October 2012


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Report of the 2012 North East Victoria Flood Review

TRIM ID: CD/12/448164*
Date: 2 October 2012
Version: Final
FINAL REPORT

for

Emergency Services Commissioner

Department of Justice

Prepared by

Molino Stewart Pty Ltd

OCTOBER 2012
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EXECUTIVE SUMMARY

KEY FINDINGS

- Community flood awareness levels were relatively high across the area impacted by the 2012 March flood, however this did not translate strongly into preparedness behaviours.
- Public warnings and information were generally effective, except in a few communities, such as Numurkah.
- The planned response by the emergency services was generally effective in some communities, such as Tallygaroopna and Nathalia, but not in others, such as Numurkah.
- The Numurkah Hospital flooded before any warning had been received or preventative action taken. This was due largely to a combination of the following factors:
  - a flood warning system that was unable to provide accurate and timely data - a lack of river gauges that could have enabled more reliable prediction
  - reliance on historical precedents whereas the 2012 flood displayed a number of very different characteristics
  - limited coordination of the local emergency services.
- Some Victoria State Emergency Service volunteers had not been trained to fulfil the leadership roles expected of them.¹

INTRODUCTION

Heavy rain fell across North East Victoria during late February and early March 2012 causing record flooding in some parts of the Goulburn-Broken river system.

The most flood-affected watercourse was Broken Creek and its associated tributaries, such as Boosey Creek, Muckatakah Creek and Major Creek. The extent of flooding in the Broken Creek catchment was 70,000 hectares. Townships in this catchment include Numurkah, Nathalia, Tungamah and Katamatite, Lake Rowan, Wilby, Invergordon, Wunghnu and Naring.

The Bureau of Meteorology (BoM) has the responsibility for monitoring and prediction of weather events in Victoria. It uses a range of data to forecast and make flood predictions which are subsequently communicated to the public and emergency service providers (ESPs) as Flood Watches and Flood Warnings.² The Victoria State Emergency Service (VICSES) release flood bulletins based on a range of predictions and intelligence sourced from the BoM and Goulburn Broken Catchment Management Authority (GBCMA). In addition to the flood predictions and river heights, the bulletins provide additional information of possible consequences and localised public safety advice actions. VICSES is the agency nominated to control response activities to flood in Victoria.

Emergency services, including VICSES, the Country Fire Authority (CFA), the Department of Sustainability and Environment (DSE) and Victoria Police, worked with Local Government in the area to conduct a series of incident management actions to warn communities and help ensure their safety during the flood. This report recognises the efforts and valuable contribution of all volunteers that willingly gave their time to support their communities.

It is also recognised that the emergency services and other agencies were operating in a dynamic environment and, as is the case with this review, decisions taken by them at the time have then been scrutinised by others who now have the benefit of hindsight.

¹ The report notes that VICSES has now developed, and is delivering a sector and divisional commander course.
The flood had significant impacts on property and infrastructure; for example roads and irrigation across the affected area. Fortunately there were no fatalities. Of particular concern was the evacuation of inpatients at Numurkah Hospital on Sunday 4 March after floodwaters had started to enter the building.

As part of its role to provide assurance on the effectiveness of Victoria’s emergency management arrangements, the Office of the Emergency Services Commissioner (OESC) coordinated an independent review of the 2012 March North East Victoria Flood. The OESC engaged consultants Molino Stewart Pty Ltd to help conduct the review.

The terms of reference for the Review were:

1. Assessment of community preparedness and the effectiveness of public information and warnings issued during the event
2. Determination of the effectiveness of elements of incident management arrangements as it relates to response, planning and strategies implemented prior to, during and immediately following the event.
3. To compare the findings against the recommendations of the Review of the 2010-11 Flood Warnings and Response.

In consultation with the OESC, Molino Stewart developed a review plan relating to the terms of reference and the draft OESC Performance Monitoring Framework (the Framework). The review used a range of data sources. These included:

- a community survey of over 500 flood-affected residents conducted by Strahan Research Pty Ltd
- interviews conducted by Molino Stewart with 16 emergency services personnel that were involved in the flood at state, regional and local levels
- an online survey conducted by VICSES of almost 200 emergency service personnel involved in the flood
- submissions from the public about the flood
- written evidence including emergency agency reports, media articles and maps.

**SUMMARY OF FINDINGS**

**Preparedness**

The review found that on average about three-quarters of residents surveyed across the flood-affected areas were aware of the flood risk. However, this awareness did not translate strongly into preparedness behaviours, with only on average 35 percent saying they had an emergency kit available before the flood, and less than ten percent saying they had a written emergency plan.

About one-third of those surveyed said they had been involved in flood planning prior to the flood. There was a strong self-confidence displayed in dealing with a flood, with over 90 percent of community survey respondents believing they could keep themselves safe in a flood, and 87 percent believing they could keep their family safe.

VICSES is the control agency for flood in Victoria. When surveyed, the majority of people recognised this fact and also the supporting role of the other emergency services, such as the CFA.

Only one of the three councils in the flood-affected area had an up-to-date register of vulnerable people (for example elderly, sick, disabled) prior to the flood.
Effectiveness of public information and warnings

Flood watches and warnings (predictions) are issued by the BoM where flood warning systems are available. When the BoM issues a flood watch or warning, VICSES prepares a flood bulletin using available information or flood intelligence, and provides a description of possible flood consequences and specific localised public safety advice and actions. These bulletins are distributed to the community through the media and are available from the VICSES website. Thus VICSES is dependent on the BoM for flood warning predictions. Depending on the urgency of a warning, an Emergency Alert warning message may also be issued to mobile telephones with a billing address in the area and individual landlines in the area.

The review found that people first learnt about the flood mainly by observing the heavy rain, and also through radio, television and from warnings from others in the community. Over three-quarters of people surveyed felt these first warnings were timely enough to protect themselves, their family and property. About two-thirds were satisfied with the way in which they first found out about the flood. The main reason for satisfaction was that the warning was early; “lack of warning”, was the main reason for dissatisfaction of the remaining one-third.

A large majority of people were able to obtain information they needed about the flood as it progressed. During the flood, the main information sources that people used were neighbours, emergency services, television and ABC Local Radio.

About half of the people surveyed reported taking some action during the flood to lessen the impact of the flood. The main actions were checking on family and friends, monitoring the flood through listening to radio and television, and checking on vulnerable people.

Evacuation warnings were issued to some communities in the flood-affected area. About one-third of people across the area confirmed that they received an evacuation warning. According to those surveyed, the main source of evacuation warnings was Emergency Alert. About 14 percent of those surveyed believed they should have received an evacuation warning but did not receive one.

About 20 percent of those surveyed said they evacuated (whether they received an evacuation warning or not). About two-thirds of those surveyed in Nathalia that evacuated did so as soon as they received the first evacuation warning.

People said they evacuated mainly to ensure the safety of their family. The main reason for not evacuating was that people did not believe their property, their safety and the safety of their family was threatened.

Evacuees tended to go to stay with friends and family. Only about five percent of the evacuees said they went to an evacuation centre. There were some accounts from people in Nathalia that they were told to go to the evacuation centre at Cobram and encountered the evacuation route cut in places by rising floodwaters.

Effectiveness of incident management arrangements

About one-fifth of those people surveyed said they required assistance; for example sandbagging, from the emergency services. About three-quarters of these people said they were satisfied or very satisfied with the assistance they received. The main reason for satisfaction was that the emergency services were “helpful and prompt”. About 18 percent of respondents were dissatisfied with the assistance they received. The main reason for dissatisfaction was that people did not receive the assistance they required or it was inadequate.

The majority of people from the flood-affected communities were confident that the planned response by the emergency services would protect themselves and their community. The main reason for this confidence was that the emergency services were well-organised, efficient and knew what they were doing. Confidence levels were lowest in Numurkah. The main reasons for lack of confidence related to lack of assistance and little or no warning (mainly due to a lack of recognition of the speed of the flood peak by the emergency services).
The majority of agency personnel interviewed thought that incident management during the flood could have been improved. The main concerns related to gaps in flood intelligence data, the lack of capacity of VICSES during scaling up for the flood, and communication issues between the Shepparton Incident Control Centre (ICC), local Divisional Commands and field crews. On the other hand, there appeared to be effective relationships between the state and regional incident management levels.

The majority of agency personnel (state, regional, local) surveyed believed that the emergency services worked well together, although this view was less supported by field personnel. However, several personnel interviewed raised concerns about the agencies using incompatible information systems and different radio frequencies.

The majority of agency personnel interviewed thought that the use of local intelligence/knowledge could have been improved in incident management. The main reason for this was the “poor communication” between the Shepparton ICC and Divisional Commands at Nathalia and Numurkah (based on anecdotal evidence). Both Divisional Commands and the Numurkah VICSES Unit felt that the ICC was not listening to the local input (including real-time observations) they were providing. This also was the main reason for the majority of personnel interviewed feeling that there was not a clear understanding of roles and responsibilities, especially at the local level.

The lack of training of some VICSES personnel in using the Australasian Inter-service Incident Management System (AIIMS) was identified as an issue in the review.

FURTHER ANALYSIS

The response in Numurkah

The community survey responses for Numurkah in comparison to the other flood-affected townships were, in most cases, significantly different. Of particular note was Numurkah’s:

- lower flood risk perception
- lower level of preparedness
- less involvement in flood planning
- less perceived flood warning time
- lower level of confidence in the planned response.

This, coupled with emergency service interviewee concerns about flood prediction and intelligence, prompted the need for further investigation. It was hoped that this further analysis would also help explain the late evacuation of Numurkah hospital.

Using a comparison between Nathalia and Numurkah, further investigation was conducted into elements that might cause the variation in Numurkah’s community survey responses.

The investigation found that there were marked differences between the level of flood planning, mitigation and community education in the two towns prior to the flood including:

- Nathalia had a levee to help protect the town; Numurkah had no levee. However, studies have shown that without floodplain management interventions (for example levees) a greater part of Nathalia is threatened by flooding.
- Nathalia had a floodplain management plan that included a flood study providing intelligence about potential flood behaviour up to the Probable Maximum Flood (PMF), and management options to help manage the town’s flood risk. Numurkah had a completed flood study but no floodplain management plan at the time of the flood. Both studies had limitations on predictive value as they referenced the 1993 flood.
• Nathalia had a flood warning system using three upstream river gauges and one at the town. This system would greatly help flood prediction by the BoM. On the other hand, there was no permanent river gauge at Numurkah on Broken Creek – predictions there were dependent on two upstream gauges which only partially covered flows from the upstream catchment.

• There was a more complex hydrology upstream of Numurkah than Nathalia, thus making prediction of flood behaviour more difficult at Numurkah.

• Nathalia had a community education reference group that had implemented several education and engagement activities in the town to help raise risk awareness, increase preparedness levels and understanding of the flood warning system. Numurkah had received little flood education prior to the flood, and that was limited to a few activities in FloodSafe Week in 2011.

Flood studies for Numurkah and Nathalia were based on historical data such, as the behaviour of the 1993 flood, and had not considered the potential for substantial change in the rate of the flood wave that was experienced in the 2012 flood. The main reason for the variance in 1993 and 2012 flood behaviour was the different location of upstream heavy rainfall. In October 1993 there was relatively little rainfall over the Broken Creek catchment, with an average of about 120 mm falling in five days. The 1993 flood was caused by the large volume of water breaking away from the Broken River at Casey’s Weir downstream of Benalla. On the other hand, there was close to record rainfall recorded in the Broken Creek catchment in March 2012, with an average of 250 mm in six days. However, the Broken River catchment received considerably less rain and did not even produce minor flooding at Benalla. Although the flood peak arrived far earlier than predicted at Numurkah, the flood size was similar to that of the 1993 flood.

In the absence of any formal warning system at Numurkah, the BoM (in its early flood warnings), the ICC and the local community acted on the assumption that the behaviour of the 1993 flood and the March 2012 flood were similar. As there was no flood warning system and limited flood intelligence, it would have been difficult to accurately predict the size and timing of the 2012 flood peak for Numurkah, especially given the record height of the flood.

This factor, plus the poor local coordination of the Numurkah Divisional Command and the VICSES Unit, meant that Numurkah Hospital was not warned about the flood threat, and therefore measures put in place to protect the hospital were not triggered until after floodwaters entered the building.

It should be noted that the prediction of both flood height and time was very accurate for Nathalia. Using its permanent levee augmented by demountable levees, the town was protected from floodwaters on this occasion.

The above demonstrates that with appropriate holistic floodplain risk management measures in place (for example flood mitigation, flood warning systems, adequate gauge coverage, well-coordinated local incident management) there is a greater ability to reduce the impacts on property, ensure safety and build community resilience.

Comparison with the Review of the 2010-11 Flood Warnings and Response

It was not the intention of this review to track progress against the findings and recommendations of the Review of the 2010-11 Flood Warnings and Response. However, some similar findings were identified including:

• the importance of having a flood warning system using river gauges and associated telemetry
• the need for ongoing flood mapping and community education programs
• the use of local real-time input through trained flood observers
• clear command and control is required across all levels of incident management.

Since the flood event VICSES has recently received funding to employ twelve (12) Community Education officers around the state over three years commencing 2011/12.
1 INTRODUCTION

1.1 TERMS OF REFERENCE

As part of its role to provide assurance on the effectiveness of Victoria’s emergency management arrangements, OESC coordinated an independent review of the 2012 March North East Victoria Flood.

The OESC engaged consultants Molino Stewart Pty Ltd to help conduct the review using the draft Framework (Section 2.1).

The terms of reference for the Review were:

1. Assessment of community preparedness and the effectiveness of public information and warnings issued during the event. (see findings Section 3.1 and 3.2)

2. Determination of the effectiveness of elements of incident management arrangements as it relates to response, planning and strategies implemented prior to, during and immediately following the event. (see findings Section 3.3)

3. To compare the findings against the recommendations of the Review of the 2010-11 Flood Warnings and Response. (see Section 4.2)

1.2 THE 2012 NORTH EAST VICTORIA FLOOD

1.2.1 Flood behaviour

Heavy rain fell across North East Victoria during late February and early March 2012. Over six days (28 February to 4 March), 200-300 mm fell across large areas of this part of the State, with most of the rain falling on two days – 28 February and 1 March 2012.

It should be noted that the soil would have been saturated due to above-average rain in the area over the past two years. This saturation level would have caused most rain to run off during the February/March rainfall event, thus causing flooding.

The 2012 North East Victoria flood was primarily in the eastern part of the Goulburn-Broken system, with some flooding along the upper parts of the Murray River; for example at Walwa. Some towns along the Kiewa, Mitta Mitta, Ovens and King Rivers were also at risk of flooding. A map showing towns affected by flooding and at risk as at 4 March is provided (Figure 1).

