Queensland Floods Commission of Inquiry

Interim Report

August 2011

Queensland Floods Commission of Inquiry

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1 August 2011

The Honourable Anna Bligh MP
Premier and Minister for Reconstruction
Executive Building
100 George Street
BRISBANE QLD 4002

Dear Premier

In accordance with *Commissions of Inquiry Order (No.1) 2011*, it is my pleasure to present the interim report of the Queensland Floods Commission of Inquiry.

The interim report makes recommendations on matters associated with flood preparedness prior to the next wet season.

Yours sincerely

C. Holmes

Commissioner
Justice C E Holmes

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Preface

The floods of December 2010 and January 2011 strained the resources of a state more used to coping with drought than flood. Their consequences were shocking; no-one could have believed that people could be swept by a torrent from their homes and killed, as they were in Grantham; that nine motorists could be drowned in the attempt to negotiate floodwaters; that some towns could be completely isolated for weeks, or that every last citizen of others would have to be evacuated; that residents of cities like Ipswich and Brisbane could lose everything they owned in waters which wrecked thousands of homes.

On 17 January 2011, the Queensland Government established the Commission of Inquiry into the 2010/2011 flood events. The terms of reference are extensive: as Commissioner, I am to inquire (in summary) into the preparation and planning for the flooding by governments at all levels, emergency services and the community; the supply of essential services during the floods; the adequacy of forecasts and early warning systems, with particular reference to Toowoomba and the Lockyer Valley; compliance with, and the suitability of, dam operational procedures for safety and flood mitigation; land use planning to minimise flood damages; and the performance of insurers in meeting their claims responsibilities.

The Commissions of Inquiry order under which the Commission was established requires the provision of an interim report – this report – by 1 August 2011 on matters associated with flood preparedness, to enable early recommendations to be implemented before next summer's wet season. This report endeavours to make recommendations which can be put into effect in time to provide some safeguards should flooding recur this summer. It also deals, particularly where dam operations are concerned, with work which cannot be completed by summer, but the commencement of which is so important that it should not be delayed until the Commission's final report is provided.

This report does not deal with the questions of insurance and land use planning, because they are not matters which lend themselves to useful recommendations for the next wet season. They will instead be the subject of the Commission's next round of hearings, in September and October 2011. Those hearings will also return to and further explore some aspects of the terms of reference dealt with in this report.

The Commission was directed by the Commissions of Inquiry order to 'take into account the regional and geographic differences across affected communities' and to 'seek public submissions and hold public hearings in affected communities'. The Deputies and I have done our best to meet those obligations, holding meetings in towns from Grantham to Jericho and public hearings in centres from Rockhampton to St George. We will continue that pattern over the time left for our inquiries.

Six and a half months is not very long to set up a Commission, receive submissions, identify issues, assemble evidence, hold hearings and produce a report. That it has been possible is a credit to the Commission's energetic and dedicated staff. The report strives to be practical, rather than descriptive; we have not dwelt on the tragedies suffered, because the most helpful thing we can do is to make suggestions to guard against their repetition.

C.E. Holmes
Commissioner

Recommendations

Chapter 2 Dams

2.1 Seqwater should review all arrangements for the operation of the dams during flood events for the entire wet season by 30 September each year, and ensure that all parties are adequately prepared, in the process ensuring that:

- Seqwater can comply with every aspect of the Wivenhoe and North Pine manuals
- the flood operations centre is ready and capable of operating during any flood event of whatever duration, including in terms of communications, equipment, rostering of and facilities for staff
- the flood operations centre has available to it all tools, studies, equations and data necessary for it to be fully appraised of the consequences of its operation of the dams, including:
  - hydrodynamic model of the Brisbane River downstream of the Wivenhoe Dam
  - hydrodynamic model of the Bremer River
  - copy of damage curves from Brisbane Valley Damage Minimisation Study 2007
  - equations for flow out of fuse plugs, if initiated.

2.2 It should be accepted that control over temporary alteration of the full supply level of Wivenhoe, Somerset and North Pine dams is solely the function of the Queensland Government acting through the responsible Minister.

2.3 The regulatory framework by which the responsible Minister can effect a temporary alteration to full supply level should be simplified.

2.4 For the purposes of making any decision about a temporary alteration to full supply level, the Minister should receive advice from:

1. Seqwater, as to the flood mitigation impacts of such an alteration
2. the Water Grid Manager, as to the security of water supply implications of such an alteration
3. the Water Commission, as to both the flood mitigation impacts and the security of water supply implications of such an alteration
4. DERM as to an analysis of the above advice, its own advice as to dam safety, the regulatory framework and any other matter within its expertise.

2.5 If the Bureau of Meteorology makes a similar seasonal forecast to that made for the 2010/2011 wet season, expressed with equal or greater confidence, for the 2011/2012 wet season, the Queensland Government should temporarily reduce the full supply level of Wivenhoe Dam to 75 per cent, with a concomitant adjustment to the trigger levels for the strategies in the Wivenhoe manual.

2.6 The requirements of the chief executive of DERM as to training of operational personnel should be provided to Seqwater on a regular and formal basis.

2.7 Seqwater should ensure all staff and engineers who may be involved in flood operations are involved in formal training exercises which address the full range of possible operating situations.

2.8 Seqwater should:

1. conduct an interim review of the Wivenhoe manual
2. have the draft manual assessed by independent expert peer reviewers
3. consider the expert peer reviews
4. submit the draft manual to DERM for approval under the Act so that it can be approved before 1 October 2011.

2.9 The following matters require particular attention during the interim review of the Wivenhoe manual:

- definition of what 'best forecast rainfall' means
- prescription about how forecast rainfall information is to be used by the flood engineers

- definition of 'predicted lake level' and the use of consistent language throughout the Wivenhoe manual about predicted lake levels
- clarification of options for transition to strategies W2 or W3 from strategy W1
- clarification of the rules for drawdowns of the dams following flood events
- removal of the term 'non-damaging flows' (and similar terms) to describe flows below 4000 m^3/s at Moggill
- clarification of whether W3 allows the flood engineers to release water which would create a flow at Moggill of over 4000 m^3/s
- precise definition of the maximum mechanical capability of the gate opening mechanism
- clarification of how part 8.6 should be followed in strategy W4, including clarifying the use of the word 'generally'.

2.10 Seqwater should act immediately to establish:

1. a steering committee to oversee the long term review of the Wivenhoe manual including senior representatives of at least DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council, Ipswich City Council and Somerset Regional Council
2. a technical review committee comprised of independent experts in at least hydrology, meteorology and dam operations to examine all technical work completed as part of the review.

2.11 The steering committee should ensure the scientific investigations and modelling outlined in recommendation 2.12 and 2.13 are completed. It should also assess the need for any other work to be done, and instigate any other investigations or work considered necessary for a full and proper review of the Wivenhoe manual.

2.12 The following scientific investigations should be carried out prior to modelling work under the supervision of the steering committee and reviewed by the technical review committee:

1. review of the design hydrology:
   a. using a stochastic or Monte Carlo or probabilistic approach
   b. taking into account observed variability in temporal and spatial patterns of rainfall
   c. taking into account observed variability in relative timings of inflows from the dams and downstream tributaries.
2. production of a digital terrain model incorporating a bathymetric survey of all critical sections of creeks and rivers upstream and downstream of the dam relevant to flood modelling
3. assessment of the reliability of the 24 hour, the three day and the five day rainfall forecasts
4. consideration of whether and how weather radar can be incorporated into decision making
5. requesting information from the Bureau of Meteorology as to its willingness to provide ensemble forecasts
6. consideration as to whether and how ensemble forecasts can be incorporated into decision making.

2.13 The following modelling work should be carried out under the supervision of the steering committee and reviewed by the technical review committee:

1. modelling across the range of full supply levels, operating strategies and flood events (historical, design and synthetic) in each case assessing the consequences in terms of risk to life and safety and economic, social and environmental damage. In terms of operating strategies, using a full range of strategies including:
   a. a stepped change from W3 to W4
   b. moving to a higher rate of release earlier in W1
   c. bypassing W1
   d. altering maximum release rates under W3
   e. operating the gates in conjunction with the initiation of any of the fuse plugs in order to achieve a lower rate of discharge
2. simulations to test the robustness of relying on the 24 hour, the three day and the five day rainfall forecasts

3. development of a probability distribution for the time between closely spaced flood peaks in the catchment using historical records.

2.14 The Commission recommends that a review be conducted of the number and distribution of ALERT gauges within the Wivenhoe and Somerset catchments. This review should include an assessment of the usefulness and cost effectiveness of installing more gauges, particularly at high elevations in the catchment. Such an assessment would appropriately involve the Bureau of Meteorology, DERM and Seqwater, and the relevant local councils.

2.15 Seqwater should:

- immediately recruit and train additional flood engineers to ensure at least five flood engineers are available for flood operations
- establish a formal flood event operation training program for junior engineers to ensure the flood operations centre will be staffed by appropriately qualified and experienced personnel in the medium and long term.

2.16 In addition to the on duty flood engineer(s), Seqwater should ensure that the flood operations centre is staffed by a trainee flood engineer on each shift (in addition to the technical assistants) to conduct the modelling.

2.17 Seqwater should ensure that, during major flood events, flood engineers do not have responsibility for, and are not required to, organise food, sleeping arrangements or access to facilities, such as power supply and communications equipment.

2.18 An accurate record should be kept of reasons for key decisions, including changes in strategy and releases. Documents relevant to key decisions should also be kept, including:

- each version of the gate operations spreadsheet which contains a different input gate operation scenario
- all graphical depictions of model runs produced
- a version of the gate operations spreadsheet which contains the gate operation scenario which will be implemented marked so that it is clear it is the one agreed to be implemented.

2.19 Seqwater should ensure that all telephone calls within the flood operations centre are digitally recorded to create an accurate record of decision-making during major flood events.

2.20 Seqwater should develop procedures which require the flood engineers to check the entries in the flood operations centre's flood event log at a near contemporaneous time, such as the end of their shift, to ensure accuracy and the recording of significant events. Seqwater should make sure that the operation of the flood operations centre enables the flood engineers to comply with that procedure.

2.21 Seqwater should produce a template situation report in consultation with the flood engineers and recipient agencies. As part of this process, consideration should be given as to whether the quality and timeliness of the dissemination of information about flood operations would be improved if a single document, rather than a situation report and a technical situation report, were used for the purpose of communicating flood operations to all concerned parties. The template situation report should include, at a minimum, dedicated space for the following:

- meteorological observations and situation, including forecasts
- identification of the current operating strategy
- the strategy, aims and objectives of the flood engineers
- actual and expected releases
- any other comments.

2.22 Seqwater should create a regular forum for discussion between all operational staff of the flood operations centre and Bureau staff to:

- increase the knowledge of flood operations centre staff about the Bureau's products, abilities, advice and operations
- reach agreement as to the frequency and type of information to be shared between the Bureau and the flood operations centre during a flood event

- discuss advances in technology and science in areas including forecasting, data collection and modelling
- build relationships between the staff of both organisations.

2.23 Seqwater should give consideration to creating a communications position within the flood operations centre filled by an engineer with experience in dam operations and emergency management processes.

2.24 Seqwater should give consideration to posting information about current and future releases on its website during flood events as one method of ensuring accurate and timely information is available to the public.

2.25 Seqwater should:

1. conduct an interim review of the North Pine manual
2. have the draft manual assessed by independent expert peer reviewers
3. consider the expert peer reviews
4. submit the draft manual to DERM for approval under the Act so that it can be approved before 1 October 2011.

2.26 Particular attention should be paid during the interim review of the North Pine manual to clarifying the circumstances in which pre-releases under part 8.4 are permitted.

2.27 Seqwater should act immediately to establish:

1. a steering committee to oversee the long term review of the North Pine manual including senior representatives of at least DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council and the Moreton Bay Regional Council
2. a technical review committee comprised of independent experts in at least hydrology, meteorology and dam operations to examine all technical work completed as part of the review.

2.28 The steering committee should:

1. oversee the continuation of Seqwater's *North Pine Dam Acceptable Flood Study Investigations* in accordance with the scope and program of activities advised to the Commission as at 6 May 2011
2. determine whether any hydrological studies, in addition to those undertaken as part of the *North Pine Dam Acceptable Flood Study Investigations*, are required
3. ensure that modelling across a range of full supply levels and operating strategies, including variations of the gate increments and gate opening intervals is undertaken
4. ensure all of the above work is reviewed by the technical review committee.

2.29 The Moreton Bay Regional Council should investigate options for the upgrade of Youngs Crossing and undertake a cost-benefit analysis of these to determine an outcome which best serves the public interest.

2.30 The Moreton Bay Regional Council should consult with Seqwater and the local police, ambulance and fire and rescue services to make arrangements for emergency vehicles to access Vores Road and Grant Street, Whiteside, when Vores Road is closed by the flooding of Whiteside Creek.

Chapter 3 Disaster frameworks, preparation and planning

3.1 The state disaster management group should include representatives of the Australian Defence Force and the Australian Red Cross in its planning and preparation for the next wet season.

3.2 Risk management is fundamentally important to disaster management. The Queensland Government should, before the next wet season, ensure that the state-wide natural hazard risk assessment is completed and its results provided to local governments.

3.3 Emergency Management Queensland should, as part of its review of local disaster management planning guidelines, consider whether consistent activation terminology should be adopted.

3.4 Every local government susceptible to flooding should ensure that, before the next wet season, its local disaster management plan:

- is consistent with the *Disaster Management Act 2003*

- addresses local risks and circumstances
- can be used easily in the event of a disaster.

3.5 Every person who is required to work under a local disaster management plan should be familiar with the plan before the next wet season.

3.6 Every local government should publish its disaster management plan (and relevant sub-plans) on its website before the next wet season.

3.7 Emergency Management Queensland should proceed with its proposed reviewing system before the next wet season.

3.8 Each district disaster co-ordinator should ensure that, before the next wet season, the disaster management plan of every local government in the co-ordinator's district susceptible to flooding:

- is consistent with the *Disaster Management Act 2003*
- addresses local risks and circumstances
- can be used easily in the event of a disaster.

3.9 In order to assist district disaster co-ordinators in this task, and to ensure consistency and effectiveness, Emergency Management Queensland should:

- provide a standardised approach for district disaster co-ordinators to follow, with all necessary guidance
- generally oversee the reviewing process
- before the next wet season, review a selection of local disaster management plans of local governments susceptible to flooding, which have already been reviewed at the district level.

3.10 Emergency Management Queensland should assess the effectiveness of the review system before the end of 2011, and report its results to the Commission by 31 December 2011.

3.11 Emergency Management Queensland should endeavour to ensure that before the next wet season:

- training is provided to those involved in disaster management at the local and district levels to ensure that the respective roles of all agencies, and in particular local government and the Queensland police, during an event are clearly understood
- training is provided to all local disaster co-ordinators
- training is provided to SES volunteers
- local disaster management groups are given practical training based on the event of large-scale flooding across different local government regions (as in Exercise Orko).

3.12 If training cannot be provided to every local government and disaster district before the next wet season, priority should be given according to each region's susceptibility to flooding.

3.13 Before the next wet season, local governments susceptible to flooding should conduct community education programs which provide local information about (at least) the following topics:

- the measures households should take to prepare for flooding
- the roles and functions of the SES and details of how to contact and join it
- whom to contact if assistance is needed during a flood
- contact details for emergency services in the area
- the types of warnings that are used in the area, what they mean and what to do in the event of a warning
- where and how to obtain information before, during and after a disaster
- what is likely to happen during a disaster (for example, power outages and road closures)
- evacuation
- measures available for groups who require particular assistance (for example, the elderly, ill and people with a disability).

3.14 To ensure consistency, the Queensland Government should assist local governments to develop and deliver the community education programs.

3.15 Before the next wet season, the Queensland Government should conduct a public education campaign about the dangers of driving into floodwaters.

3.16 The campaign should use various media and be designed to reach as many people as possible.

3.17 The National Emergency Management Committee should, as part of its education initiatives, consider developing a national public education campaign about the dangers of driving into floodwaters, using various media and commencing, if possible, before the next wet season.

3.18 The Queensland and Commonwealth governments should liaise to ensure a consistent message is delivered to the public.

Chapter 4 Forecasts, warnings and information

4.1 In issuing warnings for a district or region, local and state authorities should use a range of different warning mechanisms effective for the particular district or region, including methods which do not rely on electricity.

4.2 Councils should prepare SMS alert templates covering a range of different flood scenarios before the wet season.

4.3 SMS alerts should direct recipients to websites or contact numbers providing more detailed information about flood locations and predictions, the location of evacuation centres and evacuation routes.

4.4 Councils and Emergency Management Queensland should work together to ensure the approval process does not cause delays in delivering SMS alerts.

4.5 Wherever possible, Emergency Management Queensland should consult with local disaster management groups before sending emergency alerts to residents. Emergency Management Queensland should inform the local disaster management group, as soon as it can, about any message already sent to residents in that local disaster management group's area.

4.6 Individuals and businesses should be encouraged to acquire battery operated radios for use in emergencies.

4.7 Councils should ensure that residents are aware of the frequency of the radio station or stations in their local area that will disseminate flood warnings and other information during disasters.

4.8 Councils that have not already done so should consider how social media may be used effectively to provide accurate information about flood levels and local conditions to residents during a flood event.

4.9 A siren may be appropriate in smaller towns or rural communities susceptible to flash flooding. If councils rely on sirens to warn residents, they should ensure that the community understands the meaning of the siren.

4.10 Councils, with the assistance of the Bureau of Meteorology, should examine the feasibility of and priorities for installing additional river height and rainfall gauges in areas of identified need.

4.11 Councils, with the assistance of the Bureau of Meteorology, should consider the susceptibility of their regions to flash flooding, and whether it is feasible and necessary to acquire and operate an automated local evaluation in real time system (ALERT system) for particular waterways.

4.12 The Queensland Government should consider assisting less well-resourced councils to fund the installation of an ALERT system where a case is made for its adoption.

4.13 Councils should ensure that residents and businesses can clearly understand the impact of predicted flood levels on their property. This may include one or more of the following methods:

- information on rates notices about flooding at individual properties
- geospatial mapping, available to the public, that depicts inundation at certain river heights
- flood markers
- flood flag maps and floodwise property reports
- colour coded maps
- information that relates gauge heights with the level of flooding to be expected at a property.

4.14 In the course of flood events, warnings referring to gauge heights should include information about the location of the gauge.

4.15 Each local disaster management group should include in its meetings a representative of the operator of any dam upstream of its region which contributes water to flooding.

4.16 Dam operators should plan to contact people identified by their emergency action plans about dam outflow in sufficient time for them to be able to respond to the information.

4.17 Dam operators should ensure each emergency action plan includes a clear statement as to the frequency of, and circumstances in which, warnings will be issued to people listed in the emergency action plan.

4.18 Dam operators should assess the effectiveness of using SMS and/or email as a bulk instantaneous communication to all people on the notification list while individually contacting those whom it is essential to inform immediately.

4.19 Seqwater should consider consolidating its communication arrangements and responsibilities in a single document for each dam it operates.

4.20 The operator of each dam should, upon request, provide to any person on the notification list in the emergency action plan an explanation of the arrangements as to the type and frequency of communications required by that plan.

4.21 Operators of dams should assess their current compliance with the DERM *Queensland Dam Safety Management Guidelines* (February 2002), the ANCOLD *Guidelines on Dam Safety Management* (August 2003), and the Australian Government *Emergency Management Planning for Floods Affected by Dams* (2009) and if appropriate, comply with those guidelines.

4.22 Operators should include in their emergency action plan a description of the type of information that will be provided to those on the notification list.

4.23 Operators of dams should publicise, in a newspaper circulating in the local area and by posting a notice on its website every year before the wet season, the opportunity for local residents immediately downstream of a dam to be included on the existing notification list, and:

- consider whether an applicant for notification is so close to the dam that the warning time before water from the dam affects them is less than that available through the emergency management system
- consider whether they can be effectively notified by SMS or email
- if it is necessary to contact the applicant personally, agree with him or her a mode for that communication.

4.24 The operator of any referable dam and the local disaster management group should develop a common understanding as to their respective roles in a flood event and the type and frequency of information the dam operator will provide to it and local residents.

4.25 The Department of Transport and Main Roads, in its capacity as the primary provider of information about road conditions to the public, should continue to improve the accuracy of road condition information and the timeliness of its distribution to the public and other agencies.

4.26 The Department of Transport and Main Roads should identify and include local road names when reporting road conditions.

4.27 The Queensland Government should work with the New South Wales Government to co-ordinate road condition reporting procedures to inform local councils and road users of interstate road conditions in a variety of different ways.

4.28 In rural and remote areas where telecommunications are not effective, measures that do not rely on internet and mobile telephone services should be implemented to inform the travelling public of road conditions ahead, for example:

- signs with detailed information
- providing tourist information centres and tourist radio stations with information on road conditions.

4.29 The Bureau of Meteorology should endeavour to make clear the areas actually covered by its warnings, and specify what may be expected in particular areas, so that the relevance and significance of any warning is obvious to residents of the area at risk.

4.30 Councils should continue to take responsibility for issuing flash flooding warnings. However, where the Bureau of Meteorology becomes aware of weather conditions likely to cause flash flooding that is likely to endanger life or property in a particular council's region, it should, performing its functions in the public interest, directly communicate that information to the relevant council.

4.31 Councils should advise the Bureau of Meteorology of any information they possess about flash flooding (or the immediate prospect of it) likely to endanger life or property in their region, and of any warnings they issue about such flash flooding. The Bureau of Meteorology should consider in each case whether any such warning should be re-published (whether as a warning emanating from the Bureau itself or as attributed to the relevant council) on the Bureau's website, or whether it should provide a link to any council warning or other information regarding flash flooding provided by councils or disaster management agencies.

4.32 Where the Bureau of Meteorology has information which leads it to anticipate flash flooding likely to endanger life or property in a specific area, it should publish a warning to that effect on its website.

4.33 The Bureau of Meteorology should do its best to develop working relationships with all councils, particularly for the purpose of exchanging information in severe weather and flood events.

4.34 The Bureau of Meteorology should expand its volunteer rainfall and river height networks to incorporate residents of the Lockyer Valley, particularly property owners living on watercourses who can provide manually obtained readings of water heights where no automatic gauge is available, or can confirm automatic gauge readings where there is concern about their accuracy.

4.35 The Bureau of Meteorology should consider identifying amateur weather-watch groups it considers credible and likely to have useful local knowledge, and establish means (similar to those available to the storm spotters) by which they can expeditiously communicate with the Bureau.

4.36 Somerset Regional Council, in consultation with Seqwater and the Bureau of Meteorology, should consider how warnings can be provided to residents living near the Brisbane River at Fernvale about the expected level of flooding in their area.

Chapter 5 Emergency response

5.1 When a local government cannot effectively manage its response to a disaster, disaster management personnel from local governments in a position to assist should be deployed to help the local disaster management group.

5.2 Local governments should consider adopting uniform disaster management software, to enable inter-council assistance to be given more easily and effectively.

5.3 To ensure effective co-ordination in larger-scale disasters, deployment of personnel (and other resources) between local governments should be facilitated through the Council to Council (C2C) program.

5.4 The C2C program should be incorporated into the state disaster management arrangements and operate within the structure of the state disaster co-ordination centre.

5.5 The state disaster management group, Emergency Management Queensland and the Local Government Association of Queensland should do further work before the next wet season to ensure that during a disaster:

- the C2C program meets requests for assistance as efficiently as possible
- local governments and other prospective participants understand how the C2C program works.

5.6 As part of their planning before the next wet season, local disaster management groups should identify communities which, because of distance, the potential for isolation by disaster, or any other reason, may require specific disaster management arrangements, and take steps to establish them. Such arrangements may include forming disaster management sub-groups in those communities.

5.7 Whatever form arrangements take, they should seek to ensure that, in the event that flooding causes isolation:

- there are lines of communication between the local disaster management group and the community
- the community has the basic resources it needs to cope with its situation
- the local disaster management group is aware of what supplies the community may need in prolonged disaster, and can respond to requests for assistance in a timely way
- potential evacuation routes and centres are known.

5.8 Where a local government forms a sub-group of its disaster management group:

- the responsibilities of the sub-group must be clearly defined within the local disaster management arrangements
- each member of the sub-group must clearly understand his or her role.

The Commission recommends that sub-groups and local disaster management groups set out their respective roles and responsibilities in writing.

5.9 Until the All Hazards Information Management System is in place and allows the status of requests for assistance to be tracked, other means should be used to keep local disaster management groups informed of the progress of requests for assistance.

5.10 A clear protocol should be developed for managing the participation of local and district disaster management groups in the state level teleconferences, to govern and make more efficient participation in the teleconferences.

5.11 The Queensland Fire and Rescue Service should increase the number of swift water technicians (Level 2) to at least meet the quota for the approved number of rescue technicians in each region.

5.12 The Queensland Fire and Rescue Service should consider whether the approved number of swift water technicians in each region is appropriate to meet the demands of that region.

5.13 The Queensland Fire and Rescue Service should revise the Operations Doctrine to clarify:

- how many Level 2 swift rescue technicians and Level 1 support personnel are required to safely perform a swift water rescue
- the options available to an incident controller at a swift water incident with fewer than the required personnel and what considerations they should take into account in their decision-making.

5.14 The Queensland Fire and Rescue Service should consider providing Level 1 swift water rescue training to all auxiliary firefighters stationed in areas susceptible to flooding.

5.15 The Queensland Fire and Rescue Service should ensure all rural fire service volunteers and auxiliary firefighters stationed outside areas susceptible to flooding receive Awareness Level swift water rescue training.

5.16 The Queensland Fire and Rescue Service should identify areas that are likely to require, but do not have, swift water capability during the wet season and consider how it can best provide a permanent capability to any such area.

5.17 The memorandum of understanding between the Queensland Fire and Rescue Service and Emergency Management Queensland should be finalised.

5.18 The joint helicopter operations training program contemplated by the memorandum should be devised and provided to all relevant staff of the Queensland Fire and Rescue Service and Emergency Management Queensland.

5.19 The Queensland Fire and Rescue Service should purchase waterproof radio equipment that:

- is appropriate for swift water and normal fire fighting environments
- will attach securely to firefighters in a way that does not hamper their operations.

5.20 The Queensland Fire and Rescue Service should work towards providing hands-free means of communications to swift water technicians for in-water operations.

5.21 The Queensland Fire and Rescue Service should ensure that rescue technicians on deployment are provided with individual radios, rather than sharing a communications pack.

5.22 Permanent urban appliances should carry at least five personal floatation devices to ensure there is a floatation device for each firefighter and a spare for rescues.

5.23 Every rescue appliance should carry personal floatation devices suitably sized for children or infants.

5.24 The Queensland Fire and Rescue Service should consider upgrading all personal floatation devices to a type which allows the firefighter to release himself or herself from an attached rope in the event of getting caught, or in other life threatening situations.

5.25 The Queensland Fire and Rescue Service should investigate the feasibility of acquiring motorised inflatable work platforms with guarded propellers to improve the safety of swift water rescue.

5.26 Queensland Fire and Rescue Service should review whether it has enough vehicles capable of traversing floodwaters.

5.27 The Queensland Fire and Rescue Service should ensure all station officers are informed about the locations and availability of additional equipment and how to obtain it.

5.28 The Queensland Fire and Rescue Service should ensure that staff in Ipswich can rapidly obtain additional swift water rescue equipment in the case of an emergency.

5.29 The Queensland Fire and Rescue Service should consider isolating repeaters during a large scale emergency response. If this solution is found to be feasible, it should be implemented as protocol as soon as possible. If it is not, the Queensland Fire and Rescue Service should explore other solutions to the issue of the fire communications network being overloaded and firefighters resorting to localised networks during large scale emergency response situations.

5.30 The Queensland Fire and Rescue Service needs to define clearly what its protocol is for volunteer firefighters in disaster scenarios other than fire when they are the only or primary rescue service in a community.

5.31 The Queensland Fire and Rescue Service should clarify in practical terms the role of firefighters in sandbagging, the provision of road blocks and similar activities.

5.32 Before the next wet season, councils, SES controllers and Emergency Management Queensland should work together to identify and address deficiencies in the ability of the SES to respond effectively to flooding. At the very least, suitable flood boats and flood boat training should be provided to SES units which require them.

5.33 The Queensland Government and councils should take measures, as soon as possible, to attract more SES volunteers, particularly in areas susceptible to flooding which do not have sufficient numbers. New SES units should be established where possible.

5.34 The Commission acknowledges that it may not be possible to recruit and train sufficient numbers of SES volunteers to the extent needed before the next wet season. However, this should not prevent steps being taken as soon as possible to identify the factors impeding the recruitment and retention of SES volunteers, action being taken to address them, and the commencing of recruitment activity.

5.35 Before the next wet season, the Department of Public Works should ensure that Smart Service Queensland can manage a significant increase in calls to the 132 500 number, to at least the level that occurred during the 2010/2011 floods.

5.36 As a matter of priority, the Emergency Helicopter Network requires a system of 'single point tasking'; that is, a central organisation exercising command and control of all helicopters in the Emergency Helicopter Network, according to availability, task, priority and location. This is a change, which will require all the government agencies concerned to consider the operational needs, resources, protocols, guidelines and training required for its implementation. Ideally, those steps should be completed and the change made before the next wet season.

5.37 At the very least, by the beginning of the wet season, an interim structure needs to be formally in place under which one organisation is informed of the status, location, capabilities and allocated task of each helicopter in the Emergency Helicopter Network at any given time. The deployment of helicopters should be made through this organisation.

5.38 Queensland Police Service call-takers across the state should be trained to a uniform standard, consistent with the standard of the training provided by the Brisbane Police Communications Centre.

5.39 Emergency Management Queensland should finalise the draft evacuation guidelines for approval by the state disaster management group as soon as possible, addressing the issues identified from the 2010/2011 floods.

5.40 Each council should develop an evacuation sub-plan in accordance with the Emergency Management Queensland guidelines. This includes involving local groups and people in the planning process.

5.41 Councils with existing evacuation sub-plans should review them to ensure they address the issues identified from the 2010/2011 floods.

5.42 Where flooding is governed by a particular watercourse, the evacuation sub-plan should identify triggers in the form of those water level heights at which it is known that preparation for evacuation will be necessary.

5.43 It is a matter for councils whether or not they choose to publicise the location of evacuation centres before a disaster but there is a good deal to be said for doing so, particularly in smaller communities where the options are limited. Whether or not councils publicise the location of evacuation centres before a disaster, they should include in their disaster education programs information on evacuation procedures, and how to ascertain evacuation centre locations and safe evacuation routes.

5.44 During floods, councils should as quickly as possible provide people in the relevant areas with advice as to the location of and routes to evacuation centres.

5.45 That advice should be given using as many mechanisms as appropriate, including text message, radio and door knocking.

5.46 Councils should identify a range of evacuation centres as part of their disaster preparation and planning.

5.47 Councils should audit identified evacuation centres to ensure the facilities and location are appropriate, preferably in consultation with the Australian Red Cross and the Department of Communities.

5.48 Councils should be aware of what facilities are available at each evacuation centre, at particular times of the year.

5.49 Councils should identify areas that are susceptible to isolation, including locations in which community groups established informal evacuation centres during the 2010/2011 floods, with a view to incorporating evacuation centres at those locations into their evacuation sub-plans.

5.50 Councils should identify community groups who may take responsibility for establishing and operating evacuation centres in the future.

5.51 The identified groups and councils should, before the next wet season, establish cooperative arrangements as to how the centres should operate, and to ensure the centres have appropriate facilities.

5.52 Councils should recognise that community groups may establish makeshift evacuation centres during a disaster. When this occurs, councils need to identify and establish communications with the centres as soon as possible.

5.53 Councils should develop plans for the effective and timely re-supply of makeshift centres.

5.54 The Queensland Government should investigate the possibility of providing indemnity or obtaining insurance for makeshift evacuation centres established in good faith, and in the absence of official alternatives, to meet community needs.

5.55 All councils should consider entering a memorandum of understanding for evacuation centres with the Australian Red Cross which clearly sets out the roles and responsibilities of the parties in planning and responding to evacuation requirements in a disaster.

5.56 Each council with a memorandum of understanding with the Australian Red Cross should consider undertaking practice exercises with the Australian Red Cross to ensure both parties understand their respective roles and responsibilities.

5.57 Local disaster management groups and district disaster management groups of which the Australian Red Cross is not currently a member should include the Australian Red Cross in disaster preparation and planning as well as response, whether as a member or otherwise (see also recommendation 3.1).

5.58 Local and district disaster management groups should notify the Australian Red Cross of their evacuation needs as soon as possible in a disaster.

5.59 Disaster response agencies should use the National Registration Inquiry System.

5.60 During a disaster, councils and the Queensland Police Service should encourage individuals to self-register with the National Registration Inquiry System.

5.61 Councils should include information about the National Registration Inquiry System as part of their community education.

5.62 In areas susceptible to flooding, councils should identify facilities housing people who may require assistance to evacuate. Councils should work with the operators of these facilities to ensure they have appropriate evacuation plans and that they are aware of the council's disaster management arrangements.

5.63 Councils should identify the specific evacuation needs of these facilities, such as increased timeframes for withdrawal or transport by ambulance.

5.64 Councils should include the location, contact details, and specific evacuation needs of these facilities in their evacuation sub-plans.

5.65 Councils should identify organisations (for example, Meals on Wheels and Bluecare) that provide services to people in the community who may be unable to evacuate without assistance. Councils should include the contact details of these organisations in their evacuation sub-plans.

5.66 Councils should work with these service providers to identify: the number of people who may require assisted evacuation; the general nature of their needs, including any necessary medical supplies and equipment; warning message formats and dissemination; increased timeframes needed for evacuation; transportation requirements; and shelter requirements. Councils should include this information in their evacuation sub-plans.

5.67 Facilities housing people who may be unable to evacuate without assistance should develop evacuation plans to ensure residents are provided with appropriate transportation, emergency accommodation, trained carers and medical support if necessary. Where possible, residents of those facilities should be relocated to other similar facilities or accommodation other than evacuation centres. These plans should be developed in consultation with councils and relevant agencies such as Queensland Health.

5.68 Facilities housing people who may be unable to evacuate without assistance should prepare disaster recovery plans, particularly for the provision of back up power and emergency supplies, including medical oxygen and common medications, to minimise the need for evacuation where there is no direct threat from natural disaster.

5.69 The Queensland Government and councils should ensure information about emergency preparedness, warnings and evacuation is available in the different languages of ethnic groups in the community and in Auslan.

5.70 As part of their community education strategy, councils should ensure tourists are made aware of evacuation procedures, how to ascertain evacuation centre locations and safe evacuation routes. That may be done through tourism boards, operators and accommodation providers.

5.71 Councils, as part of their community education program for disaster preparation, should encourage pet owners to consider what they will do with their pets if they need to evacuate.

5.72 Councils should work with the RSPCA to develop plans about transporting and sheltering pets should they need to be evacuated with their owners.

5.73 Animal shelters, zoos, stables, and similar facilities should develop plans for evacuating or arranging for the care of animals in consultation with their local council. Local disaster co-ordinators should be aware of what plans exist.

5.74 Alignment of police district boundaries, disaster district boundaries and local government boundaries is unlikely to be feasible in the short-term. However, where police district boundaries are being re-assessed for other reasons, conformity between boundaries of police districts, disaster districts and local government regions, should be a major objective.

5.75 Before the 2011/2012 wet season, all local and district disaster management groups should formally adopt the Queensland Re-supply Guidelines and have arrangements in place for the prompt re-supply of towns, properties and residents isolated by floodwaters.

5.76 The Department of Employment, Economic Development and Innovation should establish, preferably with the assistance of AgForce, procedures to co-ordinate fodder drops to isolated landowners in future flood events.

5.77 The Department of Employment, Economic Development and Innovation should ensure rural communities are aware of the processes and the payment arrangements for fodder drops.

5.78 Local governments should investigate the feasibility of permitting local landowners to carry out temporary repairs on flood-damaged public roads to allow access to their properties.

5.79 Local governments and the Queensland Government should work with their New South Wales counterparts to set up procedures for co-ordinating emergency responses in the region of the Queensland/New South Wales border.

Chapter 6 Essential services

6.1 Local, district and state disaster management groups should include essential services providers in their disaster planning and preparation and in their meetings at an early stage during disasters.

6.2 Power distributors should review network switching options before next wet season (to optimise switching arrangements) so that, where possible, power is disconnected only to those who are flooded.

6.3 Power distributors should consider pre-emptively installing generators in areas known to become isolated (but not inundated) during flooding, if the power supply cannot otherwise be maintained.

6.4 The control and coordination centre for Water Grid operations should be located where, at the least, it is not susceptible to flooding or to its power supply being interrupted.

6.5 Essential service providers should continue to develop ways to share available resources within their respective industries during disasters.

6.6 Essential service providers should formalise arrangements to share information about the status of services during a disaster.

6.7 Brisbane Markets Limited should contact the Brisbane City Council on a regular basis in the lead-up to and during flooding to seek local flood information. In response, the council should provide readily understood information which, as far as possible, explains the level of flooding to be expected at the Rocklea Markets site.

6.8 The Brisbane City Council should attend to the clearing of the flood mitigation channel on the western side of the market site before the next wet season.

Chapter 7 Lockyer Valley and Toowoomba

7.1 The Toowoomba Regional Council should consider amending stage one of the Cooby Dam emergency action plan to extend the five kilometre limit for alerting residents downstream of the Cooby Dam.

7.2 Lockyer Valley Regional Council should investigate the feasibility of installing alarm-activating gauges in the creeks at Spring Bluff, Murphys Creek and other communities where communication systems are poor and there is a risk of rapid and unexpected water rise.

7.3 Lockyer Valley Regional Council should identify those areas vulnerable to flooding within its region, should identify appropriate evacuation collection points and centres accordingly, and consider whether it should make those known to the community.

7.4 Lockyer Valley Regional Council should immediately develop a plan for the removal of debris, man-made and natural, from waterways in the Lockyer Valley and put it into effect so as to minimise the risk should flooding recur in the coming wet season.

Tara QFCI community meeting announcement, 23 March 2011 (photo courtesy Gerard Hinchliffe)

Introduction

Prolonged and intensive rainfall over large areas of Queensland, coupled with already saturated catchments, led to significant flooding in Queensland in December of 2010, stretching into January of this year.

Thirty-five people died in the floods; three remain missing. More than 78 per cent of the state (an area bigger than France and Germany combined) was declared a disaster zone, with over 2.5 million people affected.[1] Some 29 000 homes and businesses suffered some form of inundation.[2] The Queensland Reconstruction Authority has estimated that the cost of flooding events alone will be in excess of $5 billion.[3]

The scale of the disaster led to the establishment, on 17 January 2011, of the Commission of Inquiry into the Queensland floods of 2010/2011.

The Commission of Inquiry

The Queensland Floods Commission of Inquiry is an independent inquiry, vested with wide-ranging powers by the *Commissions of Inquiry Act 1950*. The Honourable Justice Catherine Holmes was appointed as Commissioner to inquire into specific matters (the 'terms of reference') relating to the Queensland floods of 2010/2011. Mr James (Jim) O'Sullivan AC and Mr Phillip Cummins were appointed as Deputies to assist her. (Appendix 1 sets out the complete terms of reference.)

Two barristers, Mr Peter Callaghan SC and Ms Elizabeth Wilson, were appointed as Counsel assisting the Commission. Other staff of the Commission are drawn from fields of expertise relevant to the Commission's work, including the legal, policy, research and policing professions. Experts in certain fields have also been engaged to assist the Commission as required.

Report to government

The Commission is required to provide the Queensland Government with an interim report (this report) by 1 August 2011 on matters associated with flood preparedness before next summer's wet season.

The terms of reference originally required the Commission to provide a final report by 17 January 2012. The date for the final report has since been extended by the government to 24 February 2012 because of the Commission's extensive public hearing schedule and the volume of evidence that must be considered.

The terms of reference require the Premier to make the report public once it is provided to Government. The Commission will also make both reports available on the Commission's website.

Deputy Commissioner Jim O'Sullivan speaks at Rolleston QFCI community meeting, 28 March 2011 (photo courtesy Gerard Hinchliffe)

The Commission's work

From its inception, the Commission set out to make its work and information about its processes as accessible as possible to the general public. The Commission's website (**www.floodcommission.qld.gov.au**) provides information about the progress of the inquiry as well as email, postal and telephone contact details so that anyone, regardless of geographical location, can provide information or submissions to the Commission. The Commission's website provided live streaming of public hearings. Daily transcripts from the public hearings were made available on the website within 24 hours, so that the public could be kept informed of the Commission's progress.

Having taken the necessary steps to establish the Commission's staff and offices, the next priority for the Commissioner was to visit the communities worst affected by the flood events. In late January 2011 the Commissioner with the two Deputy Commissioners twice visited the townships of Grantham, Murphys Creek and Postman's Ridge to witness first hand the destruction wrought by the floods. They also visited Toowoomba. The impressions left by those visits were profound.

The Commission employed a number of methods to obtain as much information as possible and to identify relevant issues.

The Commission held two community consultation meetings in Grantham and Murphys Creek in the Lockyer Valley. No formal evidence was taken at these meetings; but it was a useful way for the Commission to hear directly from members of the Lockyer Valley community what they regarded as questions needing answers.

Deputy Commissioner O'Sullivan held community meetings in other communities in regional Queensland, providing information about how community members could participate in the inquiry process. Community meetings were held in:

- Jericho
- Alpha
- Chinchilla
- Condamine
- Surat
- Tara
- Rolleston
- Theodore
- Mundubbera
- Gayndah
- Gin Gin.

Before public hearings got under way, the Commissioner and the Deputy Commissioners visited the Wivenhoe and Somerset dams to inspect their operations.

Members of the public were invited to provide written submissions, by post or online through the Commission's website. More than 660 public submissions were received.

People and organisations (private and public sector) were required, through the use of Commission powers, to provide information and to produce material which was examined and analysed. Sworn statements were obtained from a range of people – members of the public, emergency personnel, employees of relevant corporations and government agencies, representatives of local and state government – as to their knowledge and personal experience of the events the subject of the terms of reference. Experts were asked to report and gave evidence in hearings to assist the Commission in its deliberations.

The Office of the Queensland Chief Scientist established an expert panel of academics and practitioners to provide assistance to the Commission on relevant science, engineering and technology issues. This group, known as the Science, Engineering and Technology Panel, has produced a short report which became publicly available on 14 July 2011.

Much of the evidence and information required by the Commission was taken in writing and, where possible, electronically. To add to that written material, public hearings were conducted around the state:

- **Brisbane** (19 days)
- **Toowoomba** (5 days)
- **Dalby** (1 day)
- **Goondiwindi** (1 day)
- **St George** (1 day)
- **Ipswich** (1 day)
- **Rockhampton** (1 day)
- **Emerald** (2 days)

The places for the regional hearings were chosen to enable the Commission to canvass local issues in regional Queensland and to ensure communities in those regions were involved in the inquiry process.

The hearings were held over a period of seven weeks. At the close of the hearings, the Commission had heard evidence from 167 witnesses.

The hearings inquired into the operation of dams, in particular the Wivenhoe and Somerset dams, as well as the adequacy of warnings, preparation, planning and response to the 2010/2011 floods. The hearings in Toowoomba focussed in particular on the adequacy of warnings and the preparation for and emergency response to flash flooding on 10 January 2011 in Toowoomba and the Lockyer Valley.

The hearings were open to the public and were conducted within a legal framework: witnesses were called, examined and cross-examined, exhibits were tendered, and transcripts were prepared. There was no requirement for those involved to have legal representation. Lifeline counsellors engaged by the Queensland Government supported witnesses before, during and after their appearance before the Commission.

The Commission received 35 applications seeking permission to appear as a party at public hearings. Parties whose interests were likely to be affected in an individual, direct and immediate way by the Commission's findings or recommendations were given leave to appear. This enabled their legal representatives to challenge any adverse evidence. Appendix 2 sets out the list of parties with leave to appear.

Those who unsuccessfully sought leave to appear on the basis of a more general interest in the matters the subject of inquiry were given other opportunities to put forward their views and information, by way of submission, formal statement to Commission staff or by being called to give evidence.

In the course of its work, the Commission has given effect to the principle of natural justice and has given notice to persons and entities whose conduct might be the subject of adverse findings in this report.

Flood related deaths

The flood related deaths that occurred during the 2010/2011 wet season are required to be investigated by the Coroner under the *Coroners Act 2003*. The Commissioner agreed with the Coroner that matters under section 45 of the *Coroners Act 2003* (inquiring into the event of death, the identity of the deceased, how, when and where they died and the immediate cause of death) remained within the Coroner's jurisdiction. Broader systemic questions of preparation for and response to the flood events fell within the Commission's terms of reference; where those issues were directly raised, the circumstances of the deaths would be examined by the Commission. The Coroner therefore continued to conduct investigations into the deaths, but provided all investigative material as it was finalised to the Commission.

A number of the Coroner's investigations had not been concluded at the time of publication of this report. It remains to be seen whether the circumstances of those matters will raise issues requiring investigation by the Commission. If so, they will be dealt with in the final report.

Scope of interim report

As required by the Commission's terms of reference, the main focus of the interim report is to make recommendations relating to flood preparedness so that they can be acted on before next summer's wet season.

This report does not attempt to catalogue every action undertaken in preparing, planning and responding to the 2010/2011 floods. The Commission has concentrated on the preparation and planning needed to ensure

an emergency response that will prevent the loss of life and property. The Commission has sought to identify recommendations that can realistically be implemented before the next wet season, but it has also made recommendations about work of such importance that it should be commenced, even if it cannot be completed, before the next wet season.

This report is as comprehensive as the strict time constraints allow, but some of the issues it raises may prove to require further comment or elaboration in the final report. That report will canvass longer term questions of improvement and reform and will address the remaining terms of reference: the performance of private insurers in meeting their claims responsibilities and aspects of land use planning.

Structure of report

The report's first chapter sets the scene by providing a chronological summary of the weather and flood events as they unfolded between late November 2010 and mid-January 2011. Many Queensland communities had been subjected to flooding earlier in 2010. Those flood events are outside the scope of the Commission's terms of reference and are not canvassed in any detail in this report.

Subsequent chapters address the operation of dams, in particular the Wivenhoe and Somerset dams, preparation and planning, forecasting and early warning systems and emergency response to the 2010/2011 floods. Because of the scale of the disasters in Toowoomba and the Lockyer Valley, and the number of people who lost their lives there, a separate chapter is devoted to the events in those areas.

The Commission's recommendations are set out in the chapter to which they relate, preceded by a discussion of the facts and supporting material relied on in making them. A complete list of recommendations is set out following the Commissioner's preface.

The recommendations have been framed with the underlying aim of preventing future loss of life, injury and damage to property. It remains, however, the case that resourcefulness in natural disasters is not just the province of government: it is the collective responsibility of all sections of society and, more fundamentally, of each individual within the community. It is incumbent on governments at all levels to develop policy and frameworks that establish the arrangements for disaster management, and on the individual, properly informed, to make preparations and decisions.

Something which has emerged strongly in the Commission's work is the bravery and determination of the state's emergency and disaster personnel – SES officers, firefighters, police, ambulance officers, and other emergency service workers – during the floods. Similarly, mention should be made of the volunteers, non-government organisations and businesses who assisted in some of the worst hit communities. More generally, the strength and resilience of flooded communities throughout Queensland is an encouraging starting point for building the capacity of Queenslanders to prepare for future natural disasters.

(Endnotes)

1 Queensland Government, *Operation Queenslander: The State Community, Economic and Environmental Recovery and Reconstruction Plan*, 2011 [p3].

2 Queensland Government, *Operation Queenslander: The State Community, Economic and Environmental Recovery and Reconstruction Plan*, 2011 [p4].

3 Queensland Government, *Operation Queenslander: The State Community, Economic and Environmental Recovery and Reconstruction Plan*, 2011 [p4].

1 Summary of weather and flood events

What follows is an overview of the weather events leading up to and during the 2010/2011 floods with a summary of their effects across the state. It is not intended as an exhaustive account.

1.1 Summary of weather leading to 2010/2011 flood events

The Queensland wet season extends from October to April, with the initial monsoonal onset usually occurring in late December. The 2010/2011 wet season was different.

In June 2010 the Australian Bureau of Meteorology warned that a La Niña event was likely to occur before the end of the year.[1] The La Niña change has historically brought above average rainfall to most of Australia and an increased risk of tropical cyclone events for northern Australia. Previous La Niña effects had been associated with flooding in eastern Australia, including the large scale and devastating floods which occurred in 1955 and 1973/1974.[2]

As predicted, a strong La Niña event took place in the Pacific Ocean in late 2010. La Niñas are often described in terms of a positive Southern Oscillation Index, which represents the normalised pressure difference between Darwin and Tahiti and gives a positive reading when pressures are high in Tahiti and low in Darwin.[3] The index ranges from about -35 to +35.[4] During December 2010 the Southern Oscillation Index was +27.1, representing the highest December value on record and the highest monthly value since 1973.[5]

In turn, Australia experienced an extremely strong La Niña during the end of 2010 and beginning of 2011; the second strongest on record since 1917-1918.[6]

Coupled with the effect of the La Niña event, Australia also experienced uncharacteristically persistent monsoonal rainfall during the end of 2010 and beginning of 2011, with periods of rain lasting longer than usual.[7] Very strong bursts of the Madden-Julian Oscillation (which reflects patterns of atmospheric circulation and convection and, as it rises, manifests in tropical thunderstorm activity) in the Australian region also occurred between October and January, which increased the strength of the monsoon.[8] On 4 October 2010, the Madden-Julian Oscillation was at its strongest since the early 1980s.[9]

As a result of both the La Niña episode and the increased strength of the annual monsoon, Australia experienced record rainfalls during the end of 2010 and beginning of 2011.

The period from July to December 2010 was the wettest on record for Australia,[10] while December 2010 was the wettest on record for Queensland and third wettest recorded for the whole of Australia.[11]

The above average rainfalls experienced throughout Queensland during late 2010 meant that many catchments were already very wet before

the Queensland floods occurred.[12] When further record rainfalls were experienced in December 2010 and January 2011, already soaked catchments could not absorb the excess rain.

In turn, flooding was experienced across the state. Some of this flooding was caused when river systems overflowed; some of it resulted from 'short-period' falls where considerable amounts of rain fell in small areas within short time frames. Whatever the causes, the effects across Queensland were widespread and long-lasting.

1.2 Summary of 2010/2011 flood events

1.2.1 General note on terminology for flood levels

This summary describes events in terms of river level peaks that occurred during the 2010/2011 Queensland floods. A 'peak' represents the highest river height (in metres) reached by a river at a specified gauge site during a flood event.[13] Peaks are described as 'minor', 'moderate' or 'major', denoting the severity of the peak and its likely impact on nearby areas.

1.2.2 December 2010

Queensland experienced higher than average rainfall during early December 2010. Between 28 November and 4 December 100 to 300 millimetres of rain fell in central Queensland between Mackay and Emerald, resulting in the Capricorn Highway being cut between Rockhampton and Emerald on 3 December.[14] Between 4 and 10 December, major flood peaks were recorded in the Balonne River at St George and Dawson River at Theodore.[15] The Balonne River at St George exceeded its major flood level again on 16 December.[16]

The Fitzroy River at Rockhampton remained above its minor flood level between 13 and 20 December.[17] By 20 December, flood warnings were current for the Barcoo, Bremer, Bulloo, Don (Bowen), Condamine, Balonne, Moonie, Paroo and Warrego rivers; the Fitzroy River Basin; the Brisbane River above Wivenhoe Dam; the Burnett catchment; the Mary River and Cooper Creek; and the Laidley and Warrill creeks.[18]

On 21 December, the Balonne River at St George again exceeded its major flood level, where it remained for a total of 43 days.[19] St George experienced partial inundation at this time, causing some residents, including high care patients in local hospitals, to evacuate.[20] By 23 December there were flood warnings for the Fitzroy River system (including the Comet, Connors, Dawson, Don, Nogoa and Mackenzie rivers), the Bremer River and the Lockyer Creek.

On 25 December, residents of Theodore experienced the Dawson River's third major flood peak since the start of December, causing a number of road closures and resulting in the inundation of two Theodore houses.[21] By 26 December, at least six families had self-evacuated from Theodore.[22]

By the end of December 2010, tropical cyclone Tasha had formed off the Queensland coast. Tasha crossed the coast as a category 1 cyclone around 5.30 am on 25 December between Gordonvale and Babinda, bringing more significant rainfall to northern Queensland.[23]

Emerald was put on high alert on 26 December. On the same day, a minor flood peak was recorded at the Lockyer Creek at Helidon while a major flood peak occurred in the Laidley Creek at Laidley.[24]

On 27 December, 20 people were evacuated from Chinchilla when the town experienced major flooding.[25] The Comet River at Rolleston also experienced a major flood peak when river levels reached 8.54 metres (4.04 metres above the river's major flood level) and set a new record.[26] Major flood peaks were observed in the Condamine River at Warwick and the Myall Creek at Dalby. The Condamine River peak affected about 45 homes and forced many Warwick residents to evacuate to local sports centres and schools. The Myall Creek flood split the town of Dalby in two and inundated some 100 properties.

On 28 December Charleys Creek in Chinchilla experienced a major flood peak, affecting about 36 properties.[27] It remained above its major flood level until 1 January 2011.[28] Also on 28 December, the Fitzroy River at Rockhampton exceeded its moderate flood level and an evacuation centre was established at a local university.[29] Approximately 4000 Rockhampton properties were affected. About 1000 homes had yard flooding, while 150 were inundated, that figure rising to 200 by the end of the month.[30]

After already experiencing three major flood peaks, the Dawson River at Theodore had another major peak on 28 December. On 27 December, Theodore and Bundaberg were isolated by floodwaters and by the following day, all 300 Theodore residents were evacuated from the town.[31]

The Jordan River at Jericho also peaked on 28 December.[32] Several properties were flooded across Jericho and severe damage was caused to local roads, the railway, local school and businesses. On the same day, the Alpha Creek at Alpha peaked, damaging local properties and infrastructure.[33] By 30 December, 150 people had been evacuated from Alpha and five houses had been inundated.[34] Most residents stayed with family and friends, though evacuation centres were established in both towns.[35]

Between 29 and 31 December, major flood peaks were recorded in the Dawson River at Taroom, the Burnett River at Bundaberg, and the Nogoa River at Emerald. Two hundred and eight Bundaberg houses were ultimately inundated, while the 16.05 metre peak in the Nogoa River at Emerald on 31 December set a new record for the town.[36] The Nogoa River peak caused major flooding in Emerald, where between 1000 and 1200 houses were flooded to some degree and approximately 95 per cent of businesses were damaged. Two thousand, four hundred and sixty-three residents registered as evacuees; more than 400 were forced to stay in evacuation centres.[37]

Flooding in the North Burnett Regional Council local government area during the end of December caused damage to the Gayndah town water supply station, prompting the council to introduce level 5 water restrictions.[38] At this time, four houses were inundated in Gayndah while 22 more were inundated in nearby Mundubbera.[39] Ninety per cent of the area's local industry was affected.[40]

1.2.3 January 2011

On 1 January 2011 the Condamine River at Condamine and the Dawson River at Theodore experienced major flood peaks.[41] The Condamine River remained above its major flood level for 29 days between 24 December 2010 and 22 January 2011.

On 4 January the Fitzroy River at Rockhampton peaked at Yaamba and Rockhampton, leaving both isolated.[42] About 1200 houses in Rockhampton were affected, with 400 houses flooded above floor level.[43] By 6 January, around 500 Rockhampton residents had self-evacuated.[44] The Balonne River also peaked at Surat on 4 January.[45]

As a result of major flood levels since 21 December 2010, on 5 January 2011 an emergency evacuation centre was established in the town of St George.[46] On 6 January Rockhampton was still isolated due to flooding on the Bruce and Capricorn Highways. Supermarkets in the region ran low on food stocks and the Australian Defence Force provided emergency food drops to some isolated areas.

The Balonne River experienced a major flood peak on 8 January.[47] The river water supply at St George failed as a result of the flooding, though the Balonne Shire Council managed to restore limited supplies.[48] A number of townships within the Balonne Shire experienced isolation during the early January flood. These included St George, Dirranbandi and Hebel. In some areas supplies were air-dropped by the Australian Defence Force or moved by boat or high vehicle transfers provided by the SES and local council.[49] By 10 January around 25 properties in the Balonne Shire Council local government area had water in their yards while 11 houses had experienced inundation.[50]

On 10 January, a major flood peak was observed in the Quart Pot Creek at Stanthorpe, resulting in 12 houses being inundated and the evacuation of 50 people.[51] Inundation of the Stanthorpe sewerage treatment plant resulted in effluent flowing into Quart Pot Creek and residents were advised to boil their water as a precautionary measure.[52] By the end of 11 January, 27 Stanthorpe homes were inundated to a depth of 100 to 150 millimetres.[53]

Oakey Creek burst its banks on the same day.[54] By 11 January, 128 homes were inundated by floodwaters, as were some businesses.

Between 12.45 pm and 2.15 pm on 10 January, heavy rainfall was recorded in the Toowoomba area.[55] This rainfall resulted in flash flooding in the centre of the city, which killed two people. The Lockyer Valley was also subjected on that afternoon to unprecedented flash floods following heavy rainfall across almost all catchments in the Upper Lockyer Valley. Flood water flowed through the Upper Lockyer Valley, causing severe damage in Murphys Creek, Spring Bluff, Withcott, Postman's Ridge, Helidon and Grantham, finally reaching Gatton after 5.00 pm. Sixteen lives were lost in the Lockyer Valley floods, while three people still remain missing. The events in Toowoomba and the Lockyer Valley are described in more detail in chapter 7.

After flooding in late December, the Burnett River at Bundaberg exceeded its minor flood level again from 10 to 15 January.[56] A major flood peak in the Condamine River at Warwick on 11 January resulted in the inundation of around 150 homes and 30 businesses.

Also on 11 January, the Caboolture River peaked at Caboolture, affecting 300 houses and damaging local roads and infrastructure. Woodford, Kilcoy and Moore were isolated while eight rooftop rescues were conducted at Lowood in the Somerset Regional Council area.[57] Residents of Condamine were again evacuated to Dalby while residents in low lying areas of Ipswich, Brisbane and the Sunshine Coast Hinterland were told to move to higher ground.[58] At around 5.00 pm the Mary River at Gympie experienced a major peak, inundating houses and businesses in Gympie's main street. Between 10 and 12 January, the Mary River remained above its major flood level.

On 12 January a moderate flood peak was experienced in the Myall Creek at Dalby while major peaks were recorded in Charleys Creek at Chinchilla and the Dumaresq River at Texas. Chinchilla was left with 35 inundated homes and 213 premises without power.[59] The flood peak in the Dumaresq River reached 9.21 metres, sitting 1.21 metres above the river's major flood level and representing its highest flood peak since 1956.[60] Texas suffered large crop and stock losses.[61]

On 12 January the Bremer River at Ipswich also experienced a major flood peak, the river's highest since 1974.[62] Around 7221 buildings were flood-affected, including 3000 homes. Approximately 1000 Ipswich homes were inundated.[63] The floods also caused widespread damage to local roads and infrastructure. Some 1100 Ipswich residents stayed in evacuation centres; another 3000 residents stayed with family and friends. Clean up crews began work in Ipswich on the morning of 13 January. By the morning of 14 January, 15 000 premises were still without power in Ipswich and surrounding areas.

The Brisbane City flood gauge exceeded its major flood level on 12 January. That night, electricity was switched off in many parts of Brisbane's central business district and most businesses were closed. Energex advised that around 115 000 customers across Queensland were without supply, with this number expected to increase to 150 000.[64] At approximately 3.00 am on 13 January the Brisbane River experienced a major flood peak of 4.46 metres; its highest peak since 1974.[65] During the flood peak, 14 100 Brisbane properties were affected, with 1203 houses suffering inundation.[66] Businesses were also severely affected: 1879 were partially inundated and 557 were completely inundated.[67] A great deal of debris washed down the Brisbane River, including a large section of Brisbane's floating 'River Walk' and numerous privately and publicly owned jetties, which were washed into Moreton Bay.[68]
On 14 January the Brisbane River fell below its minor flood level and the council's focus shifted towards re-supplying essential items to flood-affected western suburbs.[69] By 15 January, the total number of Brisbane properties still affected was 5930, with 5755 partially flooded and 175 still completely inundated.[70]

On 14 January the Macintyre River at Goondiwindi experienced a major flood peak, with some evacuations from the town. By 16 January, a monsoon trough over Cape York Peninsula moved south, bringing rain and thunderstorms to north Queensland.[71] The Condamine River at Condamine experienced another major peak on 16 January.[72]

By Monday 17 January, 10 000 homes in Brisbane and Ipswich were still without power and the receding floodwaters had left a thick layer of mud across both cities. On the first weekend after the Brisbane flood, 20 000 volunteers attended coordination points across the city to help in the clean up and recovery efforts to follow.

On 18 January another major flood peak was recorded in the Balonne River at Surat, causing further flooding in the township.[73] On 19 January, Flinton and Goondiwindi were both isolated, requiring re-supply efforts in both areas.[74]

The Bureau of Meteorology registered record flood peaks at over 100 Queensland river height stations during the 2010/2011 Queensland floods, indicating that in many locations, the floods were the most severe in living memory.[75] Response and recovery efforts continued in most flood-affected Queensland communities throughout January and February 2011. In many areas, recovery is expected to take months and even years.

(Endnotes)

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2 Australian Bureau of Meteorology, *Special climate statement 24: an extremely wet end to 2010 leads to widespread flooding across eastern Australia,* 2011 [p2].

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4 Australian Bureau of Meteorology, *Southern oscillation index,* 2011.

5 Australian Bureau of Meteorology, *Special climate statement 24: an extremely wet end to 2010 leads to widespread flooding across eastern Australia*, 2011 [p2].

6 Transcript, James Davidson, 13 April 2011, Brisbane [p269: line 39].

7 Transcript, James Davidson, 13 April 2011, Brisbane [p268: line 20].

8 Transcript, James Davidson, 13 April 2011, Brisbane [p271: line 19].

9 Transcript, James Davidson, 13 April 2011, Brisbane [p271: line 16].

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11 Australian Bureau of Meteorology, *Special climate statement 24: an extremely wet end to 2010 leads to widespread flooding across eastern Australia,* 2011 [p2].

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13 Australian Bureau of Meteorology, *Flood warning services,* 2011.

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28 Information received from Australian Bureau of Meteorology, 24 March 2011 [p50].

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33 Information received from Australian Bureau of Meteorology, 24 March 2011 [p86].

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35 Exhibit 470, Statement of Desmond Howard, 1 April 2011 [p4].

36 Information received from Australian Bureau of Meteorology, 24 March 2011 [p65].

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38 Information received from North Burnett Regional Council, 23 March 2011 [p90].

39 Statement of MJP Pitt [p4: para 12].

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46 Exhibit 271, Balonne LDMG Situation Reports 3 January 2011 to 22 January 2011 [p10].

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49 Information received from Balonne Shire Council, 14 March 2011 [p198-199, p229].

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52 Information received from Queensland Government, 31 March 2011 – State Disaster Coordination Centre situation report [p1816].

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71	Australian Bureau of Meteorology, *Monthly weather review: January 2011*, 2011 [p3].
72	Information received from Australian Bureau of Meteorology, 24 March 2011 [p55].
73	Information received from Australian Bureau of Meteorology, 24 March 2011 [p130].
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75	Exhibit 38, Presentation by James Davidson, 13 April 2011 [p60].

2 Dams

2.1 Relevant agencies and legislation

2.1.1 Department of Environment and Resource Management

The Department of Environment and Resource Management (DERM) was established on 26 March 2009 when the Department of Natural Resources and Water and the Environmental Protection Agency were combined.

Before 21 February 2011, DERM's responsible Ministers were the Minister for Natural Resources, Mines and Energy and the Minister for Climate Change and Sustainability. In the lead up to, and during the 2010/2011 wet season, these offices were held by Stephen Robertson MP and Kate Jones MP. From 21 February 2011, DERM's responsible ministers were the Minister for Energy and Water Utilities and the Minister for Environment and Resource Management.[1] Following a further change in administrative arrangements, since 22 June 2011 DERM has three responsible Ministers. They are the Minister for Energy and Water Utilities, the Minister for Finance, Natural Resources and The Arts and the Minister for Environment.[2]

Legislation administered by DERM and relevant to the Commission's investigations includes that regulating water supply, dam safety, vegetation management and environmental protection. The following list of activities undertaken by DERM staff illustrates the importance of DERM to the management of flooding in Queensland:

- the regulation of dam safety
- the provision of technical advice in relation to the review of proposals, usually by local councils, for state and federal government funding for flood mitigation projects, and also about state planning policies and local government planning schemes[3]
- the publication of important technical documents relied upon by local councils in relation to flood management, for example, the *Queensland Urban Drainage Manual*[4]
- the provision of technical advice about state government water supply and flood mitigation projects[5]
- the undertaking of hydrological modelling about groundwater and surface water which is used in the allocation of water entitlements[6]
- the assessment of applications to remove vegetation, excavate or fill in a watercourse, lake or spring[7]
- rainfall and stream flow gauging, including flood gauging[8]
- flood mapping[9]
- the assessment of pollution caused by flooding (for example, hazardous waste overflow from mine dams and sewerage plants)[10]
- the production of seasonal climate outlook information.[11]

To date, the Commission's inquiries in connection with DERM have largely focussed upon its role in the regulation of large dams. For the purposes of its final report, the Commission expects to consider other aspects of DERM's responsibilities, particularly those touching upon land planning issues.

2.1.2 Queensland Water Commission

The Queensland Water Commission is a statutory body which was established by the Queensland Government in 2006 in response to the lengthy drought then being experienced. The main functions of the Water Commission, for the south-east Queensland region and other designated regions, are to:

- advise the Minister on matters relating to water supply and demand management
- advise the Minister on the delivery of desired level of service objectives for water supplied
- facilitate and implement regional water security programs
- ensure compliance with the programs and with water restrictions.[12]

The Water Commission is required to consider flood mitigation and dam safety in the preparation of assessments of water supply.[13]

A principal means through which the Water Commission has advised the government about water supply and demand management is the *South East Queensland Water Strategy*, which was released in July 2010. This strategy included a plan to carry out detailed investigations into increasing the full supply level of Wivenhoe Dam without raising the dam wall. Pursuant to this plan, on 10 January 2011, the Water Commission engaged Seqwater to conduct a flood hydrology impact study on the raising of Wivenhoe Dam's full supply level.[14]

Any increase in the full supply level of Wivenhoe Dam without changing the dimensions of the dam would reduce its flood mitigation capacity and have implications for dam safety.[15] Accordingly, although the Water Commission plays no role in the regulation of dam safety or in dam operations, even during flood events, this is an example of how its actions may potentially have an impact on flood mitigation and dam safety.

2.1.3 SEQ Water Grid Manager

In 2007, the Queensland Government commenced a major reform of south-east Queensland's urban water supply industry. The government's intention was to achieve a more equitable and sustainable distribution of water in the region.[16] Stage one of this reform restructured the bulk water supply and transport businesses, which were previously owned by 25 different entities serving 17 retail businesses. The second phase of the reform involved the establishment of three new retail businesses. The south-east Queensland water grid was created; it includes a network of treatment facilities and two-way pipes which allows for some movement of drinking water around south-east Queensland.[17]

The SEQ Water Grid Manager is a statutory authority established under the *South East Queensland Water (Restructuring) Act 2007*, the Act which introduced the reforms. Its functions are to purchase water services and sell water and to do 'anything else likely to complement or enhance' one of these functions, to the extent they are consistent with its operational and strategic plans. These plans must be submitted to the Water Grid Manager's responsible Ministers for approval each financial year.[18]

The Water Grid Manager holds various water entitlements which give it the right to be supplied water from dams owned by Seqwater. It purchases other water services from Seqwater, which also manufactures (recycles and desalinates) water, and from LinkWater, which transports water. The Water Grid Manager sells water to its customers: three council owned retail businesses,[19] Toowoomba Regional Council, CS Energy and Tarong Energy.

The Water Grid Manager plays no role in dam operations, including during flood events. However, following October 2010 flood releases from the Wivenhoe and Somerset dams, a draft *Protocol for the Communication of Flooding Information for the Brisbane River Catchment – including Flood Water Releases from Wivenhoe and Somerset Dams* was created. Pursuant to the draft communications protocol, during the January 2011 flood events, the Water Grid Manager supplied information about floodwater releases to the Directors-General of the Department of the Premier and Cabinet and DERM and to relevant local councils. The Water Grid Manager also published media releases about dam operations and other flood related topics. For further discussion of the draft communications protocol see, *2.6.10 Communications*.

2.1.4 Queensland Bulk Water Supply Authority trading as Seqwater

The Queensland Bulk Water Supply Authority, which trades as Seqwater, is a statutory authority responsible for bulk water supply to south-east Queensland. It was established on 16 November 2007 under the *South East Queensland Water (Restructuring) Act 2007*.

