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May 2009 East Coast Low Flood Warning Community Feedback Report

Neil Dufty



MOLINO STEWART

ENVIRONMENT & NATURAL HAZARDS



NSW SES



May 2009 East Coast Low Flood Warning Community Feedback

Report



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REPORT

for

NSW SES

by

Molino Stewart Pty Ltd
ACN 067 774 332

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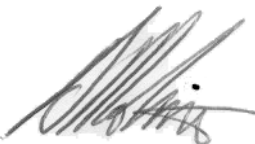
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1 PROJECT BACKGROUND

1.1 EAST COAST LOW FLOOD EVENT

In May 2009, substantial flooding occurred in Northern NSW as a consequence of an intense low pressure system called an 'East Coast Low'.


The main flood-affected catchments associated with this event were the Richmond/Wilsons, Clarence and Macleay. The main centres at risk of flooding were Lismore, Grafton, Maclean, Ulmarra/ Brushgrove/Cowper, Kempsey, Smithtown and Gladstone.

The Bureau of Meteorology (BoM) issued a Flood Watch on Tuesday 19 May. Severe Weather Warnings for Flash Flooding were issued for the Northern Rivers and Northern Tablelands, and later also included the Mid North Coast. Over the week, the BoM issued Flood Warnings for all coastal river valleys from the Manning to the Queensland border.

In Lismore, the flood reached its predicted height of 10.4 metres on 22 May. In Grafton, the flood peak was 7.4 metres on 23 May which was lower than the predicted level of 7.8 metres. In Kempsey, the flood peak was 6.9 metres on 24 May which was slightly lower than the predicted level of 7.0 metres.

In response to the flood warnings, the NSW State Emergency Service (SES) ordered the evacuation of the following centres:

- Lismore including North, South and Central Lismore (population 5,000)
- Grafton including Grafton and low lying parts of South Grafton (population 9,000)
- Properties behind the levee at Maclean
- Ulmarra/Brushgrove and Cowper (population 1,000)
- Kempsey CBD (population 600)
- Smithtown and Gladstone (population 900).



Evacuation centres were established to accommodate evacuees. According to the SES, in Lismore 227 people attended the evacuation centre at the Southern Cross University. In Coffs Harbour (the evacuation centre for Grafton), 209 people attended the centre. Sixty five people attended the evacuation centres in Maclean. In Kempsey, 185 people attended the evacuation centre at West Kempsey High School and 26 attended Melville High School, South Kempsey (SES Project Brief).

According to the SES, 'numerous people were isolated in raised houses above floodwater, many requiring emergency rescue or resupply. Others were cut off due to flooding of access roads. The communities of Bellingen, Maclean, Yamba, Iluka, Smithtown, Gladstone, Hat Head, South West Rocks and Crescent Head were each cut off for several days' (SES Project Brief).

1.2 THE PROJECT OBJECTIVES

It is critical that the SES regularly reviews its effectiveness in preparing for and responding to floods. This will enable it to continuously improve this service to the community during flood events.

Molino Stewart Pty Ltd was engaged by the SES to carry out a project that reviewed flood warning and public information services related to the May 2009 East Coast Low event.

One of the project objectives was to evaluate the community perceptions, attitudes and behaviour in response to warning and evacuation in the communities, with reference to previous relevant social research. This report details that research and its findings.

2 SURVEYING THE COMMUNITY

2.1 SOCIAL RESEARCH

The SES requested Molino Stewart to conduct social research in the flood-affected communities related to the following five main research questions:

- How were warnings used to advise residents?
- How well were the warnings understood by residents?
- What were the responses of residents to warnings issued?
- How prepared were residents for the flood?
- How effective was the public information provided?

From previous experience in this type of social research, Molino Stewart in liaison with the SES, decided to use a series of focus groups in conjunction with broader community surveying to conduct the social research. It was felt that the focus groups would provide 'depth' to community responses whilst the surveys enabled canvassing of views from across the communities.

Focus groups were held in four locations:

- Kempsey
- Smithtown
- Grafton
- Maclean

No focus groups were held in the Lismore area due to organisational issues. Instead, an extra advertisement was placed in the local paper encouraging residents to complete the survey.

Participants in the focus groups were invited to attend by the respective local SES units. However, to ensure impartiality in response the participants were chosen from a range of backgrounds and locations and were not aligned with the SES, including as SES volunteers. There were also no SES staff members in attendance at the focus groups.

The number of those attending for each focus group is provided in Table 1.

The survey was conducted across the flood affected communities using three methods:

- 1) An online survey accessed by respondents through the internet at: www.molinostewart.com.au/0357Survey
- 2) A hard copy survey that could be collected by respondents at local community centres such as libraries and general stores
- 3) The same hard copy survey that could be obtained by emailing or phoning the Molino Stewart office.

Table 1: Number of focus group participants

Location	Date	Venue	Number of participants
Kempsey	22/07/09	Kempsey Shire Council Chambers	15
Smithtown	23/07/09	Smithtown RSL Bowling Club	8
Grafton	27/07/09	Grafton Shire Council	15
Maclean	28/07/09	Maclean CWA Room	3
TOTAL			41

A flyer that advertised these options was distributed throughout the communities by letter box drop. Community members were given at least 18 days to respond to the survey.

Table 2 shows the number of respondents from each community surveyed. It also compares this to



the number of flyers distributed in each community giving a survey response rate.

Table 2: Number of survey respondents from the flood affected communities

Community	Surveys Completed	Flyers Distributed	Survey Response Rate
Kempsey	30	520	6%
Smithtown	7	130	6%
Brushgrove	22	30	74%
Cowper	25	30	84%
Maclean	12	120	10%
Grafton	77	600	13%
South Grafton	15	80	19%
Ulmarra	21	140	15%
North Lismore	10	120	3%
Central Lismore	17	650	3%
South Lismore	7	230	3%
TOTAL	243	2,650	9%

It should be noted that the internet response method was more successful than the hard copy response to the survey. Fifty seven percent of responses were obtained through the online survey whilst 43 percent of respondents used hard copy.

2.2 FRAMEWORK AND LIMITATIONS

The survey questions and focus group questions emanated from the social research component of the review framework. The survey questions are provided in Appendix A and the focus group questions in Appendix B. Both sets of questions were signed off by the SES prior to use.

Attempts were made to minimise SES involvement in focus groups to enable them to be as objective as possible. However, it could be argued that people participated in the focus groups because they had a particular interest or concern about flooding. This 'personal bias' should be noted as an underlying factor in the focus group findings.

The small number of focus group participants at Maclean limits the use of the focus group at that location in the findings. At Lismore no focus groups were able to be organised and therefore there was no opportunity to obtain detailed community response.

There was a reasonable response rate to the survey. From Molino Stewart experience, response rates for deposited hard copy surveys are generally around five to ten percent depending on the issue being surveyed. Response rates are generally higher for phone and door-to-door interviews; however, far more time is required to obtain the same number of respondents as the drop-off method due to length of interview time.

As shown in Table 2 approximately nine percent of those that received a flyer responded to the survey. There were significant variations to this overall response rate – the response rates in Brushgrove (74 percent) and Cowper (84 percent) were very high whilst the rate in Lismore (nine percent in North Lismore and three percent in Central and South Lismore) was low.

The Lismore response was of particular concern. Although, an extra advertisement was placed in the local newspaper encouraging people to fill in the survey, there were low levels of interest in the survey.

It should be further noted that not all people to whom the evacuation order applied in the flood event received a flyer advertising the community

survey. At least 16,500 people in the flood affected communities were subject to the evacuation orders and only 2,650 flyers were distributed. However, there was radio and newspaper coverage in the three catchments about the opportunity to participate in the community survey.

With the reasonably small number of surveys compared with the number of people subject to the evacuation orders, there can be no statistical confidence in the data and thus it has more indicative than quantitative value. However, when coupled with the focus group findings, a comprehensive and robust review of the warning and public information performance is possible.

A further limitation to the community survey is that it may attract those that have a particular concern or complaint regarding the warning system and public information performance thus biasing the survey findings towards the more critical views. On the other hand, the method used captures a far larger potential survey sample (16 percent of those ordered to evacuate) than could be achieved through alternative methods such as door-to-door and telephone surveying.

3 KEY SOCIAL RESEARCH FINDINGS

3.1 PROFILE

Several questions in the survey were asked to obtain an understanding of the profile of the residents sampled. This information could be used to explain some of the findings in this section. For example, the age of the sample could be a variable in evacuation behaviours.

A description of these potential profile variables are provided below.

3.1.1 Place of residence

The place of residence of the survey sample is provided in Table 2.

3.1.2 Length of residence

Question 31 in the survey (Appendix A) asked respondents about how long they had lived in the area. Seventy three percent of the total respondents have lived in the area for more than ten years. This trend is reflected across the three river catchments. It should be noted that the respondents living in the area for more than ten years would have experienced the 2001 flood event in the area.

3.1.3 Type of home/business

In Question 32, respondents were asked whether their home or business was rented, owned/mortgaged or was a holiday house. Coupled with 'length of residence', this is an indicator of the transience of the sample.

Eighty eight percent of respondents live in owned/mortgaged premises whilst 12 percent live in rental accommodation. No respondents lived in holiday houses. Again, this trend is reflected across the three affected river catchments.

To gain an understanding of the structural flood protection for their residences, respondents were asked in Question 32 if their properties were

protected by levees. In the Clarence catchment, 52 percent of respondents (almost all from Grafton) said they were protected by a levee. In the Wilsons/Richmond catchment, 35 percent (all from South or Central Lismore) believed they were protected by a levee. In the Macleay catchment, 23 percent (all from Kempsey) thought they were protected by a levee.

To understand the flood proofing of their residences for flooding, respondents were also asked in Question 32 if their house was two stories or more or was raised more than one metre above the ground. The findings for this question are provided in Table 3.

Table 3: Flood proofing of residences

Catchment	House 2 or more storeys	House raised more than 1m above ground	House raised less than 1m above ground
Clarence	35%	43%	22%
Wilsons/Richmond	39%	61%	0%
Macleay	30%	52%	18%
All areas	35%	47%	18%

As shown in Table 3, 82 percent of residences are either raised over one metre above the ground or are double story. The one exception to this trend is the Wilsons/Richmond catchment where no residences were below one metre or were double storied. This most likely reflects the success of the house-raising scheme particularly in North Lismore.

3.1.4 Age

Age can be a variable in relation to several aspects of flood preparedness and response e.g. previous flood experience, the capacity to carry out flood behaviours. Respondents were asked what age



bracket they fell into. The results for the three catchments are shown in Figure 1.

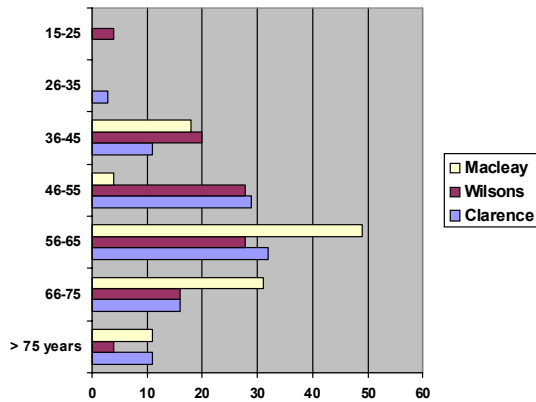


Figure 1: Percentage of respondents in each age bracket

As shown in Figure 1, the majority of respondents across the total area were over 45 years. In the Macleay catchment respondents were particularly aged.

3.1.5 Gender

In Question 34 respondents were asked to note their gender. Again, this may be a variable related to preparedness and response behaviours.

The gender ratio of respondents differed across the flood affected region. In the Clarence catchment 64 percent of respondents were male, whilst in the Wilsons (24 percent male) and Macleay catchments (45 percent male) the majority were female.

3.1.6 Dependents

The number of dependents may also impact on preparedness and response behaviours e.g. the desire to evacuate. In Question 35, respondents were asked to identify their number of dependents.

There was an average number of 1.32 dependents per respondent – a trend reflected across the flood affected region. Thirty one percent of respondents had no dependents. For those respondents with dependents the average was 1.97 dependents per respondent.

3.2 HOW WERE WARNINGS USED TO ADVISE RESIDENTS?

3.2.1 Clarence Catchment

From Question 2, the most common ways respondents heard initial warnings were through radio announcements (66 percent of respondents), BoM website (42 percent), television (27 percent) and family and friends (22 percent). This trend is supported by the Grafton and Maclean focus groups where participants identified two local radio stations (2GF and 2NR) and the BOM website as the main warning mechanisms.

From those respondents that did so, the most popular ways to verify or confirm the initial flood warnings from Question 4 were:

- Listening to a radio announcement (78 percent of respondents)
- Going down to the river for a look (50 percent)
- Logging onto the BoM website (49 percent).

The Grafton and Maclean focus groups confirmed that most people in those communities depended on the radio stations – especially 2GF and 2NR – for warning information.

There was concern in the Grafton focus group that the SES is reliant on the BoM for warning information that they believe does not have enough local input from recorders higher up the catchment. One comment was 'the SES is disregarding local knowledge and is making arbitrary decisions from Wollongong'.

There was also a concern that there is a need for local backup information when a gauge fails. There was a perception in the group that the Prince Street gauge failed in the May 2009 event.

Grafton focus group participants believed the Copmanhurst gauge was important in providing accurate flood warnings to Grafton and downstream. They felt that readings from this gauge should regularly be provided via radio to residents to assist in their assessment of flood risk.

An additional concern was that there was a perception that no warning was given for local 'pooling' events that were not linked to Clarence River predictions (note that Severe Weather Warnings were issued for the area). That is, there are areas within towns protected by levees or other locations which were not threatened by riverine flooding which flooded due to the ponding of water.

Some downstream communities such as Southgate were not mentioned in warnings and felt they were left out of communication.

The Manager of 2GF said that he believed it had a legal obligation to broadcast warnings every 15 minutes and was expecting to get more regular updates from the SES than he did. He said updates were sometimes more than two hours apart.

The Maclean focus group was concerned that the warning communication between BoM, the SES and affected residents was poor and that once the flood peak had left Grafton the number and accuracy of warnings downstream according to them seemed to diminish. Some parts of Harwood Island and Woodford Island received no warning or assistance from the SES.

3.2.2 Wilsons/Richmond Catchment

From Question 2, the most common ways respondents heard initial warnings was through radio announcements (80 percent), BoM website (59 percent), family and friends (45 percent) and television (38 percent).

From those respondents that did so, the most popular ways to verify or confirm the initial flood warnings from Question 4 were:

- Listening to a radio announcement (74 percent of respondents)
- Logging onto the BoM website (64 percent)
- Going down to the river for a look (58 percent).

3.2.3 Macleay Catchment

From Question 2, the most common ways respondents heard initial warnings was through

radio announcements (81 percent), family and friends (55 percent), BoM website (39 percent) and television (33 percent). Radio and the BoM website were confirmed by the focus group participants as the main ways local residents obtained warnings prior to the flood.

From those respondents that did so, the most popular ways to verify or confirm the initial flood warnings from Question 4 were:

- Listening to a radio announcement (71 percent of respondents)
- Speaking with family and friends (59 percent)
- Going down to the river for a look (55 percent)
- Listening to talk back radio (42 percent).

It should be noted that logging onto the BoM website was a considerably low option to verify or confirm warnings used by only 21 percent of Macleay catchment respondents.

The Kempsey focus group was also concerned about the apparent lack of local knowledge that was being used in predicting flood levels and used in warnings. They raised concerns about lack of warnings being delivered to the Maria River area and Crescent Head where apparently there was no communication with the SES.

Focus group participants were also concerned about phoning the SES 132 500 line and receiving flood warning information from SES Headquarters in Wollongong with information that, in some cases, was inaccurate.

The focus group noted that there is a reasonably low use of the internet in the area and that other ways of communicating with people, especially away from Kempsey, should be investigated.