The most flood-affected watercourse was Broken Creek and its associated tributaries, such as Boosey Creek, Muckatah Creek and Major Creek. In the 2012 March event, the extent of flooding in the Broken Creek catchment was 70,000 hectares. Townships in this catchment include Numurkah, Nathalia, Tungamah and Katamatite (see Section 1.3 for more details). When not in flood, streamflow across the Broken Creek catchment is variable - both annually and seasonally - and has been modified for agricultural activities (see Section 1.3.2).

Figures 2 and 3 give an insight into the flood behaviour in the Broken Creek catchment during the March 2012 event. The Figure 2 map was prepared by emergency services on 5 March, the day after the flood peaked at Numurkah. It shows that the flood peak travelled about 20 kms (straight line distance) in one day from Katamatite to Numurkah, but would then take another four days to travel approximately the same straight line distance to Nathalia.

Figure 3 supports this view of flood peak timing, based on post-flood data analysis. It shows that the peak in fact took only 14 hours to travel between Katamatite and Numurkah, whereas, as predicted, it took four days to travel between Numurkah and Nathalia.
Figure 1: Towns affected by flooding and at risk as at 4 March 2012 (Source: Victoria State Emergency Service)
Figure 2: Indicative flood extent and flood peak timing for the Broken Creek catchment as at 5 March 2012 (Source: Victoria State Emergency Service)
Figure 3: Analysis of flood peaks (1 March 2012 to 18 March 2012) in the Broken Creek catchment (Source: Goulburn Broken Catchment Management Authority)
In terms of flood height, the 2012 flood broke several records (Goulburn Broken Catchment Management Authority, 2012):

- Tungamah: Peaked at 2.88m, 1 March (record flood and 80mm higher than 1974 flood)
- Katamatite: Peaked at 3.10m, 3 March (record flood and 300mm higher than 1974 flood)
- Nathalia: Peaked 3.26m, 8 March (record flood and 180mm higher than the 1993 flood)

Although there is no permanent gauge at Numurkah, a temporary gauge was installed, which showed Broken Creek peaked on 4 March at a level higher than the flood of 1974 by 150 to 280 mm.

Floods were the largest on record and exceeded the current 100-year Average Recurrence Interval (ARI) flood for areas upstream of Walshs Bridge near Nathalia. Downstream of Walshs Bridge the floods were indicative of the 100-year ARI flood.

1.2.2 Emergency management response

Specific control and coordination arrangements during an emergency, including a flood, are outlined in the Emergency Management Manual Victoria (EMMV). The EMMV identifies VICSES as the agency nominated to control response activities to flood in Victoria. The Bureau of Meteorology (BoM) has the responsibility for monitoring and prediction in Victoria. Victoria Police retains the responsibility for emergency services coordination during a flood. The EMMV also details the responsibilities of several other agencies involved in flood management including local councils, CMAs, CFA, DSE and Department of Human Services (DHS).

Emergency services implemented a series of actions (eg. Emergency Alerts, BoM issuing flood warnings) during the 2012 floods to warn communities and help ensure safety. The efforts of all volunteers that willingly gave their time to assist their communities should be acknowledged.

Some of the key actions are summarised in Table 1; particularly in relation to the Broken Creek catchment.

Table 1: Summary of key emergency management response actions focussing on the Broken Creek catchment

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Action- ESPs and the BoM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun 26 Feb</td>
<td>Goulburn Broken Basins Upper Murray, Kiewa, Mitta Mitta, Ovens, King catchments</td>
<td>Flood Watch (BoM)</td>
</tr>
<tr>
<td>Mon 27 Feb</td>
<td>Boosey Creek area including Tungamah and Katamatite; Tallygaroopna area</td>
<td>Community update via One Source One Message (OSOM) (Benalla RCC)</td>
</tr>
<tr>
<td>Wed 29 Feb</td>
<td>VICSES Emergency Management Liaison Officer deployed to Tallygaroopna</td>
<td>Tallygaroopna and Boosey Creeks community meeting (Benalla RCC)</td>
</tr>
<tr>
<td></td>
<td>Prepare to evacuate for Tallygaroopna and Congupna</td>
<td>Sent via Emergency Alert (Benalla RCC)</td>
</tr>
<tr>
<td>Thurs 1 Mar</td>
<td>Evacuation community update</td>
<td>Sent via OSOM</td>
</tr>
</tbody>
</table>

*The source of the information included in BoM warning messages for the Broken Creek was Goulburn Broken CMA as part of its local flood monitoring responsibility*
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri 2 Mar</td>
<td>Broken Creek</td>
<td>Shepparton ICC established</td>
</tr>
<tr>
<td>Sat 3 Mar</td>
<td>Broken Creek</td>
<td>Flood warnings from BoM, minor flood warning sent via OSOM (Shepparton ICC); flood community updates (Shepparton ICC)</td>
</tr>
<tr>
<td>Sun 4 Mar</td>
<td>Broken Creek</td>
<td>Flood warnings from BoM, minor flood warnings sent via OSOM (Shepparton ICC) including related to Numurkah; flood community updates (Shepparton ICC); community meetings including at Numurkah</td>
</tr>
<tr>
<td>Mon 5 Mar</td>
<td>Walwa (Murray River)</td>
<td>“Evacuate now” warning sent by Emergency Alert, OSOM (Wangaratta ICC)</td>
</tr>
<tr>
<td></td>
<td>Broken Creek</td>
<td>Flood warnings from BoM, major flood warnings sent via OSOM (Shepparton ICC); flood community updates (Shepparton ICC)</td>
</tr>
<tr>
<td>Tues 6 Mar</td>
<td>Broken Creek</td>
<td>Flood warnings from BoM; community meetings including at Numurkah; major flood warnings sent via OSOM (Shepparton ICC); flood community updates (Shepparton ICC); community newsletter</td>
</tr>
<tr>
<td></td>
<td>Nathalia</td>
<td>“Prepare to evacuate” warning sent via OSOM (Shepparton ICC)</td>
</tr>
<tr>
<td>Wed 7 Mar</td>
<td>Broken Creek</td>
<td>Flood warnings from BoM; major flood warnings sent via OSOM (Shepparton ICC); Numurkah recovery meeting; Nathalia community meeting; flood community updates (Shepparton ICC); community newsletter</td>
</tr>
<tr>
<td></td>
<td>Nathalia rural areas outside levee</td>
<td>“Prepare to evacuate” sent via OSOM (Shepparton ICC)</td>
</tr>
<tr>
<td>Wed 8 Mar</td>
<td>Broken Creek</td>
<td>Flood warnings from BoM; major flood warnings sent via OSOM (Shepparton ICC); flood community updates (Shepparton ICC)</td>
</tr>
<tr>
<td></td>
<td>Nathalia inside the levee</td>
<td>“Prepare to evacuate” sent via Emergency Alert (Shepparton ICC); “evacuate immediately” warning sent by OSOM (Shepparton ICC)</td>
</tr>
</tbody>
</table>
1.2.3 Flood impacts

The 2012 floods had significant impacts on property across the area affected. There were no fatalities. Figure 4 provides details of damaged properties across the flood area. It shows that 135 residences were damaged by floodwaters in Moira Shire (93 of which were in Numurkah). A further 31 residences were damaged in Greater Shepparton City. There was also extensive damage to local roads, irrigation infrastructure and to farm properties.

As reflected in numerous media articles, of particular community concern was the evacuation of inpatients at Numurkah Hospital on 4 March after floodwaters had started to enter the building.

1.3 THE STUDY AREA

The study area is that impacted by the March 2012 flood event. As shown in Figure 4, the study is mainly in the local government areas (LGAs) of Moira and Greater Shepparton.

Flood-affected communities in Moira Shire included:

- Numurkah
- Nathalia
- Wunghnu
- Tungamah
- Lake Rowan
- Wilby
- Invergordon
- Naring
- Katamatite

Flood-affected communities in Greater Shepparton City included:

- Tallygaroopna
- Congupna

Other flood-affected communities included Walwa (Towong Shire).
1.3.1 Demographics

The communities in the study area are predominantly service centres for the surrounding agricultural area.

Numurkah is located on Broken Creek, which flows west into the Murray River north of the town of Barmah. The population of Numurkah in 2011 was 4,768 (Australian Bureau of Statistics, 2012). This is a slight increase from 2006 when the population was 4,653.

Numurkah has a population with approximately 54 percent aged 45 years or older. Almost all the inhabitants speak English and were born in Australia. Approximately 90 percent of houses in the town are separate houses, with the remainder being mainly flats or apartments in a one or two storey block.

Nathalia is also located on the banks of Broken Creek. The population of Nathalia in 2011 was 1,902 (Australian Bureau of Statistics, 2012). This is a significant increase from 2006 when the population was 1,431.

Nathalia has a slightly younger population than Numurkah, with approximately 48 percent aged 45 years or older. Like Numurkah, almost all the inhabitants speak English and were born in Australia.

Approximately 97 percent of houses in Nathalia are separate houses with the remainder being mainly flats or caravans and cabins.

Tallygaroopna is located in the Goulburn River floodplain. The population of Tallygaroopna in 2011 was 573 (Australian Bureau of Statistics, 2012). This is a significant increase from 2006 when the population was 270, possibly due to nearby Shepparton’s growth.

Tallygaroopna also has a younger population than Numurkah with approximately 45 percent aged 45 years or older. Most inhabitants speak English and were born in Australia. All houses in the town are separate houses.

The other flood-affected communities are of similar size to or smaller size than Tallygaroopna.
Figure 4: Residential impacts – March 2012 North East Flood (Source: Victoria State Emergency Service)
1.3.2 Land use

A large proportion of the study area is used for agriculture – both dryland and irrigation. Approximately one-third of the Broken Creek catchment is under irrigation. Goulburn-Murray Water provides water services to irrigators in this area.

Flow from the floodplain of the Broken River and Broken Creek has been extensively modified by agriculture and urban development, especially the construction of irrigation water supply channels and return drains (Cottingham et al, 2001). Flow is diverted from Broken River into Broken Creek via a diversion channel at Casey’s Weir. These diversions are undertaken all year round to meet stock and domestic demands and in the drier months to meet irrigation demands.

Mean annual streamflow for the Broken Basin is approximately 325 gigalitres (GL), with an average flow of approximately 236 GL in the Broken River below Casey’s Weir and an average flow of approximately 71 GL in Broken Creek at Rice’s Weir (Department of Water Resources, 1989). Streamflow is variable, both annually and seasonally, and is modified by the following processes:

- the presence and operation of Lake Nillahcootie
- the construction of irrigation supply and drainage schemes
- the presence and operation of numerous weirs, both on the Broken River and Broken Creek
- progressive extraction of water from the Broken River and Broken Creek for irrigation and stock and domestic water supply
- changes to the form of the channel due to channelisation and snag removal
- changes to floodplain drainage through the construction of levees and drains.

1.4 THIS REPORT

This report was prepared by Molino Stewart for the Emergency Services Commissioner.

The report provides an outline of the review methodology in Section 2. In Section 3, the report presents the main findings of the review in relation to the Terms of Reference (Section 1.1). Section 3 also provides a summary of findings in relation to the Framework (see Section 2.1).

Section 4 is a reflection and discussion of the main issues emanating from Section 3. In particular, it compares and contrasts findings related to Numurkah and Nathalia, and attempts to identify reasons for these differences. Section 5 is the report conclusion and Section 6 lists the references cited in the review.
2 METHODOLOGY

2.1 OESC PERFORMANCE MONITORING FRAMEWORK (draft)

As part of its role to provide assurance on the effectiveness of Victoria’s emergency management arrangements, the OESC is developing a Performance Monitoring Framework (Framework) to track the performance of elements of emergency management across all hazards. Once finalised, the Framework will enable the OESC to use a consistent post-incident approach to measure performance to support improvement across the emergency services sector.

Using the Framework across the spectrum of Prevention, Preparedness, Response and Recovery (PPRR), the Framework lists a series of Expectations with accompanying Key Performance Questions and Performance Measures/Evidence. The section of Framework relevant to the Terms of Reference of this review is provided in Appendix A.

2.2 LINES OF ENQUIRY

The Lines of Enquiry (evaluation plan) are the starting point or basis for the review. The Lines of Enquiry also identify the data sources (Sections 2.3 and 2.4) related to the relevant parts of the Framework (Section 2.1).

In consultation with the OESC, Molino Stewart refined the Lines of Enquiry prior to starting the review. The final Lines of Enquiry are provided in Appendix A.

2.3 PRIMARY DATA SOURCES

Primary data sources were the first-hand evidence provided by participants or observers at the time of events. As outlined in the Lines of Enquiry (Appendix A), the following main primary sources were used in the review:

- community survey responses (see Section 2.3.1)
- stakeholder interview responses (Section 2.3.2)
- workforce survey responses (Section 2.3.3)
- public submissions about the flood (Section 2.3.4)
- media releases
- maps (see Section 1 for examples)
- emergency agency de-briefs
- emergency agency situational reports for example by the intelligence cell at the Shepparton Incident Control Centre (ICC).

2.3.1 Community survey

Strahan Research Pty Ltd was engaged by the OESC to conduct a community telephone survey. The questions were developed in consultation with the OESC and Molino Stewart.

“The objective of this research was to elicit the actual experience of households of the flood events and to understand their attitudes, values and expectations of emergency management information, processes and response services related to the flood”.
Specifically the research addressed:

- risk perception of floods including plans and risk management
- household and community planning for floods
- experience of and satisfaction with emergency response
- official warnings and information sources
- householder experiences, decisions and actions
- evacuation experience
- demographics including age, gender, disability, income group, language spoken at home and geographic location.

A telephone survey of 528 households was conducted in ten targeted localities in North-East Victoria between 10th and 21 July 2012. These were categorised into four areas.

- Numurkah area (Numurkah)
- Nathalia area (Nathalia)
- Mid-area (Congupna, Katandra West, Tallygaroopna, Wunghnu/Karimba)
- Remaining areas (Barmah/Picola, Katamatite, Tungamah, Walwa).

A stratified sample was drawn from these. Applying a confidence limit of 95 percent, the total sample results are within 3.9 percent of population values of all areas surveyed.

The demographics of the survey can be compared with that from the Australian Bureau of Statistics (2012), part of which is outlined in Section 1.3.1. Of note in terms of differences is the older population surveyed (71 percent were 45 years and older) compared with the average of about 50 percent were 45 years and over across the study area from the 2011 census data. Also, in terms of gender, 58.7 percent of the surveyed population were female compared with 48 percent across the study area from the 2011 census data.

About 60 percent of the survey respondents lived in a house in a residential area, with almost all of the others living on a farm or rural residential property.

The findings of the survey are summarised and related to the Terms of Reference in Section 1.1.

### 2.3.2 Stakeholder interviews

Stakeholders from across the emergency services that were involved in the flood were also seen by the OESC as an important source of evidence for the review. Molino Stewart, in consultation with the OESC, prepared a set of stakeholder interview questions in relation to the Lines of Enquiry prior to the interviews. A sample of the interview questions is provided in Appendix B.