Seqwater was previously known as the Brisbane Area Water Board (from about 1990 to 1993), the South East Queensland Water Board and the South East Queensland Water Corporation trading as SEQ Water.[20] Changes in Seqwater's roles and responsibilities during the past two decades have mirrored significant legislative and policy changes.

Seqwater owns, operates and manages 26 dams and 47 weirs across south-east Queensland. Dams owned by Seqwater include Wivenhoe, Somerset, North Pine, Hinze and Baroon Pocket dams. Seqwater also owns 46 water treatment plants.[21] On 1 July 2011, Seqwater became the owner of the Western Corridor Recycled Water Scheme and the Gold Coast desalination plant.[22]

2.1.5 SunWater Limited

SunWater Limited is a government owned corporation which is a bulk water infrastructure developer, owner and manager. Burnett Water Pty Ltd, the owner of Paradise Dam, is a wholly owned subsidiary of SunWater. The Minister for Energy and Water Utilities and the Minister for Finance, Natural Resources and The Arts are SunWater's shareholding ministers.

SunWater is a registered large service provider for water supply and services under the *Water Supply (Safety and Reliability) Act 2008* (the Water Supply Act). SunWater owns and operates 23 referable dams, including 18 major dams, 60 weirs and barrages, 77 major pump stations, 2920 kilometres of pipelines and channels and 690 kilometres of drainage works.[23]

Before July 2008, SunWater owned a number of water supply schemes and large dams in south-east Queensland, including Atkinson Dam, Bill Gunn Dam, Clarendon Dam, Maroon Dam and Moogerah Dam. These were sold to Seqwater in connection with the state government's reform of the water supply sector discussed above.

SunWater currently manages the following dams pursuant to facility management contracts with their owners: Glenlyon Dam for the Borders River Commission, Ross River Dam for the Townsville City Council and Scrivener Dam in the Australian Capital Territory.[24]

Until 1 July 2011 and under contract, SunWater operated the flood operations centre for Wivenhoe, Somerset and North Pine dams on Seqwater's behalf. The manner in which this service was provided is discussed below at *2.3.1 Arrangements for flood operations* and *2.6 Decision-making and conditions at the flood operations centre*.

2.1.6 Relationships between DERM and the water agencies

The Minister for Energy and Water Utilities and the Minister for Finance, Natural Resources and The Arts are portfolio Ministers for the Queensland Water Commission, the Water Grid Manager, Seqwater and SunWater (the water agencies). Until 21 February 2011, the water agencies were within the portfolio of the Minister for Natural Resources, Mines and Energy. (The water agencies' relationships with their other responsible Ministers have not been relevant to the Commission's inquiries.)

The Ministers hold various powers relevant to the business of the water agencies.
For example:

- Under section 38(1) of the *Water Act 2000,* the Minister may prepare a water resource plan for any part of Queensland to advance the sustainable management of water.
- Under section 61 of the *South East Queensland Water (Restructuring) Act 2007*, the Minister may give a written direction to the boards of the Water Grid Manager or Seqwater if satisfied that, because of exceptional circumstances, it is necessary to give the direction in the public interest. (The section does not provide limitations on the subject matter or scope of such directions. Nor does it provide any guidance as to what might constitute 'exceptional circumstances'.)

- The Water Commission is not ordinarily subject to direction by the state, but the Minister holds a reserve power to give written directions as to the Water Commission's performance of its non-advisory functions, if satisfied that because of exceptional circumstances it is necessary to do so in the public interest.[25] (Again, the term 'exceptional circumstances' is not explained.)

The Water Act, the Water Supply Act and the *South East Queensland Water (Restructuring) Act 2007* contain many provisions allowing for the making of regulations and statutory instruments with consequences for the business of the water agencies. Proposed regulations, or amendments to regulations, are considered by the Executive Council. The Minister for Energy and Water Utilities is responsible for taking the revision of some regulations and statutory instruments to the Executive Council.[26] If the Executive Council agrees with the Minister's proposal, it advises the Governor of Queensland accordingly. If the Governor approves the draft regulations or statutory instrument and signs the relevant Executive Council minute, the regulations or statutory instrument come into effect.

The legislation requires that the water agencies report regularly to the Ministers about many matters. Representatives of the water agencies meet with the Ministers regularly, and the Ministers also require briefings on particular issues. For example, on 16 January 2011, in response to a request from the Minister's office, Seqwater provided a briefing note to the Minister about the January 2011 flood event and Wivenhoe Dam operations.

It is clear from considering the legislative scheme provided by the three Acts that Parliament intended that the Minister would be responsible for setting policy frameworks, supervising the water agencies and exercising certain emergency powers if necessary in the public interest. It is of course the case under our system of government that Ministers are responsible to Parliament for the administration of their portfolios.

Many of the powers under the Water Act, *South East Queensland Water (Restructuring) Act 2007* and Water Supply Act are held by the Director-General of DERM. For example:

- The chief executive (the Director-General) may prepare a resource operations plan to implement a water resource plan.[27] The chief executive may grant resource operations licences, distribution operations licences and water allocations.[28]
- The Director-General may apply safety conditions to an existing referable dam.[29]
- If the Director-General is satisfied or reasonably believes there is danger of the failure of a dam, the failure is likely to pose a risk to safety or health of the public or individual and immediate action is necessary to prevent or minimise the impact of the failure, the Director-General may take reasonable steps to prevent or minimise the impact of the failure.[30]

For the most part, this legislative scheme provides that the Director-General has responsibility for the setting of operational rules, the assessment of applications and enforcement activities. As is usually the case, many of the Director-General's powers have been delegated to other officers within the department.

As the chief executive, the Director-General retains responsibility for any decisions made under delegation and, of course, for all of DERM's operations. The Director-General bears responsibility for ensuring that the Ministers are provided with appropriate advice by DERM officers about policy matters requiring the Ministers' attention, including matters which must be taken to the Executive Council.

The Director-General is very often responsible for contacting the water agencies on the Ministers' behalf, although the Commission notes that the ministerial staff of the current Minister for Energy and Water Utilities have made inquiries of the water agencies on his behalf.

2.1.7 Local councils

Some local councils own and operate referable dams. For example, Wide Bay Water Corporation, which owns and operates Lenthalls and Cassava dams, is wholly owned by the Fraser Coast Regional Council. Councils which own referable dams are subject to the same regulatory scheme as other dam owners.

Local councils which do not own referable dams have no part in their regulation or operation, whether for water supply or flood mitigation purposes. By way of example, the Brisbane City Council, Ipswich City Council and Somerset Regional Council play no role in relation to the operation of Somerset and Wivenhoe dams. Likewise, the Brisbane City Council and Moreton Bay Regional Council are not involved in North Pine Dam operations. However, local councils are responsible for communicating information about flooding, including flooding related

to dam releases, to local residents. The role of local councils in communicating information about flooding is discussed in chapter *4 Forecasts, warnings and information.*

2.2 Dam history, functions and capacities

2.2.1 Referable dams

The Commission's investigations have so far only involved referable dams.

The Water Supply Act sets out a regulatory framework for the provision of water and sewerage services. It also provides for the regulation of referable dams. Referable dams are those which are assessed as posing a risk to the safety of two or more people should they fail. There are presently 106 referable dams in Queensland.[31]

Dams containing hazardous contaminants (for example, tailings waste produced by mines) are not referable dams. Dams of this type posing a significant or high hazard are regulated separately under the *Environmental Protection Act 1994*.

The Water Supply Act is administered by DERM, and the department's Director-General is the regulator under the Act.[32] Staff within DERM's Office of the Water Supply Regulator are delegated the dam-related powers of the Director-General under the Water Supply Act.[33] Peter Allen, the Director, Dam Safety, Water Supply (the Dam Safety Regulator) is stationed within the Office of the Water Supply Regulator.

The Water Supply Act provides that failure impact assessments must be undertaken by registered professional engineers on dams or proposed dams which exceed certain dimensions. The Act also allows for the imposition of safety conditions on existing referable dams. Safety conditions are imposed upon new referable dams pursuant to development permits issued under the *Sustainable Planning Act 2009*. The Water Supply Act provides the regulator with emergency powers in the event that there is a danger of failure of a dam.

2.2.2 Flood mitigation manuals

Chapter 4, Part 2 of the Water Supply Act deals with the preparation and approval of manuals of operational procedures for flood mitigation for dams. Prior to the enactment of the Water Supply Act, identical provisions were located in the Water Act.

The Water Supply Act provides that a regulation may nominate that an owner of a dam must prepare a flood mitigation manual by a certain date.[34] No guidance is provided by the Act in relation to circumstances which might trigger the making of such a regulation. To date, no dam owner has been compelled by regulation to prepare a flood mitigation manual. The Commission notes that the manuals for Wivenhoe and Somerset dams and North Pine Dam pre-date this legislative scheme.

Section 371 of the Water Supply Act provides that the chief executive may, by gazette notice, approve a flood mitigation manual. Such an approval must be for a period of no more than five years. There are currently only two approved flood mitigation manuals, one for Wivenhoe and Somerset dams, the most recent revision of which was gazetted on 22 January 2010, and the other for North Pine Dam, the most recent revision of which was gazetted on 17 December 2010.

The Water Supply Act does not contain any criteria against which a flood mitigation manual must be assessed. The Act does provide that the chief executive may get advice from an advisory council before approving the manual, but it does not give any guidance as to the composition of any such advisory council. No advisory council has been convened since the commencement of the Water Act.[35]

Subsequent to the most recent approval of the Wivenhoe and North Pine flood mitigation manuals, the dam safety regulator approved a document entitled *DS 5.1 Flood Mitigation for a Dam*.[36] This document outlines procedures to be followed by DERM officers who are assessing flood mitigation manuals.

Section 372 of the Water Supply Act provides that a dam owner must comply with a requirement issued by the chief executive to amend a flood mitigation manual. In consequence, the regulator can be the instigator of change to a flood mitigation manual. The section does not include any limitations as to the subject matter or scope of a requirement to amend a flood mitigation manual. As far as the Commission is aware, the power to require amendment of a flood mitigation manual has never been exercised.

Importantly, section 373 of the Water Supply Act provides that prior to the expiry of the approval of a flood mitigation manual, the dam owner must 'review, and if necessary, update the manual' and give the manual to the chief executive for approval. The Act does not provide any guidance as to the form or content of a review of a flood mitigation manual.

Interestingly, there is no statutory obligation for a dam owner to comply with its flood mitigation manual. However, section 374(2) of the Water Supply Act provides that an owner of a dam who observes the operational procedures in an approved flood mitigation manual does not incur civil liability for an act done, or omission made, honestly and without negligence.[37]

2.2.3 Flood mitigation and water supply

Only a few referable dams have been built for both water supply and flood mitigation purposes. Dams with flood mitigation capacity are of two types: active flood mitigation and passive flood mitigation dams. Active flood mitigation dams are those where the dam operator controls releases; passive flood mitigation dams are those where the dam operator has effectively no discretionary control over outflows.[38]

Active flood mitigation dams usually have spillway gates or large sluice gates. Wivenhoe Dam is an example. The operators of active flood mitigation dams aim to fill the flood storage compartment of the dam during the peak of the inflows into the dam, so as to maximise the attenuation of outflows from the dam.[39] The Commission accepts that, primarily because of uncertainties associated with rainfall predictions, the achievement of an ideal strategy is usually only possible with the benefit of hindsight.

It is trite to say, yet important to note, that the capacity of flood mitigation dams to contain floods is subject to the volume of rainfall experienced in the dam's catchment. The ability of operators to manage a flood is very limited when the volume of rainfall run-off greatly exceeds the volume of the available flood storage within the dam. The peak of the flood will normally be reduced because a part of the flood is absorbed in raising the water level within the dam. In large floods the principal flood mitigation benefit may arise from delaying the onset of the flood to provide more time for warnings and evacuations.

Even those dams without gates or sluices attenuate floods, even if only to a small extent. The peak discharge or outflow from a water supply dam will be less than, and will occur some time after, the peak inflow.[40] This is the only flood mitigation capacity that by far the overwhelming majority of referable dams possess.

2.2.4 Full supply level

The full supply level of a referable dam is the level to which the water supply compartment of the dam is filled. The full supply level is usually based on engineering studies conducted at the time of the dam's design. The flood mitigation compartments of those few referable dams which have them were also established at the time of the dams' design.

One way of indicating that a dam's full supply level has been reached is to say that it is 100 per cent full. It follows that a dam which has a flood mitigation compartment may, during a flood event, be described as being at 120 per cent of capacity, 150 per cent of capacity and so on.

2.2.5 Resource operations plans and licences

The Water Act governs water resource planning; this Act allows the Minister to make a water resource plan for any part of Queensland 'to advance the sustainable management of water'.[41] Section 95 of the Water Act allows the chief executive (that is, the Director-General of DERM) to prepare a 'resource operations plan'. Resource operations plans outline how water resource plans are to be implemented. Their principal relevance to the Commission's investigations about dams lies in the rules they contain about the operations of dams.

Section 105(1) of the Water Act permits the Director-General to amend a resource operations plan. The Director-General must do a number of things in relation to amending resource operations plans, including providing public notice and allowing for submissions. Section 106 of the Water Act provides that in certain instances, the Governor in Council may make minor or stated amendments to resource operations plans. This may be done without first taking the steps ordinarily required of the Director-General when resource operations plans are amended.

The Moreton Resource Operations Plan, made under the Water Act, commenced on 7 December 2009. It provides that the operating levels 'for infrastructure in the central Brisbane River and Stanley River water supply schemes' – that is, Wivenhoe and Somerset dams – are specified in a designated attachment. The full supply levels set out in the attachment remain those which were set at the time of each dam's completion. They have remained the same through various changes in the legislative scheme governing flood mitigation and water supply and changes in which agency operates the dams, including during floods.

Seqwater holds resource operations licences for Wivenhoe, Somerset and North Pine dams. These licences, issued by DERM officers holding appropriate delegations from their Director-General, require Seqwater to comply with the Moreton Resource Operations Plan. The licences permit Seqwater to interfere with the flow of water in the relevant river to the extent necessary to operate the dam to which the licence applies.

On 14 February 2011, under section 106(b) of the Water Act, the Governor in Council approved an amendment to the Moreton Resource Operations Plan.[42] This amendment allowed Seqwater to submit a 'revised interim program' under the Moreton Resources Operation Plan for the Director-General's consideration. On 17 February 2011, the Director-General approved Seqwater's application for a 'revised interim program'. This approval allowed Seqwater to temporarily reduce the level of Wivenhoe Dam to 75 per cent of full supply level until 31 March 2011. This decision and the process leading to it are discussed in detail below at *2.4 Temporary alteration of full supply level*.

Seqwater had previously held an interim program permitting flood mitigation releases when any of the dams exceeded full supply level. This interim program did not permit releases below full supply level, including pre-emptive releases outside floods.

The full supply levels for Wivenhoe, Somerset and North Pine dams are described in, but not set by, the relevant flood mitigation manuals. For the purposes of the flood mitigation manuals, a flood is taken to commence when the dam reaches prescribed levels above the full supply levels. The flood mitigation manuals require the flood engineers, who operate the dams during floods, to continue releasing water only until the level of the dam decreases to full supply level.

2.2.6 Types of dams

Some large water supply dams are gated. These include the Callide, Coolmunda, EJ Beardmore and Leslie dams.[43] Gates are used to attempt to match spillway discharge to the rate of inflows into a dam.[44]

Some of the gated dams have automatic gates (for example, Coolmunda Dam)[45] and others have gates which require control by operators (for example, North Pine Dam).

Many referable dams have ungated (or uncontrolled) spillways and are designed to commence discharging water in the event that water rises above the level of the spillway (for example, Fairbairn Dam).

The means of construction of referable dams varies. For example, Wivenhoe Dam is an earth and rock fill embankment dam with a concrete spillway and Somerset Dam is a mass concrete dam.[46] Differences in construction have only proved relevant to the Commission's investigations in so far as they influence the manner in which dams are operated during flood events. By way of example, Wivenhoe Dam's construction means that allowing the embankment to overtop would risk the safety of the dam, whereas some other water supply dams are not gated and are designed to withstand limited overtopping during flood events.

2.2.7 Somerset Dam

Somerset Dam is located on the Stanley River. It was completed in 1953, construction having been commenced in 1935, but interrupted because of World War II.[47] The site was identified as a potential dam site following the 1893 flood.[48]

Somerset Dam was built for both water supply and flood mitigation purposes. When construction commenced, the water supply to flood compartment ratio was to be about fifty-fifty.[49] This planned ratio was reviewed in the 1950s[50] and Somerset Dam's full supply level has remained at 99 metres[51] since it was commissioned.[52] When the flood compartment is filled, the dam level reaches approximately 107.45 metres.[53] The water supply compartment of Somerset Dam holds approximately 379 800 megalitres[54] and its flood mitigation capacity is approximately 524 000 megalitres.[55]

Radial gates, sluice gates and regulator valves are used to release water from Somerset Dam.[56]

2.2.8 Wivenhoe Dam

Investigations into the possible construction of a dam on the upper Brisbane River commenced prior to the 1974 floods. In 1971, a report completed by the Co-ordinator General recommended the construction of a dam at Wivenhoe.[57] The Wivenhoe Dam was planned to fulfil both water supply and flood mitigation purposes.

Whatever the source of the apparent popular misconception that Wivenhoe Dam would contain all floods emanating in the upper Brisbane River, it is certainly not any of the engineering investigations conducted in connection with the dam during the past four decades. The Commission has considered many of the engineering reports produced about Wivenhoe Dam. All of these reports recognise that other than for relatively small floods, Wivenhoe Dam is only capable of mitigating floods, not preventing them.

Apart from the limited flood mitigation capacity of the Wivenhoe and Somerset dams, it is important to note that approximately 50 per cent of the Brisbane River catchment is below the dams.[58] Even when the Wivenhoe and Somerset dams completely contain rainfall which would otherwise produce flooding, it is possible that major flooding will occur in Ipswich and Brisbane, simply because of the duration and intensity of rainfall elsewhere in the catchment.

Wivenhoe Dam has a full supply level of 1 165 000 megalitres, which is achieved when the lake level reaches 67 metres. The full supply level was identified at the time of Wivenhoe Dam's design, as was the flood storage compartment of 1 420 000 megalitres. The dam has a gated spillway, with five radial gates and an auxiliary spillway fitted with three erodible fuse plugs, which was completed in 2005 and is discussed in more detail in *2.2.9 Fuse plugs.*

In flooding, Somerset and Wivenhoe dams are operated in conjunction so as to maximise flood mitigation.[59] An operating target line is used to set a goal for balancing the water levels in each dam. The Commission has received no evidence contesting the use of the operating target line.

2.2.9 Fuse plugs

In the late 1990s and early 2000s, significant improvements were made in the procedures used to estimate the maximum floods which could be expected to occur. These are known as probable maximum floods. During the same period, the Australian National Committee on Large Dams (ANCOLD) published a series of guidelines relevant to the assessment of capacities of referable dams.[60] The improvement in flood estimation techniques and the ANCOLD guidelines prompted the undertaking of assessments of the risk of the failure of Wivenhoe Dam. In response to these assessments, Seqwater decided upon a program of works to upgrade Wivenhoe Dam.

The purpose of these upgrades was to reduce the risk of the failure of Wivenhoe Dam, particularly through extreme flood events. For Wivenhoe Dam to fail would be an almost unimaginable disaster; the number of people estimated to be at risk should it fail is 244 000.[61]

Stage 1 of the upgrade included 'upgrading the embankment crest to retain a maximum flood level of EL 80 with nil freeboard' and 'upgrading associated structures as appropriate, including protection of the main spillway gates and bridge, and strengthening of the spillway gravity structure by post tensioning'.[62]

Stage 1 of the upgrade also included construction of an auxiliary spillway designed to enable the dam to pass 'an inflow flood with an [annual exceedance probability] of 1 in 100 000 at a maximum flood level of EL80'.[63] This auxiliary spillway is not gated, but instead is controlled by three fuse plugs, at 75.7 metres, 76.2 metres and 76.7 metres.[64] The fuse plugs are designed to erode should the lake level overtop them. The erosion of a fuse plug would lead to an uncontrolled release of water. This would increase the discharge, the intention being to prevent the failure of the dam by overtopping.

The level at which the Wivenhoe manual requires flood engineers to prioritise the structural safety of the dam remained the same following the insertion of the fuse plugs; at that point (when strategy W4 comes into effect) large outflows to stabilise the lake level must occur, with or without fuse plugs. The Wivenhoe manual states that the senior flood engineer may exercise reasonable discretion in moving to strategy W4 (which requires that the primary consideration is protecting the structural safety of the dam) if earlier commencement is able to prevent triggering of a fuse plug.[65] Under the heading 'Strategy W4B – Fuse Plug Initiation Possible' the Wivenhoe manual prescribes that, providing the safety of the dams is not compromised, where early opening of the gates and/or

varying the operational procedures at Somerset Dam can keep the lake level below 75.5 metres, those steps should be taken to prevent fuse plug initiation.

Should a fuse plug be breached there would be a rapid release of water from Wivenhoe Dam, which it may be possible to offset through gate operations. The flood mitigation capacity of the dam may be reduced for some months while the auxiliary spillway is repaired. There is also the issue of the cost of repairs, although, in the context of the damage occasioned by a large flood, this is of limited relevance.

The Commission is not presently in a position to reach a conclusion about the appropriateness of the Wivenhoe manual's according of importance to the protection of the fuse plugs. This is a matter which may be dealt with in the course of the longer term review of the Wivenhoe manual discussed below in *2.5 Manual of operational procedures for flood mitigation at Wivenhoe Dam and Somerset Dam*.

The Commission notes that Wivenhoe Dam does not presently comply with ANCOLD guidelines in that it could not presently withstand a probable maximum flood. However, the reconstruction of Wivenhoe's saddle dam 2 as a fourth fuse plug spillway is planned. The completion of this further upgrade would mean that the dam's spillway was designed to withstand 100 per cent of the probable maximum flood.[66] Under the *Queensland Dam Safety Guidelines*, this upgrade is not required until 2035. The Commission understands that Seqwater's present plan is to review the requirement for this further upgrade in around 2015.[67]

2.2.10 North Pine Dam

North Pine Dam was completed in 1976. It is located on the North Pine River, immediately upstream of an urban area within the Moreton Bay Regional Council's region.

North Pine dam was built for water supply only. It has a full supply level of 39.6 metres or approximately 214 000 megalitres. It is a mass concrete dam not designed to withstand overtopping. During floods, water is released through the dam spillway using five radial gates.[68]

The North Pine manual refers to the dam as having a flood storage compartment,[69] but this 'compartment' is the five centimetres between the dam's full supply level, 39.6 metres, and the level at which gate openings are triggered, 39.65 metres. [70] This space is only 0.5 per cent of the volume of full supply of North Pine Dam.[71] In effect, the flood storage compartment provides only a short delay between full supply level being reached and flood releases commencing.[72] This means, once the dam is full, floods pass through the reservoir with little mitigation benefit.[73]

In some previous wet seasons, North Pine Dam has been maintained at 95 per cent of full supply level so as to provide a small flood mitigation buffer. The Commission accepts that the main purpose of this was to allow for increased notice to local residents about road closures, which almost inevitably result from any flood release from North Pine Dam.

2.2.11 Regional dams

Many of the most significant issues associated with the operations of regional dams relate to communication issues. These are discussed below at *4.1.4 Warnings about dam spillway outflow*.

2.3 Flood preparedness of Seqwater

The prediction of a La Niña wet season by the Bureau in October 2010 had (or should have had) implications for Seqwater, as an owner and operator of dams in south-east Queensland. All of these dams have the potential, through releases in floods, to affect populations in downstream areas.

2.3.1 Arrangements for flood operations

Seqwater (and its predecessors) engaged SunWater (and its predecessors) to manage the operation of the Wivenhoe, Somerset and North Pine dams during flood events for more than 10 years to 1 July 2011. That arrangement continued to 30 June 2010, under an agreement dated 13 October 2009. The agreement set out, by schedule, the tasks SunWater was to perform for Seqwater in return for a fixed sum.

SunWater was, among other things, to:

- ensure all staff and contractors who may be involved in flood operations are adequately trained[74]
- review the operation of the flood operations centre and the data collection network and report annually as to maintenance and upgrades required[75]
- perform emergency maintenance in the case of equipment failure[76]
- manage flood events in accordance with the standard operating procedures, emergency action plans and the Wivenhoe manual and North Pine manual[77]
- establish and maintain a flood operations centre from which to manage flood events[78]
- check the rainfall gauge network and validate data at rainfall gauges[79]
- connect the rainfall gauge network to the models available in the flood operations centre[80]
- arrange with Seqwater a program of training for flood operations staff[81]
- submit a statement of flood preparedness to Seqwater each year including an assurance that SunWater is prepared to deal with any flood event[82]
- mobilise the flood operations centre for each flood event and manage the event[83]
- prepare a flood event report within two weeks of the end of the flood event.[84]

The agreement in effect delegated many of Seqwater's responsibilities as operator of the dams during times of flood. It appears that Seqwater did not ensure the continuity of the arrangement throughout the 2010/2011 wet season. The agreement expired on 31 October 2010, and was not extended until a further deed was signed on 24 December 2010. That deed backdated the term of the contract to ensure it was continuous; but between 1 November and 23 December 2010, no written contract was in place. Despite that, SunWater continued to provide flood management services in accordance with the agreement and Seqwater accepted those services.[85]

The fact that such an agreement could lapse, albeit only formally, raises concerns about the priority accorded by Seqwater to flood preparedness.

2.3.2 Annual Wivenhoe and North Pine manual review

The agreement for flood management services described above also required SunWater to review the Wivenhoe and North Pine manuals. In July each year, SunWater was obliged to report in writing to Seqwater regarding recommended improvements, or to confirm that the manuals remained satisfactory.[86] This was a requirement additional to the formal review process under part 7 of the Wivenhoe and North Pine manuals.

During this time, SunWater participated in formal reviews of the Wivenhoe manual in 2002, 2004 and 2009 and of the North Pine manual in 2002 and 2007. SunWater's involvement was primarily through Robert Ayre, an employee of SunWater and a senior flood engineer. In 2002 and 2004, Mr Ayre took a lead role in the review and re-drafting of the two manuals.

SunWater could not establish that it provided any advice, in accordance with the requirements of the agreement, in the period 2001 to 2010.[87] In six of the annual reports of activities performed by SunWater under the agreement, SunWater stated that it had 'reviewed' the manuals in the lead up to the wet season.[88] In one, no mention is made of any pre-wet season review of the manuals.[89] In none of the annual reports, however, can be found a

recommended improvement or a confirmation that the manuals remained satisfactory; nor is there any evidence of a request from Seqwater that SunWater comply with this aspect of its obligations.

This omission assumes some significance when it is acknowledged that the Wivenhoe manual has, in important respects, been found to be ambiguous and in need of amendment (see *2.6 Decision-making and conditions at the flood operations centre*).

2.3.3 Tools at the flood operations centre

The flood engineers make operational decisions about dam releases on the basis of the relevant manual. In the Wivenhoe manual, the protection of urban areas from inundation is the primary consideration during strategies W2 and W3, and a lower level consideration when the dam is operated in strategies W1 and W4.

The flood engineers' evidence was that the *Brisbane Valley Damage Minimisation Study* completed in 2007 provided them with some understanding of the consequences of different flows.[90] That study dealt with damage for residential and non-residential areas of the Brisbane, Ipswich and Somerset local council regions at different flow rates.[91] The real time flood monitoring system (used in the flood operations centre for 15 years, with some modifications to both hardware and software) originally included a hydrodynamic model to determine flow velocities and levels along the river system.[92] However, when its hardware platform was changed that model was not retained, and it was not replaced. The flood engineers did not have access to hydrodynamic modelling which would have given more precise indications of flood levels at particular locations downstream during the height of the flood event. They relied instead on the hydrologic models in the real time flood model, although during the drawdown phase they were given access to a hydrodynamic model for the Brisbane River system.[93] They had no hydrodynamic model for the Bremer River at any time during the January 2011 flood event.[94]

One benefit of a hydrodynamic model is that it can account for flow interactions at the confluence of waterways, such as where the Lockyer Creek or the Bremer River meet the Brisbane River.[95] For example, in Ipswich, the height of the Bremer River is affected by whether water is able to flow into an already flooded Brisbane River. Mr Ayre explained that because the hydrologic models do not satisfactorily account for this backwater effect, the flood engineers were not able readily to assess the impacts of discharges from Wivenhoe on flooding in Ipswich.[96] None of the modelling done on the downstream impacts of releases related to impacts in the Ipswich area.[97] It was anticipated that the flood engineers would in the future have access to a hydrodynamic model dealing with Ipswich.[98]

A second benefit of a hydrodynamic model is that it converts flow into height. While water level, flow rate and volume are all important to determine the impacts of flooding, for damage caused to urban areas height of inundation is a significant factor.[99] While none of the parameters of the strategies is expressed in terms of height, one of the flood mitigation objectives under the Wivenhoe manual is to provide protection of urban areas from inundation. The same peak flow at one point can produce different heights at a second point downstream depending on many things, including the time the peak flow endures.[100]

An expert hydrologist engaged by the Commission, Mark Babister, considered that having such a model would be helpful in giving an understanding of the effects of releases from the dam.[101] Mr Ayre accepted that it would have been useful to have a hydrodynamic model at the flood operations centre,[102] although he expressed concern that it might take substantial effort to calibrate it to the event.[103] Mr Babister was of the view that if a model were properly calibrated to historical floods, there would be no need to calibrate it in real time during the event.[104]

The flood engineers say that having a hydrodynamic model would not have affected how they managed the dams during the January 2011 event.[105] However, the Commission considers that the flood engineers should have hydrodynamic models available to them in the flood operations centre to assist determining the downstream impacts of releases from the dams.

During the flood event, the flood engineers requested two pieces of information to assist in their operational decision making – a copy of the damage curves developed by the Brisbane City Council from the Brisbane Valley damage minimisation study 2007[106] and the equations for the flow out of the fuse plug spillway after a fuse plug has triggered at different lake levels.[107] It would be appropriate for those tools also to be available to the flood engineers for all flood events.

2.3.4 Seqwater's flood preparedness activities

Seqwater has various programs and documents in place to guide its operation of its dams, including:

- a dam safety management program[108]
- standard operating procedures prepared in accordance with the dam safety conditions imposed on it by DERM[109]
- five year comprehensive safety inspections of its dams, the most recent on Wivenhoe Dam having been completed in September 2010[110]
- emergency actions plans (see further, *4.1.4 Warnings about dams spillway outflow*)
- the flood mitigation manuals (for a description of the Wivenhoe manual, see *2.5.1 Structure of the Wivenhoe manual.* For a description of the North Pine manual, see *2.10.1 Managing flood events*).

Those documents and programs have long term aims and application. None is specific to an approaching wet season. The first three deal primarily with the safety of the dam; they refer to flooding only in the context of dam failure. To the limited extent that they apply to other flood operations, they simply refer to the manuals. The manuals remain the key documents by which risks of downstream flooding are identified outside of a dam failure situation. See *2.5.8 Longer term review of the Wivenhoe manual.*

Each manual prescribes some preparedness activities to be undertaken by Seqwater. They require that by 30 September each year, Seqwater report to DERM on:[111]

- training and state of preparedness of flood operations staff
- the adequacy of communication and data collection facilities
- the reliability of the communication facilities, real time flood model and ALERT network over the previous 12 months
- the reliability of the system (being the flood monitoring and forecasting system described in part 5 of the Wivenhoe and North Pine manuals) and under prolonged flood conditions
- the accuracy of the forecasted flood flows and heights
- the overall state of preparedness of the system.

A summary of the preparedness activities undertaken before the 2010/2011 wet season in accordance with the manuals' stipulations is contained in the *Flood Operations Preparedness Report Wivenhoe, Somerset and North Pine Dam* (October 2010).[112] The report deals with facilities available at the flood operations centre and the back-up flood operations centre, the performance of the flood model and rainfall gauge network, new rainfall gauges installed, accuracy of the models during the flood events that occurred in 2009/2010 and availability of suitable flood operations staff. The report concludes by saying that although all aspects of the system were satisfactory, Seqwater was already taking steps to renew the system and improvements were expected for the 2010/2011 year. (Similar information about Seqwater's activities to prepare for the 2010/2011 wet season is contained in section 4 of its report on the flood events at Somerset and Wivenhoe dams.[113])

There are limitations in the review undertaken in the *Flood Operations Preparedness Report.* It did not attempt to assess every aspect of Seqwater's ability to comply with the manuals during the wet season. Obvious matters requiring attention were:

- checking whether the people listed on the schedule of flood engineers were registered with the Board of Professional Engineers Queensland, as required by the Wivenhoe and North Pine manuals.[114] It was later discovered that one of the flood engineers was not registered, a breach of part 2.5 of both manuals.[115] See also *2.5.6 Registration of flood engineers*.
- considering access to the flood operations centre and the back-up flood operations centre if Brisbane city were flooded. An inability to reach and use one or the other of those premises could have prevented the flood operations centre from controlling the dams.

Seqwater's flood preparedness activities also do not seem to have extended to matters affecting the practical ability of the flood engineers to carry out their duties. These include:

- the conditions under which staff would have to work in a prolonged flood event, with regard to the availability of food, accommodation, contact with family and friends and fatigue management. See *2.6 Decision-making and conditions at the flood operations centre.*
- the lack of any training exercise which included a situation in which strategy W4 under the Wivenhoe manual was invoked. This flood event was the first time W4 had ever been triggered, in training or in real operations.[116] See *2.5.5 Training.*

There is no evidence to suggest the last two matters adversely affected the flood engineers' performance during the January 2011 flood event. The point is that they were matters which should have been identified and addressed by Seqwater prior to the wet season.

These four examples are not individually significant. However, they reveal that the process by which flood preparation was undertaken was inadequate.

Recommendation

2.1 Seqwater should review all arrangements for the operation of the dams during flood events for the entire wet season by 30 September each year, and ensure that all parties are adequately prepared, in the process ensuring that:

- Seqwater can comply with every aspect of the Wivenhoe and North Pine manuals
- the flood operations centre is ready and capable of operating during any flood event of whatever duration, including in terms of communications, equipment, rostering of and facilities for staff
- the flood operations centre has available to it all tools, studies, equations and data necessary for it to be fully appraised of the consequences of its operation of the dams, including:
  - hydrodynamic model of the Brisbane River downstream of the Wivenhoe Dam
  - hydrodynamic model of the Bremer River
  - copy of damage curves from *Brisbane Valley Damage Minimisation Study 2007*
  - equations for flow out of fuse plugs, if initiated.

2.4 Temporary alteration of full supply level

2.4.1 Fixing and altering the 'full supply level' of dams

As noted in *2.2.5 Resource operations plans and licences*, the *Water Act 2000* allows the chief executive (the Director-General of DERM) to prepare a 'resource operations plan' and to amend it after undertaking a consultation process. In some circumstances however, the Water Act allows a resource operations plan to be amended without undertaking the consultation process; this may be done by the Governor in Council.

The Moreton Resource Operations Plan specifies by an attachment[117] the operating level for Wivenhoe Dam. It designates the full supply level of that dam as 67 metres, and the full supply volume as 1 165 200 megalitres.[118]

The same 'full supply level' is reflected in the Wivenhoe manual for the operation of the dam, but that manual has no part in setting that level. That much is obvious when it is acknowledged that the provisions of the Wivenhoe manual which include reference to full supply level have application only during a 'flood event'.[119]

2.4.2 Drought and proposals to raise full supply level

South-east Queensland was affected by drought from 2001 to 2009. During this period the water levels of Somerset and Wivenhoe dams were well below the full supply level of each dam.[120] It was only when the combined storage capacity of Somerset, Wivenhoe and North Pine dams reached 60 per cent on 20 May 2009 that the drought was declared over.[121]

Over the preceding decade, south-east Queensland's water supply had been put at some risk. As a result, investigations began into the means by which there could be an increase in the volume of water supply or 'yield' that could be drawn from the Brisbane River catchment. Investigations of this kind included:

- Seqwater's March 2007 report, *Provision of Contingency Storage in Wivenhoe & Somerset Dam* (March 2007 report), prepared in conjunction with the then Queensland Department of Natural Resources and Water. This included investigations for the provision of an additional 200 000 to 600 000 megalitres of contingency storage in the Brisbane River catchment by raising the full supply level of Wivenhoe Dam or Somerset Dam.[122]
- SunWater's December 2007 report, *Assessment of Wivenhoe Dam Full Supply Level on Flood Impacts*, prepared at the request of Seqwater for the purpose of securing south-east Queensland's water supplies. This report considered three full supply levels scenarios, 67 metres (current), 68 metres and 69 metres under certain assumptions,[123] to determine the impact on Wivenhoe and Somerset dams and flooding in areas downstream.[124]
- GHD's December 2009 report, *Report for Wivenhoe Dam Full Supply Level Review Technical Assessment of Raising Potential*, commissioned by Seqwater. This report assessed the structural capacity of Wivenhoe Dam to cope with a two metre increase in full supply level.[125]

The March 2007 report informed the draft *South East Queensland Water Strategy,*[126] while the final *South East Queensland Water Strategy*, released in July 2010, stated that the Queensland Water Commission and Seqwater would conduct a detailed investigation to determine the maximum level to which the working storage of Wivenhoe Dam could be raised without raising the dam wall.[127]

The Water Commission commenced the preliminary investigations required by the *South East Queensland Water Strategy* into raising the full supply level of Wivenhoe in about March 2010.[128] Seqwater became actively involved in the study later that year.[129]

By a briefing note dated 11 October 2010, the Water Commission advised the Minister, Mr Robertson, that raising Wivenhoe Dam's full supply level by one metre would increase yield by 5000 megalitres while any raising of the full supply level 'above one metre actually results in a lower overall yield from the system due to higher evaporation losses'.[130] At that time, a pre-feasibility study was expected to be completed by March 2011 and a feasibility study involving further work was anticipated to take a further 12 months.[131]

As late as 10 January 2011, the chief executive officer of Seqwater, Peter Borrows, wrote to the chief executive officer of the Water Commission to confirm Seqwater's willingness to conduct a flood study on the raising of Wivenhoe Dam's full supply level.[132] At the time of the Commission's public hearings, the investigations were 'paused' but not discontinued.[133]

2.4.3 Community concern

On 10 December 2010 Seqwater's dam operations manager, Robert Drury, met with representatives of the Mid Brisbane River Irrigators Incorporated. That organisation represents irrigators in the mid Brisbane River region, which extends from Wivenhoe Dam to Mt Crosby Weir. Its aim is to promote effective sustainable catchment management and water quality in the region.[134] During that meeting, the Mid Brisbane River Irrigators sought a reduction in the level of Wivenhoe Dam to 70 to 80 per cent of full supply level under the Wivenhoe manual to 'act as a buffer and to enable long, slow water releases with an extended drain down phase to prevent hydraulic drawdown of the river banks, thus replicating a natural flow' and 'avoid the risk of flood' in the coming wet season.[135] Mr Drury advised the Mid Brisbane River Irrigators' representatives that amendment of the Wivenhoe manual was not the appropriate way to effect a temporary reduction in the level of Wivenhoe Dam; they were talking to the wrong people about the issue.[136]

On 23 December 2010, the Chairman of the Mid Brisbane River Irrigators, Ken Schmidt, wrote a letter to Mr Robertson to express concern about the management of water releases from Wivenhoe Dam and their effect on the mid Brisbane River region.[137] The letter expressed the view that the water released from Wivenhoe Dam during October 2010 flooding, combined with the flow from tributaries below Wivenhoe Dam, resulted in major riverbank slumping, loss of vegetation, erosion, and damage to irrigation, stockwater pumps and fences in the mid Brisbane River region. It went on to propose that such damage could be significantly reduced, or avoided

altogether, if the relevant authorities took a number of measures including reducing the lake level of Wivenhoe Dam during the wet season to 80 per cent to better enable it to control the effects of heavy rainfall in the Somerset and Wivenhoe catchments.[138]

On 9 March 2011, Mr Robertson responded to Mr Schmidt's letter, noting the establishment of the Commission. The Minister also noted that on 13 February 2011 he had announced a decision to temporarily reduce the lake level of Wivenhoe Dam to 75 per cent of full supply level.[139]

2.4.4 October 2010 process

In fact, the Minister had, in October 2010, already begun an inquiry into the possibility that the full supply level of Somerset, Wivenhoe, North Pine and Leslie Harrison dams might temporarily be lowered.

On 18 October 2010, James Davidson of the Bureau of Meteorology briefed Cabinet about the seasonal forecast, warning that the 2010/2011 wet season would be unusually intense.[140] The Bureau's seasonal forecast was, in short, for a 75 per cent chance of above median rainfall in south-east Queensland for the period November 2010 to January 2011 and an active cyclone season. Those briefings included warnings that:[141]

- there was a well established and quite strong La Niña pattern, more than 'run-of-the-mill', which was expected to persist until at least March
- there was a historical correlation between La Niña events and tropical cyclones in the Coral Sea
- above normal rainfall would continue over much of Queensland.[142]

As a result, the Minister looked to the office of the South East Queensland Water Grid Manager for advice. (For an explanation of the role of the Water Grid Manager, see *2.1.3 SEQ Water Grid Manager*).

Following discussions with DERM officers,[143] Daniel Spiller, the Water Grid Manager's director, operations, prepared correspondence which was signed by the Minister and, to complete the circle, sent by the Minister to the Water Grid Manager.[144] That correspondence, dated 25 October 2010, requested the Water Grid Manager's urgent advice about options for and benefits of releasing water from 'key storages' – at a minimum, Wivenhoe, North Pine and Leslie Harrison dams – in anticipation of major inflows over the coming summer. Mr Spiller also prepared for the Minister a draft media release announcing 'measures to configure the [water] Grid for improved flood mitigation'. That media release anticipated the results of an 'analysis', even though no analysis had been done – or even commenced – at the time it was prepared.[145]

It should also be noted that the only source from which the Minister sought advice was the Water Grid Manager, which in turn consulted with Seqwater.[146] No advice was sought from anyone within DERM,[147] notwithstanding the interest that this department and other arms of government had (or ought to have had) in the topics of dam safety[148] and flood mitigation.[149]

On 13 December 2010, Mr Robertson met, for various purposes, with the Board of the Water Grid Manager.[150] The Minister gave evidence that on that date he had been verbally briefed about the Water Grid Manager's preliminary view, which was that it thought that a minor reduction was possible but that it would not make an appreciable impact on flood levels.[151]

On the basis of the information received on 13 December 2010, Mr Robertson said, he made the decision not to proceed with the proposal for a temporary reduction of the full supply levels.[152] The process was 'parked'.[153]

There is no record of the Minister's having made this decision or telling anyone about it – then or at any time.[154] He was required to provide the Commission with an account of all discussions on the topics of possible alteration of the full supply level and changes to the level of Somerset and Wivenhoe dams in which he participated between 1 September 2010 and 30 March 2011.[155] He said in evidence that he 'would have' discussed this matter with his Director-General, but this possibility was not raised in his witness statement.[156] No explanation was forthcoming for this apparent failure to comply with the Commissioner's requirement.[157] His Director-General, John Bradley, could not confirm that the Minister made this decision on that day, or at all.[158]

The Minister explained aspects of the process by which he made his decision. Firstly, he took the view that a five per cent reduction in the full supply level was 'meaningless'.[159] The absence of any written record of the decision-making process makes it impossible to determine the basis for this conclusion. If the advice that he received

included the observation that a small reduction in full supply level could minimise operational and community impacts in minor inflow events, then the Minister must be understood to be of the view that these benefits were, in the scheme of that which he was considering, unimportant. Clearly this aspect of his decision did not accommodate the Mid Brisbane River Irrigators' concerns as ultimately expressed on 23 December 2010. See *2.4.3 Community concern*.

Second, it is apparent that the Minister was expecting the relevant advice to come from people who were busy managing the dams at the time.[160] For that reason, so the logic seemed to run, the potential advisors should not be pressed too hard for a response to his initial inquiry. It should be remembered that the only entity from which advice had been sought directly was the Water Grid Manager. It had no operational role in managing the dams, although it sought advice from Seqwater, which did.

In any case, since both were oblivious to the Minister's state of mind, these parties were, as late as 24 December 2010, working to provide a response to the initial inquiry. Even then, it appears that there was some confusion as to who was responsible for bringing this process to a conclusion.

In a letter bearing the date 24 December 2010, the Water Grid Manager finally responded to the request of 25 October 2010. It did not recommend a pre-emptive release on such a scale. The potential water security impacts were considered to be more significant than the benefits, although the nature of the prospective 'benefits' seems to have been the subject of only limited exploration.[161] The letter suggested that a temporary reduction in the level of Wivenhoe and Somerset dams (to 95 per cent of the combined full supply level) might provide some benefits in terms of 'reduced community and operational impacts during minor inflow events'. [162] It was noted, however, that such pre-emptive releases would provide negligible benefits for medium and major flood events. To have any impact on events of those kind, pre-emptive releases of a much greater quantity (about 16 per cent of the 'combined storage capacity' of the dams) would be necessary.[163]

The advice, which drew upon modelling work done by Seqwater,[164] went only so far as to say that there was 'no in principle objection' to Wivenhoe and Somerset dams being drawn down to 95 per cent of the combined full supply level.[165] It was confirmed, as part of this advice, that from a water security perspective, the Queensland Water Commission had also agreed that there were no objections to a release on this scale.[166] The Water Grid Manager's letter reflected in summary form Seqwater's advice about the downstream flood impacts of temporarily lowering the full supply level of Wivenhoe and Somerset dams.

The correspondence concluded with a recommendation that the existing investigations which were examining the opportunity of raising the full supply level (for the purpose of water supply) should be expanded to include options involving the release of additional water once major inflows into the dam were forecast.

At 10.18 am that day, the Water Grid Manager sent to the Water Commission an email indicating that it was 'planning to send [a letter] to Seqwater giving [its] permission to lower Wivenhoe below full supply level down to 95%…'. [167] The Water Grid Manager asked the Water Commission to note the proposed strategy and reply by midday, apologising 'for the short turnaround period'. [168]

Once the Water Commission confirmed it had no objection to the proposed release, the chief executive officer of the Water Grid Manager, Barry Dennien, sent the letter to the chief executive officer of Seqwater.[169] In reply, Mr Borrows enquired whether the letter was 'meant to be a direction to release to levels below FSL [full supply level]' for Wivenhoe, Somerset and North Pine dams.[170] In response, Mr Dennien called Mr Borrows to advise that his letter was not a direction to release water below full supply level.[171]

Ultimately Mr Borrows, 'decided not to progress' the issue.[172]

In sum, an examination of the activities and correspondence reveals that the relevant responsibilities were not the subject of a clear understanding between those involved. The Minister did nothing to resolve this confusion.

2.4.5 February 2011 process

The concept of a temporary reduction in the full supply level of the dams was revisited after the flood events of January 2011. Following a series of meetings and communications between relevant parties, the decision to release 25 per cent of the water then in Wivenhoe Dam was finally implemented.[173] The process, however, was not straightforward. Once again, the relevant responsibilities were not the subject of clear understanding.

In a letter of 20 January 2011, the Minister requested as a matter of priority that Seqwater's report on the recent flood events at Wivenhoe and Somerset dams (required by clauses 2.9 and 7.4 of the Wivenhoe manual) 'include consideration of the appropriate full supply levels'.[174]

On 25 January 2011, Seqwater agreed that it would conduct modelling to provide an indicative assessment of the benefits or otherwise of undertaking a pre-release strategy to pre-emptively reduce the full supply level of the dams.[175] This was confirmed by Seqwater in a letter of 27 January 2011.[176]

In a meeting of 31 January 2011, Mr Robertson requested Seqwater take the lead on communication surrounding this issue.[177] He specified that this was not to be the role of either his department or the Water Grid Manager. Mr Borrows responded by stipulating that his organisation could provide advice as to what an appropriate full supply level might be, but could not make a policy decision.

The next day, 1 February 2011, Mr Borrows met with senior representatives of DERM, the Water Grid Manager and the Queensland Water Commission and reiterated this position.[178] Mr Borrows said that full supply level was a 'policy call of [government]', and noted the tension between maintaining sufficient supply of drinking water and sufficient space for flood storage. Mr Allen, Dam Safety Regulator, of the Minister's own department, supported this assessment. Mr Allen noted that the dam operators were not traditionally asked for any analysis on pre-releases or questions of supply level. These areas were 'out of bounds', because they were levels which are set by state instruments.

By letter dated 4 February 2011, Phil Hennessy, chairman of Seqwater, informed the Minister that Seqwater's modelling was to provide the indicative assessment referred to on 25 January 2011, in order to assist DERM.[179] This was being done 'to assist DERM in formulating its policy position'.[180] He went on to note that, should DERM be satisfied on advice from the Water Commissioner and the Water Grid Manager that, from a water supply security perspective, Wivenhoe Dam's full supply level could be 'reduced in the short term to, say, 75% of its current FSL [full supply level]', then Seqwater could confirm that such a reduction would provide flood mitigation benefits.[181] He also offered assistance to DERM regarding 'the Moreton Resource Operations Plan and the appropriate mechanism by which such a pre-release strategy would be implemented'.[182]

On 7 February 2011, Mr Borrows sent a letter and memorandum entitled *Impact of Reducing the Full Supply Level of Wivenhoe Dam on Flood Discharges* to Mr Bradley.[183] The memorandum presented a number of scenarios for consideration by DERM for it to determine, from a policy perspective, whether the full supply levels of dams should be changed. The scenarios presented in the memorandum provided an approximate analysis. Mr Borrows advised that more accurate estimates would require a detailed investigation and analysis of the entire river system, using multiple flood events and a combination of hydraulic, hydrological and routing models. The relevant part of this analysis, presented as 'option five', pursuant to which the full supply level of Wivenhoe Dam would be reduced to 75 per cent of its full supply level is discussed in greater detail below.

On 8 February 2011, representatives of DERM and Seqwater again met.[184] The exchange began with Mr Bradley enquiring as to the status of the modelling being done by Seqwater. Mr Borrows advised that it had been provided by an email 12 hours earlier. Mr Bradley queried whether this document expressed a recommendation, or whether it was 'simply data'.[185]

In the course of this meeting, Mr Bradley is recorded as saying that:[186]

- DERM 'were asking for explicit advice from Seqwater on the FSL'
- he had a 'different expectation of advice from Seqwater under the manual'
- he 'could not comprehend how an owner and operator can't come to a corporate position of FSL as required by the statutory report under the manual'
- 'Seqwater appeared to be not taking control and that there was no ownership by Seqwater'

- 'the manual was now the operating framework that specifies FSL and was therefore the regulatory instrument'
- 'if the manual was not the instrument to change FSL – what is the other regulatory instrument – it is not the ROP'
- 'the Minister expected the Board [of Seqwater] to provide corporate decisions on FSL'
- Seqwater is the organisation that takes into account 'downstream impacts through the manual'
- 'to not come to a position on the benefits and desirability of changing FSL/releases is a fundamental vacation of the area that [Seqwater] should be expert in'.

Mr Borrows resisted the proposition that the responsibility for setting full supply level rested with Seqwater. He pointed out that the Wivenhoe manual was not the mechanism by which full supply level was set – it was a 'taker' and not a 'decider' of full supply level.[187] Nor was the review of the flood event, as required by the Wivenhoe manual, something that could drive a change to the designated full supply level.[188] Mr Borrows further articulated the fundamental difference between full supply level from a water security point of view and the way in which it was relevant to the Wivenhoe manual. [189] This was not, he said, a Seqwater decision. [190]

On 10 February 2011, Mr Borrows sent to the Minister a letter that reflected a change in position.[191] He had received some advice from the Water Grid Manager the previous day.[192] Mr Dennien had told him that, from a water security perspective, a temporary drawdown of Wivenhoe Dam to 75 per cent of its full supply level was unlikely to 'impact our ability to comply with' the contract for the supply of water from the dams to the Grid Manager.[193] Mr Borrows referred to Seqwater's modelling, which had already been provided to DERM, and concluded that a reduction in the full supply level to 75 per cent would 'provide appreciable flood mitigation benefits'.[194] In the light of the modelling results and the advice from Mr Dennien, Mr Borrrows wrote, 'Seqwater recommends that Wivenhoe Dam's storage level be temporarily reduced to 75% of its FSL in order to temporarily increase its flood mitigation capacity'.

After receiving this correspondence, DERM held a number of discussions to speed up the implementation of Seqwater's recommendation to reduce the storage level of Wivenhoe Dam to 75 per cent of its full supply level.[195] DERM and Seqwater agreed to implement the temporary reduction of the full supply level by, in substance, amending the Moreton Resource Operations Plan to permit Seqwater to submit to Mr Bradley an interim program for operations under which the storage level of Wivenhoe Dam would be reduced to and maintained at 75 per cent of its full supply level until 31 March 2011. On approval of the interim program, Seqwater would duly draw the dam down to 75 per cent of full supply level.[196]

On 13 February 2011, Mr Robertson issued a media statement[197] in which he announced that Seqwater had 'formally recommended that Wivenhoe Dam's [sic] would be temporarily reduced to 75% of its current Full Supply Level'. The Minister reported that the release had been recommended by Seqwater after recent hydrologic analysis, and was a precaution against the 'second strongest La Niña pattern in history'[198] which was continuing to influence the current wet season. According to the media statement, Mr Dennien had advised Seqwater that a reduction to 75 per cent would be manageable from a water security perspective. The proposition that 'the recently completed Wyaralong Dam was now full five years earlier than expected and now storing 103,000 megalitres which is able to be connected to the Water Grid when required' was also attributed to Mr Dennien.

On 14 February 2011 the Water Commission advised Mr Borrows as to the potential impact on the security of water supply if a significant volume of water was released from Wivenhoe Dam.[199] This advice had been shared with Seqwater officers during the course of its preparation, and provided to them on 12 February 2011.[200] In sum, the report concluded that the release of 25 per cent of the dam's water as a temporary measure would meet the risk criteria of the South East Queensland System Operating Plan.[201]

On 14 February 2011, the Governor in Council approved an amendment to the Moreton Resource Operations Plan.[202] The amendment appeared in the government gazette that day.

On 17 February 2011, Seqwater submitted to DERM a revised interim program giving effect to the agreed reduction of full supply level to 75 per cent.[203] On the same day, Mr Bradley approved the revised interim program pursuant to section 13 of the Moreton Resource Operations Plan.[204] The reduction was to have effect until 31 March 2011. While Mr Bradley was the one to *make* the decision under the Water Act, Mr Robertson agreed in

his evidence before the Commission that Mr Bradley was under the direction of himself and Cabinet; that nothing would happen until he and Cabinet had agreed.[205] The Minister is the only one who can *effect* a reduction in full supply.[206]

Even after this process was completed, on 22 March 2011, Mr Borrows responded to the Water Commission's advice. In the course of that letter he expressed the view that it was beyond the scope of Seqwater's function to comment on the water supply security implications of the scenarios presented in the report, other than to provide comment and modelling on the respective flood mitigation impacts of those scenarios.[207]

2.4.6 Relevant and responsible decision-maker

An overall examination of the efforts – in October 2010 and February 2011 – to reduce, temporarily, the full supply level of dams in south-east Queensland for the purposes of flood mitigation leads to a conclusion that reform is necessary.

The water agencies and DERM seem incapable of agreeing upon their respective roles. Seqwater and DERM have had fundamental disagreements about the advice Seqwater should be providing to the Minister.[208] The Queensland Government has maintained its position that Seqwater is the appropriate body to give recommendations to the Minister as to reduction of full supply level in its submissions to the Commission. Seqwater has not, in its submissions to the Commission, departed from the view expressed in its letter of 22 March 2011.[209] The Water Grid Manager also submits that Seqwater should be making recommendations as to alteration of full supply level to the Minister. The Queensland Water Commission is part way through a study into the roles of the different water authorities in Queensland, almost five years after the water authorities were created in 2007.[210]

In that environment, it cannot be left to the water agencies to determine who should provide what advice to the Minister during a consideration of a change in full supply level.

It seems to the Commission that, given the competing interests between which a balance must be struck, the ultimate decision is one for the accountable Minister. The Minister accepted in his evidence before the Commission that he was the only one who could effect a reduction in full supply level.[211]

Of course it is a decision which should be made on advice, but it is not one which can or should be abdicated to agencies whose functions are prescribed by statutes which omit any reference to a responsibility of this kind. Agencies such as Seqwater or the Water Grid Manager cannot be expected to form the overview that is an essential prerequisite to the making of such an important decision.

Recommendations

2.2 It should be accepted that control over temporary alteration of the full supply level of Wivenhoe, Somerset and North Pine dams is solely the function of the Queensland Government acting through the responsible Minister.

2.3 The regulatory framework by which the responsible Minister can effect a temporary alteration to full supply level should be simplified.

2.4 For the purposes of making any decision about a temporary alteration to full supply level, the Minister should receive advice from:

1. Seqwater, as to the flood mitigation impacts of such an alteration
2. the Water Grid Manager, as to the security of water supply implications of such an alteration
3. the Water Commission, as to both the flood mitigation impacts and the security of water supply implications of such an alteration
4. DERM as to an analysis of the above advice, its own advice as to dam safety, the regulatory framework and any other matter within its expertise.

2.4.7 Proposed temporary reduction of Wivenhoe Dam in 2011/2012

The question that remains is what should be done about Wivenhoe Dam's full supply level in preparation for next summer's wet season.

The Commission's recommendation on this issue must be based on the evidence it has received to date, notwithstanding its limitations and the merits of a fuller scientific assessment of the kind the Commission recommends for the longer term. See *2.5.8 Longer term review of the Wivenhoe manual*.

Seqwater performed modelling for DERM of the effect of reducing the Wivenhoe lake level below full supply level after the January 2011 event. A summary of that modelling was provided to DERM on 7 February 2011.[212]

The modelling considered five options; the most relevant here being the situation where the lake level had been drawn down to 75 per cent of full supply level (64.0 metres) and the Wivenhoe manual been amended so that gate operations would occur when the water level exceeded 75 per cent. The modelling showed that for the January 2011 event, the peak flow out of the dam would have been 4512 m^3/s, a 40 per cent reduction on the actual peak flow of the event (7528 m^3/s). The lake level would have peaked at 74.25 metres, as compared to 74.98 metres, so strategy W4 would still have been triggered. [213]

The modelling also indicated that for the 1999 flood, such a starting point would have reduced peak flow by 32 per cent; for the 1974 flood, such a starting point would have reduced peak flow by 24 per cent.[214] Seqwater concluded that 'large changes' to full supply level would be necessary to achieve 'appreciable reductions in flood magnitude'.[215]

In the absence of further modelling, the Commission acknowledges this is merely an estimate. See *2.9 Effects of dam releases*. However, it was the basis for the advice given by Seqwater to the Minister in February 2011[216] and which the Minister presented as proving that a reduction to 75 per cent would provide 'appreciable flood mitigation benefits'.[217] The Commission recognises the other limitations of this modelling which include the following:

- it is based on the gate openings which the Wivenhoe manual specifies for use if the dam operator loses communication with the flood operations centre; this entails set gate openings depending on lake level only[218] and so does not mirror the gate opening strategies actually employed by the flood engineers in the January 2011 flood event
- it is based on the January 2011 flood event and will not necessarily apply to other flood events; in particular, it will do nothing to mitigate floods caused by rainfall downstream of the dams
- no analysis has been done of the effect of a drawdown to 75 per cent of full supply level on the periods of inundation of bridges in the Brisbane Valley.

The Commission also notes the conclusions of the investigations of the Queensland Water Commission[219] and the Water Grid Manager.[220] These indicated that there was little risk posed in the medium term to water security should Wivenhoe and Somerset dams be temporarily lowered to 75 per cent of full supply level. The basis for this assessment was the very wet weather of the past year and the current state of the south-east Queensland water grid, including the then full Wyaralong Dam. These recommendations were made in the absence of an assessment of the true economic and environmental costs of, for example, using the Tugun desalination plant at a greater capacity. The Commission is aware, too, that Wyaralong Dam is not currently connected to the water grid.[221]

On the basis of the available evidence, and because the Commission considers a precautionary approach is best adopted for the short term, given the potential for harm by flooding, the Commission recommends a temporary reduction in the full supply level of Wivenhoe Dam, to 75 per cent of full supply for the 2011/2012 wet season, with a concomitant adjustment to the trigger levels for the strategies in the Wivenhoe manual.

However, the Commission is of the view that this recommendation should only be taken up if the Bureau of Meteorology makes a similar seasonal forecast to that made for the 2010/2011 wet season, expressed with equal or greater confidence, for the 2011/2012 wet season.

Recommendation

2.5 If the Bureau of Meteorology makes a similar seasonal forecast to that made for the 2010/2011 wet season, expressed with equal or greater confidence, for the 2011/2012 wet season, the Queensland Government should temporarily reduce the full supply level of Wivenhoe Dam to 75 per cent, with a concomitant adjustment to the trigger levels for the strategies in the Wivenhoe manual.

2.5 Manual of operational procedures for flood mitigation at Wivenhoe Dam and Somerset Dam

The drought brought home the value of water; the flood showed its capacity for destruction. These events demonstrated that Wivenhoe Dam is at once the most valuable and dangerous piece of public infrastructure in Queensland. The regulation and control of any such item is a matter of importance to the whole community.

The need for such regulation is acute during floods. At such times there will be, in the case of gated dams such as Wivenhoe and Somerset, the capacity for human intervention which can affect, and at times largely dictate, the amount of water which will flow into the Brisbane River.

The quantity of water released, and the rate at which such releases occur are matters that may affect many parties in many different ways. When such interests compete, it is elementary good sense that the considerations which guide the exercise of relevant discretions should be codified and published. To this end, a document such as the *Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam* can assist in removing 'any political influence from decisions to retain or release floodwaters'.[222]

These considerations confirm that there should be a manual and there is a public interest which attaches to its effectiveness. It is against this background that particular aspects of the document itself must be assessed.

Although the Wivenhoe manual governs the operation of Somerset Dam as well, for practical reasons the focus of the analysis which follows will be on the provisions which relate to Wivenhoe. There is also a manual for North Pine Dam: the *Manual of Operational Procedures for Flood Mitigation at North Pine Dam.*[223] While similar in form, the operational strategies which pertain to North Pine Dam are very different and much simpler (see *2.10.1 Managing flood events*). The Commission's recommendations which apply to the North Pine manual are dealt with at *2.10.5 Interim review of the North Pine manual* and *2.10.6 Longer term review of the North Pine manual*, below.

2.5.1 Structure of the Wivenhoe manual

The Wivenhoe manual itself is exhibit 21, but attention can be drawn to some of its more noteworthy provisions.

Title and introduction

The Wivenhoe manual's title, *Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam,* is misleading in more than one way. It is not concerned with dam operating procedures which might generally have the effect of mitigating floods (such as pre-emptive water release) but only with those operational procedures which take place during a flood event. And it is not confined to operational procedures; it contains parts on the preparation for and the review of flood events.[224]

The Commission has identified deficiencies in Seqwater's preparation for flood events – see *2.3.4 Seqwater's flood preparedness activities*. Given the importance of preparation, it should be the subject of explicit requirements. It would seem appropriate, therefore, for such topics to be excised from the Wivenhoe manual and contained in a separate document which could be given force of law by statute or regulation. The provisions relating to review of flood events could be extracted into the same document.

This possibility might be dealt with in a longer term review of the Wivenhoe manual – see *2.5.8 Longer term review of the Wivenhoe manual*.

In its introduction, the Wivenhoe manual acknowledges its own legal status.[225] That is, it is a document which has been prepared in accordance with the Water Supply Act, and which is relevant to the protection from liability provided by section 374 of that Act.

Its use, for the operation of the dams during flood events, is mandatory according to its own terms,[226] but not as a result of any legislative provision.

The Wivenhoe manual remains in force for a 'period of approval'[227] as determined by the Director-General of DERM. The Director-General delegated his power to approve flood mitigation manuals under the Water Supply Act to the Dam Safety Regulator,[228] a position held at all times relevant to this report by Mr Allen. Seqwater is required to review, and if necessary update, the Wivenhoe manual before its approval expires.[229] The currently applicable revision of the Wivenhoe manual was approved by Mr Allen on 22 December 2009.[230]

Direction of operations

Part 2 of the Wivenhoe manual is concerned with the actual operation of the dams during flood events. Seqwater must ensure that sufficient numbers of suitably qualified personnel are available to operate both the dams and a 'flood operations centre' if a flood event occurs.

For the purposes of that requirement, an individual 'suitably qualified' to be a flood engineer is one who holds, along with appropriate engineering qualifications, a certificate of registration as a registered professional engineer of Queensland.

Seqwater must ensure that operational personnel receive 'adequate training' in the various activities involved in flood control operation. The requirements, in this regard, are to be set by the Director-General of DERM.[231]

One suitably qualified individual, a 'duty flood operations engineer' is to be on call at all times. This person must constantly review weather forecasts and catchment rainfall. If, on the strength of the prevailing or predicted weather conditions, it is expected that the full supply level of either Wivenhoe or Somerset dams will be exceeded, then a flood event must be declared.[232] Following the declaration of a flood event, the dams must be operated in accordance with the manual.

Flood mitigation objectives

The Wivenhoe manual identifies a collection of 'flood mitigation objectives' in part 3. In descending order of importance they are to:

- ensure the structural safety of the dams
- provide optimum protection of urbanised areas from inundation
- minimise disruption to rural life in the valleys of the Brisbane and Stanley rivers
- retain the storage at Full Supply Level at the conclusion of the flood event
- minimise impacts to riparian flora and fauna during the drain down phase of the flood event.

One of these stands apart from the rest: the retention of storage at full supply level is not really something which sits comfortably with description as a flood mitigation objective.

In the course of elaborating on these objectives, the Wivenhoe manual notes that both dams are susceptible to destruction in the event that they are 'overtopped'. It notes also that historical records show that there is a significant probability of two or more flood producing storms occurring in the Brisbane River system within a short time of each other.

Flood classification

Four magnitudes of flooding are classified in part 4 of the Wivenhoe manual: minor, moderate, major and extreme.

Flood monitoring and forecasting system

Part 5 of the Wivenhoe manual describes the real time flood monitoring and forecasting system, which allows for the collection of rainfall and stream flow information. This information is transmitted to the flood operations centre and processed using a real time flood model, which estimates likely dam inflows 'based on forecast and potential

rainfall in the dam catchments'. Seqwater is responsible for improving the operation of the real time flood model over time by, among other things, updating software in line with modern day standards.

Communications

Part 6 of the Wivenhoe manual recognises the interests of different agencies who are dependent upon information from the flood operations centre during times of flood. Specifically, the manual identifies the Bureau of Meteorology, DERM, Somerset Regional Council, Ipswich City Council, and Brisbane City Council as agencies with whom Seqwater must liaise and consult.

The Wivenhoe manual also declares that Seqwater is responsible for the issue of information regarding current and proposed releases from the dams to the media and the public.[233] However, this does not reflect Seqwater's communication practice during the January 2011 flood event. See *2.6.10 Communications*.

Review

Part 7 of the Wivenhoe manual is titled 'Review'. The manual acknowledges that its relevance may change with changing circumstances, and that changes of personnel involved in the management of flood events may result in a diminished understanding of the basic principles upon which the operational procedures are based.[234] To that end, it requires Seqwater to report to the chief executive as to the status of the training of personnel and overall preparedness in the event of flood.

It also requires that, within six weeks of any flood event which requires mobilisation of the flood operations centre, a report be made to the chief executive on the effectiveness of the operational procedures contained in the Wivenhoe manual.

Wivenhoe Dam flood operations

Part 8 of the Wivenhoe manual deals with the operation of Wivenhoe Dam during a flood event.

There are two distinct aspects to the operation of the dam during a flood event. The first is the selection of strategy. The second is the decision as to the amount of water that is to be released from the dams. The second decision will be circumscribed by the first, since three of the four strategies conceived by the Wivenhoe manual set an upper limit for the amount of water which may be released while that strategy is in place. In the fourth, strategy W4, there is no upper limit to the quantum of release.

While the choice of strategy is to be made by the senior flood engineer on duty at any given time, the manner in which the choice is to be made is codified by the Wivenhoe manual.[235] This aspect of the document, and in particular part 8.4, is considered in more detail below.

Following the text in part 8.4 of the Wivenhoe manual there is a series of tables which specify the considerations which will inform the choice of strategy, and the conditions which will apply for so long as each strategy is maintained.

Part 8.5 deals with the factors to be considered when the flood engineers are closing the gates after the peak of the flood has passed. Among them is the requirement that the dams be drawn down to full supply level within seven days after the flood peak has passed through the dams.

Somerset Dam flood operations

Part 9 is concerned with the operation of Somerset Dam and deals with the manner in which it is necessary for both dams to be operated together. As described in *2.2.8 Wivenhoe Dam*, the manual contains a target operating line which sets the optimum lake levels of the dams relative to each other.

Emergency flood operations

Part 10 of the Wivenhoe manual sets out specific provisions for emergency flood operations. It is emphasised that, whatever the circumstances, every endeavour must be made by the progressive opening of operative spillway gates to prevent overtopping of Wivenhoe Dam.

