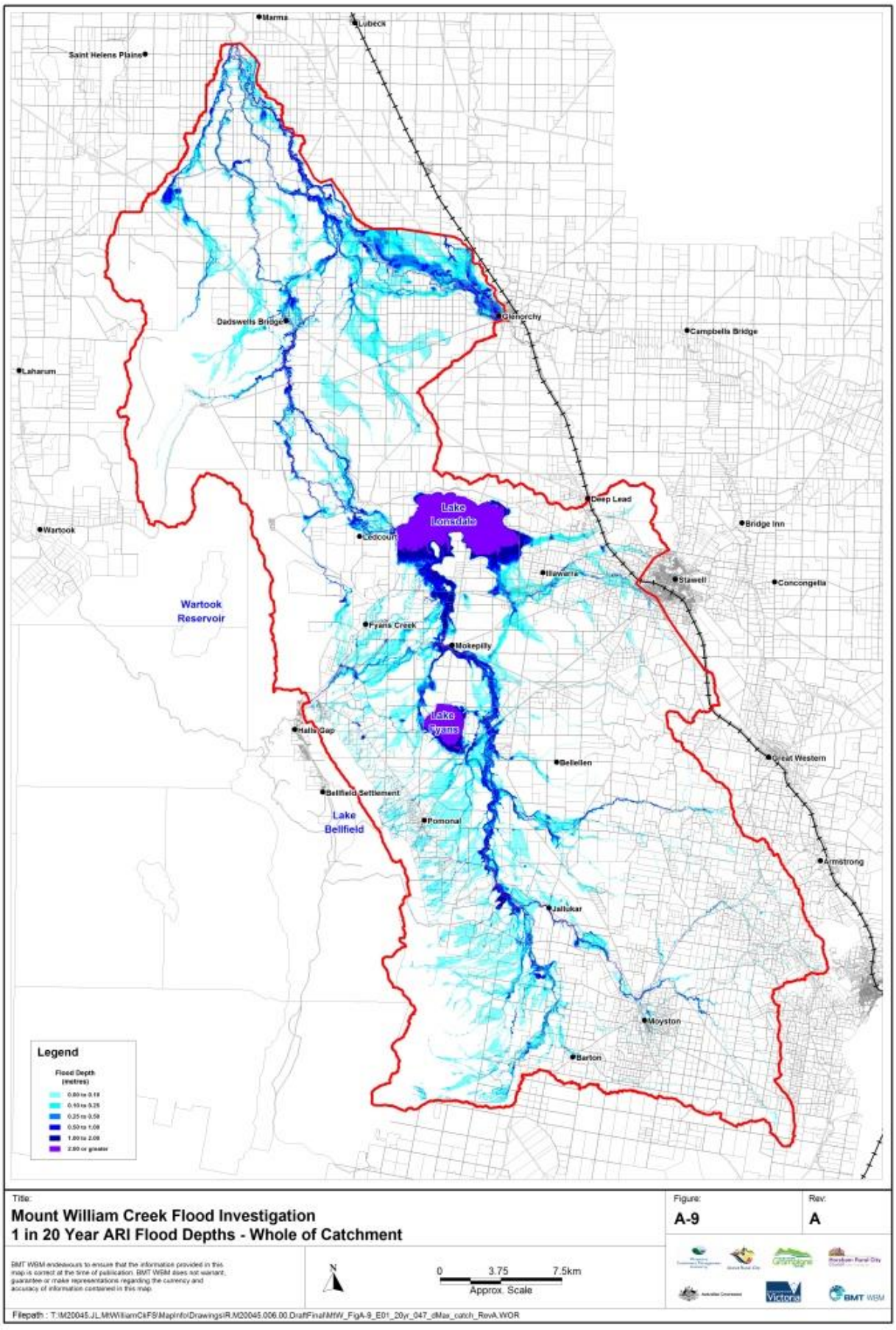
Flood extent and depths for the 20% AEP (5 year ARI) event – whole catchment (WBM, 2014)