The following organisations were interviewed by Molino Stewart:

- VICSES
- Country Fire Authority
- Parks Victoria
- Victoria Police
- Goulburn Broken Catchment Management Authority
- Department of Sustainability and Environment
- Greater Shepparton City Council
• Towong Shire Council
• Moira Shire Council

The BoM was interviewed by the OESC.

The interviews were conducted with personnel from State, Regional, Incident Control Centre (ICC) and Divisional Command levels. A total of 17 interviews were conducted from 17 to 27 July 2012.

The findings of the stakeholder interviews are summarised and related to the Terms of Reference in Section 1.1.

2.3.3 Workforce survey

An online survey (undertaken as part of VICSES’ After Action Review) of the field workforce that was involved in the emergency management response was conducted by VICSES using Survey Monkey. There were three categories of workforce personnel interviewed:

1. Incident management personnel (70 responses to the survey)
2. Specialist support personnel (19 responses)
3. Field operations personnel (108 responses)

Although the survey was conducted independently to this review, there are some questions that can provide evidence to support the Lines of Enquiry (Appendix A), and relevant responses are summarised in Section 3.1.

2.3.4 Public submissions

The OESC advertised the review data collection process (including the community survey) to communities in the study area during July 2012. It also provided the opportunity for members of these communities to provide written submissions regarding the flood during this period. Only five written submissions were received; however, these do provide individual insight into the flood that have been analysed and used; particularly in Section 4.

2.4 ADDITIONAL DATA SOURCES

Secondary sources are materials that digest, analyse, evaluate and interpret information contained within primary sources or other secondary sources. Related to the Lines of Enquiry, the main secondary sources accessed for this review were:

• legislation
• plans
• policies
• procedures
• census reports
• technical flood reports
• previous flood reviews (see Section 4.3).

These secondary sources are listed in the references (Section 6).
2.5 LIMITATIONS

There are some limitations that should be acknowledged for this review.

1. Due to the time elapsed (four months) after the flood event, the memory of details for those interviewed may have blurred. Ideally, the community survey should be conducted within one month after the flood event to enable specific details of the incident to be retained by respondents.

2. The survey respondents are self-reporting their preparedness levels; for example written emergency plans, emergency kits, and the responses could not be validated through proof of these preparedness activities.

3. There was a small sample of stakeholder interviewees from those involved in the flood incident. It should be noted, therefore, that the results in Section 3.2, relating to the stakeholder responses, are based on this small sample and should only be viewed as indicative.

4. As there was no river gauge at Numurkah, no prediction capability was possible, nor was there any meaningful flood intelligence available (further discussed in Section 4).
3 FINDINGS

3.1 COMMUNITY PREPAREDNESS

3.1.1 Risk awareness

Risk perception is one factor that may lead to preparedness and appropriate response (Paton, McClure, & Burgelt, 2006; Grothmann and Reusswig, 2006).

Respondents to the community survey were asked if they were aware there was a flood risk in the area prior to the floods. The survey found that about three-quarters of respondents across the study area said they were aware there was a flood risk in their area prior to the floods.

There was a variation across the communities of the study area. Nathalia had the highest level of reported flood risk awareness (90.7 percent) compared with the Mid-area settlements (see Section 2.3.1), with only 66 percent, and Numurkah with 73.8 percent.

3.1.2 Community pre-planning

Emergency kit

The VICSES FloodSafe program promotes the preparation of an emergency kit as an important flood preparedness precaution for members of the community. The preparation of the kit is, therefore, one indicator of community preparedness. The emergency kit includes a torch, first aid kit and battery-powered radio.

Respondents to the community survey were asked if they had prepared an emergency kit. Thirty-five percent of respondents across the study area said they had prepared an emergency kit prior to the floods. The lowest level of reported emergency kit preparation was Numurkah, with 30.2 percent, and the highest being Nathalia (43 percent).

Emergency plan

The FloodSafe program also educates people in flood-affected communities to prepare a written emergency plan for their households, business or farm. The preparation of the emergency plan is another indicator of community preparedness.

The community survey asked respondents if they had prepared a written emergency plan for their household. Only 9.1 percent of respondents across the study area said they had prepared a written emergency plan for their household. The highest level was for Nathalia (15 percent), with Numurkah having the lowest level (4 percent).

The results for those having a written emergency plan for their farm or business were considerably lower than for households. Across the study area, of the 48 percent of respondents who lived on a farm or owned or ran a business, only 2.7 percent said they had a written emergency plan for their farm or business prior to the floods. Again, Nathalia had the highest level with 6.5 percent, and Numurkah had the lowest level with 0.7 percent.

Of the households and businesses that said they had a written emergency plan, 39.7 percent reported that they had used the plan in the March 2012 flood event. Nathalia (45.5 percent) and Numurkah (42.9 percent) had the highest reported levels of emergency plan use during the flood.
3.1.3 Involvement in mitigation planning

Community survey respondents were asked if they or any member of their household had been involved in or contributed to flood planning in their community. Flood planning for the communities in the study area is detailed and discussed in Section 4.

About one-third of respondents said they or another member of their household had been involved or contributed to flood planning in their community. Residents of Nathalia had the highest levels of flood planning involvement with 43 percent, whilst Numurkah (23.5 percent), and the Mid-area communities (23.1 percent) had the lowest levels of involvement.

3.1.4 Understanding of roles

The draft Framework includes an expectation that the community, individuals, businesses, volunteers, emergency service providers (ESPs) and other government agencies understand their roles in the event of an emergency so they can respond in an effective, coordinated and timely way.

With this expectation in mind, respondents to the community survey were asked which of the following organisations they thought was responsible for helping them deal with this emergency. The results from across the study area were:

- VICSES (75 percent)
- CFA (39.4 percent)
- Local Government (39.4 percent)
- Police (34.1 percent)
- Army (8.7 percent).

The above confirms that the majority of people knew (correctly) that VICSES was the lead control agency for flood events. However, about one-quarter of those surveyed did not acknowledge VICSES as an ESP, possibly due to its lack of volunteer capacity in the smaller townships. This is confirmed in Numurkah – where there is a VICSES Unit of about 20 volunteers – having a higher level of VICSES confirmation (81.9 percent) compared to Nathalia (69.2 percent) where there is no VICSES Unit in the town.

Respondents were also asked to identify those organisations they thought were the most important in providing them help in this emergency. The VICSES was ranked more than twice as important as the CFA and Local Government, and almost three times more important than police. In Numurkah, the VICSES was viewed as about 2.5 times more important than the next organisation, Local Government. In Nathalia, it was slightly more than 1.5 times greater than the next-placed Local Government.

Regional and local stakeholder interviewees were asked if prior to the flood the community and ESPs understood their roles in the event of a flood emergency. Thirty-three percent of interviewees thought there was an understanding in communities and emergency services and other agencies, whilst 67 percent thought there was not an understanding of the roles.

There was a feeling from interviewees that the Nathalia and Tallygaroopna communities generally had a good understanding of their roles. One interviewee commented that a FloodSafe education program was being developed for Nathalia and should be rolled out throughout communities across the study area. According to another interviewee, there had been a community meeting at Tallygaroopna as flood waters were rising which helped clarify roles and led to actions; for example organising pumps and checking issues with irrigation channels. Also, there were local residents at Tallygaroopna who apparently had a good understanding of potential flood behaviour based on previous flood experience.
On the other hand, those interviewees who thought the communities did not understand their roles mainly cited the extended recent drought as a cause of complacency and contributing to a lack of understanding, particularly in terms of evacuation.

The few interviewees who thought ESPs understood their roles cited the Municipal Emergency Management Plan (MEMP) as the key document in clarifying roles. Some interviewees also thought there was confusion; particularly in Numurkah, as to the respective roles of the Divisional Command and the VICSES Unit for flood response.

3.1.5 Self-efficacy

Self-efficacy is people’s assessment of their resources; for example confidence, to enable an action (Paton, McClure and Burgelt, 2006). It is also an important factor in flood preparedness and appropriate flood response (Paton, McClure and Burgelt, 2006; Grothmann and Reusswig, 2006)

Community survey respondents were asked how confident they were in doing the following if their neighbourhood was threatened by a flood:

- “Keep yourself safe”
- “Keep your family members safe”
- “Protect you house and property”
- “Help your neighbours”

The results for respondents that agreed they were confident to carry out these actions are provided in Table 2.

Table 2: Self-efficacy of respondents

<table>
<thead>
<tr>
<th>Action</th>
<th>Numurkah</th>
<th>Nathalia</th>
<th>Mid-area</th>
<th>Remaining areas</th>
<th>Study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep safe</td>
<td>91.3%</td>
<td>90.7%</td>
<td>93.3%</td>
<td>94.9%</td>
<td>92.6%</td>
</tr>
<tr>
<td>Keep family safe</td>
<td>79.2%</td>
<td>82.2%</td>
<td>91.8%</td>
<td>94.9%</td>
<td>87.1%</td>
</tr>
<tr>
<td>Protect house &amp; property</td>
<td>70.5%</td>
<td>72.9%</td>
<td>79.1%</td>
<td>79.0%</td>
<td>75.4%</td>
</tr>
<tr>
<td>Help neighbours</td>
<td>78.5%</td>
<td>76.6%</td>
<td>76.1%</td>
<td>84.1%</td>
<td>79.0%</td>
</tr>
</tbody>
</table>

As shown in Table 2, there is a high level of self-efficacy in relation to people keeping themselves and their families safe. This declines to about three-quarters of people for protecting house and property (possibly influenced by experiences in the March 2012 floods) and close to four-fifths for confidence in helping neighbours. As is also shown in Table 2, there is a high level of consistency in responses across the communities in the study area.

3.1.6 Vulnerable people

As shown in Section 3.1.5, over 90 percent of respondents believed they could keep themselves safe in a flood. However, there were about seven percent that felt they were not confident or “didn’t know”. These people would include vulnerable people; for example elderly, sick or disabled, in the community.
There is no current requirement for flood-prone areas to hold a vulnerable persons register; only one of the three local council interviewees confirmed that their council had a Vulnerable Persons Register. The two councils that did not have a Vulnerable Persons Register hoped to develop one. One council cited “understaffing” as a reason for not developing the register.

3.2 EFFECTIVENESS OF PUBLIC INFORMATION AND WARNINGS

One of the expectations in the draft Framework states that members of the community receive timely, relevant and tailored information in an appropriate format about the proposed response and actions they should take.

3.2.1 Threat information sources

Community survey respondents were asked the open-ended question how they first found out about the flood threat to them/their community. The top eight flood information sources were:

1. Saw water rising/heavy rain (18 percent of respondents)
2. Radio (17.8 percent)
3. Television (13.3 percent)
4. Locals advised/neighbours warned (11.2 percent)
5. When we were flooded/in the absence of any warning (8.4 percent)
6. Experience/local knowledge (6.9 percent)
7. Emergency services (5.5 percent)
8. Upstream communities flooded (4.4 percent)

Thus, apart from observation, radio and television were the main sources of information about flood threat.

Although there has been extensive recent literature on the use of social media in providing flood information (Queensland Police Service, 2011; White, 2012), only 1.1 percent identified social media as their first source of information in this flood event. Also, only two percent first accessed the internet.

Also from the survey results:

- Emergency Alert messages – either delivered by landline or mobile phone – provided first information to about four percent of survey respondents.
- Local community meetings run by the ESPs were identified by about three percent of the respondents.
- 8.4 percent of respondents indicated that they received no prior information before being flooded.

3.2.2 Timeliness of information

Community survey respondents were asked if after they first found out about the flood threat whether they had enough time to act to prevent harm to: themselves; their family; their property. The results are summarised in Table 3.
Table 3: Respondents’ assessment of timeliness of threat information

<table>
<thead>
<tr>
<th>Action</th>
<th>Numurkah</th>
<th>Nathalia</th>
<th>Mid-area</th>
<th>Remaining areas</th>
<th>Study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enough time to protect self</td>
<td>81.2%</td>
<td>90.7%</td>
<td>79.1%</td>
<td>87.0%</td>
<td>84.1%</td>
</tr>
<tr>
<td>Enough time to protect family</td>
<td>67.8%</td>
<td>82.2%</td>
<td>78.4%</td>
<td>85.5%</td>
<td>78.0%</td>
</tr>
<tr>
<td>Enough time to protect property</td>
<td>72.3%</td>
<td>88.8%</td>
<td>69.2%</td>
<td>72.5%</td>
<td>75.0%</td>
</tr>
</tbody>
</table>

As shown in Table 3, at least three-quarters believed that the initial flood information was timely to allow them to take actions to protect themselves, their family and their property. It should be noted that the results from Numurkah was lower than the average for the study for self, family and property. On the other hand, Nathalia had above average results for each.

3.2.3 Satisfaction with flood threat information

Community survey respondents were asked how satisfied they were with the way they first found out about the flood threat to their community.

About two-thirds of respondents were satisfied or very satisfied with the way in which they first found out about the flood threat. On the other hand, about one-quarter were either dissatisfied or very dissatisfied with the way they found out. The community with the most dissatisfied respondents was Numurkah (38.3 percent).

The primary reasons that respondents were satisfied with the initial flood information were:

- Had time to prepare/early warning (24.5 percent)
- Information good/knew what was happening (12.8 percent)
- Rely on local knowledge/experience (8 percent).

The main reasons for respondents’ dissatisfaction were:

- Emergency services did not warn/support (7.2 percent)
- No warning given (7.2 percent)
- Warning too late/ no time to act (6.1 percent)

People living in Numurkah (12.4 percent) more than others were dissatisfied with the way they first found out about the flood threat, because the emergency services did not warn or support them.

3.2.4 Access to information during the flood

Community survey respondents were asked if they were able to obtain information they needed about the flood.

Eighty-five percent of respondents from across the study area confirmed that they were able to obtain the information they needed about the floods.
People living in Numurkah (25.7 percent) more than others were not able to obtain the information they needed. Of concern is that households from across the study area with a member with a disability (22.6 percent) also said they were unable to obtain the information they needed.

### 3.2.5 Information sources during the flood

Community survey respondents were asked to identify the sources that they received flood information from during the flood.

Across the study area, the primary sources of information used during the flood were:

- Neighbours (40.5 percent)
- Emergency services for example VICSES, CFA, Police (33 percent)
- Television (26.7 percent)
- ABC Local Radio (21.8 percent)

Only 17.6 percent reported that they used the Internet to obtain information during the flood.

People also received information from other sources, predominantly community meetings.

### 3.2.6 Ways to improve community information

Respondents were asked to identify ways to improve access to flood information. About 40 percent believed that either access to information could not be improved, or that it had been shown to be adequate to their needs.

The main improvement suggested was better access to local knowledge, including the experience and insights of locals.

Respondents were also asked about ways to provide more timely and useful information to them. The most popular response was “nothing more needed” (14.3 percent). Other responses were:

- Use local radio/TV/local focus (12.2 percent)
- Emergency Alert/SMS messages (11.8 percent)
- Local information up-to-date/correct/clear (10.7 percent).