Appendices

There are 11 appendices that address a range of technical and logistic issues. It is worth noting the contents of appendix A. This appendix identifies the agencies, and the responsible people within them, who will hold a controlled copy of the Wivenhoe manual. These include the duty officer from the Department of Emergency Services, the local disaster response co-ordinator from the Somerset Regional Council, Ipswich City Council and Brisbane City Council, and the regional director of Emergency Management Queensland.[236] There is no requirement that any such individual be an appropriately qualified engineer.

2.5.2 Choice of strategy/forecast rainfall

It is fair to say that, during the course of the Inquiry so far, part 8.4 of the Wivenhoe manual has attracted more attention than most other parts of the document. This part of the manual includes the following directions:

The strategy chosen at any point in time *will depend* on the actual levels in the dams and the *following predictions*, which are *to be made using the best forecast rainfall* and stream flow information available at the time:

- Maximum storage levels in Wivenhoe and Somerset Dams
- Peak flow rate at the Lowood Gauge (excluding Wivenhoe Dam releases)
- Peak flow rate at the Moggill Gauge (excluding Wivenhoe Dam releases).

Strategies are likely to change during a flood event as forecasts change and rain is received in the catchments. It is not possible to predict the range of strategies that will be used during the course of a flood event at the commencement of the event. Strategies are changed in response to changing rainfall forecasts and stream flow conditions to maximise the flood mitigation benefits of the dams. [Emphasis added.]

Prior to the January 2011 flood event, few people had occasion to interpret the words of the Wivenhoe manual. Whatever those people understood by the words of part 8.4, and whatever was intended by their author, the Commission considers that their meaning is plain. As written, the Wivenhoe manual requires predictions as to lake level to be made using both forecast rainfall and stream flow information. The Wivenhoe manual does not prioritise one over the other, but does require that both be used.

The choice of strategy depends upon those predictions, the actual levels in the dams and predictions as to flow rates at Lowood and Moggill excluding Wivenhoe releases. No one of these has a decisive effect, but the choice of strategy, however made, will depend upon some assessment of all of them.

2.5.3 Use of forecasts – January 2011

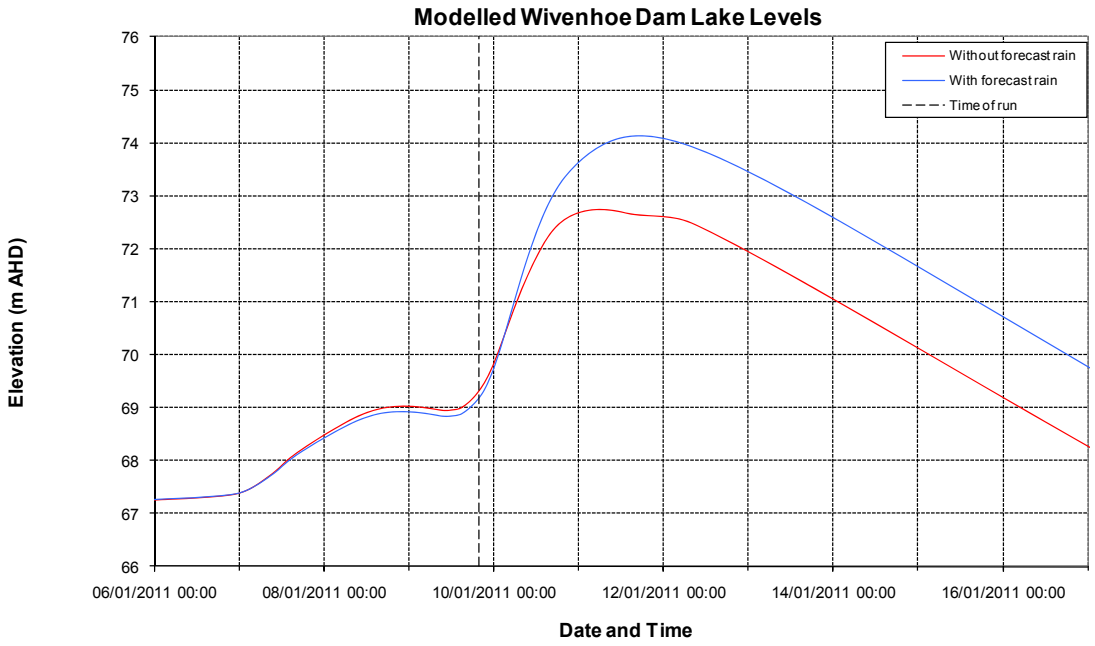
The oral evidence on this issue was variable and at times confusing.[237] In part this may have been as a result of failure, in either question, answer or both, to discriminate between the role of forecast rainfall in the choice of strategy, as opposed to its role in the determination of the releases to be made or for some other purpose.

In any case, so far as the question of the way the flood engineers predicted the lake level in January 2011 is concerned, their evidence admits of only one conclusion. Forecast rainfall was not used for this purpose.

The real time flood model made predictions as to lake level.[238] Mr Ayre, the senior flood engineer,[239] advised the Commission that peak lake level and maximum storage level are interchangeable terms.[240]

The real time flood model provides two predictions of lake level (see *2.6 Decision-making and conditions at the flood operations centre*). They are: a 'with forecast' prediction, which is tracked in a blue line, and a 'without forecast' prediction, which is depicted on the printout in a red line. At 8.00 pm on 9 January, for the first time, the model's 'with forecast' prediction suggested that the level of the lake would exceed 74.0 metres, the tipping point for the purposes of strategy W4. A graphical depiction of the 8.00 pm with and 'without forecast' model results appears below.

Figure 2(a)



Source: Exhibit 22, Model runs.

There were a further 15 model runs between 8.00 pm on Sunday 9 January and 8.00 pm on Tuesday 11 January. In all of those the 'with forecast' model indicated a dam level above 74 metres. There is no record of a suggestion, based on any or all of those models, that a transition to strategy W4 should be made. It was only after runs 34 to 37 inclusive, in all of which the 'without forecast rain' model indicated a peak dam level at or above 74.0 metres, that the decision was made. Terrence Malone, one of the flood operations engineers, did communicate with the Bureau of Meteorology in order to confirm that the rain falling in the dam catchment was likely to continue. It is said that this information was relied upon when the decision was made to transition to strategy W4.[241] However, the inference that forecast rain was, during at least the period between 8.00 pm on 9 January and 3.00 am on 11 January not used by the flood engineers for the purposes of making their lake level prediction – on which their strategy choice would depend – is irresistible.

Indeed, nothing in the submissions received on behalf of Seqwater really contends to the contrary. It is accepted that the flood engineers:

> did not decide to make additional releases, or to transition from one strategy to the next, on the faith of the blue line in the model results. For this purpose, the blue line was accorded zero weight.[242]

The 'red line' was used as the basis of the flood engineers' prediction of the lake level, and was in effect the factor which was decisive in making the decision to transition to strategy W4.[243]

2.5.4 Interpretation and compliance

It has been argued that the approach described above was in fact a faithful application of the Wivenhoe manual as written. The argument rests upon the proposition that as 'skilled addressees' the four flood engineers would have known, however the Wivenhoe manual might be read by anyone else, that they were in fact at liberty to ignore – or give 'zero weight to'– forecast rainfall for the purposes of making predictions as to the level of the lake. As well, Seqwater rejects any suggestion that the tension between the approach adopted and the plain terms of part 8.4 might be a cause to either modify the use of forecast rainfall, or even amend the Wivenhoe manual to make its status clear. Its position is encapsulated in the assertion that 'if the manual is perceived by others to be ambiguous, the fact is of little moment'.[244]

This submission must be rejected. The fact that the current flood engineers may agree on what to others carries a different meaning, will be useless in the event of accident or illness which incapacitates one or more of them. In that

case it may be necessary for others to be appointed as flood engineers at short notice. Indeed the Commission notes that one of the flood engineers who managed the January 2011 event is currently unregistered (see *2.5.6 Registration of flood engineers*) and another is no longer available, with the ending, on 1 July 2011, of the arrangement for SunWater to provide flood management services to Seqwater. At the time of writing, there are just two flood engineers who are both available for flood operations and familiar with the Wivenhoe manual.

It cannot be accepted that the flood engineers will be the only people ever to interpret a document such as the Wivenhoe manual, especially when the document itself acknowledges[245] that the identities of these individuals will change. And the Wivenhoe manual itself contemplates that its readership might extend beyond the flood engineers. That much is obvious when regard is had to the identities of the individuals referred to in Appendix A of the Wivenhoe manual. Moreover, the status conferred upon the manual by section 374 of the Water Supply Act contemplates that its readership may be considerably wider.[246] If only for the last reason, the Wivenhoe manual ought to be intelligible to all who might have an interest in the consequences of its application. Of course it must also function as an operational document that is meaningful to qualified engineers. Properly written, it could and should do both.

It can, therefore, be said that in relation to the requirement that the flood engineers' prediction as to lake level be made using the best available forecast rainfall information, and that the subsequent choice of strategy should depend upon that prediction, there was a failure to comply with the Wivenhoe manual.

That finding, however, must be qualified by the following observations:

- the flood engineers were acting in the honest belief that the Wivenhoe manual did not, and ought not, compel choice of strategy to be made by reference to forecast rainfall
- on the evidence, it is not possible to articulate a method by which it would be possible to predict lake level with any precision or confidently change strategies on the basis of rainfall forecasts. The existing science suggests that such forecasts lack the reliability which would be necessary before they could be incorporated into such a process.

The finding does not therefore necessarily reflect upon the flood engineers operating the dams, nor can any particular consequence flowing from the breach be identified.

However, and at the very least, the need for review of the Wivenhoe manual is underscored by the fact that, as written, it does not reflect the practice unanimously endorsed and adopted by the flood engineers. For a discussion of the interim and longer term review of the Wivenhoe manual, see *2.5.7 Interim review of the Wivenhoe manual* and *2.5.8 Longer term review of the Wivenhoe manual*.

2.5.5 Training

Part 2.7 of the Wivenhoe manual requires that Seqwater ensure operational personnel receive adequate training as required by the chief executive. There is no evidence that the chief executive has ever required anything of Seqwater as to the training to be provided. Training was usually provided by SunWater under its agreement to provide flood management services to Seqwater. See *2.3.1 Arrangements for flood operations*.

Mr Ayre gave evidence that no training exercise in which strategy W4 was invoked had ever been provided.[247] This approach to the topic of training by DERM and Seqwater is flawed. The Wivenhoe manual pre-supposes that training would be beneficial and elementary good sense would in any case suggest as much. Mr Ayre said that incorporating a training exercise into the program which includes triggering W4 would be useful.[248]

Whether the performance of the flood operations centre might have been improved had the flood engineers had the benefit of relevant training will never be known. In order to ensure any such speculation does not attend future events, training across the full range of operating strategies should be undertaken. Consideration should be given to the involvement of independent experts in such training.

Recommendations

2.6 The requirements of the chief executive of DERM as to training of operational personnel should be provided to Seqwater on a regular and formal basis.

2.7 Seqwater should ensure all staff and engineers who may be involved in flood operations are involved in formal training exercises which address the full range of possible operating situations.

2.5.6 Registration of flood engineers

As outlined above in part 2.5.1, the Wivenhoe manual requires Seqwater to nominate one or more 'suitably qualified and experienced persons' to be flood engineers.[249] If approved by the chief executive, the nominated person can appear on a Schedule of Authorities.[250] The qualifications and experience required are set out in part 2.5 of the Wivenhoe manual; the flood engineers must all hold a certificate of registration as a registered professional engineer of Queensland, an appropriate engineering qualification, have knowledge of design principles of large dams and possess relevant science and engineering expertise.[251]

It was discovered after the flood event that one of the flood engineers was not registered with the Board of Professional Engineers Queensland throughout the 2010/2011 wet season. The circumstances in which that flood engineer's registration lapsed were of a personal nature and were perhaps understandable.[252] That lack of registration is a breach of part 2.5 of the Wivenhoe manual. There is no suggestion that the lack of registration had any effect on the operation of the dams; the breach is technical. However, it assumes relevance in the context of Seqwater's failure to check its compliance with the Wivenhoe manual in advance of the wet season. See also *2.3.4 Seqwater's flood preparedness activities*.

2.5.7 Interim review of the Wivenhoe manual

The Commission finds that an interim review of the Wivenhoe manual is required, aimed at resolving uncertainty about the manual's meaning and effect.

It should not be difficult to ensure consistency in the use of language throughout the Wivenhoe manual. This might be achieved by the engagement of a technical writer to assist with re-writing, organising material and reviewing the document for consistency and intelligibility.

Draft changes to the Wivenhoe manual settled upon by Seqwater should be forwarded to independent expert peer reviewers. Following Seqwater's consideration of the expert reviews and the incorporation of any recommended amendments, the draft revision of the Wivenhoe manual should be submitted for approval to DERM before 1 October 2011.

No accompanying changes in strategies are recommended prior to a full review of the Wivenhoe manual.

Recommendations

2.8 Seqwater should:

1. conduct an interim review of the Wivenhoe manual
2. have the draft manual assessed by independent expert peer reviewers
3. consider the expert peer reviews
4. submit the draft manual to DERM for approval under the Act so that it can be approved before 1 October 2011.

2.9 The following matters require particular attention during the interim review of the Wivenhoe manual:

- definition of what 'best forecast rainfall' means
- prescription about how forecast rainfall information is to be used by the flood engineers
- definition of 'predicted lake level' and the use of consistent language throughout the Wivenhoe manual about predicted lake levels
- clarification of options for transition to strategies W2 or W3 from strategy W1
- clarification of the rules for drawdowns of the dams following flood events
- removal of the term 'non-damaging flows' (and similar terms) to describe flows below 4000 m^3/s at Moggill
- clarification of whether W3 allows the flood engineers to release water which would create a flow at Moggill of over 4000 m^3/s
- precise definition of the maximum mechanical capability of the gate opening mechanism
- clarification of how part 8.6 should be followed in strategy W4, including clarifying the use of the word 'generally'.

2.5.8 Longer term review of the Wivenhoe manual

The Commission finds that a fundamental review of the Wivenhoe manual is required in the longer term. It is acknowledged that a review of this type may take many months or even years to finalise. It is also the case that such a review may be expensive. However, the Commission is of the view that both time and money are well spent on this project. The intent of recommending a complete review of the Wivenhoe manual is to ensure that the final document enables the optimal use of the flood mitigation capabilities of Wivenhoe and Somerset dams. In light of the risks associated with flood releases from these dams, particularly during large floods, the community should be left in no doubt that the Wivenhoe manual reflects current best practice in hydrology, meteorology and dam management.

The Commission acknowledges that there will be costs and benefits associated with any set of draft strategies identified during the review of the Wivenhoe manual. For example, it might be determined during the review that in certain types of floods, a draft set of strategies for operating the dams minimises flood damage in parts of Brisbane at the cost of severe flooding and resultant damage to the Fernvale area. It is for the Queensland Government, based on advice as to the results of the review of the Wivenhoe manual and studies into water security and the impact on the floodplain, to endorse a set of strategies which best satisfies the needs of the community. Any decision by government should follow extensive consultation with councils and the community.

The Wivenhoe manual should not be substantially re-written until such a preferred set of strategies is decided upon by the Queensland Government. The Commission's focus therefore is on the task of identifying technical work which must be undertaken before options as to strategies can be presented to government.

The recommendations below are for a review of the hydrology used for the Wivenhoe manual and other technical work which the Commission finds should be done before any preferred strategies for the operation of the dams can be settled on or substantial re-writing of the Wivenhoe manual commences. The proposals are based upon the evidence of the expert hydrologist engaged by the Commission, Mr Babister, together with the evidence of other expert witnesses, including Dr Rory Nathan, Emeritus Professor Colin Apelt, Mr Allen and the four flood

engineers. A draft list of proposed work was sent to Mr Babister, all of the expert witnesses engaged by Seqwater and DERM, expert witnesses identified by Brisbane City Council and Ipswich City Council, Mr Allen, Ronald Guppy of DERM, Peter Baddiley of the Bureau, Barton Maher of Seqwater and the four flood engineers. Comments, where received, were taken into account in formulating the proposals below. This list of work, although extensive, should not be seen as complete. Inevitably, further requirements will be identified as the review progresses.

The first stage of the review will entail scientific investigations. The second stage will involve modelling. The specific recommendations relating to each of those two stages follows. Recommendations as to further stages of review will be dealt with in the Commission's final report.

This review should be supervised by a steering committee which includes senior representatives from DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council, Ipswich City Council and Somerset Regional Council. Each of these agencies has particular expertise in flood mitigation and managing floods in south east Queensland.

The role of the steering committee in undertaking the technical phase of the review is to:

1. select and supervise a project manager
2. support the project manager in making arrangements for the completion of the technical work, discussed below
3. select and oversee the expert review panel, described below
4. provide the government with reports as to the progress of the review
5. have the expert review panel assess the completed technical work
6. report to government as to a range of potential strategies for the operation of the dams.

The Bureau has indicated that it does not wish to be involved in the steering committee. The Commission notes the Bureau's expertise in meteorology and hydrology. It would be desirable if the Bureau participated in the review.

SunWater likewise does not wish to be involved in the steering committee. The Commission understands that SunWater's reluctance to be involved in the steering committee is based on the fact that it is no longer providing any flood management services in connection with Wivenhoe and Somerset dams. The Commission notes that SunWater is a highly skilled dam operator and considers that it would be useful if SunWater were involved in the review.

A small panel of independent experts should examine technical work undertaken during the review. These experts should possess professional qualifications and experience relevant to the review and be recognised leaders in their fields. The panel should at least include members with backgrounds in hydrology, meteorology and dam operations. In order to maintain public confidence in the independence of the review of technical work, members of this panel should not have been previously involved in studies or work used as a basis of previous versions of the Wivenhoe manual or in writing it. It may be necessary to engage interstate, or even overseas, experts so as to ensure that an independent examination of the highest calibre is made of the technical work produced during the review.

Recommendations

2.10 Seqwater should act immediately to establish:

1. a steering committee to oversee the long term review of the Wivenhoe manual including senior representatives of at least DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council, Ipswich City Council and Somerset Regional Council
2. a technical review committee comprised of independent experts in at least hydrology, meteorology and dam operations to examine all technical work completed as part of the review.

2.11 The steering committee should ensure the scientific investigations and modelling outlined in recommendation 2.12 and 2.13 are completed. It should also assess the need for any other work to be done, and instigate any other investigations or work considered necessary for a full and proper review of the Wivenhoe manual.

2.12 The following scientific investigations should be carried out prior to modelling work under the supervision of the steering committee and reviewed by the technical review committee:

1. review of the design hydrology:
   a. using a stochastic or Monte Carlo or probabilistic approach
   b. taking into account observed variability in temporal and spatial patterns of rainfall
   c. taking into account observed variability in relative timings of inflows from the dams and downstream tributaries.
2. production of a digital terrain model incorporating a bathymetric survey of all critical sections of creeks and rivers upstream and downstream of the dam relevant to flood modelling
3. assessment of the reliability of the 24 hour, the three day and the five day rainfall forecasts
4. consideration of whether and how weather radar can be incorporated into decision making
5. requesting information from the Bureau of Meteorology as to its willingness to provide ensemble forecasts
6. consideration as to whether and how ensemble forecasts can be incorporated into decision making.

2.13 The following modelling work should be carried out under the supervision of the steering committee and reviewed by the technical review committee:

1. modelling across the range of full supply levels, operating strategies and flood events (historical, design and synthetic) in each case assessing the consequences in terms of risk to life and safety and economic, social and environmental damage. In terms of operating strategies, using a full range of strategies including:
   a. a stepped change from W3 to W4
   b. moving to a higher rate of release earlier in W1
   c. bypassing W1
   d. altering maximum release rates under W3
   e. operating the gates in conjunction with the initiation of any of the fuse plugs in order to achieve a lower rate of discharge
2. simulations to test the robustness of relying on the 24 hour, the three day and the five day rainfall forecasts
3. development of a probability distribution for the time between closely spaced flood peaks in the catchment using historical records.

2.6 Decision-making and conditions at the flood operations centre

Until 1 July 2011, SunWater had responsibility under a contract with Seqwater for establishing a flood operations centre and ensuring it had appropriate facilities to manage Wivenhoe, Somerset and North Pine dams during floods.[253] The flood operations centre at the time of the flood event was located at SunWater's premises in Turbot Street, Brisbane; the operations at Wivenhoe, Somerset and North Pine dams were directed from those premises.

The centre was led by four flood engineers, highly experienced in all aspects of flood operations including flood forecasting and modelling, hydrology, meteorology and dam operations. They were assisted by nine flood officers (technical assistants) working on roster, whose duties included reviewing rainfall and stream flow data and making entries in the flood event log. No-one may perform the role of engineer unless he or she holds current registration as a professional engineer and has been approved by the chief executive of DERM.[254]

During the 2010/2011 wet season, there were four flood engineers approved by the chief executive under the Wivenhoe and North Pine manuals: Robert Ayre from SunWater, John Ruffini from DERM and Terrence Malone and John Tibaldi from Seqwater. Each flood engineer was on call three out of every four weeks throughout the year. One engineer was always on 'close call', which required that he be available to receive communications from Seqwater and the Bureau of Meteorology and be able to attend the flood operations centre to mobilise it for flood operations within two hours.[255] When a flood event is declared, the engineers leave their usual employment, and work in the flood operations centre in shifts.

These four men have been acting in this high-pressure role, some for many years, without any additional payment and with little recognition. Nothing in the evidence heard or the material received by the Commission suggested anything other than that they are diligent and competent and acted in good faith throughout the flood event.

2.6.1 Weather forecasts

In January 2011, the flood engineers had Bureau of Meteorology information available to them; in particular, they could see the state of the weather radar on the Bureau's web site and they received 24 hour quantitative precipitation forecasts for the dams' catchment. Radar provides an effective tool for the detection of rain, but the Bureau cautions that in some circumstances it can produce poor estimates, overestimating or under estimating rainfall rates by factors of two or more. [256]

Seqwater observed in its flood event report on the operation of Somerset Dam and Wivenhoe Dam[257] that the quantitative precipitation forecasts corresponded reasonably well (with some slight overestimating) with the actual average rainfall recorded in its gauges in the dams' catchment up until 4.00 pm, 8 January 2011. In contrast, in the period between 4.00 pm, 8 January and 10.00 am, 11 January, the 24 hour forecasts regularly underestimated the average rainfall which was subsequently recorded as falling in the dams' catchment: the average recorded falls were generally two to three times what was predicted. At 10.00 am, Tuesday 11 January, that situation reversed: the morning forecast was of 100 millimetres to be received on average in the dams' catchment over the ensuing 24 hours, as compared with an average of 51 millimetres actually recorded; and in the afternoon 75 millimetres forecast as compared with an average of 12 millimetres recorded.[258]

However, this qualification should be made in relation to the recorded falls: as identified in the Seqwater report, there is a lack of rain gauges in the catchment immediately above the Wivenhoe Dam. This meant that rainfall in that area (likely to result in rapid lake rises) was not recorded.[259] In addition, Dr Nathan, a hydrological expert engaged by Seqwater, points to there being fewer gauges at high elevations of the Wivenhoe and Somerset catchment than at the lower elevations. This may have meant that some rainfall in that area was not recorded.[260] Generally, and not unusually, the flood engineers had to contend with gaps in the information available from rainfall gauges in the catchment, which diminished the value of the rainfall data able to be captured by the ALERT gauge network. For a description of ALERT gauges, see *4.1.1 Warning mechanisms*.

In 2001, one of the flood engineers, Mr Ayre, prepared a report for Seqwater, titled *Feasibility of Making Pre-releases from SEQWC Reservoirs* which concluded that the quantitative precipitation forecasts were not sufficiently reliable to form the basis of operational decision making for the dam. Mr Baddiley of the Bureau of Meteorology gave the flood engineers advice to the same effect in 2006,[261] reiterating it in 2010. [262]

This topic should be the subject of ongoing review. See also *2.5.8 Longer term review of the Wivenhoe manual* that an assessment of the reliability of forecasts for the dams' catchment form part of the longer term review of the Wivenhoe manual.

2.6.2 Rainfall gauges

Rainfall gauges are inherently limited by their size and location: they can only measure rainfall that falls directly above them. As rain can fall intensely over a small area as well as lightly over a larger area – and everything in between – there is no guarantee a gauge will give an accurate representation of the rainfall in the area around it. That limitation has implications for the reliability of rainfall forecasts and the ability to test the accuracy of models using rainfall as the primary input; for example, the hydrologic models that form part of the real time flood model.

While some witnesses before the Commission contended that more gauges were needed in certain areas (for example, the part of the Wivenhoe catchment immediately surrounding the lake and high elevations of the Wivenhoe catchment and the upper reaches of the Lockyer catchment), cost will be a factor in how many should be installed. There should be an appraisal, which must involve the Bureau of Meteorology, as to the locations in which gauges are most needed in order to improve the accurate predictions of floods. See also *4.1.1 Warning mechanisms*.

Recommendation

2.14 The Commission recommends that a review be conducted of the number and distribution of ALERT gauges within the Wivenhoe and Somerset catchments. This review should include an assessment of the usefulness and cost effectiveness of installing more gauges, particularly at high elevations in the catchment. Such an assessment would appropriately involve the Bureau of Meteorology, DERM and Seqwater, and the relevant local councils.

2.6.3 Stream gauges

There are a number of gauges on the Brisbane River between Wivenhoe Dam and the Port Office gauge. All of these gauges are river height gauges and do not directly measure flow. In fact, there is no evidence before the Commission that a gauge which directly measures flow in a natural watercourse is available.

Flow can be determined from river height by the use of a rating curve, developed over time by physically measuring the flow (using, in recent times, Doppler sonar) at varying heights. Rating curves have some inherent limitations. Large river heights and flows only occur during floods and so are quite rare; the flow at the larger heights may never have been measured. Measurement of flow at key gauges during flood events enables improvement of the rating curve, but for obvious reasons, the measurement process, often undertaken by boat, can be dangerous. (Near the peak of the 6 to 19 January 2011 flood event, DERM measured the flow at Jindalee to improve its rating curve.[263]) The rating curve is extrapolated mathematically to heights greater than have actually been observed.

For the reasons identified, there is always some uncertainty in stream flow estimates.[264] Another problem is that waterways often have a different rating for rising waters and falling waters because the flow is not uniform. The rating curve represents some middle point; an approximation for both rising and falling waters. A third obstacle to accuracy arises when a stream breaks its banks as the flow height increases, so that some of the flow occurs out of the steam channel (that is, in the floodplain). In those circumstances, the height in the stream may be a less reliable indicator of the flow. Despite those limitations, the use of a rating curve is the standard practice for estimating flows from river height.[265]

2.6.4 The real time flood model

The flood engineers used the real time flood monitoring system for flood monitoring and forecasting.[266] It consists of a data capture module (FLOOD – Col), a data analysis module (FLOOD – Ops) and the gate operations spreadsheet. The information in the FLOOD – Col database is obtained through rainfall and water level gauges (of which there are 129 in the Brisbane River basin), the data being transmitted in real time by radio telemetry to the flood operations centre computers. The rainfall and the water level gauges, the radio network and the data collection software combine to form an automated local evaluation in real time system (the ALERT system).

The FLOOD – Ops software uses data from the FLOOD – Col database to calculate areal rainfall and produce hydrographs of runoff. It contains a suite of individual hydrologic models to determine runoff in the catchments of Somerset and Wivenhoe dams, the Lockyer Creek, the Bremer River and the Pine River.[267]

The third component of the real time flood model is the gate operations spreadsheet. This allows the flood engineers to input a specific gate operations strategy and assess the consequences of that strategy for lake level and flows downstream. The model results provided in Seqwater's flood event report are a graphical depiction of the effects of one gate opening scenario.[268] Those graphs are the result of the one strategy saved into the spreadsheet and kept as a record, but are not necessarily the strategy actually implemented or even intended to be implemented at that time.[269]

In oral evidence and each of their statements, the flood engineers did not volunteer that there had been more than one strategy input into the spreadsheet. In a report provided after the draft findings were issued,[270] Seqwater explained that the flood engineers continuously amended the strategy in the spreadsheet throughout the event.

For comments on the completeness of this record-keeping, see *2.6.9 Records of decision-making*.

2.6.5 'With forecast' and 'without forecast' model runs

The runs of the model that predicts the lake level at Wivenhoe received significant attention during the public hearings of the Commission. This is a hydrologic model that converts rain falling in the dam catchments into inflows into the dam and subsequent changes in lake level.

There are two situations modelled at each time: the 'without forecast' model which excludes forecast rainfall and the 'with forecast' model which includes forecast rainfall.[271]

The 'without forecast' model assumes that no further rain will fall and only models the effect on lake level of the rain already on the ground.[272]

The 'with forecast' model includes both the rain already on the ground and the most recent quantitative precipitation forecast issued by the Bureau.[273]

The full quantitative precipitation forecast was included in each model run regardless of the time of the model run. This meant that sometimes the forecast included in such a model run would represent a figure larger than the actual forecast because some part of the forecast rain had already fallen as rain on the ground before the time of the model run.[274]

In practice, this variable approach had no consequence, because the flood engineers did not give the 'with forecast' model any weight (see *2.5.3 Use of forecasts – January 2011*).[275] If the 'with forecast' model is to be used, there should be further investigation as to the most appropriate way in which to input rainfall forecast into models run substantially after the forecast's time of issue.

2.6.6 Estimating flows from the Lockyer and Bremer

The real time flood model estimates the flows coming out of the Lockyer Creek and the Bremer River using a suite of hydrologic models. A hydrologic, or runoff routing model, uses rainfall data and estimates of the proportion of the rainfall which turns into runoff (that is, which does not soak in) and the time which the runoff from each part of the catchment takes to flow into the stream. These inputs are used to estimate the flow in the stream. The Bureau uses the same type of model to estimate flow.

The rainfall gauge and rating curve limitations discussed above limit the accuracy of this estimate. In addition, it is difficult to estimate how much rainfall turns into runoff and makes its way into the stream. That depends on factors such as loss to groundwater and the saturation of the soil, which are not constant.

To check the hydrologic model which estimates lake level, Seqwater continually updates its estimate of these factors by comparing the model results to actual lake level rises.[276]

The flood engineers check these runoff estimates by comparing the hydrologic model results as to flow in the Bremer River and the Lockyer Creek against flow estimates for those waterways gained from using the height measurement from a gauge and the rating for that gauge.[277] Seqwater's flood event report indicated that its runoff routing models for the Lockyer and Bremer catchments matched closely to the Bureau estimates.[278]

It is more difficult to produce a hydrologic model for the Lockyer Creek catchment because it has complex terrain including floodplains.[279]

It is clear that backwater effects, which occur when water is prevented from entering an already flooded channel, were a factor in the flooding in the Ipswich area during January. Mr Ayre gave evidence that Seqwater's hydrologic model does not 'satisfactorily account for backwatering effects'[280] and that the flood engineers did not carry out any modelling to predict flood heights in Ipswich.[281] Mr Babister, the Commission's expert hydrologist, recommended that Seqwater obtain a hydrodynamic model which would properly account for those effects.[282] Mr Ayre agreed that access to such a model would be useful.[283]

2.6.7 Estimating flow at Moggill

Given the significance of the flow at Moggill in the Wivenhoe manual,[284] it is necessary to examine the manner in which that figure is estimated.

There are two ways in which the flood engineers can estimate the flow at Moggill. One is to route the releases from Wivenhoe down the river incorporating flows from downstream tributaries using the runoff routing model in the real time flood model. The other, more approximate approach is to simply add the releases from Wivenhoe to the estimates of flows from the Lockyer Creek and Bremer River. Mr Ayre gave evidence that the flood engineers generally used the latter approach[285] because the former took longer to accomplish.[286]

The flood engineers must also confront the difficulty of estimating flows in the Lockyer and Bremer from rainfall in the order of 16 hours ahead because of the time it takes for water released from Wivenhoe to reach Moggill. For example, they must estimate what rain is going to fall in the Ipswich area hours in advance to determine what flow will be emerging from the Bremer when the current Wivenhoe release reaches Moggill.

Seqwater has judged the Moggill gauge to be the best location to estimate flows in the Brisbane River because it is the first gauge location after the confluence of the Bremer River and the Brisbane River.[287] However, estimations of the flow at Moggill are affected by the geography of the location. It is adjacent to a hairpin bend in the river and is affected by tides.

The flood engineers maintained that the tidal influence at Moggill was subsumed at 2000 m^3/s.[288] This question will be the subject of further review by Mr Babister.

Seqwater calibrates or checks its model results during the flood event from the real time flood model against estimated stream flow figures obtained by using rating tables for the Moggill gauge.[289] Both estimates can be checked against a measurement physically taken by hydrographers.

An examination of the figures shows that there can be variation between the estimated and measured flow. At the height of the flood on 12 January 2011, a joint DERM and Seqwater hydrographic team gauged the flow six times at Jindalee,[290] just downstream of Moggill, and measured the average flow at around 9800 m^3/s. Seqwater's hydrologic model estimated the flow at that time to be 9300 m^3/s.[291]

In broader scientific terms, such variance might be perfectly acceptable. However, given the significance that the flow rate at Moggill assumes for the purposes of the Wivenhoe manual, it would be prudent for the review of the manual to acknowledge the inaccuracy inherent in such estimations.

2.6.8 Working conditions at the flood operations centre

Mr Malone was the engineer on duty when the flood event was declared on 6 January 2011. For the first part of the flood event, the flood engineers worked singly in 12-hour shifts, until 7.00 pm on 9 January 2011, when two engineers worked each shift until the flood peak had passed.[292] The decision to work in pairs meant that their shifts were separated by only 12 hours.[293] From Tuesday 11 January, three of the four engineers were forced to stay in the flood operations centre because they could no longer reach their homes. They slept in a meeting room in the building housing the centre. The engineers not on duty regularly offered assistance to those who were. Some of the technical assistants were also unable to reach their homes; a number had concerns about flooding of their homes and the safety of their family members.[294]

The Commission understands that from 1 July 2011 the flood operations centre will be located at new premises with facilities for food preparation and a rest area, and suitable accommodation nearby should staff have to work more than one shift.[295]

A great deal was demanded of the flood engineers over the period of the flood event; they were working in conditions which were stressful, fatiguing and physically uncomfortable. While there is a good deal to be said for operating with a small, tight team in the management of a flood crisis, the demands placed on the four flood engineers in the January event were excessive. The Commission recommends that Seqwater give urgent attention to the engagement of a fifth flood engineer. There is also the question of succession planning: there is an obvious need for training of their prospective replacements. As one of the flood engineers pointed out, there would be advantages to engaging trainee flood engineers whose responsibilities during a flood event would include modelling, so as to free the flood engineers from that task.[296]

Recommendations

2.15 Seqwater should:

- immediately recruit and train additional flood engineers to ensure at least five flood engineers are available for flood operations
- establish a formal flood event operation training program for junior engineers to ensure the flood operations centre will be staffed by appropriately qualified and experienced personnel in the medium and long term.

2.16 In addition to the on duty flood engineer(s), Seqwater should ensure that the flood operations centre is staffed by a trainee flood engineer on each shift (in addition to the technical assistants) to conduct the modelling.

2.17 Seqwater should ensure that, during major flood events, flood engineers do not have responsibility for, and are not required to, organise food, sleeping arrangements or access to facilities, such as power supply and communications equipment.

2.6.9 Records of decision-making

During flood events, Seqwater's internal flood procedures manual requires that an 'event log', a document recording significant events, be maintained at all operational sites including the flood operations centre.[297] During the January 2011 flood events at Somerset, Wivenhoe and North Pine dams, the technical assistants in the flood operations centre kept a combined event log for all three dams on a computer. In a number of instances, mistakes were later identified by the flood engineers in the recording of details in the flood event log, including, in some instances, the terms of significant conversations.[298] Some telephone conversations were not recorded at all; in others the participants were incorrectly identified. The log did not record all model runs undertaken or the time at which they were undertaken,[299] and no note was made of decisions to change strategy or their basis.[300]

Some of the deficiencies are explicable, although undesirable. The technical assistants recording telephone discussions were often not participants in them.[301] They were not always informed about the flood engineers' actions as they were taken.[302] There was no particular form or process for the recording of information, and the entries were not checked by the flood engineers.[303]

A comprehensive and consistent approach to maintaining the flood log would:

- allow flood engineers coming onto shift to have an accurate understanding of the situation they were entering
- assist in providing consistent information to councils and other agencies
- assist in post-event debriefs and training exercises.

To achieve those goals, the log must also record significant decisions, including transitions between strategies under the Wivenhoe manual and changes in releases at all dams. The decision and reasons for it must be clearly stated in the log.

The flood engineers themselves will have to shoulder some responsibility for checking the flood event log contemporaneously as the ones involved in the conversations. Seqwater may have to change the procedure for handovers between flood engineers to ensure the flood engineers going off shift have sufficient time to complete this task.

It would also be prudent if records (hard copy or electronic) relevant to decisions made using the gate operations spreadsheet were kept, including:

- each version of the gate operations spreadsheet which contains a different input gate operation scenario
- all graphical depictions of model runs produced
- a version of the gate operations spreadsheet which contains the gate operation scenario which will be implemented marked so that it is clear it is the one agreed to be implemented
- a note of key reasons why the particular scenario decided upon is the most appropriate one.

Such records would be useful both for handovers between shifts and for post-event reviews and training exercises.

Recommendations

2.18 An accurate record should be kept of reasons for key decisions, including changes in strategy and releases. Documents relevant to key decisions should also be kept, including:

- each version of the gate operations spreadsheet which contains a different input gate operation scenario
- all graphical depictions of model runs produced
- a version of the gate operations spreadsheet which contains the gate operation scenario which will be implemented marked so that it is clear it is the one agreed to be implemented.

2.19 Seqwater should ensure that all telephone calls within the flood operations centre are digitally recorded to create an accurate record of decision-making during major flood events.

2.20 Seqwater should develop procedures which require the flood engineers to check the entries in the flood operations centre's flood event log at a near contemporaneous time, such as the end of their shift, to ensure accuracy and the recording of significant events. Seqwater should make sure that the operation of the flood operations centre enables the flood engineers to comply with that procedure.

2.6.10 Communications

The flood mitigation manuals and the emergency action plans for Somerset, Wivenhoe and North Pine dams require the flood engineers to provide information during flood events to a number of agencies, including the Bureau of Meteorology, DERM, Somerset Regional Council, Moreton Bay Regional Council, Ipswich City Council and Brisbane City Council.[304]

Following flooding in October 2010, arrangements for communications between these agencies, not including the Moreton Bay Regional Council, were also formalised by the draft *Protocol for the Communication of Flooding Information for the Brisbane River Catchment – including Floodwater Releases from Wivenhoe and Somerset Dams* initiated by the Queensland Government through DERM and Emergency Management Queensland.[305]

For discussion on warnings about dam releases generally, and under these documents, see *4.1.4 Warnings about dam spillway outflow*.

The focus of this part of the report is how the 2010/2011 flood events at Somerset, Wivenhoe and North Pine dams tested the flood operations centre's communication capacity and the areas of improvement which can now be identified. Despite difficulties experienced contacting some agencies, there has been no suggestion that the flood engineers did not do everything possible, with the information and tools they had available to them, to give useful information to the councils and other agencies.

Situation reports and technical situation reports

During the January 2011 flood event, the flood engineers sent situation reports by email between three and four times a day to various agencies, giving information about recorded rainfall, lake level, and rate of release from the dams, as well as information as to projected releases and their likely impact.[306]

The dam operations manager of Seqwater, Robert Drury, also provided edited versions of the situation reports, called 'technical situation reports', to the Water Grid Manager, who in turn sent them on to different agencies such as the Queensland Police Service, DERM and the Department of the Premier and Cabinet.[307]

These arrangements were in accordance with the draft *Protocol for the Communication of Flooding Information for the Brisbane River Catchment*.[308]

There was some overlap between the entities who received the situation reports and the technical situation reports; the local disaster co-ordinator of the Somerset Regional Council recalled that he often received the same information from both the flood engineers and Mr Drury.[309]

Improvements to this process suggested by some of the flood engineers include:

- the use of a pro forma for situation reports and training for recipient agencies to ensure consistent interpretation of the pro forma material[310]
- the production of a single document for all interested parties rather than the production of several different messages for a range of different agencies.[311]

Recommendation

2.21 Seqwater should produce a template situation report in consultation with the flood engineers and recipient agencies. As part of this process, consideration should be given as to whether the quality and timeliness of the dissemination of information about flood operations would be improved if a single document, rather than a situation report and a technical situation report, were used for the purpose of communicating flood operations to all concerned parties. The template situation report should include, at a minimum, dedicated space for the following:

- meteorological observations and situation, including forecasts
- identification of the current operating strategy
- the strategy, aims and objectives of the flood engineers
- actual and expected releases
- any other comments.

Communication with councils

The chief means of communication between the flood operations centre and local councils was the provision of situation reports.

The flood engineers also contacted local governments by telephone during the event, including when strategies were changing, such as after the 3.30 pm engineer conference on 9 January 2011[312] and after Wivenhoe Dam was moved into strategy W4 in the morning of 11 January 2011.[313] The flood event log of communications with the flood operations centre also indicates numerous telephone calls from staff of all four councils requesting information and discussing strategy with the flood engineers.[314]

Difficulty was encountered in contacting some of the councils at critical times; some calls were not answered.[315] Flooding elsewhere prevented some contact, including with the local disaster co-ordinator of Somerset Regional Council from the night of 10 January to the afternoon of 11 January when his area lost power which cut email access and decreased phone reception.[316] That meant the flood engineers could not speak to him directly when attempting to advise of the transition to strategy W4, but had to leave a message.[317]

The local disaster co-ordinator of the Ipswich City Council gave evidence that he found the communications from the flood operations centre very useful in organising the council's response to flooding.[318] The local disaster co-ordinator of Somerset Regional Council indicated that the flood engineers gave more information to him than they agreed to under the draft Protocol, recognising that his council had less hydrological expertise than Brisbane and Ipswich.[319] He indicated he was aware he could contact the flood engineers 24 hours a day and he found them helpful to deal with.[320]

While the evidence about the flood engineers' interactions with councils was positive, there are concerns about the flood engineers themselves carrying the burden of communication, see *2.6.10 Communcations, Need for dedicated communications resources*.

Communication with the Bureau of Meteorology

The flood engineers had regular informal discussion with the Bureau of Meteorology regarding rainfall forecasts,[321] including at key times, such as when considering a transition to strategy W4 at Wivenhoe on the morning of 11 January.[322] Bureau forecasters are available directly to the flood engineers to answer queries.[323] The Bureau lost some of its telephone lines when power was lost in the central business district of Brisbane,[324] but it provided the flood engineers with alternative contact details.[325]

Mr Ayre gave evidence that the lines of communication between the flood operations centre and the Bureau were 'excellent' and 'serve[d] their purpose well'.[326] However, he did consider that there was scope to improve the communications between the flood operations centre and the Bureau. He said that the flood engineers' understanding of the meteorological situation would be improved by formalising the communication between the two entities during flood events.[327] In particular, Mr Ayre suggested the frequency and type of information to be obtained by the flood operations centre from the Bureau should be clarified.[328]

One of the other flood engineers, Mr Tibaldi, who was generally on duty with Mr Malone (a flood engineer who had previously worked at the Bureau), said that of the two of them, generally it was Mr Malone who would call the Bureau because he was familiar with the people there.[329] While such familiarity is useful, it would assist for all flood engineers to have close relationships with Bureau staff to improve the transfer of information between the two entities.

Recommendation

2.22 Seqwater should create a regular forum for discussion between all operational staff of the flood operations centre and Bureau staff to:

- increase the knowledge of flood operations centre staff about the Bureau's products, abilities, advice and operations
- reach agreement as to the frequency and type of information to be shared between the Bureau and the flood operations centre during a flood event
- discuss advances in technology and science in areas including forecasting, data collection and modelling
- build relationships between the staff of both organisations.

Need for dedicated communications resources

According to one of the flood engineers, Mr Ayre, one of the reasons the flood operations centre was staffed by two flood engineers from Sunday 9 January 2011, was in recognition of the fact that, during large flood events, more people are affected, require information and express interest in the event's management.[330]

This sentiment was reflected by the breadth of information requests made to the flood operations centre during the January 2011 flood event which included:[331]

- contributing to a briefing for the Premier[332]

- preparing a powerpoint presentation for the chief executive officer of Seqwater about the operation of Somerset and Wivenhoe dams[333]
- contributing to a Ministerial Briefing Note for an Emergency Cabinet meeting[334]
- preparing responses to media enquiries.[335]

Mr Ayre also considered it important that the flood operations centre have a limited and focussed role in the provision of communications to other agencies during a flood event, in order to allow the flood operations centre to focus its attention upon 'matters such as the rainfall and inflow data, lake levels, directives, status of the dams and any other issue that may arise during a flood event'.[336] Another of the flood engineers, Mr Malone, similarly considered that there should be 'some dedicated resources more closely related to the flood operations centre' providing information about the flood operations centre's activities to the public.[337]

In the Commission's view, direct communication by the flood operations centre with other agencies is critical to the management of flood events; but it would be preferable if the flood engineers had a limited role in the provision of communications extraneous to their flood operation duties.

Recommendation

2.23 Seqwater should give consideration to creating a communications position within the flood operations centre filled by an engineer with experience in dam operations and emergency management processes.

Communication with the public

Notwithstanding *4.1.4 Warnings about dam spillway outflow*, the Commission recognises that the volumes of current and expected releases from Seqwater's dams may be of acute interest to some members of the public. This information would, in the ordinary course of events, be communicated to councils electronically, so it would seem unlikely that posting that same information on the website would be an onerous undertaking. Indeed, the original source of this idea was one of the flood engineers.[338]

Recommendation

2.24 Seqwater should give consideration to posting information about current and future releases on its website during flood events as one method of ensuring accurate and timely information is available to the public.

2.7 Chronology of the operation of Wivenhoe and Somerset dams in January 2011

As well as statements, testimony and reports, the chronology that follows relies on results of the real time flood model saved into spreadsheets and provided to the Commission by Seqwater.[339] Comments on the completeness of the records kept by Seqwater of the decision-making process of the flood engineers are made in *2.6.9 Records of decision-making*.

In the 24 hours to 9.00 am on 6 January 2011, the Wivenhoe and Somerset dams' catchment experienced steady rainfall in the order of 20 to 50 millimetres. At 7.00 am that day, the Wivenhoe lake level was 67.31 metres and the Somerset lake level was 99.34 metres.[340] Flood releases are expected at those lake levels;[341] consequently the flood operations centre was mobilised at 7.42 am. The start of this flood event was similar to those that affected the dams in October and December 2010 – but that is where the similarity ends.

2.7.1 The beginning: the bridges

7.00 am, 6 January to 8.00 am, 8 January

Flood releases are not made at Wivenhoe Dam until the lake level exceeds 67.25 metres.[342] The first strategy to be used to operate the dam is W1; the primary consideration at this stage is minimising disruption to downstream rural life. The aim is to keep particular downstream bridges open for as long as possible.

There are seven important bridges downstream of Wivenhoe Dam, the submerging of which causes inconvenience and leaves some communities isolated. All bridges are below the intersection of the Lockyer Creek and the Brisbane River, so flows from the Lockyer catchment also affect them. As the lake level rises, the focus of the strategy changes to higher bridges.

In the first 24 hours after the flood event was declared, rain in the order of 10 to 30 millimetres fell in the catchments above the dams. In the next 24 hours, to 9.00 am on 8 January, totals around 100 millimetres fell in the upper catchment, with falls around 10 millimetres elsewhere.[343] Inflows from that rainfall caused the lake level progressively to trigger the five sub-strategies of W1, as the following table illustrates.

Figure 2(b)

Strategy	Bridge aimed to be kept open (maximum flow until bridge is submerged)[344]	Lake level trigger (m)	Trigger for commencement of strategy and status of gates[345]
W1A	Twin Bridges (50 m^3/s including the Lockyer Creek) Savages Crossing (110 m^3/s including the Lockyer Creek) Colleges Crossing (175 m^3/s including the Lockyer Creek)	67.25	7.42 am, 6 January. All gates closed.
W1B	Colleges Crossing (175 m^3/s including the Lockyer Creek) Burtons Bridge (430 m^3/s including the Lockyer Creek)	67.50	Lake level measured at 67.52m, at 2.00 am, 7 January. All gates closed.
W1C	Burtons Bridge (430 m^3/s including the Lockyer Creek) Kholo Bridge (550 m^3/s including the Lockyer Creek)	67.75	Lake level measured at 67.75m at 9.00 am, 7 January. All gates closed.
W1D	Kholo Bridge (550 m^3/s including the Lockyer Creek) Mt Crosby Weir Bridge (1900 m^3/s including the Lockyer Creek)	68.00	Lake level measured 68.03m at 3.00 pm, 7 January. First gate opened at 3.00 pm, 7 January.
W1E	Mt Crosby Weir Bridge (1900 m^3/s including the Lockyer Creek) Fernvale Bridge (2000 m^3/s including the Lockyer Creek)	68.25	Lake level measured at 68.26m at 10.00 pm, 7 January. Transition to W3 at 8.00 am, 8 January when the lake level measured 68.52m.

2.7.2 Transition to strategy W3

8.00 am, 8 January

The Wivenhoe manual requires a transition to strategy W2 or W3 when the Wivenhoe lake level exceeds 68.50 metres, as it did at 8.00 am on 8 January.[346] Strategy W2 requires the releases from Wivenhoe to be managed so that the flow in the Brisbane River does not exceed the naturally occurring peaks at Lowood and Moggill.[347] At 8.00 am, the requirements of strategy W2 were impossible to meet: the predicted natural peak was 530 m^3/s at Lowood and 770 m^3/s at Moggill, while releases from Wivenhoe were already in the order of 900 m^3/s.[348]

The flood engineers moved immediately to strategy W3, which on their understanding required the flow at Moggill to be limited to 4000 m^3/s, the threshold of non-damaging flows in urban Brisbane, according to the Wivenhoe manual.[349]

2.7.3 Rise and fall

8.00 am, 8 January to 12.00 pm, 9 January

From 8.00 am to 5.00 pm on 8 January, the lake level at Wivenhoe rose extremely slowly, from 68.52 metres to 68.65 metres. The rate of rise averaged just 1.4 centimetres per hour. The lake stabilised at 68.65 metres until 11.00 pm and then decreased slowly, recording 68.54 metres at 12.00 pm on 9 January.

The flood engineers' strategy during this time was to minimise releases.[350] Two bridges remained open (Fernvale Bridge and Mt Crosby Weir) and at this stage the flood engineers thought that they would be able to keep them open.[351]

On 8 January, Somerset, still operated under its second strategy focussed on minimising impacts below Wivenhoe Dam,[352] held water back to allow the runoff from the upper Brisbane River catchment to run through Wivenhoe.[353] From 8.00 am on 9 January, the sluice gates were progressively opened to move the dam levels back to the target operating line (a best case relationship between the level at Wivenhoe and the level at Somerset).[354]

The forecast from the Bureau of Meteorology indicated high rainfall in south-east Queensland for the next four days, from 8 January through to Wednesday 12 January.[355] On 8 January, the falls in the catchments upstream of the dams were relatively small, generally less than 30 millimetres, with some instances over 40 millimetres. With the lake level under 69 metres, the flood engineers were comfortable maintaining releases of under 1250 m^3/s. They reasoned that if the forecast rain did fall, there was sufficient storage capacity in the lake to contain it.[356]

Figure 2(c)

Hour	Lake level (m)	Predicted peak exc forecast rainfall[357]	Predicted peak inc forecast rainfall[358]	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
8.00 am 8/1	68.52			1515	927	895
9.00 am	68.55			1649	980	950
10.00 am	68.56			1755	1031	1002
11.00 am	68.59			1399	1085	1050
12.00 pm	68.60			1260	1138	1095
1.00 pm	68.61			1530	1189	1136
2.00 pm	68.61	68.7 (at 7.00 pm 8 Jan)	69.1 (at 4.00 am 10 Jan)	1799	1239	1181
3.00 pm	68.63			1581	1240	1224
4.00 pm	68.64			1418	1241	1263

Hour	Lake level (m)	Predicted peak exc forecast rainfall[357]	Predicted peak inc forecast rainfall[358]	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
5.00 pm	68.65			1227	1242	1302
6.00 pm	68.65	68.8 (at 9.00 pm 8 Jan)	69.2 (at 8.00 am 10 Jan)	1255	1242	1340
7.00 pm	68.65			1255	1242	1377
8.00 pm	68.65			1255	1242	1413
9.00 pm	68.65			1282	1242	1449
10.00 pm	68.65			1091	1242	1485
11.00 pm	68.65			899	1242	1522
12.00 am 9/1	68.64			926	1241	1552
1.00 am	68.63	68.7 (at 7.00 pm 8 Jan)	68.9 (at 3.00 pm 10 Jan)	925	1240	1588
2.00 am	68.62			943	1286	1623
3.00 am	68.61			1189	1285	1660
4.00 am	68.60			970	1285	1697
5.00 am	68.60			802	1336	1733
6.00 am	68.58	68.8 (at 10.00 pm 8 Jan)	69.3 (at 1.00 am 11 Jan)	1047	1335	1769
7.00 am	68.57			1046	1334	1755
8.00 am	68.56	68.7 (at 7.00 pm 8 Jan)	69.5 (at 3.00 am 11 Jan)	773	1334	1742
9.00 am	68.55	68.9 (at 12.00 pm 10 Jan)	69.8 (at 12.00 am 11 Jan)	1182	1333	1730
10.00 am	68.53			1536	1332	1719
11.00 am	68.54			1646	1332	1737
12.00 pm 9/1	68.54	69.2 (at 7.00 pm 10 Jan)	70.4 (at 2.00 am 11 Jan)	2080	1384	1763

Notes to table:

1. The figures in the Estimated Flow at Moggill column have been taken from Seqwater's modelling, run 45, completed at 12.00 pm, 19 January 2011. The flow at Moggill is estimated by the use of a rainfall runoff model which forms part of the real time flood model.
2. Releases from Wivenhoe Dam reach Moggill approximately 16 hours after release, although the exact time taken depends on the size of the release.[359]

2.7.4 Heavy rain and the threat of urban flooding

12.00 pm, 9 January to 9.00 pm, 9 January

In the 24 hours from 9.00 am on 9 January, widespread heavy rain fell in the dam catchments. Across the catchments, rainfall gauges recorded falls between 100 and 200 millimetres, with falls as high at 310 millimetres recorded.[360]

Heavy falls were also recorded in areas below the dams: up to 113 millimetres in the lower Brisbane River catchment, 86 millimetres in the Lockyer Creek catchment and 68 millimetres in the Bremer River catchment.[361]

At 2.12 pm, the Bureau issued a flood warning for the Brisbane River and Stanley River above Wivenhoe Dam which predicted heavy rainfall in the catchments for all of 9 and 10 January.[362]

At 3.30 pm, all four flood engineers met to discuss the strategy to be adopted. Wivenhoe's lake level was 68.61 metres, and they were in strategy W3. The seven day forecast indicated three days of solid rain ahead, and a severe weather warning was current for the dam catchments.[363] The three day ACCESS[364] forecasts predicted average falls of 140 millimetres in the Somerset catchment and 170 millimetres in the Wivenhoe catchment. The five day ACCESS forecasts predicted average falls of 141 millimetres in the Somerset catchment and 171 millimetres in the Wivenhoe catchment.[365] A large volume of water was on the ground and expected to flow into the dam and cause the lake level to rise to 70.5 metres.[366] The 'with forecast' model of the lake level showed a peak of 71.8 metres. The Bureau's ACCESS model and general synoptic forecast indicated the rainfall system currently drenching the dam catchments was expected to move south in 24 to 36 hours.

The four flood engineers decided to maintain releases at around 1400 m^3/s in an attempt to keep Fernvale Bridge and Mt Crosby Weir Bridge open, given rainfall was expected to increase the flows from the Lockyer Creek and the Bremer River.[367] The flood engineers were concerned that if they increased releases and the rain system moved south, they might increase flooding downstream.

Modelling was performed by the flood engineers just before that meeting, at 3.00 pm. The 'without forecast' model run shows the flow at Moggill peaking at around 1850 m^3/s.[368] The corresponding 'with forecast' model run shows flow at Moggill peaking at just over 2600 m^3/s. (As explained earlier, the gate strategy saved in the spreadsheet is not necessarily the one implemented.) The gate strategy input into the model was to make no change to the gate openings (at approximately 1400 m^3/s) until well after the peak when the gates would begin to be closed. That gate strategy left a buffer, even if the full amount of forecast rain were to fall, between the expected flows (2613 m^3/s peak) and damaging flows in Brisbane (4000 m^3/s according to the Wivenhoe manual) of almost 1400 m^3/s.

The situation report at 9.04 pm, 9 January recorded very heavy rainfall in the previous six hours.[369] Inflows into the dam increased dramatically, from 3448 m^3/s at 3.00 pm to 7935 m^3/s at 11.00 pm, 9 January. The lake level responded quickly to these inflows, rising from 68.58 metres at 2.00 pm on 9 January to 69.80 metres by midnight and reaching 71.36 metres by 8.00 am on 10 January.

The predicted peak lake level from the 'without forecast' model which until midday on 9 January was consistently below 69.0 metres, was then predicted to reach 72.7 metres in the model run at 8.00 pm on 9 January. (The 'with forecast' model run at 8.00 pm was the first to return a peak lake level of over 74 metres, the trigger point for strategy W4.)

On the basis of these developments, at 9.04 pm the flood engineers abandoned all plans of keeping Fernvale Bridge and Mt Crosby Weir Bridge open. The inflows were too high to maintain sufficiently low releases.[370]

Figure 2(d)

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
12.00 pm 9/1	68.54	69.2 (at 7.00 pm 10 Jan)	70.4 (at 2.00 am 11 Jan)	2080	1384	1763
1.00 pm	68.56			2054	1385	1767
2.00 pm	68.58	70.0 (at 12.00 am 11 Jan)	71.3 (at 11.00 am 11 Jan)	3448	1386	1777
3.00 pm	68.61	70.5 (at 12.00 am 11 Jan)	71.8 (at 11.00 am 11 Jan)	4136	1388	1792
4.00 pm	68.70	70.9 (at 11.00 pm 10 Jan)	72.7 (at 9.00 am 11 Jan)	3946	1394	1822
5.00 pm	68.77	71.2 (at 12.00 am 11 Jan)	73.0 (at 10.00 am 11 Jan)	4733	1398	1867
6.00 pm	68.86			5454	1404	1933

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
7.00 pm	68.97	72.1 (at 3.00 am 11 Jan)	73.9 (at 1.00 pm 11 Jan)	5848	1411	1923
8.00 pm	69.10	72.7 (at 6.00 am 11 Jan)	74.1 (at 5.00 pm 11 Jan)	7338	1419	1912
9.00 pm 9/1	69.24			7659	1428	1969

2.7.5 Water continues to flow in

9.00 pm, 9 January to 8.00 am, 10 January

Inflows had continued to build through the night, peaking at 10 095 m^3/s at 8.00 am on 10 January. The expectation from the Bureau's forecast issued at 10.38 pm, 9 January was that very heavy rainfall would be experienced downstream of the dams' catchments as the system which had been over the dam catchments moved south.[371] Dam levels were rising at both Wivenhoe and Somerset and increased gate openings were planned for each.[372]

At 12.45 am, 10 January, Mr Ruffini, one of the flood engineers on duty (with Mr Ayre) took a call from Ken Morris of the Brisbane City Council. Mr Morris took issue with a statement in the most recent situation report that the limit of non-damaging flows downstream of Moggill was 4000 m^3/s, stating that the council's information was that 3500 m^3/s was the correct figure. Mr Ruffini agreed to excise references to non-damaging flow limits from the situation reports (as it was properly a matter for the council to comment on), but the engineers decided to continue to use the 4000 m^3/s figure because of its presence in the Wivenhoe manual.[373] When Mr Malone and Mr Tibaldi started their shift the next morning at 7.00 am, and discussed the issue with the council at 9.40 am,[374] they indicated that they would attempt to limit the flow at Moggill to 3500 m^3/s; which reflected the council's view that that figure represented the lower limit of damaging flows in urban Brisbane and was consistent with the W3 aim of protecting urban areas from inundation.[375]

At around 6.30 am, the flood engineers were aware that the upper Brisbane River (above Wivenhoe Dam) had peaked in the early hours of the morning. Releases were around 1800 m^3/s compared to inflows of 9312 m^3/s. The lake level was 70.77 metres and rising sharply, having risen 40 centimetres in the last two hours. However, with inflows from the upper catchment diminishing, the flood engineers expected the event could be contained within strategy W3. Given the rainfall was predicted to move downstream, and was already starting to have an impact on the Lockyer catchment and metropolitan Brisbane, the flood engineers continued to minimise releases in an effort to reduce inundation of urban areas as far as possible.[376]

The situation report issued at 6.30 am, 10 January warned that the threshold of damaging discharge in urban areas might be exceeded within 24 to 48 hours if predicted rainfall in the downstream tributary catchments eventuated.[377]

Figure 2(e)

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
9.00 pm 9/1	69.24			7659	1428	1969
10.00 pm	69.44			7646	1440	1968
11.00 pm	69.60			7935	1450	1944
12.00 am 10/1	69.80			7936	1462	1923
1.00 am	69.97	72.9 (at 5.00 am 11 Jan)	74.7 (at 10.00 pm 11 Jan)	8449	1473	1906
2.00 am	70.17			8732	1539	1890
3.00 am	70.36	73.0 (at 6.00 am 11 Jan)	74.8 (at 12.00 am 12 Jan)	9133	1605	1893
4.00 am	70.57	72.8 (at 6.00 am 11 Jan)	74.5 (at 12.00 am 12 Jan)	8759	1672	1951
5.00 am	70.77			8933	1740	1947
6.00 am	70.96			9312	1806	1947
7.00 am	71.16			9351	1875	1944
8.00 am 10/1	71.36			10095	1944	1993

2.7.6 Holding Moggill to 4000 m^3/s

8.00 am, 10 January to 12.00 am, 11 January

As quickly as the inflows had risen, to 10 095 m^3/s at 8.00 am on 10 January, so now they fell (with some interruptions to the downwards trajectory): to 4574 m^3/s by 11.00 pm, 10 January. But the large inflows had had a marked effect on the lake level, and the flood engineers were forced to escalate releases.

At 9.16 am, the Bureau issued a flood warning for the Brisbane River and Stanley River above Wivenhoe Dam.[378] It stated that up to 300 millimetres of rain had fallen in the catchment in the previous 24 hours and that further heavy rainfall was expected to continue through the day.

Around midday on 10 January, the flood engineers still intended to keep flows in the Brisbane River at Moggill to 3500 m^3/s,[379] the figure mentioned in their discussions with the Brisbane City council. The 10.00 am quantitative precipitation forecast issued by the Bureau indicated 50 to 100 millimetres of rain was expected in the next 24 hours in the dam catchments.[380]

By 3.00 pm, the plan to keep flows at Moggill to 3500 m^3/s was overtaken by significant rain falling in the dams' catchment: the aim was changed to hold the flow at Moggill to 4000 m^3/s.[381] The dam levels at Wivenhoe and Somerset were both rising; at Wivenhoe, the lake level was 72.54 metres, having risen 13 centimetres in the previous hour and over a metre since 8.00 am. Somerset was now releasing about 1700 m^3/s into Wivenhoe, which was releasing about 2500 m^3/s downstream.[382] The inflows were falling and the predicted peak of Wivenhoe, from the 'without forecast' model, was 73.6 metres.[383] The 'with forecast' model run predicted a lake level peak of 75.2 metres, which was expected to occur at 11.00 am on 12 January.[384]

At 5.32 pm, the flood engineers were advised, by an email from the Bureau of Meteorology, of a flash flood event in the Lockyer Creek catchment.[385] That email sets out rises in river heights at gauges, but at that stage the advice did not extend to rainfall, flow or volume information. The flood engineers also received the following warnings from the Bureau:

- flash flood warning issued for Lockyer Creek at 5.00 pm,[386] which reported 'very heavy rainfall' and 'extreme rises' in the Lockyer Creek
- flood warning issued for Lockyer Creek, Bremer River, Brisbane River and Warrill Creek at 6.12 pm[387] which reported 'moderate to major flooding' in Lockyer Creek and Bremer River, expecting further heavy rainfall; 'major flood peak' for the Lockyer of around 13 metres, expected rises to about 14.5 to 15 metres.

At 6.43 pm, the flood engineers issued a situation report. The most recent modelling had been done at 5.00 pm. The 'without forecast' model showed a predicted peak flow at Moggill of 3946 m^3/s; the 'with forecast' model showed a predicted peak flow of 4529 m^3/s.[388] The situation report stated '[t]he flash flooding experienced in the upper areas of the Lockyer Creek have [sic] been examined and are [sic] not expected to significantly increase Brisbane River flows above the current projection of 4000 m^3/s at Moggill'. That statement seems to have been made on slender grounds**.** When the 5.00 pm model run (which showed the flow, without forecast rain, remaining below 4000 m^3/s) was performed, no detailed information had been received about the magnitude of the rainfall in the Lockyer catchment or the flows from the Lockyer Creek.

During an 8.00 pm telephone conference, the Bureau advised the flood engineers that it estimated the rainfall in the Lockyer catchment to be as much as 600 millimetres.[389]

The flood engineers reviewed Bureau modelling which suggested the flow from the Lockyer Creek would exceed 1400 m^3/s; added to the Wivenhoe releases, it would tip the Moggill gauge over what they regarded as the 4000 m^3/s threshold.[390]

The flood engineers worked on options to hold back releases until after the Lockyer peak had entered the Brisbane River. Mr Ayre contacted the dam safety regulator, Mr Allen, to discuss a possible departure from the procedures of the Wivenhoe manual to exceed 74.0 metres for a short period without invoking strategy W4.

By midnight, the lake level was 73.26 metres; inflows had fallen to 4654 m^3/s while outflows were 2713 m^3/s. The flow at Moggill was 3405 m^3/s. The strategy remained to contain flows at Moggill to 4000 m^3/s, the flow which, in the engineers' view, the Wivenhoe manual set as the upper limit of non-damaging flows.[391]

Figure 2(f)

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
8.00 am 10/1	71.36			10095	1944	1993
9.00 am	71.56	72.9 (at 7.00 am 11 Jan)	74.5 (at 5.00 am 12 Jan)	9731	2015	2085
10.00 am	71.78			7267	2031	2146
11.00 am	71.95			8059	2044	2199
12.00 pm	72.07	73.3 (at 12.00 pm 11 Jan)	75.6 (at 10.00 am 12 Jan)	9026	2053	2285
1.00 pm	72.26			7384	2067	2416
2.00 pm	72.41			7856	2077	2555
3.00 pm	72.54	73.6 (at 3.00 pm 11 Jan)	75.2 (at 11.00 am 12 Jan)	8411	2087	2675
4.00 pm	72.70	73.7 (at 3.00 pm 11 Jan)	75.7 (at 2.00 pm 12 Jan)	6568	2155	2789
5.00 pm	72.84	73.8 (at 3.00 pm 11 Jan)	74.6 (at 7.00 am 12 Jan)	5116	2277	2893
6.00 pm	72.92			5286	2399	3025
7.00 pm	72.99			4946	2517	3130

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
8.00 pm	73.06	73.6 (at 4.00 pm 11 Jan)	74.3 (at 9.00 am 12 Jan)	4920	2695	3207
9.00 pm	73.11			5026	2699	3265
10.00 pm	73.17			4488	2705	3324
11.00 pm	73.22			4574	2709	3374
12.00 am 11/1	73.26	73.5 (at 7.00 pm 11 Jan)	74.1 (at 7.00 am 12 Jan)	4654	2713	3405

2.7.7 Another downpour

12.00 am, 11 January to 8.00 am, 11 January

As at midnight on 11 January, the Bureau's most recent quantitative precipitation forecast, (issued at 4.00 pm the previous day) predicted average falls of 25 to 50 millimetres with isolated falls to 100 millimetres.[392]
At 10.00 am, 11 January, the quantitative precipitation forecast for the dams' catchment advised expected falls of over 100 millimetres in the next 24 hours.

The inflows into the dams continued to decrease until 2.00 am. In the early hours of 11 January, however, intense rainfall again fell over the dam catchments. The intensity of the rainfall was not captured by rain gauges; but the flood engineers realised heavy rain must be falling because of the increase in Wivenhoe's lake level. The hydrologic model was not matching well with the lake level rises. A reverse process was carried out which estimated the rainfall which must have occurred to cause the observed rise in lake level. The estimate was of over 700 millimetres, an enormous amount. As a result of that estimate, inflow estimates increased sharply, up to 6817 m^3/s by 6.00 am and 8060 m^3/s by 8.00 am. Discharge from the dam was fairly constant, around 2700 m^3/s. The lake level was moving steadily up toward 73.5 metres.