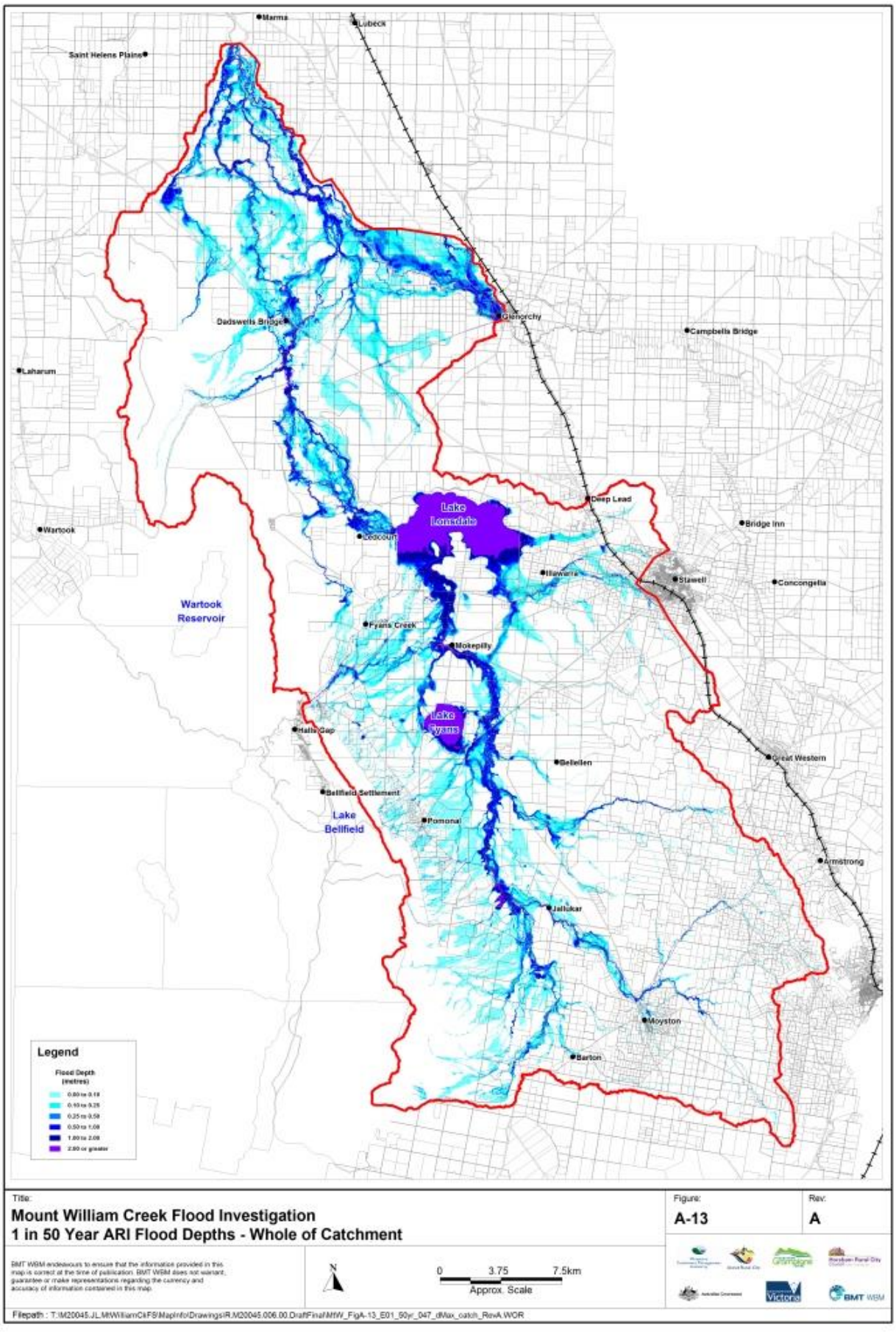
Flood extent and depths for the 10% AEP (1 year ARI) event – whole catchment (WBM, 2014)