### 3.2.7 Community actions to lessen flood impact

Community survey respondents were asked about the actions they took once they became aware of the likely impact of the floods.

The responses were almost evenly split, with 45.7 percent of all respondents saying they needed to take actions, compared with 54.3 percent saying they did not take actions or took limited actions.

Those living in Numurkah (61.5 percent) had a higher level of taking no or limited action than the other communities in the study area.

The three main actions of all respondents who took an action to lessen the flood’s impact were:

1. Checked on family and friends (88 percent)
2. Listened to the radio and/or television to get information (53.9 percent)
3. Checked on vulnerable people (53.9 percent)

Respondents also moved their car (47.3 percent), their animals, including stock and pets (46.1 percent), or lifted furniture (45.2 percent).
In addition, 62.2 percent of respondents who took action said they sandbagged their property. Those living in Numurkah (87.7 percent) more than other communities sandbagged their properties.

From the above it is clear that due to the extent of inundation in the town, Numurkah residents either took no action or, if they did take action, mainly sandbagged their property.

### 3.2.8 Evacuation warnings

Evacuation warnings were issued to a few communities in the study area (see Table 1), such as Walwa (Remaining-area), Tallygaroopna (Mid-area), Congupna (Mid-area) and Nathalia. No evacuation warning was issued to Numurkah residents.

More than one-third (34.3 percent) of respondents from across the study area said that they received an evacuation warning during the flood. It was Nathalia respondents (84.1 percent) that primarily reported receiving an evacuation warning. About one-third of respondents from the Mid-area and Remaining areas said they received evacuation warnings, whilst understandably virtually no respondents from Numurkah said they received an evacuation warning.

The main source of receiving an evacuation warning was Emergency Alert (44.2 percent). Other sources included direct evacuation warnings from the VICSES (20.2 percent) and from police or other ESPs (17.8 percent).

Those respondents living in Nathalia (59 percent) and localities in the Mid-area (58.3 percent) tended to receive an evacuation warning through Emergency Alert. On the other hand, people living in the remaining area (44 percent) tended to receive a warning through the VICSES.

About 14 percent of respondents across the study area believed that they should have received an evacuation warning but did not. The main group concerned about not receiving an evacuation warning was the respondents from Numurkah.

About 20 percent of respondents from across the study area said that they evacuated during the flood (whether due to an evacuation warning or not). By far the main community to evacuate was Nathalia (38.3 percent of responses), which did receive an evacuation warning. On the other hand, there were still 13.5 percent of Numurkah residents that reported evacuating, even though an evacuation warning was not issued in the town.

Respondents tended to evacuate as soon as they received their first evacuation warning. This was particularly evident in Nathalia where 63.4 percent of respondents that evacuated, did so as soon as they received the first evacuation warning. On the other hand, respondents from Numurkah tended to evacuate as floodwater entered their property or house.

The main reason (59.3 percent of responses) for evacuating was that respondents were concerned about the safety of their family. Some that evacuated also did so because they were advised to evacuate by the emergency services (20.4 percent).

Of those who evacuated across the study area, 69.4 percent of respondents went to stay with friends or family. Only five percent said they went to an evacuation or relief centre in the area.

The main reasons for not evacuating cited by respondents were:

- Their property was not threatened (42.3 percent)
- There was no threat to themselves and/or their family (32.9 percent).

A few of the stakeholder interviewees were critical of the triggers used by the Shepparton ICC to disseminate evacuation warnings; particularly at Nathalia. They thought that the town was asked to evacuate too early, and a belief the town would not be inundated. They also identified issues with evacuation routes leading from Nathalia to the evacuation centre at Cobram. This route had areas that had been inundated by floodwaters, putting evacuees further at risk.
3.3 EFFECTIVENESS OF INCIDENT MANAGEMENT ARRANGEMENTS

3.3.1 Assistance required by communities

Community survey respondents were asked if they required assistance from any organisation during the flood.

From across the study area, 22.2 percent of respondents confirmed that they needed help from an organisation during the flood. Respondents from the Mid-area (31.3 percent) were most likely to require assistance, with Nathalia (14 percent) requiring the least level of assistance. The main type of assistance required was sandbagging (22.5 percent of responses).

About three-quarters of respondents said they were satisfied or very satisfied with the assistance they received. The main reasons given were: helpful; prompt/timely help; and, job done well/hardworking.

Across the study area 18.6 percent of respondents were dissatisfied or very dissatisfied about the assistance they received. There was a higher level of dissatisfaction in Nathalia (33.3 percent) and Numurkah (25 percent) in comparison with other communities. The main reason for dissatisfaction was that respondents did not receive assistance with their property or, in some cases, felt that it was inadequate.

3.3.2 Community confidence in the planned response by emergency services

Community survey respondents were asked about how confident they were that the planned response by the emergency services to the flood would protect themselves and their community.

More than half (57.9 percent) of all respondents were fairly confident or very confident that the planned response by the emergency services would protect them. About the same level (56.2 percent) were fairly confident or very confident that the emergency services’ response would protect their community. Levels of confidence were greatest in Nathalia (74.8 percent for themselves; 70.1 percent for their community).

The main reasons why respondents were confident that the planned response would protect them and their community were that the emergency services:

- Were well-organised, efficient and knew what they were doing (10.8 percent of responses)
- Provided assistance, doing the best they possibly could under difficult circumstances (9.9 percent)
- Were extremely hard working and continuously on the job (9.8 percent).

Across the study area, 26.8 percent were not confident at all that the planned response by the emergency services would protect them. A similar result (27.9 percent) was obtained for not being confident at all in relation to protecting the community. Levels of lack of confidence in the planned response were greatest in Numurkah (36.5 percent for themselves; 40.5 percent for their community) and the Mid-area (33.5 percent for themselves; 34.3 percent for their community).

The main reasons for lack of confidence in the planned response were:

- Gave no or inadequate assistance in preparing for or dealing with the flood (10.3 percent) and no or inadequate warning or advice (5.1 percent)
- Lacked knowledge of the area and made mistakes and bad decisions (8.1 percent)
- Ignored knowledge and advice that was provided by locals with previous flood experience in the area (7.3 percent)
• Were badly organised and managed (6.3 percent)
• Did not see small villages, isolated communities or farms as important, and did not give them any priority (3.4 percent).

3.3.3 Community ideas for improvement

Community survey respondents were asked: “if you were flooded again, what things should be done differently to better assist you?”

There was a broad range of responses to this question, with listening and using local knowledge/experience in preparing for and dealing with the flood emergency (13.6 percent of responses) the most popular suggested improvement. This improvement was identified most in Nathalia (20.9 percent) and Numurkah (17.5 percent).

Other suggested improvements included:

• Address infrastructure issues, including building drains, levees and pumping systems (12.5 percent), and maintain and clean creeks and drains (3 percent)
• Provide earlier warnings, including more timely Emergency Alerts (10 percent)
• Improve local information on the flood, so that they know what is going on in their area, including up to date information on flood levels and projections and rain forecasts (6.4 percent)
• Provide more resources for preparing for and dealing with the flood, including more personnel, sand and sandbags and pumps (5.9 percent)
• Prepare and respond earlier, including establishing plans, organisation and defences (5.8 percent)
• Improve communication with the community, including regular local meetings, announcements on local media, and use of local websites (5.1 percent)
• Better organisation, management and coordination of the emergency services, so that they can provide effective leadership and support during the emergency (5.1 percent).

It should be noted that a significant proportion of respondents (15.9 percent) believed nothing should be done differently if the area was flooded again.

3.3.4 Seamless and integrated approach

As per the Framework, there is an expectation that ESPs collaborate with each other to deliver a quality, seamless, integrated, “one sector” approach to emergency management for the community.

State and regional-level stakeholder interviewees were asked if they believed a seamless and integrated approach was provided to the community by ESPs during the flood. Only 37.5 percent felt there was a seamless and integrated approach delivered for this incident. Some of the interviewees, who answered “no”, qualified their response by saying that in some areas, such as Walwa, there was a seamless and integrated approach, whilst particularly in Numurkah there was not.

The main reasons for those thinking the approach was seamless and integrated was that they observed good procedures in place and strong interagency support and cooperation.

It was also reported that there were effective interrelationships between the State Control Team and the State Emergency Management Team throughout the incident. The interrelationships between Regional Control and the Regional Emergency Management Team were also reported by several interviewees as being effective throughout the flood.
Those interviewees who felt there was not a seamless and integrated approach cited a range of reasons including:

- The lack of capacity of VICSES and, therefore, its heavy reliance on DSE and the CFA in flood events. This impacted on the ease of scaling up for the flood.
- “Cultural differences” between the agencies, with still some competition (although a few interviewees believed this issue was improving since the 2010-11 floods).
- Early information suggested that the main flood threat was further to the east; for example Wangaratta, with main resources deployed there, which then had to be quickly deployed to the west.
- Lack of flood intelligence data; particularly for Numurkah.
- ICC and Divisional Command links to the field were “not dynamic” – some field crews had to send photographs of the flood via their personal smart phones, as the CFA and VICSES information systems were not compatible.
- Lack of training of some VICSES personnel in AIIMS.

The main five issues identified by stakeholder interviewees for improvement to deliver a seamless and integrated approach to the incident were:

1. Greater resourcing for VICSES (personnel and funds)
2. Further rolling out and training for VICSES personnel in AIIMS
3. A greater coverage of flood studies, floodplain management plans and municipal flood plans across the region to provide a better basis for flood intelligence.
4. Increased community flood education and engagement; for example FloodSafe program, to help communities in the region understand their flood risk, become better prepared and know how to respond appropriately to a flood.
5. Improving the compatibility of systems across the agencies and conducting cross-agency pre-event exercising using these compatible systems.

### 3.3.5 Interoperability of personnel

As per the Framework, there is an expectation that ESPs’ workforces share a core set of skills and competencies so that, during a major or extended incident, personnel can operate between ESPs without adverse impacts on the level or the quality of services provided to the community.

Workforce survey respondents were asked if the emergency services worked well together in this operation. Incident management personnel were the only category asked this question, and 55.4 percent agreed that the agencies worked well. Only 3.6 percent said they did not, with 41.1 percent saying they worked partly well together.

All categories of workforce survey respondents – incident management, specialist support, field operations – were asked to rate the multi-agency response in the flood operation using a Likert scale ranging from “poor” to “excellent”. The results are shown in Figure 5.

As shown in Figure 5, well over half of the incident management personnel rated the multi-agency response as “above average” or “excellent”, although 8.8 percent of incident management personnel rated it as “below average”. On the other hand, less than half (46 percent) of the field operations personnel rated the multi-agency response as “above average” or “excellent”, with 6.3 percent rating it as “poor”.

Stakeholder interviewees were also questioned in relation to any interoperability issues they identified during the flood event. Of those interviewed, 72.3 percent said they experienced or knew of interoperability issues during the flood.

Four interviewees felt there was a lack of coordination in Numurkah between the local CFA, which housed the Divisional Command and the local VICSES Unit. They believed this hampered the planned response in that town.

At a regional level, one interviewee identified the inability to utilise DSE personnel due to their involvement in planned burn operations elsewhere in the State.

A few interviewees believed that the approach required for fire and flood is different at the ICC, and this needs to be further clarified and included in future training in all agencies.

### 3.3.6 Interoperability of information and communication systems

Several interviewees reported issues with incompatible systems (radio frequencies, information systems) used by the VICSES and the CFA. This was supported by comments in agency de-brief meetings.

### 3.3.7 Incident management coordination and communication

Stakeholder interviewees were asked if they believed that there were plans/processes/protocols in place to ensure the incident was well-managed, coordinated and communicated. Only one interviewee believed that plans/processes/protocols were not in place. This interviewee believed that there should be more templates available for the Divisional Commander to help guide his/her role.

Only 40 percent believed that the plans/processes/protocols achieved the desired outcome in the flood. Of those who thought this, most thought that coordination and communication was better in the
east for example at Walwa. Some thought that the use of plans/processes/protocols was effective at the regional and state level.

Of the 60 percent of interviewees who did not believe the incident was well managed, coordinated and communicated, the main reasons for this view according to the interviewees were:

- Lack of flood intelligence particularly for Numurkah.
- According to the Divisional Command and VICSES interviewees at Numurkah, advice was received from the Shepparton ICC that the hospital was not under threat of flooding, therefore the hospital evacuation plans were not activated.
- There were some cases of personnel at Divisional Command level not being replaced and working excessive hours.

The above issues are supported by agency de-brief notes.

3.3.8 Local level input used in incident management

Stakeholder interviewees were asked if there were plans/processes/protocols in place to ensure the appropriate local level of input was taken into account. All but two interviewees felt that there were appropriate plans/processes/protocols in place to access local level of input. One interviewee could not identify a procedure for providing Divisional Command input to the Shepparton ICC (a state level interviewee confirmed that there was no protocol for taking in local knowledge).

However, only 37 percent of interviewees believed that the plans/processes/protocols achieved the desired outcome of using an appropriate local level of input. The main reasons for believing that the desired outcome was reached, included practice with recent minor floods, local people listened to by the Nathalia Divisional Command, and the effective use of community meetings to obtain local residents’ knowledge and experience.

Of those who did not feel there was an appropriate local level of input, the main reasons offered were:

- Nathalia and Numurkah Divisional Commands reported the communication linkages with the Shepparton ICC as “poor”. Interviewees from the Divisional Commands and the Numurkah VICSES Unit felt their local knowledge input was not being listened to by the Shepparton ICC.
- Some interviewees from the ICC felt that the local knowledge particularly originating from local residents was difficult to filter and validate.
- No Flood Warden or local flood observers program in place, therefore it is difficult to know who in the local community to go to for reliable local input.

The above issues are supported by agency de-brief notes.

3.3.9 Understanding of ESPs’ roles and responsibilities

Stakeholder interviewees were asked if plans/processes/protocols were in place to ensure that there was a clear understanding of roles and responsibilities during the incident between State, Region, the ICC and Divisional Command.

Almost all interviewees thought that the plans/processes/protocols were in place. However, some questioned whether there were protocols regarding the role of the Divisional Command in relation to the other tiers. Two interviewees also questioned the role of the region in the incident and felt there was “too much noise from above” that could distract the Incident Controller who should be talking directly with the State Control and Divisional Command.

Only 27 per cent of interviewees thought that the plans/processes/protocols achieved the desired outcome in terms of clear understanding of roles and responsibilities. The main concerns were:
The roles of the Divisional Command and the VICSES Unit at Numurkah were not clearly defined in relation to the Shepparton ICC. The Divisional Command could have used the VICSES Unit as a sector under its command but did not do so. However, according to one Divisional Command interviewee, they did not know their role due to lack of training. The poor clarity caused confusion about, and in some cases duplication of, operational activities, such as sandbagging.

The role of the CMA was not clear to all interviewees, however CMA were co-opted into the intelligence cell of the Shepparton ICC. CMA is undertaking AIIMS training at the invitation of VICSES.