At 3.00 am and 4.00 am, the two flood engineers on duty (Mr Ayre and Mr Ruffini) performed modelling on the predicted lake levels. The models indicated the lake level would peak at or above 74.0 metres, both with and without forecast rainfall. The flood engineers did not move to strategy W4 at this time, which they considered would require stabilising the lake level by opening the gates quickly to match outflows and inflows. [393] Instead they strove to keep the dam operating in strategy W3. With unknown inflows from the Lockyer Creek, a rainfall system moving south to areas downstream of the dam and a dam level more than 0.5 metres below 74.0 metres, the flood engineers did not want to release large volumes until they considered it absolutely necessary.[394] They maintained constant releases from Wivenhoe at just over 2700 m^3/s but directed that three sluice gates at Somerset be shut to decrease the inflow into Wivenhoe.[395]

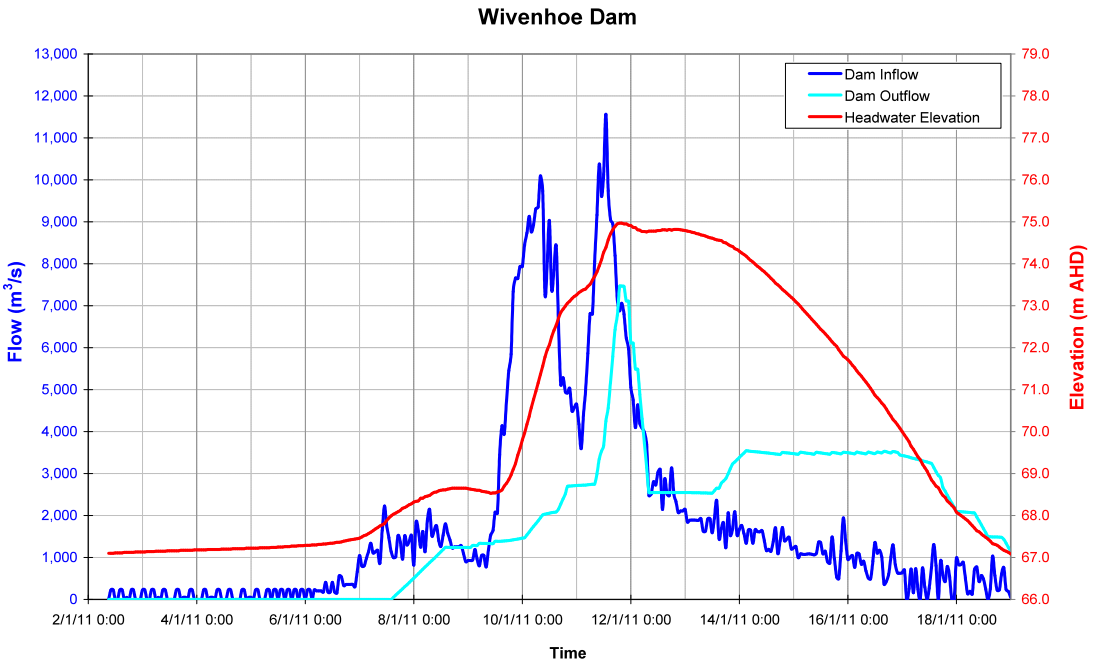
At 7.00 am, the other two flood engineers (Mr Malone and Mr Tibaldi) began their shift. They quickly performed modelling and noted the rapid increase in inflows into the dam during the previous two hours.[396] They sought advice from the Bureau, which agreed with their predicted inflow figures and confirmed that the heavy rain being experienced over the dams' catchment would continue.[397] The rate of rise in Wivenhoe's lake level and inflows and the confirmation of continuing heavy rain finally ended the hope that the flood could be contained in strategy W3. Strategy W4 was invoked, for the first time in Wivenhoe's history, at 8.00 am.

Figure 2(g)

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
12.00 am 11/1	73.26	73.5 (at 7.00 pm 11 Jan)	74.1 (at 7.00 am 12 Jan)	4654	2713	3405
1.00 am	73.31			4175	2717	3439
2.00 am	73.35	73.9 (at 3.00 am 12 Jan)	74.6 (at 11.00 am 12 Jan)	3594	2721	3423
3.00 am	73.38	74.0 (at 4.00 am 12 Jan)	74.8 (at 12.00 pm 12 Jan)	4388	2724	3409
4.00 am	73.40	74.1 (at 5.00 am 12 Jan)	74.9 (at 1.00 pm 12 Jan)	4974	2726	3399
5.00 am	73.46			5866	2731	3392
6.00 am	73.51			6817	2736	3394
7.00 am	73.61	74.3 (at 4.00 am 12 Jan)	76.2 (at 9.00 pm 12 Jan)	6802	2745	3404
8.00 am 11/1	73.70	74.5 (at 4.00 am 12 Jan)	75.1 (at 12.00 pm 12 Jan)	8060	2753	3481

The figure below indicates the two peaks in inflow affecting the dam between 9 and 12 January.

Figure 2(h)



Source: Seqwater, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, page iv.

2.7.8 Increasing releases in W4

8.00 am, 11 January to 11.00 pm, 11 January

The only consideration when operating Wivenhoe in accordance with W4 is the safety of the dam. The strategy is to open the gates continuously, as far as is safely possible, until outflows match inflows and the lake level stabilises. In these circumstances, it meant that a rapid rise in releases from the dam was inevitable.

At the start of W4, outflows were 2753 m^3/s and inflows 8060 m^3/s. The strategy at 12.00 pm was to attempt to limit releases to 4500 m^3/s.[398] Further rainfall prevented this being achieved, and by 6.00 pm, the flood engineers were predicting releases of around 8000 m^3/s.[399]

Inflows peaked at 11 561 m^3/s at 1.00 pm, when outflows had increased to 4250 m^3/s. The lake peaked at 74.97 metres at 7.00 pm when outflows for the first time exceeded inflows: 7464 m^3/s to 6876 m^3/s. Throughout, the flood engineers were reviewing strategies every 30 minutes.[400]

The following gate opening sequence was adopted to deal with the rapid rises in inflow: the gates were opened to 6.0 metres by 12.00 pm, then all five gates were opened to 7.0 metres at 1.00 pm, 7.5 metres at 2.00 pm, 8.5 metres at 3.00 pm, 9.5 metres at 4.00 pm, 10.5 metres at 5.00 pm, 11.0 metres at 6.00 pm and then held constant at 12.0 metres from 7.00 pm to 9.00 pm.[401] The sharp incline in the light blue line in the graph above indicates the increase in releases as a consequence of these gate openings.

By 9.00 pm the flood engineers were satisfied that the lake level had stabilised and would start to fall. Their strategy was to close the gates as quickly as they had opened them, attempting to limit as far as possible the flood which would be caused by such high flows out of the dam.[402] Each gate opening was reduced to 5.0 metres by 7.00 am on 12 January.

Figure 2(i)

Hour	Lake level (m)	Predicted peak exc forecast rainfall	Predicted peak inc forecast rainfall	Inflow (m^3/s)	Outflow (m^3/s)	Estimated Flow at Moggill (m^3/s)
8.00 am 11/1	73.70	74.5 (at 4.00 am 12 Jan)	75.1 (at 12.00 pm 12 Jan)	8060	2753	3481
9.00 am	73.81			9165	2991	3652
10.00 am	73.95	75.0 (at 3.00 am 12 Jan)	76.5 (at 8.00 pm 12 Jan)	10376	3347	3876
11.00 am	74.10			9606	3533	4182
12.00 pm	74.27			10120	3667	4613
1.00 pm	74.39	75.0 (at 3.00 am 12 Jan)	76.2 (at 9.00 pm 12 Jan)	11561	4250	4905
2.00 pm	74.57	75.1 (at 3.00 am 12 Jan)	76.3 (at 10.00 pm 12 Jan)	9739	4562	5245
3.00 pm	74.71			9055	5167	5562
4.00 pm	74.81			8947	5786	5823
5.00 pm	74.89			8196	6432	6041
6.00 pm	74.95			7141	6774	6204
7.00 pm	74.97	75.0 (at 10.00 pm 11 Jan)	75.2 (at 3.00 pm 12 Jan)	6876	7464	6305
8.00 pm	74.97			7060	7464	6352
9.00 pm	74.95	74.7 (at 8.00 pm 12 Jan)	No run	6797	7458	6350
10.00 pm	74.95			6229	7111	6393
11.00 pm 11/1	74.92			5964	7103	6555

2.7.9 The days after: the drawdown

9.00 pm, 11 January to 12.00 pm, 19 January

Once the lake level had stabilised, the flood engineers' strategies were firmly focussed on downstream impacts. The Wivenhoe manual requires that both Wivenhoe and Somerset dams be drawn down to full supply level within seven days of the peak of the flood passing through the dam. According to Seqwater's modelling, the flow at Moggill peaked at 12 095 m^3/s at 11.00 am on 12 January 2011.[403] After the Brisbane River at the City Gauge peaked early in the morning of 13 January, the strategy at Wivenhoe was to control the flow at Moggill at 3500 m^3/s.[404] Seqwater's modelling showed the flow below 4000 m^3/s by 8.00 pm on 13 January, and below 3500 m^3/s by 10.00 am on 16 January 2011.[405]

Releases from Wivenhoe were increased as the flows from the Lockyer Creek and the Bremer River decreased, balancing the downstream water levels.[406]

As the gates were shut and the flows decreased, the rural bridges were re-opened.

The gates were finally shut at 12.00 pm, 19 January.

2.8 General comments on the operation of Wivenhoe Dam

2.8.1 The interpretation of strategy W3

Strategy W3 is outlined on page 28 of the Wivenhoe manual, which states:

> The intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4000 m^3/s, noting that 4000 m^3/s is the upper limit of non-damaging floods downstream ... depending on natural flows from the Lockyer and Bremer catchments, it may not be possible to limit the flow at Moggill to below 4000 m^3/s. In these instances, the flow at Moggill is to be kept as low as possible.

The flood engineers' common interpretation of strategy W3 is that it does not allow releases from Wivenhoe that produce a flow at Moggill taking into account flows from the Lockyer and Bremer catchments of more than 4000 m^3/s.[407] That interpretation is open from the words of the Wivenhoe manual.

A different interpretation is that W3 allows the discharge from Wivenhoe to cause a flow at Moggill (taking into account flows from the Lockyer and Bremer catchments) above 4000 m^3/s if that is necessary to minimise inundation in urban areas, which is the primary consideration under strategy W3. That situation may arise where inundation at lower levels is considered necessary to reduce the risk of large scale inundation; for example, to guard against the event that a heavy rainfall forecast proves well-founded, and larger dam releases are necessary. If that view is preferred, there is a strong case for saying that the flood engineers should have modelled the effects of increasing the flow at Moggill to, for example, 4500 m^3/s or 5000 m^3/s or even higher, and compared the results with the results of maintaining the Moggill flow at 4000 m^3/s until W4 was invoked and then rapidly increasing releases to stop the lake level rising.[408]

Modelling from Seqwater suggests that an increase in releases earlier in W3 would not have reduced the flood peak downstream of Moggill; it remains to be seen whether the review of the modelling currently being undertaken by Mr Babister confirms that conclusion. It must be emphasised however, that the ambiguity of the Wivenhoe manual on the question means that it is impossible for the Commission to say the flood engineers were in breach of the Wivenhoe manual in taking the approach that such releases were prohibited. Their reading was open on the manual's words.

The flood engineers also state that preventing the lake level from reaching the trigger level of strategy W4 is not a consideration when operating the dam under strategy W3.[409]

The actual words articulating strategy W3 do not directly indicate that any consideration of the triggering of W4 should enter the flood engineers' decision-making. However, the triggering of W4 was in the flood engineers' minds according to the flood event report that was jointly authored by them.[410] In any case, given that the aim of W3 is to provide protection against urban inundation and strategy W4 necessarily entails such inundation,[411] it is hard to see why the prospect of triggering W4, and the avoidance of it, would not be rational considerations in operating under strategy W3.

The fact that more than one interpretation is open on these points is not to say that the flood engineers' interpretation is without merit or that it will not produce better flood mitigation results. They are, however, examples of the sort of ambiguity that arises from the current wording of the Wivenhoe manual. That wording should be changed in the interim review of the Wivenhoe manual: see *2.5.7 Interim review of the Wivenhoe manual*.

2.8.2 An earlier move to W4?

It is arguable that, objectively considered, and taking forecast rainfall into account, the conditions existed at 3.00 pm, 10 January 2011 for a move to W4. The lake level was 72.54 metres, having risen more than a metre since 8.00 am that morning. The predicted peak, according to the 'without forecast' model was 73.6 metres; according to the 'with forecast' model it was 75.2 metres. The inflows far exceeded releases (8411 m^3/s to 2087 m^3/s) and had shown no sign of any consistent fall. The 10.00 am quantitative precipitation forecast was predicting 50 to 100 millimetres in the catchment; it was raining at the dam;[412] the three day forecast, issued at 10.00 pm the night before, predicted peak inflows in the range of 8000 m^3/s. It was known that the lake level was capable of rising two or three metres in the space of 24 hours.

However, hindsight judgment of this kind can be confounded by events. Had the engineers taken the approach suggested, the result for downstream communities might well have been worse, for the simple reason that there was an unknown factor at that stage. The extraordinary flooding in the upper Lockyer Creek had started about two hours earlier. Those flows would add significantly to the water moving down the Brisbane River. Meanwhile, the flows into the Wivenhoe Dam actually started to decrease from 3.00 pm on 10 January until the early hours of the following morning. The example is useful to illustrate this proposition: there will always be a range of possible judgments, and the one which might seem most appropriate on the evidence may not, as events unfold, produce the optimal outcome. The best approach is to ensure that the flood engineers are guided in their decision-making by a clear, unambiguous manual, based on the best available science, and are equipped with ample and up-to-date modelling tools.

2.8.3 Gate openings in W4

The explanation of strategy W4 on page 29 of the Wivenhoe manual says the following about gate openings:

> Opening of the gates is to occur generally in accordance with the requirements of Section 8.6, until the storage level of Wivenhoe Dam begins to fall.
>
> There are no restrictions on gate opening increments or gate opening frequency once the storage level exceeds 74.0 AHD, as the safety of the dam is of primary concern at these storage levels.

Seqwater asserts that no flexibility exists in the implementation of strategy W4.[413] That proposition cannot be sustained; while the gates must be opened continuously until the lake level begins to fall, the rate at which they can be opened is entirely discretionary. That flexibility is clearly shown by the gate opening sequences implemented by the flood engineers in strategy W4, discussed at *2.7.8 Increasing releases in W4*. Such flexibility is important because the rate, volume and period of releases can have a substantial influence on the eventual peak lake level and peak dam outflow.[414] The senior flood operations engineer during the January 2011 event, Mr Ayre, agreed in his evidence that the flood engineers had complete flexibility over how and when to release water in W4, except for some minor limitations (for example, the requirement to have all the gates fully open by the time the first fuse plug initiates at 75.5 metres).[415]

Part 8.6 of the Wivenhoe manual states that the target minimum interval for individual gate openings of 0.5 metres is 10 minutes. It also says that interval can be decreased if the safety of the dam is at risk, which it necessarily is in strategy W4. It says that each gate can be opened more than five metres in one hour, and sets a normal sequence of gate openings. It is unclear from the use of 'generally' exactly which portions of part 8.6 should be followed when in W4. Little detail is given of the mechanical capability of the system for operating the gates.

This is an area of the Wivenhoe manual which lacks precision as to what can be done and how it should be done, the language of which should be made considerably clearer. See *2.5.7 Interim review of the Wivenhoe manual*.

2.8.4 Reaction to Brisbane City Council advice regarding threshold of damaging flows in Brisbane

The issue of the flood engineers' response to the Brisbane City Council's advice that the real threshold of non-damaging flows at Moggill was 3500 m^3/s can be dealt with briefly.

The Commission does not consider that there was anything untoward either in the decision by Mr Ayre and Mr Ruffini to continue to work off the 4000 m^3/s figure because it appeared in the Wivenhoe manual or in the later, short-lived attempt by Mr Malone and Mr Tibaldi to keep flows at Moggill to 3500 m^3/s. Both sets of engineers were, in their respective approaches, continuing to take account of their interpretation of the primary consideration under strategy W3, the protection of urban areas from inundation.

2.9 Effects of dam releases

2.9.1 Dam releases and the flow at Moggill

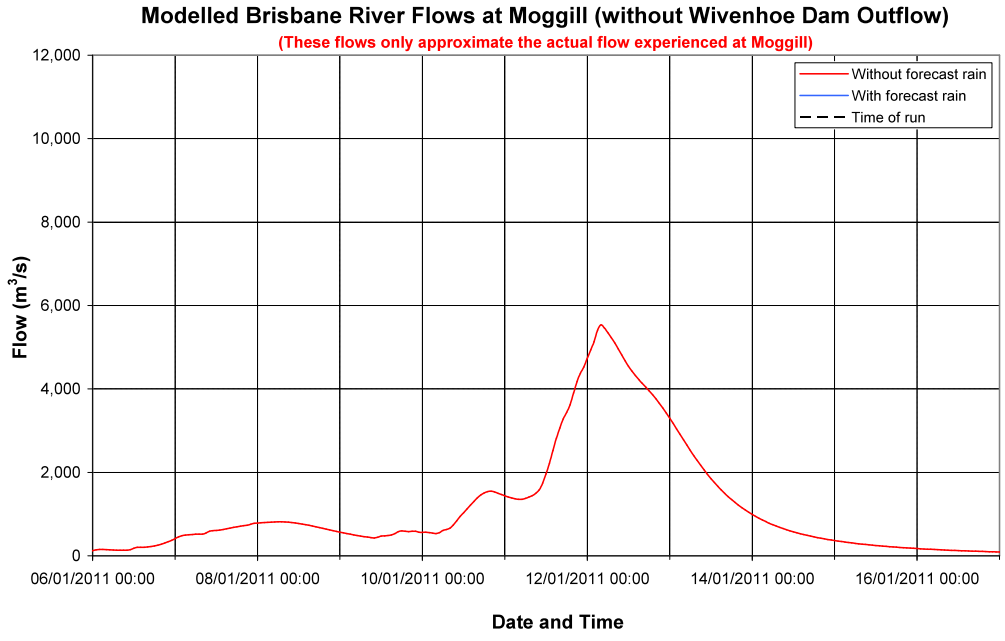
The flow at Moggill is influenced by Wivenhoe releases, rainfall leading to inflows into the Brisbane River downstream of Wivenhoe and flows from the Lockyer Creek and the Bremer River.

Water released from Wivenhoe reaches Moggill in approximately 16 hours, depending on the amount of water released and other variables.[416] The table below allows a comparison between the releases from Wivenhoe and the flow at Moggill 16 hours later.

It may be noted that the peak release from Wivenhoe was at 7.00 pm on 11 January (7464 m^3/s) and the peak flow at Moggill was 16 hours later at 11.00 am on 12 January (12 095 m^3/s). Drawing a conclusion from these figures is complicated by the fact that the flows from the Lockyer Creek and Bremer River were also affecting Moggill at this time; however, those figures at least show that the water from Wivenhoe constituted a significant portion of the peak of 12 095 m^3/s at Moggill.

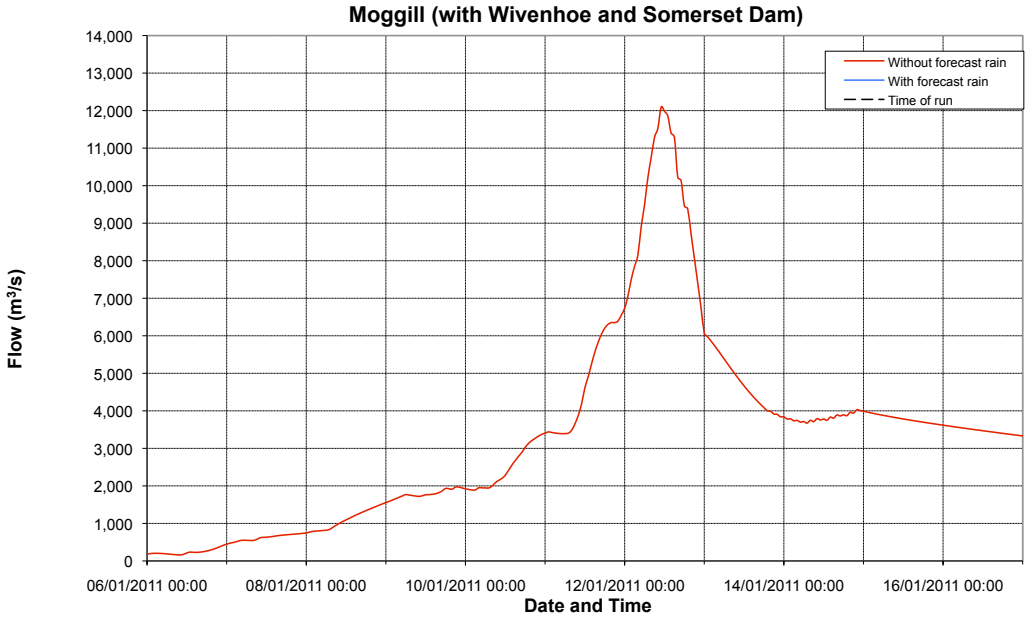
According to Seqwater's modelling,[417] the difference between the two graphs below illustrates the contribution of Wivenhoe discharge to the flow at Moggill.

Figure 2(j)



Source: Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 45. (Note: original graph supplied has only red line.)

Figure 2(k)



Source: Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 45. (Note: original graph supplied has only red line.)

A comparison can also be made regarding the recession of flow at Moggill. The table below shows that for 12 hours the flow at Moggill receded at a similar rate to the flow from Wivenhoe, which was rapidly decreased by the flood engineers from the evening of 11 January. For example, the flood engineers reduced outflow by about 5000 m^3/s from 7464 m^3/s at 8.00 pm on 11 January to 2547 m^3/s by 8.00 am on 12 January. Sixteen hours later at Moggill, the flows decreased by about 5900 m^3/s from 11 981 m^3/s at 12.00 pm 12 January to 6076 m^3/s at 12.00 am 13 January.

From that time onwards though, the rate of change in flow diverged. At Wivenhoe, releases were kept roughly the same (within 10 m^3/s) from 8.00 am 12 January to 9.00 am 13 January. In that same period 16 hours later at Moggill, the flow decreased from 6076 m^3/s at 12.00 am 13 January to 3871 m^3/s at 1.00 am 14 January. It can be inferred that this decrease in flows relates to the recession of the flows from the Lockyer, and/or the Bremer and/or rainfall or other local stream flows flowing into the Brisbane River below Wivenhoe.

Figure 2(l)

Time of release	Release (m^3/s)	Time 16 hours later	Flow in Moggill 16 hours later
10/01/11 11:00	2044	11/01/11 03:00	3409
10/01/11 12:00	2053	11/01/11 04:00	3399
10/01/11 13:00	2067	11/01/11 05:00	3392
10/01/11 14:00	2077	11/01/11 06:00	3394
10/01/11 15:00	2087	11/01/11 07:00	3404
10/01/11 16:00	2155	11/01/11 08:00	3481
10/01/11 17:00	2277	11/01/11 09:00	3652
10/01/11 18:00	2399	11/01/11 10:00	3876
10/01/11 19:00	2517	11/01/11 11:00	4182
10/01/11 20:00	2695	11/01/11 12:00	4613

Time of release	Release (m^3/s)	Time 16 hours later	Flow in Moggill 16 hours later
10/01/11 21:00	2699	11/01/11 13:00	4905
10/01/11 22:00	2705	11/01/11 14:00	5245
10/01/11 23:00	2709	11/01/11 15:00	5562
11/01/11 00:00	2713	11/01/11 16:00	5823
11/01/11 01:00	2717	11/01/11 17:00	6041
11/01/11 02:00	2721	11/01/11 18:00	6204
11/01/11 03:00	2724	11/01/11 19:00	6305
11/01/11 04:00	2726	11/01/11 20:00	6352
11/01/11 05:00	2731	11/01/11 21:00	6350
11/01/11 06:00	2736	11/01/11 22:00	6393
11/01/11 07:00	2745	11/01/11 23:00	6555
11/01/11 08:00	2753	12/01/11 00:00	6734
11/01/11 09:00	2991	12/01/11 01:00	7067
11/01/11 10:00	3347	12/01/11 02:00	7510
11/01/11 11:00	3533	12/01/11 03:00	7854
11/01/11 12:00	3667	12/01/11 04:00	8158
11/01/11 13:00	4250	12/01/11 05:00	8918
11/01/11 14:00	4562	12/01/11 06:00	9489
11/01/11 15:00	5167	12/01/11 07:00	10214
11/01/11 16:00	5786	12/01/11 08:00	10754
11/01/11 17:00	6432	12/01/11 09:00	11287
11/01/11 18:00	6774	12/01/11 10:00	11524
11/01/11 19:00	7464	12/01/11 11:00	12095
11/01/11 20:00	7464	12/01/11 12:00	11981
11/01/11 21:00	7458	12/01/11 13:00	11860
11/01/11 22:00	7111	12/01/11 14:00	11401
11/01/11 23:00	7103	12/01/11 15:00	11290
12/01/11 00:00	6118	12/01/11 16:00	10230
12/01/11 01:00	6109	12/01/11 17:00	10143
12/01/11 02:00	5492	12/01/11 18:00	9460
12/01/11 03:00	5483	12/01/11 19:00	9385
12/01/11 04:00	4888	12/01/11 20:00	8727
12/01/11 05:00	4304	12/01/11 21:00	8079
12/01/11 06:00	3727	12/01/11 22:00	7428
12/01/11 07:00	3143	12/01/11 23:00	6764
12/01/11 08:00	2547	13/01/11 00:00	6076
12/01/11 09:00	2547	13/01/11 01:00	5973
12/01/11 10:00	2547	13/01/11 02:00	5864
12/01/11 11:00	2547	13/01/11 03:00	5749
12/01/11 12:00	2547	13/01/11 04:00	5629
12/01/11 13:00	2547	13/01/11 05:00	5507
12/01/11 14:00	2549	13/01/11 06:00	5383

Time of release	Release (m^3/s)	Time 16 hours later	Flow in Moggill 16 hours later
12/01/11 15:00	2549	13/01/11 07:00	5258
12/01/11 16:00	2548	13/01/11 08:00	5135
12/01/11 17:00	2550	13/01/11 09:00	5013
12/01/11 18:00	2548	13/01/11 10:00	4894
12/01/11 19:00	2550	13/01/11 11:00	4778
12/01/11 20:00	2550	13/01/11 12:00	4665
12/01/11 21:00	2550	13/01/11 13:00	4557
12/01/11 22:00	2549	13/01/11 14:00	4454
12/01/11 23:00	2548	13/01/11 15:00	4355
13/01/11 00:00	2547	13/01/11 16:00	4260
13/01/11 01:00	2547	13/01/11 17:00	4170
13/01/11 02:00	2546	13/01/11 18:00	4085
13/01/11 03:00	2544	13/01/11 19:00	4004
13/01/11 04:00	2544	13/01/11 20:00	3987
13/01/11 05:00	2542	13/01/11 21:00	3914
13/01/11 06:00	2541	13/01/11 22:00	3905
13/01/11 07:00	2540	13/01/11 23:00	3840
13/01/11 08:00	2539	14/01/11 00:00	3839
13/01/11 09:00	2537	14/01/11 01:00	3781
13/01/11 10:00	2536	14/01/11 02:00	3787
13/01/11 11:00	2534	14/01/11 03:00	3735
13/01/11 12:00	2534	14/01/11 04:00	3745
13/01/11 13:00	2592	14/01/11 05:00	3699
13/01/11 14:00	2650	14/01/11 06:00	3714
13/01/11 15:00	2650	14/01/11 07:00	3672

Notes to table:

1. The Wivenhoe outflow figures are from the Dam Inflow and Flood Release Details section of the Seqwater Flood Event Report, 2 March 2011 (Exhibit 24), pages 154 to 166.
2. The figures in the Estimated Flow at Moggill column have been taken from Seqwater's modelling, run 45, completed at 12.00 pm, 19 January 2011. The flow at Moggill is estimated by the use of a rainfall runoff model which forms part of the real time flood model.

2.9.2 Modelling of the impact of dam releases on flooding

It is not disputed by any party that releases from Wivenhoe contributed significantly to flooding downstream. The proportions of that contribution are the subject of continuing modelling work.

Seqwater has engaged Sinclair Knight Merz to update a hydrodynamic model of the Brisbane River to simulate the January 2011 flood event. (As discussed elsewhere in more detail, a hydrodynamic model is considered to provide more accurate estimates of the effect of releases in terms of flood levels and inundation areas than hydrologic models.) See also *2.3.3 Tools at the flood operations centre* and *2.6 Decision-making and conditions at the flood operations centre*.

The Commission engaged Mr Babister to review and assess that modelling. It was not until 5 July 2011 that Mr Babister and Sinclair Knight Merz agreed on a model build and calibration. His review, completed on 13 July 2011, was received by the Commission after the process of printing this Interim Report had begun. His report has been

published on the Commission's website. It will be examined and the Commission will receive further submissions as to the conclusions which might be drawn from it for the purposes of its final report.

The Commission is of the view that nothing said by Mr Babister affects the recommendations which have been made in this Interim Report.

To the extent the Commission has found Seqwater has not complied with the Wivenhoe manual, that non-compliance has been of limited functional significance. The effect of failing to take into account forecast rainfall cannot be quantified because the evidence before the Commission allows no clear conclusion as to how and to what extent it should have been factored into lake level prediction. Consequently, no conclusions can be drawn about the consequences of non-compliance, whether on the basis of the modelling performed for Seqwater, or any other modelling done for the event.

That is not to say that such modelling work has no purpose. The modelling can provide analysis of the timing and quantity of releases and be used to test whether different operating strategies may have had different consequences. Those issues are part of the Commission's recommendations as to the process by which the future Wivenhoe manual should be developed. See also *2.5.8 Longer term review of the Wivenhoe manual*.

2.9.3 Effect of releases on riverbanks

The Commission received several submissions from people who live or work in the mid Brisbane River region, extending from Wivenhoe Dam to Mt Crosby Weir,[418] and along the Brisbane River north of Wivenhoe Dam,[419] most notably the township of Harlin. Many of those making submissions own land that suffered severe erosion or bank slumping (where chunks of bank material become unstable and topple into the river in a single event) during the 2010/2011 wet season.[420]

For some of these landowners the loss of land has been substantial:[421] a resident of Borallon whose land borders the Brisbane River reports the loss of 15 acres of land[422] while a Harlin landowner describes losses of up to 30 acres from his property.[423] Others comment more generally, stating that large areas of land have been washed away along kilometres of the riverbanks in these regions.[424]

The Minister for Energy and Water Utilities, Mr Robertson, gave evidence that he had viewed the riverbanks below Wivenhoe Dam since the 2010/2011 flooding and agreed there had been significant damage to these riverbanks.[425]

Under the Moreton Resource Operations Plan, Seqwater, as the holder of the Resource Operations Licence,[426] is required to undertake inspections of the streams within the Central Brisbane River and Stanley River water supply scheme for evidence of bank slumping resulting from the operation of Seqwater's water infrastructure.[427] The Commission is advised that Seqwater is carrying out preliminary surveys and assessments of the remedial works required within relevant areas.[428]

Whether the operation of Wivenhoe and Somerset dams during the 2010/2011 wet season caused or contributed to instability, slumping or erosion of the Brisbane River's banks is, in Seqwater's view, a matter for detailed expert evidence. This view is also shared by Terry Wall, the acting Director-General of DERM, who considers a comprehensive geomorphological assessment necessary to determine the causative effect of the bank slumping.[429]

While there is strong evidence that the releases from Wivenhoe Dam had an effect on the banks downstream of it,[430] the Commission's view is that this is a matter more properly considered in its final report, and that Seqwater should be allowed, as it proposes, to adduce expert evidence on the topic.

2.10 Operation of North Pine Dam

2.10.1 Managing flood events

As with Wivenhoe and Somerset dams, Seqwater is not obliged by legislative or regulatory rules to operate North Pine Dam during a flood event in a particular manner. Seqwater, as the owner of North Pine Dam, is immune from civil liability if it, honestly and without negligence, operates North Pine Dam in compliance with the current *Manual of Operational Procedures for Flood Mitigation at North Pine Dam*.[431]

The North Pine manual has only one flood operation strategy: to release the whole volume of a flood through the dam while attempting to keep the volume of the outflows lower than the volume of the inflows.[432] To achieve this strategy, the North Pine manual specifies that the dam's gates are to be opened to particular increments at particular time intervals determined by the lake level.[433]

Overtopping of North Pine Dam is likely to result in dam failure.[434] The dam's emergency action plan identifies that, if North Pine Dam were to fail, the safety of 838 people would be at risk.[435] Unsurprisingly, then, the primary objective of the North Pine manual flood operation strategy is ensuring the structural safety of the dam.[436]

The second objective is to minimise disruption to the community in areas downstream of the dam.[437] This objective involves minimising the incidence of submergence of bridges, such as Youngs Crossing, and public areas downstream of the dam.[438]

The other objective of the procedures in the North Pine manual is the minimisation of impacts to riparian flora and fauna during the drain down phase of a flood event.[439] The retention of full supply level at the conclusion of a flood event is included as an objective but, as noted in *2.5.1 Structure of the Wivenhoe manual*, it does not in truth warrant description as a flood mitigation objective.

The North Pine manual articulates the general aim of the flood engineers: to empty stored floodwaters as quickly as possible while meeting all of these objectives.[440]

During flood events, Seqwater transfers control over North Pine Dam from its own staff to a dedicated flood operations centre.[441] For a description of the workings of the flood operations centre, see *2.6 Decision-making and conditions at the flood operations centre*.

2.10.2 Wet season flood events

North Pine Dam experienced 18 separate flood events between Sunday 10 October 2010 and Saturday 5 March 2011.[442] The flood operations centre was mobilised for each event before the lake level reached the gate opening trigger.[443] The table below details the duration and extent of these flood events, as specified in the text of Seqwater's *2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam* (May 2011) and *January 2011 Flood Event Report on the Operation of North Pine Dam* (11 March 2011).[444]

Figure 2(m)

Flood event	Start	End	Peak inflow (m^3/s)	Peak outflow (m^3/s)	Peak lake level (metres)
1	11 Oct 2010 6.00 am	14 Oct 2010 8.00 am	950	907	40.12
2	16 Oct 2010 6.00 am	16 Oct 2010 6.00 pm	220	200	39.68
3	4 Dec 2010 7.05 am	5 Dec 2010 7.00 am	(not specified)	151	39.64
4	6 Dec 2010 12.35 pm	7 Dec 2010 3.00 pm	200	332	39.82
5	9 Dec 2010 7.10 pm	10 Dec 2010 5.00 am	(not specified)	152	39.66
6	14 Dec 2010 7.20 pm	15 Dec 2010 5.00 am	(not specified)	104	39.67
7	16 Dec 2010 7.40 pm	17 Dec 2010 5.15 am	90	80	39.63
8	18 Dec 2010 7.10 pm	19 Dec 2010 7.00 am	(not specified)	152	39.68
9	19 Dec 2010 9.10 pm	21 Dec 2010 5.00 am	200	200	39.68

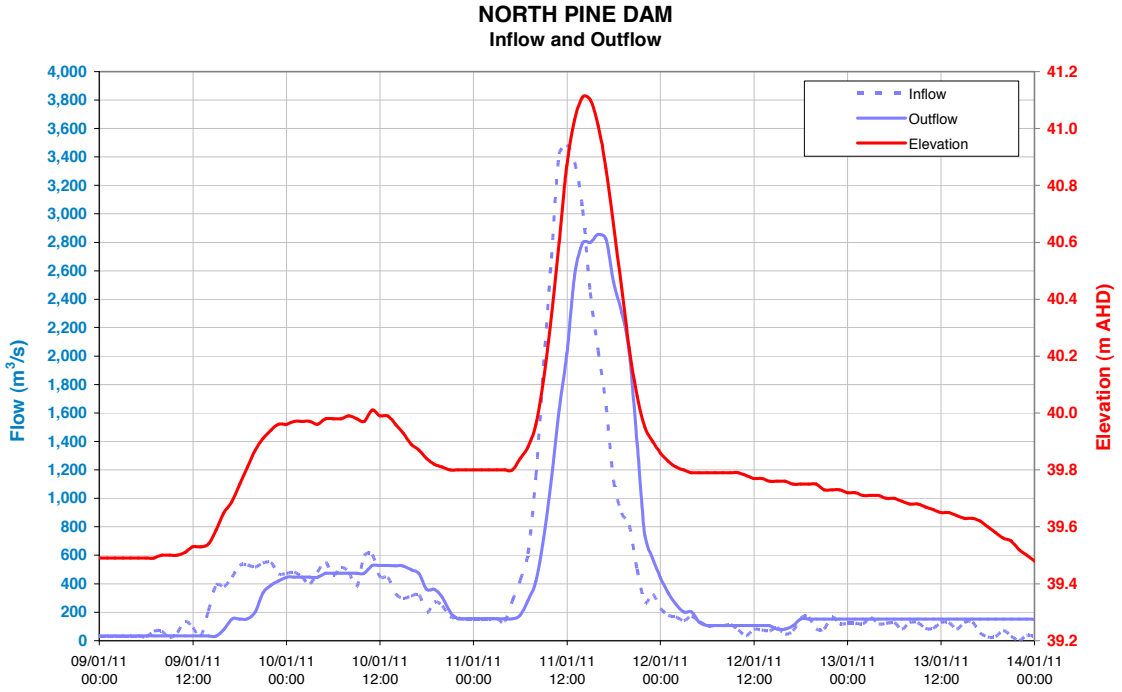
Flood event	Start	End	Peak inflow (m^3/s)	Peak outflow (m^3/s)	Peak lake level (metres)
10	23 Dec 2010 7.20 pm	24 Dec 2010 4.45 am	(not specified)	197	(not specified)
11	25 Dec 2010 7.15 pm	26 Dec 2010 7.15 am	(not specified)	275	(not specified)
12	26 Dec 2010 8.00 pm	29 Dec 2010 7.00 am	450	200	39.77
13	1 Jan 2011 7.30 pm	2 Jan 2011 7.00 am	(not specified)	200	39.66
14	6 Jan 2011 7.42 am	14 Jan 2011 5.00 am	3 484	2 854	41.11
15	18 Jan 2011 9.15 pm	19 Jan 2011 5.00 am	(not specified)	200	(not specified)
16	20 Jan 2011 12.40 am	20 Jan 2011 2.00 pm	550	150	(not specified)
17	21 Feb 2011 9.00 pm	22 Feb 2011 6.15 am	150	200	(not specified)
18	4 Mar 2011 7.00 pm	5 Mar 2011 7.00 am	65	48	(not specified)

Excluding the flood event of 6 January 2011 to 14 January 2011 (flood event 14 in the above table), the other 17 flood events can be described as frequent flood events.[445] The chance that such an event will occur in any one year is less than 1 in 50.[446]

The flood event of 6 January 2011 to 14 January 2011 was the biggest flood event ever experienced at North Pine Dam, both in terms of inflow volume and inflow rate.[447] The peak inflow (3484 m^3/s) to North Pine Dam was estimated to occur at 12.00 pm on 11 January 2011.[448] Two hours later, the peak lake level for the event, 41.11 metres, was reached. This was 1.51 metres above North Pine Dam's full supply level, but 3.68 metres below the level of its embankment crest.[449] Another two hours later, at 4.00 pm, the peak outflow from North Pine Dam was estimated as being 2854 m^3/s.[450]

The graph below shows North Pine Dam's lake level, inflows and outflows during the 6 January 2011 to 14 January 2011 flood event.

Figure 2(n)



Source: Seqwater, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011, page 68.

At 5.30 pm on 6 January 2011, the flood operations centre issued North Pine Directive 1. It required gate operations to commence at 7.00 pm that night, subject to Moreton Bay Regional Council's confirmation that Youngs Crossing had been closed.[451] In fact, the gate openings at North Pine Dam were delayed until about 7.15 pm because the gates at Youngs Crossing were not closed until 7.00 pm.[452] Youngs Crossing remained closed to traffic until the morning of 14 January 2011.[453]

As the graph above shows, releases dramatically escalated on Tuesday 11 January 2011 when intense rainfall produced unprecedented inflows at North Pine dam from about 7.00 am to 2.00 pm.[454] During this seven hour period, 85 gate operations were undertaken.[455]

The prescribed gate operating intervals aim to minimise adverse impacts on the river system caused by rapid rises in downstream water levels.[456] The North Pine manual states that the opening intervals can be reduced if the gates are at risk of being overtopped or the safety of the dam is at risk; in that case they are 'generally not allowed' to fall more than three increments behind the prescribed setting for the given lake level.[457] The North Pine manual also permits reduction in the closing intervals to preserve storage and reduce downstream flooding.[458]

The evidence of one of the senior flood engineers, Mr Ayre, is that the gate opening and closing intervals provided by part 8.6 of the North Pine manual were followed at all times except during the rapid rise in water levels on 11 January 2011, and directly following the flood peak.[459] In the first of these periods the gate opening intervals were reduced to manage rapid water level rises; the reasonable inference is that this was to preserve the safety of the dam.[460] The interval was appropriately adjusted to ensure the gates were never more than three increments behind the minimum setting for the given lake level.[461] Following the peak the gate closing intervals were reduced to preserve storage and reduce downstream flooding.[462]

2.10.3 Safety concerns

Two key issues in relation to the safety of North Pine Dam emerged during the flood event of 6 January 2011 to 14 January 2011: the reliability of North Pine Dam's design flood hydrology and the adequacy of its gate operating systems. These issues, and Seqwater's investigations and proposed actions to redress them are discussed below.

Reliability of the design flood hydrology

The design flood hydrology for North Pine Dam was reviewed by SunWater in October 2007.[463] A hydrologic model was developed and calibrated to three pre-dam floods and four post-dam events.[464] According to this study, the peak lake level of North Pine Dam during the 6 January 2011 to 14 January 2011 flood event (41.11 metres) was consistent with a flood event with a chance of occurring in any one year of close to 1 in 10 000.[465]

However, the catchment average rainfall intensity for the 12 hour period to Tuesday 11 January 2011 at 3.00 pm (which included the period of the heaviest rainfall recorded in the North Pine catchment) indicated that the rainfall event had between a 1 in 200 and a 1 in 500 chance of occurring in any one year.[466]

The discrepancy in the assessment of the rarity of the flood event as determined on the one hand by the peak lake level, and on the other hand by the catchment average rainfall intensity of the 12 hour period to Tuesday 11 January 2011 at 3.00 pm, raises questions about the design flood hydrology for North Pine Dam.[467]

The current assessment of the maximum flood which North Pine Dam is capable of passing without the dam failing is based on the operating rules in the North Pine manual and the design flood hydrology.[468] Therefore, questions about the accuracy of the design flood hydrology have direct implications for the current assessment of North Pine Dam's flood capacity. Because North Pine Dam is required to be able to pass a flood of a particular size under the DERM *Guidelines on Acceptable Flood Capacity for Dams,*[469] uncertainty about North Pine Dam's flood capacity in turn affects the assessment of whether North Pine Dam complies with these safety guidelines.

Adequacy of the gate operating mechanism

During the 6 January 2011 to 14 January 2011 flood event, North Pine Dam reached a peak lake level that was only 50 centimetres below the level of the electric winch motors which control the dam's gates.[470] If the electric winch motors become submerged, they cannot operate and normal control of the gates is lost.[471] This may result in overtopping of the dam.[472]

Currently, if failure or submergence of the electric winch motors were to occur, an auxiliary gate operating mechanism (a trailer mounted motor with petrol driver generator) would allow the winches to be operated from the crest of North Pine Dam.[473]

In September 2010, Seqwater commenced a project to provide an additional backup system for the operation of the dam's gates. The project has identified a preferred option (an independent hydraulic system) to operate the gates and is now part of Seqwater's *North Pine Dam Acceptable Flood Study Investigations* (discussed below).

Seqwater's investigations

The Commission is advised that Seqwater is undertaking a project called *North Pine Dam Acceptable Flood Study Investigations* aimed at, among other things, investigating and improving the reliability of the design flood hydrology and the adequacy of the gate operating systems for North Pine Dam.[474] Seqwater proposes to report to the Dam Safety Regulator, Mr Allen, on at least a monthly basis in relation to its progress with this project.

Seqwater is reviewing the dam hydrology and flood event details as part of these investigations. It has engaged an engineering firm to review this work and identify further work required to evaluate the performance of North Pine Dam.[475]

The investigations include the following tasks:

- a review of the rainfall data to determine the rarity of the 6 to 14 January 2011 flood event
- a review and recalibration of the design flood hydrology by using the rainfall and flow data obtained in the 6 to 14 January 2011 flood event
- a review of the rating curves (which show the relationship between outflow and lake level) for the gates
- a review of the storage curve (which shows the storage volume of North Pine Dam at given lake levels)
- a review of the structural adequacy of the dam
- a review of the gate operational procedures to assess the impact on flood capacity
- improvement of the gate operating mechanism.

In conducting these investigations, Seqwater is prioritising the identification of the maximum flood that can be safely passed by the dam.[476]

2.10.4 Personal safety of the dam operator

On 11 January 2011, from about 11.00 am until about 7.00 pm, the area in which the primary controls for North Pine Dam's gates are located was inundated with flowing water.[477] The dam operator working during those hours operated the gates from this area at risk to his personal safety. The water reached a level about half way up the operator's lower leg; he described the velocity of the water was such that if he tripped and fell he could have been washed out of the area.[478]

A safety harness was available for the operator's use and he had the option of operating the gates from a control room inside the dam wall which was not affected by water.[479] He elected to operate the gates from the inundated platform because it was the only location from which he could observe the gates while opening.[480]

Seqwater has since installed a duplicate electronic gate control panel which will allow gate operations to be undertaken from a higher position.[481] The Commission is satisfied that the installation of the duplicate electronic gate panel will remove this particular safety risk to dam operators in similar future flood events.

2.10.5 Interim review of the North Pine manual

Part 8.4 of the North Pine manual sets out the flood operation strategy for North Pine Dam.[482] It states that the gate opening settings shown in Appendix C of the North Pine manual are normally used to determine flood releases but permits departures from those settings in limited circumstances. One of those circumstances is that, subject to the senior flood engineer's exercising his reasonable discretion under part 2.8 of the North Pine manual to depart from the manual, pre-release of water is allowed to reduce the risk of the dam overtopping.

The meaning of 'pre-release' in this context is unclear. It could permit releases of water before the onset of a flood event. It could also mean that the flood operation engineers can open the gates more quickly than the sequence prescribed by the North Pine manual.

One of the senior flood engineers gave evidence that he would expect pre-releases under part 8.4 to occur when he (or another senior flood engineer) had relatively good knowledge about the magnitude of the likely inflows. The only practical example he suggested was where a gate malfunction made pre-releases necessary in order to accommodate a loss of release capacity.[483]

What is meant by the term 'pre-release', and in turn the basis on which early release of water (not in accordance with usual gate openings) is permitted under the North Pine manual, remains obscure.

As for the Wivenhoe manual (see *2.5.7 Interim review of the Wivenhoe manual*) the Commission finds that an interim review of the North Pine manual is required before the onset of the next wet season to ensure the manual clearly identifies the permitted practice.

Recommendations

2.25 Seqwater should:

1. conduct an interim review of the North Pine manual
2. have the draft manual assessed by independent expert peer reviewers
3. consider the expert peer reviews
4. submit the draft manual to DERM for approval under the Act so that it can be approved before 1 October 2011.

2.26 Particular attention should be paid during the interim review of the North Pine manual to clarifying the circumstances in which pre-releases under part 8.4 are permitted.

2.10.6 Longer term review of the North Pine manual

Seqwater's view is that the very large size of the flood event of 6 to 14 January 2011 necessitates a formal review of the North Pine manual[484] and the Commission agrees. The Commission also considers, particularly in light of the dam's location in an urban area and the risks associated with its failure, that the community has a right to expect that the North Pine manual should incorporate current best practice in hydrology, meteorology and dam management.

As with the review of the Wivenhoe manual, the Commission acknowledges that the review of the North Pine manual may involve considerable time and expense, but considers this kind of investment, managed well, would serve the public interest.

To ensure the review is comprehensive and takes into account the views of all of the agencies affected by the operation of North Pine Dam, the Commission recommends that the review of the North Pine manual be supervised by a steering committee of senior representatives from DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council and the Moreton Bay Regional Council. As to the involvement of the Bureau of Meteorology and SunWater, the comments in *2.5.8 Longer term review of the Wivenhoe manual* apply equally here.

The role and function of the steering committee should be substantially as described at *2.5.8 Longer term review of the Wivenhoe manual*.

The Commission specifically recommends that the steering committee determine whether any hydrological studies in addition to Seqwater's review of the design flood hydrology[485] are required to be carried out. The results of these hydrological studies should be incorporated into the review of the North Pine manual. The steering committee should engage independent experts to peer review the technical work undertaken during the review.

Further, the steering committee should oversee modelling which assesses the consequences in terms of risk to life and safety, and economic, social and environmental damage of all potential operating strategies and full supply

levels. However, the responsibility for identifying which operating strategy best satisfies the needs of the community rests with the Queensland Government.

Once draft changes to the North Pine manual are settled upon, the steering committee should engage independent experts to peer review the draft manual before it is submitted to DERM for approval.

Recommendations

2.27 Seqwater should act immediately to establish:

1. a steering committee to oversee the long term review of the North Pine manual including senior representatives of at least DERM, Seqwater, the Water Commission, the Water Grid Manager, Brisbane City Council and the Moreton Bay Regional Council
2. a technical review committee comprised of independent experts in at least hydrology, meteorology and dam operations to examine all technical work completed as part of the review.

2.28 The steering committee should:

1. oversee the continuation of Seqwater's *North Pine Dam Acceptable Flood Study Investigations* in accordance with the scope and program of activities advised to the Commission as at 6 May 2011
2. determine whether any hydrological studies, in addition to those undertaken as part of the *North Pine Dam Acceptable Flood Study Investigations*, are required
3. ensure that modelling across a range of full supply levels and operating strategies, including variations of the gate increments and gate opening intervals is undertaken
4. ensure all of the above work is reviewed by the technical review committee.

2.10.7 North Pine River crossings

Youngs Crossing (on Youngs Crossing Road, Petrie) and AJ Wyllie Bridge (on Gympie Road, Petrie) are both located downstream of North Pine Dam. They are the only two points at which cars can cross the North Pine River. Youngs Crossing is controlled by the Moreton Bay Regional Council while A J Wyllie Bridge is a state controlled road.

Youngs Crossing was closed during each of the 18 flood events which occurred during the period 10 October 2010 to 5 March 2011,[486] including from 7.00 pm on 6 January 2011 to early on the morning of 14 January 2011.[487] Over the October to March period, the flood engineers tried, where they could, to limit disruption to the community downstream of North Pine Dam by minimising the period during which the crossing was closed to traffic and avoiding closures during peak traffic periods. Even so, the frequent closures of Youngs Crossing during this period caused inconvenience to that community.

The two northbound lanes (low bridge) and two southbound lanes (high bridge) of A J Wyllie Bridge suffered damage and were closed following the 2010/2011 floods.[488] During the closure of A J Wyllie Bridge, traffic was diverted via the Bruce Highway or Youngs Crossing Road.[489] Emergency repairs to the low bridge were undertaken to enable one lane of traffic to pass in each direction by 25 January 2011.[490] On 24 March 2011 the Minister for Main Roads, Fisheries and Marine Infrastructure announced that the high bridge would be demolished and a new bridge constructed.[491]

Closure of either one of Youngs Crossing or A J Wyllie Bridge causes congestion and delays on other major roads. The bridge closures have been the subject of concern to North Pine residents[492] and the Moreton Bay Regional Council.[493]

One of the flood engineers considered that upgrading Youngs Crossing, so that it would need to be closed less frequently by releases from North Pine Dam, would make a big difference to the operation of North Pine Dam and resolve most of the local community's issues with the dam.[494]

As shown on the table in *2.10.2 Wet season flood events* above, the peak outflow from North Pine Dam exceeded 300 m^3/s on three occasions during the period 10 October 2010 to 5 March 2011. Seqwater's *2010/2011 Wet*

Season Flood Events Report on the operation of North Pine Dam concludes that if Youngs Crossing were raised so that it would only be inundated by flows exceeding 300m^3/s, it is unlikely to have been closed by 16 of the 18 flood events.[495]

Recommendation

2.29 The Moreton Bay Regional Council should investigate options for the upgrade of Youngs Crossing and undertake a cost-benefit analysis of these to determine an outcome which best serves the public interest.

2.10.8 Isolation of some Whiteside residents

The submission of the North Pine Residents Association proposed that Seqwater permit vehicular access via North Pine Dam's wall to emergency vehicles and residents of Vores Road and Grant Street, Whiteside (a suburb adjacent to North Pine Dam), when Vores Road, the residents' only evacuation route, becomes impassable because of the flooding of Whiteside Creek.[496] The President of the residents association estimated that about 40 houses or 150 people became isolated by the flooding of Whiteside Creek and the closure of Vores Road. This was thought to have occurred about six times in the prior year and a half.[497]

North Pine Dam's wall is not a designated road, but its crest could serve as a single lane concrete roadway.

The chief executive officer of Seqwater indicated that Seqwater would be open to allowing emergency services vehicles to use North Pine Dam's wall as an alternative access route but, because it is an operating work site, it would be too dangerous to permit residents use of the dam wall as a general alternative access route.[498]

The Commission accepts that the dangers identified by Seqwater make it impracticable for Whiteside residents to use North Pine Dam's wall as an access road during flood events.

However, access arrangements for emergency services vehicles to reach the affected residents when isolated, which may include the use of North Pine Dam's wall, should be put in place before the commencement of the next wet season.

Recommendation

2.30 The Moreton Bay Regional Council should consult with Seqwater and the local police, ambulance and fire and rescue services to make arrangements for emergency vehicles to access Vores Road and Grant Street, Whiteside, when Vores Road is closed by the flooding of Whiteside Creek.

(Endnotes)

1 Administrative Arrangements Order (No.1) 2011.

2 Administrative Arrangements Order (No.2) 2011.

3 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p9].

4 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p9].

5 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p21].

6 Exhibit 43, Transcript of Interview by Commission staff of John Ruffini [p2-3].

7 Section 266 of the *Water Act 2000* provides that such applications must be made to the chief executive (Director-General of DERM).

8 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p11].

9 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p38-41].

10 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p9].

11 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p23].

12 Section 345, *Water Act 2000*.

13 Section 346(g), *Water Act 2000*.

14 Exhibit 393, Statement of Peter Borrows, Annexure PB-2.

15 Exhibit 397, Statement of Peter Allen [p37-38: para 110-112; p 42: para 125].

16 Queensland, Parliamentary Debates, Legislative Assembly, 30 October 2007 (Hon AP Fraser, Second Reading Speech) [p3905].

17 Submission of Seqwater, 11 March 2011 [p16: para 57].

18 Sections 45 and 46, *South East Queensland Water (Restructuring) Act 2007*.

19 Queensland Urban Utilities, Allconnex Water and Unity Water.

20 Exhibit 17, First Statement of Robert Ayre [p12: para 51].

21 Submission of Seqwater, 11 March 2011 [p6: para 11; p15: para 51(a)].

22 Submission by Seqwater, 11 March 2011 [p16: para 59].

23 Exhibit 501, First Statement of Robert Keogh [p9: para 4].

24 Exhibit 501, First Statement of Robert Keogh [p13].

25 Section 360ZH, *Water Act 2000*.

26 The other portfolio Ministers are responsible for taking some proposed regulations to the Executive Council.

27 Section 95, *Water Act 2000*.

28 Chapter 2, Part 4, *Water Act 2000*.

29 Section 353(1), *Water Supply (Safety and Reliability) Act 2008*.

30 Section 359A, *Water Supply (Safety and Reliability) Act 2008*.

31 Submission of the State of Queensland, 11 March 2011, Volume 9, Section 6 [p13].

32 Section 10, *Water Supply (Safety and Reliability) Act 2008*.

33 Exhibit 390, Statement of John Bradley, Annexure JNB-06 'DERM *Water Supply (Safety and Reliability) Act 2008* Water Supply (Chief Executive) Delegation (No.1) 2010'. These delegations are permitted by section 15(1) of the *Water Supply (Safety and Reliability Act) 2008*.

34 Section 370, *Water Supply (Safety and Reliability) Act 2008*.

35 Exhibit 397, Statement of Peter Allen [p7: para 28].

36 Exhibits 49 and 391, DERM, DS5.1 Flood mitigation manual for a dam.

37 Section 374(4) provides that for the purposes of the section 'owner' of a dam includes the operator of the dam, a director of the owner or operator, an employee of the owner or operator or an agent of the owner or operator.

38 Exhibit 501, First Statement of Robert Keogh [p22-23].

39 See, for example, Exhibit 501, First Statement of Robert Keogh [p22].

40 Exhibit 501, First Statement of Robert Keogh [p21]; Exhibit 407, Report to the Queensland Floods Commission of Inquiry, Mark Babister, 11 May 2011 [p12].

41 Section 38(1), *Water Act 2000*.

42 Exhibit 390, Statement of John Bradley, Annexure JNB-19.

43 Exhibit 501, First Statement of Robert Keogh [p13].

44 Exhibit 501, First Statement of Robert Keogh [p13].

45 Exhibit 501, First Statement of Robert Keogh, Schedule 17 [p4].

46 Submission of Seqwater, 11 March 2011 [p27: para 123-124].

47 Exhibit 397, Statement of Peter Allen [p5: para 19].

48 For a detailed history as to the investigations leading to the construction of Somerset Dam, see Submission of Geoffrey Cossins, received 10 March 2011 [p6-7].

49 Submission of Geoffrey Cossins, received 10 March 2011 [p7].

50 Submission of Geoffrey Cossins, received 10 March 2011 [p7].

51 All references to metres in this chapter are to metres AHD (Australian Height Datum).

52 Exhibit 397, Statement of Peter Allen [p5: para 21].

53 Submission of Seqwater, 11 March 2011 [p31: para 130(b)].

54 Exhibit 17, First Statement of Robert Ayre [p18: para 88].

55 Submission of Seqwater, 11 March 2011 [p31: para 30(b)].

56 Submission of Seqwater, 11 March 2011 [p28: para 28].

57 See Exhibit 397, Statement of Peter Allen [p3: para 10], reference to 'Future Brisbane Water Supply and Flood Mitigation', June 1971.

58 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011[pi].

59 Exhibit 17, First Statement of Robert Ayre [p59-60: para 281-290].

60 For example, Guidelines on Assessment of the Consequences of Dam Failure, ANCOLD, 2000; Guidelines on Selection of Acceptable Flood Capacity for Dams, ANCOLD, 2000.

61 Exhibit 397, Statement of Peter Allen [p3: para 9].

62 Exhibit 426, Statement of Barton Maher [p3: para 14].

63 Exhibit 426, Statement of Barton Maher [p3: para 14].

64 Exhibit 17, First Statement of Robert Ayre [p12: para 291].

65 There are conditions attaching to the exercise of reasonable discretion by the senior flood engineer - see Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p7-8].

66 Exhibit 397, Statement of Peter Allen [p4: para 14].

67 Exhibit 426, Statement of Barton Maher [p3: para 15].

68 Submission of Seqwater, 11 March 2011 [p37].

69 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p18].

70 Exhibit 17, First Statement of Robert Ayre [p19: para 96]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p4].

71 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p4].

72 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p4].

73 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p4].

74 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p6].

75 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p7].

76 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p8].

77 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p10].

78 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p10].

79 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p11].

80 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p12].

81 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p12].

82 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p13].

83 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p14].

84 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p15].

85 Letter from Holding Redlich (representing SunWater) to Commission dated 6 July 2011; Letter from Allens Arthur Robinson (representing Seqwater) to Commission dated 6 July 2011.

86 Exhibit 416, Seqwater SunWater Service Level Agreement – Flood Management Services, Service Schedule [p4].

87 Training & Flood Preparedness for Seqwater Dams for the Year Beginning 30 September 2009, SunWater, October 2009; Training & Flood Preparedness for Seqwater Dams for the Year Beginning 30 September 2008, SunWater, October 2008; Training & Flood Preparedness for SEQWater Dams for the Year Beginning 30 September 2007, SunWater, October 2007; Training & Flood Preparedness for SEQWater Dams for the Year Beginning 30 September 2006, SunWater, October 2006; Statement of Preparedness for 2004-2005 Wet Season, SunWater, October 2004; Report on Training and Flood Preparedness for SEQWCo. Dams for Year Beginning 30 September 2002, SunWater, October 2002; Report on Training and Flood Preparedness for SEQWater Dams for Year Beginning 30 September 2001, SunWater, September 2001; SunWater Annual Reports on Contract with Seqwater, 2006-2007, 2005-2006, 2004-2005, 2003-2004, 2002-2003, 2002-2001, 2000-2001; SunWater Monthly Work Activities Status Report, Oct 2005, Nov 2005, Mar 2006, Jul 2006, Aug 2006, Sept 2006, Oct 2006, Nov 2006, Dec 2006, Jan 2007, Feb 2007, Mar 2007, Apr 2007, May 2007, Jan 2008, Feb 2008, Mar 2008, Apr 2008, May 2008.

88 SunWater Annual Reports on Contract with Seqwater, 2006-2007, 2005-2006, 2004-2005 2003-2004, 2002-2003, 2001-2002.

89 SunWater Annual Report on Contract with Seqwater, 2000-2001.

90 Transcript, 11 April 2011, Brisbane [p83: line 30].

91 Exhibit 403, Statement of Kenneth Morris, Annexure KJM-03. Note that the report deals with the Esk Shire Council area which has now been incorporated into the Somerset Regional Council.

92 See Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p13].

93 Transcript, 12 April 2011, Brisbane [p110: line 45].

94 Transcript, 13 April 2011, Brisbane [p216: line 30].

95 Exhibit 407, Report to the Queensland Floods Commission of Inquiry, Mark Babister, 11 May 2011 [p35-36].

96 Transcript, 13 April 2011, Brisbane [p215: line 45].

97 Transcript, 13 April 2011, Brisbane [p216: line 8].

98 Transcript, 13 April 2011, Brisbane [p216: line 30].

99 Mark Babister and Rhys Hardwick-Jones, Review and Comment on Seqwater Report, 6 July 2011 [p11: para 28].

100 Mark Babister and Rhys Hardwick-Jones, Review and Comment on Seqwater Report, 6 July 2011 [p9: para 22].

101 Exhibit 407, Report to the Queensland Floods Commission of Inquiry, Mark Babister, 11 May 2011 [p36].

102 Transcript, 12 April 2011, Brisbane [p110: line 45]; Transcript, 13 April 2011, Brisbane [p216: line 30].

103 Transcript, 12 April 2011, Brisbane [p110: line 45].

104 Mark Babister and Rhys Hardwick-Jones, Review and Comment on Seqwater Report, 6 July 2011 [p13: para 31].

105 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p28].

106 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p84] (entry at 8.50 pm, 9 January 2011).

107 Exhibit 48, Email from Rob Drury to Flood Engineers including email from Flood Engineers to Barton Maher, 14 January 2011; Transcript, 15 April 2011, Brisbane [p375: line 41].

108 Exhibit 426, Statement of Barton Maher, Annexure 4(m).

109 Exhibit 426, Statement of Barton Maher, Annexure 4(k). See also Exhibit 426, Statement of Barton Maher, Annexure 4(r).

110 Exhibit 426, Statement of Barton Maher, Annexure 4(h).

111 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p17]; Exhibit 29, Manual of Operational Procedures for Flood

Mitigation at North Pine Dam, Revision 5, 2010 [p16-17].

112 Exhibit 26, Flood Operations Preparedness Report – Wivenhoe, Somerset and North Pine Dam, October 2010; Seqwater Supplementary Submission, 2 June 2011 [p96: para 420].

113 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p39-45].

114 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p6]; Exhibit 29, manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p6-7].

115 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p6]; Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p6-7].

116 Transcript, 12 April 2011, Brisbane [p115: line 57].

117 Exhibit 396, DERM, Moreton Resource Operations Plan 2009, Attachment 5 [p91].

118 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p19]; Appendix C.

119 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, parts 1.1, 2.2, 3.1, 3.5, 8.4, 8.5, 9.3, 9.4 and 10.3. See also, the evidence of Minister Robertson about the mechanism by which full supply level is determined and altered: Transcript, 11 April 2011, Brisbane [p29: line 40].

120 Exhibit 9, Graph: Historical dam levels, Wivenhoe & Somerset dams.

121 Exhibit 417, Statement of Barry Dennien, Annexure C, South East Queensland Water Strategy, 2010 [p148].

122 Exhibit 426, Statement of Barton Maher, Annexure BM-5, Provision of Contingency Storage in Wivenhoe & Somerset Dams, 2007 [p13].

123 Assumptions included a range of flood events of different magnitude and duration, modifying the gate operation triggers for small flood events and the situation in which one gate at Wivenhoe Dam was inoperable.

124 Exhibit 426, Statement of Barton Maher, Annexure BM-6, SunWater, Assessment of Wivenhoe Dam Full Supply Level on Flood Impacts, 2007 [p1].

125 Exhibit 426, Statement of Barton Maher, Annexure BM-7, GHD, Report for Wivenhoe Dam Full Supply Level Review Technical Assessment of Raising Potential, 2009.

126 Exhibit 432, Statement of Daniel Spiller [p39: para 139].

127 Exhibit 417, Statement of Barry Dennien, Annexure C, South East Queensland Water Strategy, 2010 [p98 and 143].

128 Exhibit 418, Statement of Karen Waldman [p17: para 11.2].

129 Exhibit 393, Statement of Peter Borrows [p3: para 20].

130 Exhibit 11, Statement of Stephen Robertson, Annexure SR5.

131 Exhibit 11, Statement of Stephen Robertson, Annexure SR5.

132 Exhibit 393, Statement of Peter Borrows, Annexure PB-2.

133 Transcript, 18 May 2011, Brisbane [p2277: line 10]; Exhibit 418, Statement of Karen Waldman [p17-18: para 11.3-11.4].

134 Exhibit 422, Statement of Kenneth Schmidt, Annexure 2 [p3: para 1].

135 Exhibit 422, Statement of Kenneth Schmidt, Annexure 2 [p14: para 58-59].

136 Exhibit 422, Statement of Kenneth Schmidt, Annexure 2 [p14: para 60].

137 Exhibit 14, Letter from Kenneth Schmidt to Minister Robertson, 23 December 2010.

138 Exhibit 14, Letter from Kenneth Schmidt to Minister Robertson, 23 December 2010.

139 Exhibit 15, Letter from Minister Robertson to Kenneth Schmidt, 9 March 2011.

140 Exhibit 11, Statement of Stephen Robertson [para 5-7]; Exhibit 37, Statement of James Davidson. [p27-28: para 106-107]; Transcript, 11 April 2011, Brisbane [p31: line 21]; Transcript, 14 April 2011, Brisbane [p284: line 50].

141 Exhibit 390, Statement of John Bradley [p2: para 9]; Exhibit 11, Statement of Stephen Robertson [para 5-7]; Exhibit 37, Statement of James Davidson, Annexure JD-1 [p28: para 107(f)]; Transcript, 14 April 2011, Brisbane [p31: line 21].

142 Exhibit 11, Statement of Stephen Robertson [para 6].

143 Exhibit 432, Supplementary Statement of Daniel Spiller [p6-16: para 21-60]; Transcript, 18 May 2011, Brisbane [p2263:line 8]; Transcript, 16 May 2011, Brisbane [p2036: line 38].

144 Exhibit 390, Statement of John Bradley, Attachment JNB-09; Exhibit 417, Statement of Barry Dennien [p13: para 46]; Annexure E [p276-287].

145 Exhibit 417, Statement of Barry Dennien, Annexure E [p255-258]; Transcript, 16 May 2011, Brisbane [p2035: line 30].

146 Exhibit 417, Statement of Barry Dennien, Annexure E [p345-350]; Transcript, 16 May 2011, Brisbane [p2067: line 10]; Transcript, 16 May 2011, Brisbane [p2236: line 28].

147 Transcript, 16 May 2011, Brisbane [p2037: line 8]; Transcript, 16 May 2011, Brisbane [p2042: line 7].

148 Chapter 4, *Water Supply Act (Safety and Reliability) Act 2008*; Transcript, 16 May 2011, Brisbane [p2037: line 36]. See also *2.2.1 Referable Dams*.

149 Refer to *2.1.1 Department of Environment and Resource Management*. See also Transcript, 16 May 2011 [p2037: line 41].

150 Exhibit 11, Statement of Stephen Robertson [para 64]; Exhibit 417, Statement of Barry Dennien [p18-20: para 63]; Transcript, 11 April 2011, Brisbane [p34: line 56].

151 Transcript, 11 April 2011, Brisbane [p35: line 6].

152 Transcript, 11 April 2011, Brisbane [p43: line 25].

153 Transcript, 11 April 2011, Brisbane [p44: line 25].

154 Transcript, 11 April 2011, Brisbane [p42: line 11; p44: line 51]; Transcript, 16 May 2011, Brisbane [p2237: line 7]; Transcript, 18 May 2011, Brisbane [p2263: line 57]; Transcript, 18 May 2011, Brisbane [p2266: line 22]; Transcript, 18 May 2011, Brisbane [p2278: line 19].