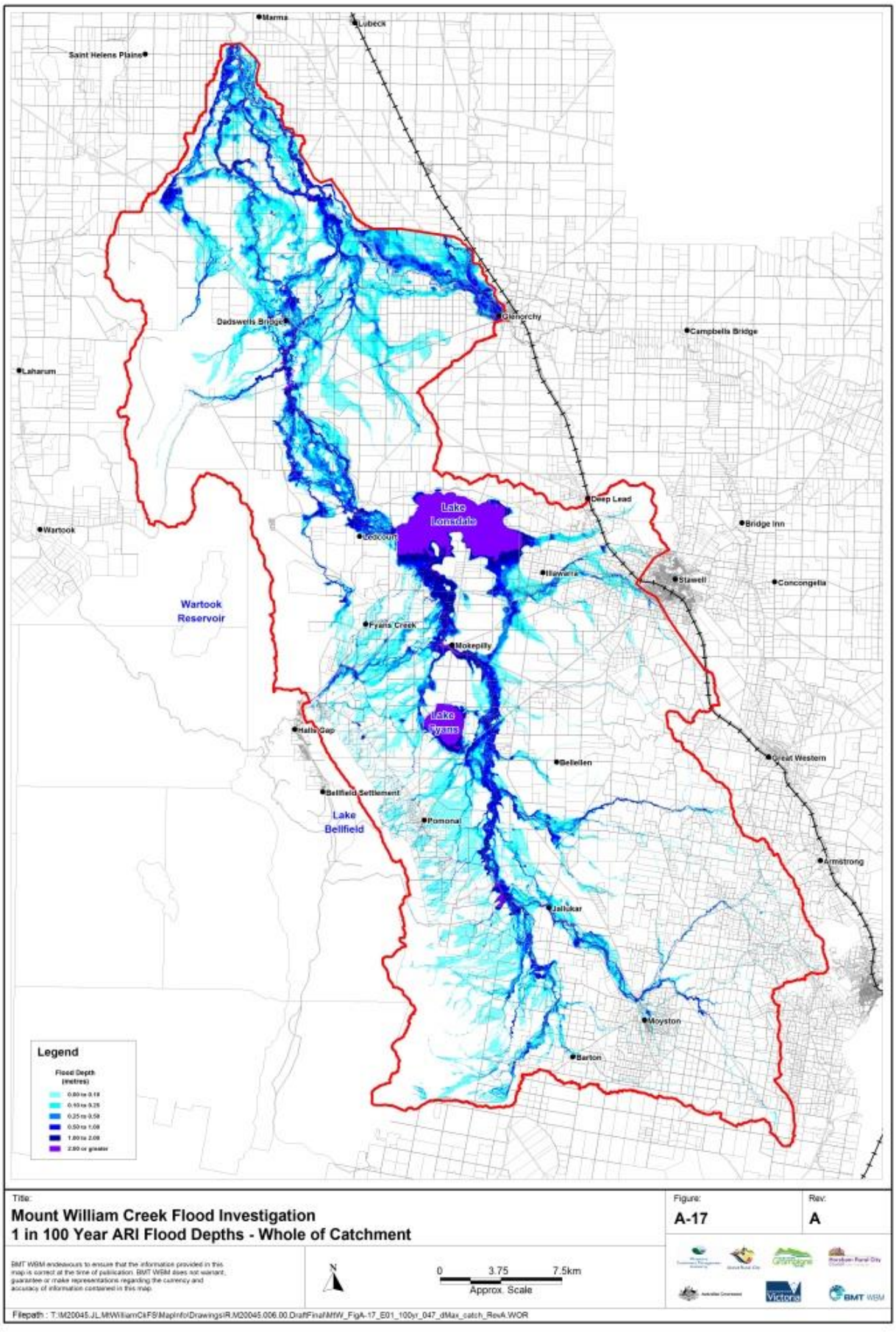
Flood extent and depths for the 5% AEP (20 year ARI) event – whole catchment (WBM, 2014)