The Smithtown focus group thought that there needed to be broader warning broadcasts across the media outlets. TANK FM and ABC Regional were the only main sources and it was felt that warning information should be disseminated more broadly, including through local television stations.

According to the Smithtown focus groups, many of the warnings were communicated too late, especially for dairy farmers that had to move their

cattle. It was felt that local gauge heights upstream in the Macleay catchment should have been regularly communicated along with the official BoM warnings.

3.2.4 Across the flood affected region

In response to Question 2, there were similar responses across the region for the ways people heard those initial warnings. The responses for all options across the region are shown in Figure 2.

There were no variables that impacted on this trend other than age. More respondents under 35 years used the BoM website than radio announcements whilst those over 65 years almost totally relied on radio announcements to obtain early warning.

There were similar responses across the region to Question 4 except in the Macleay catchment where speaking with family and friends was of second importance and logging onto the BoM website was relatively low compared with the other two catchments.

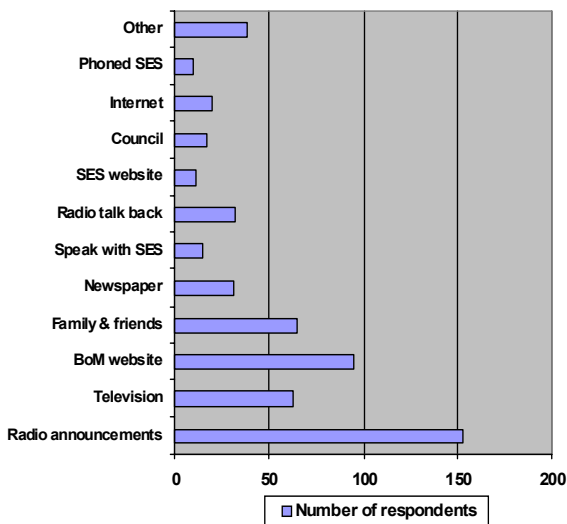


Figure 2: Ways in which respondents heard initial warnings

The ways that the respondents verified or confirmed the initial warnings are shown in Figure 3.

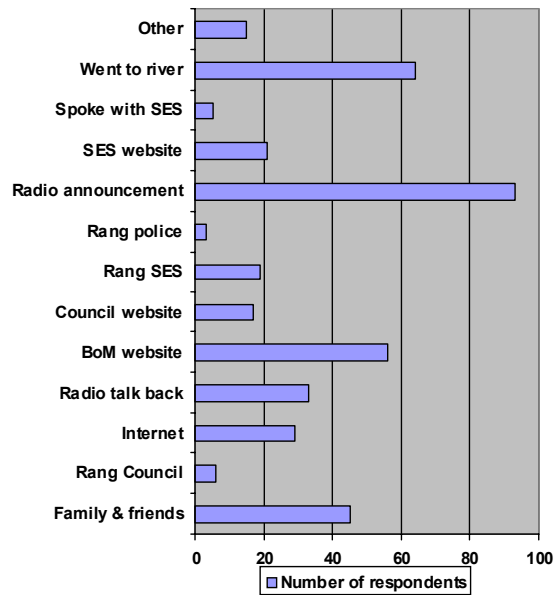


Figure 3: Ways in which respondents verified or confirmed initial warnings

As for Question 2, there was a similar reliance on radio announcements by those over 65 years and greater use of internet sites (BoM and SES) from those under 35 years. Respondents across all ages went to the river for a look at levels.

The four focus groups were more concerned about the accuracy of warnings and communication 'problems' than how the warnings were relayed. They believed that there was generally good coverage by radio and television of the movement of the East Coast Low as it tracked south from South East Queensland in the week leading up to the floods in the North Coast NSW region.

However, all the focus groups believed that the warnings closer to local flood peaks could not be trusted. Most participants felt that there was little or no local knowledge used in the flood forecasts and warnings and cast doubt on the accuracy of warnings issued by the BoM especially as they believed that some gauges (e.g. Prince Street) failed. As a result, it was generally felt the SES was tending to provide inaccurate local information that was sourced from BoM modelling.

In the opinion of those surveyed in the focus groups, due to these inaccuracies in information sourced from the BoM, in the case of Kempsey and Grafton CBDs the flood peaks were overstated.

On the other hand, downstream parts of the Clarence and Macleay received significant flooding that they feel was poorly communicated to them.

In lower parts of both catchments, participants believed they were left to their own devices with warnings seeming to 'turn off' once levee overtopping had been avoided in Kempsey and Grafton.

These and other issues from the focus groups are further discussed in this section.

3.3 HOW WELL WERE WARNINGS UNDERSTOOD BY RESIDENTS?

3.3.1 Clarence Catchment

From Question 1 in the survey, 88 percent of the Clarence catchment respondents were aware that flooding was expected to affect parts of their community in the days leading up to the floods in May 2009. Twelve percent of respondents were not aware of the impending flood.

Fifty eight percent of those respondents that heard initial warnings said they tried to verify or confirm initial flood warnings whilst 42 percent did not do so (Question 3).

Participants from the Grafton focus group felt that it was confusing as to how official the warning was, whether the evacuation was mandatory and where the warning originated. They believed that there was confusion also due to the time lag between BOM warnings on the website and warnings issued through local radio stations. Apparently, some of the warning information issued through the SES 132 500 number was incorrect – it provided information for a river that was not even in the Clarence catchment.

The Grafton focus group felt that some residents were unsure about what the warnings meant to them and what preparations they needed to carry out prior to possible evacuation.

The Maclean focus group believed that communication to residents and businesses was not consistent across the different mediums (i.e. internet, radio, television) thus leading to some confusion about each warning and what they meant.

3.3.2 Wilsons/Richmond Catchment

From Question 1 in the survey, 97 percent of the Wilsons/Richmond catchment survey respondents were aware that flooding was expected to affect parts of their community in the days leading up to the floods in May 2009.

Sixty six percent of those respondents that heard initial warnings said they tried to verify or confirm initial flood warnings whilst 34 percent did not do so (Question 3).

3.3.3 Macleay Catchment

From Question 1 in the survey, 92 percent of the Macleay catchment survey respondents were aware that flooding was expected to affect parts of their community in the days leading up to the floods in May 2009.

Seventy eight percent of those respondents that heard initial warnings said they tried to verify or confirm initial flood warnings whilst 22 percent did not do so (Question 3).

The Kempsey focus group noted local concern about road closure information where some roads were flooded but not officially closed. There was apparent confusion about whether an evacuation was 'voluntary' or 'mandatory'. There was also confusion around the practical meaning of the warning language issued: 'the river is rising', 'the river will peak', 'the river is peaking' and 'the river is falling'.

The Smithtown focus group felt that many local farmers were confused about warnings as they were unsure about the local input into gauge readings and thus what it meant to them for preparation e.g. moving cattle. At one stage only 'minor flooding' was communicated but this was later updated to 'major flooding'. The time delay between these warnings could have major impacts on farmers.

One Smithtown participant maintained that the SES has to be careful with media statements during and after a flood that can be misleading or inflammatory. This was in relation to a reported statement from the Kempsey unit that the 'opening the gates at Kinchela and Belmore stopped the water going over the Kempsey

levees', a statement with which the participant did not agree.

3.3.4 Across the region

As shown above, there were similar responses across the region for Question 1. Most people appeared to be aware that flooding was expected to affect parts of their community in the days leading up to the floods across the region in May 2009.

When applying the variables outlined in Section 5.1, it appears that time of residence is a factor in whether people were aware of imminent flooding. This is supported that three out of five respondents (i.e. 60 percent) of those living in the region for less than one year were unaware of impending flood. This is far higher than 12 percent that were unaware from all respondents across the region.

Other factors in the awareness of flooding appear to be residential status and age. Renters (23 percent unaware) were less aware than owners/mortgagees (11 percent unaware). Those under 35 years (40 percent unaware) were less aware than those over 35 (12 percent unaware).

There was a reasonably consistent response across the region to Question 3 about whether they tried to verify (or confirm) the initial warning. Results in the affirmative ranged from 58 percent in the Clarence catchment to 78 percent in the Macleay catchment. Those respondents aged 36-45 years were most motivated to verify or confirm initial flood warnings with 91 percent doing so. Females (73 percent of those that heard warnings) appeared to be keener to verify or confirm initial warnings than males (56 percent).

As noted above the main concern from the focus groups was what the warnings actually meant for the landholders i.e. what were the appropriate actions to take. The language related to river levels appears to have been confusing and again needs to be related to appropriate action. It appears that some residents were unsure if evacuation orders were 'mandatory' or 'voluntary'.

3.4 WHAT WERE THE RESPONSES OF RESIDENTS TO WARNINGS ISSUED?

3.4.1 Clarence Catchment

Question 5 asked about the length of warning time respondents had. Seventy four percent of respondents in the Clarence catchment said they had more than six hours warning time. Fourteen respondents (ten percent) said they had no warning time at all. The remaining 16 percent had some warning time that was less than six hours.

When asked in Question 6 if this was enough time to prepare for flooding, 84 percent of respondents in the Clarence catchment confirmed that it was. The remaining 16 percent felt that they did not have enough preparation time.

In Question 7, respondents were asked to choose the actions they carried out in their warning time. The most popular actions were:

- Listened to radio for information, updates and advice (71 percent of respondents)
- Moved my car to higher ground (39 percent)
- Checked that neighbours or neighbouring business were aware of warning/evacuation order (35 percent)
- Prepared my family for evacuation (32 percent).

Question 8 asked about whether the respondents acted straight away after hearing the warning or waited for another cue. Twenty three percent of Clarence catchment respondents said they acted straight away after hearing the first warning whilst a further 13 percent only waited a few hours before acting. Sixty four percent of respondents waited for another cue with 30 percent waiting until water reached a particular level at the gauge. Fifteen percent waited until they heard the evacuation order before they acted and only three percent waited until the SES doorknocked their property.

In Question 9, respondents were asked about the ways the May 2009 flood event impacted on them

and their property. In the Clarence catchment the most frequent responses to this question were:

- Roads I normally travel on were closed (51 percent of respondents)
- My community was cut off for a period of time (39 percent)
- Access to my home/business was cut off for a period of time (38 percent).

Twenty nine percent of respondents had their yard flooded, 19 percent had their paddocks flooded and eight percent had floodwaters over the floors of their home/business. Thirty two percent said that because their house was raised there were no floodwaters over the floor but there was floodwater underneath the building.

Questions 10-15 in the survey investigated responses to evacuation orders. In Question 10, respondents were asked if their community (or parts of it) were told to evacuate in May 2009. Twenty five percent of respondents in the Clarence catchment said they were not told to evacuate in May 2009. Of the 75 percent that were told to evacuate, only thirty two percent did so (Question 11).

From Question 12, the most common places that respondents evacuated to were homes of friends and family outside of the floodplain e.g. Junction Hill. No respondents said they evacuated to evacuation centres. The average time for evacuation was two hours, with responses ranging from 15 minutes to nine hours. The main transport for evacuation was personal car.

Question 13 asked for reasons for not evacuating. The main reasons for not evacuating were property protection, lack of trust in the evacuation order (many thought it was premature and based on inaccurate forecasting) and belief from experience that their property would not be flooded. Several also thought that it was a voluntary evacuation.

Only one respondent from the Clarence catchment needed rescue assistance to get them or their family out of their house by boat or helicopter (Question 14). The reason for not evacuating earlier was the need to raise stock.

With regard to Question 15, "Regardless of whether you evacuated or didn't in May, what

would convince you to evacuate in the future?" the most common responses given were:

- more accurate predictions based on river heights in the upper catchment, (19%)
- local knowledge that it was to be an extreme event (17%)
- demonstrated proof that the levee will overtop in Grafton (12%)
- evidence of the house being unliveable (12%)
- being formally told by the SES or emergency services (12%).

Some people gave more than one response without indicating whether they required either of those circumstances to convince them or both.

Approximately 20 percent of respondents in the Clarence catchment said they would not evacuate in any circumstances.

Grafton focus group participants believed that the main reason that there was a low evacuation rate in Grafton was due to lack of belief in the accuracy of river height predictions and warnings and experience based on the 2001 flood experience where the levee was not overtopped. As noted above, many businesses take up to four hours to evacuate, so they believe that they need to be assured of flooding to invest this time. Twenty percent of respondents said they would not evacuate under any circumstances.

There was also concern about the evacuation centre in Coffs Harbour when local information suggested the route there could be flooded. It was felt that evacuation routes require reviewing (the opinion of those surveyed was that local schools, Junction Hill would be a better option). Furthermore, residents and business owners were unsure as to what to do once they evacuated and how long they might be evacuated.

A local resident, who had been in the area for a short time, was unsure what to do after hearing the warnings and evacuation order.

For some landholders in the Maclean district, the evacuation order could not be carried out as roads were already closed. It was felt that the pumps helped the business district of Maclean, although many of the businesses were evacuated with stock and equipment having been raised.

3.4.2 Wilsons/Richmond Catchment

Question 5 asked about the length of warning time respondents had. Seventy eight percent of respondents in the Wilsons/Richmond catchment said they had more than six hours warning time. Twelve percent said they had no warning time at all. The remaining 10 percent had some warning time that was less than six hours.

When asked in Question 6 if this was enough time to do what they needed to prepare for flooding, 88 percent of respondents in the Wilsons/Richmond catchment confirmed that it was. The remaining 12 percent felt that they did not have enough preparation time.

In Question 7, respondents were asked to choose the actions they carried out in their warning time. The most popular actions were:

- Listened to radio for information, updates and advice (57 percent of respondents)
- Moved my car to higher ground (38 percent)
- Checked that neighbours or neighbouring business were aware of warning/evacuation order (38 percent).

Question 8 asked about whether the respondents acted straight away after hearing the warning or waited for another cue. Twenty four percent of respondents said they acted straight away after hearing the first warning whilst a further 24 percent only waited a few hours before acting. Fifty two percent of respondents waited for another cue with 24 percent waiting until water reached a particular level at the gauge. Six percent waited until they heard the evacuation order before acting and only three percent waited until the SES doorknocked their property.

In Question 9, respondents were asked about the ways the May 2009 flood event impacted on them and their property. In the Wilsons/Richmond catchment the most frequent responses to this question were:

- Roads I normally travel on were closed (44 percent of respondents)
- Floodwater didn't affect my property this time (41 percent)

- My community was cut off for a period of time (38 percent)

Twenty five percent of respondents had their yard flooded, nine percent had their paddocks flooded and six percent had floodwaters over the floors of their home/business. Nineteen percent said that because their house was raised there were no floodwaters over the floor but there was floodwater underneath the building.

Questions 10-15 in the survey investigated responses to evacuation orders. In Question 10, respondents were asked if their community (or parts of it) were told to evacuate in May 2009. Forty percent of respondents in the Wilsons/Richmond catchment said they were not told to evacuate in May 2009. Of the 60 percent that were told to evacuate, only thirty six percent did so (Question 11).

From Question 12, the most common places that respondents evacuated to were homes of friends and family outside of the floodplain e.g. Goonellabah. No respondents said they evacuated to evacuation centres. The average time for evacuation was 1.5 hours, with responses ranging from 30 minutes to four hours. The main transport for evacuation was personal car.

Question 13 asked for reasons for not evacuating. The main reasons for not evacuating were property protection (especially for businesses in Central Lismore) and belief from experience that their property would not be flooded.

Only one respondent from the Wilsons/Richmond catchment needed rescue assistance to get them or their family out of their house by boat or helicopter (Question 14). The reason for not evacuating earlier was previous experience of flooding.

With regard to Question 15, "Regardless of whether you evacuated or didn't in May, what would convince you to evacuate in the future?" the most common responses given were:

- more accurate predictions based on river heights in the upper catchment, (19%)
- local knowledge that it was to be an extreme event (15%)
- being formally told by the SES or emergency services (11%)

- demonstrated proof that the levee will overtop (7%)
- evidence of the house being unliveable (4%)

As with Grafton, several people gave more than one response.