155 Exhibit 10, Requirement to Provide Statement to the Honourable Stephen Robertson MP [p1-2: para 5-6, 10 and 11].

156 Transcript, 11 April 2011, Brisbane [p43: line 39]; Exhibit 11, Statement of Stephen Robertson.

157 Transcript, 11 April 2011, Brisbane [p42: line 11; p44: line 51].

158 Transcript, 16 May 2011, Brisbane [p2039: line 1].

159 Transcript, 11 April 2011, Brisbane [43: line 39; p45: line 10].

160 Transcript, 11 April 2011, Brisbane [p35: line 34; p36: line 36; p38: line 3; p40: line 21].

161 Exhibit 417, Statement of Barry Dennien, Annexure E [p923].

162 Exhibit 11, Statement of Stephen Robertson, AnnexureSR11; Exhibit 417, Statement of Barry Dennien [p20: para 64].

163 Exhibit 11, Statement of Stephen Robertson, Annexure SR11.

164 Exhibit 427, Statement of James Pruss, Annexure JP2, JP3; Exhibit 417, Statement of Barry Dennien, Annexure E [p494-495; p545-547].

165 Exhibit 11, Statement of Stephen Robertson, Annexure SR11.

166 Exhibit 11, Statement of Stephen Robertson, Annexure SR11 [p2].

167 Exhibit 418, Statement of Karen Waldman [p5: para 4.6-4.8]; Annexure [p11-37].

168 Exhibit 418, Statement of Karen Waldman, Annexure [p11].

169 Exhibit 393, Statement of Peter Borrows, Annexure PB-10 [p56-58].

170 Exhibit 393, Statement of Peter Borrows, Annexure PB-10 [p59].

171 Exhibit 393, Statement of Peter Borrows [p4: para 33-34].

172 Exhibit 393, Statement of Peter Borrows [p4: para 34].

173 Exhibit 390, Statement of John Bradley [p12: para 68]; Annexure JNB-22, JNB-23.

174 Exhibit 393, Statement of Peter Borrows, Annexure PB-13.

175 Exhibit 393, Statement of Peter Borrows [p6: para 50].

176 Exhibit 393, Statement of Peter Borrows, Annexure PB-15.

177 Exhibit 393, Statement of Peter Borrows [p6: para 52]; Annexure PB-16.

178 Exhibit 393, Statement of Peter Borrows [p6-7: para 53-56]; Annexure PB-17.

179 Exhibit 393, Statement of Peter Borrows, Annexure PB-18.

180 Exhibit 393, Statement of Peter Borrows, Annexure PB-18.

181 Exhibit 393, Statement of Peter Borrows, Annexure PB-18.

182 Exhibit 393, Statement of Peter Borrows, Annexure PB-18.

183 Exhibit 393, Statement of Peter Borrows [p7: para 58]; Annexure PB-19.

184 Exhibit 393, Statement of Peter Borrows, Annexure PB-21.

185 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p199].

186 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p199-200]; Transcript, 16 May 2011, Brisbane [p2047: line 54].

187 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p199-201].

188 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p200].

189 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p200].

190 Exhibit 393, Statement of Peter Borrows, Annexure PB-21 [p200].

191 Exhibit 393, Statement of Peter Borrows [p7: para 61]; Annexure PB-23.

192 Exhibit 393, Statement of Peter Borrows [p7: para 60]; Annexure PB-22. The Commission notes the date on the letter, 9 February 2010, is plainly an error.

193 Exhibit 393, Statement of Peter Borrows, Annexure PB-22.

194 Exhibit 393, Statement of Peter Borrows, Annexure PB-23.

195 Exhibit 390, Statement of John Bradley, Annexure JNB-18.

196 Exhibit 390, Statement of John Bradley, Annexure JNB-18.

197 Exhibit 393, Statement of Peter Borrows, Annexure PB-30.

198 Exhibit 393, Statement of Peter Borrows, Annexure PB-30.

199 Exhibit 393, Statement of Peter Borrows, Annexure PB-31.

200 Exhibit 418, Statement of Karen Waldman [p23: para 12.14-12.16]; Annexure [p339-377].

201 Exhibit 393, Statement of Peter Borrows, Annexure PB-31 [p268].

202 Exhibit 390, Statement of John Bradley [p11: para 62-63]; Annexure JNB-19.

203 Exhibit 390, Statement of John Bradley [p11: para 65]; Annexure JNB-21.

204 Exhibit 390, Statement of John Bradley [p12: para 68]; Annexure JNB-22, JNB-23.

205 Transcript, 11 April 2011, Brisbane [p31: line 1].

206 Transcript, 11 April 2011, Brisbane [p36: line 15].

207 Exhibit 393, Statement of Peter Borrows, Annexure PB-32 [p285].

208 Exhibit 393, Statement of Peter Borrows Annexure PB-17; Annexure PB-21.

209 Exhibit 393, Statement of Peter Borrows, Annexure PB-32.

210 Exhibit 418, Statement of Karen Waldman [p10: para 9.3]; Annexure [p202-241].

211 Transcript, 11 April 2011, Brisbane [p36: line 31].

212 Exhibit 393, Statement of Peter Borrows, Annexure PB-19.

213 Exhibit 393, Statement of Peter Borrows, Annexure PB-19 [p4].

214 Exhibit 393, Statement of Peter Borrows, Annexure PB-19 [p4].

215 Exhibit 393, Statement of Peter Borrows, Annexure PB-19 [p6].

216 Exhibit 393, Statement of Peter Borrows, Annexure PB-23.

217 Ministerial media statement of the Honourable Stephen Robertson, Transcript: press conference on Wivenhoe Dam releases, 13 February 2011. Available at: www.cabinet.qld.gov.au/mms.

218 Exhibit 393, Statement of Peter Borrows, Annexure PB-19 [p2].

219 Exhibit 393, Statement of Peter Borrows, Annexure PB-31.

220 Exhibit 417, Statement of Barry Dennien, Annexure E [p2110-2118].

221 Ministerial media statement of the Honourable Stephen Robertson, Transcript: press conference on Wivenhoe Dam releases, 13 February 2011. Available at: www.cabinet.qld.gov.au/mms.

222 Exhibit 397, Statement of Peter Allen [p6: para 23].

223 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010.

224 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, parts 2 and 7.

225 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 1.1.

226 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 1.7.

227 Of up to five years, see also: Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, part 1.6.

228 Exhibit 390, Statement of John Bradley, Annexure JNB-06.

229 Exhibit 21, *Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam*, Revision 7, 2009, part 7.5.

230 Exhibit 398, Statement of Ronald Guppy [p4: para 25].

231 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 2.7.

232 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 2.2.

233 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 6.3.

234 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 7.1.

235 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009, part 2.3.

236 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, Revision 7, 2009 [p50].

237 See Transcript, 11 April 2011, Brisbane [p85: line 30]; [p86: line 50]; Transcript, 12 April 2011, Brisbane [p103: line 51]; [p104: line 1]; [p108: line 47]; [p162: line 22]; [p163: line 1]; [p167: line 1]; [p183: line 32]; [p186: line 4]; Transcript, 13 April 2011, Brisbane [p200: line 48]; [p206: line 4]; [p230: line 19]; [p239: line 1]; [p245: line 39]; [p261: line 24]; Transcript 14 April 2011, Brisbane [p320: line 4]; [p321: line 29]; [p323: line 45]; [p324: line 19]; [p336: line 27]; Transcript, 15 April 2011, Brisbane [p381: line 41]; [p384: line 2]; [p441: line 29]; [p444: line 43]; [p447: line 9]; [p449: line 18].

238 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p97].

239 See *2.6 Decision-making and conditions at the flood operations centre*.

240 Transcript, 11 April 2011, Brisbane [p82: line 1].

241 Transcript, 15 April 2011, Brisbane [p409: line 54]; Transcript, 15 April 2011, Brisbane [p464: line 40].

242 Second Supplementary Submission of Seqwater, 3 June 2011 [p45: para 190(b)].

243 Transcript, 11 April 2011, Brisbane [p86: line 50].

244 Second Supplementary Submission of Seqwater, 3 June 2011 [p7: para 27].

245 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, part 7.1.

246 Section 374 of the *Water Supply (Safety and Reliability) Act 2008* (Qld) provides Seqwater with immunity from civil liability for an act done (honestly and without negligence) whilst observing the procedures for which the manual provides.

247 Transcript, 12 April 2011, Brisbane [p115: line 57].

248 Transcript, 12 April 2011, Brisbane [p116: line 4].

249 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, part 2.4.

250 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, part 2.6.

251 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, part 2.5.

252 Transcript, 18 May 2011, Brisbane [p2248: line 51].

253 Exhibit 416, Service Level Agreement – Flood Management Services.

254 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p6].

255 Exhibit 42, Statement of John Ruffini [p5: para 26].

256 Exhibit 37, Statement of James Davidson, Annexure JD-1 [p876].

257 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011.

258 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p55-58].

259 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p111].

260 Exhibit 409, January 2011 Flood Event: Report on the operation of Somerset Dam and Wivenhoe Dam, Review of Hydrological Issues, Final A, 11 March 2011, Rory Nathan [p3].

261 Exhibit 496, First Statement of Peter Baddiley, Annexure PB-7.

262 Exhibit 36, Email from Peter Baddiley to Rob Drury dated 1 December 2010.

263 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p18-19]; Exhibit 33, Second Statement of Terrence Malone [p1: para 3(a)-(b)].

264 Exhibit 407, Report to the Queensland Floods Commission of Inquiry, Mark Babister, 11 May 2011 [p14].

265 The Institution of Engineers Australia, Australian Rainfall and Run-off (Book 6); Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p13].

266 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p4-6].

267 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p4].

268 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix A.

269 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p5].

270 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p4-6].

271 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix A.

272 Exhibit 45, First Statement of Terrence Malone [p10: para 44].

273 Transcript, 11 April 2011, Brisbane [p87: line 46].

274 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix A; Transcript, 11 April 2011, Brisbane [p87: line 46]; Transcript, 15 April 2011, Brisbane [p449: line 35]; Transcript, 15 April 2011, Brisbane [p455: line 38]; Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p23-24].

275 Second Supplementary Submission of Seqwater [p4: para 14].

276 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p106]; Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation

of Operational Methods and Decision-Making Practices, July 2011 [p22].

277 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, part 7.

278 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p112].

279 Exhibit 45, First Statement of Terrence Malone [para 64].

280 Transcript, 13 April 2011, Brisbane [p215: line 48].

281 Transcript, 13 April 2011, Brisbane [p216: line 10].

282 Exhibit 407, Report to the Queensland Floods Commission of Inquiry, Mark Babister, 11 May 2011 [p35-36].

283 Transcript, 13 April 2011, Brisbane [p216: line 30].

284 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p28].

285 Transcript, 12 April 2011, Brisbane [p109: line 40].

286 Transcript, 12 April 2011, Brisbane [p110: line 10].

287 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p16].

288 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p15].

289 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p18].

290 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p18].

291 Exhibit 33, Second Statement of Terrence Malone [p1: para 3(a)-3(b)].

292 Exhibit 17, First Statement of Robert Ayre [p24: para 125].

293 Exhibit 17, First Statement of Robert Ayre [p91: para 396].

294 Exhibit 17, First Statement of Robert Ayre [p91: para 395].

295 Letter from Allens Arthur Robinson (representatives for Seqwater) to Commission, 6 June 2011 – Arrangements in New Flood Operations Centre.

296 Exhibit 17, First Statement of Robert Ayre [p91: para 396-397].

297 Exhibit 426, Statement of Barton Maher, Annexure BM4(b).

298 Exhibit 45, First Statement of Terrence Malone [p14-15: para 77-79]; Exhibit 43, Transcript of Interview by Commission staff with John Ruffini [p64: line 30].

299 Transcript, Brisbane, 11 April 2011 [p89: line 45]; Transcript, Brisbane, 11 April 2011 [p92: line 41].

300 Transcript, Brisbane, 11 April 2011 [p93: line 35].

301 Exhibit 43, Transcript of Interview by Commission staff with John Ruffini [p65: line 28]; Exhibit 46, Transcript of Interview by Commission staff with Terrence Malone [p11: line 30; p14: line 6].

302 For example, there were some conversations which were not attributed to any flood engineer: Exhibit 44, Transcript of Interview by Commission staff with Robert Ayre, (30 March 2011) [p27: line 13].

303 Exhibit 51, First Statement of John Tibaldi [p6: para 24-25]; Exhibit 17, First Statement of Robert Ayre [p49: para 234]; Exhibit 43, Transcript of Interview by Commission staff with John Ruffini [p73: line 15]; Exhibit 44, Transcript of Interview by Commission staff with Robert Ayre [p30: line 5].

304 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p15]; Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam [p14]; Exhibit 327, Seqwater Wivenhoe Dam Emergency Action Plan, Appendix A; Exhibit 314, Seqwater North Pine Dam Emergency Action Plan, Appendix A; Seqwater, Somerset Dam Emergency Action Plan, Appendix A.

305 Exhibit 417, Statement of Barry Dennien, Appendix D; Exhibit 430, Statement of Robert Drury [p2: para 11].

306 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix E.

307 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix F. For an example of where the SEQ Water Grid Manager has provided a technical situation report, see Exhibit 417, Statement of Barry Dennien, Annexure E [p1340].

308 Exhibit 417, Statement of Barry Dennien, Appendix D; Exhibit 430, Statement of Robert Drury [p2: para 11].

309 Transcript, 10 May 2011, Brisbane [p1617: line 47].

310 Exhibit 42, Statement of John Ruffini [p15: para 92]. Mr Robert Ayre similarly suggested a 'more structured and consistent approach' to the information contained in situation reports and technical situation reports would an improvement: Exhibit 17, First Statement of Robert Ayre [p92: para 402].

311 Exhibit 44, Transcript of Interview by Commission staff with Robert Ayre, 30 March 2011 [p14: line 44].

312 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam Appendix M [p82].

313 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam Appendix M [p90].

314 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M; Exhibit 23, Unredacted flood event log.

315 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M [p79, 82, 88]; Exhibit 17, First Statement of Robert Ayre [p50: para 240]; Exhibit 322, Statement of Tony Jacobs [para 7(d), 8(c), 8(d), 9(c), 10(b)-(e)].

316 Exhibit 322, Statement of Tony Jacobs [para 7(d), 8(c), 8(d), 9(c), 10(b)-(e)].

317 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M [p89] (entry at 8.16am, 11 January 2011).

318 Transcript, 20 May 2011, Ipswich [p2403: line 49].

319 Transcript, 10 May 2011, Brisbane [p1617: line 29].

320 Transcript, 10 May 2011, Brisbane [p1618: line 10].

321 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M; Exhibit 17, First Statement of Robert Ayre [p49: para 237].

322 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M [p88-89].

323 Transcript, 13 April 2011, Brisbane [p236: line 41].

324 Exhibit 17, First Statement of Robert Ayre [p50: para 240].

325 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, Appendix M [p99] (entry at 6.43 am, 13 January 2011).

326 Transcript, 13 April 2011, Brisbane [p236: line 45].

327 Exhibit 17, First Statement of Robert Ayre [p49: para 237; p92: para 404]; Transcript, 12 April 2011, Brisbane [p116: line 57].

328 Exhibit 17, First Statement of Robert Ayre [p49: para 237].

329 Exhibit 55, Transcript of Interview by Commission staff with John Tibaldi [p17: line 4].

330 Exhibit 44, Transcript of Interview by Commission staff with Robert Ayre [p14: line 29].

331 Bundle of emails sent between 7 and 17 January 2011 in relation to the communications role of the flood engineers and effectiveness of the draft communications protocol.

332 Email from Peter Allen to Duty Engineer, 11 January 2011 4.54 pm.

333 Email from Duty Engineer to Robert Drury, 12 January 2011 1.17 pm.

334 Email from Rob Drury to 'Duty Seq', 16 January 2011 6.43 pm.

335 Email from John Tibaldi to Peter Borrows, 17 January 2011 2.36 pm.

336 Exhibit 17, First Statement of Robert Ayre [p48: para 229].

337 Exhibit 46, Transcript of Interview by Commission staff with Terrence Malone [p5: line 27].

338 Exhibit 45, First Statement of Terrence Malone [p8: para 28].

339 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1'.

340 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix M [p78].

341 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p25, 39].

342 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p21].

343 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p65-66] cf Appendix O [p126-129] which indicate falls less than 50 millimetres.

344 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p24-26].

345 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p10-13; p154-155].

346 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p23, 27, 28].

347 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p27].

348 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p13].

349 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p28].

350 Exhibit 18, Supplementary Statement of Robert Ayre [p17].

351 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p16]; Appendix E [p13-14] (Situation Report, 6.32 am, 8 January 2011); Appendix E [p15-16] (Situation Report, 2.22 pm, 8 January 2011).

352 Exhibit 21, Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam [p39].

353 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p13-14] (Situation Report, 6.32 am, 8 January 2011).

354 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p16].

355 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p13-14].

356 Exhibit 18, Supplementary Statement of Robert Ayre, 29 March 2011 [p16-17].

357 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix A.

358 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix A.

359 Exhibit 18, Supplementary Statement of Robert Ayre, Annexure 1.

360 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p68].

361 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p68].

362 Exhibit 497, Second Statement of Peter Baddiley, Annexure PB2-8(20) [p12].

363 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p17-18] (Situation Report 6.15 am 9 January 2011).

364 Australian Community Climate and Earth-System Simulator. See Exhibit 37, Statement of James Davidson, Annexure JD-1 [p59: para 25].

365 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p57].

366 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 18.

367 Exhibit 18, Supplementary Statement of Robert Ayre [p22-24].

368 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 18.

369 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p21-22] (Situation Report 9.04 pm 9 January 2011).

370 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p21-22] (Situation Report 9.04 pm 9 January 2011).

371 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p23-24] (Situation Report 13, 1.14 am 10 January 2011); Second Statement of Peter Baddiley, Annexure PB2-8(20) [p13].

372 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p23-24] (Situation Report 13, 1.14 am 10 January 2011).

373 Exhibit 44, Transcript of Interview by Commission staff with Mr Robert Ayre [p20].

374 Exhibit 403, First Statement of Kenneth Morris [p20].

375 Exhibit 51, First Statement of John Tibaldi [p13].

376 Transcript, 13 April 2011, Brisbane [p251: line 9].

377 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p25-26] (Situation Report 14, 6.30 am 10 January 2011).

378 Exhibit 497, Second Statement of Peter Baddiley, Annexure PB2-8(20) [p14].

379 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p28-29] (Situation Report 15, 12.16 pm 10 January 2011).

380 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix C [p176].

381 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p20].

382 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p30-31] (Situation Report 16, 6.43 pm 10 January 2011).

383 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 28.

384 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 28.

385 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p32-33] (Situation Report 17, 11.56 pm 10 January 2011); Exhibit 18, Supplementary Statement of Robert Ayre, 29 March 2011 [p40-41: para 114-117].

386 Exhibit 37, Statement of James Davidson, Annexure JD-1 [p815].

387 Exhibit 497, Second Statement of Peter Baddiley, Annexure PB2-8(21) [p49].

388 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 30.

389 Exhibit 18, Supplementary Statement of Robert Ayre [p40-41].

390 Exhibit 18, Supplementary Statement of Robert Ayre [p41].

391 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p32-33]. (Situation Report 17, 11.56 pm 10 January 2011),

392 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix C [p177-178].

393 Transcript, 14 April 2011, Brisbane [p352: line 10]; Transcript, 15 April 2011, Brisbane [p408: line 1].

394 Exhibit 18, Supplementary Statement of Robert Ayre [p48-49].

395 Exhibit 18, Supplementary Statement of Robert Ayre [p49].

396 Transcript, 15 April 2011, Brisbane [p409: line 38].

397 Transcript, 15 April 2011, Brisbane [p410: line 15]; Transcript, 15 April 2011, Brisbane [p464: line 40].

398 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p36] (Situation Report 19, 12.11 pm 11 January 2011).

399 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p37] (Situation Report 20, 6.00 pm 11 January 2011).

400 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p37] (Situation Report 20, 6.00 pm 11 January 2011).

401 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p158-159].

402 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p26].

403 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 45.

404 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix E [p45-46] (Situation Report 25, 5.43 am 13 January 2011).

405 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 45.

406 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p29].

407 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p11-12].

408 While the flood engineers' evidence is that they modelled different gate opening scenarios using the gate operation spreadsheet, the Commission cannot determine whether any flood engineers modelled these particular scenarios because few records were kept.

409 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p12].

410 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011 [p17].

411 Exhibit 51, First Statement of John Tibaldi [p8: para 37]; Exhibit 45, First Statement of Terrence Malone [p11: para 54].

412 Exhibit 24, January 2011 Flood Event Report on the operation of Somerset Dam and Wivenhoe Dam, 2 March 2011, Appendix O [p144].

413 Seqwater, Operation of Wivenhoe Dam and Somerset Dam January 2011 Flood Event Explanation of Operational Methods and Decision-Making Practices, July 2011 [p12].

414 Mark Babister and Rhys Hardwick-Jones, Review and Comment on the Seqwater Report, 6 July 2011 [p11: para 27].

415 Transcript, 12 April 2011, Brisbane [p101: line 35].

416 Exhibit 18, Supplementary Statement of Robert Ayre, Annexure 1.

417 Exhibit 524, Full time-series sets and spreadsheets used to create the values and graphs contained in Appendix A to the January 2011 Flood Event Report on the Operation of Wivenhoe and Somerset Dams and the document named 'Appendix A1', Run 45.

418 For example, Submission of the Mid Brisbane River Irrigators, Submission of Merven Hoppner, Submission of Darren Zanow, Submission of Pine Mountain Botanics Pty Ltd, Supplementary Submission of Pine Mountain Botanics Pty Ltd and Submission of Jocelyn Bailey.

419 For example, Submission of Christopher McConnel; Submission of Douglas and Cheryl McDade; Submission of Mark and Jenny Moore; Submission of Barrie Dunning, 24 February 2011; Submission of Barrie Dunning, 10 March 2011; Submission of Barrie Dunning, 31 March 2011; Submission of Neil and Dennis O'Connor; Submission of Keith Moore; Submission of Robert Brown and Helen Wordsworth; Submission of Ray and Jane Miller.

420 Exhibit 14, Letter from Kenneth Schmidt to Minister Robertson, 23 December 2010; Submission of Jocelyn Bailey [p2], Transcript, 14 April 2011, Brisbane [p300: line 25], Submission of Neil O'Connor [p1], Submission of Helen Wordsworth and Robert Brown; Submission of Barrie Dunning, 31 March 2011; Submission of Barrie Dunning, 24 February 2011 [p1, 3]; Submission of Barrie Dunning, 10 March 2011 [p1] and Submission of Douglas and Cheryl McDade [p4].

421 Transcript, 14 April 2011, Brisbane [p300: line 25].

422 Exhibit 504, Statement of Russel Bernitt [p7: para 26].

423 Submission of Barrie Dunning [p3].

424 Exhibit 14, Letter from Kenneth Schmidt to Minister Robertson, 23 December 2010; Submission of Bruce and Cheryl McDade [p4].

425 Transcript, 11 April 2011, Brisbane [p72: line 19].

426 Submission of Seqwater, 11 March 2011 [p21: para 82]; Attachment 3.

427 Sections 159, 162, 165 and 166, Moreton Resource Operations Plan 2009.

428 Statement of Terry Wall, Annexure TWW-4.

429 Statement of Terry Wall [p7: para 24].

430 Statement of Terry Wall, Annexure TWW-4 [p3]; Transcript, 12 April 2011, Brisbane [p191: lines 25].

431 Section 374, *Water Supply (Safety and Reliability) Act 2008*; Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, August 2010.

432 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p19].

433 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p19]; Appendix C.

434 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p9].

435 Exhibit 314, North Pine Dam Emergency Action Plan, Revision 2, September 2010 [p5]. See also, section 346(2), *Water Supply (Safety and Reliability) Act 2008* (Qld).

436 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p9].

437 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p9].

438 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p10].

439 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p9].

440 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p10].

441 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p10-15]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p13-14].

442 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p8].

443 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p8]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p11]; Exhibit 18,

Supplementary Statement of Robert Ayre, [p5: para 15(a)].

444 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p56-64]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p6, 11].

445 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p22].

446 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p22].

447 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p6].

448 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p91].

449 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p91].

450 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p91].

451 Exhibit 18, Supplementary Statement of Robert Ayre [p4: para 14(a)].

452 Exhibit 18, Supplementary Statement of Robert Ayre [p5: para 16].

453 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p10].

454 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p10].

455 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p10]; Exhibit 17, First Statement of Robert Ayre [p90: para 390].

456 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p20].

457 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p20].

458 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p20-21].

459 Exhibit 17, First Statement of Robert Ayre [p90: para 390-391].

460 Exhibit 17, First Statement of Robert Ayre [p90: para 390-391].

461 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p20].

462 Exhibit 17, First Statement of Robert Ayre [p90: para 391].

463 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010, Appendix E.

464 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010, Appendix E.

465 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p124].

466 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p7].

467 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p131]; Exhibit 397, Statement of Peter Allen [p51: para 149(a)].

468 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010, Appendix E; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p85].

469 Exhibit 397, Statement of Peter Allen [p50: para 144]; Exhibit 426, Statement of Barton Maher, Annexure BM3(a) [p18].

470 Exhibit 17, First Statement of Robert Ayre [p79: para 368].

471 Exhibit 17, First Statement of Robert Ayre [p70: para 317].

472 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010 [p23].

473 Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010, Appendix D; Exhibit 17, First Statement of Robert Ayre, [p70: para 317].

474 Seqwater, North Pine Dam Acceptable Flood Study Investigations, 4 May 2011; Seqwater, North Pine Dam – AFC Assessment Project Status Report, 6 May 2011.

475 Seqwater, North Pine Dam Acceptable Flood Study Investigations, 4 May 2011.

476 Seqwater, North Pine Dam – AFC Assessment Project Status Report, 6 May 2011.

477 Exhibit 429, Statement of Brett Schultz [p4: para 26].

478 Exhibit 429, Statement of Brett Schultz [p4: para 26, 30].

479 Exhibit 429, Statement of Brett Schultz [p4: para 30, 31].

480 Exhibit 429, Statement of Brett Schultz [p5: para 32].

481 Transcript, 12 April 2011, Brisbane [p124: line 29]; Exhibit 429, Statement of Brett Schultz [p5: para 33].

482 Exhibit 29, Manual of Operational Procedures for Flood Mitigation at North Pine Dam, Revision 5, 2010 [p19].

483 Transcript, 12 April 2011, Brisbane [p123: line 28].

484 Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p131].

485 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, 2011 [p77].

486 Outflow required to close Youngs Crossing to traffic is $10m^3/s$: Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p128]; Exhibit 29, Manual of operational procedures for flood mitigation at North Pine Dam, Revision 5, 2010, Appendix B. The peak outflows from North Pine dam of each of the 18 flood events substantially exceeded $10m^3/s$: Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, May 2011 [p56-64]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p6, 11].

487 Exhibit 18, Supplementary Statement of Robert Ayre [p5: para 16]; Exhibit 30, January 2011 Flood Event Report on the operation of North Pine Dam, 11 March 2011 [p10].

488 Exhibit 425, Statement of Emma Thomas [p9: para 40].

489 Exhibit 425, Statement of Emma Thomas [p9: para 40].

490 Exhibit 425, Statement of Emma Thomas [p9: para 41].

491 Exhibit 425, Statement of Emma Thomas [p9: para 45]; Annexure N.

492 Exhibit 310, Statement of Dr Peter Hackney, Attachment 1; Transcript, 9 May 2011, Brisbane [p1515: line 26].

493 Transcript, 9 May 2011, Brisbane [p1524: line 40].

494 Exhibit 43, Transcript of Interview by Commission staff with John Ruffini, 30 March 2011 [p17: line 12].

495 Seqwater, 2010/2011 Wet Season Flood Events Report on the Operation of North Pine Dam, 2011 [p76].

496 Exhibit 310, Statement of Dr Peter Hackney, Attachment 2.

497 Transcript, 9 May 2011, Brisbane [p1516: line 30].

498 Transcript, 18 May 2011, Brisbane [p2261: line 9].

3 Disaster frameworks, preparation and planning

3.1 Disaster management framework

3.1.1 National disaster management framework

Queensland is part of a national disaster management framework, under which states and territories are responsible for planning for and responding to disasters and emergencies. However, in major disasters, the states and territories can seek assistance from the Commonwealth Government, as Queensland did in the 2010/2011 floods. Chapter *5 Emergency response* has more information about the roles played by Commonwealth agencies, and in particular the Australian Defence Force, during the floods.

3.1.2 Queensland disaster management arrangements

The *Disaster Management Act 2003* provides the legislative basis for Queensland's disaster management arrangements. It establishes a disaster management hierarchy of three levels: the state disaster management group, district disaster management groups, and local disaster management groups.

In accordance with the Act, Queensland's state disaster management group has prepared a state disaster management plan which identifies four phases of disaster management: prevention, preparedness, response and recovery.[1]

Local government plays a central role in all four phases and represents the front line in Queensland's disaster management arrangements.[2]

Local disaster management groups, established by local governments, have principal responsibility for managing disasters because they are best placed to decide what resources are required, when they are required and how best to apply them.[3] A local group without sufficient resources to respond to a disaster can seek help from the district disaster management group. If the district group cannot provide the necessary assistance, it can request the aid of the state group. The state group, in turn, can seek assistance from the Commonwealth.

In 2008, the Queensland Government commissioned an independent review of Queensland's disaster management legislation, policies, guidelines and plans, to ensure that they were appropriate and effective (the O'Sullivan Review).[4] The review also considered management and accountability in the State Emergency Service (SES). Many of the review's recommendations took effect in November 2010 through amendments to the *Disaster Management Act 2003*. One of the major changes was a shift in responsibility for the co-ordination of the disaster response phase from Emergency Management Queensland to the Queensland Police Service (see *3.1.3 Disaster agencies in Queensland*).

Set out below is a summary of the arrangements and a brief description of the main government agencies involved in disaster management.

State level

The state disaster management group is the peak decision-making body for disaster management in Queensland. The state group is made up of the chief executive officers of all government departments, the principal officer of Emergency Management Queensland and chief executive of the Local Government Association of Queensland. It is responsible for ensuring that the state is in the best possible position to respond to potential disasters; part of that responsibility is the development and review of the disaster management strategic policy framework and the state disaster management plan. The state group co-ordinates the disaster response and recovery activities across all government agencies. It also liaises with Commonwealth agencies (the Australian Defence Force in particular) and non-government organisations with a role to play in disaster management.

The chairperson of the state group – the chief executive of the Department of the Premier and Cabinet – is responsible for appointing a state disaster co-ordinator and state recovery co-ordinator. During the 2010/2011 floods, Deputy Police Commissioner Ian Stewart was appointed the state disaster co-ordinator. Major-General Michael Slater DSC AM CSC currently holds the temporary appointment of state recovery co-ordinator.

State disaster management plan

The *Disaster Management Act 2003* requires that all disaster events be managed in accordance with the state disaster management plan.

The state plan articulates Queensland's disaster management arrangements. The current state plan was approved by the state disaster management group on 22 December 2010, during the Queensland floods. Until then, the 2008 version of the state disaster management plan applied. The 2008 state plan was based on four tenets:

- its approach should be based on the four disaster management phases of prevention, preparedness, response and recovery
- disaster management plans should cater for all hazards and disaster risks
- the responsibility for disaster management is to be shared among various agencies at all levels of the disaster management hierarchy
- communities need to be alert to natural disaster hazards in their area and informed about what to do in disasters.

The 2010 state disaster management plan reflects the changes made in November 2010 to the *Disaster Management Act 2003*. Importantly, the updated plan incorporates a fifth tenet that emphasises local level responses as central to Queensland's disaster management arrangements.

District level

District disaster management groups are the middle tier in the disaster management hierarchy. There are currently 23 district disaster management groups, each covering one or more local government regions. (See *5.6 Boundaries* for more information on the interplay between boundaries.)

District disaster management groups must develop district disaster management plans for their geographic areas. Each district group is chaired by a district disaster co-ordinator who is a police officer at the rank of Inspector or above. The district disaster co-ordinator also co-ordinates resources across the district and seeks state assistance as needed during major disasters.

Local level

Local level disaster management is the foundation of Queensland's disaster management arrangements, and played a pivotal role in all phases of the 2010/2011 floods.

Under the arrangements, each local government establishes a local disaster management group whose functions include:

- developing and annually reviewing local disaster management plans for its region

- managing operations during a disaster
- liaising with the district group about the local group's disaster management activities
- educating members of the community about how they can prepare for, respond to and recover from disasters.

The mayor or another councillor of the local government is the chairperson of the local group and must appoint a local disaster co-ordinator for the region.

In 2009 the O'Sullivan Review confirmed that the pivotal role of local level groups was sound and effective, provided they received necessary resources and guidance from the district and state levels.[5]

More detail about local government's role in the response phase to the 2010/2011 floods can be found in *5.1 Local government response.*

3.1.3 Disaster agencies in Queensland

During the 2010/2011 floods, numerous government agencies were involved during the preparation, response and recovery phases. The main disaster organisations are described below.

Emergency Management Queensland

Emergency Management Queensland leads the co-ordination of disaster *prevention, preparedness* and *recovery* activities in Queensland. (Since November 2010 the Queensland Police Service has been responsible for coordinating the *response* phase of disaster management.) Emergency Management Queensland's functions include:

- monitoring the performance of state, district and local disaster management groups and their compliance with legislation and policy (see further discussion on this point at *3.3.2 Oversight of disaster management plans*)
- liaising with the Commonwealth Government about disaster management
- providing disaster management training, advice and other support to state, district and local disaster management groups (see *3.4 Disaster management training*)
- arranging the re-supply of essential goods to isolated communities (see *5.7 Re-supply* for discussion of re-supply arrangements during the 2010/2011 floods)
- managing the SES (*5.3.7 State Emergency Service* discusses the role of the SES during the 2010/2011 floods).[6]

Emergency Management Queensland produces guidelines to assist local, district and state disaster management groups in preparing their disaster management plans, and in other matters related to disaster planning (for example in how to evacuate communities). The agency is currently reviewing the local government disaster planning guidelines.[7] The updated guidelines will be finalised before the next wet season and will assist local governments to revise their local disaster management plans. Other guidelines (for example, evacuation guidelines) are in draft form and will also be completed before the next wet season. Issues about the development and review of the guidelines are addressed at *3.3.3 Disaster management guidelines.*

Disaster response agencies

The Queensland Police Service leads the response phase in disasters, with senior officers performing the roles of district disaster co-ordinators during the 2010/2011 floods. During disasters, a temporary policing structure may be created in a region to cater for day to day policing as well as disaster response work.[8]

The SES is Queensland's primary response agency for storm and flood emergencies, but also provides support to other emergency service agencies.[9] The SES is almost entirely staffed by volunteers who are organised into local groups and who work closely with local government. SES volunteers were involved before, during and after the 2010/2011 Queensland floods and have a continuing role in disaster preparation activities.

The Queensland Fire and Rescue Service provides response and rescue services for all hazards, including floods. Some firefighters are trained in swift water rescue and were called upon to perform rescues during the 2010/2011 floods (see section 5.3.1 for discussion of the role of the Queensland Fire and Rescue Service).

As well as its normal role in responding to medical emergencies, during the floods the Queensland Ambulance Service was involved in the co-ordination of aeromedical services, particularly in regional and isolated areas.[10]

Outside times of disaster, each of the disaster response agencies has a role in educating the community about disaster management and their agency's role in responding to disasters.

3.1.4 Disaster framework in the 2010/2011 floods

On the basis of the evidence the Commission has considered thus far, no changes are required to the fundamental structure of the disaster management system before the next wet season.

When the system operated as intended during the 2010/2011 floods, it functioned effectively. In some cases it did not operate as intended, requiring some improvement before the next wet season to address deficiencies in:

- awareness about the roles and responsibilities of local government, the Queensland police and other disaster agencies during a disaster (detailed in *3.4 Disaster management training*)
- local government capability to respond to disasters (detailed in *5.1 Local government response*)
- communication between the local, district and state disaster management groups during a disaster (detailed in *5.2 Communication between local, district and state groups*).

The arrangements with the Commonwealth generally worked well and the support provided was responsive and effective.[11] The ways in which those arrangements could be enhanced are discussed further at *3.2.2 State level planning*.

3.2 Preparation and planning

3.2.1 Local government preparation

Local governments across the state prepared in different ways for the 2010/2011 wet season and the ensuing floods; some took practical measures, while others took little action. Those local governments which had experienced flooding in early 2010 had a better understanding of what was needed to prepare their communities for the following wet season.

Most flood-affected councils, including Central Highlands, Balonne, Banana, Brisbane, Gladstone, Ipswich, North Burnett, Maranoa, Mackay, Moreton Bay, Goondiwindi, Somerset, and Southern Downs established stockpiles of sand and/or sandbags and distributed these as required before the floods.[12] In Brisbane, over 300 000 sandbags were filled and distributed,[13] while around 10 000 were stockpiled by the Central Highlands Regional Council[14] and 11 000 distributed by the Ipswich SES.[15]

The Fraser Coast Regional Council constructed a temporary levee in Maryborough,[16] while new levees were constructed and existing levees inspected across the Balonne Shire and Goondiwindi region.[17] The Balonne Shire Council also set up water pumps in the town of Dirranbandi to combat the possibility of leaks from an existing levee.[18]

The Gladstone, Ipswich, Central Highlands and Mackay local governments cleared vegetation and debris from drainage systems and flood gates to ensure these would not back up or overflow with the heavy rainfall predicted over the wet season.[19] The Balonne Shire Council blocked the St George stormwater system to prevent backflow inundation.[20] The Ipswich, Central Highlands and Banana local governments checked and updated emergency supplies and equipment.[21] The Central Highlands Regional Council provided its local SES and emergency service units with a new flood boat, new tyres for an existing vehicle, replacement boat propellers and hired an additional four wheel drive vehicle.[22] The Council also worked with the Bureau of Meteorology and other bodies to ensure its ALERT river height and rainfall gauge network was operating correctly.[23]

The ability of councils to prepare properly was influenced by the same factors that affected their ability to respond to the disaster: geographic differences and vulnerability to particular types of disasters; the priority they gave to disaster management; their experience in dealing with disasters; the resources available for disaster management; and the expertise and training of their staff.

See *5.1 Local government response* for a further discussion of local government response to the floods including recommendations for improvement.

3.2.2 State level planning

During the 2010/2011 floods the state disaster management group held 18 extraordinary meetings. Representatives from various non-member organisations attended these meetings and contributed to the decisions about the response and recovery.

The Australian Defence Force played an important role in the response through the deployment of helicopters to evacuate communities as well as to re-supply isolated communities. In other Australian jurisdictions, the defence force is a member of the relevant state or territory emergency committee (the equivalent of Queensland's state disaster management group).

The Australian Red Cross also played a significant role in both the response and immediate recovery phase through its management of evacuation centres. More information about the role of the Red Cross can be found in *5.5.6 Australian Red Cross involvement in evacuations*.

The important role of these agencies in the response to the 2010/2011 floods could be enhanced by their involvement at an earlier stage in the state disaster management group's preparation and planning for disasters.

Recommendation

3.1 The state disaster management group should include representatives of the Australian Defence Force and the Australian Red Cross in its planning and preparation for the next wet season.

Recommendations about the role of essential service providers in state level preparation and planning are included in chapter *6 Essential services.*

The role of the Australian Red Cross in local and district disaster management groups is discussed in *5.5.6 Australian Red Cross involvement in evacuations.*

3.2.3 Risk management

Queensland adopts a risk management approach to manage disasters.[24] The state disaster management plan describes this as 'a systematic process of identifying, analysing, assessing, treating and mitigating risk to people, property and the environment'.[25]

The state disaster management plan indicates (as did the 2008 version of it) that a state-wide register of Queensland's natural hazards is to be developed. This would include an assessment of potential disaster risks and how they are to be mitigated. Specifically, the 2010 state disaster management plan states:

> EMQ (Emergency Management Queensland) is responsible for ensuring the conduct of a state-wide prioritised natural disaster risk assessment to inform the development of the State Risk Register. A state natural hazard risk assessment is being conducted in 2010-11 and an overview of the results will be provided in future versions of this Plan.[26]

The state-wide natural hazard risk assessment was not completed during the currency of the 2008 plan which first proposed it, but it is presently under way. Once finished, it will be provided to local governments to help in refining their local disaster management plans. On the strength of the risk assessment's conclusions, the state will work with local governments most at risk of flooding. The risk assessment will also form the basis for the state-wide risk register, which is expected to be completed in time for the 2012/2013 wet season.

The importance of a hazard risk profile in disaster management was raised in the O'Sullivan Review.[27] The review emphasised the need to ensure that appropriate risk assessment informs strategic and policy decisions at all levels of the disaster management hierarchy.[28] It also suggested that the state disaster management plan should provide a strategic overview of the state's hazard and risk profile and agreed risk management strategies for certain disasters in certain parts of the state.[29]

Recommendation

3.2 Risk management is fundamentally important to disaster management. The Queensland Government should, before the next wet season, ensure that the state-wide natural hazard risk assessment is completed and its results provided to local governments.

3.2.4 Activation level terminology

Disaster management groups use activation levels to describe their status in times of disaster. For example, the state disaster management group uses the following activation levels:

- 'alert', when warnings of a potential disaster have been received
- 'lean forward', which indicates an increased level of readiness; disaster co-ordination centres are placed on standby
- 'stand up', when emergency response is under way; disaster co-ordination centres are activated
- 'stand down' indicates the transition stage from response to recovery.

Local and district groups' use of activation terminology is idiosyncratic; there is no requirement for them to use the same terminology as each other or the state group. This can create difficulties. For example, the Bundaberg local group's use of different terminology from other participants in a disaster management teleconference caused confusion.[30]

In large-scale disasters, where a number of disaster management groups are activated and are communicating with each other, a consistent use of terminology among the disaster management groups would avoid uncertainty. It may also be useful when councils seek assistance from other councils during a disaster. (Council-to-council assistance during the 2010/2011 floods is discussed in greater detail in *5.1.1 Council-to-council assistance*.)

Ipswich City Council supports adoption of consistent activation terminology across local, district and state groups. Brisbane City Council, on the other hand, considers that terminology should be tailored to the circumstances of each council.

The issue of whether consistent terminology should be adopted requires further examination. As a starting point, it should be included in Emergency Management Queensland's consultation with local governments as part of its review of local disaster management planning guidelines.

Recommendation

3.3 Emergency Management Queensland should, as part of its review of local disaster management planning guidelines, consider whether consistent activation terminology should be adopted.

3.3 Disaster management plans

State, district and local disaster management groups must develop disaster management plans that address risks in the areas for which they are responsible.[31] Disaster management plans must be consistent with the Emergency Management Queensland planning guidelines and with the Disaster Management Strategic Policy Framework. Local disaster management plans must be approved by the relevant local government and must be made available for inspection by the public. The *Disaster Management Act 2003* requires that local and district groups review the effectiveness of their plans at least annually. Part of Emergency Management Queensland's function to assess the effectiveness of disaster management includes reviewing local, district and state disaster management plans.

3.3.1 Local disaster management plans

The adequacy of local disaster management plans varied at the time of the 2010/2011 floods. Some had been revised and consolidated following council amalgamations in 2008,[32] others had not.[33] Some plans had been amended to take into account changes to the disaster management legislation (in November 2010), while the review of some plans had not been completed or commenced.[34] Some plans had not identified the isolation of communities which occurred in the 2010/2011 floods as a possible risk.[35]

Emergency Management Queensland was involved in developing some plans[36] but played no part in the production of others.[37] It said that it had a limited capacity to assist local groups prepare their plans.[38] (At least one local government engaged a private consultant to review its local disaster management plan.)[39] The view of the Local Government Association of Queensland was that Emergency Management Queensland's planning guidelines did not provide sufficient detail to satisfy the intent of the legislation.[40] Emergency Management Queensland is currently revising its local government disaster management planning guidelines. The Local Government Association has also expressed its willingness to support the development of plans.[41]

Many local disaster management groups are reviewing or will review their disaster management plans to address the issues arising from the 2010/2011 floods. (Under the *Disaster Management Act 2003,* all groups must annually review their plans.) For example, Ipswich City Council, having concluded that its plan was not user-friendly, is amending it (with funding from the Natural Disaster Resilience Program)[42] so that the plan will be a series of step-by-step guides based on the different disaster phases.[43] Somerset Regional Council has also obtained funding to review its local disaster management plan.[44] The Local Government Association considers that priority should be given to ensuring that each local government has a plan that caters for large-scale events such as the 2010/2011 floods.[45]

In addition to having a plan in place, it is important that members of local disaster management groups understand the local disaster management plan. One local disaster co-ordinator stated that he and the council-employed SES controller would have been the only council employees familiar with the local disaster management plan.[46]

Local disaster management plans should be as accessible as possible to the local community. (The *Disaster Management Act 2003* requires a local government to make the local disaster management plan available for inspection.)[47] Any person can also obtain a copy of it by paying an appropriate fee. Local governments could increase general community awareness and understanding about local disaster management in their regions by publishing their plans (or relevant parts of their plans) on their websites.

Recommendations

3.4 Every local government susceptible to flooding should ensure that, before the next wet season, its local disaster management plan:

- is consistent with the *Disaster Management Act 2003*
- addresses local risks and circumstances
- can be used easily in the event of a disaster.

3.5 Every person who is required to work under a local disaster management plan should be familiar with the plan before the next wet season.

3.6 Every local government should publish its disaster management plan (and relevant sub-plans) on its website before the next wet season.

The publication of evacuation centre locations is discussed in *5.5 Evacuation.*

3.3.2 Oversight of disaster management plans

Emergency Management Queensland is responsible for reviewing and assessing the effectiveness of disaster management plans.

It has not had a consistent approach to the conduct of reviews: the way in which a disaster plan is reviewed is largely at the discretion of the Emergency Management Queensland director for the region in question.[48]

The Local Government Association of Queensland suggested that oversight of plans needed to be strengthened, with more active review by Emergency Management Queensland.[49] There is no doubt that stronger reviewing mechanisms are required.

Emergency Management Queensland accepts that there is room for improvement in the processes it uses for reviewing local and district disaster management plans.[50] The agency is currently developing an 'audit tool' to standardise reviews, which district disaster co-ordinators will use in reviewing local plans. Meanwhile, Emergency Management Queensland will review district plans and a sample of local plans. It will also continue in its role of monitoring the 'planning environment across the state'.[51] According to Emergency Management Queensland, the system can be in place before the next wet season.[52]

District disaster co-ordinators are well placed to assess local disaster management plans because of their operational skills and knowledge of local conditions. The process might also help to develop relationships between the local and district levels. The concept of an audit tool to ensure consistency has merit, provided district disaster co-ordinators have the ability and the resources they need to review plans to the necessary level of detail.

Recommendations

3.7 Emergency Management Queensland should proceed with its proposed reviewing system before the next wet season.

3.8 Each district disaster co-ordinator should ensure that, before the next wet season, the disaster management plan of every local government in the co-ordinator's district susceptible to flooding:

- is consistent with the *Disaster Management Act 2003*
- addresses local risks and circumstances
- can be used easily in the event of a disaster.

3.9 In order to assist district disaster co-ordinators in this task, and to ensure consistency and effectiveness, Emergency Management Queensland should:

- provide a standardised approach for district disaster co-ordinators to follow, with all necessary guidance
- generally oversee the reviewing process
- before the next wet season, review a selection of local disaster management plans of local governments susceptible to flooding, which have already been reviewed at the district level.

3.10 Emergency Management Queensland should assess the effectiveness of the review system before the end of 2011, and report its results to the Commission by 31 December 2011.

3.3.3 Disaster management guidelines

Concerns were raised about the timing of Emergency Management Queensland's release of some of the disaster management guidelines in late 2010; including draft evacuation guidelines (see *5.5 Evacuation*) and re-supply guidelines (see *5.7 Re-supply*).

There was a view that the release of these guidelines was too close to the wet season, making it difficult for local governments to incorporate them into their disaster plans (particularly without prior consultation or training).[53] In future, Emergency Management Queensland should allow sufficient time for prior community consultation and training of disaster agencies before guidelines take effect.

3.4 Disaster management training

The *Disaster Management Act 2003* and the state disaster management plan require agencies and officers involved in disaster management to be appropriately trained and fully prepared to deal with disaster situations.[54] Emergency Management Queensland is primarily responsible for providing training in Queensland's disaster management arrangements.

In 2010, training was provided in various forms including short courses,[55] workshops, training exercises and consultation sessions.[56] In the lead up to the 2010/2011 wet season, Emergency Management Queensland also conducted various '*Disaster Management Act 2003*' consultation sessions and pre-season operational briefings. The consultation sessions explained the amendments to the legislation and their effects while the pre-season operational briefings were used to provide a seasonal outlook for the coming wet season.

Some local disaster management groups also conducted their own exercises following the commencement of the changes to the *Disaster Management Act 2003* in November 2010; both the Brisbane and Redlands local groups conducted desktop exercises based on disaster events in their regions.[57]

3.4.1 Exercise 'Orko'

From 2 to 4 November 2010 Emergency Management Queensland conducted Exercise Orko, based on a hypothetical extreme weather event affecting three disaster districts (Toowoomba, Warwick and Dalby) and five local governments (Toowoomba, Lockyer Valley, Western Downs, Southern Downs and Goondiwindi) in south-west Queensland. It provided an opportunity to practise disaster agency co-ordination and test evacuation plans, emergency call centre capacity, re-supply arrangements, and communication between disaster management groups.

Eighty-three participants from each of the disaster management groups were required to respond as they would in a real event using their disaster management plans, standard operating procedures, supporting documentation and local knowledge. Participants considered the exercise useful; it allowed them to identify gaps in their disaster response.[58]

3.4.2 Adequacy of training

Emergency Management Queensland has not had a consistent approach to identifying who needs training and the type of training required; something, it says, it is in the process of rectifying.[59]

In the 2010 calendar year there was certainly variation in the training Emergency Management Queensland provided at the local level; some areas were given several training opportunities, others none. Indeed, some of the large local governments – generally those with resources dedicated to disaster management – conducted their own in-house training exercises in the lead up to the 2010/2011 wet season.[60]

There were some general criticisms of the availability and effectiveness of the training provided by Emergency Management Queensland.[61] At least one local government had developed its own disaster management training program and had provided training materials to other local governments.[62] The same local government has also been approached by other local governments to provide disaster management training to its staff.[63] However, one local government mayor considered that Emergency Management Queensland had performed well in the training it delivered on changes to the *Disaster Management Act 2003*.[64]

The Local Government Association of Queensland suggested there was a need for more practice and training between events, noting in general terms that Commonwealth and state funding reductions have affected the accessibility of training.[65] There is general acceptance that an increased emphasis on training in disaster management roles and responsibilities would enhance Queensland's overall disaster preparedness and response.

Emergency Management Queensland acknowledges that its own training has not been supported by a consistent framework and the existing training packages need to be reviewed and updated to align with the recent changes to the disaster management legislation and policy.[66] It has developed a training framework aimed at key positions in the Queensland disaster management arrangements and is liaising with Queensland police to deliver training at the district level. It has set a completion date of 30 June 2012 for the development of training material. In the meantime, training will be prioritised to regions that are at high risk of flooding.

There was a lack of disaster management expertise in some regions during the 2010/2011 floods, in part because of the disparity in levels of training received across the state. Large local governments with significant resources are in a better position than smaller or regional local governments as they have greater access to training.[67] The timing of the changes to the *Disaster Management Act 2003* and disaster arrangements in November 2010 may have limited the opportunity for training before the 2010/2011 wet season.[68]

In regions that had previously been flooded in early 2010, there was a close working relationship between the local and district groups which, they considered, assisted greatly in their handling of the 2010/2011 floods.[69] Regular training exercises outside actual disaster situations, as well as affording opportunities to practise and to test disaster management plans, would help to develop these relationships.

The Commission has identified that training in a number of areas is needed before the wet season. For example, evidence from two local disaster co-ordinators, a district co-ordinator and an Emergency Management Queensland regional director suggested there are misunderstandings about roles under the post-amendment disaster arrangements.[70] District disaster management groups also identified training as a significant issue that they needed to address as a priority.[71]

Recommendations

3.11 Emergency Management Queensland should endeavour to ensure that before the next wet season:

- training is provided to those involved in disaster management at the local and district levels to ensure that the respective roles of all agencies, and in particular local government and the Queensland police, during an event are clearly understood
- training is provided to all local disaster co-ordinators
- training is provided to SES volunteers
- local disaster management groups are given practical training based on the event of large-scale flooding across different local government regions (as in Exercise Orko).

3.12 If training cannot be provided to every local government and disaster district before the next wet season, priority should be given according to each region's susceptibility to flooding.

3.5 Community education and driving in floodwaters

3.5.1 Community education

The importance of community education and awareness initiatives on flooding was a recurrent theme in submissions and in evidence before the Commission.

There have been various community education initiatives on disaster management at a national level. For example, in late 2010 the SES Natural Hazards Children's Awareness and Education Program launched a national campaign that included information to discourage children from swimming in flooded creeks.

This program also provided information about how to mitigate flood risks and work with the community to encourage disaster preparation.

Emergency Management Queensland has responsibility for ensuring communities are as prepared as possible for disasters.[72] It conducts various educational campaigns, distributes brochures in the lead up to storm seasons and holds information sessions for community and school groups and at other public events to increase public awareness.[73]

Local governments also play a central role in educating their communities about the natural hazards in their area and how community members can prepare for, respond to and recover from disasters. Some local governments made concerted efforts in the lead up to the 2010/2011 wet season through focussed community education and awareness programs.

The Barcaldine Regional Council, Central Highlands Regional Council and Mackay Regional Council disseminated information (as they do annually) through their periodical publications about how households could prepare in the lead up to the 2010/2011 wet season.[74] The same information was published on the councils' websites and local notice boards around the community.[75]

After the 2008 Emerald floods, the then Emerald Shire Council (now part of the Central Highlands Regional Council) developed a guide for residents that was distributed throughout the shire.[76] The guide contained information on how to prepare and plan for disasters, including contact numbers for emergency service, council and essential services personnel in the region.[77] It also included evacuation maps and provided advice on how to prepare for an evacuation.[78] The document is currently being revised and will eventually be redistributed throughout the community.[79] The council is considering the use of other media such as DVDs to inform the public about disaster preparation.[80]

With some help from State Government funding, the Rockhampton Regional Council prepared and distributed a disaster awareness DVD in the lead up to the 2010/2011 floods.[81] The council considered it had been a success thanks to its marketing as a practical and useful advisory resource and its distribution in advance of the wet season.[82]

The Mackay Regional Council took a number of measures to improve community awareness about disaster events in the lead up to the 2010/2011 floods. These included disseminating an emergency action guide with information about survival strategies during disaster situations which it advertised on a local billboard for six months,[83] using electronic billboards to broadcast safety messages before the floods,[84] publishing a 'Surviving Emergencies 2010/2011' notification in a local newspaper,[85] conducting a 'Cyclone Saturday' event, in which public displays were set up at a local shopping centre and warehouse,[86] and advertising the emergency action guide, key messages for the season and the Cyclone Saturday event in a local newspaper.[87]

ABC local radio stations also played a significant role in providing information to the community about what to do to prepare for the wet season, as well as what to do in the event of a disaster. After the Bureau of Meteorology briefed ABC local radio managers about the prospect of widespread heavy rainfall and cyclones for the 2010/2011 wet season, ABC local radio stations broadcast more of these community service announcements than usual, with greater detail about how to prepare for emergency situations.[88]

Community awareness was lacking in some areas. Community members in many of the flooded areas indicated that they were not aware of, or had not understood: the risk of flooding in their local area; the meaning and significance of flood warnings; whom they should contact for assistance in a disaster situation (see *5.3.7 State Emergency Service*); or when to evacuate and the location of evacuation centres (see *5.5 Evacuation*). In some regions the community was given very little, if any, disaster preparation and management advice before the floods.

Communities that are informed about risks in their region, and what to do when they eventuate, respond better to disasters. Emergency Management Queensland recognises that, in delivering disaster community education programs, it needs to co-ordinate with local government.[89] The agency is also exploring the use of social networking as a means to deliver disaster education initiatives in the future.[90] More community education is essential before the next wet season to improve general preparedness for flooding and the way communities respond. And, more particularly, the state and Commonwealth governments should both play a role in ensuring that the general public is aware of the dangers of driving in floodwaters (see *3.5.2 Driving in floodwaters* below).

Recommendations

3.13 Before the next wet season, local governments susceptible to flooding should conduct community education programs which provide local information about (at least) the following topics:

- the measures households should take to prepare for flooding
- the roles and functions of the SES and details of how to contact and join it
- whom to contact if assistance is needed during a flood
- contact details for emergency services in the area
- the types of warnings that are used in the area, what they mean and what to do in the event of a warning
- where and how to obtain information before, during and after a disaster
- what is likely to happen during a disaster (for example, power outages and road closures)
- evacuation
- measures available for groups who require particular assistance (for example, the elderly, ill and people with a disability).

3.14 To ensure consistency, the Queensland Government should assist local governments to develop and deliver the community education programs.

The importance of providing information to the community is discussed further in *4 Forecasts, warnings and information* and in *5 Emergency response.*

3.5.2 Driving in floodwaters

Nine people died in Queensland during the 2010/2011 floods when their vehicles were caught in floodwaters.

Queensland police received many reports during the floods of drivers ignoring road closure signs and continuing to drive on flooded roads.[91] To combat the risks involved, one district disaster co-ordinator used his daily media updates to remind people about the risks of driving into floodwaters.[92] Some local radio and television stations had broadcast warnings against driving into floodwaters in the months leading up to the 2010/2011 wet season. In its severe weather warnings during the floods, the Bureau of Meteorology included advice from the SES which urged against driving, walking or riding through floodwaters.[93] Emergency Management Queensland had used media outlets willing to assist (as a community service) to issue similar warnings.

The significant number of deaths which occurred warrants a larger, state-wide and State Government-sponsored education campaign. There are also opportunities to address the problem at a national level. The National Emergency Management Committee is a Commonwealth body that provides advice and direction on national emergency management issues and policy. It has a community engagement sub-committee which conducts community engagement activities with a view to improving the way in which communities respond to emergency situations. There is a clear alignment between the role of the National Emergency Management Committee community engagement sub-committee and the need to educate the Australian public about the dangers of driving in floodwaters. A National Emergency Management Committee education strategy aimed at minimising road deaths through driving in floodwaters would also accord with Australia's *Natural Disaster Resilience Strategy.*[94]

Recommendations

3.15 Before the next wet season, the Queensland Government should conduct a public education campaign about the dangers of driving into floodwaters.

3.16 The campaign should use various media and be designed to reach as many people as possible.

3.17 The National Emergency Management Committee should, as part of its education initiatives, consider developing a national public education campaign about the dangers of driving into floodwaters, using various media and commencing, if possible, before the next wet season.

3.18 The Queensland and Commonwealth governments should liaise to ensure a consistent message is delivered to the public.

(Endnotes)

1 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p5].

2 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p7].

3 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p14].

4 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, 2009, *Report on a Review of Disaster Management Legislation and Policy in Queensland.*

5 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, 2009, *Report on a Review of Disaster Management Legislation and Policy in Queensland* [p vii].

6 Exhibit 494, Statement of Bruce Grady, Appendix BG-1 - *Roles and responsibilities in support of disaster management arrangements – draft document,* 2010.

7 Information received from Queensland Government – State Disaster Management Group meeting 20 May 2011, draft minutes.

8 Transcript, Assistant Commissioner Stephen Gollschewski, 27 April 2011, Toowoomba [p811: line 34].

9 Department of Community Safety, *SES: Ordinary people doing extraordinary things*, 2009.

10 Exhibit 491, Statement of Mark Elcock, 17 May 2011 [p4: para 15; p5: para 18; p8: para 34].

11 Exhibit 495, State Disaster Management Group Ordinary Meeting Minutes, 2 March 2011 [p5]; Exhibit 302, Statement of Assistant Commissioner Peter Martin, 9 March 2011 [p17: para 76]; Exhibit 462, Statement of Inspector Marcus Hill, 4 March 2011 [p8].

12 Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p2: para o]; Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p4: para 2a-2b]; Exhibit 288, Statement of Colin Jensen, 25 March 2011 [p5: para 2.5]; Exhibit 334, Statement of Mark Holmes, 25 March 2011 [p2]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p22: para 81]; Exhibit 336, Statement of Stuart Holley, 9 May 2011 [p2]; Exhibit 312, Statement of Anthony Martini, 8 May 2011 [p3]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [p1: para 2a]; Exhibit 249, Statement of Rodney Ferguson, 14 April 2011 [p4: para 33]; Exhibit 240, Statement of Peter Stewart, 4 April 2011 [p1: para 2a(i)]; Information received from Andrew Byrnes, 31 March 2011 [p1, para:2]; Statement of Mark Pitt, 1 April 2011 [p1: para 2].

13 Exhibit 288, Statement of Colin Jensen, 25 March 2011 [p5: para 2.5].

14 Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p2: para o].

15 Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p22: para 81].

16 Information received from Michael Kruger, 31 March 2011 [p1].

17 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2: para 2a-b, e-f, h-k]; Exhibit 240, Statement of Peter Stewart, 4 April 2011 [p1: para 2a(ii)].

18 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2: para 2l].

19 Exhibit 334, Statement of Mark Holmes, 25 March 2011 [p2]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p22: para 79]; Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p2: para h-k]; Exhibit 336, Statement of Stuart Holley, 9 May 2011 [p1].

20 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p2: para 2d].

21 Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p33: para 121c]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p3: para j]; Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p5-6: para 5 (d)-(g)].

22 Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p5-6: para d-g].

23 Exhibit 481, Statement of William Wilkinson, 6 April 2011 [p3: para p].

24 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p8].

25 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p9].

26 State Disaster Management Group, 2010, *Queensland State Disaster Management Plan* [p22].

27 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland,* 2009 [p20, p31].

28 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland,* 2009 [p31].

29 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a review of disaster management legislation and policy in Queensland,* 2009 [p30].

30 Exhibit 522, Statement of Michael Clerke, 27 May 2011 [p5].

31 Sections 49, 53, 57, *Disaster Management Act 2003*.

32 Exhibit 240, Statement of Peter Stewart [p1: para:1(b)]; Exhibit 334, Statement of Mark Holmes, 25 March 2011 [p1].

33 Exhibit 369, LGAQ Submission on Flood Preparedness, 11 March 2011 [p5].

34 Transcript, Anthony Jacobs, Brisbane, 9 May 2011 [p1589: line 19]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p2: para: g].

35 Exhibit 290, Brisbane City Council Local Disaster Management Plan; Exhibit 313, *Moreton Bay Regional Council Local Disaster Management Plan*.

36 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1520: line 39].

37 Transcript, Mark Holmes, 11 May 2011, Brisbane [p1704: line 30].

38 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2656: line 36].

39 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1588: line 37].

40 Transcript, Gregory Hoffman,13 May 2011, Brisbane [p1984: line 54].

41 Transcript, Gregory Hoffman,13 May 2011, Brisbane [p1984: line 38].

42 The Natural Disaster Resilience Program is a funding partnership between the Commonwealth Government and states and territories that provides funding for disaster mitigation activities.

43 Exhibit 446, Statement of Anthony Trace, 10 May 2011 [p70: para 262]; Exhibit 447, Submission of Ipswich City Council [p63: para 13.29].

44 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1611: line 9].

45 Exhibit 369, LGAQ Submission on Flood Preparedness, [p5].

46 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1589: line 52].

47 Section 60, *Disaster Management Act* 2003.

48 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2655: line 43].

49 Exhibit 369, LGAQ Submission on Flood Preparedness, 11 March 2011 [p7].

50 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2655: line 35].

51 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2656: line 4].

52 Transcript, Bruce Grady, 26 May 2011 Brisbane [p2656: line 14].

53 Exhibit 334, Statement of Mark Holmes, 25 March 2011 [p12].

54 Section 16A(e), *Disaster Management Act 2003*; State Disaster Management Group, *State Disaster Management Plan*, 2010 [p28].

55 Emergency Management Queensland refers to the provision of 'training' and 'exercises'. However, for the purpose of this report, Emergency Management Queensland's 'training' courses are referred to as 'short courses', while its 'exercises' are referred to as 'training exercises'.

56 Exhibit 494, Statement of Bruce Grady, Appendix BG-3, BG-4, BG-5, BG-6, BG-7, BG-8, BG-10, 26 May 2010.

57 Exhibit 302, Statement of Assistant Commissioner Peter Martin, 9 March 2011 [p4: para 13; p5 para: 15].

58 Exhibit 249, Statement of Rodney Ferguson, 14 April 2011 [p1: paras 4-5]; Information received from Robert Bundy, 27 May 2011 [p3, para:9]; Exhibit 258, Stanthorpe Sub-Group – Incident Control Centre Debrief 17 January 2011 [p6].

59 Information received from Queensland Government [p10-11].

60 Exhibit 445, Statement of Anthony Keith Trace, 6 April 2011 [p17].

61 Transcript, Warren Day, 11 May 201, Brisbane [p1772: line 48].

62 Exhibit 340, Statement of Warren Day, 14 April 2011 [p10-11: paras 80-87].

63 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1609: line 24].

64 Transcript, Brad Carter, 23 May 2011, Rockhampton [p2452: line 24].

65 Transcript, Gregory Hoffman, 13 May 2011, Brisbane [p1985: line 28].

66 Information received from Queensland Government [p8].

67 Transcript, Warren Day, 11 May 201, Brisbane [p1771: line 31].

68 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1609: line 33].

69 Transcript, Brad Carter, 23 May 201, Rockhampton [p2457: line 19].

70 Transcript, Mark Holmes, 11 May 201, Brisbane [p1709: line 20]; Transcript, Mark Holley, 11 May 2011, Brisbane [p1717: line 4]; Exhibit 462, Statement of Inspector Marcus Hill, 4 March 2011 [p10]; Information received from Robert Bundy, 27 May 2011 [p1].

71 Information received from Bundaberg District Disaster Management Group, debrief meeting minutes 3 March 2011.

72 Transcript, Robert Bundy, 28 April 2011, Toowoomba [p1000: line 30].

73 Transcript, Robert Bundy, 28 April 2011, Toowoomba [p1000: line 35].

74 Exhibit 471, Barcaldine Regional Council public notice, 24 May 2011 [p1-16]; Exhibit 479, Central Highlands Regional Council regional roundup, 25 May 2011 [p1]; Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p2].

75 Exhibit 471, Barcaldine Regional Council public notice, 24 May 2011 [p1-16]; Transcript, Peter Maguire, 25 May 2011, Emerald [p2588: line 48].

76 Transcript, Peter Maguire, Emerald, 25 May 2011 [p2588: line 47]; Exhibit 478, Statement of Peter Maguire, Annexure G, *Emerald and Gemfields Region: A residents' guide to preparing and responding to disasters*, 25 May 2011 [p1-19].

77 Exhibit 478, Statement of Peter Maguire, Annexure G, Emerald and Gemfields Region: A residents' guide to preparing and responding to disasters, 25 May 2011 [p4].

78 Exhibit 478, Statement of Peter Maguire, Annexure G, Emerald and Gemfields Region: A residents' guide to preparing and responding to disasters, 25 May 2011 [p8-13].

79 Transcript, Peter Maguire, 25 May 2011, Emerald [p2588: line 49].

80 Transcript, Peter Maguire, 25 May 2011, Emerald [p2588: line 58].

81 Exhibit 459, Statement of Brad Carter, 31 March 2011 [p9]; Transcript, Brad Carter, 23 May 2011, Rockhampton [p2451: line 36].

82 Transcript, Brad Carter, Rockhampton, 23 May 2011 [p2451: line 47].

83 Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p2].

84 Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p2].

85 Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p2].

86 Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p3].

87 Exhibit 337, Second statement of Stuart Holley, 9 May 2011 [p2].

88 Statement of Stephen McClelland, 29 April 2011 [p7-8: paras 26-28].

89 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2675: line 55]

90 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2676: line 1].

91 Transcript, Assistant Commissioner Peter Martin, Brisbane, 6 May 2011 [p1475: line 40 – p1476 line 10].

92 Transcript, Assistant Commissioner Peter Martin, Brisbane, 6 May 2011 [p1475: line 41].

93 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p76-80, 82-141, 144-492, 776-870].

94 Council of Australian Governments, *National Strategy for Disaster Resilience: Building our nation's resilience to disasters*, 2011.

4 Forecasts, warnings and information

4.1 Flood warning systems

A flood warning system is made up of at least the following elements:

- prediction of flooding, usually by reference to river height
- interpretation of the prediction to determine the likely flood impacts on the community
- dissemination of warning messages about likely flood impacts to authorities and the community
- response to warning messages by the community and authorities.

In Queensland, responsibility for each of these components is divided between several agencies.

The Bureau of Meteorology has primary responsibility for the first element in the flood warning system: the prediction of flooding. The Bureau also has responsibility for providing warnings about weather conditions likely to give rise to floods.[1] It disseminates this information to state and local authorities and the public.