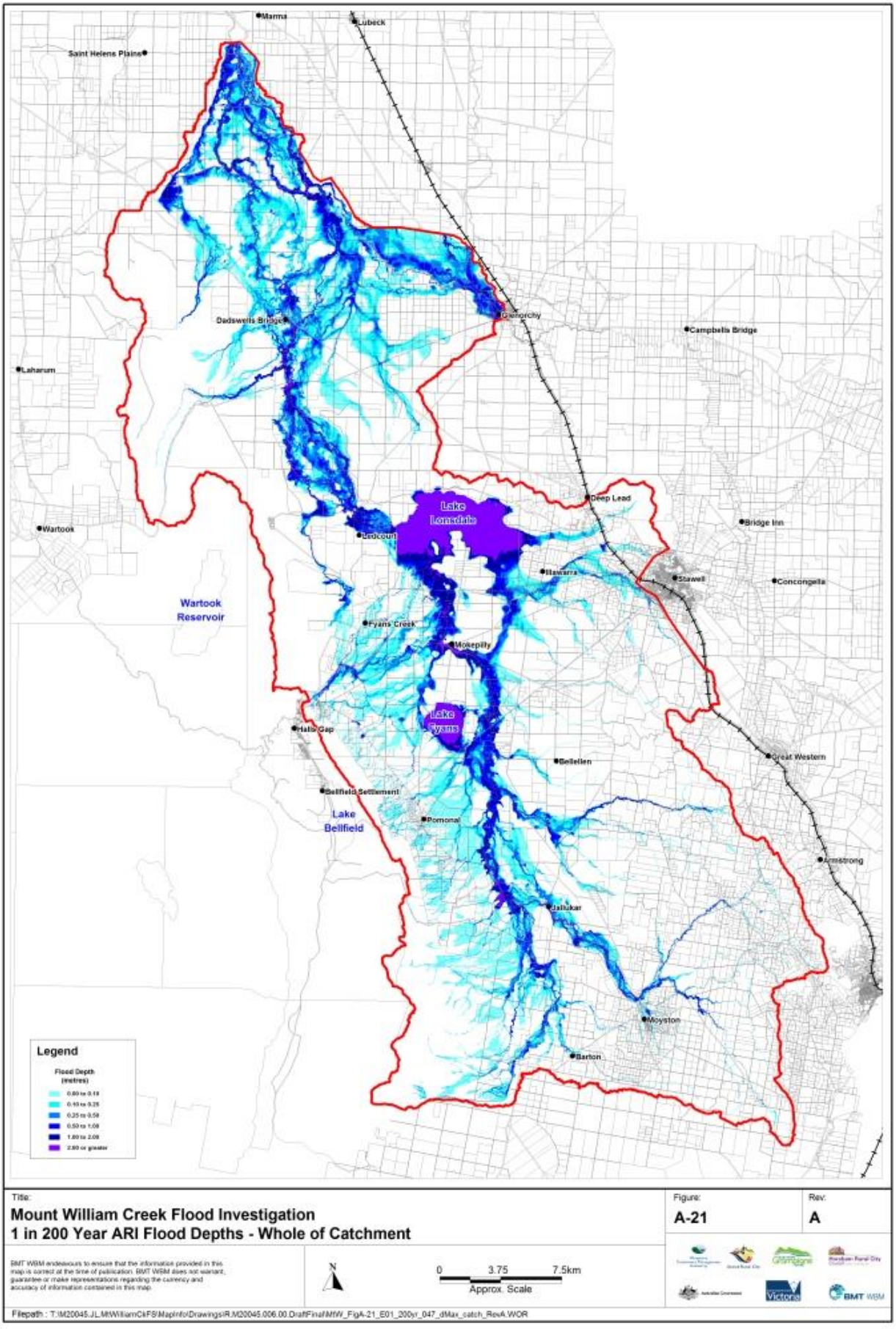
Flood extent and depths for the 2% AEP (50 year ARI) event – whole catchment (WBM, 2014)