Approximately 30 percent of respondents in the Richmond/Wilsons catchment said they would not evacuate under any circumstances.

3.4.3 Macleay Catchment

Question 5 asked about the length of warning time respondents had. Forty seven percent of respondents in the Macleay catchment said they had more than six hours warning time. Twelve percent said they had no warning time at all. The remaining 41 percent had some warning time that was less than six hours

When asked in Question 6 if this was enough time to do what they needed to prepare for flooding, 58 percent of respondents in the Macleay catchment confirmed that it was. The remaining 42 percent felt that they did not have enough preparation time.

In Question 7, respondents were asked to choose the actions they carried out in their warning time. The most frequently used actions were:

- Listened to radio for information, updates and advice (80 percent of respondents)
- Moved my car to higher ground (53 percent)
- Checked that neighbours or neighbouring business were aware of warning/evacuation order (53 percent)
- Prepared my family for isolation (being cut off) (53 percent)
- Checked sheds and out buildings (50 percent).

Question 8 asked about whether the respondents acted straight away after hearing the warning or waited for another cue. Forty seven percent of catchment respondents said they acted straight away after hearing the first warning whilst a further six percent only waited a few hours before acting. Forty seven percent of respondents waited for another cue with 24 percent waiting until water

reached a particular level at the gauge. Six percent waited to act until they heard the evacuation order and only three percent until the SES doorknocked their property.

In Question 9, respondents were asked about the ways the May 2009 flood event impacted on them and their property. In the Macleay catchment the most frequent responses to this question were:

- Roads I normally travel on were closed (89 percent of respondents)
- Access to my home/business was cut off for a period of time (80 percent)
- My community was cut off for a period of time (71 percent).

Fifty six percent of respondents had their yard flooded, 47 percent had their paddocks flooded and three percent had floodwaters over the floors of their home/business. Forty five percent said that because their house was raised there were no floodwaters over the floor but there was floodwater underneath the building.

Questions 10-15 in the survey investigated responses to evacuation orders. In Question 10, respondents were asked if their community (or parts of it) were told to evacuate in May 2009. Forty four percent of respondents in the Macleay catchment said they were not told to evacuate in May 2009. Of the 56 percent that were told to evacuate, only forty five percent did so (Question 11).

From Question 12, the most common places that respondents evacuated to were homes of friends and family outside of the floodplain e.g. higher parts of Kempsey. No respondents said they evacuated to evacuation centres. The average time for evacuation was two hours, with responses ranging from 30 minutes to six hours. The main transport for evacuation was personal car.

Question 13 asked for reasons for not evacuating. The main reasons for not evacuating were property protection, lack of trust in the evacuation order (many thought it was premature and based on inaccurate forecasting) and belief from experience that levee in Kempsey would not be overtopped. Several also thought that it was a voluntary evacuation.

No respondent from the Macleay catchment needed rescue assistance to get them or their family out of their house by boat or helicopter (Question 14).

With regard to Question 15, "Regardless of whether you evacuated or didn't in May, what would convince you to evacuate in the future?", the most common responses given were:

- local knowledge that it was to be an extreme event (29%)
- more accurate predictions based on river heights in the upper catchment, (23%)
- demonstrated proof that the levee will overtop in Kempsey (13%)
- being formally told by the SES or emergency services (3%)

As with the other locations, some people gave multiple answers.

Approximately 30 percent of respondents in the Macleay catchment said they would not evacuate under any circumstances (Question 15)

The Kempsey focus group believed that most businesses in Kempsey took preparatory measures e.g. lifting stock and equipment but less than half evacuated after being told to do so. The main reasons for not evacuating were lack of trust in the warnings and predictions and the time required to evacuate.

There were more concerns about response from the Smithtown focus group. Apparently, in Smithtown/ Gladstone residents could not evacuate out of the towns after the evacuation order was given as all routes were impassable. Also there appeared to be a lack of sand supplies for sand bagging and no medical team or ambulance in the towns.

3.4.4 Across the region

For Question 5, there was a consistency between the Clarence and the Wilsons/Richmond catchment responses for the length of respondents' warning time. On the other hand, it appears respondents believe that they had considerably less warning time in the Macleay catchment. Furthermore from Question 6, a smaller proportion of respondents in the Macleay

catchment believed they had adequate time to prepare. Based on information from the focus group, this could be due to the faster rising nature of the Macleay River.

For Questions 7-9 there was reasonable consistency with responses across the region. From Question 8, it appears that a considerably higher proportion of respondents in the Macleay catchment acted after the first warning than in the other two catchments. Also from Question 9 it appears that a greater proportion of respondents in the Macleay catchment were impacted by road closures and access being cut off.

Evacuation rates ranged from 32 percent in the Clarence catchment to 45 percent in the Macleay catchment (Question 11). The following trends across the region were identified:

- The variability of length of residence appears to have an impact on evacuation rates with an evacuation rate of 20 percent for those respondents living in the area for more than 10 years compared with 40 percent for those less than ten years.
- The 56-75 year age bracket appears to be the least willing to evacuate with very low evacuation rates of approximately 15 percent.
- The evacuation rate increased with increasing number of dependents e.g. the rate for a respondent with one dependent was 17 percent and that for a respondent with four dependents was 54 percent.
- Renters (evacuation rate of 44 percent) appear to be more compliant to evacuate than owner/mortgagees (20 percent rate).
- Those living in raised accommodation (evacuation rate 21 percent) or in two storey houses (15 percent rate) appear to be less keen to evacuate than those living in non-raised residences (54 percent rate).
- The evacuation rate across the region was 23 percent for males compared with 32 percent for females.

The reasons respondents gave for not evacuating (Question 13) were consistent especially in the Clarence and Macleay catchments where many respondents vented their concern about the

perceived inaccuracy of warning predictions and their lack of trust in evacuation orders.

The responses to ways to encourage residents to evacuate were consistent across the region. Generally, a greater proportion of those in Kempsey than in Lismore or Grafton would expect forecasts of higher flood levels, forecasts based on upstream catchment observations or tangible evidence of levee overtopping before they would evacuate. Kempsey respondents would appear to be less likely to accept evacuation orders from emergency services. Between 20 and 30 percent across the region said they would not evacuate under any circumstances.

3.5 HOW PREPARED WERE RESIDENTS FOR THE FLOOD?

3.5.1 Clarence Catchment

Questions 28-30 in the survey investigated the preparedness levels in the Clarence catchment. Question 28 asked respondents about the kind of flood preparations they had in place before the May 2009 flood event. The most common preparedness measures were having a portable radio (47 percent), making sure they had first aid kit/torch/spare batteries (41 percent) and having a stockpile of food and water (30 percent). Thirty eight percent of respondents said they had nothing special in place prior to the flood. Seventeen percent said they had a Home or Business Emergency Flood Plan.

In Question 29, respondents were asked to identify what prevents them from being more prepared. Sixty five percent believed they were prepared enough for the flood. The main barriers to being more prepared were the risk is not that high and the time it takes to prepare.

Seventy four percent said they have taken no actions since May 2009 to be more prepared for future floods (Question 30). The main actions taken by the remaining 26 percent of respondents were to develop ways to lift items quicker, updated emergency contacts and improved

standard of fencing. One respondent has constructed a new flood mound for cattle.

The Grafton focus group generally felt that people were reasonably well prepared although there was a concern about the lack of preparedness of new residents and business owners. It was felt that most businesses in the Grafton CBD have a flood plan (at least in their head) and are practised in using it. The Maclean focus group thought that businesses in Maclean were reasonably well prepared and that on-ground coordination between emergency services and voluntary organisations e.g. Salvation Army was good.

3.5.2 Wilsons/Richmond Catchment

Questions 28-30 in the survey investigated the preparedness levels in the Wilsons/Richmond catchment. Question 28 asked respondents about the kind of flood preparations they had in place before the May 2009 flood event. The most common preparedness measures were making sure they had first aid kit/torch/spare batteries (62 percent), having a portable radio (47 percent) and having a stockpile of food and water (47 percent). Thirty one percent of respondents said they had nothing special in place prior to the flood. Twenty three percent said they had a Home or Business Emergency Flood Plan.

In Question 29, respondents were asked to identify what prevents them from being more prepared. Fifty four percent believed they were prepared enough for the flood. The main barriers to being more prepared were the risk is not that high and the time it takes to prepare.

Sixty six percent said they have taken no actions since May 2009 to be more prepared for future floods (Question 30). The main actions taken by the remaining 34 percent of respondents were to develop ways to lift items quicker and updated emergency contacts. One respondent had since developed a Business Flood Emergency Plan.

3.5.3 Macleay Catchment

Questions 28-30 in the survey investigated the preparedness levels in the Macleay catchment. Question 28 asked respondents about the kind of

flood preparations they had in place before the May 2009 flood event. The most common preparedness measures were making sure they had first aid kit/torch/spare batteries (75 percent), having a stockpile of food and water (62 percent) and having a portable radio (52 percent). Twenty three percent of respondents said they had nothing special in place prior to the flood. Seventeen percent said they had a Home or Business Emergency Flood Plan.

In Question 29, respondents were asked to identify what prevents them from being more prepared. Forty six percent believed they were prepared enough for the flood. The main barriers to being more prepared were the risk is not that high and the time it takes to prepare.

Forty nine percent said they have taken no actions since May 2009 to be more prepared for future floods (Question 30). The main actions taken by the remaining 51 percent of respondents were to develop ways to lift items quicker, updated emergency contacts and improved standard of fencing and cattle mounds.

The Kempsey focus group thought that most of the local businesses were well prepared for the flood but residents and newcomers not well prepared. In Smithtown the concern was more with the level of preparedness of the SES (in terms of lack of personnel and resources such as incident control centre) and its coordination with other agencies e.g. RFS, Police.

3.5.4 Across the region

Respondents appeared to have undertaken similar preparations for the May 2009 flood in the three catchments across the region.

Figure 4 gives an indication of the preparations that respondents said they had in place prior to the May 2009 flood.

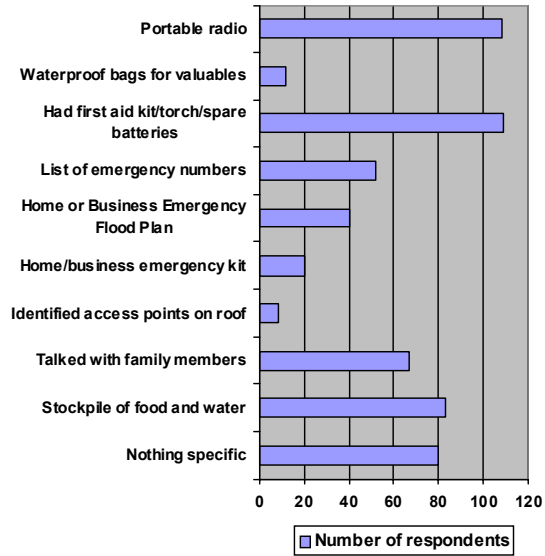


Figure 4: Preparations respondents reported to have in place prior to May 2009 flood event

On average, about 30 percent of respondents across the region reported that they had no specific preparations in place prior to the flood. Time of residence appeared to be a factor relating to whether respondents have specific preparations in place. Those that had lived in the area for more than ten years had a greater propensity to have no preparations in place. Also, a greater percentage of males had no preparations in place than females.

An average of 55 percent of respondents across the region believed that they were prepared enough for the flood. Perception of low flood risk and time for preparation were the main preparedness barriers across the region.

An average of 65 percent of respondents said they had not taken actions since May 2009 to be more prepared for future floods. There were relatively disparate actions taken, although the most common across the region were actions related to improving ease of lifting during floods and updating emergency contact lists.

3.6 HOW EFFECTIVE WAS THE PUBLIC INFORMATION PROVIDED?

3.6.1 Clarence Catchment

Questions 16-25 examined the effectiveness of the public information provided during the May 2009 flood event. Question 16 asked respondents to identify the sources of information that helped them decide what to do during the flood event. The most used source of flood information in the Clarence catchment was the radio (82 percent of respondents) and then the BoM website (53 percent). Nine percent of respondents used the SES 132 500 service, two percent the SES 1800 201 000 phone service, 16 percent contacted the local SES unit and 18 percent accessed the SES website.

From Question 17, the main types of information that respondents were looking for were current river levels (93 percent of respondents), predicted river levels (93 percent), rainfall information (78 percent), what impacts were expected to occur e.g. levee overtopping (55 percent) and road information (51 percent).

Fifty four percent of respondents confirmed that they easily found the information, 26 percent found the information after trying several sources and 20 percent could not find the information they were looking for (Question 18). Of those that found information, 46 percent thought the information was factual, 46 percent thought it was timely and 76 percent found it useful in answering their questions (Question 19).

From Question 20, 62 percent of respondents confirmed that they accessed the internet for flood information. The most common types of website used were government websites (98 percent of respondents using the internet) and news websites (33 percent) (Question 21). The main type of computer used was the home PC/laptop (95 percent of respondents using the internet) followed by the office PC/laptop (36 percent) (Question 22).

Question 23 asked about the use of the radio to find flood information. Ninety six percent of respondents said they used the radio to find flood information. The main radio stations listened to in

the Clarence catchment were 2GF and 2NR (ABC Regional). There was generally a high level of satisfaction with the radio station with 82 percent believing it met their information needs. Only two of the respondents listen to another station (a local FM station).

From Question 24, respondents felt the best ways to receive the flood information they required was by radio (90 percent of respondents) followed by official websites such as the SES, BoM (49 percent). The best ways to hear about official warnings according to the respondents were radio (92 percent), the SES and BoM websites (49 percent) and television (37 percent) (Question 25).

In Question 26, respondents were asked to rank the ways for them to be told about the need to evacuate. The highest ranked methods were radio, word of mouth and then door knock from emergency services.

Question 27 asked respondents to identify flood education or information that they are aware of or participated in. The most common responses were the experience of family and friends (70 percent) and Floodsafe brochures (22 percent).

The Grafton focus group believed that the community need regular community flood education and seminars on the flood situation. According to the group, both businesses and residents should all have flood emergency plans. Other ideas from the group to improve public information and community education are discussed in Section 6. The Maclean focus group believed there was more community education required, especially for new businesses and residents.

3.6.2 Wilsons/Richmond Catchment

Questions 16-25 examined the effectiveness of the public information provided during the May 2009 flood event. Question 16 asked respondents to identify the sources of information that helped them decide what to do during the flood event. The most used source of flood information in the Wilsons/Richmond catchment was the radio (73 percent of respondents) and then the BoM website (58 percent). Twenty three percent of respondents used the SES 132 500 service, four percent the SES 1800 201 000 phone service, four percent

contacted the local SES unit and 20 percent accessed the SES website.

From Question 17, the main types of information that respondents were looking for were predicted river levels (97 percent), current river levels (93 percent of respondents), rainfall information (73 percent), what impacts were expected to occur e.g. levee overtopping (66 percent) and road information (62 percent).

Seventy eight percent of respondents confirmed that they easily found the information, seven percent found the information after trying several sources and 15 percent could not find the information they were looking for (Question 18). Of those that found information, 74 percent thought the information was factual, 61 percent thought it was timely and 96 percent found it useful in answering their questions (Question 19).

From Question 20, 66 percent of respondents confirmed that they accessed the internet for flood information. The most common types of website used were government websites (100 percent of respondents using the internet) and news websites (59 percent) (Question 21). The main type of computer used was the home PC/laptop (95 percent of respondents using the internet) followed by the office PC/laptop (36 percent) (Question 22).

Question 23 asked about the use of the radio to find flood information. Ninety seven percent of respondents said they used the radio to find flood information. The main radio stations listened to in the Wilsons/Richmond catchment were 2LM and ABC Regional. There was generally a high level of satisfaction with the radio station with 80 percent believing it met their information needs. Only one of the respondents listens to another station (a local FM station).