There is a need for more AIIMS training at the local level.

The above issues are supported by agency de-brief notes.

### 3.3.10 Timely and quality decisions made by ESPs

Stakeholder interviewees were asked if plans/processes/protocols were in place to ensure there were timely and quality decisions made at all levels.

Several interviewees did not believe that there were adequate plans/processes/protocols at the local level, although the state and regional plans/processes/protocols were in place; for example, State Flood Plan and Regional Flood Plan. Of major concern was the lack of consistency in the standard of municipal flood plans across some parts of the study area. This hampered the ability of ESPs to understand flood behaviour and make timely and quality decisions.

The majority of interviewees (56 percent) believed that timely and quality decisions were made during the flood event by ESPs. However, this view was mainly from state, regional and local council interviewees. Local level interviewees tended to feel that the Shepparton ICC was too slow in decision-making; particularly in relation to the fast rising flood waters at Numurkah.

The above issues are supported by agency de-brief notes.

### 3.3.11 Timely and adequate intelligence

Stakeholder interviewees were asked if plans/processes/protocols were in place to ensure that timely and relevant intelligence was received to inform both decision-making and community information and warning messages.

Some interviewees commented on the inconsistent standard of municipal flood plans for those communities that have them. The VICSES is moving to improve this issue through the use of a standard template for these plans.

Only 36 percent of interviewees thought that the plans/processes/protocols achieved the desired outcome to provide timely and relevant intelligence. Apart from the issues discussed above in this section, others issues raised were:

- Flood warnings issued by the BoM were generally viewed by interviewees as sound, although initially advice was that there appeared to be greater flood threat to the east of the study area; for example Benalla and Wangaratta.

- It was apparently difficult for the Shepparton ICC initially to extract BoM warnings for the Broken Creek catchment, as they were included under the Broken River warnings. This was due to the lack of an established flood warning system for Broken Creek.

- It was apparently difficult for the intelligence unit in the Shepparton ICC to filter local observations due to no protocol in place to assure quality intelligence.

- The VICSES does not have geographic information system (GIS) capability across the State, and thus other GIS capabilities; for example CMA, had to be accessed by the Intelligence Unit at the Shepparton ICC.
- Lack of a flood intelligence system across the State.
- There have been changes across the landscape; (for example laser-levelling, on-farm dams, new irrigation channels, contour banks), which in a flat topography can have a major influence on localised flood behaviour that can further challenge the provision of flood intelligence.

The above issues are supported by agency de-brief notes.

**3.3.12 Were plans enacted?**

Stakeholder interviewees were asked if the Municipal Emergency Management Plan (MEMP) or other relevant local plan was activated during the incident.

From their responses, it is clear that the MEMP(s) were activated in the three LGAs.

**3.3.13 Improvements in incident management**

Stakeholder interviewees were asked to identify ways in which incident management could be improved based on learnings from the flood. The top eight improvements identified were:

1. Conduct flood studies and develop floodplain management plans for townships that do not have them.
2. Improve municipal flood emergency plans for the townships across the study area so that they include a detailed understanding of flood risk and behaviour.
3. Consider further use of the Portable Automated Logger System (PALS), which is able to be rapidly deployed to assist the intelligence cell in the ICC by providing real-time water level information at locations outside the permanent monitoring network. However, it was conceded that there is no substitute for a properly designed, maintained and operational data telemetry network.
4. Clarify chain of command and improve communications from ICC to Divisional Command to VICSES Unit (under Division Command)
5. Conduct inter-agency exercising around flood and fire scenarios
6. Ensure that all ESPs have access to the same information system and radio frequency
7. Build VICSES capability in the new structure of AIIMS through training and pre-event drilling.
8. Increase and improve community flood education across the study area so that residents and businesses are aware of the flood risk, increase their flood preparedness and know what to do in response to a flood.

**3.3.14 Requests for support**

The Emergency Services Telecommunications Authority (ESTA) is responsible for handling Triple Zero calls in Victoria, and providing and managing emergency operational communications for the dispatch of police, fire, ambulance and VICSES.

Data from ESTA shows that on average 90 percent of 132 500 flood emergency calls during the floods were answered within 20 seconds (an ESTA benchmark). It was only on 1 March 2012 that the system appeared stretched, with only 46.7 percent of calls achieving the benchmark due to a spike in calls (14.7 percent of the total calls from across the State).
3.3.15 Support for vulnerable people

According to local and regional stakeholder interviewees, because there was not a vulnerable persons register available in two of the three LGAs (see Section 3.1.6), vulnerable people were sometimes difficult to locate and, sometimes, only located by emergency calls. Nevertheless, with these being small townships, it appears local knowledge helped greatly with locating vulnerable people.

3.3.16 Access to support and essential services

Stakeholder interviewees at the regional and local level were asked if people in the community were well-informed about support and essential services and whether they were provided in a timely way. All these interviewees believed that people in the community were well-informed about support and essential services and that this was provided in a timely way. The main mechanism for providing information in a timely way was seen to be via community meetings, which were generally well-attended across the study area. Other mechanisms for disseminating information were by radio announcements, electronic bulletins, newsletters and by doorknocking.

Two issues identified were:

- Difficult to service medical needs of people, as supplies; for example common medicines, started to run low.
- People who were cut off by floodwaters could not attend community meetings and thus had to use other means; for example radio to obtain information.

3.3.17 Assessment of impacts

Local and regional stakeholder interviewees were asked if the social, economic and environmental impacts of the flood were rapidly assessed and reflected in a well-planned and communicated recovery plan.

All but two of the interviewees agreed that a Rapid Impact Assessment had been made.

The interviewees who thought there were issues said that the assessment found it difficult to locate houses that experienced above floor flooding, particularly in isolated locations; for example farmhouses. These interviewees thought the assessment was slower than anticipated across the flood-impacted area.

3.4 SUMMARY OF FINDINGS

The findings provided in Section 3 are summarised in Appendix A in relation to the Lines of Enquiry.
4 DISCUSSION

The main trend throughout the findings in Section 3 is the considerable difference in the community survey responses of Nathalia respondents compared with Numurkah respondents. These differences are highlighted in Table 4. These related to selected performance indicators from the Framework.

Table 4: Selected significant differences in community survey responses from Nathalia and Numurkah

<table>
<thead>
<tr>
<th>Performance indicator</th>
<th>Nathalia</th>
<th>Numurkah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of flood risk</td>
<td>91%</td>
<td>74%</td>
</tr>
<tr>
<td>Have an emergency kit</td>
<td>43%</td>
<td>30%</td>
</tr>
<tr>
<td>Have a written emergency plan</td>
<td>15%</td>
<td>4%</td>
</tr>
<tr>
<td>Involvement in flood planning</td>
<td>43%</td>
<td>24%</td>
</tr>
<tr>
<td>Time to protect self after receiving warning</td>
<td>91%</td>
<td>81%</td>
</tr>
<tr>
<td>Time to protect family after receiving warning</td>
<td>82%</td>
<td>68%</td>
</tr>
<tr>
<td>Time to protect property after receiving warning</td>
<td>89%</td>
<td>72%</td>
</tr>
<tr>
<td>Not confident that planned response by emergency services would protect them/their community</td>
<td>15%</td>
<td>37%</td>
</tr>
</tbody>
</table>

From Table 4 it is clear that Nathalia residents were more aware, better prepared and more involved in flood planning than Numurkah. It also appears that flood warnings were more timely for Nathalia residents. Numurkah residents had far less confidence that the planned response by emergency services would protect them/their community.

The results in Table 4 prompted further investigation of the reasons for the differences in responses between the two communities.

Another prompt for further investigation was the community backlash; for example as evidenced in media releases, public submissions to this review, to the evacuation of Numurkah hospital after floodwaters entered the building.

Of course, the responses in relation to some of the performance indicators should be seen as no more than a reflection of the reality that one town was more affected by flooding than the other.

Section 4.1 attempts to provide reasons for the differences in responses and for the Numurkah hospital situation.
4.1 KEY ISSUES

4.1.1 Flood planning and mitigation

There are some references in Section 3 to possible issues relating to flood planning and mitigation for Nathalia and Numurkah that require further investigation. The main plans and mitigation options to investigate are:

1. Presence of a levee
2. Flood study and Floodplain management plan
3. Municipal flood emergency plans

1. Presence of a levee

Northfield et al. (2005) found that the damage to Nathalia in a 100 year ARI flood such as 2012 would have been considerable (515 houses affected, 94 commercial and industrial buildings affected) without flood mitigation options. Although Nathalia is a smaller town, a greater proportion of the town is threatened by flooding than Numurkah.

According to SMEC (2005), “during the 1974 flood it was reported that parts of the township of Nathalia were flooded. Following that event a flood study was undertaken to determine the nature of flooding in Nathalia and to identify appropriate flood mitigation options. As a result of the recommendations of that study a levee and floodway system was constructed. During the 1993 flood these works protected the township of Nathalia from extensive flooding”.

Prior to the 2012 flood, and as part of the Nathalia Floodplain Management Plan (SMEC, 2005), the Nathalia town levees were raised along approximately eight kilometres in length. Demountable (portable) flood barriers were purchased and installed ahead of the 2012 flood (Goulburn Broken Catchment Management Authority, 2012).

According to evidence given by the Goulburn Broken Catchment Management Authority to the Victorian Government's Inquiry into Flood Mitigation Infrastructure in Victoria (Environment and Natural Resources Committee, 2012), “the only formal levee scheme on the Broken system is Nathalia. That is the only formal levee system we have in place. We have always maintained the philosophy that a town levee for the community is best managed by the local government agency. In this case it is Moira Shire Council. They can look at routine maintenance of a formal levee scheme. Anywhere else there is not any at all. There are probably less than 15 formal levee schemes across Victoria”.

Thus Numurkah has no formal levee scheme. Instead it has “a couple of levees pushed up in Numurkah down by the caravan park and around. They were pushed up sort of informally, but there is no design, design elevation or freeboard. It is all what are called informal levees put in opportunistically during the flood, but they have not been designed to any standard”. (Environment and Natural Resources Committee, 2012).

2. Flood study and Floodplain management plan

The development of flood studies and floodplain management plans is a key program of the Goulburn Broken Regional Floodplain Management Strategy (Goulburn Broken Catchment Management Authority, 2002). “A flood study characterises the flooding behaviour of the catchment and the results from the hydraulic model produced. The results of the hydraulic model provide information on the flood hazard and a means of assessing the impact of options emerging from the floodplain management studies on flooding behaviour and flood hazard” (SMEC, 2005).

The flood study forms the basis for a floodplain management study leading to development of a floodplain management plan which, through stakeholder and community consultation, identifies
management options to manage flood risk. The three categories of options considered in a floodplain management plan are:

- structural measures (flood modification)
- land use planning measures (property modification)
- flood emergency measures (response modification).

The Nathalia Floodplain Management Plan was developed in 2005. "The preparation of a Floodplain Management Plan for Nathalia was an outcome of the Broken Creek strategy report, which recognised Nathalia as a Number 1 priority. Furthermore, Nathalia was recognised as a high priority under the Draft Regional Floodplain Management Strategy for the Goulburn Broken Catchment Management Authority District" (SMEC, 2005). The management options in the Plan include:

- levee-raising (mentioned above)
- new flood maps
- land use zoning
- flood warning system
- community Awareness and Preparedness
- emergency plans (including the incorporation of flood inundation maps from the flood study).

Most of the management options in the Nathalia plan were implemented prior to the 2012 flood (Goulburn Broken Catchment Management Authority, 2012).

In comparison, Numurkah had a flood study (Tate et al., 2011), but no floodplain management study or floodplain management plan at the time of the 2012 flood. According to evidence provided by the Goulburn Broken Catchment Management Authority to the Victorian Government’s Inquiry into Flood Mitigation Infrastructure in Victoria (Environment and Natural Resources Committee, 2012), "We have not looked at or explored mitigation options for Numurkah at this stage. We have only been doing the fact-finding missions of a flood study at this stage. We are not looking into options, but we should".

Although hydrologic studies had been completed for Numurkah and Nathalia, these studies require calibration to historic events. Upon calibration of the hydrologic models for Numurkah and Nathalia, Northfield et al. (2005) and Tate et al. (2011) did not propose that flood peaks could arrive substantially earlier than historically had been the case. They found that there is considerable uncertainty and complexity in the hydrology given the break out of flows from the Broken River and the lack of stream flow and rainfall data.

3. Municipal emergency management plans

All Victorian local councils are required to have a Municipal Emergency Management Plan (MEMP). For those councils with flood risk, a Municipal Flood Emergency Plan (MFEP) is recommended. The MFEP “contains intelligence on what is at risk from flooding, both riverine and stormwater, within the Municipality. This intelligence should be derived from past experience, flood and drainage study outputs and other sources of flood related information. The MFEP should contain information on what needs to be done to reduce flood impacts and detail flood prevention, preparedness, response and recovery planning arrangements” (VICSES, 2011a).

As a sub-plan of its MEMP, in 2002 Moira Shire developed the Moira Shire Flood Sub-Plan with the most updated version being May 2010. However, because the Sub-Plan predated the Numurkah flood study, the May 2010 version states, “In large flows, flooding of land in and around Numurkah from the Broken Creek causes considerable inconvenience and some property damage. However, the relatively large waterway through Numurkah and the timely operation of the slide doors in the weirs in the town limit the damage to a relatively minor level”. Furthermore, it states, “Although the Town is not seriously threatened by major floods, there are important actions which must be carried out to prevent either the Creek backing up through the town drainage system or other drainage problems”. The Sub-
Plan thus in no way recognised the risks and impacts of a large (above 100 year ARI) flood for Numurkah, nor did it detail appropriate PPRR for this level of flood.

4.1.2 Total flood warning system

There are some references in Section 3 to possible issues relating to flood warning systems for Nathalia and Numurkah that require further investigation.

Analysis of the total flood warning system should be conducted through the Manual 21 Flood Warning (Attorney-General’s Department, 2009). Manual 21 lists six components of the total flood warning system:

1. Monitoring and prediction: detecting environmental conditions that lead to flooding, and predicting river levels during the flood
2. Interpretation: identifying in advance the impacts of the predicted flood levels on communities at risk (includes flood intelligence)
3. Message construction: devising the content of the message which will warn people of impending flooding
4. Communication: disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood
5. Protective behaviour: generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community
6. Review: examining the various aspects of the system with a view to improving its performance

The Victorian Warning Protocol (Office of the Emergency Services Commissioner, 2009) covers several of these components; for example situational awareness and analysis, message construction and dissemination.

From the issues raised in Section 3 and the analysis in Section 4.1.1, the top components require further investigation.

The BoM has responsibility for the monitoring of situations likely to lead to flooding and for the prediction of floods throughout the period of flooding in rural Victoria. It uses a range of data to forecast and make flood predictions that are communicated to the public as Flood Watches and Flood Warnings. Sources of data include rain and stream gauges (from many partner agencies), which are used with forecast rainfall in flood prediction models.