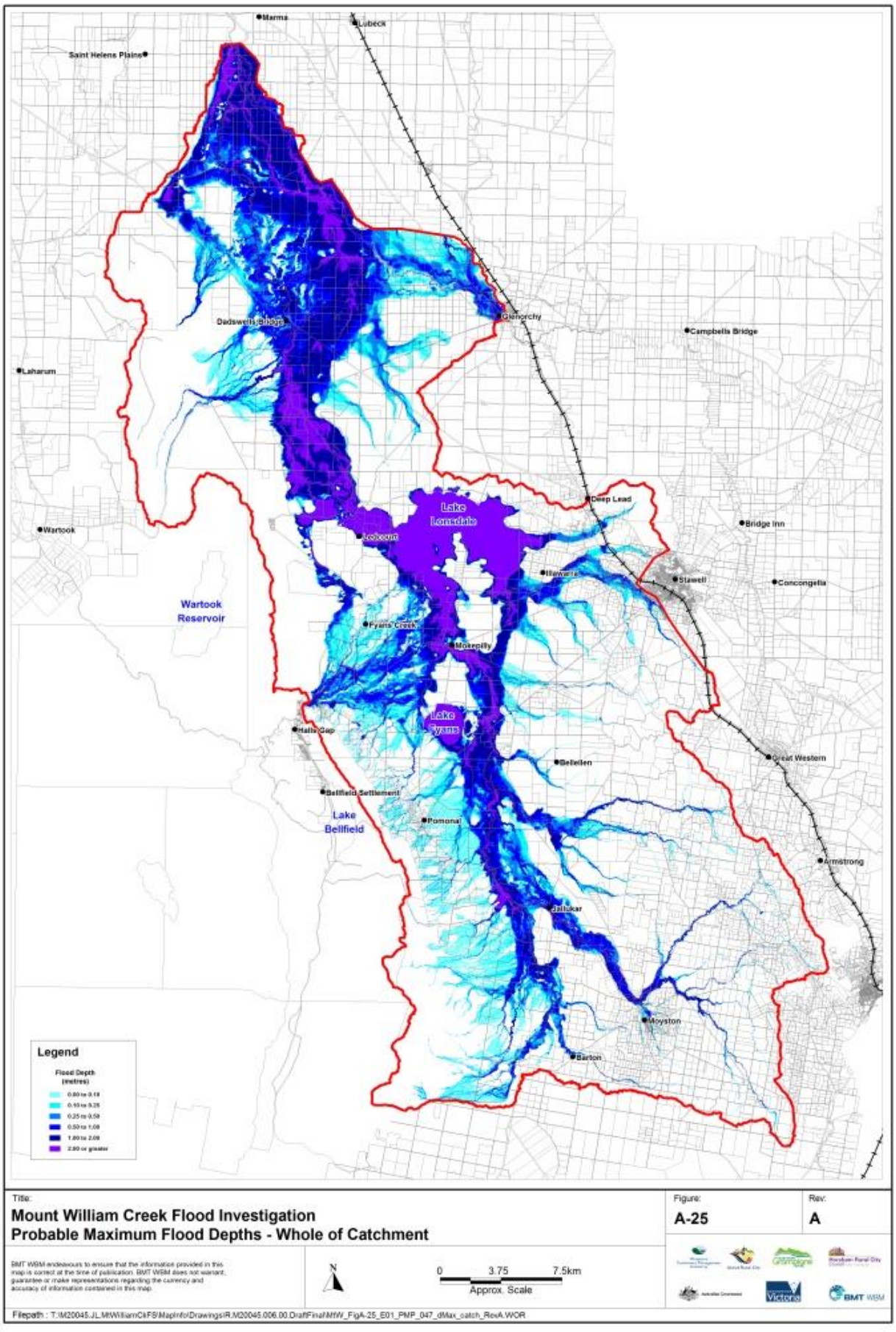
Flood extent and depths for the 1% AEP (100 year ARI) event – whole catchment (WBM, 2014)