From Question 24, respondents felt the best ways to receive the flood information they required was by radio (89 percent of respondents) followed by official websites such as the SES, BoM (62 percent). The best ways to hear about official warnings according to the respondents were radio (93 percent), the SES and BoM websites (58 percent), automated recording message to telephone or mobile (39 percent) and television (39 percent) (Question 25).

In Question 26, respondents were asked to rank the ways for them to be told about the need to evacuate. The highest ranked methods were radio and then door knock from emergency services.

Question 27 asked respondents to identify flood education or information that they are aware of or participated in. The most common responses were the experience of family and friends (70 percent), Floodsafe brochures (50 percent) and community information displays (35 percent).

3.6.3 Macleay Catchment

Questions 16-25 examined the effectiveness of the public information provided during the May 2009 flood event. Question 16 asked respondents to identify the sources of information that helped them decide what to do during the flood event. The most used source of flood information in the Macleay catchment was the radio (97 percent of respondents) and then friends and family (65 percent), and the BoM website (52 percent). Seventeen percent of respondents used the SES 132 500 service, four percent the SES 1800 201 000 phone service, 17 percent contacted the local SES unit and four percent accessed the SES website.

From Question 17, the main types of information that respondents were looking for were current river levels (95 percent of respondents), predicted river levels (95 percent), rainfall information (86 percent), road information (71 percent) and what impacts were expected to occur e.g. levee overtopping (62 percent).

Forty nine percent of respondents confirmed that they easily found the information, 31 percent found the information after trying several sources and 20 percent could not find the information they were looking for (Question 18). Of those that found information, 61 percent thought the information was factual, 40 percent thought it was timely and 57 percent found it useful in answering their questions (Question 19).

From Question 20, 46 percent of respondents confirmed that they accessed the internet for flood information. The most common types of website used were government websites (100 percent of respondents using the internet) and news websites (27 percent) (Question 21). The main type of computer used was the home

PC/laptop (94 percent of respondents using the internet) followed by the office PC/laptop (20 percent) (Question 22).

Question 23 asked about the use of the radio to find flood information. Ninety four percent of respondents said they used the radio to find flood information. The main radio stations listened to in the Macleay catchment were TANK FM and ABC Regional at Port Macquarie. There was generally a high level of satisfaction with the radio station with 88 percent believing it met their information needs. Only two of the respondents listen to another station (a local FM station).

From Question 24, respondents felt the best way to receive the flood information they required was by radio (89 percent of respondents) followed by family and friends (42 percent) and official websites such as the SES, BoM (42 percent). The best ways to hear about official warnings according to the respondents were radio (86 percent), from family and friends (39 percent), the SES and BoM websites (33 percent) and television (30 percent) (Question 25).

In Question 26, respondents were asked to rank the ways for them to be told about the need to evacuate. The highest ranked methods were door knock from emergency services, radio and then television.

Question 27 asked respondents to identify flood education or information that they are aware of or participated in. The most common responses were the experience of family and friends (68 percent), community meetings (27 percent) and FloodSafe brochures (27 percent).

The Kempsey and Smithtown focus groups made several suggestions for improving public information and community education which are discussed below in 3.7.

3.6.4 Across the region

Question 16 asked respondents to identify where they found information about the flood to help them decide what they needed to do. There were generally consistent results across the region although respondents in the Macleay catchment identified friends and family as a main source of information along with radio and the BoM

website. Figure 5 shows the responses to this question across the region.

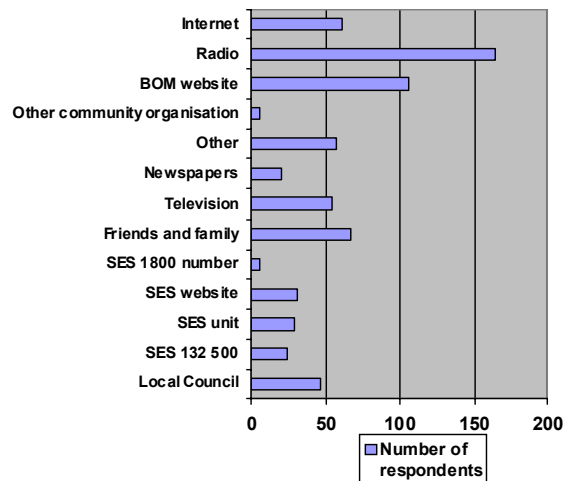


Figure 5: Main sources of information that helped respondents decide what they needed to do in the May 2009 flood event

The 'other' actions in Figure 5 mainly consisted mainly of using rainfall data coupled with personal experience to help decision-making. The main other community organisation accessed was the local Rural Fire Service unit.

In relation to Question 16, Question 17 asked respondents what information they were looking for. Current and predicted river levels and rainfall information were the most accessed types of information across the region. Respondents were also seeking road information and an understanding of what impacts were expected to occur e.g. levee overtopping.

Residents in the Macleay catchment appeared to find it more difficult to access flood information they needed. There was no variation related to age for this question (Question 18) i.e. each group found it equally easy to access the information they needed.

There were reasonably low response rates to how factual and timely this information was (Question 19). This was especially the case in the Clarence and Macleay catchments and is consistent with the concern participants raised in focus groups in these catchments about the accuracy of warning predictions and the timeliness of their release.

The internet was used by approximately 65 percent of respondents in the Clarence and Wilsons/Richmond catchment but its use was considerably lower in the Macleay catchment. This may relate to the greater use of social networks to obtain information (see above) in the Macleay catchment and a slightly older demographic of respondents (see Figure 1).

From Question 23, there was high use of the radio across the region. The ABC regional stations were praised in focus groups for their involvement in helping convey information, as were stations 2GF and TANK-FM.

In Question 24, respondents were asked about the best ways for them to receive flood information. The best ways were through radio and SES/BoM websites. Friends and family were also an important source of information in the Macleay catchment. This response was generally replicated for Question 25 that asked about the best ways to hear about official flood warnings. The responses for Question 25 across the region are shown in Figure 6..

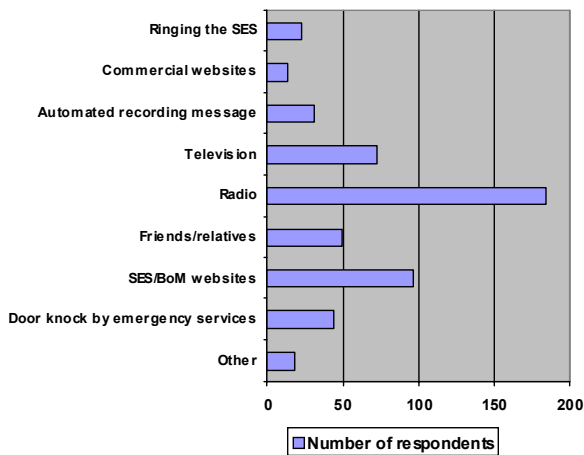


Figure 6: Best ways to hear about official warnings

In Question 26, respondents were asked to rank from 1 (best) to 8 (worst) the ways to be told about the need to evacuate. Table 4 provides the rankings for each catchment and for the region.

Table 4: Rankings for the best ways to be told about the need to evacuate

Option	Clarence rank	Wilsons/Richmond rank	Macleay rank	Region wide rank
Radio	1	1	2	1
Door knock by SES	3	2	1	2
Word of mouth	2	3	4	3
Television	4	3	3	4
Ringing the SES	5	4	3	5
Official websites	7	3	7	6
Automated message to phone or mobile	6	3	8	7
Commercial websites	7	7	3	7

In Question 27, respondents were asked about what flood education or information they were aware of or participated in. There were reasonably consistent responses from the three catchments with family and friends being by far the main education source followed by FloodSafe brochures and community information displays. The responses for the whole region are provided in Figure 7. Note that the responses for 'other' in Figure 7 mainly relate to personal experience of flooding as an education method.

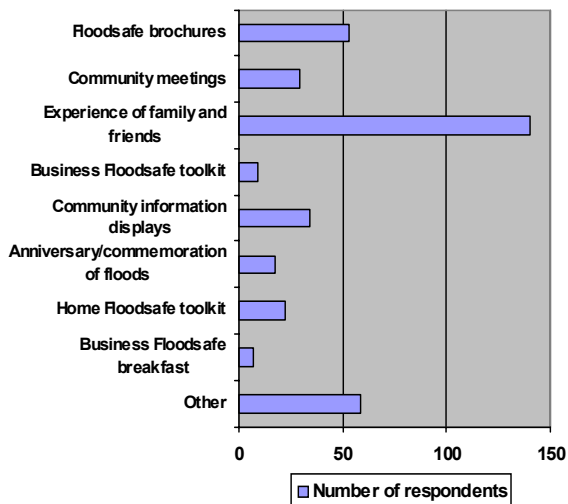


Figure 7: Flood education that respondents are aware of or have used

3.7 OTHER FOCUS GROUPS FINDINGS AND RESEARCH

The focus groups made some comments that were not related directly to the social research questions. The groups also provided several suggestions to improve the performance of warning systems and public information. Both of these are discussed below.

3.7.1 Grafton Focus Group

As discussed above, the main concerns of the Grafton focus group related to their perceptions of:

- The lack of local input into river height predictions and warnings
- The exaggeration of river height predictions for the Clarence River at Grafton
- Evacuation order for Grafton based on inaccurate river height predictions.

There was a strong feeling that until local residents have faith in the accuracy of river predictions and warnings, they will not take the evacuation order seriously and the evacuation rate may be even lower in the next flood.

Other comments from the Grafton focus group included:

- There is a need for back up when a gauge fails ("as the Prince Street gauge failed in this flood")
- 'BoM directs the activity. If it gets it wrong with predictions and warnings, then so will the SES with their responsibilities such as evacuations'.
- SES provided some inaccurate telephone information about predictions, evacuation. Group felt that there is lack of local trust when the information is provided by the SES at distant Wollongong.
- The SES doorknock was 'very determined'. There appeared to be no delineation of 'low-lying' areas i.e. most vulnerable areas.
- In Ulmarra after the evacuation order, Council apparently dumped sand bags on the front lawn of older people who refused to evacuate.
- There was a concern about when the electricity was going to be cut off.
- "If they (SES) are evacuating petrol stations, how can we get petrol to evacuate to Coffs Harbour?"
- Concern with Police lock out of the main street in Grafton where some business owners were prevented from entering to evacuate their businesses.

The Grafton focus group offered several suggestions to improve flood preparedness, warning and response. Participants were keen to see ongoing dialogue between community, the SES, BoM, Police and the local council to better prepare the district and improve warnings and response. With this in mind, they suggested a Flood Planning Seminar (apparently the last one was held eight years ago). They also felt that there should have been a community de-brief after the May 2009 flood (apparently only an agency de-brief was held).

The group made other suggestions, several related to community education, including:

- Only 43 percent of local people use the internet, so there is a need to use other mechanisms in community flood education

- For doorknocking divide Grafton into low, moderate and high risk levels and commence with highest risk
- Encourage people to have their radio on to listen to warnings
- New residents appear to be unsure as to how to prepare and what to do in a flood. Council should provide a flood kit to all new ratepayers
- A manual for Grafton needs to be developed to better coordinate preparedness, response and recovery across community, emergency agencies and local council.
- As with fire drills, there should be regular flood evacuation drills
- Use flood wardens to operate in small areas to pass on information and coordinate preparedness and response
- Further promote and distribute SES FloodSafe guides e.g. with rate notices, schools
- Erect a sign with a map of flooded areas of Grafton with information on how to prepare and respond
- Ensure that there is a reliable, single source of information broadcast during and after the flood
- Support local SES volunteers with accurate predictions and warnings so they can best do their job
- Encourage people to help those in highest risk areas.
- Residents on the hill behind the Maclean levee were apparently told to evacuate which was 'completely unnecessary'
- There was lack of information e.g. road closures provided about whether you could evacuate out of Maclean
- Pumps really helped save Maclean CBD
- SES call centre in Wollongong appeared unsure as to what was going on in the Lower Clarence
- There were about 40-50 evacuees that were housed in Civic Centre (location of evacuation centre changed from the Showground that was deemed unsuitable)
- SES activity on-ground was excellent but they appeared to be hampered by lack of accurate river height predictions
- Anecdotally, residents that were evacuated from further upstream than Maclean were funnelled into Maclean without being told what was happening. There appeared to be little communication relating to evacuation between upstream in the Clarence and the mouth of the River.
- There are many people on Harwood and Woodford Islands that will not evacuate due to fear of looting
- There was no clear information stream to Maclean businesses to give them an idea of what to do during the flood
- Local people are usually well-prepared but only when they have adequate warning as was not the case with this flood

The Grafton focus group requested that this report be sent to the NSW Premier and Emergency Services Minister and that the community and local council be informed of its general findings.

3.7.2 Maclean Focus Group

As mentioned above, the main concern of the Maclean focus group related to the timing and general lack of local warnings and the poor communication of these downstream of Grafton.

Other concerns and comments of the group were:

A few comments were made to improve flood preparedness and response in the area.

- Have an ongoing community education program that encourages people (especially new residents) to become better prepared and know how to respond to flood events
- Use a siren in Maclean that warns businesses and residents of imminent flooding and to turn on their radios for warning information

- There is relatively low use of the internet so use radio and television as the main mediums to convey flood information.

3.7.3 Kempsey Focus Group

As noted above, the Kempsey focus group was mainly concerned about the lack of local input into predicting river heights and the communication of flood information including warnings in the district.

Other comments made by this group included:

- Some Kempsey businesses received no notification of the evacuation order
- SES phone response came from Wollongong and was inaccurate at times
- Police were only stopping traffic going one way (East to West) on Kempsey Bridge. One business owner was refused entry across the Bridge even though he was authorised by the SES to pass.
- There was a communication breakdown where seven or eight flood peaks were predicted but the river was still rising
- Apparently there was a telemetry breakdown at Turners Flat Crescent Head and Maria River appears to be a 'black spot' for flood communication as some radio stations difficult to hear. Also 'black spots' in upper reaches of the Macleay where internet can't be accessed and radio reception is poor.
- Road closure information was poorly communicated e.g. RTA website not accurate
- There were messages around the community that the Kempsey levee was going to be overtopped – need to be accurate, confident and consistent messages relayed from the SES via radio.

There were several suggestions made to improve preparedness, warnings and response in the Kempsey district. Considerable discussion was had around developing a system whereby upstream authorised recorders would phone river heights into a local centre (e.g. the SES, Council) which would then be relayed to the BoM for inclusion in its flood prediction modelling and warnings.

Upstream river heights would also be broadcast on the radio along with current warnings and predictions to help people assess the possible impacts and actions required.

Other suggestions included:

- Establish neighbourhood networks or phone trees to warn and help others especially the aged
- Allow stock access along roads to be a priority
- Review FloodSafe Guides, website and other SES and Council information to ensure that the levels are correct
- Procedure for floodgate opening should be reviewed
- Educate the community about the size of the Macleay catchment and that it is a relatively fast flowing stream. Also educate that flooding is intermittent but all need to be prepared.
- Use August commemoration event to further build understanding of what to do in a flood, warnings, levels, AHD etc.
- Encourage all businesses to have a flood emergency plan with relevant warnings, levels, contacts, actions etc.
- Chamber of Commerce, Council and the SES should impress on residents and businesses to all have flood emergency plans.

The Kempsey focus group and Kempsey Shire Council requested that they receive a summary of this report and wished to be kept abreast of its outcomes.

3.7.4 Smithtown Focus Group

As outlined above, the Smithtown focus group was mainly concerned about the accuracy of flood warnings and predictions, and the poor communication of flood information in the lower reaches of the Macleay.