Councils bear the primary responsibility for translating flood predictions into the likely impact of flooding on local communities. As part of this role, councils are expected to provide information to the community about inundation at individual properties.

Dam operators may also play a role in flood warnings by distributing information about expected and actual outflow from dams, and data obtained from river height or rainfall gauges owned by the dam operator. This information is commonly used by councils and the Bureau to predict river heights and flooding. Dam operators are not generally involved in warning the community directly, although there is a narrow set of circumstances in which it is appropriate for them to do so.

The responsibilities of each of these agencies are interrelated; they should work together to provide effective flood warnings to the community.

This section examines issues related to two of the flood warning system elements listed above: *dissemination* of warning messages and *interpretation* of flood level predictions. In particular, it considers the effectiveness of warning mechanisms used by councils and disaster management organisations, and the information provided to the community about flood levels and road conditions. The section also outlines the role of dam operators in providing information relevant to flood warnings.

Issues relevant to the role of the Bureau, and specific warnings provided by the Bureau to councils and the public, including those in Toowoomba and the Lockyer Valley are examined in *4.2 Warnings and forecasts: Bureau of Meteorology and councils*.

4.1.1 Warnings

Effective warnings and information about flooding help the community and authorities to protect lives and property. The Queensland Floods Science, Engineering and Technology Panel convened by the Queensland Office of the Chief Scientist, identified that to be effective, a warning must be, amongst other things, informative, accurate, timely and trustworthy.

When providing warnings and information about flooding to the community, local and state authorities, and the Bureau, should take into account the particular needs of people from non English speaking backgrounds and the deaf community.

Community education is also vital to ensure that warnings are understood by their intended recipient and elicit an appropriate response. See chapter *3 Disaster frameworks, preparation and planning* for a more detailed discussion of community education.

During the 2010/2011 floods, the community received warnings and information by the following means:

- SMS alerts ('short message service', or text message)
- radio and television announcements
- social media such as Facebook and Twitter
- media releases and community service announcements
- information posted on websites
- door knocking.

No single warning mechanism is effective in all cases; some work well in some communities, or in some circumstances, but not others. Where flash flooding occurs or communities are threatened by rapidly rising water, a mechanism that can deliver immediate warnings should be used. Using a range of warning mechanisms helps to make sure that warnings reach all members of the community at risk of flooding, are effective for particular locations and are received even when power is lost.

Recommendation

4.1 In issuing warnings for a district or region, local and state authorities should use a range of different warning mechanisms effective for the particular district or region, including methods which do not rely on electricity.

Specific warning mechanisms

SMS alerts

In Queensland, there are three types of SMS alert systems. Emergency Alert is a national warning system that allows SMS alerts and recorded voice messages to be sent to affected individuals and businesses.[2] In Queensland, Emergency Alert is managed by Emergency Management Queensland.[3] Brisbane City Council and Townsville Regional Council have engaged a private company that sends SMS alerts, emails and recorded messages to individuals and businesses who have subscribed to the service.[4] Some councils have developed their own SMS alert systems. Generally, SMS alerts were an effective method of delivering flood warnings and information in the 2010/2011 floods.[5]

However, SMS alerts containing insufficient information are of little use, and can be positively harmful. An SMS alert sent to residents of Moreton Bay council region contained the following message:

> Immediate Flash Flood Warning for Caboolture, Burpengary Area. Very high water levels in Rivers and Creeks. Seek higher ground NOW.[6]

It caused confusion and even panic in some of those who received it.[7]

The problem, of course, is that the information SMS alerts can contain is limited to 160 characters. Consequently, SMS alerts work better when the text, as well as including critical information, refers recipients to other sources of information about what to do and where to go.

Some councils experienced delays when sending SMS alerts to residents, caused by the time taken to draft the text of the alert and identifying which residents should receive it. Councils need to understand the risk of flooding in their region so they can quickly determine which residents should receive an SMS alert and what that alert should say.

It is critical that such delays are avoided because SMS alerts must be timely in order to provide effective warning. An SMS sent by Ipswich City Council was received by some residents after their properties had been inundated.[8] Moreton Bay local disaster management group decided against sending an SMS alert to warn residents about dam releases because, by the time it was ready to be sent, the dam releases had peaked.[9] Since the January 2011 floods, both of these councils have decided to create message templates specific to each community that is at risk of flooding.[10]

SMS alerts are also not a reliable method of providing flood warnings in parts of Queensland which experience problems with telephone coverage. That difficulty is compounded during a flood, when telephone reception can be affected by flood related power outages and congested telecommunications networks.[11]

While any SMS alert system may have problems of the kind described, some particular limitations of the Emergency Alert system emerged during the 2010/2011 floods.

In Queensland, the use of Emergency Alert is governed by the Emergency Alert Operational Guidelines. The guidelines stipulate that, during a flood or severe weather event, Emergency Management Queensland or the state disaster co-ordination centre must approve an alert before it is issued. The approval process can take between 30 and 95 minutes;[12] two councils expressed concern that this process reduced the timeliness of Emergency Alerts sent.[13]

Councils and local disaster management groups should be aware that the Emergency Alert system cannot deliver alerts to all intended recipients instantaneously.[14] The time it takes for all Emergency Alerts to be delivered depends on how congested the telephone networks are, and the number of individuals who need to be warned.[15] According to the Director-General of Emergency Management Queensland, in some circumstances, it can take some hours for all SMS alerts to be sent.[16]

While councils often request that an alert be sent, Emergency Management Queensland or the state disaster co-ordination centre can issue an alert on their own initiative if immediate action is needed. In the Moreton Bay council area and the Somerset council area, SMS alerts were sent to residents by the state disaster co-ordination centre without the knowledge of the local disaster management groups.[17] In Moreton Bay, this meant that the council was not able to cope with the large volume of calls (approximately 5000) the council's call centre received after the SMS alert was sent.[18] To make matters worse, the local disaster management group was not in a position to provide information about what particular areas should be evacuated or the location of any evacuation centres.[19]

There will be occasions when a threat is so imminent that the state group must send an Emergency Alert without the knowledge of a council or local disaster management group. However, wherever possible, the state group should inform the council or local group of Emergency Alerts so the council or local group can prepare and provide appropriate supplementary information to members of the community.

At present, Emergency Alert delivers SMS alerts to residents based on their billing address. This meant that during the 2010/2011 floods some residents received alerts about flooding in Queensland while they were overseas.[20] Conversely, those who are visiting an area affected by flooding will not receive an SMS alert because their telephone billing address is elsewhere. The SMS alert operator for Brisbane City Council has the capacity to provide alerts to people based on their location (location based warnings).[21] However this function is not currently available Queensland wide. Victoria, on behalf of the Commonwealth Government and other state governments, is working with telecommunications companies to develop the capacity for Emergency Alert to send location based warnings.[22]

Following the use of Emergency Alert during the recent floods and Cyclone Yasi, the Commonwealth Government has commissioned an independent review of Emergency Alert to assess whether the system provides timely and adequate information. The outcomes of this review are expected to be considered by the National Emergency Management Committee in the latter part of the year. (The role of the National Emergency Management Committee is described in *3.5.2 Driving in floodwaters*.)

In addition, the Queensland Police Service and Emergency Management Queensland are reviewing the current version of the Emergency Alert guidelines. This review will incorporate comments made by district disaster

co-ordinators and district disaster management groups about the performance of Emergency Alert during the 2010/2011 floods. These comments reflect some of the problems identified by the Commission.

The State Government has indicated that the new Emergency Alert guidelines will be completed by the next wet season. It is important that this goal is achieved so local and state authorities have sufficient time to familiarise themselves with the new guidelines and any new procedures.

Recommendations

4.2 Councils should prepare SMS alert templates covering a range of different flood scenarios before the wet season.

4.3 SMS alerts should direct recipients to websites or contact numbers providing more detailed information about flood locations and predictions, the location of evacuation centres and evacuation routes.

4.4 Councils and Emergency Management Queensland should work together to ensure the approval process does not cause delays in delivering SMS alerts.

4.5 Wherever possible, Emergency Management Queensland should consult with local disaster management groups before sending emergency alerts to residents. Emergency Management Queensland should inform the local disaster management group, as soon as it can, about any message already sent to residents in that local disaster management group's area.

Radio

The 2010/2011 floods demonstrated the importance of radio as a means of communicating natural disaster information to the community.

Radio is an effective means of communicating information to isolated communities where internet and mobile telephones are either not available or not reliable. Battery operated radios have the particular advantage of continuing to function after power has been lost. One local commercial radio station, with a local electrical appliance retailer, organised a successful initiative before the floods to encourage the community to purchase discounted battery operated radios.[23]

The community relies on radio as a source of information about local conditions during a disaster. During the floods, radio stations broadcast information from members of the community about road closures, unofficial evacuation centres, where to go, and what to do in their particular area.[24] Radio stations in Ipswich and Moreton Bay gave accounts of their telephone lines being overwhelmed with calls from listeners seeking, and wanting to provide, information.[25]

For many regional communities, ABC local radio is an essential source of information. The ABC was widely commended for its coverage of the floods. Councils in regional Queensland recognised that ABC radio is critical for the dissemination of information, and worked closely with the ABC to provide warnings to their communities.[26] One local disaster management group even arranged for a representative of ABC radio to be on site at the co-ordination centre during the flood response.[27] The ABC has indicated it is willing to work with councils to ensure that residents are aware of the ABC radio frequency that will provide warnings and other information during future floods.

In some instances, a radio station's frequency covered a geographical region experiencing flooding at a number of locations. For example, the Banana Shire Council is covered by three different ABC radio frequencies. These frequencies also cover parts of Western Downs Regional Council. Because of this, during the 2010/2011 floods, the ABC radio frequency that covers both Banana Shire Council and Toowoomba city focussed its coverage on the events in Toowoomba. As a result, Banana Shire Council could not assume that residents listening to that frequency would receive timely information for their area. The Banana Shire Council is currently discussing this particular issue with the ABC.[28]

Recommendation

4.6 Individuals and businesses should be encouraged to acquire battery operated radios for use in emergencies.

4.7 Councils should ensure that residents are aware of the frequency of the radio station or stations in their local area that will disseminate flood warnings and other information during disasters.

See chapter *3 Disaster frameworks, preparation and planning.*

Social media

During the 2010/2011 floods, some councils and the Queensland Police Service used social media such as Twitter and Facebook to disseminate flood warnings and information about local conditions.

Where it was used, social media was found to be an effective way to provide information to the community.[29] An independent review of the Brisbane City Council's response to the January 2011 floods determined that Facebook and Twitter were used extensively to access information about the 2010/2011 floods.[30]

Many of the councils that do not currently use social media to provide information to residents have indicated an intention to do so in future disaster events.[31]

As it may be possible for the public to post information directly to an official social media site, there are concerns that a member of the public might post false information.[32] For example, inaccurate information was published on the Western Downs Regional Council Facebook page.[33] The Commission acknowledges that additional staff, beyond the resources of some councils, may be needed to prevent inaccurate information being posted. However, where there are enough staff to monitor content, social media can be a useful tool to respond to rumours in the community. For example, two employees of Goondiwindi Regional Council updated the council's Facebook site 24 hours a day to correct rumours promptly and to provide up-to-date information to the community.[34] The Queensland Police Service also used its Facebook site to respond to rumours; for example, a rumour about the failure of Wivenhoe Dam.[35]

Recommendation

4.8 Councils that have not already done so should consider how social media may be used effectively to provide accurate information about flood levels and local conditions to residents during a flood event.

Sirens

Sirens were not widely used in the 2010/2011 floods. However, when the threat of flooding is imminent and is confined to an identifiable area, a siren may be an effective means to warn the community.

Since the 2010/2011 floods, residents in Fernvale and the Lockyer Valley have proposed sirens as an effective means of warning their communities, given the susceptibility of these locations to rapid rises in water levels or flash flooding.[36] Goondiwindi Regional Council is also considering using a siren for the town of Killarney, where flooding occurs quickly.[37]

Sirens may also convey information other than an immediate threat of flooding. For example, upon hearing a siren, the community of Condamine gather at the SES shed to hear further information.[38] The Local Government Association of Queensland and Mackay Regional Council have suggested that community members be educated to understand that, if a siren or other signal is played, they should turn on their radio to hear further information.[39]

Recommendation

4.9 A siren may be appropriate in smaller towns or rural communities susceptible to flash flooding. If councils rely on sirens to warn residents, they should ensure that the community understands the meaning of the siren.

Door knocking

During the 2010/2011 floods, door knocking was used to warn residents about flooding in both large and small communities. Door knocking was conducted by council staff, Queensland police, SES volunteers or members of the local community. Providing information directly to individuals is one of the more reliable ways to convey flood warnings. However, because of the time it takes, there may not be enough people or time to warn everyone at risk of flooding.

Door knocking is more likely to be an effective method in areas that are known to be susceptible to flooding, so that there is ample notice and opportunity to warn residents. Some councils commence door knocking of these areas after a certain trigger is reached, such as predetermined river height or certain outflows occurring from a nearby dam. This kind of arrangement exists for residents in Mackay, Moreton Bay, Gladstone and Chinchilla.[40]

Of course, as the area likely to be flooded increases, the ability to door knock all residents is reduced. In Brisbane, as the predictions for the height of the Brisbane River rose on 11 January 2011, the number of properties to be door knocked increased from about 10 000 to 30 000;[41] a number beyond the capacity of Brisbane City Council staff to achieve in time. Nonetheless, if resources permit, door knocking should not be discounted as a warning mechanism for large communities. Brisbane City Council staff were able to reach nearly all of the initial 10 000 properties predicted to be affected before the flood waters peaked.[42]

Some local disaster management groups, rather than arranging for council staff to speak directly to residents, used local sub-groups as a conduit for information to communities affected by flooding. A description of these sub-groups, and the role they played in providing warnings and information to isolated communities can be found at *5.1.2 Locality-based disaster management*.

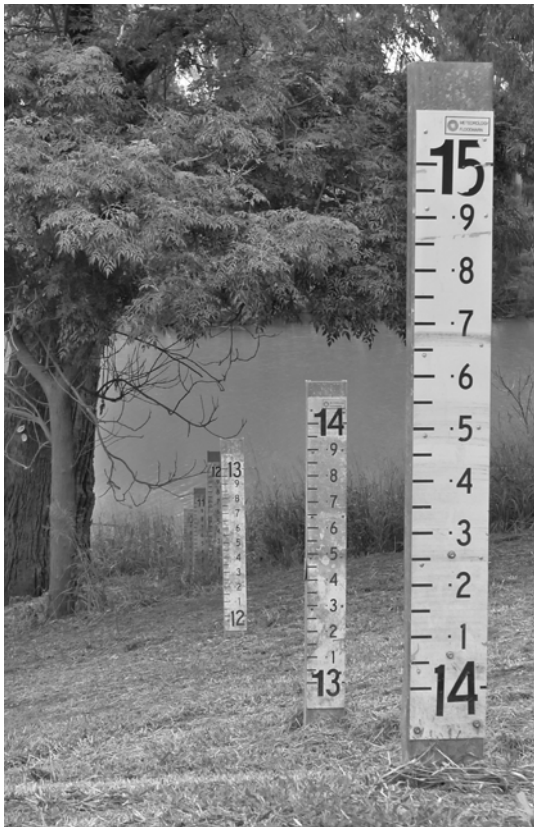
'Bush telegraph'

During the 2010/2011 floods, residents living near water courses in rural areas provided great assistance by warning councils and other local residents about large volumes of water moving through the local systems.

In Jericho and Alpha the accumulated knowledge of local landowners, living on different streams and tributaries, was provided to local police who acted on that information and warned the towns downstream about flooding.[43] Similarly, in the Central Highlands council region, rural residents are able to estimate the likely flood levels downstream in Rolleston by using information about water levels in the Panorama and Brown rivers and Carnarvon Creek, and comparing it to previous floods.[44] Based on this information, residents operate a 'bush telegraph' by calling each other and ensuring those at risk of flooding are evacuated in time.[45]

However, informal flood prediction systems using local knowledge are not always permanent. The town of Condamine lost an important source of information about flooding when the property of a long term resident was sold and the resident moved away from the area.[46]

It is plain that councils, particularly those in rural Queensland, should continue to take advantage of local knowledge about river heights and rainfall.



Flood markers showing water levels at Dawson River, Theodore, photographed after floods (photo courtesy Gerard Hinchliffe)

Gauges

Gauges and flood warning

To warn the community about flooding or severe weather, authorities must first be able to monitor rainfall and water levels and predict further rises in water level. For

this purpose, the Bureau has access to about 2200 gauges across Queensland.[47] About half of these are owned by other agencies such as the Department of Environment and Resource Management, Seqwater, SunWater and local councils. These gauges monitor either river heights, rainfall or a combination of weather conditions (the latter type includes automatic weather stations).

Types of gauges

The gauges used in flood warning can be categorised broadly as either manual or automatic.[48] Automatic gauges can be divided further into two broad categories: telemeter gauges and ALERT gauges.

A telemeter gauge sends river height or rainfall data at periodic intervals to a computer. This data is sent by telephone communication, such as landline, mobile or satellite, and is used by the Bureau and the owner of the gauge.

ALERT stands for automated local evaluation in real time. ALERT gauges comprise a network of river height and rainfall gauges that continuously report data by VHF radio to computers at either a council or the Bureau. ALERT gauges provide a continuous stream of data, but can also be configured to send an email or SMS alert to council staff when a predetermined trigger is reached, such as a certain river height.[49] For example, after receiving an alert, Mackay Regional Council's procedure is to commence door knocking of particular streets at high risk of flooding. The Bureau considers that ALERT gauges are ideal for areas at risk of flooding, including flash flooding.[50]

Installing additional gauges

Many local councils and some residents considered that, located in places of identified need, additional gauges would bolster existing flood warning systems by improving the accuracy and timeliness of predictions about flooding.[51] For example, in Emerald, the council estimated that a strategically located gauge would allow the council 12 to 24 hours additional warning of a potential flood.[52]

Clearly, gauges are integral to predicting flooding and providing timely warnings to the community. However, gauges have a number of limitations, which are discussed in the context of their use by the flood operations centre in section *2.6 Decision-making and conditions at the flood operations centre*.

Where additional gauges should be located, the type to be used and whether additional gauges should be installed at all, depend on a range of factors. These include the type of warning to be achieved, the size of the catchment and the causes of flooding in the particular river system and its tributaries.

The cost of gauges is also a factor to consider. Councils can apply to the Natural Disaster Resilience Program for funding for river height and rainfall gauges required for flood warning purposes. However, even where this funding is obtained, councils are required to contribute to the maintenance of the gauges and any related equipment (such as telemeter equipment for data reporting).[53]

The Bureau considers that councils should initiate the process of obtaining additional river height and rainfall gauges in their council region.[54] Since the 2010/2011 floods, a number of councils have already commenced discussions with the Bureau about installing additional gauges.[55]

Recommendations

4.10 Councils, with the assistance of the Bureau of Meteorology, should examine the feasibility of and priorities for installing additional river height and rainfall gauges in areas of identified need.

4.11 Councils, with the assistance of the Bureau of Meteorology, should consider the susceptibility of their regions to flash flooding, and whether it is feasible and necessary to acquire and operate an automated local evaluation in real time system (ALERT system) for particular waterways.

4.12 The Queensland Government should consider assisting less well-resourced councils to fund the installation of an ALERT system where a case is made for its adoption.

4.1.2 Information about flood levels

Residents and businesses need accurate information about how possible flood levels will affect their properties.

During the 2010/2011 floods, the Bureau, councils, state authorities and the media provided information about predicted flooding to the community. They used a range of methods including references to river heights at certain gauges in terms of AHD (Australian Height Datum), the Q100 level and other technical terms, as well as historical flood levels.

River heights measured in AHD at certain gauges

Flood levels are often described by reference to the height of a river at a certain gauge in terms of AHD. AHD is a unit for measuring height where 0.00 metres is the average sea level recorded at 30 tide gauges around the coast of Australia. For example, in Brisbane, when a river height is described as 4.5 metres AHD at the Port Office gauge, this means that the height of the river is approximately equal to 4.5 metres above sea level at the location of the Port Office gauge.

References to river heights in terms of AHD at a certain gauge are useful for those with technical knowledge, such as engineers or hydrologists working for the Bureau or local and state authorities. Some people understand the significance of river heights described in AHD for potential flooding on their properties. For example, the residents of Dale Street, Burpengary live very near the Burpengary Creek and regularly refer to the Bureau's information about river heights at the Burpengary Creek gauge to assess whether flooding is likely to occur on their properties.[56]

However, references to river heights in terms of AHD were meaningless to some residents and businesses in trying to assess the likely impact of flooding on their properties.[57]

The height of the river measured in AHD is often dependent on the location of the gauge, consequently, residents and businesses need to be aware of which gauge is relevant to their location. For example, the height of the Brisbane River at the Port Office gauge will not accurately predict flood levels in the Brisbane suburb of Archerfield, which is some distance from the Port Office gauge and where flooding is also caused by the nearby Oxley Creek.[58] For residents of this suburb, a river height gauge that measures the height of the Oxley Creek would be a more useful indication of likely flood levels in their area. Information about the location of gauges can be found on the Bureau's website and the locations of some gauges are included in the Bureau's flood warnings. When warnings are provided about river heights, the location of the gauge should be specified.

The actions taken by the Central Highlands Regional Council provide a good example of how information about the river heights at particular gauges can be made understandable to residents. The council's local disaster co-ordinator met with residents of a street at high risk of flooding and advised them what river height at the Fairbairn Dam spillway gauge would result in water over the floors of their houses.[59]

Q100 and other technical terms

Q100, an ARI (annual recurrence interval) of 100 and an AEP (annual exceedance probability) of one per cent are interchangeable terms denoting that every year there is a one per cent chance of a flood of that magnitude or greater occurring at that particular location. A one per cent chance in any one year is equivalent to the average time between such floods occurring being 100 years. The meanings of these terms are not well understood in the community and are often wrongly understood to signify that a flood will occur only once in every 100 years.[60]

Historic flood levels

References to historic flood levels were widely used during the 2010/2011 floods. Such references give a good indication of the likely magnitude of a flood and can help residents get a sense of the potential level of flooding. When residents of Brisbane were advised that they could expect a flood comparable to the historic 1974 flood, it helped them understand the scale of predicted flooding.

Of course, every flood is different and people need to understand that references to historic flood levels are a guide only, and cannot give certainty about whether and to what extent flooding will occur at individual properties.

Communicating the impacts of predicted flooding to residents

While many agencies provide the community with general information about flooding, it is the responsibility of councils to provide information about the likelihood and extent of inundation at individual properties.

Councils can use a range of methods to help individuals easily understand the likely impact of predicted flood levels on their property. For example, Ipswich City Council is considering using a colour coded system for residents to identify whether their properties are likely to be flooded.[61] This system is similar to the Coastal Evaluation system used in some coastal regions to provide information to residents about the likely impact of a storm surge.[62] Brisbane City Council makes flood flag maps and flood wise property reports available to residents, both of which are designed to provide information about when flooding will occur at specific properties.[63]

Other examples include: flood markers, information on rates notices about flooding at individual properties, and geospatial mapping that depicts inundation at certain river heights and is available to the public.

Recommendations

4.13 Councils should ensure that residents and businesses can clearly understand the impact of predicted flood levels on their property. This may include one or more of the following methods:

- information on rates notices about flooding at individual properties
- geospatial mapping, available to the public, that depicts inundation at certain river heights
- flood markers
- flood flag maps and floodwise property reports
- colour coded maps
- information that relates gauge heights with the level of flooding to be expected at a property.

4.14 In the course of flood events, warnings referring to gauge heights should include information about the location of the gauge.

4.1.3 Flood mapping and flood modelling

Flood mapping is the best way for councils to determine the impact of flooding at certain properties. In most cases, a comprehensive flood map is created using a flood model; the latter having been derived from a flood study.

Brisbane City Council has a complex flood model known as 'the Bender' which can account for factors such as fluctuations in tide heights, releases from dams upstream of Brisbane and flows from other river systems and tributaries. During the January 2011 floods in Brisbane, this model was run regularly and was used by the council's call centre staff to provide information to callers about flooding at specified properties[64] and to determine which properties should be door knocked.[65]

The Commission is aware that a number of councils are in the process of creating up-to-date flood studies and flood models.[66]

Current reviews relating to flood mapping

Every council is required to identify in its planning scheme 'natural hazard management areas' affected by floods in accordance with State Planning Policy 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*. The guidelines to the State Planning Policy 1/03 state that 'natural hazard management areas should be identified through a comprehensive and detailed natural hazard assessment study' and provide an outline of possible methods for undertaking flood studies. The natural hazard management area is generally defined by flood maps.

Presently the state and Commonwealth governments are undertaking reviews of flood mapping. In March 2010, the Queensland Government approved a review of the State Planning Policy 1/03 which is expected to take approximately 18 months.[67] The Commonwealth Government's National Disaster Insurance Review has released an issues paper seeking comments on who should bear responsibility for producing, maintaining and funding flood maps and the need for national standards in this area. The review is due to present its report on 30 September 2011.

The Commonwealth review will deal directly with an issue of major concern to some councils: how flood mapping should be funded. This debate arises in part because flood mapping funded by councils also helps other entities, such as essential services providers, to plan and prepare for flooding.

Flood mapping can be a complex, time consuming and expensive process that is unlikely to be completed before the next wet season. Issues relating to flood mapping are likely to be considered by the Commission as part of its investigation into land planning and insurance. In addition, the outcomes of the state and Commonwealth government reviews are still pending. Given those considerations, the Commission will refrain from making recommendations about flood mapping at this stage.

4.1.4 Warnings about dam spillway outflow

This part applies only to operators of referable dams which have a spillway. A 'referable dam' is a dam whose failure places the safety of at least two people at risk.[68] (For a general description of dams see *2.2 Dam history, functions and capacities*.)

The Commission has examined the activities of dam operators during the 2010/2011 floods at various dams around Queensland, including:

- Fairbairn Dam outside of Emerald, Callide and Kroombit dams near Biloela, Beardmore Dam above St George, Coolmunda Dam above Inglewood, Glenlyon Dam near Texas and Leslie Dam near Warwick, operated by SunWater
- Cooby Dam outside of Toowoomba, operated by Toowoomba Regional Council
- Awoonga Dam outside of Gladstone, operated by Gladstone Area Water Board
- North Pine Dam north of Brisbane and Wivenhoe and Somerset dams that sit upstream of Brisbane city, operated by Seqwater.

For the dams outside south-east Queensland (that is, all dams except Wivenhoe, Somerset and North Pine Dam), the operators have no discretion as to when to let water out, and how much, during floods. The dams are either ungated, or have automatic gates which open as the water level increases. Water flows over the spillway of the dam as soon as it reaches a certain height. The spillway of each dam is at a lower height than the dam embankment so that water can flow over the spillway and safely out of the dam. The dams do not have any empty space in them to hold flood water; they are kept as full as possible to provide water for drinking, irrigation and industry. It follows that the Commission's focus has been on the operators' procedures for providing warnings to disaster management personnel and local communities. (See chapter *2 Dams* for a discussion of the operation of Wivenhoe, Somerset and North Pine dams, each of which have flood mitigation capacity.)

The warnings procedures for all of these dams are set out in emergency action plans.[69] Those plans deal with what should be done in all types of emergency, including flood, earthquake and terrorist attack. Each plan is different, but all identify the parties who should be warned about outflow, and the time and manner in which the warning should be given.

Need for warnings about dam outflow

The presence of a dam necessarily affects the manner in which a region floods. A dam is often situated at the convergence of the catchment's flow. Dams can, therefore, be ideal locations at which to gauge water flow during floods, since water from a whole catchment flows out of the dam through a defined area - the spillway. In any case, a dam's presence will affect how water flows toward and down waterways.

Because of those characteristics, dam operators must be involved in the emergency response to floods. It is important that information about lake levels and flows into and out of a dam is received by local disaster management groups, who must make water height predictions for residents and formulate flood warnings.

Local disaster management groups are assisted in their response to flooding by dam operators' sharing information with them. For example, the Mayor of Central Highlands Regional Council described how SunWater staff would not only give useful information to the local disaster management group, but would also participate in phone conferences between council hydrologists and the Bureau of Meteorology to discuss the developing situation.[70] In Emerald, information was shared by email, telephone calls and the presence of SunWater staff at local group meetings; those discussions proved very useful for the local group.[71]

SunWater's manager, Asset Management, Robert Keogh, stated that the sharing of information was easiest when there was an established relationship between the dam operator and the local disaster management group.[72] SunWater has accepted that more work is required to strengthen relationships with some local groups;[73] since the 2010/2011 floods, it has taken steps to ensure its dam staff around Queensland initiate and improve those relationships.[74]

Others who require warnings from dam operators are residents living immediately downstream of dams. Spillway outflow can increase quickly as the result of heavy rain in the catchment. Water can reach those who live, work or own property a short distance downstream of the dam very swiftly. The need for warnings is acute for those residing below dams with gates, because the water flow may increase rapidly when the gates open. Water levels can threaten before the local disaster management group can properly process the dam information and issue a warning. This leads to a confined exception to the general rule that dam operators are not responsible for providing warnings directly to the community. It is recognised in the Australian Government publication *Emergency Management Planning for Floods Affected by Dams*[75] that dam operators must take responsibility for identifying and warning that limited category of people.

The warning of local residents close to Wivenhoe Dam, upstream of Brisbane, provides an example. The dam operator, Seqwater, entered into an agreement with a group of landholders downstream, the Mid Brisbane River Irrigators, to send email updates about current and predicted future releases directly to them. The Commission received some evidence that these communications assisted property owners downstream of the dam to be aware of the developing situation and to take appropriate action to protect themselves and their property.[76] On the other hand, others had difficulty accessing their email during the flood event because of interruptions to the power supply.[77] When power and mobile phone reception is lost, other modes of communication such as radio might be necessary to spread information: see also *4.1.1 Warning mechanisms*.

The DERM *Queensland Dam Safety Management Guidelines*[78] indicate that dam operators should also consider including state emergency agencies, operators of other water facilities, local governments and the Bureau of Meteorology in their list of people to receive information about dam outflow in the emergency action plans. The effective provision of information to those entities would assist in their response to flooding. Given the Bureau's responsibility for providing flood warnings, the provision of information to it is of particular importance.

Recommendation

4.15 Each local disaster management group should include in its meetings a representative of the operator of any dam upstream of its region which contributes water to flooding.

Frequency and content of warnings

Time is of the essence for warnings to local residents who are immediately downstream of the dam, so a short message giving a basic situation report is likely to be preferable. Those recipients need less specific information than local disaster management groups, who require fuller briefings on the current situation and any likely developments.

Dam operators can only provide information as to timing and volume of dam outflow; predictions as to river heights or inundation areas are the responsibility of others within the disaster management framework. (See chapter *3 Disaster frameworks, preparation and planning* for a description of the different responsibilities of entities in the disaster management framework.) It is the responsibility of residents close to the dam to apprise themselves of how certain outflows will affect their property.

Different floods call for different frequency of communication.[79] A slow rising flood may require less frequent provision of information, while a rapid rise in flows may require very regular communication. It would be appropriate for emergency action plans to contain guidelines to staff at dams about the frequency of warnings that will be appropriate in different situations. One way of doing that might be to link frequency of warning with rate of rise of the lake level.

The use of SMS and/or email warnings allows large numbers of people to be contacted simultaneously. The Commission considers that this type of bulk communication would work well for those who do not require immediate notification, leaving operational staff at the dam free to contact personally those in need of urgent

notification, such as residents immediately downstream. As to the limitations of SMS warnings see *4.1.1 Warnings mechanisms (SMS alerts)*.

Recommendations

4.16 Dam operators should plan to contact people identified by their emergency action plans about dam outflow in sufficient time for them to be able to respond to the information.

4.17 Dam operators should ensure each emergency action plan includes a clear statement as to the frequency of, and circumstances in which, warnings will be issued to people listed in the emergency action plan.

4.18 Dam operators should assess the effectiveness of using SMS and/or email as a bulk instantaneous communication to all people on the notification list while individually contacting those whom it is essential to inform immediately.

Clear warnings procedures

While most dams have a single document (the emergency action plan) dealing with communications procedures during emergencies, others have multiple documents. The communication procedures for Wivenhoe Dam are included in the emergency action plan, the Wivenhoe manual,[80] the Draft Communication Protocol of the Communication of Flooding Information for the Brisbane River catchment – including Floodwater Releases from Wivenhoe and Somerset Dams,[81] and the verbal agreement with the Mid Brisbane River Irrigators,[82] discussed above. The Commission endorses the continuing review of the content of the draft communication protocol.

Seqwater intends to make those documents consistent once the draft communication protocol is finalised; however the consolidation of information into one document should be considered. Consolidation might assist both staff and recipients in the clarification of the procedures.

Care should be taken in that consolidation to ensure the nature of the Wivenhoe manual as a document to be used by the flood engineers in the operation of the dams during floods is maintained (see section *2.5 Manual of operational procedures for flood mitigation at Wivenhoe Dam and Somerset Dam* in this report). The Commission is not suggesting that the manual, emergency action plan and protocol be amalgamated. Rather, the Commission suggests that all the communication procedures are contained in only one document (probably the emergency action plan or a separate protocol). The communications procedures in the manual are brief, and do not, as currently drafted, reflect existing practice (see *2.6.10 Communications*) and could easily be removed from that document.

Recommendation

4.19 Seqwater should consider consolidating its communication arrangements and responsibilities in a single document for each dam it operates.

Community involvement and understanding

The Australian Government guidelines *Emergency Management Planning for Floods Affected by Dams*[83] indicate that the community as well as local governments and disaster management agencies should be involved in the creation of emergency management procedures, particularly in deciding who requires warnings about dam spillway outflow.[84] The involvement of local people adds to the likelihood that the warning process will be useful and effective.

Dam operators should give community members the opportunity to request to be on the warning list about dam outflow, and consider the best option for warning those people. Not all requests must be accepted; dam operators should only be responsible for warning residents if the available warning times to those residents are less than those available through the emergency management system.[85] It is not necessary for each person who is accepted as needing such a warning to be contacted personally by phone; operators can take advantage of SMS, email and social media to provide warnings to relevant sections of the community.

Further, it is important that the communication procedures, once set, are known to all involved. All people on the list in the emergency action plan should be able to obtain information on the arrangements for communication with them. This will allow them to plan effectively as well as prevent unnecessary calls for information to dam operators during a flood emergency.

Recommendations

4.20 The operator of each dam should, upon request, provide to any person on the notification list in the emergency action plan an explanation of the arrangements as to the type and frequency of communications required by that plan.

4.21 Operators of dams should assess their current compliance with the DERM *Queensland Dam Safety Management Guidelines* (February 2002), the ANCOLD *Guidelines on Dam Safety Management* (August 2003), and the Australian Government *Emergency Management Planning for Floods Affected by Dams* (2009) and if appropriate, comply with those guidelines.

4.22 Operators should include in their emergency action plan a description of the type of information that will be provided to those on the notification list.

4.23 Operators of dams should publicise, in a newspaper circulating in the local area and by posting a notice on its website every year before the wet season, the opportunity for local residents immediately downstream of a dam to be included on the existing notification list, and:

- consider whether an applicant for notification is so close to the dam that the warning time before water from the dam affects them is less than that available through the emergency management system
- consider whether they can be effectively notified by SMS or email
- if it is necessary to contact the applicant personally, agree with him or her a mode for that communication.

4.24 The operator of any referable dam and the local disaster management group should develop a common understanding as to their respective roles in a flood event and the type and frequency of information the dam operator will provide to it and local residents.

4.1.5 Information about road conditions

Queensland has over 33 000 kilometres of state-controlled roads which are managed by the Department of Transport and Main Roads.[86] During the 2010/2011 floods some roads were inundated and had to be closed.

The Department of Transport and Main Roads has clear guidelines on closing roads. These were in place before the 2010/011 wet season.[87] The department also has guidelines on how road closures should be reported on its website.[88]

The road closure process involves the following steps:

- the road is assessed by transport department officers or police officers
- after consulting others including the transport department's website operators, local police and affected residents, the officer closes the road or imposes conditions on access
- road access information is submitted to the transport department and, following an approval process, the road condition is published on the transport department's website.[89]

This process is also used when the roads are reopened.[90]

Distribution of road condition information

Information about road conditions is provided through the transport department's website or the department's call centre. Staff at regional transport department offices were available 24 hours a day, seven days a week during the 2010/2011 floods to provide information to the department's call centre.[91]

The ABC provides information about road conditions for the whole of Queensland and distributes this information via radio broadcasts and updates on local news websites. The ABC obtains its information from the transport department's webpage, local councils, the RACQ and Queensland Police.[92]

The RACQ provides information about road conditions in regional Queensland only and distributes this information via its website and an interactive voice response telephone line.[93] The RACQ's sole source of information about road condition information is the transport department.[94] The RACQ does not provide information about road conditions in south-east Queensland; this is the responsibility of the transport department.[95]

Difficulties in distributing road condition information

Website problems

The transport department's website experienced unprecedented usage[96] during the 2010/2011 floods:

- in a nine day period from 22 to 30 December 2010, there were 358 000 website visits, which was more than the number of visits for the entire 2009/2010 wet season
- during the same nine day period, the daily average was 51 000 visits, compared to the 2010 non wet season daily average of 2441 visits
- 497 000 visits were registered on one day alone (Tuesday 11 January 2011).[97]

On 28 December 2010, the website slowed considerably as a result of the increased use. The Department of Transport and Main Roads responded by using a 'splash page' of road condition information in simple text format instead of the page with maps embedded, because the graphics took longer to load and use. After 31 December 2010, the department made available maps that could be downloaded, rather than having maps embedded in the website.[98]

The RACQ website also experienced a dramatic increase in use during the 2010/2011 floods and became extremely slow. Delays in responding to telephone calls also led to an increase in the number of abandoned phone calls to the RACQ. To address this, RACQ called in staff from leave, enhanced the interactive phone line system and increased the internet server capacity from two to five servers.[99]

Delays in providing information

The timeliness and accuracy of road condition information to the public varied significantly during the 2010/2011 floods. This was caused by a range of factors:

- Roads in remote areas were more difficult to access, resulting in reports on conditions being delayed.[100]
- The swiftness of the rise and fall of water across road surfaces meant reports were often quickly out of date. This particularly affected RACQ's ability to keep up to date with conditions, as it relies on information from the Department of Transport and Main Roads.
- Not everyone in regional and remote areas was able to access information on the internet or mobile telephone, either because of remoteness or because of the effect of the floods.
- There were also delays when the Department of Transport and Main Roads webpage, which contains detailed maps and pictures showing road closures, slowed because of the number of people accessing the site. The Department switched to the 'splash page' described above to overcome this problem.

Localised information

Some residents were confused by road condition information because they knew their local roads by colloquial names which were not used on the transport department webpage.[101] This was a particular problem when the transport department's website was changed to a text only site. This confusion was somewhat alleviated after 31 December 2011 when maps became available to download.[102]

Effect on road users

As a result of inaccurate or tardy information, some road users were significantly delayed or forced to take sizeable detours after relying on road condition information.[103] Holiday travellers were affected because flooding occurred over the Christmas and New Year holiday.

Some road users were stranded in communities such as Warwick and Gin Gin, causing strain on local resources and evacuation centres.[104]

The Department of Transport and Main Roads and RACQ have both taken steps since the 2010/2011 floods to enhance the information they can provide to road users including:

- the addition of state-wide summaries of major road conditions and heavy vehicle access restriction advice on the transport department website[105]
- automating updates of the RACQ website using information from the transport department website [106]
- streamlining call centre options between the transport department and RACQ.[107]

Councils are also liaising with the transport department to overcome the difficulties they encountered with lack of timely or accurate information about road conditions.[108]

Recommendations

4.25 The Department of Transport and Main Roads, in its capacity as the primary provider of information about road conditions to the public, should continue to improve the accuracy of road condition information and the timeliness of its distribution to the public and other agencies.

4.26 The Department of Transport and Main Roads should identify and include local road names when reporting road conditions.

Cross border/interstate information

During the 2010/2011 floods, drivers in New South Wales had difficulty accessing information about flooded roads.

There are agreements regarding the exchange of road condition information between the Queensland and New South Wales governments which are intended to ensure that information about road conditions is shared between the Queensland Department of Transport and Main Roads and the New South Wales Roads and Traffic Authority. One of these agreements ensures that the Department of Transport and Main Roads in the Darling Downs region provides the New South Wales Roads and Traffic Authority with daily reports on road conditions.[109]

However, despite this arrangement, drivers in New South Wales could not easily obtain information from the radio or tourist information centres about the road conditions in Queensland.[110] Although this information was available on the internet, not all travellers could gain access to it.

In some instances, travellers relied on information from fellow road users or local police who had recently used the road ahead.[111]

Lack of road condition information led to drivers who had entered the state from the south becoming being stranded in Warwick. Approximately 280 interstate travellers had to be accommodated in evacuation centres.[112] As a result, signs were placed further south, in Stanthorpe, to warn people of road conditions ahead.[113]

Strategies that were suggested for regional and remote roads included:

- using signs that inform road users of road conditions far ahead, where detours are difficult or impossible
- using tourist information centres to provide road conditions to travellers with face to face or on noticeboards after-hours
- using tourist radio stations to transmit road conditions.

Recommendations

4.27 The Queensland Government should work with the New South Wales Government to co-ordinate road condition reporting procedures to inform local councils and road users of interstate road conditions in a variety of different ways.

4.28 In rural and remote areas where telecommunications are not effective, measures that do not rely on internet and mobile telephone services should be implemented to inform the travelling public of road conditions ahead, for example:

- signs with detailed information
- providing tourist information centres and tourist radio stations with information on road conditions.

4.2 Warnings and forecasts: Bureau of Meteorology and councils

4.2.1 How the Bureau provides information

The Bureau of Meteorology issues weather warnings on its website, and also distributes them to disaster and emergency management organisations, state and local government agencies, water agencies and media. As well as giving warnings, the Bureau provides information and advice to state and local governments and emergency services.

During the 2010/2011 floods, the Bureau gave briefings to the state disaster co-ordination centre, the state disaster management group and emergency services agencies. It also provided advice to a number of local governments, the Seqwater flood operations centre, and Sunwater. During December 2010 and January 2011, the Bureau's website was accessed over 9.4 billion times and Bureau staff took part in numerous interviews for television and radio.

4.2.2 The Bureau's warnings

Under section 6 (1)(c) of the *Meteorology Act 1955* (Cth), one of the functions of the Bureau of Meteorology is to issue warnings of weather conditions likely to give rise to floods; a function which on any rational reading must extend to warnings of weather conditions likely to give rise to flash floods, particularly those likely to endanger life or property. Sections 6 (1)(d) and (h) of the Act require the Bureau to give meteorological advice and information. Its functions are to be performed in the public interest (section 6 (2)). They are not necessarily discharged by the giving of generalised weather warnings.

4.2.3 Severe weather warnings

The Bureau issues severe weather warnings by reference to 15 districts across the state, the descriptions of which do not always make it clear what areas they encompass. By way of example, on 9 and 10 January 2011, severe weather warnings were issued 'for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation For [sic] people in the Southeast Coast district, southern parts of the Wide Bay and Burnett district and eastern parts of the Darling Downs and Granite Belt district'.[114] For Lockyer Valley residents to recognise the significance of such warnings for them, they had to appreciate that the Bureau regarded the Lockyer Valley as incorporated in the 'Southeast Coast district'; something not necessarily obvious to people living a considerable distance from the coastline. None of the severe weather warnings over those days was any more specific. Nor did the language of the warnings change as the situation in Toowoomba and the Lockyer Valley worsened dramatically on 10 January.

The Bureau's website, which contains maps of river systems and forecast districts, radar imagery, and images depicting the location of severe weather and thunderstorms, can assist individuals and businesses in determining whether severe weather or floods are likely to affect them. However, the site's multimedia formats provide no assistance to those listening to warnings issued by radio, without access to a computer.

4.2.4 Flood warnings

The Bureau issues flood warnings for river systems or catchments. The warnings contain information about actual and predicted river heights at certain gauges and whether further rises are predicted, and give a description of flooding in terms of minor, moderate or major flooding. Warnings may also contain information about river heights at significant road crossing or bridges and references to recent or historically significant past floods.[115] So, for example, on 11 January 2011 the Bureau issued a warning comparing the flooding expected in the Brisbane and Bremer Rivers and related tributaries with the flood levels reached in 1974. The reference to 1974 helped many people in Brisbane appreciate the size of the predicted flood and the impact it might have on them.

However, as in the case of severe weather warnings, it can be difficult to identify the particular areas to which a flood warning relates. Between 9 and 11 January, warnings issued for the middle and lower Brisbane River referred to flooding at Savages Crossing and Mt Crosby, giving river heights there. People living on or near the middle stretch of the river, including those living at Fernvale, had to know where Savages Crossing was in relation to them, and the significance of the river height gauge reading there, in order to understand what the warning meant for them. Residents' statements make it clear that many did not. (For further discussion of warnings to Fernvale residents see *4.2.11 Warnings for Fernvale*.)

Recommendation

4.29 The Bureau of Meteorology should endeavour to make clear the areas actually covered by its warnings, and specify what may be expected in particular areas, so that the relevance and significance of any warning is obvious to residents of the area at risk.

4.2.5 Weather conditions likely to cause flash flooding

The Bureau is obliged to warn of weather conditions likely to give rise to (among other things) flash floods and to give meteorological advice and information in the public interest (see *4.2.2 The Bureau's warnings*). Those obligations may not be met by the provision of a severe weather warning in broad terms.

By way of example, see *4.2.8 Warnings for Lockyer Valley and Toowoomba*, which deals with the events of 10 January 2011, when the Bureau advised the state disaster co-ordination centre watch desk of heavy rainfall moving over the Toowoomba town area with expected flash flooding, but did not similarly inform the Toowoomba Regional Council. Its website maintained a general warning for heavy rainfall leading to localised flash flooding for a number of areas including eastern parts of the Darling Downs, without any particular reference to Toowoomba.

The Commission accepts the Bureau's contention that it has been the practice for state and local governments to manage local flash flood warning systems with advice provided by the Bureau, but does not consider that practice to be inconsistent with the recommendations made below.

Recommendations

4.30 Councils should continue to take responsibility for issuing flash flooding warnings. However, where the Bureau of Meteorology becomes aware of weather conditions likely to cause flash flooding that is likely to endanger life or property in a particular council's region, it should, performing its functions in the public interest, directly communicate that information to the relevant council.

4.31 Councils should advise the Bureau of Meteorology of any information they possess about flash flooding (or the immediate prospect of it) likely to endanger life or property in their region, and of any warnings they issue about such flash flooding. The Bureau of Meteorology should consider in each case whether any such warning should be re-published (whether as a warning emanating from the Bureau itself or as attributed to the relevant council) on the Bureau's website, or whether it should provide a link to any council warning or other information regarding flash flooding provided by councils or disaster management agencies.

4.32 Where the Bureau of Meteorology has information which leads it to anticipate flash flooding likely to endanger life or property in a specific area, it should publish a warning to that effect on its website.

4.2.6 Bureau communications with councils during 2010/2011 floods

With primary responsibility for the management of disaster events, councils need detailed and accurate information from the Bureau about weather conditions and flooding in council regions. During the 2010/2011 floods, councils could obtain weather and flood information by participating in the state disaster co-ordination centre teleconferences at which the Bureau gave briefings or by contacting the state disaster co-ordination centre watch desk. In addition, the Bureau encouraged local council engineers to contact the Bureau's flood warning centre to speak with Bureau staff directly.[116]

The Bureau distributes a variety of forms of warning by email and facsimile to those on its client list, including councils. It does not, however, communicate directly with all councils during severe weather events and flooding. During the 2010/2011 floods, there were some councils with which the Bureau conducted a mutual exchange of information, the Bureau advising river heights, and the councils advising of local weather and river conditions. For example, before and during the December 2010 flooding in the Nogoa and Comet Rivers, the Central Highlands Regional Council was in regular contact with Bureau hydrologists in relation to predicting flood levels in the region. The particular advantage of this approach was that it allowed the Bureau to take into account information about river levels from local farmers and rural residents.[117]

However, the Bureau's practice of maintaining direct contact with councils was not uniform throughout the 2010/2011 floods. According to the Bureau, it has stronger relationships with some councils than others and will actively contact the former to discuss evolving weather situations in their area. It is in the process of improving its relationships with all councils.[118] A number of councils, including Moreton Bay Regional Council and Goondiwindi Regional Council, have recently approached the Bureau to develop a closer partnership with it for weather and flood events.[119]

Recommendation

4.33 The Bureau of Meteorology should do its best to develop working relationships with all councils, particularly for the purpose of exchanging information in severe weather and flood events.

4.2.7 Bureau communication with Ipswich City Council on 11 January 2011

On 11 January 2011, the height which the Bureau was predicting for the Bremer River rose significantly over a period of six hours. At 4.07 am on 11 January 2011, the Bureau's prediction, as it had been since the preceding afternoon, was that the river would reach a height of 12.7 metres. However, according to Anthony Trace, the local disaster co-ordinator, at 8.00 am on 11 January the local disaster management group learned from the Bureau's website that the predicted height was 14.7 metres; and an hour and a half later, at 9.28 am the Bureau issued a fresh warning that the Bremer River would reach 16 metres, with higher levels expected. On his account, he confirmed by a telephone call to the Bureau at 2.00 pm that afternoon that the prediction remained unchanged at 16 metres, and duly reported that information to a meeting of the local disaster management group. The difference between 12.7 metres and 16 metres was significant in terms of the impact the flooding would have on the city, and what response was required and possible.

At 3.00 pm, however, the Bureau's website showed an expected flood height of 18 to 19 metres, and when Mr Trace rang to enquire about it, he was informed that the prediction was now for a level of 22 metres. That information was confirmed in an official warning issued at 3.24 pm. The Bureau's advices over the following evening and the next day predicted river heights of between 20.5 and 22 metres; in fact the Bremer River peaked at 19.4 metres at 1.00 pm on 12 January. The Bureau's failure to provide warnings between 9.28 am and 3.24 pm was, Mr Trace said, a cause of some concern.

However, the sequence of Bureau warnings and predictions which Mr Trace describes does not accord with the Bureau's account. At an 11.00 am briefing of the state disaster co-ordination centre, Peter Baddiley, the Bureau's regional hydrology manager, advised that the Bremer River was likely to reach 18 metres. The Ipswich City Council did not participate in this briefing, although the Ipswich district disaster co-ordinator was present.[120] The Bureau's

call log shows attempts by the flood warning centre to ring Mr Trace's mobile telephone at 11.40 am, and then a call received, apparently from that mobile number, at 11.50 am. Mr Baddiley and another Bureau hydrologist, James Stuart, took part in a conversation lasting almost nine minutes, of which both made brief notes. In it, they advised that the Bremer River would reach 18 metres that night, with further rises the following day. The caller advised that the council's response plans were based on the Bureau's prediction plus one metre. Asked what message the council would want the Bureau to give about the situation in any radio broadcast, the caller asked that they direct Ipswich residents to the council's website and advise them that if they lived close to a stream, they should self-evacuate. All of that, Mr Trace agreed when he gave evidence, accurately reflected the council's approach. However, he said, he did not make any such call, and its contents did not come to his attention. Mr Trace's mobile telephone records were made available to the Commission; they show no call made at the relevant time.

The Commission has no reason to doubt the evidence of either Mr Baddiley or Mr Trace. Mr Baddiley and his fellow hydrologist plainly spoke to someone from the Ipswich City Council and advised him of the expected river height of 18 metres. It is inconceivable that if Mr Trace had received that information, he would not have passed it on to the local disaster management group; but it is clear that when the group met at 2.00 pm that afternoon he was still under the impression that the river would not rise above 16 metres. The only possible conclusion is that another officer from the council spoke to the two hydrologists and failed to pass the information on to Mr Trace. The problem was compounded when Mr Trace, ringing the Bureau at 2.00 pm, was given to understand that the river height prediction remained unchanged. It seems entirely possible that he and whomever he spoke to in the call (which was extremely brief: 43 seconds) were at cross purposes about what predicted height was being confirmed.

The Commission does not see any benefit in further inquiry into the matter. The end result of what occurred is that the local disaster management group operated for some three hours under a misapprehension that the predicted river height level was significantly lower than the actual prediction. The confusion would have been avoided had the Bureau's hydrologists followed their advice up by email confirmation; but given the demands made on them by the events of the day, it is not surprising that they did not. The episode underlines the importance of agencies operating during a disaster keeping clear records of significant information received and given, which is immediately accessible to those who need to use it or need to know what has been conveyed.

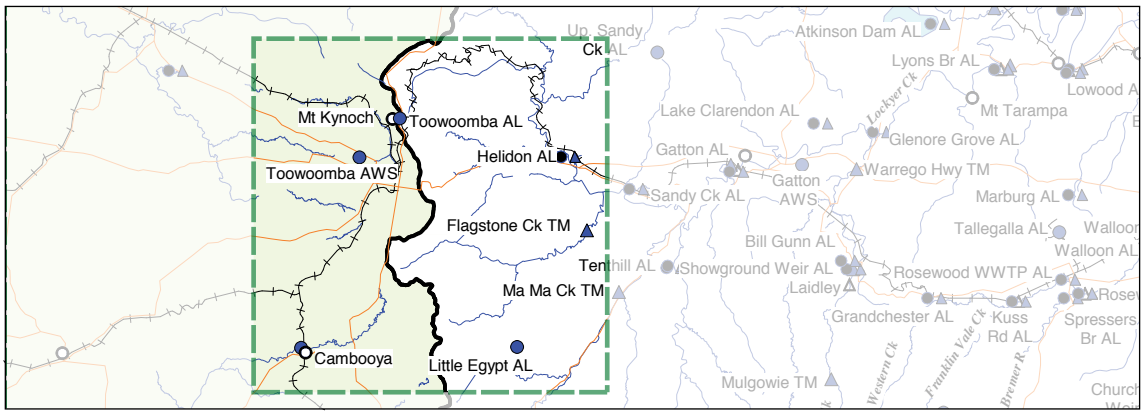
4.2.8 Warnings for Lockyer Valley and Toowoomba

The Bureau of Meteorology provides the Toowoomba Regional Council (by email), and the Lockyer Valley Regional Council (by email and facsimile) with a number of types of warnings, including, in both cases, severe weather warnings and flood warning summaries. The Toowoomba council is also sent severe thunderstorm warnings, while the Lockyer Valley council is provided with three-hourly river height bulletins for the Brisbane River and its tributaries (which include Lockyer Creek).[121]

Weather data from Toowoomba

The weather warnings which the Bureau issues in Toowoomba reflect real time rainfall data received from two stations in the Toowoomba area. The Bureau's AWS (an automatic weather station that monitors temperature, humidity, wind speed, pressure and rainfall) is situated at the Toowoomba Airport. Seqwater operates an ALERT station (reporting rainfall continuously via VHF radio) near Mt Kynoch, about six kilometres north of Toowoomba. Both stations are located outside the catchments of creeks upstream of Toowoomba's central business district.

Figure 4(a) Location of Toowoomba stations



(Source: Bureau of Meteorology, Map 143.1)

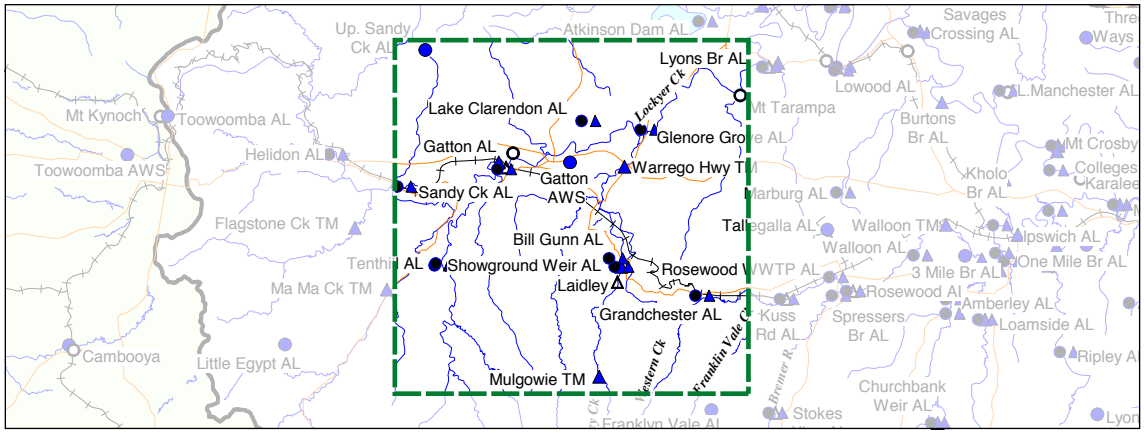
In addition to these two stations, the Toowoomba Regional Council manages a rain gauge network across Toowoomba's central business district and surrounding suburbs. Rainfall data from these stations, however, are not provided to the Bureau during rain-flood events.[122]

Weather data from the Lockyer Valley region

The Bureau of Meteorology provides information about flood conditions in the Lockyer Creek system in the course of issuing flood warnings for the Brisbane River basin. Warnings are issued if a key river height station in a major Brisbane River tributary, including the Lockyer Creek, exceeds a moderate flood level.

The warnings for the Lockyer Valley region reflect river height and rainfall data received from river height and rainfall gauges across the Valley, including ALERT and telemeter stations on the Lockyer Creek at Helidon; manual, ALERT and telemeter stations on the Lockyer Creek at Gatton; and ALERT gauges at Upper Sandy Creek and Sandy Creek Road near Grantham. DERM owns the telemeter station at Helidon, Seqwater owns the ALERT station at Helidon and both stations at Gatton, and the Lockyer Valley Regional Council owns the Upper Sandy Creek and Sandy Creek Road gauges. The Bureau has real time access to all of these gauges during a weather event. It does not monitor them to detect flash floods, but rather uses the data obtained to forecast flows in the lower catchment. Its automatic systems collect and publish river height data from the gauges on its website every 15 minutes, with maps, tables and plots updated every 30 minutes.[123] DERM also operates a water level station at Spring Bluff; but the Bureau says that it holds no data from it for the flood events of the December 2010/January 2011 period.[124]

Figure 4(b) Location of Lockyer Valley stations



(Source: Bureau of Meteorology, Map 143.1)

Community sources of information

The Bureau operates a network of 'storm spotters' who can report to it if they observe or hear of a severe thunderstorm in their local areas. They are registered with the Bureau and can provide their information by using a freecall phone number or by lodging a report electronically or by post.[125] There are nine registered 'storm spotters' in the Toowoomba Lockyer Valley region. The Bureau says that it also maintains volunteer rainfall and river height networks at many locations.[126] However, as is explored further in *4.2.9 Helidon gauge spike*, it appears that those networks are by no means comprehensive in their coverage.

Warnings in the period leading up to 10 January

The Bureau of Meteorology issued flood warnings referring to the Lockyer Valley four times on 5 December 2010 and six times between 19 and 22 December. At 12.45 pm on 23 December 2010, a severe weather warning was issued for 'rainfall with locally moderate to heavy falls and the potential for flooding' over a broad area of Queensland from the Gulf of Carpentaria to south-east Queensland; incorporating, without specifying, the Lockyer Valley in its reference to south-east Queensland. The warning was re-issued every six hours until 28 December 2010. At 7.57 pm on 26 December 2010, a 'Priority Flood Warning' was issued, which included mention of Lockyer Creek. Specific flood warnings for the Lockyer Creek were then issued between 27 December and 30 December 2010.[127]

From 5 January 2011, the Bureau issued severe weather warnings for the south-east coast district (which the Bureau, as already mentioned, regards as including the Lockyer Valley). Those warnings identified the threat of heavy rain and thunderstorms which could lead to localised flash flooding or worsen existing river flooding. On 9 January, four such warnings were issued, at 4.40 am, 10.55 am, 4.55 pm and 11.00 pm. The last three extended the warning to the eastern Darling Downs. [128] In addition, Bureau staff gave interviews to radio, including Toowoomba-based radio stations, newspaper and online media.[129]

Warnings for Lockyer Valley and Toowoomba on 10 January 2011

On 10 January 2011 the Bureau issued warnings relevant to the Toowoomba region and the Lockyer Valley as set out in the table below.[130]

Figure 4(c)
Warnings issued on 10 January 2011 for Toowoomba and the Lockyer Valley

Date	Time of issue	Warning header
10 January 2011		
	12:36 am	FLOOD WARNING FOR THE LOWER BRISBANE BELOW WIVENHOE Issues at 12:36 AM on Monday the 10th of January 2011
	5:00 am	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation For people in the Southeast Coast district, southern parts of the Wide Bay and Burnett district and eastern parts of the Darling Downs and Granite Belt district. Issued at 5:00 am on Monday 10 January 2011
	9:19 am	FLOOD WARNING FOR COASTAL STREAMS FROM MARYBOROUGH TO THE NSW BORDER Issued at 9:19 AM on Monday the 10th of January 2011
	10:28 am	FLOOD WARNING FOR THE LOCKYER, BREMER, WARRILL AND BRISBANE RIVER BELOW WIVENHOE Issued at 10:28 AM on Monday the 10th of January 2011
	11:00 am	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation for people in the Southeast Coast district, southern parts of Wide Bay and Burnett district and eastern parts of the Darling Downs and Granite Belt district. Issued at 11:00 am on Monday 10 January 2011

Date	Time of issue	Warning header
	11:05 am	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing worsening the existing river flood situation for people in the Southeast Coast district, southern parts of Wide Bay and Burnett district and eastern parts of the Darling Downs and Granite Belt district. Issued at 11:00 am on Monday 10 January 2011(Re-issued to amend update time)
	11:40 am	Flood summary Issued at 11:40 AM on Monday the 10th of January 2011
	4:16 pm	FLOOD WARNING FOR THE LOCKYER, BREMER, WARRILL AND BRISBANE RIVER BELOW WIVENHOE INCLUDING BRISBANE CITY Issued at 4:16 PM on Monday the 10th of January 2011
	5:00 pm	FLASH FLOOD WARNING FOR LOCKYER CREEK Issued at 5:00 PM on Monday the 10th of January 2011
	5:05 pm	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation For people in the Southeast Coast district, far southern parts of the Wide Bay and Burnett district and eastern parts of the Darling Downs and Granite Belt district. Issued at 5:05 pm on Monday 10 January 2011
	6:12 pm	FLOOD WARNING FOR THE LOCKYER, BREMER, WARRILL AND BRISBANE RIVER BELOW WIVENHOE INCLUDING BRISBANE CITY Issued at 6:12 PM on Monday the 10th of January 2011
	6:30 pm	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation. For people in the Southeast Coast, Darling Downs and Granite Belt and eastern parts of the Maranoa and Warrego districts. Issued at 6:30 pm on Monday 10 January 2011
	7:50 pm	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation For people in the Southeast Coast, Darling Downs and Granite Belt, far southern parts of the Wide Bay and Burnett and eastern parts of the Maranoa and Warrego districts. Issued at 7:50 pm on Monday 10 January 2011
	8:37 pm	FLASH FLOOD WARNING FOR LOCKYER CREEK Issued at 8:37 PM on Monday the 10th of January 2011
	9:44 pm	FLOOD WARNING FOR THE LOCKYER, BREMER, WARRILL AND BRISBANE RIVER BELOW WIVENHOE INCLUDING BRISBANE CITY Issued at 9:44 PM on Monday the 10th of January 2011
	11:00 pm	SEVERE WEATHER WARNING for heavy rainfall leading to localised flash flooding and potentially worsening the existing river flood situation For people in the Southeast Coast, Darling Downs and Granite Belt, far southern parts of the Wide Bay and Burnett and eastern parts of the Maranoa and Warrego districts. Issued at 11:00 pm on Monday 10 January 2011

As noted already, such warnings are provided to the Toowoomba and Lockyer Valley councils by email or facsimile; but the Bureau was not in direct communication with either council, the Toowoomba disaster district co-ordinator or the Emergency Management Queensland office based in Toowoomba. It was expected that the district co-ordinator would become aware of material information through state disaster co-ordination centre teleconferences and state disaster management group meetings and would telephone the Bureau for additional advice if required.[131]

Bureau warning to the state disaster co-ordination centre about Toowoomba

Between 11.00 am and 11.40 am on 10 January 2011, a meteorologist and hydrologist from the Bureau took part in a teleconference with the state disaster co-ordination centre. During it, they brought to the attention of those conferring the existing severe weather warning which included the prospect of flash flooding. At 11.55 am, a Bureau

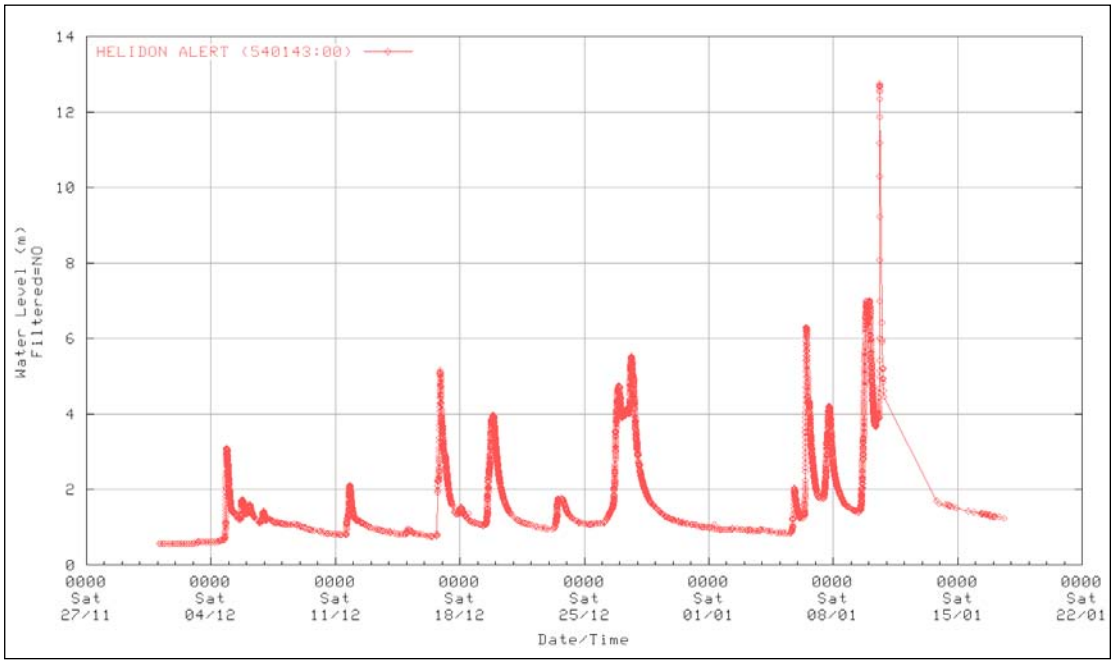
meteorologist telephoned the state disaster co-ordination centre watch desk to warn of a severe thunderstorm for the Darling Downs and further north.[132]

At 1.00 pm on 10 January, a Bureau meteorologist again contacted the state disaster co-ordination centre to advise of extremely heavy rainfall moving over the Toowoomba town area with expected flash flooding in the next hour or two, which could result in calls for assistance. He advised, too, that a Bureau 'storm spotter' had reported very heavy rainfall in the Cressbrook Dam area. The Bureau did not update its website, considering that the existing severe weather warning for eastern parts of the Darling Downs covered the situation.[133] Nor did it contact the Toowoomba Regional Council to provide it with the same advice.

It would have been desirable for the Bureau to have directly communicated this warning to the Toowoomba Regional Council. However, the Commission accepts the evidence of Ken Gouldthorp, chief executive officer of Toowoomba Regional Council, that it was unlikely such a warning would have enabled the local disaster management group to respond any more quickly or effectively to the events which unfolded.

4.2.9 Helidon gauge spike

Water level rises commenced at the Lockyer Creek at Helidon at approximately 2.20 pm on 10 January 2011. At 2.50 pm the Helidon TM gauge gave its highest reading of 12.66 metres; no further reports were received. The other gauge at this location, the Helidon AL gauge, gave its highest reading at 2.53 pm of 12.74 metres and then several readings which made it seem (erroneously) that it had peaked at this level, before ceasing to report for approximately two and a half hours. (Both gauges had failed because of inundation. DERM subsequently surveyed the creek and estimated the flood peak at 13.88 metres, occurring at approximately 3.10 pm. That was more than six metres higher than the level recorded in the 1974 flood.) The Bureau's 3.30 pm river height bulletin gave the latest available levels at Helidon as 12.66 metres R (for rising) at 2.50 pm and 12.68 metres at 3.02 pm.[134]



Water levels for Lockyer Creek at Helidon AL during 9 to 11 January 2011. (Date/time is EST)[135]

Water level readings at Helidon became available in the Bureau's computer system at around 3.00 pm or shortly after. According to the Bureau, only a few of the readings were then available; the computer had automatically marked most of the readings, which were incomplete, from the Helidon AL station as incorrect.[136] However, it appears that readings for Helidon appeared on the Bureau's website at about 3.00 pm and were read with a mixture of concern and disbelief by some residents of Grantham who were paying attention to the site.[137]

The Bureau contends that those readings that had been received had the characteristics of a faulty station; and there was no flood warning rainfall or water level network above the Helidon gauge to enable it to assess with any accuracy the water levels at Helidon.[138] No member of the public or of emergency services organisations had given

it any advice of flash flooding at Helidon, Murphy's Creek, Postman's Ridge or Withcott. Its attention was focussed on potential flooding in the Brisbane and Bremer Rivers. Staff of the Bureau's flood warning centre did not become aware of the readings until between 4.00 pm and 4.30 pm, and did not appreciate their significance until they saw television footage at 4.30 pm of the flash flood in Toowoomba. They then took steps to verify them, with the result that the Bureau issued a flash flood warning for the Lockyer Creek at 5.00 pm on 10 January. By that time, of course, the flood peak had already passed through Grantham; the warning advised of 'very fast and dangerous rises possible downstream at Gatton'.