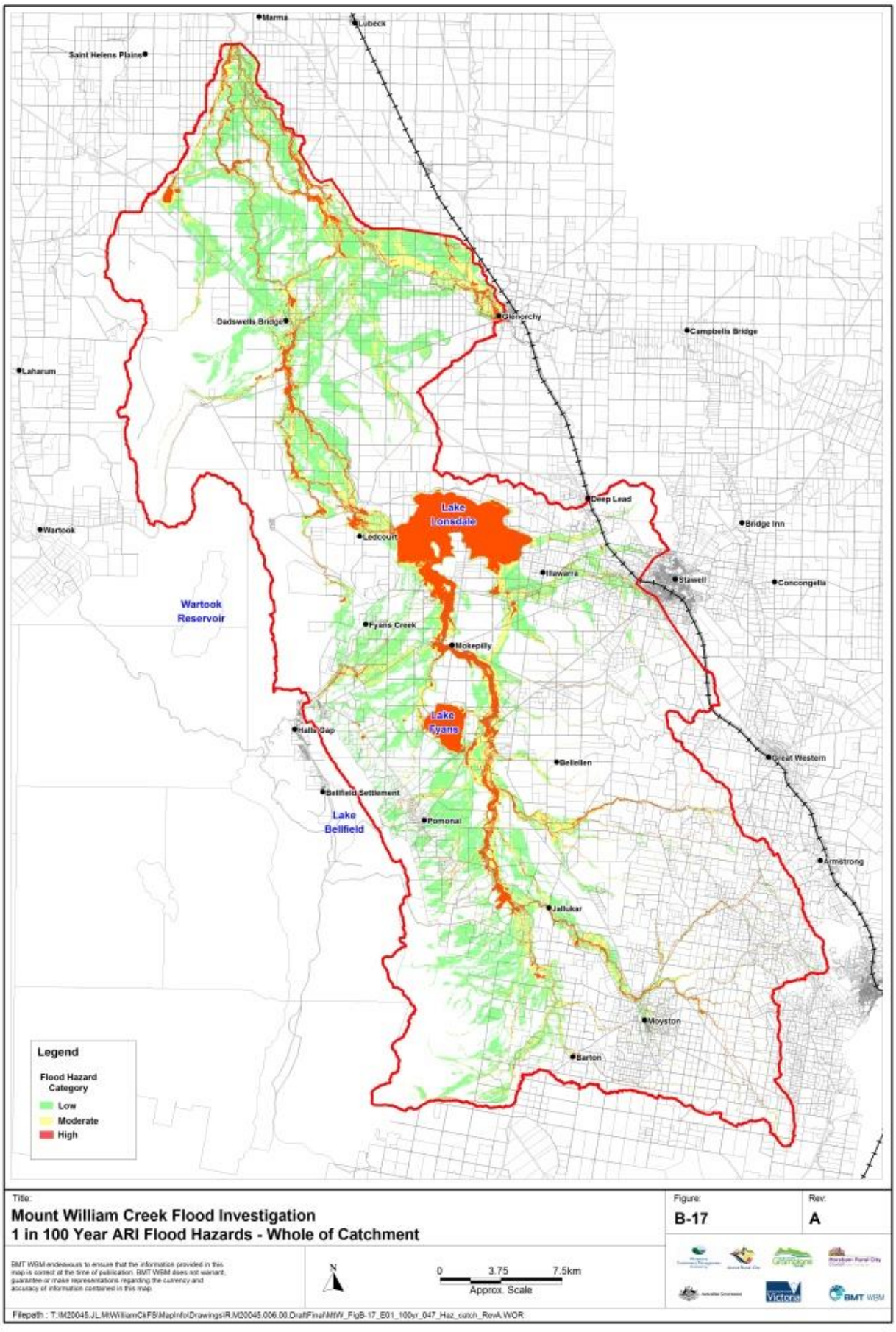
Flood extent and depths for the 0.5% AEP (200 year ARI) event – whole catchment (WBM, 2014)



Flood extent and depths for the PMF event – whole catchment (WBM, 2014)



1% AEP flood hazard map – Mount William Creek catchment



APPENDIX G – REFERENCES AND INTEL SOURCES

The following studies may be useful in understanding the nature of flooding within Northern Grampians Shire.