Other comments included:

- The community de-brief in Kempsey was run by Council – there is a need for an independent facilitator in future

- There needs to be better coordination regarding warnings and other emergency activities between the BoM and the SES headquarters, local unit and volunteers.
- There needs to be broader range of sources for flood information – needs to be expanded in lower Macleay from ABC Radio and TANK across other commercial radio and television.
- It was difficult to obtain accurate readings to know when to move cattle and machinery. Some farmers took risks to do this in the dark.
- There is a need to do manual checks on river heights particularly as support for current gauges
- For a range of properties, warning was received too late to move cattle and evacuate as roads were already cut off.
- Big tides played havoc on river height predictions
- Issues about opening floodgates at Kinchela and Belmore. SES said that it helped levees overtopping in Kempsey though this is debatable.
- There was misinterpretation of information to the public – flood was described as ‘minor flooding’
- It appeared that messages to SES at Gladstone were coming from several sources – Wollongong, Kempsey, Taree – which added to their confusion
- The number of SES rescues were not indicative of the impact of the flood as many evacuated themselves in their own boats and vehicles
- There was confusion over road closures e.g. misleading signs, lack of signage
- RFS involved in local emergency work and efforts need to be better coordinated with the SES
- First cattle lost in this area since the 1950s – an indicator that response has not progressed
- Residents in Smithtown were told to evacuate but there was nowhere to go as roads were already closed around the town

- Access to medical supplies and services were not available
- Local knowledge information was rejected for not being ‘official’

There were several suggestions made to improve preparedness, warnings and response in the lower reaches of the Macleay River.

- Improve the public knowledge of gauge locations
- Use local residents to check gauges and river heights and feed through SES to BoM
- Preliminary warnings could be given as soon as there is a chance of flooding – path of the East Coast Low was understood by BoM at least one week before the flood
- A review of the gauge system should be conducted e.g. to audit gauges, review their adequacy
- Establish an emergency control centre in Smithtown, instead of taking directions from Taree
- Needs to be a coordinated local community emergency plan for people, livestock, machinery
- There should be annual drills on flood procedures carried out by local residents, SES, BoM, Council together
- Review and improve the evacuation plan for Smithtown and Gladstone

The Smithtown focus group participants requested that they receive a summary of this report and wished to be kept abreast of its outcomes. They also requested that the report be sent to the local Mayor.

3.8 COMPARISON WITH SOCIAL RESEARCH DATA FROM THE MARCH 2001 EAST COAST LOW FLOOD EVENT

In March 2001, an East Coast low-pressure system passed over the North Coast area of NSW bringing with it torrential rain that caused serious flooding

on several river systems including the Clarence. During this event the BoM predicted that the Clarence River would rise to 8.1m or more at Grafton. As a consequence, the SES ordered the evacuation of the town. However, this warning was ignored by the majority of the community (Pfister 2001).

A study was subsequently undertaken by Pfister (2001) to evaluate warning and evacuation performance during the 2001 event. By comparing the findings of Pfister (2001) with the findings of this review, an understanding of the differences and similarities of the warning and evacuation performances during the 2001 and 2009 events in the Clarence Valley can be achieved.

During the 2001 event at Grafton, the Clarence River peaked at 7.75m. This was higher than the 7.4m flood peak at the same location in 2009. On each occasion, the actual flood peak was significantly lower than the BoM's predicted flood peak (8.1m in 2001 and 7.8m in 2009). On both occasions this resulted in flood evacuation orders being given by the SES which, in the opinion of many residents surveyed, turned out to be 'unnecessary'. The SES pointed out that given the lead times required for evacuation and the flood forecasts available at the time that the SES had to make a decision, then in both instances the orders were warranted.

According to the results of surveys undertaken of Grafton and other Clarence Valley residents following the 2001 and 2009 flood events, there appears to be a significant difference in the proportion of the community which were told to evacuate. During the 2001 event, 97 percent of those surveyed said they were told to evacuate whereas in 2009 only 75 percent of those surveyed were told to evacuate. However, despite a lower proportion of people being told to evacuate in 2009, it appears that a higher proportion of people actually evacuated in 2009 compared to 2001. During the 2009 flood, 24 percent of those surveyed from the Clarence Valley said that they evacuated, compared to 13 percent of people who said that they evacuated in 2001.

Pfister (2001) reports that, of the people who did not evacuate in 2001, 18 percent said they would consider evacuating next time because of the 'close call'. On the other hand, only two out of the

37 evacuees surveyed in 2001 reported that the experience of 2001 would influence any future decision to evacuate. This indicates that the experience of 2001 could be a factor as to why evacuation rates were higher in 2009 than 2001.

There were interesting similarities and differences in the way respondents heard about the evacuation orders given in 2001 and 2009. Radio broadcast was the most common way of learning of the order during both events (63 percent in 2001 compared with 66 percent in 2009). Hearing from family and friends was also a common way of learning of the order during both events (31 percent in 2001 and 22 percent in 2009). However, in 2001 SES doorknockers were the only other notable way in which respondents (25 percent) heard of the evacuation order. This differs significantly to 2009 where the BoM website (42 percent) and television (27 percent) were the other notable means through which respondents learnt of the evacuation order.

In 2001 the main reason behind those surveyed not evacuating was the belief that they were not at risk. While this was also an important reason why many people did not evacuate in 2009, other reasons given by many respondents for not evacuating in 2009 such as property protection and a lack of trust in the evacuation order, do not appear to have been significant factors for not evacuating in 2001.

3.9 COMPARISONS WITH OTHER RELEVANT SOCIAL RESEARCH DATA

3.9.1 Lismore

In June 2005, substantial flooding occurred in Lismore and Byron Shire communities following heavy rain over North East NSW. Flood warnings and evacuations were issued in both Lismore and the Byron Shire (Molino Stewart 2006).

Following this event, Molino Stewart (2006) undertook a survey of the SES's warning and evacuation performance.

The survey found that two percent of people in Byron Shire and 61 percent of people in Lismore

heard the evacuation notification compared to the 75 percent of people in the Clarence Valley who were told to evacuate during the 2009 event.

During the 2005 flood event in Lismore and Byron Shire, the most common way residents found out about the evacuation notification was through SES door knockers. The next most common means of notification was through radio broadcasts, followed by learning about it from friends or family. In 2009 radio broadcasts were the most common way to find out about the order to evacuate, however very few respondents reported being told to evacuate by SES doorknockers. Also, in 2009 many people heard about the evacuation order through television and the BoM website, whereas in the Lismore and Byron Shire 2005 floods this was not the case.

The survey conducted following the 2005 flood indicates that 40 percent of people in Lismore and 19 percent of people in Byron Shire evacuated compared to 24 percent of people in the Clarence Valley who evacuated in 2009.

3.9.2 Grafton

In 2008, Molino Stewart (2009) undertook a survey of Grafton residents to ascertain their flood evacuation behaviour. This survey found that 63 percent of people would evacuate if the levee was going to overtop and they were advised to evacuate. This is significantly higher than the 32 percent of respondents from the Clarence Valley who said they evacuated during the 2009 flood event out of those who said they heard the evacuation order.

In 2005, GNS Science (2007a) undertook a survey of Grafton residents to ascertain community perceptions in regards to flood risk, flood education and flood warning. This was followed by a resurvey in 2007 (GNS 2007b).

The survey and resurvey asked what people would do if they were told to evacuate their property during a flood. In 2005, 39 percent of people said they would evacuate immediately compared to 34 percent in 2007. These results are similar to the percentage of people from the Clarence Valley (32 percent) who said they evacuated in 2009 out of those who heard the order.

However, the GNS Science (2007a & 2007b) surveys found that when asked what they would do if they were told to evacuate their property during a flood, 17 percent of respondents in 2005 and 26 percent in 2007 said they would wait for a door knock. Presumably this means that following a door knock, they would be more inclined to evacuate. Therefore, if door knocking had been more common in Clarence Valley during the 2009 flood event, a higher percentage of people may have evacuated, since very few people surveyed following this event reported hearing about the evacuation order from SES door knockers.

3.9.3 Kempsey

In 2004, Molino Stewart (2004) undertook a baseline survey of businesses in the town of Kempsey to determine the level of flood awareness and preparedness. This survey found that 50 percent of people would expect to find out that their business was about to be flooded by listening to the radio. Another 38 percent said they would expect to find out from a SES door knock.

This result further highlights the importance of radio broadcasts and door knocking in issuing flood warnings. While 66 percent of people surveyed in the Clarence Valley reported they learnt about the flood evacuation order from the radio during the 2009 event, very few reported learning about the order from a SES door knocker. This may explain why so many (25 percent) of those surveyed in the Clarence Valley in 2009 did not hear the evacuation order, as they may have been relying upon receiving a door knock rather than accessing the various forms of media used to broadcast evacuation orders.

4 ADDRESSING THE COMMUNITIES' ISSUES

The views expressed by communities are very important to the SES as it is an organisation dedicated to the well being of communities.

It also recognises that the organisation (staff and volunteers) can improve the way it plans for floods, warns communities and responds to events.

It is these principles that prompted the SES, of its own volition, to commission the community surveys reported here. The SES has committed to consider the data in this report and the matters raised by the community and review the way it warns communities in the future.

It is also important that this report records factual and contextual information which may provide a different perspective on events than those expressed by the community. This information has been independently compiled by Molino Stewart at the request of the NSW SES.

4.1 FLOOD WARNING CONTEXT

4.1.1 The Role of the BOM

The Bureau of Meteorology (BOM) is the Federal Government organisation with responsibility for issuing flood forecasts throughout Australia. The SES would be negligent to ignore flood forecasts issued by the BOM.

4.1.2 The Role of the SES

In NSW the SES is responsible for disseminating flood warnings. It bases these on BOM flood forecasts for an event and its own information about how a forecast flood level would impact different localities along a river and across a floodplain.

4.1.3 Information Limitations

The BOM has developed computer models which predict the behaviour of rivers based on rainfall and stream flow data. The models have been developed and tested using historical rainfall and flood records. During an event the BOM relies on data from rainfall gauges in the catchment and stream gauges along the river to tell it how the event is unfolding. While these gauges measure continuously they do not cover all parts of the catchment and every stream. Assumptions therefore have to be made about how rainfall and runoff is distributed across a catchment when forecasts are being made.

The SES gathers its flood impact information during actual floods, including information provided by the community, and records it in its flood intelligence system. It also takes information from flood studies commissioned by the State Government or Local Councils which record historical flood levels and impacts and model the behaviour of possible future floods. Information about historical flood levels which are used in these flood studies are often provided by the community.

This information is not always available for all parts of the floodplain.

4.1.4 Rainfall and Flood Variability

Rainfall distribution can vary considerably across a catchment but rainfall gauges are only measuring the rainfall at particular points. It also varies over time. While satellite and radar technology have improved the ability to track rain producing clouds it is still generally not possible to accurately forecast how much rain will fall where and when.

The location and timing of rainfall has a significant bearing on how a flood will develop. If two streams have significant rainfall bursts one after the other a minor flood peak might be sustained downstream of their junction as the runoff from each arrives at the junction at different times. If they both occur at the same time a shorter, high flood peak might result because they arrive at the junction at the same time.

No two floods will ever be exactly the same in terms of timing, height, rate of rise and duration

because of the variability of rainfall patterns. This makes precise flood forecasting difficult. The BOM tries to provide forecasts within 0.3m of the eventual flood level but recognises that this is not always possible because of data limitations and rainfall variability.

4.1.5 Time Limitations

The BOM can use fallen rainfall and measured streamflow records in its models to provide reasonably accurate forecasts or it can include forecast rainfall in the models to look further ahead. The further ahead a forecast is made, the higher the risk of an inaccurate forecast. However, the less time between the measured rainfall and river levels and the forecast, the less warning time which will be available. This is a trade off which has to be made between the accuracy and the timeliness of warnings.

Several communities, including some in the Macleay, Richmond and Clarence valleys, could suffer significant loss of life in floods which have a similar chance of occurring as many which have occurred elsewhere along the NSW Coast (and twice on the Macleay) in the past 200 years.

For communities which have significant flood risks, the SES has identified the amount of time which they would theoretically need to be able to evacuate everyone at risk in advance of a flood cutting off their evacuation routes. The NSW State Flood Plan sets these as target warning times for the BOM for these locations. In Grafton and Kempsey the target warning time for levee overtopping is 24 hours but 12 and 15 hours are more realistic for reasonably accurate forecasts in these localities. In Lismore about 12 hours warning is needed and usually achievable.

Assumptions about future rainfall may have to be made when the forecasts of major flooding are issued 12 or more hours in advance of the forecast flood level. A lot of rain can fall in 12 hours and even more in 24 hours. Alternatively, threatening weather systems might pass over without dropping nearly as much rain as might be expected. It is also possible that the rainfall measured at a rainfall gauge is not representative of the rainfall across the entire catchment but that

is not apparent until it is measured as a streamflow some hours later.

4.1.6 Erring on the Side of Caution

Because levee failure or overtopping can cause rapid and devastating flooding of towns behind levees it is the BOM practice to provide as much warning time of potential critical levels as is practical. This may mean including assumptions about forecast rainfall in the modelling.

The critical level may be the level at which a levee would overtop but in many instances the structural integrity of a levee may come into question at lower levels because of the way it has been designed, constructed or maintained. It is the critical level at which there is a risk of levee failure which is used in evacuation decisions and therefore used as a target level for forecasts. This may therefore be lower than the levee crest level.

It is also BOM practice not to revise down flood forecasts for levee failure or overtopping until there is strong evidence that the river will not reach the predicted level. This means that if an earlier forecast has had to include assumptions about forecast rainfall, so that there is sufficient warning time of possible major flooding, and that rain does not eventuate, or its timing is such that peak flood levels from tributary streams do not coincide, the BOM will only revise its forecast down when there is no longer a possibility of late rainfall causing the previously forecast level to be reached.

4.1.7 Levee overtopping variables

Although every levee has a low point where floodwaters will initially overtop it, it is not always a simple matter of matching this to a forecast flood level to understand how and when a levee will overtop. There are two main reasons for this.

Firstly, the levee low point is usually not at the same location as the gauge at which BOM forecasts relate. There are usually historical and practical reasons for the location of a gauge which mean it can be several hundred metres up or down the river from the point at which a levee overtops. Every flood has a slope to its surface and the

difference between the gauge level and the flood level at the point of levee overtopping can vary between floods depending on how quickly the flood is rising.

The practical implication of this is that there is rarely a single gauge height at which a levee would overtop. Rather, there is a range of gauge heights between which a levee might overtop depending on the rate of rise, and therefore the surface slope, of the flood. The amount of river level data available in real times means that BOM models are not able to accurately forecast the flood slope along a levee.

The second issue is that the duration of the flood, above the level at which overtopping occurs, will have a significant influence on how much water spills over the levee. If the flood peaks for a short period just above the levee low point, then only a small amount of water will spill into the town and impacts will be small. If it is sustained at that peak for a long time or continues to rise above that level then it is possible for the area behind the levee to completely fill with water until the flood level on both sides of the levee are almost equal.

The BOM model may be able to use fallen rain and measured stream flows to forecast the flood level in 12 hours time which may be when a levee overtopping could occur but it may have to use forecast rainfall to project what the river level might be in 15 hours to get an idea as to whether levee overtopping is likely to be sustained. If a "wait and see" attitude is taken to see how significant levee overtopping is likely to be, there may be insufficient time to evacuate everyone at risk should that be the appropriate response.

Where levees are at risk of failure from mechanisms other than overtopping, the aforementioned principles also apply. In fact, where a levee may have a risk of geotechnical failure before overtopping occurs, the rate of rise, or more often the rate at which the flood drops, can be the difference between and levee failing or not and is an additional variable which the BOM may need to consider.

4.2 THE MAY 2009 FLOOD WARNINGS

Appendix C is a summary of the flood warnings issued for the three river systems that are the subject of this report.

It provides details of when the warnings were issued and the details of the content of those warnings which included the BOM forecasts and information added by the SES. The following summary observations are made.