As the flood escalates, the BoM consults with the State Control Centre, Regional Control Centre and the ICC (particularly the intelligence cell) in relation to data inputs, along with advice based on monitoring and prediction activities.

Prior to the 2012 flood, infrastructure upgrades included telemetry at Tungamah (Boosey Creek) and Katamatite (Broken Creek) stream gauges. New gauges were installed with telemetry at Walshs Bridge and Nathalia, both on the Broken Creek. This allowed real time data to be utilised via the BoM (Goulburn Broken Catchment Management Authority, 2012).

On the other hand, there is no permanent stream gauge and telemetry at Numurkah. Predictions had to be made based on the upstream Tungamah and Katamatite gauges, which would have only provided an indication of some of the inflow from a range of tributaries (see Figure 3). A Portable Automated Logger System (PALS) was installed at Numurkah to provide real-time flow data. However, “the first lot (PALS) went in just after the peaks at Numurkah, so we never knew about them”. (Environment and Natural Resources Committee, 2012).

The timeliness of warnings was thus inhibited by the incomplete gauging of the tributaries flowing towards Numurkah and the lack of an associated flood warning system at Numurkah. It should be
noted that the capital costs of stream or rain gauges installed (or upgraded to telemetry) for flood warning purposes are generally shared between the state and the commonwealth, subject to ongoing maintenance and asset replacement costs being borne by local government.

However, although flood warning requires improvement at Numurkah, warnings will always tend to be more accurate and timely in Nathalia, as it is further downstream, giving an increased warning time and substantially more data on which to base a warning. The prediction of flood behaviour in Nathalia is also not confounded by the complex hydrology immediately upstream as it is at Numurkah.

It should also be noted that a Flood Response Plan (in draft) for Nathalia was tested during the flood. “Intelligence was utilised from this draft plan, which provided flood intelligence: mapping; gauged relationships between Walshs Bridge and the Nathalia Gauge; which outlying properties required sandbagging; and when to commence the installation of the demountable barriers” (Goulburn Broken Catchment Management Authority, 2012).

### 4.1.3 Community flood education

Community flood education and engagement are important mechanisms through learning to raise community risk awareness, help prepare communities and encourage appropriate response and recovery behaviours (Elsworth et al, 2009; Dufty, 2012).

Although the Goulburn Broken Catchment Management Authority and Moira Shire Council have roles in community flood education and engagement as per the Nathalia Floodplain Management Plan and MFEP, the primary provider in Victoria is VICSES.

In 2011, VICSES released its Community Education Strategy, 2011-2016 (VICSES, 2011b). The Strategy states that “Community education seeks to build acceptance of natural hazard risks within the community and to collaborate and partner with the community in preparing for them, ultimately strengthening the resilience of communities”.

The VICSES FloodSafe program is the main flood program emanating from the Strategy, and includes a comprehensive range of community engagement events and activities, such as media strategy, local resources (signs, brochure, Local Flood Guide, photos and maps) displays, visits, workshops, partnerships and community days/expos/come and try days.

According to a report prepared by VICSES for this review (VICSES, 2012), VICSES had one full-time member for community education and engagement across the whole of the North East Region and with state-wide education duties.

Prior to the 2012 flood, Nathalia was targeted for community flood education attention. According to the VICSES report, during 2009/2010 Moira Shire Council (in partnership with the VICSES and some consultancies) initiated the Nathalia FloodSafe steering committee to fully fund and implement FloodSafe and a Flood Warning Service Charter for the Broken Creek at Nathalia. This committee had developed, planned, implemented and/or installed:

- a community reference group
- a Flood Warning Service Charter, including the establishment of a FM88 community radio/warning system, and a telephone warning system (operational). This telephone flood warning system was used during Feb/March 2012 floods
- a FloodSafe brochure
- planned a field day and community launch (March–May 2010) to include set up of the flood barriers, bus trip to Walshs Bridge gauge, sandbag demo, BoM demo, school visits, BBQ.
- completed landscaping works and installed the flood barriers in situ (exercise)
- completed community engagement activities, including a FloodSafe display at Nathalia Show (2010) and FloodSafe display at Nathalia IGA (2011)
According to the report, the only community flood education and engagement activities specifically targeted for Numurkah was in 2011 when the Numurkah VICSES unit distributed FloodSafe week posters around the town/community noticeboards, and set up FloodSafe display in Newman Square, and distributed 50 FloodSafe information packs. There were also some broader range activities for FloodSafe Week in 2009, 2010 and 2011 across the study area, including media releases and a school colouring competition.

4.1.4 Summary of prevention and preparedness

From Sections 4.1.2 and 4.1.3, an understanding of the differences in flood prevention and preparedness between Nathalia and Numurkah can be gleaned that helps explain the community responses in Table 5, and the Numurkah Hospital scenario. The differences are summarised in Table 6.

Table 5: Some significant differences between Nathalia and Numurkah in relation to prevention and preparedness

<table>
<thead>
<tr>
<th>Prevention and preparedness activity</th>
<th>Nathalia</th>
<th>Numurkah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levee</td>
<td>Upgraded levee system</td>
<td>No levee</td>
</tr>
<tr>
<td>Flood study</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Floodplain management plan</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Municipal flood emergency plan</td>
<td>Yes</td>
<td>Yes (but no understanding of flood risk and behaviour)</td>
</tr>
<tr>
<td>River gauge and telemetry</td>
<td>Four gauges used in flood warning system including one at Nathalia</td>
<td>No gauge at Numurkah. Dependent on two upstream gauges with only partial catchment coverage</td>
</tr>
<tr>
<td>Flood warning system</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Draft flood response plan for town</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Community flood education and engagement</td>
<td>Targeted and tailored FloodSafe program plan developed and implemented</td>
<td>Limited to FloodSafe Week. No specific FloodSafe program plan</td>
</tr>
</tbody>
</table>

In particular, Table 5 helps to explain differences in risk awareness and preparedness levels in Table 4. One would expect that the FloodSafe program targeted and tailored to Nathalia would assist in community learning to raise risk awareness and encourage the preparation of emergency kits and plans. Furthermore, the lack of a floodplain management plan for Numurkah would help explain why the involvement in flood planning is far lower for that town in comparison with Nathalia.

4.1.5 Local knowledge

From the community survey and public submissions, the main reason for community dissatisfaction with the planned response; particularly in Numurkah, was that the emergency services did not listen to
local knowledge during the 2012 flood (see Sections 3.3.2 and 3.3.3). “Local knowledge” can be interpreted two ways:

1. Experience of previous floods for example 1993, 1974 for the study area
2. Local real-time observations during the flood.

With no gauge in Numurkah the decision was made by the BoM and the Shepparton ICC to directly refer to the 1993 flood (the last major flood in the town) in warnings, as this would trigger recognition of the likely serious nature of flooding. Manual 21 Flood Warning (Attorney General’s Department, 2009) encourages the use of past floods as references to include in warning messages. However, unfortunately from some community feedback (including public submissions), this appeared to encourage specific comparisons by parts of the local community (especially those having previous flood experience) with the 1993 flood behaviour, causing them to not be prepared as well as possible for the faster-than-expected flood peak (Section 1.2.1). Thus “local knowledge” that referenced the 1993 flood would not in hindsight have been useful for ascertaining flood peak timing, although it would have been for flood height comparisons (most of the high water marks from the 2012 flood are higher than the 1993 flood but a number are lower).

Every incident has its individual characteristics that are different from event to event, so it is not advisable to use past history without local intelligence.

What happened in Numurkah illustrates the difficulties inherent in the role of the BoM. On the one hand, it is better that the BoM provide information and warnings than not. On the other, information and warnings are only as good as the information on which they are based, whether it is historical, topographical or based on current data. In many situations the quality of the information will depend on decisions not made by the BoM itself, whether during the flood event itself or during the planning and development of a flood warning service for that area.

As a result, it would be desirable for the BoM, in providing information both to agencies and to the public, to build in caveats relating to the level of confidence that can be placed on what it is providing as predictions. BoM could also draw attention to the difficulty of giving more than broad predictions and warnings where the immediate causes (such as the volume of rainfall in a particular place) are unprecedented and the available data (such as river levels) is not complete or unavailable.

The rainfall totals shown in Table 6 suggest that the difference between the 1993 and 2012 floods may have been caused by the different centres of heavy rainfall, however there are other factors that would have influenced the runoff. In October 1993, there was relatively little rainfall over the Broken Creek catchment with an average of about 120 mm falling in five days. The flood was caused mainly by the large volume of water breaking away from Broken River at Casey’s Weir downstream of Benalla.

On the other hand, there was close to record rainfall recorded in the Broken Creek catchment in March 2012, with an average of 250 mm in six days. The Broken River catchment received considerably less rain and did not even produce minor flooding at Benalla. There was also a large amount of overland flow in the 2012 flood that contributed to the flood behaviour.

The resultant difference in flows and flood peaks between the two floods is shown in Table 7.

Table 6: Rainfall for locations in and around the Broken Creek catchment related to the 1993 flood and 2012 flood
(Source: Bureau of Meteorology website www.bom.gov.au/vic)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rainfall 1 Oct-5Oct 1993</th>
<th>Rainfall 28 Feb-4 Mar 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boorhaman</td>
<td>107.2 mm</td>
<td>299.6 mm</td>
</tr>
<tr>
<td>Tungamah</td>
<td>95.2 mm</td>
<td>289.0 mm</td>
</tr>
<tr>
<td>Gooroombat</td>
<td>106.2 mm</td>
<td>264.9 mm</td>
</tr>
</tbody>
</table>
In relation to the second interpretation of local knowledge, there was no system of flood wardens or trained flood observers in place to allow for trained local people; for example residents and farmers to provide real-time data to the ICC and Divisional Command at Numurkah. Some stakeholder interviewees said they struggled trying to validate local observations and there “appeared to be a large amount of misinformation”.

The local flood observations could also be obtained from emergency agency field crews. This occurred, but it was hampered by agencies using different information systems and radio frequencies (see Section 3). As the Divisional Command at Numurkah did not establish sectors and crews in the town, flood intelligence was not obtained in a systematic way.

### 4.1.6 March 2012 flood prediction

As a result largely of what was described in the above Section 4.1, the flood peak at Numurkah was not accurately predicted by the BoM (in consultation with the Shepparton ICC), whereas at Nathalia it was.

For Numurkah, Figure 7 provides an analysis of flood warnings provided by the BoM in relation to indicative hydrographs for the upstream Katamatite and downstream Walshs Bridge gauge. It uses river gauge data provided for these locations from the BoM flood warnings issued to the public.

The warning message on Friday 2 March indicated that “river levels at Numurkah are expected to reach similar levels as the 1993 flood by early next week”. Figure 7 shows that the flood peak arrived on Sunday 4 March at 1600 hours.

The flood warning for Broken Creek at Numurkah issued at 1015 hrs on Sunday 4 March contained different advice to those before saying, “River levels around Numurkah are currently higher than both the 1993 and 1974 levels in the area. Levels are continuing to rise with a peak expected during Sunday”.

The BoM provides categories of flood severity - Minor, Moderate, Major flooding – but to date, there have not been any flood categories defined for locations on Broken Creek. However, the Shepparton

<table>
<thead>
<tr>
<th>Location</th>
<th>Oct 1993 Peak level (m)</th>
<th>Mar 2012 Peak level (m)</th>
<th>Oct 1993 Peak Flow (ML/day)</th>
<th>Mar 2012 Peak Flow (ML/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken River at Benalla</td>
<td>5.5</td>
<td>2.4</td>
<td>112,000</td>
<td>~9,000</td>
</tr>
<tr>
<td>Boosey Creek at Tungamah</td>
<td>2.7</td>
<td>2.9</td>
<td>15,400</td>
<td>~22,000</td>
</tr>
<tr>
<td>Broken Creek at Katamatite</td>
<td>2.7</td>
<td>3.1</td>
<td>6,300</td>
<td>~13,800</td>
</tr>
</tbody>
</table>

Table 7: Flood peaks and flows in the Broken River and Broken Creek catchments in 1993 flood and 2012 flood
(Source: Goulburn Broken Catchment Management Authority data)
ICC did use this category for its OSOM releases, and issued a “Minor” flood warning for Broken Creek on Sunday 4 March (see Table 1), including 19 minutes after it had peaked at Numurkah (Evidence: OSOM log).

As shown in Figure 8, the flood prediction for Nathalia was accurate. On Monday 5 March the prediction was “a peak around 3.2 to 3.35 metres during next Thursday (8 March)” when the level was less than 2.1m and rising slowly. The resultant peak was 3.26 metres during late Thursday 8 March. Without the focus on flood mitigation in Nathalia and the accurate flood prediction for the town damages would likely have been substantially greater than at Numurkah.

4.1.7 Local emergency management coordination

For incident management at Numurkah, the above issues were exacerbated by chain of command and communication matters. As noted in Section 3.3.9, the roles of the Divisional Command and the VICSES Unit at Numurkah were not clearly defined in relation to the Shepparton ICC. The Divisional Command could have used the VICSES Unit as a sector under its command but did not do so. However, according to some stakeholder interview responses, the Divisional Command set up in the Numurkah CFA headquarters did not know its role due to lack of training. The poor chain of command and communications caused confusion and frustration, as evidenced by some interviewee comments. In some cases it led to duplication of and gaps in operational activities, such as sandbagging.

Both the Divisional Command and the VICSES Unit commented in stakeholder interviews that communications with the ICC were poor and they generally felt they “had to do their own thing”. On the night (Saturday 3 March) before the Numurkah Hospital flooded, both were told by the Shepparton ICC that there was no immediate risk of flooding in Numurkah.

4.1.8 Why the Numurkah Hospital flooded

According to public submissions to this review, floodwaters started to enter the Numurkah Hospital on Sunday 4 March at 0600 hours. This prompted immediate evacuation of the eleven patients. No warning was received to activate the hospital’s emergency plan, mainly because the ICC believed there was no risk of this level of flooding at that time. Sandbagging of the hospital did not commence until one hour before it was inundated.

The timing of flooding of Numurkah Hospital is important to note in relation to Section 4.1.6. A flood warning saying the flood levels were above 1993 and 1974 levels was first issued at 1015 hours on Sunday 4 March, some four hours after the hospital was inundated. The flood peak arrived at about 1600 hours on that day.

It is clear from the analysis that the flooding of the Numurkah Hospital, before any warning had been received or preventative action taken was due largely to a combination of the following factors:

- a flood warning system that was unable to provide accurate and timely data due to a lack of river gauges that could have enabled more reliable prediction;
- reliance on historical precedents whereas the 2012 flood displayed a number of different characteristics;
- limited coordination of the local emergency services.
Figure 6: 100 year ARI flood map for Numurkah (2008) (Source: Goulburn Broken Catchment Management Authority)
Figure 7: Analysis of flood predictions for Numurkah (Source: Molino Stewart)
Figure 8: Analysis of flood predictions at Nathalia (Source: Molino Stewart)
4.2 COMPARISON WITH THE REVIEW OF THE 2010-11 FLOOD WARNINGS AND RESPONSE

4.2.1 Review of the 2010-11 Flood Warnings and Response

Part of the terms of reference for this review is to compare the findings against the recommendations of the Review of the 2010-11 Flood Warnings and Response (see Section 1.1).