- BMT WBM (2014): *Upper Wimmera Flood Investigation Final Report*: (Report No: R.M8460.009.01.Final), May 2014.
- BMT WBM (2014): *Mount William Creek Flood Investigation Final Report*: July 2014.
- Cardno (2012): *Wickliffe Flood Investigation*: (Report No TBA), November 2012.
- Findlay Irrigation Services and BM Consulting Civil Engineers (1996): *Levee Audit Report*. Report prepared for Department of Natural Resources and Environment, 1996.
- RJKeller and Associates: *Lake Lonsdale Flooding Assessment*
- State Rivers & Water Supply Commission (SRWSC) (1982a): *Horsham Floodplain Management Study Volume 1 – Final Report*.
- State Rivers & Water Supply Commission (SRWSC) (1982b): *Horsham Floodplain Management Study Volume 2 – Technical Report*.
- URS (2001): *Lake Bellfield Flood Study*: Consulting report for Wimmera Mallee Water
- Water Technology Pty Ltd (2003): *Horsham Flood Study Report*. (Report No J035/R3 Final, Ver. A), February 2003.
- Water Technology Pty Ltd (2006): *Glenorchy Flood Study Report and Glenorchy Floodplain Management Study Report*. (Report Nos J140/R01G & J140/R04G, Draft B), April 2006.
- Water Technology Pty Ltd (2006/07): *Halls Gap Drainage Investigations.*
- Water Technology Pty Ltd (2008): *Halls Gap Flood Study Report*. (Report No J521/R01, Final 3), June 2008.
- Water Technology Pty Ltd (2011): *Wimmera Region Flood Report, January 2011*, August 2011.
- Water Technology Pty Ltd (2012): *2010-11 Victorian Floods: Rainfall and Streamflow Assessment Project*, November 2012.
- Wimmera CMA archives: *Fyans Creek & Lake Fyans Flood Investigation* (1983)

Add to list as MFEP is built

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

- http://www.wcma.vic.gov.au
  Wimmera Catchment Management Authority for various references
- http://www.nccma.vic.gov.au
  North Central Catchment Management Authority for various references
- http://planningschemes.dpcd.vic.gov.au/index.html
  Department of Planning and Community Development for planning scheme flood maps
- http://www.vicwaterdata.net/vicwaterdata/home.aspx
  for historical data on water quality, river heights and flows
- http://www.bom.gov.au
  Bureau of Meteorology for river gauge readings and flood warnings

  BoM Special Climate Statement 26 (http://www.bom.gov.au/climate/current/statements/scs26b.pdf)
- http://www.floodvictoria.vic.gov.au
  for information on historic floods in Victoria – VERY USEFUL
- http://www.ses.vic.gov.au
  Victoria State Emergency Service
- http://www.dse.vic.gov.au/fire-and-other-emergencies
  Department of Sustainability and Environment emergency management.
- COUNCIL, WCMA, NCCMA and VICSES Geographical Information System (GIS) – these contain layers showing drainage assets, flooding extents, flood related call-out locations, roads, title boundaries and other useful information.
- Water Technology (2012): Strategic Flood Intelligence Report, May 2012.

Relevant but more general references include:

- Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), Standing

Committee on Agriculture and Resource Management (SCARM) Report No 73: *Floodplain Management in Australia, Best Practice Principles and Guidelines*.

- Bureau of Meteorology (1987): *Flood Warning Arrangements - Papers prepared for discussions with Victorian Agencies, December 1987*.
- Bureau of Meteorology (1996): *Bureau of Meteorology Policy on the Provision of the Flash Flood Warning Service.* May 1996.
- Department of Natural Resources and Environment (DNRE) (2000): *Flood Data Transfer Project* – – Flood Data and Flood Planning Maps as well as Flood Mapping and River Basin Reports.
- Department of Sustainability and Environment (DSE) (2008): *Victoria Caravan Parks Flood Emergency Management Plan Template and Guidelines*. (Two documents) March 2008.
- Victorian Flood Management Strategy 1997-2007
- Emergency Management Act 1986
- Emergency Management Manual Victoria
- http://www.ema.gov.au
  Emergency Management in Australia
  - Managing the Floodplain, Manual 19, EMA 2009
  - Flood Preparedness, Manual 20, EMA 2009
  - Flood Warning, Manual 21, EMA 2009
  - Flood Response, Manual 22, EMA 2009
  - Emergency Management Planning for Flood Affected by Dams, Manual 23, EMA 2009
- Northern Grampians Shire Municipal Emergency Management Plan
- Water Act 1989
- Flood Warning Station Information Manual - February 1999