4.2.1 Macleay River

The updated Flood Watch #1 – Macleay and Hastings Rivers issued Thursday 21 May 2009 12.15am made the first mention of a flood threat to the Macleay River when numerical weather predictions extended the heavy rainfall further south than in earlier model runs.

Moderate flood warnings were issued throughout the afternoon and evening of 22nd May but these were qualified with statements that forecast rain could cause major flooding. A firm prediction of major flooding for Kempsey (Flood Warning #7) was issued at 1:25am on 23 May, notionally 4½ hours before the major flood level was expected with their prediction saying the river level would "exceed major flood level (6.6 metres) by 6am 23/5/09 - Reach 6.9 metres by noon Saturday 23/5/09". In fact, by 6am the river level was only about 6.45 metres and the major flood level of 6.6 metres was not reached until five hours later at 11:00am 23 May. The river at Kempsey did actually reach a peak of 6.9 metres but 12 hours later than forecast at around midnight 23 May. The flood was slower to rise than had been expected.

The initial "too early" prediction times were caused by the automatic gauge at Kempsey reading 0.34 metres too high. The Bellbrook gauge failed during the flood but this was after the initial 6.9m forecast for Kempsey had been made. Further heavy rain continued to fall in the lower Macleay during Saturday 23 May after the initial prediction for major flooding was issued at 1.25am and this affected the timing of the peak.

A peak as high as 7.2m at Kempsey was forecast but the eventual peak was 6.9m. SES Evacuation

Orders for Kempsey included reference to the levees in terms of the predicted flood level, i.e. "The Bureau of Meteorology has predicted a flood level of 6.6 metres at Kempsey Bridge gauge at 6 am. This means that the Kempsey levee will be overtopped and the CBD will become flooded and exceed 6.9 metres by 12 noon."

SES Evacuation Order #5 issued at 1:30pm 23 May stated "The Macleay River overtopped the levee at 12 midday today at Cochrane Street Kempsey with water now flowing into the CBD". The Kempsey levee did overtop but the impacts were less than expected because the flood would appear to have had a flatter slope than previous events (hence the river was not as high at Cochrane St as anticipated) and the forecast peak was not reached and so the duration and height of overtopping was not significant.

All flood heights recorded at Kempsey prior to 9am 23rd May were in the order of 0.34 metres higher than corrected river heights produced later by the BOM in their internal flood warning performance review. The BOM believes this was due to an instrument error.

4.2.2 Clarence River

Flood Watch #1 for the Clarence River, Nymboida River, Orara River, Coffs Creek, Bellinger Valley and Nambucca Valley was issued on Tuesday 19 May 2009 at 12.00pm nearly 56 hours before the first flood warning was issued.

The height at which the Grafton Levee is thought to be under threat could be as low as 7.8m in smaller or slowly rising floods. If this is the case, then 16 hours notice was given of this height which is less than the target 24 hours timing in the State Flood Plan but better than the 12 hours expected in that same plan. As the heaviest rain fell in the lower catchment it was only possible to provide slightly less than 11 hours notice that the flood was expected to exceed the height of the 2001 flood.

The SES Bulletins and Evacuation Orders made reference to locations inside and outside the levees at Grafton. For example "At the predicted height of 7.6m at the Prince St gauge all properties outside the Grafton levee system may experience isolation or inundation" and "The Bureau of

Meteorology has predicted a flood level of 7.8 metres at Prince Street Gauge at 12.00pm 22/05/2009. This means that the following area(s) may be inundated. The town of Grafton and low lying areas of South Grafton, except for Bent Street Hill and the high ground to the Armidale Road."

The final peak of slightly less than 7.4m was less than the earlier predicted level of 7.8m however it was not published in any forecasts until the river was peaking. The Prince St gauge and upstream gauges were functioning throughout the event.

The BOM has advised that it is reluctant to revise forecasts down when there remains uncertainty about forecast rain and only does so if it is confident that further intense rain is unlikely, particularly if the forecast level is associated with risk to life.

The flood warnings continued to make reference to Ulmurra and Maclean after the flood peak had passed Grafton. In the case of Maclean this continued for more than 21 hours.

Media monitoring was not undertaken so it is not known whether electronic media continued to broadcast warnings after the flood peaked at Grafton.

The media is not under a legal obligation to broadcast warnings every 15 minutes as some community members thought although it is generally ABC radio practice to broadcast them at least every 30 minutes. This does not mean that the warning content is updated every 30 minutes. The same warning may stand for several hours. On large rivers such as the Clarence, a 3 hourly update of river heights is entirely adequate.

4.2.3 Wilson River

Flood Warning # 7, which predicted a level of 10.4m would be reached, provided slightly over 7 hours notice for the level to exceed 10.0 metres. This did not achieve the target of 12 hours notice required for a level in excess of 10.0 metres at Lismore. This shorter than desirable notice was due to a sudden burst of intense rainfall as explained in the warning "Average of 200 millimetres of rain has fallen during the past 33 hours to 6 pm today [22/5/09]. Rainfall has

become much heavier in the past 60 minutes with up to 60 millimetres falling since that time."

The forecast peak of 10.4m at Lismore was reached.

SES Flood Bulletin #1 for Lismore issued at 9:00am 22nd May contained information concerning flooding in the Lismore CBD when it said, "It is predicted that the river will peak at a height of 10.4 metres at 12noon today Friday. This will cause major flooding of the CBD Lismore and North Lismore."

SES Flood Bulletin #3 issued Fri 22nd May at 2:30pm further confused the information for flooding in Lismore CBD saying "it is predicted that the river is close to peaking at a height of 10.4 metres which **was** reached at 2pm today Friday. This is **causing** major flooding within the CBD Lismore, South Lismore and North Lismore." (emphasis added). There was no flooding in the CBD caused by levee overtopping although internal stormwater flooding may have been an issue.

The flood intelligence information in the Lismore FloodSafe brochure says "*overtopping of the CBD levee will typically begin at this height*" (10.6-10.7). The SES has advised that the evacuation decision for Lismore CBD was based, not on the prediction of a peak of 10.4m but rather, on uncertainty about a possibly higher level if there was renewed rainfall and the lack of available time to evacuate should evacuation start after the later rain fell.

According to the SES FloodSafe brochure for South Lismore the levee there could be expected to be overtopped at a flood height of 10.0 to 10.2 m which it appears to have not been the case during the May 2009 flood.

5 CONCLUSIONS

There were several positive aspects of the flood warnings and evacuation notifications given for the Macleay, Clarence and Wilsons/Richmond valleys:

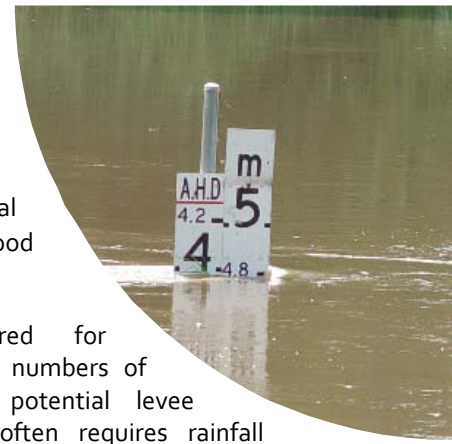
- Flood watches were issued well in advance of flooding
- Communities in the Clarence Valley (84% of survey respondents) and Wilsons/Richmond valleys (88%) said they had sufficient warning time
- Community members are interested in being involved in improving flood warning.

This investigation identified several areas for improvement. In particular:

- Only 58% of respondents in the Macleay Valley felt they had enough warning time
- At times broadcast media, websites and SES help lines reportedly provided conflicting information
- Some small downstream communities were not mentioned in flood bulletins and/or did not receive them
- Some flood bulletins and SES help line advice contained geographically incorrect information
- Many community members expressed a distrust of BoM forecasts
- Only 32-45% of communities evacuated
- 20-30% of communities said they would never evacuate.
- Many people were not sure whether evacuation was mandatory or voluntary.
- People in Smithtown and Gladstone were told to evacuate after the roads had been cut by floodwaters
- Communities expressed a desire for greater local involvement in flood forecasting and warning.
- Communities want more accurate and reliable information on road closures
- Communities want the opportunity for a debrief with an independent facilitator following a major flood.

The investigation also identified some practical issues related to flood forecast and evacuation:

- The time required for evacuation of large numbers of people ahead of potential levee overtopping/failure often requires rainfall forecasts to be used in modelling which can reduce flood forecast accuracy
- The flood slope, eventual flood peak and duration of flooding can all have an influence on whether a levee will overtop and how significant the impacts of overtopping will be
- It is difficult to forecast the flood slope and forecasting eventual peaks and durations requires further assumptions to be made about future rainfall
- The BOM is reluctant to revise “levee-overtopping” forecasts down while ever there remains a chance of late, heavy rainfall causing the earlier forecast to be reached or exceeded.



APPENDIX A – COMMUNITY SURVEY QUESTIONS

Resident Survey: May 2009 North Coast Flood Event

This survey is being conducted by Molino Stewart Pty Ltd on behalf of the NSW SES. All responses will be completely anonymous. Thank you for your participation.

Date:

Location:

Street Name of Residence/Business:

1. Were you aware that flooding was expected to affect parts of your community in the days leading up to the floods in May 2009?

- Yes No (go to Q5)

2. If yes, how did you hear those initial warnings? (Tick all that apply)

- | | |
|--|--|
| <input type="checkbox"/> Radio Announcements | <input type="checkbox"/> Radio talk back |
| <input type="checkbox"/> Television | <input type="checkbox"/> State Emergency Service (SES) website |
| <input type="checkbox"/> Bureau of Meteorology website (BOM) | <input type="checkbox"/> Council |
| <input type="checkbox"/> Family and friends | <input type="checkbox"/> Internet |
| <input type="checkbox"/> Newspaper | <input type="checkbox"/> Spoke with SES over telephone |
| <input type="checkbox"/> Spoke with SES in person | <input type="checkbox"/> Other (specify)_____ |

3. Did you try to verify (or confirm) the initial warning?

- Yes No (Go to Q5)

4. If yes, how? (Tick all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Spoke with family/friends | <input type="checkbox"/> Rang SES |
| <input type="checkbox"/> Rang Council | <input type="checkbox"/> Rang police |
| <input type="checkbox"/> Logged onto internet sites | <input type="checkbox"/> Listened to radio announcement |
| <input type="checkbox"/> Listened to radio talk back | <input type="checkbox"/> Logged onto SES website |
| <input type="checkbox"/> Logged onto BOM website | <input type="checkbox"/> Went down to the SES to speak with someone |
| <input type="checkbox"/> Logged onto Council website | <input type="checkbox"/> Went down to the river to have a look |
| <input type="checkbox"/> Other (specify)_____ | |

5. Approximately how much warning time did you have? (Specify hours or minutes)

6. Was this enough time to do what you needed to prepare for flooding?

- Yes No

7. What did you do in the time you had? (Tick all that apply)

- | | |
|---|--|
| <input type="checkbox"/> Moved my car to higher ground | <input type="checkbox"/> Prepared my family for evacuation |
| <input type="checkbox"/> Prepared my family for isolation (being cut off) | <input type="checkbox"/> Checked that neighbours or neighbouring business were aware of warning/evacuation order |
| <input type="checkbox"/> Listened to the radio for information, updates and advice | <input type="checkbox"/> Prepared to take pets in case of evacuation |
| <input type="checkbox"/> Relocated or raised possessions, records, stock or equipment on benches/tables | <input type="checkbox"/> Relocated waste containers, chemicals and poisons well above floor levels |
| <input type="checkbox"/> Backed up records and stored offsite | <input type="checkbox"/> Located emergency kit |
| <input type="checkbox"/> Secured objects that were likely to float and cause damage | <input type="checkbox"/> Located and activated flood plan |
| <input type="checkbox"/> Turned off and secured gas bottles | <input type="checkbox"/> Turned off electricity and gas at mains |
| <input type="checkbox"/> Moved livestock, including agisted animals to higher ground | <input type="checkbox"/> Stocked up on non-perishable food, essential medications, fuel or other necessities |
| <input type="checkbox"/> Located important papers, valuables and mementoes to take | <input type="checkbox"/> Relocated farm equipment including pumps to higher ground |
| <input type="checkbox"/> Checked sheds and out buildings | <input type="checkbox"/> Checked evacuation routes |
| <input type="checkbox"/> Other (specify) _____ | |

8. Did you act straight away or did you wait for another cue? (Tick one answer)

- | | |
|---|--|
| <input type="checkbox"/> No, I acted on the first warning I heard | <input type="checkbox"/> No, I didn't wait long, just a few hours |
| <input type="checkbox"/> Yes, I waited until the water reached a particular level at the gauge | <input type="checkbox"/> Yes, I waited until I could see the flood water nearing my property |
| <input type="checkbox"/> Yes, I waited until morning | <input type="checkbox"/> Yes, I waited until I heard the evacuation order |
| <input type="checkbox"/> Yes, I waited until I could see other people were beginning to pack/move stock/livestock | <input type="checkbox"/> Yes, I waited until SES doorknocked my property |
| <input type="checkbox"/> Yes I waited until _____ | |
-

**9. Did the May 2009 floods impact you and/or your property in any of the following ways?
(Tick all that apply)**

- My community was cut off for a period of time
- Access to my home/business was cut off for a period of time
- My home/business was flooded over the floors
- Our home/business is raised, we didn't flood over the floor but there was floodwater underneath the building
- My paddocks were flooded
- My yard was flooded
- I lost livestock
- Floodwater didn't affect my property this time
- I probably would have been flooded if the flood was higher and the levee overtopped
- I lost business because of the floods
- Roads I normally travel on were closed
- Other (please specify) _____

10. Was your community (or parts of it) told to evacuate in May 2009?

- Yes No

11. Did you evacuate? That is, did you leave by vehicle before the flood levels reached a height that would cut off road access or overtop the levee?

- Yes No (Go to Q13)

12. If you did evacuate where did you go? _____

How long did it take? _____

What transport did you use? _____

13. If you didn't evacuate, why not? (e.g. property protection, didn't apply, no warning?)

14. Did you or someone in your family need rescue assistance to get out of your house by boat or helicopter?

- Yes No

If yes, why did you/they not evacuate beforehand?