While it is unfortunate that the Bureau did not immediately recognise the readings and their implications for downstream residents, the Commission accepts that the Bureau's resources are not such as to permit full-time monitoring of gauge results. Although the radar imagery suggested heavy rainfall, the Bureau did not have the benefit of other gauge information in the upper Lockyer catchment area to confirm the radar readings. The rainfall gauge at Helidon itself did not give any remarkable results: 11 millimetres between 1.00 pm and 2.00 pm. The spike in the Helidon river height gauges occurred extremely suddenly (a rise of at least eight metres in less than an hour) and without warning. The Bureau received only one 'on the ground' report from the region on 10 January 2011; from a storm spotter relaying weather information about the area of the Cressbrook Dam.[139] No-one actually in the vicinity of the Lockyer Creek or other waterways in the Lockyer Valley alerted it to the rapid rise in local streams.

It seems extraordinary – and a very great pity – that the Bureau, and other agencies, were oblivious to what was actually happening in Helidon that afternoon. But in the absence of evidence that there was anything to alert the Bureau earlier to the abnormal gauge readings, it should not be criticised for failing to recognise the readings and their significance sooner than it did. It should be said, too, that even if a timely warning about the prospect of flash flooding downstream had been given, it is unlikely, given the complete absence of any precedent, that anyone would have anticipated that the Lockyer Creek would break its banks and produce the massive wave which engulfed Grantham.

The Bureau says that it maintains volunteer rainfall and river height networks. It is clear, though, from its contentions as to why it was unaware of what was occurring at Helidon, that it had no volunteers in the Lockyer Valley to inform it of events there or at Murphys Creek, Postman's Ridge, or Withcott, which might have put it on alert for abnormal rises in the Lockyer Creek. Automated systems are extremely useful, but their existence should not lead to disregard of the value of human observation and local knowledge.

Flooding in the Lockyer Creek at Helidon, 10 January 2011 (photo courtesy Martin Thomas)

Recommendation

4.34 The Bureau of Meteorology should expand its volunteer rainfall and river height networks to incorporate residents of the Lockyer Valley, particularly property owners living on watercourses who can provide manually obtained readings of water heights where no automatic gauge is available, or can confirm automatic gauge readings where there is concern about their accuracy.

4.2.10 Amateur weather watchers

On 10 January 2011 individuals posting on a publicly available Weatherzone website made observations about a severe weather event in the Toowoomba Lockyer Valley region.[140] In postings respectively at 12.16 pm and 1.10 pm they expressed concerns about probable torrential rainfall in the Gatton-Grantham area and the possibility of a dangerous flash flood, particularly in Grantham (although the watercourse identified as of concern was Sandy Creek, rather than the Lockyer Creek).

Those individuals did not fit into the Bureau's characterisation of storm spotters; their interest was in analysis of weather events, rather than in reporting observations of thunderstorms. Unsurprisingly, then, they were not registered in the storm spotter network. Had they tried to contact the Bureau as members of the public, they would have had to ring its exchange number and were likely to have their call placed in a queue, with the uncertain prospect, depending on caller volume, of being able to speak to a member of staff.[141]

Recommendation

4.35 The Bureau of Meteorology should consider identifying amateur weather-watch groups it considers credible and likely to have useful local knowledge, and establish means (similar to those available to the storm spotters) by which they can expeditiously communicate with the Bureau.

4.2.11 Warnings for Fernvale

Situated approximately eight kilometres from the Wivenhoe Dam, Fernvale experienced its first flood peak on the morning of 11 January 2011. Local water courses rose quickly; some Fernvale residents were forced onto the roofs of their homes to escape the rapidly rising waters.[142]

Later, on the evening of 11 January 2011, the Fernvale area flooded once more. Again, the speed of the rising water caught many residents unaware. In some cases, the water rose so quickly that residents had to wade through waist-high water that was not present more than five or six minutes earlier.[143] Residents were forced to higher ground to escape the flood waters, often staying with friends or relatives nearby.

The evidence of Fernvale residents suggests that they received very limited warnings about flooding. This was despite residents using internet, radio, television and social media to try to obtain meaningful information for Fernvale.[144] The Bureau publishes predictions for the height of the Brisbane River at the Lowood and Savages Crossing gauges, both of which are located in the Brisbane River and near the Fernvale community. However, the Fernvale area also contains many smaller streams and creeks. According to the Bureau, the Lowood and Savages Crossing gauges may not help to predict flooding in the Fernvale area when the flooding is caused by localised rainfall and/or rises in local streams and creeks, and not the Brisbane River.[145]

The Commission draws no conclusions about the causes of the flooding in Fernvale during the January 2011 floods.

The prediction of flooding in Fernvale may require consideration of any releases from the nearby Wivenhoe Dam. The Bureau's regional hydrology manager stated that the Somerset Regional Council would need to consult with the Bureau and the dam operator (Seqwater) to determine how best to provide accurate flood level predictions for Fernvale residents.[146]

Once the consultation process has occurred, the Bureau may be able to post river height and creek height levels specific to the Fernvale area on its website. However, it will remain the responsibility of the Somerset Regional Council to advise residents whether increasing flood levels are likely to result in inundation to their properties.

Recommendation

4.36 Somerset Regional Council, in consultation with Seqwater and the Bureau of Meteorology, should consider how warnings can be provided to residents living near the Brisbane River at Fernvale about the expected level of flooding in their area.

(Endnotes)

1 Section 6 (1)(c), *Meteorology Act 1955* (Cth).

2 Submission of Telstra Corporation Limited [p1: para 2]; Submission of the State of Queensland, Department of Community Safety, 11 March 2011 [p5]; Second Submission of the State of Queensland, Department of Community Safety, 4 April 2011 [p3].

3 Submission of State of Queensland, Department of Community Safety, 11 March 2011 [p5].

4 Transcript, Kerry Plowright, 6 May 2011, Brisbane [p1432: line 56]; Exhibit 297, Statement of Kerry Plowright [p2].

5 Transcript, Councillor Peter Maguire, 25 May 2011, Emerald [p2589: line 48]; Exhibit 478, Statement of Councillor Peter Maguire [p2: para 1(h)]; Exhibit 123, Statement of Philip Berting [p8]; Exhibit 229, Goondiwindi Regional Council local disaster management group Debrief Meeting 31 January 2011 [p7]; Transcript, Senior Sergeant Simon Chase, 20 April 2011, Dalby [p740: line 52]; Transcript, Inspector Terry Kajewski, 20 April 2011, Dalby [p755: line 19; p760: line 15].

6 Submission of the State of Queensland, Department of Community Safety, 11 March 2011, DCS-10, Annexure F, Appendix 3, [p5].

7 Transcript, Craig Hewlett, 6 May 2011, Brisbane [p1420: line 1]; Exhibit 295, Statement of Craig Hewlett, 19 April 2011 [p2: para 7]; Transcript, Superintendent Patrick Ryan, 9 May 2011, Brisbane [p1497: line 40]; Exhibit 307, Statement of Superintendent Patrick Ryan, 8 March 2011 [p6-7]; Transcript, Sergeant Jason Renwick, 9 May 2011, Brisbane [p1503: line 1].

8 Transcript, Jennifer Beattie, 20 May 2011, Ipswich [p2328: line 23]; Exhibit 438, Statement of Jennifer Beattie, 12 May 2011 [p4: para 12].

9 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1527: line 18].

10 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1538: line 1]; Exhibit 307, Minutes of Redcliffe District Disaster Management Group Extraordinary Meeting 2011 Flood Debrief, 3 February 2011 [p3]; Transcript, Anthony Trace, 20 May 2011, Ipswich [p2389: line 9].

11 Transcript, Peter Hackney, 9 May 2011, Brisbane [p1514: line 1]; Exhibit 381, Statement of Kate Girot, 18 April 2011 [p4: para 22]; Transcript, Gail Nixon, 24 May 2011, Emerald [p2571: line 4]; Transcript, Councillor Peter Maguire, 25 May 2011, Emerald [p2589: line 57].

12 Second Submission of the State of Queensland, Department of Community Safety, 4 April 2011 [p4].

13 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1524: line 55]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p49: para 186].

14 Submission of the State of Queensland, Department of Community Safety, 11 March 2011 [p5].

15 Second Submission of the State of Queensland, Department of Community Safety, 4 April 2011 [p4].

16 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2673: line 12].

17 Transcript, Superintendent Patrick Ryan, 9 May 2011, Brisbane [p1497: line 24]; Transcript, Anthony Martini, 9 May 2011, Brisbane [p1526: line 4]; Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1596: line 57].

18 Transcript, Superintendent Patrick Ryan, 9 May 2011, Brisbane [p1497: line 47]; Exhibit 307, Minutes of Redcliffe District Disaster Management Group Extraordinary Meeting 2011 Flood Debrief, 3 February 2011 [p2].

19 Transcript, Sergeant Jason Renwick, 9 May 2011, Brisbane [p1503: line 18]; Exhibit 308, Statement of Sergeant Jason Renwick, 15 April 2011 [p4: para 11]; Transcript, Craig Hewlett, 6 May 2011, Brisbane [p1420: line 19]; Exhibit

295, Statement of Craig Hewlett, 19 April 2011 [p2: line 8].

20 Transcript, Cr Peter Maguire, 25 May 2011, Emerald [p2590: line 56].

21 Exhibit 297, Statement of Kerry Plowright, 29 April 2011 [p7].

22 Submission of the State of Queensland, Department of Community Safety, 11 March 2011 [p5].

23 Transcript, David Greenwood, 20 May 2011, Ipswich [p2355: line 23]; Exhibit 443, Statement of David Greenwood, 8 April 2011 [p2].

24 Transcript, Andrew Solomon, 5 May 2011, Brisbane [p1315: line 31]; Exhibit 227, Statement of Andrew Solomon, 29 April 2011 [p4: para 12]; Transcript, Bruce Flegg, 5 May 2011, Brisbane [p1353: line 51]; Exhibit 295, Statement of Craig Hewlett, 19 April 2011 [p2: para 4; p3: para 9]; Exhibit 443, Statement of David Greenwood, 8 April 2011 [p2].

25 Transcript, Craig Hewlett, 6 May 2011, Brisbane [p1420: line 1]; Transcript, David Greenwood, 20 May 2011, Ipswich [p2358: line 30].

26 Transcript, Ray Brown, 20 April 2011, Dalby [p802: line 2]; Transcript, Graeme Scheu, 3 May 2011, Goondiwindi [p1206: line 44]; Exhibit 481, Statement of William Wilkinson, undated, [p14: para 9(o)].

27 Exhibit 481, Statement of William Wilkinson, undated, [p14: para 9(o)].

28 Transcript, Collin Head, 23 May 2011, Rockhampton [p2488: line 39]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p23: line 17(b)].

29 Transcript, Graeme Scheu, Goondiwindi, 3 May 2011 [p1205: line 20]; Transcript, Inspector David Peff, 23 May 2011, Rockhampton [p2440: line 52]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2660: line 15]; Exhibit 302, Statement of Peter Martin, 3 May 2011 [p12: para 50]; Exhibit 506, Independent Review of Brisbane City Council's Response to the January 2011 Flood [p35].

30 Exhibit 506, Independent Review of Brisbane City Council's Response to the January 2011 Flood [p35].

31 Exhibit 312, Statement of Anthony Martini, 8 May 2011 [p9: para 61]; Transcript, Rod Ferguson, 3 May 2011, Goondiwindi [p1219: line 5]; Exhibit 258, Stanthorpe Sub-Group Incident Control Centre Debrief [p9].

32 Exhibit 370, Statement of Greg Hoffman with letter dated 5 April 2011 [p9: para 4].

33 Transcript, Ray Brown, Dalby, 20 April 2011 [p802: line 21].

34 Transcript, Graeme Scheu, 3 May 2011, Goondiwindi [p1205: line 33]; Exhibit 229, Goondiwindi Regional Council Local Disaster Management Debrief Meeting, 31 January 2011 [p7].

35 Exhibit 302, Statement of Peter Martin, 3 May 2011 [p12: para 50].

36 Transcript, Daniel McCoombs, 9 May 2011, Brisbane [p1547: line 50]; Exhibit 381, Statement of Kate Girot, 18 April 2011 [p4: para 24]; Transcript, Dennis Ward, 6 May 2011, Brisbane [p1459: line 3]; Exhibit 300, Statement of Denis Ward, 8 April 2011 [p15: para 107]; Submission of Timothy Grevell; Submission of Sharon Claridge-Mohr; Submission of Joan and Howard Smith.

37 Transcript, Rod Ferguson, 3 May 2011, Goondiwindi [p1221: line 16].

38 Transcript, Sergeant Benjamin Wiltshire, 20 April 2011, Dalby [p724: line 57]; Exhibit 114, Statement of Sergeant Benjamin Wiltshire, 12 April 2011 [p3: para 30].

39 Transcript, Greg Hoffman, 13 May 2011, Brisbane [p1987: line 54]; Exhibit 336, Statement of Stuart Holley, 9 May 2011 [p9].

40 Transcript, Stuart Holley, 11 May 2011, [p1721: line 8]; Transcript, Anthony Martini, 9 May 2011, Brisbane [p1537: line 17]; Exhibit 312, Statement of Anthony Martini, 8 May 2011 [p2: para 8]; Exhibit 334, Statement of Mark Holmes, 25 March 2011 [p4: para 7; p7: para 9]; Transcript, Philip Berting, 20 April 2011, Dalby [p788: line 56].

41 Transcript, Sean Hodgson, 6 May 2011, Brisbane [p1430: line 30].

42 Transcript, Sean Hodgson, 6 May 2011, Brisbane [p1430: line 37].

43 Transcript, Sergeant James Kelly, Emerald, 24 May 2011 [p2524: line 1].

44 Exhibit 474, Statement of Councillor Gail Nixon, 17 May 2011 [p4: para 22].

45 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2571: line 27].

46 Transcript, Glen Taylor, 20 April 2011, Dalby [p694: line 22].

47 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p6: para 40].

48 Exhibit 497, Statement of Peter Baddiley, 11 May 2011 [p8-9: para 28].

49 Exhibit 497, Statement of Peter Baddiley, 11 May 2011 [p8: para 28].

50 Transcript, James Davidson, 13 April 2011, Brisbane [p266: line 10].

51 Transcript, Cleave Rogan, 4 May 2011, St George, [p1240: line 28]; Transcript, Donald Whalley, 6 May 2011, Brisbane [p1414: line 52]; Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1597: line 56]; Transcript, Collin Head, 23 May 2011, Rockhampton, [p2484: line 44; 2486: line 4]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p13: para 9(a)]; Transcript, Vaughn Becker, 23 May 2011, Rockhampton, [p2512: line 46]; Transcript, Sergeant James Kelly, 24 May 2011, Emerald, [p2533: line 2; Transcript, Gail Nixon, 24 May 2011, Emerald, [p2568: line 40]; Transcript, Desmond Howard, 24 May 2011, Emerald, [p2538: line 25]; Transcript, William Wilkinson, 25 May 2011, Emerald [p2627: line 45].

52 Transcript, William Wilkinson, 25 May 2011, Emerald [p2624: line 48].

53 Exhibit 497, Statement of Peter Baddiley, 11 May 2011 [p10-11: paras 35, 38].

54 Transcript, Peter Baddiley, 27 May 2011, Brisbane [p2702: line 33].

55 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2568: line 40]; Transcript, William Wilkinson, 25 May 2011, Emerald [p2627: line 51].

56 Transcript, Juleia Murray, 6 May 2011, Brisbane [p1480: line 19]; Exhibit 304, Statement of Juleia Murray, 22 April 2011 [p2: para 7].

57 Transcript, Andrew Young, 5 May 2011, Brisbane [p1371: line 25]; Transcript, Michael Baker, 6 May 2011, Brisbane [p1409: line 46]; Exhibit 444, Statement of Paul Tully, Attachment 1, 27 April 2011 [p2]; Exhibit 370, Statement of Greg Hoffman with letter dated 5 April 2011 [p8].

58 Exhibit 292, Statement of Michael Baker, Attachment 1, 6 April 2011 [p2].

59 Exhibit 481, Statement of William Wilkinson, undated [p4: para 2(f)].

60 Transcript, Megan McKillop, 6 May 2011, Brisbane, [p1482: line 8]; Transcript, Paul Tully, 20 May 2011, Ipswich [p2362: line 8]; Exhibit 444, Statement of Paul Tully, 27 April 2011, Attachment 1 [p1]; Exhibit 370, Statement of Greg Hoffman with letter dated 5 April 2011 [p8].

61 Transcript, Anthony Trace, 20 May 2011, Ipswich [p2386: line 1].

62 Exhibit 446, Supplementary statement of Anthony Trace, 19 May 2011 [p72: paras 271-272].

63 Exhibit 506, Independent Review of Brisbane City Council's Response to the January 2011 Flood [p36]; Exhibit 404, Statement of Kenneth Morris, 3 May 2011 [p10: para 2.2]; Submission of Brisbane City Council [p12: para 5.7(c), (d)].

64 Transcript, Kenneth Morris, 17 May 2011, Brisbane [p2155: line 31]; Exhibit 404, Statement of Kenneth Morris, 3 May 2011 [p15: para 3.10].

65 Exhibit 404, Statement of Kenneth Morris, 3 May 2011 [p14: para 3.9].

66 Exhibit 270, Statement of Scott Norman, 1 April 2011 [p10: para 19(c)]; Transcript, Collin Head, 23 May 2011, Rockhampton [p2492: line 8]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p25: para 19(a)]; Transcript, Councillor Peter Maguire, 25 May 2011, Emerald [p2595: line 53]; Exhibit 311, Statement of Anthony Martini, 4 May 2011 [p27]; Transcript, Rod Ferguson, 3 May 2011, Goondiwindi [p1218: line 29]; Exhibit 249, Statement of Rod Ferguson, 14 April 2011 [p6: paras 59-60]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1607: line 18].

67 State Planning Instruments Program 1 July 2010 to 30 June 2011, http://www.dlgp.qld.gov.au/resources/spi-program-2010-2011.pdf.

68 Sections 341 and 346, *Water Supply (Safety and Reliability) Act 2008* (Qld).

69 Exhibit 507, Emergency Action Plan – E J Beardmore Dam, January 2008; Exhibit 508,

Emergency Action Plan – Leslie Dam, January 2008; Exhibit 509, Emergency Action Plan – Coolmunda Dam, January 2008; Exhibit 510, Emergency Action Plan – Glenlyon Dam, September 2006; Exhibit 511, Emergency Action Plan – Callide Dam, January 2008; Exhibit 512, Emergency Action Plan – Kroombit Dam, January 2008; Exhibit 513, Emergency Action Plan – Fairbairn Dam, January 2008; Exhibit 426, Attachment 4 – Emergency Action Plan for Wivenhoe Dam, September 2010; Exhibit 314, North Pine Dam Emergency Action Plan, September 2010; Exhibit 502, Statement of James Grayson, Attachment JRG-04 Awoonga Dam Emergency Action Plan, November 2010; Somerset Dam Emergency Action Plan, September 2010.

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71 Transcript, William Wilkinson 25 May 2011, Emerald [p2617: line 21].

72 Statement of Robert Keogh, 1 June 2011 [p27].

73 Statement of Robert Keogh, 1 June 2011 [p27].

74 Exhibit 501, Statement of Robert Keogh, 27 May 2011, Schedule 10 [p22-23], Schedule 15 [p20-22], Schedule 17 [p16-17], Schedule 21 [p14-15].

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76 Transcript, 15 April 2011, Brisbane, [p423: line 5]; Exhibit 428, Statement of Graham Keegan, 31 March 2011.

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81 Exhibit 417, Statement of Barry Dennien, 5 April 2011, Annexure D.

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83 Statement of Robert Keogh, 1 June 2011, Attachment RKG-04, Australian Government, *Emergency Management Planning for Floods Affected by Dams*.

84 Statement of Robert Keogh, 1 June 2011, Attachment RKG-04, Australian Government, *Emergency Management Planning for Floods Affected by Dams* [p8, 10, 13, 14, 18].

85 Statement of Robert Keogh, 1 June 2011, Attachment RKG-04, Australian Government, *Emergency Management Planning for Floods Affected by Dams* [p18].

86 Statement of David Stewart, 18 April 2011 [p6].

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93 Correspondence from RACQ received by the Commission, 15 April 2011 [p1].

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95 Correspondence from RACQ received by the Commission, 15 April 2011 [p1].

96 Statement of David Stewart, 18 April 2011 [p3].

97 Statement of David Stewart, 18 April 2011 [p3].

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104 Queensland Flood Commission of Inquiry Regional Meeting Notes – Gin Gin; Statement of

Mr Rod Ferguson. 14 April 2011 [p6: para 52]; Statement of Collin Head, 5 April 2011 [p14: para (d)]; Statement of Councillor Gail Nixon, 17 May 2011 [p6: para 36].

105 Statement of David Stewart, 18 April 2011 [p4].

106 Correspondence from RACQ received by the Commission, 15 April 2011 [p2].

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108 Transcript, Colin Head, 23 May 2011, Rockhampton [p2487: line 1].

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111 Exhibit 218, Statement of John Ryall, 4 April 2011 [p3].

112 Transcript, Rod Ferguson, 3 May 2011, Goondiwindi [p1216: line 42].

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114 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p29: para 113].

115 Exhibit 494, Statement of Peter Baddiley [p17: para 60].

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124 Exhibit 38, Provision of Preliminary Meteorological and Hydrological Information: Background briefing for the QFCI, February 2011 [p11].

125 Transcript, James Davidson, 18 April 2011, Toowoomba [p554: line 10].

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131 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p34].

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136 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p45].

137 Exhibit 153, Statement of Bronwyn Darlington, 20 January 2011 [p5: paras 30-31]; Exhibit 179, Statement of Daniel Watkins, 30 January 2011 [p5-6: paras 28-30].

138 Exhibit 37, Statement of James Davidson, Annexure JD-1 Bureau of Meteorology Report to Queensland Floods Commission of Inquiry, March 2011 [p44-45].

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140 Exhibit 68, Queensland Flood Commission Report – Submission of Anthony Cornelius, undated.

141 Transcript, James Davidson, 18 April 2011, Toowoomba [p555: line 15].

142 Exhibit 300, Statement of Dennis Ward, 8 April 2011 [p8: para 56].

143 Exhibit 382, Statement of Angela Newhnam, 15 April 2011 [p8: paras 60 and 61], Exhibit 319, Statement of Janet Carpenter, 15 April 2011 [p6: paras 37 and 38].

144 Statement of Janet Carpenter, 15 April 2011 [p4: paras 21-22]; Transcript, Janet Carpenter, 9 May 2011, Brisbane [p1575: line 54].

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146 Transcript, Peter Baddiley, 27 May 2011 [p2724: line 9].

5 Emergency response

5.1 Local government response

Disaster response is based on the principle that local governments should be primarily responsible for managing disasters within their region, with support from the district and state disaster management groups.[1] Councils are statutorily required to maintain the ability to deal effectively with a disaster;[2] but they can seek assistance from the district group when they do not have the necessary resources. Disaster response operations involve co-ordination between council, police, emergency services and government departments under the management of the council's local disaster management group.[3] They are carried out at an operational level through a local disaster co-ordination centre, while response agencies (police, State Emergency Service (SES), the fire service) perform operational activities under their own command structures.[4] (For more information about the disaster response agencies see *3.1 Disaster management framework.*)

The 2010/2011 floods highlighted the fact that councils have differing abilities to respond to disaster. Generally speaking, councils' abilities vary according to a range of interrelated factors: geographic differences and vulnerability to particular kinds of disaster; the priority given to disaster management; experience in dealing with disasters (a number of councils in central and south-west Queensland had recently experienced flooding before the floods in December 2010 and January 2011); the resources available for disaster management; and the expertise and training of staff. Some councils were well-prepared and well-equipped to handle the events which confronted them during the floods. Others were less capable; but it must be borne in mind that the events to which councils had to respond differed dramatically in size, severity, suddenness and duration (as described in chapter 1).

For example, because of Rockhampton's location on the Fitzroy River, the council had ample time to prepare for impending flooding, which ultimately isolated the city for several weeks. By contrast, predicted flood levels in Ipswich escalated dramatically over the course of hours on 11 January 2011. As a result, the council had to scramble to warn residents, prepare evacuation centres and otherwise respond before the Bremer River peaked on 12 January 2011. Toowoomba Regional Council received little warning of the catastrophic flash flooding of 10 January 2011. Events in the Lockyer Valley were sudden and overwhelming, causing widespread destruction and tragic loss of life. (Events in Toowoomba and the Lockyer Valley, and the councils' responses to them, are described in detail in chapter 7.) The Somerset region also faced large-scale disaster. The council's entire region (the largest in south-east Queensland) was affected;[5] it was effectively divided into multiple isolated areas.[6] The council did not anticipate the scale of the event or the extent of isolation that occurred,[7] and a number of communities had to initiate their own responses (discussed in *5.1.2 Locality-based disaster management*).

The Lockyer Valley and Somerset councils, both less well-resourced councils, struggled in their respective responses. In the case of the Somerset council, the Ipswich district disaster co-ordinator responsible

for the Somerset region observed that events were beyond the council's capacity to manage.[8] A number of factors limited the Somerset council's effectiveness:

- The council did not have sufficient resources to deal with the size of the event and the isolation of many towns, including Kilcoy, Fernvale, Lowood, Esk, Toogoolawah, Glamorgan Vale, Moore and Wivenhoe Pocket.[9] In particular, it did not have enough staff trained in disaster management.[10] However, it received assistance from Gold Coast City Council, discussed below.
- The local group was not able to operate cohesively.[11] It had planned to meet on 10 January 2011, but members could not attend because they were cut off by floodwaters.[12] The mayor, chief executive officer and local disaster co-ordinator were isolated for a number of days.[13] The group's first meeting occurred on 12 January 2011, by which time numerous towns had been isolated for a period of days.
- The council office and planned disaster co-ordination centre in Esk were flooded, unexpectedly, on 10 January 2011 (the day of the events in Toowoomba and the Lockyer Valley), rendering the co-ordination centre unusable and disabling the council's email system.[14] A makeshift co-ordination centre was established at Fernvale, but because of power and communications failures, co-ordinating activities was 'extremely difficult'. Main operations were consequently moved back to Esk on 13 January 2011.[15]
- Deployment of resources was difficult because many roads in the region were closed.[16]
- Although lack of power did not prevent activities, it limited their timeliness and effectiveness.[17]
- Perhaps most importantly, because of loss of communications, the local disaster co-ordinator had no contact with the district co-ordinator between the morning of 11 January 2011 and late on 12 January 2011 (at least).[18] The local co-ordinator indicated that he did not have contact with other agencies during this interval;[19] however, he did have some contact with Seqwater, the operator of Wivenhoe and Somerset dams.[20] He explained that 'meaningful organisation' started when the ability to 'communicate out' was restored on 12 January 2011.[21] (This issue is discussed further in *5.2 Communication between local, district and state groups*.)

The circumstances in the Somerset region demonstrate that councils' disaster management plans should encompass contingency planning, with arrangements for alternative co-ordination centres, and back-up sources of power and means of communications, so that if facilities, power or communications are lost in a disaster, local groups can continue to function. They also demonstrate that councils need the ability, in large-scale flooding, to respond to simultaneous events in different places, a situation a number of councils faced during the 2010/2011 floods. This issue is discussed in *5.1.2 Locality-based disaster management*.

Notwithstanding the difficulties that Lockyer Valley, Somerset and some other councils experienced during the 2010/2011 floods, the role of councils under the *Disaster Management Act 2003* should not change. Nor is it necessary to add to the statutory powers which presently exist to give directions to local groups.[22] Generally, councils performed capably during the 2010/2011 floods. A great deal of evidence, from many parts of the state, confirmed that disaster responses (and other aspects of disaster management) should continue to be conducted at a local level. The importance of local knowledge in responding to disaster was a constant theme in the evidence presented to the Commission. The case for local stewardship is reinforced by evidence demonstrating the need for locality-based disaster management arrangements, discussed below (see *5.1.2 Locality-based disaster management*).

Accepting that councils should have primary responsibility as the Act prescribes, the focus, before the next wet season and in the longer term, should be on ensuring that all councils are well-prepared for disaster and able to perform their role effectively during disaster events. (Recommendations directed at these objectives are made in sections 3.3 and 3.4.) It is important that in times of disaster those at district and state levels have confidence in the ability and judgment of those co-ordinating local responses (the issue of communication between the three levels is discussed in section 5.2). This can be achieved through development of strong working relationships between the local and district levels. There must also be means of assisting councils when they experience significant difficulties during a disaster.

5.1.1 Council-to-council assistance

On a number of occasions during the 2010/2011 floods, councils provided disaster management personnel (and other resources) to other councils in need of assistance with response and recovery operations. Gold Coast City Council provided staff to help run the disaster co-ordination centre and manage the response in Somerset. While working in the co-ordination centre, Gold Coast personnel trained the Somerset staff. Murweh Shire Council assisted Lockyer Valley Regional Council with staff (discussed in *7.2.5 Lockyer Valley Regional Council response*). Mackay Regional Council sent personnel to assist in the Central Highlands disaster co-ordination centre and relieve its staff. This inter-council assistance was effective during the floods, and should be similarly used to support councils in difficulty (and to manage staff fatigue) during future disasters.

Assistance between councils during the floods was facilitated through the disaster management system, by request from the local disaster co-ordination centre through the district disaster co-ordinator to the state disaster co-ordination centre. In some cases, this process followed direct communications between councils. The Local Government Association of Queensland was also heavily involved in co-ordinating assistance between councils, through its Council to Council (C2C) program, established in early 2010 as a result of floods in south-west Queensland. The program is designed to facilitate assistance to councils during larger-scale disasters, when neighbouring councils are also affected and cannot provide it, by linking councils in need of help with other councils that are in a position to assist.

One of the larger councils expressed a concern that the C2C program involved an interruption in the chain of responsibility under the disaster management arrangements, with requests for help coming from both the state disaster co-ordination centre and the Local Government Association. This, it said, created confusion. The C2C program should be used in future disasters, to facilitate deployment of personnel and other resources to councils in need of assistance. Improvements to ensure effective co-ordination can be made, however: the program should be integrated with the state disaster co-ordination centre; and all participants must clearly understand how it operates. Emergency Management Queensland and the Local Government Association expressed an intention to work together to ensure the program's effectiveness.

The Gold Coast City Council explained that having its co-ordination centre active for the purpose of responding to requests for help enabled it to provide assistance more efficiently. It suggested that, in future disasters, non-affected councils that are able to assist should do the same, a view Ipswich City Council also propounded. In addition, a number of councils indicated that assistance between councils could be provided more easily and effectively if councils used uniform disaster management software.

Some councils intend to develop ongoing relationships with other councils for disaster management purposes; some have already done so. The Commission supports these arrangements.

Recommendations

5.1 When a local government cannot effectively manage its response to a disaster, disaster management personnel from local governments in a position to assist should be deployed to help the local disaster management group.

5.2 Local governments should consider adopting uniform disaster management software, to enable inter-council assistance to be given more easily and effectively.

5.3 To ensure effective co-ordination in larger-scale disasters, deployment of personnel (and other resources) between local governments should be facilitated through the Council to Council (C2C) program.

5.4 The C2C program should be incorporated into the state disaster management arrangements and operate within the structure of the state disaster co-ordination centre.

5.5 The state disaster management group, Emergency Management Queensland and the Local Government Association of Queensland should do further work before the next wet season to ensure that during a disaster:

- the C2C program meets requests for assistance as efficiently as possible
- local governments and other prospective participants understand how the C2C program works.

5.1.2 Locality-based disaster management

In many cases, the 2010/2011 floods affected numerous communities within council regions. The resulting challenges were compounded in some regions by distances between communities and their isolation by floodwaters. Some councils struggled to cope. Somerset Regional Council, Lockyer Valley Regional Council and Moreton Bay Regional Council did not provide well for isolated communities. Other councils, however, had the foresight to establish sub-groups of local disaster management groups before the 2010/2011 floods, giving them a means of managing multiple or distant events. Such sub-groups were an effective part of the disaster response.

These groups, which generally included local councillors or council staff, local police and representatives of local emergency services, operated in a number of locations, such as Tara, Miles and Chinchilla, in the Western Downs area; Theodore, in the Banana Shire; Inglewood in Goondiwindi Regional Council's region (a group has been formed in Texas following the floods); and Springsure, in the Central Highlands. They were formed, because of the size of councils' regions (greatly expanded by amalgamation), in order to provide organisation in communities distant from the council's major centre in times of disaster. Banana Shire Council established sub-groups after it experienced flooding in March 2010, in response to community concerns about lack of information from the council. Sub-groups were therefore formed to provide direct information to isolated communities distant from the local disaster management group (but the process had not been formalised before the onset of the floods).

Sub-groups performed this communication role effectively during the 2010/2011 floods, acting as a link between the community and the local disaster management group. They conveyed information about local conditions, allowing a more efficient response, and relayed information from the local disaster management group back to the community. They also provided a level of organisation in the community and, in some cases, co-ordinated resources and response activities. For example, the chairperson of the Springsure group (the local councillor) was involved in organising re-supplies of food and medicines. The chairperson of the sub-group in Theodore remarked that the response to the floods was better than in March 2010 because of the group's existence.

In some places where sub-groups did not exist, arrangements which served similar purposes emerged during the floods. Teleconferences between the Maranoa local disaster management group in Roma and a councillor and local emergency services in the isolated town of Surat were held on a daily basis; and the councillor kept the Surat community informed. In the Southern Downs region, significant flooding occurred in two towns: Warwick and Stanthorpe. The local disaster management group and co-ordination centre were in Warwick. An additional co-ordination centre had to be established in Stanthorpe, isolated from Warwick, to manage events in that town. This demonstrated to the council the need to have resources based in Stanthorpe to ensure the capacity to respond should disaster occur there in future.

Some isolated communities co-ordinated their own responses, independent of local disaster management groups, for want of any other option: they were cut off from assistance. These community responses were led by local SES volunteers, police, rural fire brigade officers, church and community groups or, in some cases, local residents. Some were highly organised, and successful; for example, those in parts of the Somerset region (Fernvale, Wivenhoe Pocket, Linville), Murphys Creek in the Lockyer Valley, Moggill and Mt Crosby in Brisbane, and Woodford in the Moreton Bay region. For more detailed information on the community response in Murphys Creek see chapter 7. The activities these communities managed included assisting in evacuations and rescues of residents; opening and running makeshift evacuation and relief centres (discussed in section 5.5.4); and procuring supplies and organising food drops. The ways in which these communities (and others) coped with their situations were a positive aspect of the response to 2010/2011 floods.

Some communities did run into problems, however. In Woodford and Wivenhoe Pocket, requests to authorities for supplies were not met. The communities instead obtained what they needed by their own means.[23] Residents in Moggill and surrounding areas did not believe they were kept informed as they should have been; they felt that authorities were not aware of their situation.[24] An organiser of the relief centre at Moggill had some difficulty in dealing with the council when trying to procure food supplies, and sought the help of his local councillor.[25] She contacted the local disaster co-ordination centre, which already had arrangements afoot, and supplies were later delivered.[26]

Similar issues will arise whenever a community becomes isolated and immediate assistance is not available. Communities in these circumstances would be aided by established processes for obtaining information and supplies.

The councillor for the Pullenvale Ward in Brisbane (into which Moggill falls) had, in fact, created a community-based group in 2009, because of the risk of the community's becoming isolated and having to manage a response during a disaster. The Pullenvale group was not part of the council's disaster management arrangements and had not reached a stage of organisation which would allow it to operate during the 2011 floods; although the councillor herself took on the role of communicating the needs of the community to the local disaster co-ordination centre. It is advisable that links are established between groups such as this and local disaster management groups.

Some councils have established or intend to establish local arrangements in the wake of the 2010/2011 floods, to deal with large distances (Barcaldine Regional Council) or the risk of isolation. As to the latter, Gladstone Regional Council is seeking to form community-based groups in Agnes Water and the Baffle Creek area as conduits for communication with the local disaster management group. It intends that these groups will ameliorate communication problems which occurred during the floods. Ipswich City Council is developing specific plans for communities susceptible to isolation, such as Goodna, Redbank, Rosewood and Karalee. This may involve establishing groups capable of co-ordinating a response. Moreton Bay Regional Council intends to establish arrangements in Woodford (and other communities) based on that which was organised by the community in January 2011. Brisbane City Council is also developing a plan for the Pullenvale Ward, following a recommendation of the independent review into the council's response.[27]

Other communities affected by the 2010/2011 floods would benefit from specific disaster management arrangements. Murphys Creek (discussed in section *7.2.5 Lockyer Valley Regional Council response*), Oakey and communities in the Somerset region are examples. This is not to say councils should necessarily create sub-groups as other councils have done. But the useful functions such groups performed during the floods demonstrate the advantages of having some arrangements in place in communities distant from, or likely to be isolated by flooding from, regional centres. These arrangements should at least ensure, in the event of disaster, communication between the community and local disaster management group and some level of organisation in the community. They could also assist in preparing the community for disaster generally, providing warnings to residents, and operating evacuation centres (discussed in *5.5.4 Makeshift evacuation centres*). Where councils create formal sub-groups, it is important that the respective roles and responsibilities of the sub-groups and local disaster management groups are clearly understood. Written terms of reference proved to be useful to the Theodore sub-group during the floods, for instance.

Permanent or pre-existing arrangements will not always be possible, however. Isolation may occur in areas not anticipated. In these situations, local disaster management groups, at the very least, need to make contact with the community as early as possible. It is also important that communities understand what to do to cope with their circumstances. Community preparedness is therefore essential (discussed further in *3.5 Community education and driving in floodwaters*).

Recommendations

5.6 As part of their planning before the next wet season, local disaster management groups should identify communities which, because of distance, the potential for isolation by disaster, or any other reason, may require specific disaster management arrangements, and take steps to establish them. Such arrangements may include forming disaster management sub-groups in those communities.

5.7 Whatever form arrangements take, they should seek to ensure that, in the event that flooding causes isolation:

- there are lines of communication between the local disaster management group and the community
- the community has the basic resources it needs to cope with its situation
- the local disaster management group is aware of what supplies the community may need in prolonged disaster, and can respond to requests for assistance in a timely way
- potential evacuation routes and centres are known.

5.8 Where a local government forms a sub-group of its disaster management group:

- the responsibilities of the sub-group must be clearly defined within the local disaster management arrangements
- each member of the sub-group must clearly understand his or her role.

The Commission recommends that sub-groups and local disaster management groups set out their respective roles and responsibilities in writing.

5.2 Communication between local, district and state groups

Communication is essential to effective disaster response. During a disaster, the disaster management system depends on the flow of information between the local, district and state disaster management groups.[28] Communication from the local group to the district group, in particular, is critical. The local group reports on the disaster situation. The district and state groups depend on this local information; demands for information were high during the 2010/2011 floods. When the local group requires assistance, it communicates its request to the district; and, since disaster responses are to be managed primarily at the local level, ordinarily the local group receives assistance from the district and state only if the former requests it.[29] A disaster response can therefore be hindered if a local group is prevented from communicating information or requests to the district, as happened in the Somerset region.

The Somerset local group had no contact with the Ipswich district group between (at least) early on 11 January 2011 and late on 12 January 2011, because of loss of communications.[30] The district group received information from local police in some areas of the region, who were in contact with some members of the council.[31] The district co-ordinator was aware some 'activities [were] occurring in parts' of the region,[32] and of the status of water and power supply in some areas.[33] But his knowledge was limited as to the extent of the situation, the degree to which the local group was functioning, and what assistance it needed.[34] Physical access to affected areas was restricted, if not prevented, by road closures and scarcity of helicopters.[35] (Further information about the response in the Somerset region is provided in *5.1 Local Government Response.*)

Disaster response has the potential to break down if communication between the local and district groups is lost. When this occurs, a district co-ordinator should take action to ascertain the situation as completely as possible; establish communication with the local disaster co-ordinator or otherwise satisfy himself or herself that the local group is functioning; and ensure the local group receives necessary assistance.

5.2.1 Communication with local groups

Just as the district and state levels rely on local groups for information, local groups rely heavily on information from the district and state levels. As the bodies with primary responsibility for managing disasters, local groups should be informed of all matters relevant to the performance of their functions. On occasions during the 2010/2011 floods, local groups were not kept as informed as they should have been. In some cases, for instance, information was not forthcoming about the status of requests local groups had made. This made their planning more difficult.[36]

In other instances, local groups were not consulted when that would have been prudent. For example, an emergency alert text message was sent to residents of the Moreton Bay region at the state group's direction, without the local group's having been informed. (This is discussed further in *4.1.1 Warnings.*) Local groups were not consulted on some occasions where the state group sent resources which had not been requested (a departure from the usual process by which local groups receive assistance, but contemplated by the state disaster management plan).[37] In one such case, arrangements were made at state level with the Australian National Retailers Association for a food re-supply to Rockhampton, but the local group (which had a food re-supply process in place) and the district group were not informed of the arrangements.[38] In another case, the state group sent an Emergency Management Queensland helicopter (see *5.3.8 Emergency Helicopter Network*) from Townsville to St George, anticipating that it might be required in that region.[39] Neither the local group nor the district co-ordinator had requested it. The helicopter was not required and was sent elsewhere the next day. Defence force helicopters were also sent to St George and Roma on a different occasion.[40] While these helicopters provided assistance, the local groups were not initially aware of the decision to deploy them to their regions. This apparently caused some logistical difficulties.[41]

The Commission is not critical of the state group's actions in these cases. Pre-emptive actions may be advisable, and indeed necessary, in times of disaster, and the Commission does not wish to discourage the state group's taking precautionary steps in future. Where the state group proposes to take such action, however, it should consult with local groups and district groups unless it is simply not possible to do so, in order to assist local level planning and avoid unnecessary deployment of resources. As the O'Sullivan Review said on this topic:

> [It is essential] that District and Local levels are fully informed about the State's requirements, intentions and actions so that they don't compromise, but enhance, District and Local arrangements already in place.[42]

The Commission also notes, in this context, that consultative decision-making is an important principle under the state disaster management plan,[43] which also states that 'all deployments should be co-ordinated with [local groups] and should not be a drain on local resources'.[44]

A state-wide information and communication technology system, to which all levels of disaster management (and other disaster management agencies) are connected, could address some of these issues.[45] Presently different systems are used by councils, police, emergency services and government agencies. The O'Sullivan Review considered this an impediment to effective co-ordination during a disaster, and a matter requiring 'urgent attention'.[46] Emergency Management Queensland is developing the All Hazards Information Management System, which will provide participants in the disaster management system with a single source of information.[47] The Commission notes that funds were allocated in the 2011/2012 State Budget towards its development. Among other functions, the system will enable local, district and state groups to track the status of requests for assistance.[48] This function will not be available by the next wet season, however. The system is being developed progressively, because of the significant work and costs involved.

The Commission supports the development of the All Hazards Information Management System as the state's integrated communication and information system for disaster management.

Recommendation

5.9 Until the All Hazards Information Management System is in place and allows the status of requests for assistance to be tracked, other means should be used to keep local disaster management groups informed of the progress of requests for assistance.

5.2.2 Participation in teleconferences

The large scale of the 2010/2011 floods resulted in numerous local and district groups participating in regular state-wide state disaster co-ordination centre teleconferences. The large number of participants meant that the meetings could last for more than three hours at a time, making them time-consuming. Concerns were expressed about the potential this had to distract both local and district level participants from their immediate operational responsibilities, which was particularly frustrating if the contribution required of them was minimal. The effect was exacerbated in smaller districts where there were typically fewer disaster management personnel available to respond to an event.[49]

Nevertheless, the Commission acknowledges that the teleconferences provide a vital forum for the exchange of up-to-date first-hand information, and remain the single most important means for doing so at a state-wide level. Not only can a strategic overview be developed at the state level, but critical intelligence can be conveyed to local level participants. By way of an example of the disadvantages of non-involvement, the Ipswich City Council was not present at a state teleconference on 11 January 2011 to hear advice from the Bureau of Meteorology about a significant increase in its predictions for the height of the Bremer River. (This is discussed further in *4.2.7 Bureau communication with Ipswich City Council on 11 January 2011*.)

There is a need to strike a balance between the competing imperatives of using the time of local and district level personnel to best effect on the one hand, and the need to maintain the timely flow of important information within the disaster management system on the other. To this end, a communication protocol could be developed by the state disaster management group to govern, and make more efficient, participation in the state-wide teleconferences.

There are a number of ways by which the duration of the teleconferences, for individual participants at least, could be shortened without compromising the effectiveness of the meetings. The Local Government Association of Queensland proposed that local groups participate in state teleconferences only when faced with a specific or immediate threat, so that the state group could obtain the most current advice as to the local situation in those cases. Outside these occasions, the relevant district disaster co-ordinator could represent the local group at the state teleconference.[50] Should arrangements of this nature be implemented, clear communication protocols between local and district groups would also need to be developed and applied during disaster events.

Alternatively, and ideally, the development of the All Hazards Information Management System could enable the focus of the state disaster management group teleconferences to move from data collection to data presentation and strategic response.[51] This could reduce the length of the meetings, so that broad participation could be maintained. It could also enhance the quality and timeliness of the strategic-level response.

However, the Commission understands that the All Hazards Information Management System may not provide this function by the next wet season. In the meantime, communication protocols are an appropriate interim measure.

Recommendation

5.10 A clear protocol should be developed for managing the participation of local and district disaster management groups in the state level teleconferences, to govern and make more efficient participation in the teleconferences.

5.3 Rescue

5.3.1 Queensland Fire and Rescue Service

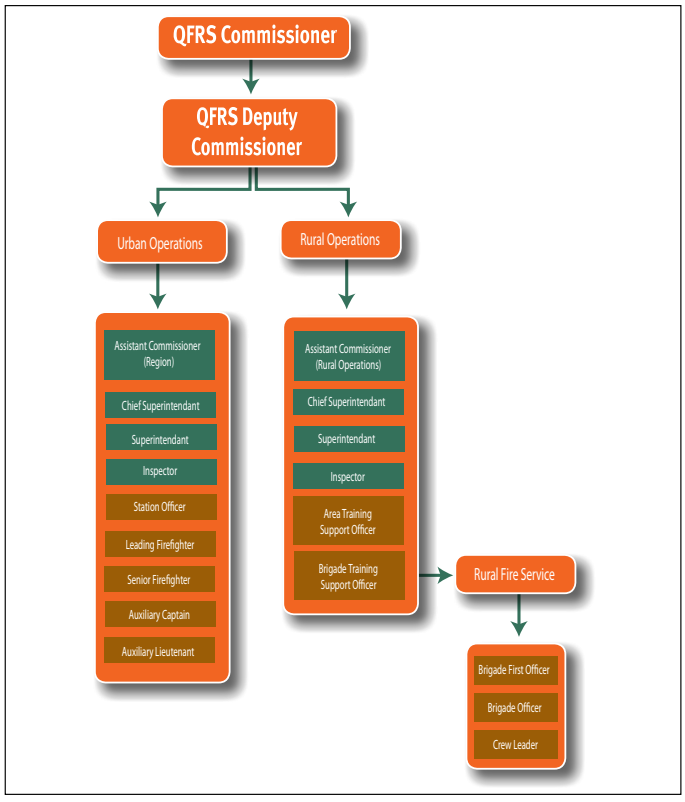
The Queensland Fire and Rescue Service was heavily involved in the response and rescue effort in the 2010/2011 floods. The fire service is one of four operational divisions of the Department of Community Safety and provides a range of rescue services in addition to its firefighting capabilities. It is the only agency in Queensland that performs swift water rescue, a capability that was in unprecedented demand during the floods across Queensland, especially in Toowoomba and the Lockyer Valley. The floods revealed some particular limitations in the fire service's capacity to provide swift water rescue.

The Commission has been advised that the fire service is conducting a state-wide review of swift water rescue considering: training and numbers of staff trained based on regional risk assessments; equipment; current procedures and compliance with them; deployments; and possible future growth; and that the findings of that review are to be implemented before the next wet season.[52]

Background – fire service operations

The fire service is divided into urban and rural operations, overseen by the Commissioner and Deputy Commissioner, as illustrated in figure 5(a).

Figure 5(a)

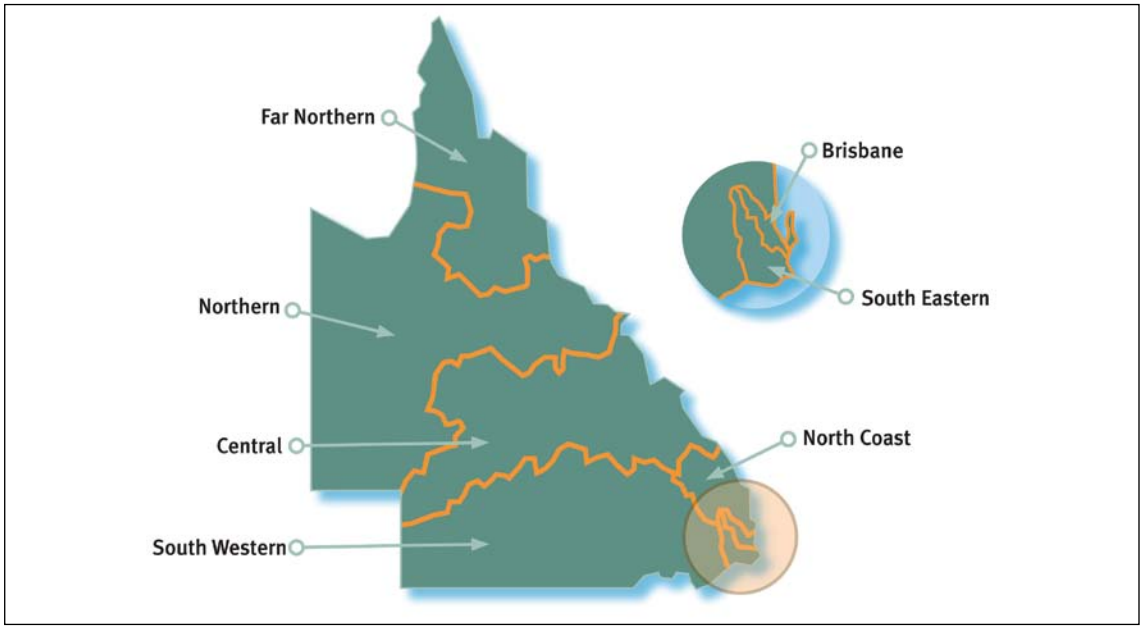


Source: Foundations of Queensland Fire and Rescue Service, p30 [amended]

Urban Operations is divided into seven regions, each managed by an Assistant Commissioner. The seven regions, illustrated in figure 5(b) are:

- far northern region
- northern region
- central region
- north coast region
- south-western region, spanning from Toowoomba in the east, west to the South Australian border and south to the New South Wales border
- south-eastern region, including Ipswich, Logan City and the Gold Coast
- Brisbane region.

Figure 5(b)



Source: Foundations of Queensland Fire and Rescue Service, p28

The regions are further divided into areas, each of which houses a combination of permanent and auxiliary fire and rescue stations. The permanent fire stations are staffed by full-time firefighters and the auxiliary stations are served by part time (auxiliary) firefighters who are on call and respond to incidents as required. Approximately 4000 full time and auxiliary firefighters staff the 243 urban stations in Queensland.[53]

The rural fire service, comprised of 34 000 volunteers across 1519 rural fire brigades, supplements the urban operations of the fire service.[54] Operating in the seven regions depicted in figure 5(b), the rural fire brigades serve localities that do not have urban stations. Rural Operations, led by the Assistant Commissioner (Rural Operations), provides support to the volunteer-run rural fire brigades. The term 'appliance' is used in this section to refer to fire trucks and other specialty vehicles used in its firefighting operations (see the glossary in Appendix 3).

Swift water rescue – training

Swift water is defined as water moving down a gradient and flowing at a speed in excess of two kilometres per hour.[55] Swift water rescues, often performed during flood seasons, can be dangerous for rescuers and those to be rescued.

Select firefighters are trained as specialist rescue technicians, receiving training across five disciplines including swift water rescue. The swift water rescue training, known as 'Level 2', is the highest level of training available and comprises 20 hours of pre-course learning and five days of face-to-face training. It is usually undertaken after the technician has completed training in the four other specialty rescue disciplines and assumes advanced knowledge of

vertical rescue (rope rescue skills). Firefighters who have completed Level 2 swift water rescue training are referred to as swift water rescue technicians.[56]

Swift water technicians are trained to locate, reach, stabilise and rescue people from swift water using a variety of land-based and water-based tactics. Water-based tactics, which entail entering the water and wading, swimming or using special boats ('inflatable work platforms'), pose the highest risk to both the rescuer and those to be rescued and can only be performed by swift water technicians.

All full time firefighters and selected auxiliary firefighters receive 'Level 1' swift water training.[57] This level of training ensures firefighters are aware of potential hazards and teaches land-based techniques including:

- communicating with the person to be rescued to keep him or her calm and to stabilise the situation
- attempting to reach the person with equipment, such as a pole, to perform a rescue without entering the water
- using throw bags or other lines to rescue a person
- providing land-based support to swift water technicians performing water-based rescues.

The lowest level of swift water rescue training, known as 'Swift Water Rescue Awareness', is made available to auxiliary and rural firefighters.[58] Awareness training is said to provide firefighters with the knowledge necessary to:

- ensure their personal safety and assess the scene
- undertake activities to stabilise the situation, such as preventing bystanders being swept away and conducting searches from the bank to identify any people who need rescue
- understand what equipment they need for a given rescue
- make appropriate requests for specialty equipment required.

At this level, firefighters are not instructed in any skills or techniques necessary to assist in performing land-based or water-based rescues. The training consists of watching a 20 minute DVD presentation, followed by discussion.

Swift water rescue – numbers and deployment

Swift water rescue technicians (Level 2)

The fire service did not have enough firefighters trained as swift water rescue technicians (Level 2) to meet the demands of the 2010/2011 floods.

As at 25 October 2010, there were 203 Level 2 swift water technicians trained across Queensland, 50 fewer than the approved total of 253.[59] The fire service had available another 43 rescue technicians who had not received swift water training, but had received training in other rescue disciplines. Thirty-one technicians were scheduled to undertake Level 2 swift water rescue training in July 2011.[60] The state manager for technical rescue explained that the approved numbers of rescue technicians are determined 'according to a business case based on a regional risk assessment'.[61]

The prevailing view among operational staff was that at least two Level 2 technicians with additional Level 1 support personnel were needed to safely perform a swift water rescue.[62] The rescue co-ordinators for the south-eastern and south-western regions both advocated an increase in the number of Level 2 swift water technicians. They argued that a base roster of two technicians per shift does not allow for complex swift water rescues, which need more than two technicians, or for the multiple swift water incidents which may occur at the same time during the wet season.[63]

There are 11 swift water technicians in the south-western region; 10 based in Toowoomba and one in Warwick. Under the present staffing model, it is not possible to ensure a minimum of two technicians are rostered at all times in the Toowoomba area.[64]

A swift water technician gave evidence that the number of swift water technicians in Toowoomba was 'manifestly inadequate through the wet period' and that rescues were delayed or carried out by members of the community because there were not enough staff to respond to the scale of the incidents.[65] Of the 39 swift water rescues that were recorded in the south-western region during the period 26 December 2010 to 11 January 2011, 24 were rescues in which only one or no Level 2 technicians took part. Of those 24 rescues:

- four were rescues in which Level 1 trained firefighters participated, with only one Level 2 technician
- five involved only Level 1 trained firefighters
- three involved Level 1 and Swift Water Awareness trained firefighters, with only one Level 2 technician
- six were performed by a combination of Level 1 and Swift Water Awareness trained firefighters, without any Level 2 technicians
- six were rescues performed by Swift Water Awareness trained firefighters only.

On 10 January 2011 in Toowoomba, there were two Level 2 technicians rostered at the city's Kitchener Street station and none at Anzac Avenue station. Having unsuccessfully sought extra technicians for the day, the Kitchener Street station officers decided to split the technicians between the two fire trucks to respond to swift water incidents in Murphys Creek, in the hope that at least one fire truck would get to the job.[66] Ultimately, both trucks were prevented by floodwaters from reaching Murphys Creek and the firefighters were redirected to other swift water incidents in Toowoomba. Both station officers gave evidence of performing rescues that were made significantly more difficult and dangerous by having only one swift water technician involved. In one case, a Level 1 trained station officer and a swift water technician attempted to rescue up to 11 people at the one time from swift water.[67] Another rescue was performed with only one swift water technician, assisted by Level 1 trained firefighters standing in chest-deep water. The technician remained in the water for 30 to 45 minutes, communicating with the person he was attempting to rescue and eventually attaching a float rope to him, but was unable to complete the rescue until a second technician arrived.[68]

The south-eastern region is one of the two regions in which the approved quota of swift water technicians has been filled, but the regional rescue co-ordinator for that region gave evidence that there are still not enough technicians.[69] An Ipswich based swift water technician also gave his view that there were not enough Level 2 technicians available during the floods.[70] The problem seems to have been exacerbated by the fire service's reliance on deploying technicians to meet swift water demands across the state, especially in areas that do not have permanently staffed stations (considered further in the section *Areas without permanently staffed stations* in 5.3.1 below). The south-eastern region was one of those required to send firefighters to assist elsewhere, and as a result, was under-resourced to respond to the floods in its own region.[71] One Ipswich based technician described being nearly on constant deployment for swift water rescue between Christmas and mid-February.[72] On 10 January 2011, of the 10 swift water technicians based in the Ipswich area, two were returning from a seven day deployment to Emerald, and another two were still on deployment to other parts of the state.[73] There was only one swift water technician at each of the Ipswich and Beenleigh stations.[74] According to the south-eastern regional functional plan for swift water rescue, when the level of swift water preparedness is elevated on the basis of wet weather, at least two swift water technicians should be on duty at the Ipswich and Beenleigh stations.[75]

There is a lack of clarity in the instructions given to firefighters about how many Level 2 swift water rescue technicians and Level 1 support personnel are required to safely perform a swift water rescue, and what to do if those minimum numbers are not available. Each of the firefighters who gave evidence on this issue believed at least two Level 2 technicians with additional support personnel were required to perform a swift water rescue in accordance with the fire service's Operations Doctrine, which governs the service's emergency response and incident management.[76] Some firefighters apprehended that if they decided to perform a rescue when the minimum numbers were not available, they were operating outside of the Operations Doctrine and potentially without the support of the fire service.[77]

The Operations Doctrine provides minimal guidance. The matter is addressed in one Fire Communications Centre Directive and one Incident Directive. *Fire Communications Centre Directive Q-3.13* states that the initial despatch to a swift water incident should be one pumper and one specialty rescue/rescue appliance.[78] (For more information about 'appliances' see the glossary in Appendix 3.) A pumper is crewed by four firefighters and a rescue appliance by two; thus, the initial despatch to a swift water incident is six firefighters.[79] *Incident Directive 24.1.5* states that 'under deployment conditions, a minimum of two (2) Level 2 Swiftwater Floodwater Rescue Technicians are to be mobilised with Level 1 Swiftwater Floodwater Rescue Technicians (for support) to all swift water rescue incidents; or to standby at areas identified as a risk'.[80] Although it is not obvious from the expression, the state manager for technical rescue explained that 'under deployment conditions' did not refer to responding to a particular incident, but only to situations where teams of firefighters were sent to an area in advance of anticipated demand.[81]

Each region also has its own functional plans for technical rescue and swift water rescue.[82] However, a comparison of the south-eastern regional functional plan, which includes a detailed section on elevated levels of preparedness for swift water rescue and the staffing of swift water technicians, and the south-western plan, with no such detail, shows the potential for variation between regions. The fire service must ensure the guidelines for swift water rescue are consistent between the regions to avoid unnecessary confusion.

Auxiliary and rural firefighters

Because there were not enough swift water rescue technicians available to respond to the swift water incidents during the 2010/2011 floods, auxiliary and rural firefighters were operating in swift water environments without the necessary training.

The state manager for technical rescue explained that the Swift Water Awareness package is available to all auxiliary and rural firefighters, but did not give evidence about how many firefighters have actually received the training.[83] The south-eastern regional rescue co-ordinator said in evidence that the majority of auxiliaries in that region have not received any training of that type.[84] In any case, awareness training only provides firefighters with sufficient knowledge to ensure their own personal safety and to perform a limited range of back up tasks to support Level 1 and Level 2 trained firefighters. They do not have the skills to assist in land-based or water-based rescues.

The figures from the south-western region set out above in the section *Swift water rescue technicians (Level 2)* show (in the last three categories listed) that 15 rescues involving auxiliary or rural firefighters with Awareness Level training, were performed with only one or no Level 2 technicians. There was evidence that in Dalby firefighters had entered flood waters with SES crews in SES flood boats to conduct rescues.[85] (SES members are untrained in swift water rescue.) A swift water technician who was both a permanent firefighter and a captain at an auxiliary station in the south-eastern region gave evidence that auxiliary firefighters performed swift water tasks when there were no technicians available because of a sense of obligation as firefighters to protect life.[86] There was also evidence that firefighters felt the pressure of community expectations to respond if they were at the scene of an incident, rather than waiting for the technicians to arrive.[87]

Because of the number of instances where auxiliary firefighters have entered swift water to conduct rescues, current and former rescue co-ordinators in the south-eastern and south-western regions recommended that all auxiliary firefighters should receive Level 1 training.[88] The south-eastern co-ordinator also advocated Awareness Level training for all rural firefighters.[89]

Areas without permanently staffed stations

The fire service faces a challenge to provide adequate swift water capability in areas that do not have permanently staffed stations; which rely on the deployment of swift water technicians from other centres.

Dalby, served only by auxiliary firefighters, was an example of an area with a history of swift water rescue incidents and yet no permanent swift water capability. While the fire service was able to deploy a team of technicians to Dalby on 27 December 2010 on the basis of flood forecasts, deployment from elsewhere is not a satisfactory or permanent solution. In the event of an unpredicted swift water incident, technicians must come from Toowoomba or Warwick, approximately one hour away by road. The Commission heard evidence of a swift water rescue in Dalby on 20 December 2010 where this delay was compounded when the first swift water team (in an SES flood boat with its driver) got into difficulties and had to await the arrival of a second team from Toowoomba. That rescue took two and a half to three hours in these circumstances.[90] Other towns face similar issues in the south-western region without permanently staffed stations, such as Roma and Goondiwindi.[91]

Recommendations

5.11 The Queensland Fire and Rescue Service should increase the number of swift water technicians (Level 2) to at least meet the quota for the approved number of rescue technicians in each region.

5.12 The Queensland Fire and Rescue Service should consider whether the approved number of swift water technicians in each region is appropriate to meet the demands of that region.

5.13 The Queensland Fire and Rescue Service should revise the Operations Doctrine to clarify:

- how many Level 2 swift rescue technicians and Level 1 support personnel are required to safely perform a swift water rescue
- the options available to an incident controller at a swift water incident with fewer than the required personnel and what considerations they should take into account in their decision-making.

5.14 The Queensland Fire and Rescue Service should consider providing Level 1 swift water rescue training to all auxiliary firefighters stationed in areas susceptible to flooding.

5.15 The Queensland Fire and Rescue Service should ensure all rural fire service volunteers and auxiliary firefighters stationed outside areas susceptible to flooding receive Awareness Level swift water rescue training.

5.16 The Queensland Fire and Rescue Service should identify areas that are likely to require, but do not have, swift water capability during the wet season and consider how it can best provide a permanent capability to any such area.

5.3.2 Queensland Fire and Rescue Service preparedness for and response to the events of 10 January 2011

Evidence from the south-eastern region

An Ipswich station officer gave evidence of the difficulties he encountered on the morning of 10 January 2011 in trying to recall additional staff, including swift water rescue technicians, for duty at Ipswich, where only one swift water technician was rostered on.[92] He was aware that there was also only one swift water technician rostered at Beenleigh. The station officer's reading of the Bureau of Meteorology website had prompted him to begin making phone calls to the duty manager of operations, from 7.30 am. He was twice told that his request for additional staff would have to wait until a management meeting later in the day. The station officer went outside the usual chain of command and made phone calls to the regional technical rescue co-ordinator and to the acting assistant commissioner for the region. He made personal contact with one swift water technician, who agreed to report for duty and arrived at Ipswich station at approximately 9.00 am. The acting assistant commissioner gave evidence of a direction given at around 8.30 am to bring in additional resources after ascertaining there would be difficulties obtaining the support usually available from Toowoomba, due to the floods.[93] Another swift water technician was called in for duty at Ipswich, reporting at approximately 12.00 pm, and a rescue appliance travelled from Beenleigh to assist in a rescue near Ipswich.

A swift water technician and two auxiliary firefighters were called in for duty at Gatton station.[94] They attended a swift water rescue in Murphys Creek at 1.40 pm. There they encountered three units from Ipswich: the rescue appliance, the pump truck and a small four wheel drive vehicle carrying the two swift water technicians called in to duty. An appliance from Helidon was also in the area.

The acting assistant commissioner gave evidence of another two appliances deploying into the Lockyer Valley later that day.[95] One, crewed by two swift water technicians from Cannon Hill in Brisbane, was diverted there after trying unsuccessfully to reach Toowoomba; the other was crewed by one swift water technician from Roma Street. There is no evidence about the time these technicians were deployed to or arrived in the Lockyer Valley, although the Cannon Hill appliance was reported as being seen at the Lockyer Creek Bridge on the Warrego Highway probably at about 6.30 pm.[96] According to the regional rescue co-ordinator, after it became apparent that there was a major disaster occurring in the Lockyer Valley, three additional units – a swift water support vehicle from Ipswich

with two swift water technicians, a utility carrying swift water rescue crew from Beenleigh and a rescue appliance brought up from Helensvale – were sent to the Gatton area between 5.00 pm and 8.00 pm.[97]

The fire service has also provided some evidence of contact made with auxiliary brigades and volunteer rural fire brigades in the south-eastern region on the morning of 10 January 2011 to warn of severe weather forecasts and check availability to report for duty.[98] A spreadsheet detailing deployment of all personnel in the south-eastern region on 10 January 2011 has been provided. The utility of this spreadsheet is limited by the fact that it does not show when people and appliances were sent, or when they arrived at their destinations. The evidence tends to indicate that significant numbers of additional personnel were deployed by the end of the day, but that the fire service would have been in a stronger position to meet the demands of 10 January 2011 if action had been taken more promptly in response to calls for additional personnel made early in the day by the Ipswich station officer.

Evidence from the south-western region

Six staff, including two swift water technicians, were rostered to Kitchener Street station in Toowoomba on 10 January 2011.[99] There were no swift water technicians on duty at Anzac Avenue station. During the previous evening, Kitchener Street staff had responded to a number of swift water incidents in Grantham. On the basis of these incidents, the station officers on 10 January 2011 decided that more swift water technicians were needed. From mid-morning, they tried unsuccessfully to contact the area inspector to authorise additional staff deployments. They left messages to which they received no response.[100] The station officers gave evidence that they received no warning from fire service management about the weather events approaching Toowoomba on 10 January 2011; the first time they became aware of the severity of the events was when they were called to a swift water rescue in Murphys Creek at 1.30 pm.[101] The difficulties they faced when performing swift water rescues without enough technicians have already been described in *Swift water rescue technicians (Level 2)* in section 5.3.1.

A tabularised summary of information of fire communications voice logger tapes provided by the fire service shows that fire communications received information that the Oakey air base was being evacuated due to forecast floods at 11.37 am and records observations of the impending storm cell on the Bureau of Meteorology website at 12.02 pm and 12.47 pm. There is no evidence that any of this information was passed onto station officers.[102]

At 12.50 pm, an additional staff member was called in to the fire communications centre. Auxiliary stations were stood up at Oakey, Pittsworth, Highfields, Millmerran and Inglewood. A Toowoomba swift water technician gave evidence of being contacted by fire communications at approximately 1.45 pm to attend for duty some hours ahead of his scheduled shift and of making efforts to mobilise other technicians.[103] Other than the call to him, there is no evidence of calls being made by fire communications to recall permanent staff to duty.

The fire communications summary indicates that a number of staff, including five additional swift water technicians, contacted fire communications and made themselves available for duty from 2.00 pm onwards. A firefighter who went to Kitchener Street station at about 1.45 pm found three appliances, though no crew.[104] The staff deployment spreadsheet for the south-western region provided by the fire service is of limited use because it does not show times of staff deployment and whether staff were recalled or self-responded. The evidence tends to indicate that management took significant steps to recall auxiliary staff (who are not trained to perform swift water rescue) to duty, but that additional permanent staff and swift water technicians responded on their own initiative.