Between September 2010 and February 2011, many Victorian towns and communities were affected by floods that caused widespread damage and loss. Several communities were subjected to successive floods causing repeated damage. On 8 February 2011, the Premier of Victoria Mr Ted Baillieu MLA announced the Review of the 2010-11 Flood Warnings and Response.

In accordance with its terms of reference, the Review of the 2010-11 Flood Warnings and Response examined:

- the adequacy of flood predictions and modelling
- the timeliness and effectiveness of warnings and public information
- emergency services command and control arrangements
- the adequacy of evacuations of people most at-risk, including those in health and aged care facilities
- the adequacy of clean-up and recovery efforts
- the adequacy of service delivery by federal, state and local governments
- the adequacy of funding provided by state and federal governments for emergency grants.

The review was led by Mr Neil Comrie AO APM, former Chief Commissioner of Victoria Police and current Bushfires Royal Commission Implementation Monitor, who holds significant expertise and understanding of the state’s emergency management arrangements.

It was hoped that the review findings would help guide the government’s response and planning to ensure Victoria is better equipped to deal with similarly severe flooding events in the future.

On 30 June 2011, the Review of the 2010-11 Flood Warnings and Response interim report was provided to Premier Mr Ted Baillieu. The interim report provided an account of the review's progress made to date, an indication of the future work program and an outline of the key themes and issues that emerged during the course of work undertaken.

On 1 December 2011, the Review of the 2010-11 Flood Warnings and Response final report was provided to Premier Mr Ted Baillieu. The final report addressed the many issues arising from the review's terms of reference and detailed 93 recommendations that, if implemented, would support necessary reform of the state’s emergency management arrangements.

4.2.2 Comparison

It was never the intention of this review to track progress against the findings and recommendations of the Review of the 2010-11 Flood Warnings and Response. Nevertheless comparisons can be made with that review; particularly in relation to:

- the adequacy of flood predictions and modelling
- the timeliness and effectiveness of warnings and public information
• emergency services command and control arrangements
• the adequacy of evacuations of people most at-risk, including those in health and aged care facilities.

In terms of flood predictions and modelling, by comparing Nathalia with Numurkah this review shows the potency of having a flood warning system using stream gauges and telemetry. This finding is strongly advocated in a range of findings and recommendations in Chapter 1 of the Review of the 2010-11 Flood Warnings and Response. For example, Recommendation 3 states that “the state develop a flood warning system for each basin and location with community input and make relevant documents publicly available. Each warning system should include key performance indicators”. Obviously, there is more work required across the Broken Creek catchment to improve flood warning systems particularly at Numurkah.

The Review of the 2010-11 Flood Warnings and Response (Chapter1) found that there were “notable gaps” in mapping, gauging and education programs related to the flood-affected areas. The same could be said for Numurkah where there was no permanent gauge with telemetry, and minimal community flood education (in comparison with Nathalia).

Recommendation 9 states that the “state, in consultation with Bureau of Meteorology and Melbourne Water, take the necessary action to ensure that all flood warnings issued are linked to the geographical location of the gauge the data was derived from”. In the 2012 flood, the early flood warnings issued for Broken Creek were subsumed into Broken River warnings. Some stakeholder interviewees believed this caused confusion in the community and made it difficult for agency interpretation.

Recommendation 14 states that “the state clarify the role of intelligence cell staff; for example, hydrologists and/or Catchment Management Authority who are utilised in Incident Control Centres during flood events”. For the 2012 flood, according to stakeholder interviewees there was an effective use of a hydrologist and Catchment Management Authority staff in the intelligence cell of the Shepparton ICC. However, it is crucial that the relevant information/intelligence is communicated between the ICC and Division Command to enable the effective use of this intelligence. This will address matters raised in sections 3.3.9 and 4.1.7 of this report.

As in this review (Section 4.1.5), the Review of the 2010-11 Flood Warnings and Response identified and discussed the use of local knowledge in flood planning and response. Like this review, it found that communities were frustrated that emergency services apparently disregarded them as an information source.

On page 65, the Review of the 2010-11 Flood Warnings and Response advocates the use of local knowledge to “inform the decisions of those responsible for response activities within the emergency management framework. It considers that accreditation of community members would strengthen the communication and information sharing processes from communities to the control agency and vice versa. The accreditation process should include an understanding of the AIIMS framework and training in data collection. This will ensure quality information is provided to the control agency, particularly where there are significant implications from the information provided”. A similar improvement was mentioned by some stakeholder interviewees in this review.

On the other hand, the Review of the 2010-11 Flood Warnings and Response warned against the dependence on previous flood behaviour understanding as part of local knowledge input to flood planning and response. On Page 64 it states, “Buloke Shire Council noted that local planning based on previous experience and knowledge was of little value as water was “behaving” in ways outside the experience of even the oldest “flood hands” in the town (although local knowledge was useful once the event unfolded)”. The same was found in this review (Section 4.1.5) where the 2012 flood in the Broken Creek catchment displayed some characteristics that were different to the 1993 flood especially in terms of timing of the flood peak.
There are also some findings from this review that are relevant to Chapter 2 (adequacy, timeliness and effectiveness of flood warnings and public information) of the Review of the 2010-11 Flood Warnings and Response.

The Review of the 2010-11 Flood Warnings and Response calls for adequate, timely and effective flood warnings. In relation to page 79 of the Review of the 2010-11 Flood Warnings and Response it appears for the 2012 flood that the BoM was unable to provide a category of “Minor”, “Moderate” and “Major” flood warnings for Broken Creek, as it did not have a specialised warning system installed in the area. From the analysis in Sections 3 and 4 of this report, in the 2012 flood the flood warnings relating to Numurkah were not timely or effective. This is well highlighted by Table 1 of this report where from VICSES logs the Shepparton ICC was issuing Minor flood warnings for Broken Creek on the same day (4 March) the flood peaked at Numurkah. The timeliness and effectiveness of warnings was obviously hampered by lack of adequate gauge coverage and a flood warning system for Numurkah.

Chapter 3 of the Review of the 2010-11 Flood Warnings and Response deals with emergency services command and control arrangements utilised to manage the emergency.

In relation to interoperability (pages 126 and 127 of the Review of the 2010-11 Flood Warnings and Response) it is clear that further work is required in the study area. As noted in Section 3 of this report, there are still some “cultural differences” between the agencies, and there were issues identified relating to different information systems and radio frequencies used by VICSES and the CFA.

The command and control (pages 120-122 of the Review of the 2010-11 Flood Warnings and Response) was poorly established and communicated in Numurkah. There was no chain of command established between the Divisional Command and local VICSES Unit. Communication between both and the ICC was described as “poor” by Numurkah stakeholder interviewees.

The Review of the 2010-11 Flood Warnings and Response “also received submissions from a number of VICSES volunteers expressing concern that they were required to act as leaders of VICSES Divisional Commands (the incident level of control) yet had not been trained or given any direction to perform such roles” (page 122). This issue of lack of training was also raised by the Divisional Command interviewees in Numurkah.

Chapter 4 of the Review of the 2010-11 Flood Warnings and Response relates to the evacuation of people at greatest risk. Three relevant issues were identified in this review:

1. Only one of the three local councils had an up-to-date register of vulnerable people.
2. Although Numurkah hospital apparently had an evacuation plan, it was not triggered due to lack of warning from the emergency services until after floodwaters entered the building.
3. Some interviewees commented on difficulties people had in travelling to the evacuation centre at Cobram as it was cut by rising floodwaters.
5 CONCLUSION

Based on its terms of reference, this review of the 2012 March North East Flood found some significant issues; particularly across the Broken River catchment, that relate to adequacy of river gauges, flood warning systems and prior community flood education. Where there was a flood warning system and adequate gauging, such as Nathalia, these led to timely warnings through robust flood intelligence. On the other hand, when there was incomplete gauging of tributaries and no flood warning system, as at Numurkah, warnings were poorly timed. Along the Broken Creek, warnings were not well distinguished from the Broken River warnings due to the lack of an established flood warning system and, therefore, they were not tailored to the local area.

One lesson is that since every incident has its own individual characteristics, it is not advisable to use past history without current local intelligence when trying to predict flood behaviour. It would be desirable for the BoM, when providing information both to agencies and the public, to include caveats relating to the level of confidence it places on the information behind predictions.

There were several other issues identified that related to incident management. Of primary concern are the poorly-defined roles of the Divisional Command and VICSES Unit at Numurkah in relation to the Shepparton ICC. This led to duplication and gaps in incident management operations, including sandbagging.

The above issues were largely responsible for the late evacuation of Numurkah Hospital.

Other incident management issues identified included interoperability of communication and information systems, cross-agency training and exercising, and VICSES capability in AIIMS.
6 REFERENCES

References included BoM flood warnings, VICSES flood bulletins and data supplied by the emergency services including OSOM logs and SITREP reports.

Other sources of evidence referenced in this report were:


Attorney-General’s Department, 2009, Manual 21 Flood Warning, Australian Emergency Manuals Series, Commonwealth of Australia

Comrie, N., 2011, Review of the 2010-11 Flood Warnings & Response, State Government of Victoria, Australia


Environment and Natural Resources Committee, 2012, Transcript - Inquiry into flood mitigation infrastructure in Victoria, Numurkah, 14 May 2012


Goulburn Broken Catchment Management Authority, 2002, Goulburn Broken Regional Floodplain Management Strategy

Goulburn Broken Catchment Management Authority, 2012, Flood at Nathalia – Largest Flood on Record, fact sheet

Grothmann, T., & Reusswig, F., 2006, People at Risk of Flooding: Why Some Residents Take Precautionary Action While Others do not, Natural Hazards Vol 38, pp 101-120


Queensland Police Service, 2011, Disaster management and social media – a case study, Media and Public Affairs Branch, Queensland Police Service


VICSES, 2012, *Response to request for flood / FloodSafe Community Education and Engagement focussing on Shepparton Numurkah and Nathalia*

GLOSSARY OF TERMS

100 year Average Recurrence Interval (ARI) flood - is a best estimate of a flood which has 1 chance in 100 of occurring in any one year. It should be noted that planning for the 1 in 100 year ARI flood does not guarantee protection for the next 100 years.

Emergency Alert (EA) - Emergency Alert is a telephone warning system that emergency services can use to send alerts to communities via landline telephones based on the location of the handset, and to mobile phones, based on the service address of the phone.

Emergency Service Provider (ESP) - An agency, department or organisation either responsible for, or that provides support for the protection and preservation of life and property from harm resulting from incidents and emergencies.

Flood Category Definitions:

Minor Flooding - Causes inconvenience. Low lying areas next to watercourses are inundated requiring the removal of stock and equipment. Minor roads may be closed and low level bridges submerged.

Moderate Flooding - In addition to the above, may require the evacuation of some houses. Main traffic routes may be covered. The area of inundation is substantial in rural areas.

Major Flooding - In addition to the above, causes inundation of extensive rural areas and appreciable urban areas. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Numerous evacuations may be required.

Flood Warning - Warning issued by the Bureau of Meteorology or Local Government (especially for flash flooding) to media, agencies and the public. The message usually contains details that flooding is about to occur or is happening, predictions, expected impact, and can include what actions should be taken. It also contains detail on when the warning was issued and when the next update can be expected.

One Source One Message (OSOM) - OSOM is the principle system used by emergency services in Victoria to issue information and warnings to the community and provides simultaneous warnings and information to the community via emergency broadcasters, the CFA, the VICSES and DSE websites and other information mediums.

Probable Maximum Flood (PMF) - the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular catchment.
APPENDIX A – REVIEW LINES OF ENQUIRY AND SUMMARY OF FINDINGS
<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Expectation</th>
<th>Key Performance Question</th>
<th>Performance Measure / Evidence</th>
<th>Data Sources</th>
<th>Review Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>EMPs collaborate with each other to deliver a quality, seamless, integrated, “one sector” approach to emergency management for the community</td>
<td>Are ESOs delivering a seamless, integrated approach to emergency management for the community?</td>
<td>% and number of stakeholders (including ESOs) agreeing there was a seamless and integrated approach to emergency management by incident. Top 5 issues identified by stakeholders that could be improved to deliver a seamless integrated approach to emergency management by incident</td>
<td>Stakeholder interview questions 3 &amp; 4 (State, Region), de-briefs, event timelines, SITREP; relate to EMMV, SOPs, flood plans, Victorian Warning Protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>EMPs’ workforces share a core set of skills and competencies so that, in a major or extended incident, personnel can be exchanged between EMPs without adverse impacts on the level or quality of services provided for the community</td>
<td>How interoperable is the workforce?</td>
<td>Percentage and number of the workforce that reported interoperability issues?</td>
<td>Stakeholder interview question 3 (Council, Div Comm) 5 (State, Region), workforce survey, de-briefs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>The community and stakeholders are aware of and understand the emergency risks and dangers they are exposed to</td>
<td>How aware is each local community of the risks they face? Did the community understand the flood risk in their area?</td>
<td>The percentage of the community of the community that have awareness (yes/no) - comparison of results The percentage of community members that received information regarding risk (yes/no) - comparison of results The percentage of community members that understood what the impacts could be on their property</td>
<td>Community survey question 1; relate with evidence of community flood education programs from VICSES, CMAs, local councils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 37.5% of stakeholders felt there was a seamless and integrated approach in the incident
- Top 5 issues for improvement were:
  - greater resourcing for VICSES (staff and funds)
  - further training for VICSES staff in AIIMS
  - greater coverage of flood studies, floodplain risk management plans across the study area
  - increased community flood education and engagement
  - improving compatibility of systems across agencies

- 55.4% of incident management staff from workforce survey agreed that agencies worked well together
- 72.3% of stakeholder interviewees reported interoperability issues