15. Regardless of whether you evacuated or didn't in May, what would convince you to evacuate in the future?

16. Where did you look for information about the flood to help you decide what you needed to do during this flood event? (Tick all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Local Council | <input type="checkbox"/> State Emergency Service (SES) website |
| <input type="checkbox"/> State Emergency Service (SES) 132 500 | <input type="checkbox"/> State Emergency Service (SES) 1800 201 000 |
| <input type="checkbox"/> State Emergency Service (SES) unit | <input type="checkbox"/> Other community organisation |
| <input type="checkbox"/> Friends and family | <input type="checkbox"/> Bureau of Meteorology (BOM) |
| <input type="checkbox"/> Television | <input type="checkbox"/> Radio |
| <input type="checkbox"/> Newspapers | <input type="checkbox"/> Internet |
| <input type="checkbox"/> Other (specify): _____ | |

17. What type of information were you looking for? (Tick all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Current river levels | <input type="checkbox"/> Predicted river levels |
| <input type="checkbox"/> Official flood warning products | <input type="checkbox"/> Rainfall information |
| <input type="checkbox"/> What impacts were expected to occur e.g levee overtopping | <input type="checkbox"/> What to do to prepare for isolation/inundation |
| <input type="checkbox"/> What to do to prepare for evacuation | <input type="checkbox"/> Where to go when evacuating |
| <input type="checkbox"/> Road information | <input type="checkbox"/> Historical flood consequences |
| <input type="checkbox"/> Historical flood levels | <input type="checkbox"/> Information about what to do with my pets |
| <input type="checkbox"/> Information about what to do with my livestock | <input type="checkbox"/> Other _____ |

18. Were you able to find out the information you needed?

- Yes, easily found the information
- I found the information after trying several sources
- No, I couldn't find the information I was looking for (Go to Q20)

19. Was the information: (Tick yes or no for each)

Factual: Yes No

Timely: Yes No

Useful in answering my questions: Yes No

20. Did you use the internet to find flood information?

Yes No (go to Q 23)

21. What sites did you use? (Tick all that apply)

- News website (i.e. ABC, SMH, local) Government website (i.e. SES, BOM)
 Commercial website (i.e. Weatherzone) Social networking sites (i.e. Facebook, Twitter)
 Other (specify): _____

22. From where did you access it? (Tick all that apply)

- Home PC/Laptop Office PC/Laptop
 PDA / mobile phone Public facility (i.e. library, internet café)
 Other (specify): _____

23. Did you listen to the radio to find flood information?

Yes No (Go to Q24)

What radio station did you listen to? _____

Did the broadcasts from the station meet your information needs? Yes No

If this was not your normal radio station – who do you normally listen to? _____

24. What are the best ways for you to receive the flood information you require? (Tick up to three below)

- Door knock by emergency services Television
 Official websites (i.e. SES/BOM) Automated recording message to your telephone or mobile
 Word of mouth from friends/relatives Commercial websites (i.e. Weatherzone)
 Radio Ringing the SES
 Other (specify) _____

25. What are the best ways for you to hear about official warnings? (Tick up to three below)

- | | |
|---|--|
| <input type="checkbox"/> Door knock by emergency services | <input type="checkbox"/> Television |
| <input type="checkbox"/> Official websites (i.e. SES/BOM) | <input type="checkbox"/> Automated recording message to your telephone or mobile |
| <input type="checkbox"/> Word of mouth from friends/relatives | <input type="checkbox"/> Commercial websites (i.e. Weatherzone) |
| <input type="checkbox"/> Radio | <input type="checkbox"/> Ringing the SES |
| <input type="checkbox"/> Other (specify) _____ | |

**26. What is the best way for you to be told about the need to evacuate?
Please rank each from 1-8 (with 1- most preferred, 8 – least preferred)**

Rank	Option
	Door knock by emergency services
	Television
	Official websites (SES/Bureau of Meteorology)
	Commercial websites (Weatherzone)
	Word of mouth from friends/relatives
	Automated recorded message to your telephone or mobile
	Radio
	Ringing the SES
	Other (specify) _____

27. In the past, what flood education or information have you been aware of or participated in? (Tick all that apply)

- | | |
|--|--|
| <input type="checkbox"/> Business Floodsafe breakfast | <input type="checkbox"/> Business Floodsafe toolkit |
| <input type="checkbox"/> Home Floodsafe toolkit | <input type="checkbox"/> Experience of family or friends |
| <input type="checkbox"/> Anniversary/commemoration of floods | <input type="checkbox"/> Community meetings |
| <input type="checkbox"/> Community information displays | <input type="checkbox"/> Floodsafe brochures |
| <input type="checkbox"/> Other (specify) _____ | |

28. What kind of flood preparations did you have in place before the May 2009 flood? (Tick all that apply)

- | | |
|--|--|
| <input type="checkbox"/> Nothing specific in place | <input type="checkbox"/> Home or Business Emergency Flood Plan |
| <input type="checkbox"/> Stockpile of food and water | <input type="checkbox"/> List of emergency numbers |
| <input type="checkbox"/> Talked with family members about what to do | <input type="checkbox"/> Made sure we had first aid kit/torch/ spare batteries |
| <input type="checkbox"/> Identified access points for the roof | <input type="checkbox"/> Waterproof bags for valuables |
| <input type="checkbox"/> Home/business emergency kit | <input type="checkbox"/> Portable radio |
| <input type="checkbox"/> Other (specify)_____ | |

29. What prevents you from being more prepared? (Tick all that apply)

- | | |
|---|---|
| <input type="checkbox"/> I'm prepared enough | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Time to prepare | <input type="checkbox"/> The risk isn't that high – I don't need it |
| <input type="checkbox"/> Lack of knowledge about what to do | <input type="checkbox"/> Other (specify)_____ |

30. Have you taken any action since May 2009 to be more prepared for future floods?

- | | |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

If Yes, what actions have you taken?

31. How long have you lived in the area? (Tick one answer)

- | | |
|---|---|
| <input type="checkbox"/> Less than one year | <input type="checkbox"/> One to five years |
| <input type="checkbox"/> Five to ten years | <input type="checkbox"/> More than 10 years |

32. Is your home /business: (Tick all that apply)

- | | |
|---|--|
| <input type="checkbox"/> Rented | <input type="checkbox"/> Two storeys or more |
| <input type="checkbox"/> Owned or mortgaged | <input type="checkbox"/> Raised more than one metre above ground |
| <input type="checkbox"/> Holiday house | <input type="checkbox"/> Protected by a levee |

33. Which age bracket do you fall into? (Tick one answer)

<15

15-25

26-35

36-45

46-55

56-65

66-75

75+

34. Are you?

Male

Female

35. How many dependants live with you? _____

Thank you for your participation

To return this survey please mail to:

Molino Stewart c/o: Alison Karwaj
PO BOX 614
Parramatta CBD BC
NSW 2124

If you have any questions or for more information, contact:

Molino Stewart (02) 9354 0300

APPENDIX B – FOCUS GROUP QUESTIONS

May 2009 Flood - Focus Group Questions

Please tell me briefly about your experience with the May 2009 flood

- (1. How were warnings used to advise residents?)
 - **What warnings did you hear and did you think they were official?**
 - **How did you hear them? Where did the information come from?**
 - **Did you listen to a radio station? If yes, which? Was this different from your usual? If so, why?**
 - **How much warning time did you receive and was it enough?**
 - **What warning methods did you think were the most effective and how would you like to receive warnings in the future?**
 - **How effective are informal warning networks?**
- (2. How well were the warnings understood by residents?)
 - **Did you realize the warning applied to you?**
 - **Were you satisfied with the warnings received? Why or why not?**
 - **What makes the communication of warnings effective or otherwise?**
 - **How confident were you regarding the message you received?**
- (3. What were the responses of residents to the warnings issued?)
 - **What actions did you take in response to the warnings?**
 - **Did you attempt to make sure warnings were correct? If yes, how long did this process take?**
 - **What encouraged you to evacuate or stopped you from evacuating? (probe for reasons)**
 - **If you didn't evacuate, what would encourage you to evacuate in the future?**
- (4. How prepared were residents for the flood?)
 - **How prepared were you for the May 2009 flood event?**
 - **Were your responses to the flood pre-planned?**
 - **What actions did you undertake in response to the warnings/ to prepare yourself? e.g. raise electrical items, move stock etc.**
 - **Do you think the flood warnings prevented damage to yourself and your property?**
- (5. How effective are community education programs and tools?)
 - **Does a levee help protect your community? If so, what level of protection does the levee provide to the community?**
 - **Did previous community education programs, activities or information influence your response? If yes, what programs and how? e.g. FloodSafe Guides, Business Breakfast, Home FloodSafe Toolkit?**

APPENDIX C – FLOOD WARNINGS SUMMARY

Flood warnings for the Clarence River at Grafton

Date & Time	Hours notice	Flood Height at Grafton	Bom Prediction/ SES Product	BoM Qualification
21/05/2009 19:52	+25 hrs	1.50	FW#1 Grafton - exceed minor flood level (2.1 metres) around 6 am (22/05/09) - reach 5m around 9pm 22/5 with moderate flooding - possible major flooding with further rain Ulmarra - reach 4 metres around 11 pm (22/05/09) with moderate flooding Maclean - reach 2.2 metres around noon (23/05/09) with moderate flooding	Further heavy rain in the order of 50 to 100 millimetres is forecast for the next 24 hours which may result in major flood levels being reached at Grafton and downstream late Friday or Saturday. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 22:45	+24 hrs	1.90	FW#2 Grafton - exceed minor flood level (2.1 metres) around 3 am (22/05/09) - reach major flood level (5.4 metres) around 11 pm (22/05/09) with major flooding - Additional rises possible with further rain Ulmarra - reach 4.4 metres around 1 am (23/05/09) with moderate flooding Maclean - reach moderate flood level (2.2 metres) around noon (23/05/09) with moderate flooding	Further heavy rain in the order of 50 to 100 millimetres is forecast for the next 24 hours which could produce some further river rises. The situation is being closely monitored. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 01:00	+22 hrs	2.10	FW#3 Grafton - exceed minor flood level (2.1 metres) around 3 am (22/05/09) - reach 6 metres around 11 pm (22/05/09) with major flooding - additional rises possible with further rain Ulmarra - reach 4.8 metres around 1 am (23/05/09) with moderate flooding Maclean - reach 2.4 metres around noon (23/05/09) with moderate flooding	Further heavy rain in the order of 50 to 100 millimetres is forecast for the next 24 hours which could produce some further river rises. The situation is being closely monitored. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 03:14	17.75 hrs	2.45	FW#4 Grafton - reach 7.6 metres around 9 pm (22/05/09) with major flooding - additional rises, possibly exceeding 8 metres, are possible with further very heavy rain Ulmarra - reach 6.0 metres around 11 pm (22/05/09) with major flooding Maclean - reach 3.3 metres around 6 pm (23/05/09) with major flooding	Further heavy rain in the order of 50 to 100 millimetres, with local heavier falls, are forecast for the next 12 to 24 hours which could produce some further river rises. The situation is being closely monitored. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 07:16	15.75 hrs	3.18	FW#5 Grafton - reach 7.8 metres around 11 pm (22/05/09) with major flooding Ulmarra - reach 6.1 metres around 1 am (23/05/09) with major flooding Maclean - reach 3.3 metres around 6 pm (23/05/09) with major flooding	Further heavy rain is forecast for the next 12 to 24 hours which could produce some further river rises. The situation is being closely monitored. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 09:44	14.75 hrs	3.80	FW#6 Grafton - reach 7.8 metres around midnight (22/05/09) with major flooding Ulmarra - reach 6.1 metres around 1 am (23/05/09) with major flooding Maclean - reach 3.3 metres around 6 pm (23/05/09) with major flooding	Rain has eased in the past 6 hours to 9 am [22/05/09], however further heavy rainfall is forecasted over the next 12-24 hours which is expected to produce further river level rises. The situation is being closely monitored. At this stage it

Date & Time	Hours notice	Flood Height at Grafton	Bom Prediction/ SES Product	BoM Qualification
				is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 13:15	10.75 hrs	6.10	FW#7 Grafton - peak near 7.8 metres around midnight (22/05/09) with major flooding Ulmarra - peak near 6.1 metres around 1 am (23/05/09) with major flooding Maclean - peak near 3.3 metres around 6 pm (23/05/09) with major flooding	The Clarence River at Baryulgil is approaching a peak near 12.8 metres. The Mann River at Jackadgery peaked near 10.7 metres around 11am this morning. The main flood waters in the Clarence river are now approaching Lilydale. Major Flooding is expected in Grafton today, with flood levels forecast to be higher than the 2001 flood. The river height predictions are being closely monitored and will be revised if necessary.
22/05/2009 15:52	+8 hrs	6.70	FW#8 Grafton - peak near 7.8 metres around midnight (22/05/09) with major flooding Ulmarra - peak near 6.1 metres around 1 am (23/05/09) with major flooding Maclean - peak near 3.3 metres around 6 pm (23/05/09) with major flooding	The Clarence River at Baryulgil peaked near 12.8 metres around 12:30pm today (22/05/09). The Mann River at Jackadgery peaked near 10.7 metres around 11am this morning (22/05/09). The main flood waters in the Clarence River are now approaching Lilydale. Major Flooding is expected in Grafton today, with flood levels forecast to be higher than the 2001 flood. The river height predictions are being closely monitored and will be revised if necessary.
22/05/2009 19:15	4.75 hrs	7.05	FW#9 Grafton - rise to slightly under 7.8 metres around midnight (22/05/09) with major flooding and peak near 7.8 metres Saturday morning (23/5/09) from the prolonged peak at Lilydale. Ulmarra - peak near 6.1 metres around 1 am (23/05/09) with major flooding Maclean - peak near 3.3 metres around 6 pm (23/05/09) with major flooding	The Clarence River at Lilydale was peaking near 18.51 metres at 6.30pm (22/5/09). Local heavy rain has caused renewed rises along the Nymboida River which is expected to cause a prolonged peak at Lilydale until early Saturday morning. The overall effect at Grafton will be a prolonged major flood peak with flood levels similar to the 2001 flood.
22/05/2009 22:02	5 hrs	7.18	FW#10 Grafton - peak slightly under 7.8 metres around 3am Saturday morning (23/5/09) with major flooding. Ulmarra - peak near 6.1 metres Saturday morning (23/05/09) with major flooding Maclean - peak near 3.3 metres around 6 pm (23/05/09) with major flooding coinciding with the high tide.	Flow from the Nymboida River is expected to prolong the high river level at Lilydale until early Saturday morning. The overall effect at Grafton will be a prolonged major flood peak with flood levels similar to the 2001 flood.
23/05/2009 03:24		7.35	FW#11 Grafton - peaking near 7.3 metres with major flooding - remain above major flood level over the weekend Ulmarra - peak near 6.1 metres Saturday morning (23/05/09) with major flooding Maclean - peak near 3.3 metres around 6 pm (23/05/09) with major flooding	At 3 am the Clarence River at Grafton was peaking near 7.3 metres with major flooding. Major flood peaks will occur at Ulmarra and Maclean later today.

Date & Time	Hours notice	Flood Height at Grafton	Bom Prediction/ SES Product	BoM Qualification
			flooding coinciding with the high tide.	
23/05/2009 04:00		7.36	FW#11(reissue) Grafton - peaking near 7.3 metres with major flooding- remain above major flood level over the weekend Ulmarra - peak near 5.8 metres around 5 am (23/05/09) with major flooding Maclean - peak near 3.2 metres around 6 pm (23/05/09) with major flooding coinciding with the high tide.	At 3 am the Clarence River at Grafton was peaking near 7.3 metres with major flooding. Major flood peaks will occur at Ulmarra and Maclean later today.
23/05/2009 06:30		7.36	Peak Level	
23/05/2009 07:05		7.35	FW#12 No prediction for Grafton after peak Ulmarra - peaking near 5.8 metres with major flooding Maclean - peak near 3.2 metres around 6 pm (23/05/09) with major flooding coinciding with the high tide.	The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding. The Clarence River at Ulmarra is approaching a peak near 5.8 metres. Major flood peaks will occur at Maclean later today.
23/05/2009 09:50		7.32	FW#13 No prediction for Grafton after peak Ulmarra - peaking near 5.8 metres with major flooding Maclean - peak near 3.2 metres around 6 pm (23/05/09) with major flooding coinciding with the high tide.	The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding. The Clarence River at Ulmarra is approaching a peak near 5.8 metres. Major flood peaks will occur at Maclean later today.
23/05/2009 13:40		7.20	FW#14 No prediction for Grafton after peak Maclean - peak near 3.3 metres around 7 pm (23/05/09) with major flooding coinciding with the high tide.	The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding. The Clarence River at Ulmarra is peaked near 5.8 metres. Major flood peaks will occur at Maclean later today
23/05/2009 18:15		7.01	FW#15 No prediction for Grafton after peak Maclean - peak near 3.3 metres around 7:30 pm (23/05/09) with major flooding coinciding with the high tide	The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding. The Clarence River at Ulmarra peaked near 5.8 metres around 10:30 am [23/06/09]. Major flood peaks will occur at Maclean later today.
23/05/2009 20:09		6.90	FW#16 No prediction for Grafton after peak Maclean - peak near 3.2 metres around 8:30 pm (23/05/09)	The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding.
23/05/2009 23:41		6.69	FW#17 The Clarence River at Grafton peaked near 7.4 metres around 5:30 am this morning [23/05/09] with major flooding and is expected to remain above major flood level (5.4 metres) until 6 am tomorrow morning (24/05/09). Maclean - peaking near current level (3.2 metres) with major flooding.	
24/05/2009 03:57		6.43	FW#18 At Grafton, the Clarence River peaked near 7.4 metres around 5:30 am Saturday	

Date & Time	Hours notice	Flood Height at Grafton	Bom Prediction/ SES Product	BoM Qualification
			(23/05/09) and is expected to remain above major flood level (5.4 metres) until this afternoon (24/05/09). Maclean - Remain above major flood level until noon today (24/05/09).	
24/05/2009 08:38		6.20	FW#19 Grafton - fall below major flood level (5.4 metres) around 3 pm today (24/05/09)	The Clarence River at Grafton and Maclean is expected to remain above major flood level (5.4 metres) until this afternoon (24/05/09).
24/05/2009 10:10		6.10		
25/05/2009 09:45		4.93		
25/05/2009 10:06		4.90	FW#20 Grafton - fall below moderate flood level (3.6 metres) Wednesday 27/05/09	River levels at Grafton are falling slowly from their flood peaks from last weekend. King tides will slow the rate of river level falls over this week.
25/05/2009 16:15		4.49	FW#20(reissue) Grafton - fall below moderate flood level (3.6 metres) Wednesday 27/05/09	River levels at Grafton are falling slowly from their flood peaks from last weekend. King tides will slow the rate of river level falls over this week.

Flood warnings for the Macleay River at Kempsey

* note all levels prior to 9am 23/5 need to reduced by about 0.3m to match the Bureau's corrected levels

Date & Time	Hours notice	Flood Height at Kempsey	Bom Prediction/ SES Product	BoM Qualification
22/05/2009 04:16		0.91	FW#1 reissue Preliminary Minor Flood Warning for the Macleay River - no prediction or comment for Kempsey	Further moderate to heavy rain in the order of 50 to 100 millimetres is forecast for the next 12 to 24 hours which is expected to initially cause minor flooding at Georges Creek and Bellbrook this morning. Additional rain is likely to produce some further river rises during the next 24 hours. The situation is being closely monitored. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 09:12	8.75 hrs 14.75 hrs	2.07	FW#2 Kempsey - exceed minor flood level (4.5 metres) around 6 pm (22/05/09).- with forecast rainfall possibly exceed moderate flood level (5.7 metres) around midnight (22/05/09).	Further heavy rain is forecast for the next 12 to 24 hours which is expected to cause minor to moderate flooding in the Macleay Valley. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 13:17	7.75 hrs	3.30	FW#3 Kempsey - exceed minor flood level (4.5 metres) around 5 pm (22/05/09). - with forecast rainfall possibly exceed moderate flood level (5.7 metres) around 9 pm (22/05/09).	Further heavy rain is forecast for the next 12 to 24 hours which is expected to cause minor to moderate flooding in the Macleay Valley. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall. The situation is being closely monitored and revised predictions issued if necessary.
22/05/2009 17:13	12.75 hrs	4.45	FW#4 Kempsey - exceed 6.2 metres around 6am tomorrow morning (23/5/09) with moderate flooding.	Further rain is forecast for the next 12 to 24 hours which is expected to cause minor to moderate flooding in the Macleay Valley. At this stage it is not possible to predict the flood peak because of uncertainties in forecasts and the situation is being closely monitored and revised predictions issued if necessary.
22/05/2009 20:07	16 hrs	5.30	FW#5 Kempsey - Reach 6.4 metres around noon Saturday (23/5/09) with moderate flooding.	Further rain is forecast for the next 12 to 24 hours which is expected to cause moderate to major flooding in the Macleay Valley. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall. The situation is being closely monitored and revised predictions issued if necessary.
22/05/2009 22:14	13.75 hrs	5.90	FW#6 Kempsey - Reach 6.4 metres around noon Saturday (23/5/09) with moderate flooding.	Further rain is forecast for the next 12 to 24 hours which is expected to cause moderate to major flooding in the Macleay Valley. At this stage it is not

Date & Time	Hours notice	Flood Height at Kempsey	Bom Prediction/ SES Product	BoM Qualification
				possible to predict the flood peak because of uncertainty over how much more rain will fall. The situation is being closely monitored and revised predictions issued if necessary.
23/05/2009 01:25	4.75hrs 10.75hrs	6.50	FW#7 Kempsey - Exceed major flood level (6.6 metres) by 6am 23/5/09 - Reach 6.9 metres by noon Saturday 23/5/09	Heavy rain in the lower Macleay Valley has caused higher than expected river rises at Kempsey. Major flooding is now expected at Kempsey this morning.
23/05/2009 02:19	40 mins 12.75 hrs	6.57	FW#8 Kempsey - Exceed major flood level (6.6 metres) by 3am 23/5/09 - Reach 7.0 metres between noon and 3pm Saturday 23/5/09 with further rises possible	Further heavy rain in the lower Macleay Valley has caused a higher than expected rate of river rise at Kempsey. Major flooding is now expected at Kempsey this morning.
23/05/2009 03:22	>8.5 hrs	6.65	FW#9 Kempsey - Peak near 7.0 metres between noon and 3pm with major flooding.	Major flooding is occurring at Kempsey this morning.
23/05/2009 06:42	5.15 hrs	6.72	FW#10 Kempsey - Peak near 7.0 metres between noon and 3pm with major flooding.	Major flooding is occurring at Kempsey this morning, which is expected to peak later this afternoon.
23/05/2009 09:53	8 hrs	6.55	FW#11 Kempsey - Peak near 7.0 metres around 6pm today (23/05/09) with major flooding.	River level readings for Kempsey have been corrected, and this morning at 9am they were 6.5 metres, with moderate flooding. Major flooding is expected at Kempsey later today.
23/05/2009 11:00		6.60	MAJOR FLOOD LEVEL	
23/05/2009 12:33	11.5 hrs	6.67	FW#12 Kempsey - Peak near 7.2 metres around midnight tonight (23/05/09) with major flooding.	Corrected River levels readings for the Kempsey River at Bellbrook have resulted in an upwards revision of river height predictions. Major Flooding is expected at Kempsey today.
23/05/2009 15:55	8 hrs	6.78	FW#13 Kempsey - Peak near 7.2 metres around midnight tonight (23/05/09) with major flooding.	No river level data is available for Bellbrook, which was forecast to peak around 4pm today. At 3pm this afternoon, river levels for the Macleay River and Toorooka appear to be approaching a peak near 10.9 metres.
23/05/2009 19:00	5 hrs	6.84	FW#14 Kempsey - Peak near 7.2 metres around midnight tonight (23/05/09) with major flooding.	The Macleay River at Bellbrook peaked near 11.35 metres around 1 pm today (23/05/09) with moderate flooding, and is expected to remain above moderate flood level (10.5) metres for next 12 hours.
23/05/2009 22:30		6.90	Peak Level	
23/05/2009 23:06	2 hrs	6.90	FW#15 Kempsey - Peak near 7.1 metres around 1 am (24/05/09) with major flooding.	The Macleay River at Bellbrook peaked near 11.35 metres around 1 pm today (23/05/09) with moderate flooding, and is expected to remain above moderate flood level (10.5) metres for next 12 hours.
24/05/2009 02:00		6.90		

Date & Time	Hours notice	Flood Height at Kempsey	Bom Prediction/ SES Product	BoM Qualification
24/05/2009 03:08		6.85	FW#16 Kempsey - Remain above major flood level (6.6 metres) until this afternoon (24/05/09).	The Macleay River at Kempsey peaked near 6.90 metres around midnight (23/05/09) with major flooding. The Macleay River at Bellbrook peaked near 11.35 metres around 1 pm (23/05/09) with moderate flooding, and is expected to remain above moderate flood level (10.5) metres until noon today (24/05/09)*.
24/05/2009 03:21		6.84	FW#16(reissue) Kempsey - Remain above major flood level (6.6 metres) until this afternoon (24/05/09).	The Macleay River at Kempsey peaked near 6.90 metres around midnight (23/05/09) with major flooding. The Macleay River at Bellbrook peaked near 11.35 metres around 1 pm (23/05/09) with moderate flooding, and has now fallen below moderate flood level (10.5 metres).
24/05/2009 09:18		6.60	FW#17 Kempsey - Remain above major flood level (6.6 metres) until around midday today (24/05/09). - Remain above moderate flood level (5.7 metres) until this evening or early Monday morning.	The Macleay River at Kempsey peaked near 6.90 metres around midnight (23/05/09) with major flooding. The Macleay River at Bellbrook peaked near 11.35 metres around 1 pm (23/05/09) with moderate flooding, and has now fallen below moderate flood level (10.5 metres).
25/05/2009 09:14		5.40	FW#18 Kempsey - Fall below minor flood level (4.5 metres) Tuesday morning (26/05/09).	The Macleay River at Kempsey is currently at 5.4 metres which is above minor flood level (4.5 metres).

Flood warnings for the Wilsons River at Lismore

Date/Time	Hours notice	Flood Height at Lismore	BoM Prediction / SES product	BoM Qualification
21/05/2009 05:20	>9 hrs	2.10	FW#1 Lismore - exceed minor flood level (4.2 metres AHD) by 3 pm (21/05/09)- further rises over the next 24 - 48 hours	Further heavy rain in the order of 100 to 200 millimetres is forecast for the next 24 hours. This rain is expected to initially cause minor flooding at Lismore around noon today. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 05:43	>6 hrs	2.20	FW#1 (reissue) Lismore - exceed minor flood level (4.2 metres AHD) between noon and 3 pm (21/05/09) - further rises over the next 24 - 48 hours	Further heavy rain in the order of 100 to 200 millimetres is forecast for the next 24 hours. This rain is expected to initially cause minor flooding at Lismore between noon and 3pm today. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 07:56	4 hrs 16 hrs 25 hrs	2.90	FW#2 Lismore - exceed minor flood level (4.2 metres AHD) around noon (21/05/09)- exceed moderate flood level (7.2 metres AHD) around midnight (21/05/09) - with forecast rainfall possibly exceed 9.0 metres AHD around 9 am (22/05/09) with moderate flooding	Further heavy rain in the order of 65 millimetres is forecast for the next 12 hours. Moderate flooding is expected at Lismore late tonight. Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 13:25	10.5 hrs 16 hrs 16.5 hrs	4.35	FW#3 Lismore - exceed moderate flood level (7.2 metres AHD) around midnight (21/05/09)- exceed 9.0 metres AHD around 6am tomorrow (22/5/09) with moderate flooding - with forecast rainfall possibly exceed major flood level (9.7 metres AHD) around noon tomorrow (22/5/09)	Moderate flooding is expected at Lismore late tonight. Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 13:56	10 hrs 16 hrs 22 hrs	4.50	FW#4 Lismore - exceed moderate flood level (7.2 metres AHD) around midnight (21/5/09) - exceed 9.0 metres AHD around 6am tomorrow (22/5/09) with moderate flooding - with forecast rainfall possibly exceed major flood level (9.7 metres AHD) around noon tomorrow (22/5/09)	Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 14:00		4.50	SES door-knock statement for North Lismore dated 21/05/09 at 1400 hrs	
21/05/2009 17:06	7hrs 13 hrs 19 hrs	5.35	FW#5 Lismore - exceed moderate flood level (7.2 metres AHD) around midnight (21/5/09) - reach 9.0 metres AHD around 6am	Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being

Date/Time	Hours notice	Flood Height at Lismore	BoM Prediction / SES product	BoM Qualification
			tomorrow (22/5/09) with moderate flooding - with forecast rainfall possibly reach major flood level (9.7 metres AHD) around noon tomorrow (22/5/09)	closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 20:48	6.25 hrs 12.25 hrs	6.75	FW#6 Lismore - reach 9.0 metres AHD around 3 am Friday (22/5/09) with moderate flooding - reach major flood level (9.7 metres AHD) around 9 am Friday (22/5/09)	Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
21/05/2009 22:40	7.25 hrs	7.44	FW#7 Lismore - reach 10.4 metres AHD with major flooding around 06:00 am Friday	Average of 200 millimetres of rain has fallen during the past 33 hours to 6 pm today [22/5/09]. Rainfall has become much heavier in the past 60 minutes with up to 60 millimetres falling since that time. River height predictions at Lismore have been raised to reflect this higher rainfall. Further heavy rainfall is expected over the next 24 to 48 hours which could produce further river rises. The situation is being closely monitored and revised predictions will be issued if necessary. At this stage it is not possible to predict the flood peak because of uncertainty over how much more rain will fall.
22/05/2009 00:12	11.75 hrs	8.07	FW#8 Lismore - Peak around 10.4 metres AHD with major flooding around 12:00 pm Friday (22/05/09)	An average of 250 millimetres of rain has fallen during the past 39 hours to 12 am this morning [22/5/09]. However, rain has eased since over the catchment in the last hour. Major flooding is forecast for the Wilsons River at Lismore.
22/05/2009 03:48	8.25 hrs	8.94	FW#9 Lismore - Peak around 10.4 metres AHD with major flooding around noon Friday (22/05/09)	An average of 250 millimetres of rain has fallen during the past 39 hours to midnight Thursday night [21/5/09]. However, rain has eased since then. Major flooding is forecast for the Wilsons River at Lismore.
22/05/2009 08:06	4 hrs	9.85	FW#10 Lismore - Peak around 10.4 metres AHD around noon Friday (22/05/09) with major flooding.	An average of 250 millimetres of rain has fallen during the past 39 hours to midnight Thursday night [21/5/09]. However, rainfall has eased since midnight. Major flooding is forecast for the Wilsons River at Lismore.
22/05/2009 11:00	3 hrs	10.21	FW#11 Lismore - Peak around 10.4 metres AHD around 2 pm Friday (22/05/09) with major flooding.	An average of 260 millimetres of rain has fallen during the past 24 hours to 9 am Friday [22/5/09]. No significant rain has occurred over the Richmond/Wilsons Valley since 11 pm 21/05/09. Major flooding is forecast for the

Date/Time	Hours notice	Flood Height at Lismore	BoM Prediction / SES product	BoM Qualification
				Wilsons River at Lismore.
22/05/2009 14:00		10.40	FW#12 The Wilsons River at Lismore is approaching a flood peak near its current level of 10.4 metres around 2pm this afternoon, with major flooding.	An average of 110 millimetres of rain has fallen during the past 24 hours to 1 pm Friday [22/5/09]. No significant rain has occurred over the Richmond/Wilsons Valley since 11 pm 21/05/09.
22/05/2009 17:15		10.30	FW#13 The Wilsons River at Lismore peaked at 10.4 metres at 2 pm this afternoon (22/05/09), with major flooding.	
22/05/2009 20:32		10.15	FW#14 no mention of Lismore – warnings and forecasts focussed on the lower Richmond River as the river at Lismore had peaked.	
23/05/2009 08:44		9.15	FW#15 no mention of Lismore	
23/05/2009 12:56		8.78	FW#16 no mention of Lismore	
23/05/2009 16:48		8.49	FW#17 no mention of Lismore	
23/05/2009 19:48		8.34	FW#18 no mention of Lismore	
24/05/2009 00:34		8.14	FW#19 no mention of Lismore	
24/05/2009 04:28		7.99	FW#20 no mention of Lismore	
24/05/2009 08:04		7.86	FW#21 no mention of Lismore	
25/05/2009 09:28		5.94	FW#22 The Richmond (should have read Wilsons) River at Lismore is expected to remain above minor flood level (4.2 metres) until Tuesday morning [26/05/09].	
26/05/2009 08:28		4.46	FW#23 The Richmond (should have read Wilsons) River at Lismore is expected to fall below minor flood level (4.2 metres) around midday today [26/05/09].	
27/05/2009 08:44		3.19	FW#24 The Richmond (should have read Wilsons) River at Lismore has fallen to below minor flood level (4.2 metres).	