- 75.8% said they were aware of the flood risk prior to the flood
<table>
<thead>
<tr>
<th>Prepare</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| H | Responsibility for emergency management is shared across the whole community, including households, community organisations, local councils, EMPs, businesses and government agencies.  
• All members of the community take appropriate actions to prevent emergencies and mitigate the identified risks  
• All members of the community have genuine opportunities to contribute to planning and preparing for emergencies in their community  
• The community, individuals, businesses, volunteers, EMPs and other government agencies understand their roles in the event of an emergency so they can respond in an effective, coordinated and timely way | Had households developed actions to minimise the risk for their household? | Percentage of the households that had discussed their risk and planned appropriately  
■ What percentage of households had a written plan for the emergency?  
■ What percentage of households had an unwritten plan for the emergency? | Community survey questions 2 and 3; relate with preparedness data from VICSES e.g. reported emergency plans also community flood education e.g. FloodSafe plans; MEMPs, Flood Plans; CMA flood studies and plans | 35% of respondents said they had an emergency kit prior to the flood  
9.1% said they had a written emergency plan prior to the flood |
|  | Have communities had opportunities to be involved and contribute to emergency planning in their community | Percentage of the community that had contributed to mitigation planning | Community survey question 4; MEMPs; Flood Plans, CMA flood studies and plans | 29.2% of respondents said they or another member of their family had been involved in or contributed to flood planning in their community |
|  | How well do people understand their roles in an emergency? | Percentage of the community that understood their roles and responsibilities in the event of an emergency | Stakeholder interview question 6 (Region) 4 (Div Comm, Council), Community survey question 5 | 75% of respondents knew that the VICSES is responsible for helping them to deal with a flood emergency  
33% of stakeholders thought that the communities and the ESPs understood their roles in the emergency |
|   | People in the community know what to do in an emergency, including how to help vulnerable people |
|   | Did the community feel the community was prepared for the imminent danger? Did the community know what to do in response to a flood event? Did the community know what to do for vulnerable people? |
|   | Percentage of the community that felt the community was prepared for the imminent danger associated with the flood event |
|   | Percentage of the community that knew what to do in response in a flood event |
|   | Percentage and number of councils that have up to date lists of where the vulnerable people would be that would require assistance in an emergency |
|   | Percentage of the community by local area that knew how to help vulnerable people in a flood event |
|   | Percentage of the community that were confident they could keep themselves safe in a flood |
|   | Percentage of the community that were confident they could keep their family safe in a flood |
|   | Percentage of the community that were confident they could protect their house and property in a flood |
|   | Percentage of the community that were confident they could help neighbours in a flood |
|   | Percentage and number of councils that have an up-to-date register of vulnerable persons |
|   | Stakeholder interview question 5 (council) - vulnerable persons list; Community survey question 6 |
|   | 92.6% of survey respondents were confident they could keep themselves safe in a flood |
|   | 87.1% of survey respondents were confident they could keep their family safe in a flood |
|   | 75.4% of survey respondents were confident they could protect their house and property in a flood |
|   | 79% of survey respondents were confident they could help neighbours in a flood |
|   | 33% of local councils had an up-to-date register of vulnerable persons |

Respond

| L | An effective incident management system is in place that ensures timely and quality decisions are made to support effective response to the emergency. |
|   | How effective was the incident management system? How adequate, timely and relevant was the information/intelligence required to inform operational decision making and community information and warning? |
|   | Percentage and number of stakeholders that agreed that the incident was well managed, coordinated and communicated |
|   | Percentage and number of stakeholders that agreed that the appropriate local level input was taken into account. |
|   | Percentage and number of stakeholders that agreed there was an understanding of roles and responsibilities |
|   | Percentage and number of stakeholders that agreed that the information/intelligence provided was adequate, timely and relevant |
|   | Percentage and number of stakeholders that agreed that there had been timely and quality decisions made |
|   | Percentage of stakeholder interviewees agreed that the incident was well managed, coordinated and communicated |
|   | 37% of stakeholder interviewees agreed that the appropriate local level input was taken into account. |
|   | 27% of stakeholder interviewees agreed there was an understanding of roles and responsibilities |
|   | 36% of stakeholder interviewees agreed that the information/intelligence provided was adequate, timely and relevant |
|   | 56% of stakeholder interviewees agreed that there had been timely and quality decisions made |

Stakeholder interview questions 7, 8, 9, 10, 11, 12 (region) 6-11 (council) 4-9 (Div Comm) 6-8 (state) ; relate time lines, SITREP to EMMV, SOPs, flood plans, MEMPs, Victorian Warning Protocol; de-briefs
<table>
<thead>
<tr>
<th>M</th>
<th>Information and communication systems across all levels of government are interoperable to ensure an effective response by EMPs to the community’s needs</th>
<th>Were the information and communication systems interoperable to ensure an effective response to the community’s needs?</th>
<th>Percentage and number of the workforce that agreed that the information and communication systems they had during the emergency were interoperable and met their needs</th>
<th>workforce survey; de-briefs; stakeholder interviews (check all questions)</th>
<th>72.3% of stakeholder interviewees reported interoperability issues</th>
</tr>
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</table>

- Conduct flood studies and develop floodplain management plans for those communities that do not have them
- Improve the quality of municipal flood emergency plans
- Consider further use of the Portable Automated Logger System to augment existing gauge and telemetry system
- Clarify chain of command from ICC to Divisional Command to VICSES Unit
- Conduct inter-agency exercising around flood and fire scenarios
- Ensure that all ESPs have access to the same information system and radio frequency
- Build VICSES capability in the new structure of AIIMS through training and pre-event drilling
- Increase and improve community flood education to assist community flood learning

- ESPs did not have access to the same information system and radio frequency
<p>| N | People receive clear, realistic and authoritative messages about the proposed response and the actions they should take. Was the information disseminated by agencies to the community during the flood event in a timely, relevant and tailored way and in an appropriate format? Could the community access the information they needed? Did the people of the community of Nathalia receive and understand the evacuation warning for Nathalia? What did the community feel could be done better in the future? | Percentage of the community that were satisfied that the information was disseminated by agencies in a timely, relevant and tailored way and in an appropriate format. What were the top 8 ways the community found about the emergency? Percentage of the community that were satisfied with how they were informed. What percentage of households were satisfied that the evacuation warnings issued to the Nathalia community were timely, relevant and informative to enable individuals to make an informed decision? Top 5 issues ways communication could be improved. | Community survey questions 7, 8, 9, 10; EA &amp; OSOM reports; de-briefs; community meeting notes; BoM warnings; VICSES media releases including evacuation warnings; public submissions. | ■ 84% of survey respondents were satisfied that the information was disseminated by agencies in a timely, relevant and tailored way and in an appropriate format to protect themselves. ■ Top 8 ways community found out about the emergency were: saw water rising, radio, TV, from locals/neighbours warnings, when flooded/no warning, experience/local knowledge, emergency services, upstream communities flooded. ■ 67.1% of survey respondents were satisfied with how they were informed. ■ 93.8% of Nathalia residents confirmed that they should have received an evacuation warning and did get one. ■ Main issues identified by the community were: to better access local knowledge including the experience and insights of local residents; use local radio/TV/local focus, Emergency Alert/SMS messages, clearer up-to-date local information. |
| O | Emergency services are mobilised and provide the emergency response in an effective and timely way, meeting the community’s needs. Did the community get the support they needed? | Percentage of the community that were satisfied with the support provided. Top 8 issues that need improving. | Community survey questions 15 and 16; de-briefs; community meetings; public submissions. | ■ 85% of survey respondents confirmed that were able to find any further information they needed. ■ The top 8 ways used by the community to get further information were: neighbours, emergency services, television, ABC local radio, community meetings, websites, community radio, family. ■ Main issues for improvement were: better assistance in preparing for flood, more timely warning, better recognition of local knowledge. |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>What type of services did the community access to get more information?</td>
<td>Percentage of the community that required assistance ▪ Breakdown of support requested from service providers ▪ Percentage of the community that were satisfied with the support Why or why not</td>
</tr>
<tr>
<td>Were service providers able to handle the surge in requests for support?</td>
<td>Evidence from ESTA ▪ Percentage of calls that were not responded in the affected communities</td>
</tr>
<tr>
<td>Did people understand what the impact of the emergency would have in their community and what the planned response was going to be?</td>
<td>Percentage of people that understood the impact the flood would have on their households and the community ▪ Percentage of the community that understood what the ESPs were going to do to respond to the emergency ▪ Percentage of the community that were confident with the planned response ▪ Percentage of the Nathalia community that evacuated ▪ Reasons for individuals in the Nathalia community evacuating or not</td>
</tr>
<tr>
<td>Did people have enough information to make their decisions about what to do?</td>
<td>Percentage of the community that thought they had enough information to respond to the emergency.</td>
</tr>
<tr>
<td>Did people use their previously planned response to inform their decisions?</td>
<td>Percentage of people that used their previously planned response to inform their decisions</td>
</tr>
<tr>
<td>Did the community consider who they should help when they were making decisions on their planned actions?</td>
<td>Percentage of the community that identified that they should help</td>
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The community and stakeholders:
- understand the imminent dangers because they have access to timely, relevant and tailored emergency management information and warnings
- make informed decisions about their safety
- have confidence in the planned response.

Information and warnings:
- are in formats appropriate to community needs
- reflect an ‘all hazards, all agencies’ approach, and are provided through suitable all-hazards channels

Did people understand what the impact of the emergency would have in their community and what the planned response was going to be?

- 22.2% of survey respondents said they required assistance during the flood
- 76.9% of survey respondents said they were satisfied with the support provided.
- Main reasons for being satisfied were helpful, prompt, hardworking
- Main reasons for being dissatisfied were did not receive assistance to their property or assistance was inadequate

Were service providers able to handle the surge in requests for support?

- 90% of calls to ESTA were answered within 20 second benchmark

Did people understand what the impact of the emergency would have in their community and what the planned response was going to be?

- 45.7% of survey respondents said they needed to take actions once they became aware of the likely impact of the flood
- 57.9% of survey respondents were confident with the planned response
- 38.3% of Nathalia survey respondents said they evacuated during the flood
- Main reasons for evacuating were for the safety of their families, and because they were told to do so be emergency services
- Main reasons for not evacuating were their property was not threatened, and there was no threat to themselves or family

Did people have enough information to make their decisions about what to do?

- 85% of survey respondents said they were able to get the flood information they needed

Did people use their previously planned response to inform their decisions?

- Anecdotal use of 1993 flood response
- 39.7% of survey respondents reported that they enacted their emergency plan

Did the community consider who they should help when they were making decisions on their planned actions?

- 79% of survey respondents said they were confident in helping others during the flood
<table>
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<tr>
<th>Q</th>
<th>Vulnerable people are supported, including during any necessary evacuations</th>
<th>How effectively were vulnerable people supported in the emergency?</th>
<th>Evidence that stakeholders contacted the necessary people to evacuate</th>
<th>Stakeholder interview question 13 (council) 11 (Div Comm) 14 (region); de-briefs; public submissions; qualitative comments in community survey</th>
<th>Only one in three councils had a vulnerable persons register, therefore vulnerable people sometimes difficult to locate (although only small townships)</th>
</tr>
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<tbody>
<tr>
<td>R</td>
<td>People and communities exercise choice and share responsibility for their safety by taking actions that align with the planned response to the emergency</td>
<td>Did people take the advice of the planned response?</td>
<td>Percentage of people that took the advice of the planned response</td>
<td>Community survey questions 21, 22, 23, 24, 25, 26, 27; de-briefs; community meetings</td>
<td>63.4% of Nathalia survey respondents that evacuated, did so as soon as they received the first evacuation warning</td>
</tr>
<tr>
<td>S</td>
<td>People affected by or responding to an emergency: • are well informed about how to access support and essential services • are provided with their immediate needs in a timely way, including shelter, food, water, medical care and other essential services • are satisfied with the level and duration of the support they receive</td>
<td>Were people well informed about how to access support and essential services? Were support and essential services provided in a timely way?</td>
<td>Views of stakeholders of whether people were well informed about support and essential services and whether they were provided in a timely way</td>
<td>Stakeholder interview questions 15, 16 (region) 12, 13 (Div Comm) 14, 15 (council); de-briefs; community meetings; DHHS reports</td>
<td>All (100%) of stakeholders interviewed believed people were well informed about support and essential services and whether they were provided in a timely way. Most effective mechanisms were community meetings, radio announcements, electronic bulletins, community newsletters, doorknocking</td>
</tr>
<tr>
<td></td>
<td>The community continues to receive essential and critical services</td>
<td>Did people continue to receive services?</td>
<td>Percentage of stakeholders that observed that people continued to receive essential and critical services</td>
<td>Stakeholder interview question 17 (region) 14 (Div Comm) 16 (Council); de-briefs; community meetings; DHHS reports</td>
<td>All (100%) of stakeholders interviewed believed people that continued to receive essential and critical services</td>
</tr>
<tr>
<td>Recovery</td>
<td>Social, economic and environmental impacts and needs are rapidly assessed and are reflected in a well planned and communicated recovery plan</td>
<td>Were the impacts and needs rapidly assessed? Was there a well planned and communicated recovery plan?</td>
<td>Percentage of stakeholders that believed the social, economic and environmental impacts were rapidly assessed</td>
<td>Percentage of stakeholders that believed the recovery plan was well planned and communicated</td>
<td>Stakeholder interview questions 17 (council) 15 (Div Comm) 18 (region); de-briefs; DHHS reports</td>
</tr>
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</table>
APPENDIX B – SAMPLE OF STAKEHOLDER INTERVIEW QUESTIONS
2012 NORTH EAST FLOODS REVIEW
STAKEHOLDER INTERVIEW QUESTIONS - Regional

Date of interview:
Interviewee:
Organisation:
Interviewer:
Location:

1. What was your organisation’s role in the 2012 NE floods?

2. What was your role in the incident?

   General approach
3. Was a seamless and integrated approach provided to the community by emergency management organisations during the incident? Yes/no (reasons)

4. What could be improved to deliver a more seamless and integrated approach? (list ways)

   Interoperability
5. Did you experience or do you know of any interoperable issues during the incident? Yes/No If so, what were they? (list issues)

   Preparedness
6. Prior to the flood, did the community, individuals, businesses and emergency management organisations understand their roles in the event of a flood emergency? Yes/No (reasons)

   Incident management
7. What plans/processes/protocols were in place to ensure the incident was well managed, coordinated and communicated? Did these achieve the desired outcome? Yes/No (reasons)

8. What plans/processes/protocols were in place to ensure the appropriate local level of input was taken into account? Did these achieve the desired outcome? Yes/No (reasons)

9. What plans/processes/protocols were in place to ensure there was a clear understanding of roles and responsibilities during the incident between State, Region and Divisional Command? Did these achieve the desired outcome? Yes/No (reasons)

10. What plans/processes/protocols were in place to ensure there were timely and quality decisions made at all levels? Did these achieve the desired outcome? Yes/No (reasons)

11. What plans/processes/protocols were in place to ensure that timely and relevant intelligence was received that informed decision making and community information and warning messages? Did these achieve the desired outcome? Yes/No (reasons)

12. Was the MEMP or any other relevant local plan activated during the incident? Yes/No (reasons)

13. How could the management of the incident be improved? (list ways)

   Capacity
14. How effectively were vulnerable people supported in the incident?
Support and essential services
15. Were people well informed about how to access support and essential services such as shelter, food, water and medical care? Yes/No (reasons)

16. Was this provided in a timely way? Yes/No (reasons)

17. Did people continue to receive essential and critical services during the incident? Yes/No (reasons)

Recovery planning
18. Were the social, economic and environmental impacts rapidly assessed to develop the recovery plan? Yes/No (reasons)

THANK YOU FOR THE INTERVIEW