Conclusion

The persuasive and consistent evidence of firefighters in the south-eastern and south-western regions was that the fire service management did not act in a timely manner to prepare permanent fire stations for the events of 10 January 2011 by passing on warnings about the approaching weather events and recalling additional staff to duty. This evidence suggests that the fire service management response was, in general, by way of reaction to events and that the successes of 10 January 2011 were largely attributable to the responses of operational staff to the unfolding emergency.

The Commission explicitly sought information from the fire service to respond to the allegations that it did not respond adequately to the events of 10 January 2011. The Commission also provided the fire service with draft findings on this point, indicating that it was not able to come to a conclusive view about the allegations without this information. The fire service has provided the Commission with some evidence in response to the allegations.

Unfortunately, whether through unwillingness or inability, it has not provided sufficient detail for the Commission to reach clear factual findings on the allegations, for the purposes of this report.

In particular, the Commission has not been provided with sufficient information to answer the following questions:

- whether management staff of the Queensland Fire and Rescue Service responded promptly to station officer requests for more staff on 10 January 2011
- whether management staff of the Queensland Fire and Rescue Service took all reasonable steps to recall staff to ensure operational preparedness for the events of 10 January 2011
- whether management staff of the Queensland Fire and Rescue Service communicated weather forecasts and warnings to station officers in order to give stations some forewarning of what local conditions were likely to be and ensure that stations were as prepared as possible for the events of 10 January 2011.

This is an interim report. The Commission is prepared to review this issue if the fire service provides evidence which allows the Commission to answer these questions.

5.3.3 Helicopter training for swift water technicians

During the 2010/2011 floods, swift water technicians were using helicopters to perform rescues and evacuations (for example, evacuations from Forest Hill using an Australian Defence Force helicopter and an emergency services helicopter)[105] without having any training in the safe performance of rescues from helicopters. One of those technicians identified a need to train swift water technicians in basic helicopter procedures, including how to use winches and how to manoeuvre in and out of the aircraft.[106]

The fire service provided a draft memorandum of understanding with Emergency Management Queensland for joint helicopter operations.[107] The memorandum envisages the development of a training program that would be compulsory for all staff from the two agencies who may be involved in joint operations. Emergency management staff will receive training about land and water-based swift water rescue operations, safety issues for swift water rescue technicians and the equipment used for rescues. Fire service staff will receive training to become familiar with the various types of aircraft used for joint operations and to understand winching and emergency procedures. The memorandum provides a basic framework for co-operation. The details of training and operational procedures will need to be formulated separately.

Recommendations

5.17 The memorandum of understanding between the Queensland Fire and Rescue Service and Emergency Management Queensland should be finalised.

5.18 The joint helicopter operations training program contemplated by the memorandum should be devised and provided to all relevant staff of the Queensland Fire and Rescue Service and Emergency Management Queensland.

5.3.4 Equipment for swift water rescue

Radio equipment

A number of firefighters gave evidence of the difficulties they faced operating during the floods without waterproof radios. They explained that the water resistant radios available to firefighters do not work in the rain and can fail completely if dropped in water.[108] As most of the work during the floods involved working in rain or floodwaters, it was impractical for firefighters to carry their radios on their persons. Instead they could use them only from sheltered positions, usually inside the fire truck from which they were working.[109] Many crews did not have additional helpers who could stay inside the truck and operate the radio while others were performing rescues. Consequently, these crews were working on 10 January 2011 without reliable radio communication.[110] It was also stated that the radios currently used hinder operations, because they are difficult to hear and to keep secure when firefighters are moving around.[111] It was suggested that even if those radios had waterproof covers, they would still be hard to use; waterproof radios were the preferred solution.[112]

Firefighters during floods at Helidon, 10 January 2011 (photo courtesy Martin Thomas)

The state manager for technical rescue responded by saying that most regions had purchased waterproof covers for the radios.[113] None had been obtained for Toowoomba as at 10 January 2011, but they have subsequently been purchased.[114] A research and development project is currently under way in preparation for the next wet season, testing waterproof radios linked to in-helmet headsets to allow swift water technicians hands-free communication.[115]

A particularly serious example of the dangers of operating in swift water environments without appropriate radio equipment occurred in Toowoomba on 10 January 2011. A Level 1 trained firefighter was assisting a Level 2 technician in a rescue in fast-flowing water when the latter was swept away with the two people he was attempting to retrieve. As they were performing the rescue without any land-based helpers, and had no waterproof radio that they could take into the water, the firefighter still on his feet had to wade back to the fire truck to make a 'code red' call (which signals that a firefighter is in immediate danger) over the radio. This process took about 90 seconds.[116] Another team was performing a rescue in water 50 metres away, but they similarly did not have radios usable in water and did not receive the 'code red' call.[117] In the event, the technician was able to rescue himself from the water and the people he was trying to rescue were intercepted further downstream.

A swift water technician working in the south-eastern region, where waterproof bags had been purchased, said that there were only a limited number of bags available. Consequently, he and his partner had no means of radio communication when they entered floodwaters to perform a rescue in the Ipswich area because the available bags had been deployed with another swift water team to Gatton.[118] He made the further point that when swift water teams are deployed to regions other than their own, they are given a communications pack containing one radio to be shared between four technicians, rather than the usual allocation of one radio per firefighter. Logically, firefighters performing rescues on deployment need the same equipment to ensure safe operation as they do when working from their home stations.[119]

Recommendations

5.19 The Queensland Fire and Rescue Service should purchase waterproof radio equipment that:

- is appropriate for swift water and normal fire fighting environments
- will attach securely to firefighters in a way that does not hamper their operations.

5.20 The Queensland Fire and Rescue Service should work towards providing hands-free means of communications to swift water technicians for in-water operations.

5.21 The Queensland Fire and Rescue Service should ensure that rescue technicians on deployment are provided with individual radios, rather than sharing a communications pack.

Personal floatation devices

Spare personal floatation devices are carried on specialty rescue appliances but not on urban pump trucks. Urban pump trucks, which are sent to assist at swift water incidents, carry between two and four personal floatation devices. Consequently, there may not be enough floatation devices for each of the four firefighters crewing the vehicle and there will only be spare floatation devices for people to be rescued once a specialty rescue appliance reaches the incident.[120]

The state manager for technical rescue gave evidence that personal floatation devices suitable for children or infants had been purchased by most regions and are now carried on some, but not all, specialty rescue appliances. He agreed that it would be desirable to have child-sized devices on all rescue appliances.[121]

There are differences between the personal floatation devices provided to Level 1 and Level 2 trained firefighters. Only Level 2 floatation devices can release from an attached rope. This is important if a firefighter is in the water and the rope gets caught in a way that puts the firefighter in danger. Although only Level 2 technicians are trained to enter the water, if a firefighter enters or falls into the water wearing a Level 1 floatation device, he or she will be unable to release the device in the event of danger.[122]

Recommendations

5.22 Permanent urban appliances should carry at least five personal floatation devices to ensure there is a floatation device for each firefighter and a spare for rescues.

5.23 Every rescue appliance should carry personal floatation devices suitably sized for children or infants.

5.24 The Queensland Fire and Rescue Service should consider upgrading all personal floatation devices to a type which allows the firefighter to release himself or herself from an attached rope in the event of getting caught, or in other life threatening situations.

Inflatable work platforms

The fire service has a number of special boats used for swift water rescue, called inflatable work platforms. Work platforms, often used with rope systems, can remove the need for technicians to enter the water, thus reducing the risk to them and to the people they are rescuing.[123] The rescue co-ordinator for the south-eastern region gave evidence that these work platforms are inadequate for some rescues because they are unmotorised and must be powered by paddle.[124] When technicians need a powered watercraft, the only option is to use SES flood boats. These boats are not suitable for swift water; they are very heavy and sit low in the water, are susceptible to being taken by the current, and use unguarded propellers which are dangerous to technicians in the water.[125] One swift water technician gave evidence of having previously used the Coast Guard's motorised platforms with guarded propellers and said they were very successful.[126]

The state manager for technical rescue advised that the fire service is currently investigating the possibility of using motorised inflatable work platforms with guarded propellers for swift water rescue.[127]

Recommendation

5.25 The Queensland Fire and Rescue Service should investigate the feasibility of acquiring motorised inflatable work platforms with guarded propellers to improve the safety of swift water rescue.

Vehicles

Firefighters from the south-eastern region and the regional rescue co-ordinator raised concerns about the command rescue vehicles that are used for swift water rescue.[128] These vehicles are typically two wheel drives that are low to the ground and not suitable for traversing country roads, dirt tracks or floodwaters. During the floods, many vehicles became stranded or were unable to cross floodwaters to reach incidents. The region does not have many four wheel drive vehicles with high clearance. The light and medium attack four wheel drive vehicles used by the rural fire brigade are too light for use in floodwater and in any case are not readily available for use by urban-based firefighters.[129]

Recommendation

5.26 Queensland Fire and Rescue Service should review whether it has enough vehicles capable of traversing floodwaters.

Stores of equipment

Each region keeps additional swift water rescue equipment at strategic locations for deployment during larger scale events.[130] An additional cache of technical rescue equipment for the south-eastern region, including swift water rescue equipment, was established at Beenleigh in November 2010.[131]

In the past, additional swift water equipment has been stored at Ipswich, but according to an Ipswich station officer, it was relocated to another store in the south-eastern region in October/November 2010.[132] Ipswich station officers were not aware where the equipment was relocated to or how to obtain it. They were also not aware of the additional equipment located at Beenleigh.[133] One of those station officers also raised the difficulty of firefighters in Ipswich obtaining equipment stored on the Gold Coast, especially if the entire region is in response mode as occurred during the 2010/2011 floods.[134]

Recommendations

5.27 The Queensland Fire and Rescue Service should ensure all station officers are informed about the locations and availability of additional equipment and how to obtain it.

5.28 The Queensland Fire and Rescue Service should ensure that staff in Ipswich can rapidly obtain additional swift water rescue equipment in the case of an emergency.

5.3.5 Communications

Firefighters use two radio networks for communications, the official UHF fire communications network and a localised VHF network for communicating between trucks and stations. Normal communications occur through the fire communications network, are voice logged and can be heard by all fire service members tuned into the network. Due to overloading on the fire communications network during the floods, however, firefighters responding to incidents used the localised channels to communicate with each other and their incident control centre, and only used the fire communications network to log in and out of incidents. As the localised networks are not monitored by the fire communications centre, this resulted in a loss of information to the fire communications centre and meant that data was not captured unless handwritten notes were made at incident control centres. It was an inefficient system as firefighters needed to transmit twice, through the fire communications network and the localised network. In addition, firefighters working in a region other than their own did not know which frequency to use for the localised network.

A station officer suggested that a solution to the problem was to isolate repeaters in areas responding to a large scale disaster, which, he said, was within the fire service's capacity.[135] Isolating repeaters would limit the communication of messages to other fire service members in that area and would enable a designated communications officer to handle all the calls for that area and gain a better sense of what was occurring there. Firefighters could then communicate on the fire communications network at all times and would automatically be switched to a different isolated repeater if they moved into another area, without needing to tune into a different radio frequency. Senior officers monitoring multiple areas could tune into multiple channels and make themselves familiar with the circumstances in each area. The localised network could still be used for less critical matters such as logistics. No evidence was put before the Commission to suggest that this solution would not work.[136]

Recommendation

5.29 The Queensland Fire and Rescue Service should consider isolating repeaters during a large scale emergency response. If this solution is found to be feasible, it should be implemented as protocol as soon as possible. If it is not, the Queensland Fire and Rescue Service should explore other solutions to the issue of the fire communications network being overloaded and firefighters resorting to localised networks during large scale emergency response situations.

5.3.6 The role of the rural fire brigade in responding to disasters other than fire

The Grantham rural fire service and the 2010/2011 floods

The Grantham rural fire brigade is made up of volunteer firefighters who are members of the Queensland Rural Fire Service. They undertake training in accordance with the 'Volunteer Learning and Development Framework'[137] offered by the service, engage primarily in rural firefighting and also assist in educating the community about fire and related hazards. The town of Grantham has a station and resources including two rural fire brigade trucks, but its rural fire brigade members receive instruction, guidance and command from the area office at Ipswich.

Between Boxing Day, 26 December 2010, and 10 January 2011, Grantham experienced a number of floods that rose and receded, affecting roadways and houses throughout the town.[138] (For more detailed information about flooding affecting Grantham, see Chapter 7.) In this period, the Grantham rural fire brigade drove fire brigade vehicles through floodwaters to assist members of the Grantham community in sandbagging their homes.[139] The fire brigade members performed the task because the SES, Lockyer Valley Regional Council and Queensland Police Service were unavailable.[140] Members of the brigade also obtained barriers from the Lockyer Valley Regional Council which they erected to prevent vehicles from entering floodwaters on the roads.[141]

On 10 January 2011 the acting area director for rural operations, Queensland Fire and Rescue contacted the officer in charge of the brigade to discuss the driving of fire trucks through floodwaters. There is some divergence in the evidence as to whether the call was made in consequence of video footage of a Grantham fire truck driving through water having been aired on the nightly news on 8 January 2011, or whether it was a response to an incident in which a fire truck became stranded in floodwaters on 9 January 2011. For present purposes, the difference is immaterial. More significant is the content of the conversation. The acting area director described it in general terms as being about safety and in particular the risks of driving appliances through floodwaters.[142] The brigade officer said that she was directly instructed that brigade vehicles were not to be driven through floodwaters and were only for fighting fires; that the rural fire brigade was to react only if activated by the SES and was not otherwise to respond; and that community calls for assistance were to be referred to the SES.[143]

Soon after the conversation, the acting area director issued a direction to all brigade training and support officers to contact their respective rural fire brigades to discuss: the importance of directing the public to appropriate response agencies (the SES for non-urgent flood problems, and the triple zero call number for emergencies); the need for brigades to log all their activities with the fire communications system; and the dangers of driving appliances through floodwaters.[144] Notwithstanding the intention evident in that direction to dissuade rural fire brigade members from intervention in crises caused by flooding, counsel representing the State of Queensland put to the brigade officer in cross-examination (and she accepted) that nothing stopped her, as a rural fire brigade member, from responding in an emergency.[145]

There remains obvious uncertainty as to what is expected of rural fire brigade volunteers in responding to disasters other than fire.

The Grantham rural firefighters were responding to flood events in their community where people were reporting they could not contact SES and were asking them directly for assistance. There was no other service available to assist.

In submissions provided by the State of Queensland, the Queensland Fire and Rescue Service is said to 'deliberately operate under an "All Hazards" approach whereby preparation and planning is conducted for all foreseeable

hazards'.[146] In a town such as Grantham, historically prone to flooding (although not on the scale of the disaster experienced on 10 January 2011), there appeared to be little regional preparation and planning for how the rural fire service would respond to the 2010/2011 floods and nothing was done to equip its members with relevant skills.

Grantham Rural Fire Brigade, 6 January 2011 (photo courtesy Geoff Purton)

Recommendations

5.30 The Queensland Fire and Rescue Service needs to define clearly what its protocol is for volunteer firefighters in disaster scenarios other than fire when they are the only or primary rescue service in a community.

5.31 The Queensland Fire and Rescue Service should clarify in practical terms the role of firefighters in sandbagging, the provision of road blocks and similar activities.

5.3.7 State Emergency Service

In Queensland, the SES is the primary response agency for storm and flood emergencies. It also provides support to other emergency service agencies.[147]

SES volunteers were vital in the response to the 2010/2011 floods. Of course, the SES did not, and could not possibly, respond in every affected area; there were simply not enough SES volunteers to do so. Moreover, the capabilities of SES units vary, depending on their set functions, size, training and equipment. Some shortcomings in training and equipment were identified during the 2010/2011 floods.

Emergency Management Queensland is responsible for training SES volunteers. Every volunteer is given initial basic training on joining the SES; further training then depends on the agreed functions of the SES unit which he or she has joined, and the preferences and capabilities of its members.[148] The content of SES training programs, which is based on national criteria, has not been criticised before the Commission. However, the availability of training opportunities is considered to be an issue in some locations,[149] while the lack, or limited number, of trained volunteers with specialised skills in flood boat operations became evident in places such as Dalby and Goondiwindi.[150] In the case of Goondiwindi, it was suggested that the SES capacity to respond during the flooding there was adequate because flood boat operators could be brought in from Warwick and Inglewood.[151] Moving additional SES personnel and equipment into areas of need was a tactic also used in Theodore and the Somerset

region.[152] Such instances highlight the need for an agile state organisation that can act quickly to support any SES unit whose capabilities are too small for the response required.[153]

The adequacy of SES equipment is a related issue. In Chinchilla, Surat, Jericho and the Somerset region, SES units did not have access to flood boats that were appropriate for the prevailing conditions.[154] Concerns were also expressed in a number of areas about the capacity and reliability of existing flood boat engines, with the suggestion that twin or at least auxiliary engine capacity was desirable.[155]

Some areas did not have any local SES unit. Woodford is an example: once cut off, it remained without SES assistance until the area became accessible again. An SES presence there, with a flood boat, would have been of great benefit to the community.[156]

Having sufficient numbers of properly trained and equipped SES volunteers who can respond in the event of disaster is vital, particularly in rural communities. The Commission acknowledges that some councils have taken steps already, in preparing for the next wet season, to improve membership levels and address the equipment and training issues identified above,[157] while Emergency Management Queensland has begun a volunteer recruitment campaign.

The issues of SES training and equipment raise questions about how Emergency Management Queensland and local government provide funds and resources to the SES. Arrangements around the state appear to be variable and to some degree uncertain. They warrant further examination, as does the issue of the 'command and control' of the SES during disaster events; both will be considered in the Commission's final report.

Recommendations

5.32 Before the next wet season, councils, SES controllers and Emergency Management Queensland should work together to identify and address deficiencies in the ability of the SES to respond effectively to flooding. At the very least, suitable flood boats and flood boat training should be provided to SES units which require them.

5.33 The Queensland Government and councils should take measures, as soon as possible, to attract more SES volunteers, particularly in areas susceptible to flooding which do not have sufficient numbers. New SES units should be established where possible.

5.34 The Commission acknowledges that it may not be possible to recruit and train sufficient numbers of SES volunteers to the extent needed before the next wet season. However, this should not prevent steps being taken as soon as possible to identify the factors impeding the recruitment and retention of SES volunteers, action being taken to address them, and the commencing of recruitment activity.

132 500 number

The 132 500 number is the dedicated telephone service by which members of the public can contact the SES for emergency assistance in non life-threatening situations.

Calls to this service are answered by the Smart Service Queensland call centre, which is operated by the Department of Public Works, except in the case of calls placed in the Brisbane metropolitan area, which are directed to the Brisbane City Council call centre.[158] The Smart Service Queensland call centre answers calls on behalf of more than 200 State Government agencies as well as to the 132 500 service.

It is apparent that callers, at certain times and in certain locations, could not contact the SES during the 2010/2011 floods.[159] It is also apparent that the Smart Service Queensland call centre could not cope with the increased demands made of the 132 500 service at critical periods during the floods.[160]

The Commission understands that the 132 500 service experienced major technical difficulties, following a large increase in the number of calls received by the Smart Service Queensland call centre from the evening of 9 January 2011. The technical problems were not resolved fully until 17 January 2011. In the meantime, Telstra provided a temporary solution enabling callers to contact the call centre again. Once it was in place, calls to the SES number were prioritised and answered before other types of calls.

The Commission notes that the Department of Public Works is proposing to improve Smart Service Queensland's operations in a number of ways. These include establishing a new call centre at Zillmere in Brisbane to provide greater capacity, refining call overflow arrangements and making various technical improvements to the service to cater for increases in the number of calls to it. The Commission endorses these steps.

Recommendation

5.35 Before the next wet season, the Department of Public Works should ensure that Smart Service Queensland can manage a significant increase in calls to the 132 500 number, to at least the level that occurred during the 2010/2011 floods.

5.3.8 Emergency Helicopter Network

The Emergency Helicopter Network consists of a number of helicopters available from Emergency Management Queensland Helicopter Rescue, a private contractor serving the Torres Strait area, and community helicopter providers. As well as the private contractor's base at Horn Island, Emergency Management Queensland Helicopter Rescue has bases at Archerfield, Townsville and Cairns Airports.[161] The community helicopter providers have bases along the Queensland coast:

- CareFlight (Qld) has bases at the Gold Coast and Toowoomba Airports.
- Sunshine Coast Helicopter Rescue Service has bases at the Sunshine Coast and Bundaberg Airports.
- Capricorn Helicopter Rescue Service is based at Rockhampton Airport.
- Central Queensland Helicopter Service is based at Mackay Airport.[162]

These network helicopters can be given tasks by any of the following state and Commonwealth organisations:

- Queensland Health
- Queensland Ambulance Service
- Queensland Police Service
- Queensland Fire and Rescue
- district disaster co-ordination centres
- the state disaster co-ordination centre
- the Australian Maritime Safety Authority.[163]

Helicopters are deployed in accordance with guidelines that were created in 2003. Since this time there has been a number of draft updates to these guidelines; however, none of these versions has been endorsed.[164]

Neither the original guidelines, nor the later draft versions, prescribe a system of 'single point tasking'; that is, a central organisation exercising ultimate command and control of all helicopters in the network, according to availability, task, priority and location. Although the most recent draft guidelines of April 2011 provide for more co-ordinated deployment of helicopters, they fall short of implementing this system.[165]

The network's helicopters are mainly used for medical tasks for Queensland Health and the Queensland Ambulance Service.[166] Any helicopter undertaking these medical tasks is deployed and tracked by the Queensland Emergency Medical System Co-ordination Centre.[167] Helicopters performing non-medical tasks, such as search and rescue, law enforcement and disaster operations are deployed on direct request by the relevant state or Commonwealth organisations.[168] The fact that a number of different agencies have the capacity to seek helicopter deployment has the potential to place pilots in the invidious position of having to consider and prioritise multiple requests for urgent assistance.[169]

That lack of central co-ordination can result in delay and confusion while time is taken to resolve competing agency demands. On 11 January 2011, there was some delay in deploying an Emergency Management Queensland helicopter to the Lockyer Valley as competing priorities had to be determined between the Queensland Police Service requiring a helicopter in the Lockyer Valley and the Queensland Emergency Medical System Co-ordination Centre requiring a helicopter for a hospital transfer from Dalby.[170] In that case the Queensland Police Service and Queensland Emergency Medical System Co-ordination Centre both contacted Emergency Management

Queensland Helicopter Rescue directly, and the pilot then had to be a part of the decision-making process, assessing the respective needs of the two agencies.[171] This example is not an isolated event. The potential for delay and uncertainty inherent in direct agency deployment exists both during defined disaster events and in normal operations.[172]

Helicopter pilots are also, on occasion, placed in the position of having to be involved in assessing priorities during operational tasks. For example, during the 2010/2011 floods, a pilot from Sunshine Coast Helicopter Rescue Service, while being deployed by Queensland Emergency Medical System Co-ordination Centre, heard reports on the Queensland Police Service radio channel of people being trapped by rising floodwaters. Before being permitted to assist with any rescues, the pilot had to convince the Queensland Emergency Medical System Co-ordination Centre operator that his crew should be released from performing medical tasks.[173] The network requires a single point of co-ordination that can quickly assess competing demands within the network and deploy helicopters accordingly.

Had the network been able to provide a more co-ordinated response, it is possible that more helicopters could have been able to respond in the Lockyer Valley on 11 January 2011;[174] although it should be said that poor weather conditions may ultimately have prevented helicopters flying in this region.[175]

Helicopter rescue at Grantham, 10 January 2011 (photo courtesy Geoff Purton)

Recommendations

5.36 As a matter of priority, the Emergency Helicopter Network requires a system of 'single point tasking'; that is, a central organisation exercising command and control of all helicopters in the Emergency Helicopter Network, according to availability, task, priority and location. This is a change, which will require all the government agencies concerned to consider the operational needs, resources, protocols, guidelines and training required for its implementation. Ideally, those steps should be completed and the change made before the next wet season.

5.37 At the very least, by the beginning of the wet season, an interim structure needs to be formally in place under which one organisation is informed of the status, location, capabilities and allocated task of each helicopter in the Emergency Helicopter Network at any given time. The deployment of helicopters should be made through this organisation.

5.4 Emergency calls

5.4.1 Background

Telstra emergency call operators

Members of the public can dial 'triple zero' to obtain assistance from emergency service organisations (fire and ambulance) and police. All triple zero calls go through to a Telstra emergency call operator in one of two national call centres, located in Melbourne and Sydney. The call operator must answer the call by saying *'Emergency - police, fire or ambulance?'* When a call is made from a landline or payphone, Telstra's Enhanced Calling Line Identification Processing System will display the caller's phone number and address on the call operator's screen. Once the caller nominates the desired emergency service, the system automatically provides the call operator with the emergency service centre of that type closest to the caller's town or postcode.

If a call is made from a mobile phone, the telephone number, the mobile service area, and the state from which the call is being made appear on the operator's screen. Having identified the required emergency service, the operator asks the caller for his or her location by saying '*What state and town is the emergency in?'* Once that location is manually entered, the system will again match the location with the requested emergency service organisation which is closest.

The operator will then say *'connecting police' (or 'fire' or 'ambulance')* and connect to the relevant service. All the information held by Telstra is displayed on the screen of the police or emergency service's call operator. Only when the call has been answered by the next operator and the conversation commenced will the Telstra operator exit the call.[176]

The Telstra system stores alternative numbers for emergency services and police in an order provided to Telstra by the relevant organisation ('overflow arrangements'). If a line is busy or remains unanswered, the Telstra operator advises the caller that he or she is trying another number and rings the next number on the list. The operator continues the process until all numbers are exhausted and then recommences at the beginning of the list. The Telstra operator is required to stay on the call and not answer other calls until it is connected.

Where a caller requests 'police' as the relevant service and nominates the Toowoomba area, the operator will attempt connection, until the call is answered, in the following order: to each of two lines at the Toowoomba Queensland Police Service communications centre, to the police service communications centre at Yamanto, Ipswich, and to the police service communications centre at Brisbane. In each case the attempt is made for a maximum period of 45 seconds.[177]

Where a Toowoomba caller answers 'fire', the operator first tries, for 27 seconds, to connect to the Queensland Fire and Rescue Service communications centre at Toowoomba, before attempting a fresh call to the same centre. If the second call remains unanswered for 27 seconds, it is transferred to the fire service communications centre at Brisbane, and if it is not taken there, it will be transferred to the Queensland Police Service communication centre at Brisbane. The police call operator will then take the details of the emergency and assume responsibility for transmitting them to the Toowoomba fire service communications centre.[178]

Queensland Fire and Rescue Service

The Department of Community Safety is responsible for the Queensland Fire and Rescue Service, as well as the Queensland Ambulance Service. The Queensland Fire and Rescue Service has seven communications centres – at Brisbane, Cairns, Townsville, Rockhampton, Maroochydore, Southport and Toowoomba – where fire communications officers answer triple zero calls.

The Department of Community Safety uses the Emergency Services Computer Aided Despatch (ESCAD) system, which enables fire communications officers (and ambulance service officers) across the state to have access to callers' data wherever it is taken and entered. (This becomes important when a major incident causes a communications centre in a particular region to be overwhelmed by triple zero calls, requiring the transfer of calls to other regions.) The system displays available resources on screen, recommends the closest and most appropriate vehicle to be despatched for the type of emergency, and allows real time monitoring of incidents and mapping of vehicles responding to incidents.[179]

All fire communication officers are trained to take emergency calls and despatch assistance. From January 2010, training for fire communication officers became centralised. Officers are required to obtain a Certificate III in Fire Communications Operations which involves a week of familiarisation within their deployment region and five weeks at the School of Fire and Rescue Service Training, Queensland Combined Emergency Service Academy. An annual core skills maintenance program, run centrally, is to be introduced this year; presently maintenance of fire communications officers' skills is left to the regions.

In accordance with Certificate III training, triple zero calls are answered by saying *'Queensland Fire and Rescue, what is the location of your emergency?'* The officer must then seek the following information to ensure appropriate resources are despatched: location, clarification of that location, type of emergency, persons involved and caller details. Having obtained that information, the operator creates an 'incident', or entry, on the computer system, which automatically assigns the emergency a priority, the highest being 1 and the lowest, 5. The system also identifies the most appropriate vehicle for response, according to the type of equipment it carries and how close it is to the emergency.[180]

This information sits on a waiting incident queue, with each call colour coded depending upon priority, until a despatching fire communications officer retrieves the entry and sends the recommended fire truck or other appliance to the incident.[181]

Queensland Police Service

The Queensland Police Service has 22 communications centres across Queensland. They are staffed by emergency call operators who may be police officers or civilians. Numbers vary from region to region. Police officers at the level of sergeant (variously referred to as 'communications co-ordinators' or 'communications room supervisors') oversee all call operator shifts.

The communication centres in Brisbane, Beenleigh, Broadbeach, Townsville and Cairns use a computer system called the Emergency Services Communications and Operational Response Tasking (ESCORT) computer aided despatch system. This system connects the five regions, enabling call operators to view data entered by an operator in another region and to despatch the required assistance to a local emergency.

Communication centres outside these five regions work on 'stand alone' computer systems, which are not compatible with each other or with the ESCORT computer aided despatch system. If, in a region without the benefit of the computer aided despatch system, there is a major incident of such proportions that triple zero calls are transferred to another region, call operators in the second region must manually create records of the calls received. Details are then sent back to the communications centre in the first region by fax, email or phone so that help can be sent. The ESCORT system automatically generates data for more fields requiring completion than a stand alone system, so that the task of a call operator working on the latter type of system is more onerous: there are more fields in which he or she must manually enter information.

The ESCORT system is also incompatible with the ESCAD system which allows both the fire and ambulance services to share information. So, for example, if the fire service needs to provide incident details to the police, it must do so by telephone. The Commission's final report will consider proposals for the extension of the computer aided despatch system across all police regions and the development of a communications system which will allow for sharing of information and despatching of assistance between the Queensland Police Service and the Department of Community Safety.

There is no standardised training across Queensland for Queensland Police Service call operators, whether they be police officers or civilians. In Brisbane, call-takers undergo a minimum of nine weeks of training, followed by one to two weeks of mentoring, in the Brisbane Police Communications Centre Education and Training Unit. Outside Brisbane, call operator training is a regional responsibility. Trainers in the regions are said to use the Brisbane training manual and course content, adapted to regional conditions; but there is no system for monitoring how it is done.

The *Queensland Police Communications Centres Call Taking Standards*[182] prescribe the method by which police call-takers are to answer triple zero calls. The call-taker must say, *'police, emergency',* state his or her rank and surname, (or, in the case of civilian operators, first name) and ask, *'what is the location of your emergency?'* Once the location is ascertained, the call-taker must ask, '*what is your emergency*?' According to the standard operating procedures, the call-taker is then to obtain information as to 'nature of incident, offender status, threats, identifiers, computer checks and external agencies'.

The call taking standards also describe the manner in which call-takers are expected to deal with callers. The caller is to be addressed 'in a respectful manner' and treated 'with fairness, equality and respect'; the call-taker is to 'not sound condescending regardless of [the caller's] race, religion, position, circumstance... language or attitude'.

A triple zero call may be assigned any one of four priority codes. Code 1, the most urgent, applies where danger to human life is imminent; Code 2 involves injury or threat of injury to person or property; Code 3 is for routine matters; and Code 4 is negotiated response (such as suggesting alternative services to the caller).

In the Brisbane communications centre, a call-taker who allocates a priority of 1 or 2 to a call will send the task immediately to a radio operator. The senior officer on duty will receive a copy of the entry to check, but a crew may be assigned immediately to an urgent job.[183]

In contrast, in the Toowoomba communications centre, a call operator wanting to give a call a priority of 1 or 2 must raise his or her hand and attract the attention of the supervising officer to seek approval. The senior officer can then direct the job to a radio operator for immediate despatch of police to the emergency.[184] Precluding a call operator from sending jobs directly to radio operators creates delay when there are large numbers of urgent priority 1 or 2 calls; the senior officer may also be answering calls, or may have a backlog of jobs to review.

5.4.2 Emergency calls in the Toowoomba region on 10 January 2011

Queensland Police Service

The Toowoomba communications centre usually receives, on average, 350 triple zero calls in a week. For a major incident, it would expect to receive 20 or 30 such calls.[185] On 10 January 2011, information provided by Telstra to the Queensland Police Service shows that Telstra operators endeavoured to connect 640 calls to the Toowoomba district communications centre, of which 328 were answered on the first attempt and the balance, in accordance with the overflow arrangements, were directed to Yamanto, Ipswich, which took 201 calls, and Brisbane, which took another 62 calls. The remaining 49 calls were answered in Toowoomba on further attempts at connection there.[186]

According to Telstra's data, 87 triple zero calls were received in the Toowoomba centre between 1.00 pm and 2.00 pm, and another 186 between 2.00 pm and 3.00 pm. Forty-one per cent were answered on the first attempt at connection and 45 per cent were answered on the second to fourth attempt. The remaining 14 per cent of calls were answered between the fifth and seventeenth presentation.[187]

The officer in charge of the Toowoomba communications centre gave different numbers for calls made and taken, based on information retrieved from the Toowoomba computer system. On her account, staff there answered 601 emergency calls in total on 10 January 2011, while another 845 calls were abandoned by the caller.[188] (The differing figures may reflect the inclusion of calls coming in direct to the centre on ordinary landlines, rather than through the dedicated triple zero lines.)

Flash flooding at the intersection of Kitchener and James streets, Toowoomba, 10 January 2011 (photo courtesy Troy Campbell)

Although it had been raining in Toowoomba throughout January 2011, there was no reason to anticipate any unusual demand for emergency services on 10 January 2011. On that morning, there were three call-takers and a communications room supervisor (sergeant) on duty at the Toowoomba centre. The usual practice is for the call operators to take calls and be supervised by the sergeant on duty, but because of the large number of calls received the sergeant was also taking calls. After a change of shift at 1.30 pm, the morning staff remained to assist those coming on duty, and an additional operator was brought in from the Toowoomba police station. In total, eight call-takers were available, after the shift change, to receive calls on the 11 available lines (of which five were dedicated triple zero call lines and six ordinary landlines).[189] The supervising sergeant described the situation as 'out of control'; there were not enough staff or lines to handle the calls.[190]

Queensland Fire and Rescue Service

On 10 January 2011 fire communications officers in the Toowoomba region received 102 triple zero calls,[191] 62 of them between 2.00 pm and 3.00 pm. (In previous years, over the same hour on 10 January 2011, it had received fewer than 10 calls.)[192] Eighty per cent of calls were answered on the first attempt at connection, 2 per cent on the second and 15 per cent on the third. Only two calls had to wait for a fourth or fifth presentation to be answered by a fire communications officer.[193]

Usually the Toowoomba fire communications centre has two consoles operating at which call-takers can receive calls and despatch assistance. There is a spare console that can take calls only; it is usually used for training. At 1.40 pm on 10 January 2011, an additional call operator came into work from leave to answer calls from that console.[194]

5.4.3 Emergency calls made by Ms Donna Rice and her son Jordan Rice

Ms Donna Rice's vehicle became stalled in floodwaters at the intersection of James and Kitchener Street, Toowoomba. Her sons, aged 11 and 13, were passengers in the vehicle. Ms Rice made a triple zero call at 1.49 pm on 10 January 2011.[195] Her call was put through to the Queensland Police Service communications centre at Toowoomba.

Ms Rice's call was answered by a call-taker who was a senior police constable recently deployed to the police communications centre. That deployment was the result of what was described as a 'management decision', prompted by an 'incident' rather than any experience or suitability on his part for the position.[196] The call-taker had undertaken a three day communications room supervisor's course but had no specific call operator training.[197] He had worked previously as a relieving communications room supervisor for different periods totalling four or five months over the preceding three years, and had performed the duties of call-taker for about three weeks leading up to 10 January 2011. His supervisors said that in neither capacity had he given any cause for concern. At the time the call-taker answered Ms Rice's call, he had been on duty for about 40 minutes.

Ms Rice informed the call-taker that her vehicle was 'stuck', with the water 'just about ready to come up the door' and asked him to ring a tow truck for her, something which was impracticable in the circumstances. However, the call-taker wasted time by repeatedly asking Ms Rice why she had driven into floodwater, and failed to ask obvious and relevant questions as to the exact height of the water on the car and whether it was rising; whether there were other people in the vehicle and if so how many; whether they were able to make their way from the vehicle to safety; and whether there were other people in the vicinity who could assist.

The call-taker ended the call by telling Ms Rice that she should not have driven into floodwaters in the first place. The call was allocated a Code 3,[198] which represents a 'routine matter'.

Seven minutes later, Ms Rice's teenage son made another emergency call and this time was put through to an experienced Queensland Fire and Rescue Service emergency call operator who responded properly to the call. At 2.03 pm fire trucks were despatched to help Ms Rice, but they were not able to reach the intersection before she and her elder son were swept away and drowned.

The Commission accepts the evidence of the Queensland Police Service call-taker who dealt with Ms Rice that he believed the call was an unexceptional stalled car complaint, and that he assumed, given his knowledge that flooding at the intersection was usually minor, that the caller was in no danger. That does not excuse his failure to ask the essential questions to ascertain Ms Rice's position and to test the correctness of his assumption that she was in no danger, whether as a matter of compliance with the relevant Queensland Police Service standards or as a matter of ordinary prudence. Nor does it justify his repeated raising of the inessential question of how she came to be in floodwaters.

As already outlined, there is no standardised training for Queensland Police Service call-takers throughout the state. The training provided to call operators in Toowoomba is considerably inferior to that provided in Brisbane. The only training this officer received was a three day communications room supervisor's course devised by the officer in charge of the Toowoomba communications centre. That was neither appropriate nor adequate training for the position of call-taker.

Given the vital role which call-takers perform, their deployment to it should always be based not on administrative convenience, but on whether the person in question has the appropriate skills and training to perform the duties of call-taker.

Recommendation

5.38 Queensland Police Service call-takers across the state should be trained to a uniform standard, consistent with the standard of the training provided by the Brisbane Police Communications Centre.

5.5 Evacuation

During the 2010/2011 floods, people throughout the state evacuated from their homes to friends or family on higher ground, to official evacuation centres established by councils, and to makeshift evacuation centres set up by community groups. Some people made their own decision to evacuate with no direction from authorities, some voluntarily evacuated on the advice of councils, and others were mandatorily evacuated under the authority of the district disaster co-ordinator following a declaration of a disaster situation.[199]

5.5.1 Evacuation plans

Section 58 of the *Disaster Management Act 2003* requires a local disaster management plan to be consistent with disaster management guidelines, which are made under section 63 of the Act. The *Queensland Disaster Management Planning Guidelines for Local Government 2005* nominate evacuation plans among a list of plans which should be prepared in the response phase 'to detail arrangements for functional support'.

In 2009 the O'Sullivan Review recommended that Emergency Management Queensland work with local, district and state disaster management groups to prepare risk-based evacuation plans supported by community education programs.[200]

Following the O'Sullivan Review, Emergency Management Queensland circulated a consultation draft of evacuation guidelines for disaster management groups in October 2010. Gladstone's local disaster co-ordinator suggested that evacuation planning was made more difficult by the release of these draft guidelines immediately before the wet season.[201] The guidelines remain in draft form; their timely finalisation would help councils to refine their own evacuation plans before the next wet season. The general issue of timely finalisation of disaster management plans is further discussed in chapter *3 Disaster frameworks, preparation and planning.*

The draft guidelines recommend that local disaster management groups work with the Queensland Police Service, the Queensland Ambulance Service, the Australian Red Cross, the SES and other agencies with a role in evacuation to develop an evacuation sub-plan identifying:[202]

- the hazards for which evacuation might be required
- the areas that may be affected by those hazards
- whom within those areas would be unable to evacuate without assistance
- when evacuation will be voluntary or mandatory
- evacuation centres and assembly points
- safe evacuation routes
- estimated evacuation timelines
- transport requirements
- traffic management strategy
- level of security to be provided to evacuated areas
- strategy for pets.

The guidelines propose that councils divide their region into evacuation zones. For floods, it is recommended that zones be based on flood inundation levels and marked by colour-coding on evacuation maps to be distributed to disaster management response agencies and to the public.[203]

The draft guidelines recommend that local disaster management groups formulate a separate evacuation centre management sub-plan to allocate roles and responsibilities for opening and staffing centres, registering evacuees, caring for elderly, ill and disabled people, caring for pets, and providing food, bedding, security, and first aid at evacuation centres. Evacuation centre management sub-plans could also address concerns that were raised about security, misconduct and mental health issues at evacuation centres during the 2010/2011 floods.[204]

Some councils, including Balonne and Banana Shire Councils, and Gladstone, Goondiwindi,[205] Lockyer Valley, Moreton Bay, South Burnett, Southern Downs and Western Downs Regional Councils, had not finalised evacuation sub-plans or incorporated informal plans into their disaster management plans before the 2010/ 2011 floods. They now need to review and formalise their evacuation plans. Other councils that did have evacuation sub-

plans are reviewing them to incorporate lessons learned during the 2010/2011 floods. In some instances this is part of a broader review of councils' local disaster management plans (as discussed in section 3.3.1).

The 2010/2011 floods demonstrated that evacuation plans need to be specific and supported by community education, effective warning systems, and disaster management training. By way of illustration, Rockhampton Regional Council's evacuation plan includes flood maps with evacuation zones, details of the location and facilities of evacuation centres, and evacuation routes. It also lists contact details for aged care facilities, disability service providers, and representatives from non-English speaking communities. The plan is supported by a community education program that includes distributing DVDs on disaster preparedness to 10 000 residents. The council had also prepared for the event by undertaking a practical exercise on disaster management for flooding with the local disaster management group, Australian Red Cross and other disaster response agencies. The plan lists the likely impact of flooding at different river gauge heights so that council is able to predict inundation and warn residents likely to be affected. During the 2010/2011 floods the council warned residents by publishing flood inundation maps in newspapers, shopping centres and on its website, and by sending letters to 2000 residents likely to be inundated.

Not all evacuation sub-plans included such practical information. During the 2010/2011 floods, Somerset Regional Council's evacuation sub-plan did not include detailed flood maps, evacuation zones or evacuation routes. It listed aged care facilities but did not include contact details for those facilities. It did give details of the location and resources of 15 evacuation centres, but only two of those centres were among the five which the council actually decided to use in the wet season.[206] Somerset Regional Council's strategy for advising people of the location of these five evacuation centres was that residents should contact emergency service providers, such as the SES, the Queensland police or the fire service.[207]

The Lockyer Valley Regional Council's evacuation sub-plan was a pro forma document into which no substantial detail had been inserted. This is discussed further in chapter 7.4.

The O'Sullivan Review recommended that evacuation plans should have triggers in the form of water level heights. The issue arose during the 2010/2011 floods, when the state disaster co-ordinator requested that the local disaster management group in Goondiwindi formulate a staggered evacuation plan based on triggers in the form of water level heights.[208] Neither the chair of the local disaster management group nor the mayor of the council had considered it necessary to develop such a plan because they did not think the flood would breach Goondiwindi's levee banks.[209] Although they promptly developed a three-stage plan as requested, they emphasised, in giving evidence, that every flood is different; trigger points would need to be decided on a case-by-case basis depending on the event.[210] Ultimately in Goondiwindi the floodwaters did not breach the levee banks. It is certainly true that the circumstances of floods and the indications for evacuation will vary, but evacuation plans should at least identify those river levels at which it is known from experience that evacuation is necessary, while making it clear that the need to evacuate may also arise in other circumstances.

Recommendations

5.39 Emergency Management Queensland should finalise the draft evacuation guidelines for approval by the state disaster management group as soon as possible, addressing the issues identified from the 2010/2011 floods.

5.40 Each council should develop an evacuation sub-plan in accordance with the Emergency Management Queensland guidelines. This includes involving local groups and people in the planning process.

5.41 Councils with existing evacuation sub-plans should review them to ensure they address the issues identified from the 2010/2011 floods.

5.42 Where flooding is governed by a particular watercourse, the evacuation sub-plan should identify triggers in the form of those water level heights at which it is known that preparation for evacuation will be necessary.

5.5.2 Informing the community about evacuation centres

During the 2010/2011 floods, councils took different approaches to publicising the location of evacuation centres. For example:

- Barcaldine Regional Council,[211] Central Highlands Regional Council,[212] Maranoa Regional Council[213] and Mackay Regional Council[214] doorknocked residents to warn them to evacuate and advise them of evacuation centre locations.
- Rockhampton Regional Council sent letters to approximately 2000 residents informing them of the evacuation centre location and opening time.[215]
- Somerset Regional Council's plan was that the SES, the local police and fire service would tell people about the five predetermined evacuation centre locations when asked.[216]
- In the Southern Downs region the SES put up signs at the Warwick town hall displaying the locations of evacuation centres. [217]

For a discussion of the Lockyer Valley Regional Council's approach to publicising the location of evacuation centres, see chapter 7.

Before the 2010/2011 floods, most councils had not publicised the location of evacuation centres. There are differing views on the merits of publicising evacuation centre locations before a disaster.

There is a risk that people may not know where to go if the location is not publicised. This is especially relevant if power or telecommunications fail or if the council cannot or does not publicise the information quickly. Residents,[218] community radio station managers, [219] police officers[220] and fire officers[221] in council regions including Moreton Bay, Ipswich and Somerset, were frustrated at not being able to obtain information about evacuation centre locations before or during the 2010/2011 floods.

However, by not announcing the location of evacuation centres before a disaster, councils retain flexibility to decide on a case-by-case basis which centres are more suitable. Publicising the location of evacuation centres before a disaster may result in people going to a centre that is unsuitable for a particular event.[222] Concerns were raised that people might endanger themselves by crossing floodwaters to reach a designated centre[223] or by sheltering in a centre which was in a place of danger or was not structurally safe.[224] That argument has greater force for larger council regions with many possible evacuation centres, than for smaller councils.[225] Most people in smaller towns and council regions, such as Alpha in Barcaldine Regional Council[226] and Theodore in Banana Shire Council,[227] knew where to go to evacuate even when the council had not publicised evacuation centre locations before the 2010/2011 floods.

However, it would (as the state disaster co-ordinator pointed out in evidence) be feasible for even larger councils to notify the public in advance of potential evacuation centres, provided they also communicated the need to confirm during a disaster event which of those centres were in operation, and ensured that information as to centre activation was effectively disseminated during the event.[228]

Since the 2010/2011 floods, some councils that did not previously provide information on evacuation centre locations have now published that information or decided to publish it before a disaster. Somerset Regional Council plans to list all of its evacuation centres on its website.[229] Similarly, Moreton Bay Regional Council has since published on its website a list of evacuation centres, identifying whether the centre is currently open or closed.[230] Barcaldine Regional Council plans to publish evacuation centre locations on its website, although it expects that the information is already generally known in the community.[231] Central Highlands Regional Council's local disaster co-ordinator recognised that the council's flood booklets for residents should in the future include evacuation centre locations (further information on these booklets is provided at chapter 3.5.1 community education).[232]

Whether or not councils choose to publicise the location of evacuation centres before an event, they must ensure that, during a disaster, information about the location of evacuation centres is accurate, and publicised quickly.[233] Methods of providing information to the community during a disaster are discussed further in *4.1.1 Warnings*.

Recommendations

5.43 It is a matter for councils whether or not they choose to publicise the location of evacuation centres before a disaster but there is a good deal to be said for doing so, particularly in smaller communities where the options are limited. Whether or not councils publicise the location of evacuation centres before a disaster, they should include in their disaster education programs information on evacuation procedures, and how to ascertain evacuation centre locations and safe evacuation routes.

5.44 During floods, councils should as quickly as possible provide people in the relevant areas with advice as to the location of and routes to evacuation centres.

5.45 That advice should be given using as many mechanisms as appropriate, including text message, radio and door knocking.

5.5.3 Official evacuation centres

Councils are responsible for selecting evacuation centres and opening them during a disaster. Councils are also responsible for organising bedding, food and security at the centres.

Emergency Management Queensland's draft guidelines recommend that councils assess proposed evacuation centres on the following criteria:

- the suitability of the location for the particular disaster
- the maximum capacity of the facility based on building codes, proposed length of stay of evacuees and the facilities available
- availability of communications including telephone access, facsimile and battery operated radio
- amenities including toilets and showers
- disability access and amenities
- kitchen facilities including access to clean drinking water and cooking facilities (unless plans cater for externally prepared meals to be provided)
- ventilation
- vehicular access
- suitable housing of pets within close proximity
- alternative power supply
- alternative water supply.

The guidelines recommend that councils include this information, along with contact details of people who have keys to the centre, in their evacuation sub-plan.

Before the 2010/2011 floods, some councils, such as Rockhampton and Goondiwindi Regional Councils, had audited and classified potential evacuation centres according to size, facilities and location.[234] In addition, some councils, such as the Brisbane City Council, worked with the Australian Red Cross to identify appropriate evacuation centre locations.

In some instances, evacuation centres were only available because the floods occurred during the holiday season. Examples included the Theodore evacuation to the mining residences in Moura,[235] evacuations in Emerald to the Agricultural College,[236] and the many evacuation centres operating in schools across the state.[237]

Since the floods, many councils have recognised the need to review their plans for evacuation centres.[238] For example, Ipswich City Council is now reviewing the advantages and disadvantages of its centralised evacuation model as part of a comprehensive review of its evacuation plans before the next wet season. During the flood, the council had used the model, registering evacuees at the Ipswich showgrounds and then transporting some of them to evacuation centres elsewhere. However, the council found that people went directly to their local evacuation centres once the media publicised their locations, either because they could not reach the showgrounds or because they preferred to stay close to home.[239] Ipswich City Council will also consult with the Australian Red Cross in auditing all proposed evacuation centres to ensure the location and facilities are appropriate.

Other councils have recognised that they need to identify more appropriate and better resourced evacuation centres,[240] to ensure the ready availability of necessary resources (such as bedding),[241] or to upgrade facilities at existing centres, as has been done at the Woodford Town Hall.[242]

Recommendations

5.46 Councils should identify a range of evacuation centres as part of their disaster preparation and planning.

5.47 Councils should audit identified evacuation centres to ensure the facilities and location are appropriate, preferably in consultation with the Australian Red Cross and the Department of Communities.

5.48 Councils should be aware of what facilities are available at each evacuation centre, at particular times of the year.

5.5.4 Makeshift evacuation centres

The 2010/2011 floods demonstrated that makeshift evacuation centres were a useful addition to the formal disaster management arrangements.[243] These informal centres arose from a need in the community for accommodation, information and community support. They had to be established quickly, with little or no planning, often by members of the community as a response to isolation. Many communities across the state depended on these centres during the floods.

Disaster management groups worked to re-supply makeshift centres as they became aware of them.[244] However, people operating some of these centres reported difficulty obtaining supplies,[245] including food[246] and bedding.[247] Issues of re-supply in Brisbane's far western suburbs are discussed further in *5.1.2. Locality-based disaster management*.

Some of these difficulties with re-supply may be alleviated in the future if councils work with community groups to make them aware of, and incorporate them into, disaster management arrangements. (This is also discussed in *5.1.2. Locality-based disaster management.*) Many local, district and state disaster management groups have recognised the benefit of incorporating these informal centres into their disaster management planning and response in the future.[248] This would enable councils to assess the suitability of the facilities and the people operating the centres[249] and to plan how to communicate with and re-supply the centres during a disaster.

Councils need to identify where community groups established makeshift evacuation centres during the 2010/2011 floods and where similar centres may be required in the future. Many councils have already begun this process.

Makeshift evacuation centre, Postman's Ridge Pioneers Memorial Hall, photographed after floods (photo courtesy Ruby Jensen)

Ipswich City Council is identifying areas that became isolated during the 2010/2011 floods, such as Karalee, Riverview, Goodna and Redbank, and developing local areas plans for these areas before the next wet season.[250] The council also recognised that residents who need medical assistance in these areas should receive warnings early enough to enable them to leave the area before it becomes isolated.[251] Warnings are discussed further in section 4.5.

Moreton Bay Regional Council is formalising the makeshift arrangements that developed in Woodford during the 2010/2011 floods and extending that model of community partnership to other areas susceptible to isolation.[252] The council will create local disaster plans for these areas, ensure the areas have appropriate resources and means of communicating during a disaster, and identify and conduct training with community groups.

Brisbane City Council is also developing an 'Isolated Communities Sub-Plan' for communities including those in the Pullenvale Ward. The council will engage with locally elected officials, community groups and the Queensland Police Service to develop the plan.

In other regions, community groups are taking the initiative. For example, in the Somerset Regional Council region a community group at Glamorgan Vale, where there are distinct areas of potential isolation, has encouraged five people to nominate their residences as 'safe havens'; they are not at risk of flood and have generators to guarantee a power supply.[253]

Locality-based disaster management is discussed further in section 5.1.2.

Makeshift evacuation centres established in the Lockyer Valley are discussed in detail in chapter 7.

Recommendations

5.49 Councils should identify areas that are susceptible to isolation, including locations in which community groups established informal evacuation centres during the 2010/2011 floods, with a view to incorporating evacuation centres at those locations into their evacuation sub-plans.

5.50 Councils should identify community groups who may take responsibility for establishing and operating evacuation centres in the future.

5.51 The identified groups and councils should, before the next wet season, establish cooperative arrangements as to how the centres should operate, and to ensure the centres have appropriate facilities.

5.52 Councils should recognise that community groups may establish makeshift evacuation centres during a disaster. When this occurs, councils need to identify and establish communications with the centres as soon as possible.

5.53 Councils should develop plans for the effective and timely re-supply of makeshift centres.

5.5.5 Indemnity insurance for makeshift evacuation centres

People or institutions running makeshift evacuation centres or on whose premises they were established were placed at risk of litigation in the event of injury to those being housed. This raises the question of how makeshift evacuation centres could be indemnified or insured.[254]

The situation of the proprietors of the Murphys Creek tavern is an example. The owner of the tavern received advice from his insurance provider that the tavern would not be covered for public liability while it was being used as a community centre. Although he consulted politicians visiting the tavern and other authorities, no one was able to assist. Subsequently another insurance company agreed to provide the necessary cover.[255] The situation of the Murphys Creek tavern is discussed further in chapter 7.

Recommendation

5.54 The Queensland Government should investigate the possibility of providing indemnity or obtaining insurance for makeshift evacuation centres established in good faith, and in the absence of official alternatives, to meet community needs.

5.5.6 Australian Red Cross involvement in evacuations

The Australian Red Cross plays an integral role in disaster management by managing evacuation centres. During the 2010/2011 floods the Australian Red Cross managed 27 evacuation centres throughout the state, ranging in size from 15 evacuees registered at the St George high school to 2367 registered at the Ipswich showgrounds.

The Australian Red Cross's role in evacuation centres is to:

- co-ordinate the activities of the centres and the other volunteer agencies involved (including Salvation Army, Lifeline and Save the Children)
- establish and enforce centre rules (such as times for meals, briefings, and lights out), register evacuees, and assign accommodation
- co-ordinate with the Queensland police and Queensland Health.

The Australian Red Cross staff and volunteers have undergone criminal history checks and undertaken training in managing evacuation centres.[256]

The Australian Red Cross is represented on, or is a member of, a number of state, district and local government disaster management groups, as well as some disaster management sub-committees. It says that this representation has enabled it, to varying degrees, to contribute to emergency management planning and preparation.[257]

To formalise their respective roles, the Australian Red Cross has memoranda of understanding with some councils, including Brisbane City Council, Burdekin, Murweh and Hinchinbrook Shire Councils, and Sunshine Coast, Central Highlands, Tablelands, Cairns, Moreton Bay and Rockhampton Regional Councils.[258] However, the Australian Red Cross noted that some councils with which it had memoranda of understanding did not always honour obligations in the memoranda, such as providing it with a list of evacuation sites each year.[259] And notwithstanding the existence of memoranda of understanding, in some council regions there was confusion about the role the Australian Red Cross could play in managing evacuation centres.[260]

According to the Australian Red Cross, there were occasions during the 2010/2011 floods when, because of inadequate notice of evacuation centre activations, it was unable to deploy teams to evacuation centres other than by helicopter or charter plane. Those delays caused some anxiety to local authorities who were expecting the Australian Red Cross to manage evacuation centres.[261]

These difficulties did not arise in Brisbane or Rockhampton where the council and the Australian Red Cross had both a memorandum of understanding and a good working relationship.[262] The Rockhampton Regional Council, for example, undertook a training exercise on flood scenarios with the Australian Red Cross and other disaster response agencies. The Executive Director of Australian Red Cross Queensland recommends these exercises as a way to clarify respective roles and responsibilities.[263]

At least ten councils, including Ipswich and Banana, which did not have memoranda of understanding with the Australian Red Cross during the 2010/2011 floods are now seeking to establish them.[264] Such memoranda of understanding should clearly set out the roles and responsibilities of the parties in planning and responding to evacuation requirements in a disaster.

Recommendations

5.55 All councils should consider entering a memorandum of understanding for evacuation centres with the Australian Red Cross which clearly sets out the roles and responsibilities of the parties in planning and responding to evacuation requirements in a disaster.

5.56 Each council with a memorandum of understanding with the Australian Red Cross should consider undertaking practice exercises with the Australian Red Cross to ensure both parties understand their respective roles and responsibilities.

5.57 Local disaster management groups and district disaster management groups of which the Australian Red Cross is not currently a member should include the Australian Red Cross in disaster preparation and planning as well as response, whether as a member or otherwise (see also recommendation 3.1).

5.58 Local and district disaster management groups should notify the Australian Red Cross of their evacuation needs as soon as possible in a disaster.

5.5.7 Registration of evacuees

The Queensland Police Service is responsible for registering evacuees in a disaster, with the assistance of the Australian Red Cross.[265] The Australian Red Cross collects registration information at evacuation centres or by people self-registering through its website or by telephone, and enters it into the National Registration Inquiry System. (The National Registration Inquiry System is an effective centralised registration system managed by the Australian Red Cross on behalf of the Commonwealth Attorney-General's Department; it is currently under review by the Department.)

Inquiries from the public are managed through the State Inquiry Centre located at the Queensland police headquarters in Brisbane.

It is important that evacuees are registered, whether they shelter in an official evacuation centre, a makeshift centre, or with friends or family. Centralised registration of evacuees is important for four reasons:

- to avoid emergency services searching for people unnecessarily
- to avoid evacuees having to register or provide their details to different emergency services multiple times[266]
- to enable friends and family easily to locate people in a disaster[267]
- to enable agencies such as the Department of Communities to target greater assistance to evacuees in the recovery phase.[268]

During the 2010/2011 floods, the Queensland Police Service encouraged people who had voluntarily evacuated as well as those at evacuation centres to register with the National Registration Inquiry System. Councils including the Mackay[269] and Central Highlands[270] regional councils also encouraged people to register. Other local and district disaster management groups identified the importance of registration following the 2010/2011 floods, especially for people who have self-evacuated to family or friends or to a makeshift evacuation centre.[271]

Recommendations

5.59 Disaster response agencies should use the National Registration Inquiry System.

5.60 During a disaster, councils and the Queensland Police Service should encourage individuals to self-register with the National Registration Inquiry System.

5.61 Councils should include information about the National Registration Inquiry System as part of their community education.

5.5.8 Assisted evacuations

People in hospitals and aged care facilities,[272] government-owned housing, schools and childcare centres, caravan parks,[273] isolated settlements[274] and people with a disability may be unable to evacuate without assistance.

People living in facilities

Local authorities need to know the location and requirements of facilities (hospitals and aged care and nursing homes) that may require assisted evacuation in areas susceptible to flooding.[275]

These facilities must have their own evacuation plans. However, it is important that they co-ordinate with councils to ensure their plans are appropriate and that they understand their responsibilities and the role of councils. Working together at a planning stage allows councils to know whether these facilities require any early warnings, and whether additional resources, such as ambulances or helicopters, may be required to evacuate. Planning to evacuate people in these facilities to appropriate accommodation also reduces the burden on evacuation centre staff and resources.[276] The preparation and planning required for assisted evacuations of these facilities will depend on the type and size of facility, whether they are a state-owned or privately-owned facility, and whether they provide a high or low level of care. Preparation and planning may need to involve other agencies including Queensland Health,[277] the Queensland Police Service, the Queensland Ambulance Service, and Emergency Management Queensland.

An example of the planning and preparation necessary for assisted evacuations was demonstrated by the experience of the Kaloma Home for Aged Care in Goondiwindi, which required evacuation during the 2010/2011 floods. However, there was misunderstanding about who was responsible for evacuating and caring for residents.[278] The evacuation from Kaloma had to be undertaken rapidly and its planned accommodation for evacuations was inaccessible due to flooding. There was a considerable delay at the airport before some of the residents could be flown out, and some residents had to be housed in unsuitable accommodation – a hall at Inglewood which was not air-conditioned or fly-screened – which caused understandable distress. Since the floods, the confusion about what each organisation does when residents require evacuation has been resolved. Kaloma has updated its emergency plan to identify trigger events to commence evacuations and nominated suitable and accessible accommodation.[279] It has also participated in council disaster planning[280] and has been reassured that there will be better communication with the local disaster management group during disasters.[281]

People at home

People who have a disability or depend on home-based care may also need assistance to evacuate. Although for most councils it would not be feasible to have a register of every person who required assistance evacuating from their home, all councils must be alert to the special evacuation requirements of these people.[282]

Those requirements begin with ensuring evacuation messages are communicated to people who have a disability or depend on home-based care. Emergency Management Queensland recommends that councils work with service providers such as home-care service agencies and electricity and telecommunications providers (which maintain lists of people whose health needs require continuity of communications and electricity supply) who could disseminate evacuation messages to these people during a disaster.[283]

Privacy considerations may preclude the identifying of, and obtaining of personal details about, people in this category. However, ascertaining the numbers of people involved and the general nature of their needs through service providers would allow councils to anticipate requirements for special transport, access to medical supplies and equipment, or special care during an evacuation. Councils would be in a better position to provide timely warnings, recommend early evacuations, arrange additional resources, and provide special assistance at evacuation centres.

Tourists, temporary residents, the deaf community and non English speaking people

Councils and the State Government also need to consider tourists and temporary residents, who may be unfamiliar with the local environment and may not have access to private vehicles in which to self-evacuate. Tourists, temporary residents, refugees, people who are homeless, non English speaking people, and the deaf community may not have access to information about emergency preparedness, warnings and evacuation.[284]

Examples of providing information to people in these groups during the 2010/2011 floods include the following:

- Southern Downs Regional Council contacted local motels, service stations and the visitor information centre to distribute information to travellers.[285]
- Multicultural Development Australia – a Queensland settlement agency for migrants and refugees – contacted all of its clients to provide regular flood updates and guidance on whether evacuation was necessary. It also worked with leaders in migrant and refugee communities to disseminate information.[286]
- Auslan interpreters were present during the Premier's press conferences.[287]
- The Australian Communications and Media Authority produced, at short notice, a video in Auslan to advise the deaf community that the National Relay Service – a national phone service for the deaf community – was out of action because of floodwaters affecting its Brisbane headquarters.[288]
- The Department of Communities made information available in over twenty 20 languages.[289]

All Hazards Information Management System

Information about facilities housing people who require assistance to evacuate, disability and home-care services, language groups in the community, and tourism providers could be contained on the All Hazards Information Management System currently being developed by the Queensland Government.[290]

Recommendations

5.62 In areas susceptible to flooding, councils should identify facilities housing people who may require assistance to evacuate. Councils should work with the operators of these facilities to ensure they have appropriate evacuation plans and that they are aware of the council's disaster management arrangements.

5.63 Councils should identify the specific evacuation needs of these facilities, such as increased timeframes for withdrawal or transport by ambulance.

5.64 Councils should include the location, contact details, and specific evacuation needs of these facilities in their evacuation sub-plans.

5.65 Councils should identify organisations (for example, Meals on Wheels and Bluecare) that provide services to people in the community who may be unable to evacuate without assistance. Councils should include the contact details of these organisations in their evacuation sub-plans.

5.66 Councils should work with these service providers to identify: the number of people who may require assisted evacuation; the general nature of their needs, including any necessary medical supplies and equipment; warning message formats and dissemination; increased timeframes needed for evacuation; transportation requirements; and shelter requirements. Councils should include this information in their evacuation sub-plans.

5.67 Facilities housing people who may be unable to evacuate without assistance should develop evacuation plans to ensure residents are provided with appropriate transportation, emergency accommodation, trained carers and medical support if necessary. Where possible, residents of those facilities should be relocated to other similar facilities or accommodation other than evacuation centres. These plans should be developed in consultation with councils and relevant agencies such as Queensland Health.

5.68 Facilities housing people who may be unable to evacuate without assistance should prepare disaster recovery plans, particularly for the provision of back up power and emergency supplies, including medical oxygen and common medications, to minimise the need for evacuation where there is no direct threat from natural disaster.

5.69 The Queensland Government and councils should ensure information about emergency preparedness, warnings and evacuation is available in the different languages of ethnic groups in the community and in Auslan.

5.70 As part of their community education strategy, councils should ensure tourists are made aware of evacuation procedures, how to ascertain evacuation centre locations and safe evacuation routes. That may be done through tourism boards, operators and accommodation providers.

5.5.9 Arrangements for animals

During the 2010/2011 floods, some pet owners were reluctant to evacuate if they could not take or make arrangements for the care of their pets.[291] This was made easier where councils had plans for sheltering pets, as for instance in Rockhampton, where the council worked with the RSPCA to shelter pets in a facility alongside the evacuation centre. Similarly the Ipswich City Council had an animal management team who were able to care for pets at the Ipswich showgrounds evacuation centre and the Lockyer Valley Regional Council worked closely with the University of Queensland Veterinary School at Gatton to care for domestic and farm animals.

The draft Emergency Management Queensland evacuation guidelines require local disaster management groups to develop a policy on the management of pets. The draft guidelines encourage local disaster management groups to consider local solutions, such as schemes for fostering pets from high-risk areas with families in low-risk areas. The RSPCA is able to assist local disaster management groups to develop these plans.

Chinchilla residents relocating chickens, 28 December 2010 (photo courtesy Sylvia Nayler)

Recommendations

5.71 Councils, as part of their community education program for disaster preparation, should encourage pet owners to consider what they will do with their pets if they need to evacuate.

5.72 Councils should work with the RSPCA to develop plans about transporting and sheltering pets should they need to be evacuated with their owners.

5.73 Animal shelters, zoos, stables, and similar facilities should develop plans for evacuating or arranging for the care of animals in consultation with their local council. Local disaster co-ordinators should be aware of what plans exist.

5.6 Boundaries

Disaster management, and disaster response in particular, involves the interplay of a number of boundaries:

- local government boundaries
- disaster district boundaries
- police district boundaries
- other emergency services boundaries (such as those of the Queensland Fire and Rescue Service)
- government agency boundaries (such those of Queensland Health and the Department of Community Safety).

These multi-layered boundaries can complicate co-ordination during a disaster response. Some councils and district disaster co-ordinators raised concerns about inconsistent boundaries,[292] particularly the anomalies which result from some local government, police district and disaster district boundaries.

Disaster districts completely encompass one or more local government regions, so that their boundaries correspond with local government borders. But they are also based loosely on police districts, and the senior officer of the police district ordinarily serves as the district disaster co-ordinator. However, police districts and disaster districts can overlap; police districts can be covered by more than one disaster district. Consequently, the boundaries of disaster districts and local governments, on one hand, and police districts, on the other, do not necessarily align.

For example, in the case of the Roma *disaster* district:[293]

- The district officer of the Roma *police* district serves as the disaster co-ordinator for the Roma *disaster* district (and as the chairperson of the Roma district disaster management group).
- The Roma *disaster* district encompasses the regions of the Balonne Shire Council and Maranoa Regional Council.
- The police divisions of Taroom, Wandoan, Dulacca and Miles come within the Roma *police* district, but not the Roma *disaster* district.
- Taroom, located in the Banana Shire, falls within the Gladstone *disaster* district. During the 2010/2011 floods, the Gladstone district co-ordinator managed disaster operations, while the Roma *police* district was responsible for policing matters.
- Condamine, in the Miles police division, lies within the Western Downs region and Dalby disaster district. It therefore came under the responsibility of the Dalby district co-ordinator during the floods, but the Roma *police* district continued to manage policing.

There is a risk that a lack of conformity between disaster and police district boundaries could cause confusion and inefficiency in managing disaster response operations, on the one hand, and core policing activities on the other.

The Ipswich *disaster* district, which consists of the regions of Somerset Regional Council and Ipswich City Council, provides another example:[294]

- The Ipswich *police* district includes communities which fall within the Brisbane *disaster* district (Karana Downs, within the jurisdiction of Brisbane City Council) and the Logan *disaster* district (Boonah, Kalbar and Harrisville, in the Scenic Rim council region).
- The towns of Moore and Kilcoy, in the Somerset region, come within the Ipswich *disaster* district, but belong in the Caboolture *police* district. The latter also covers areas of Moreton Bay Regional Council, in the Redcliffe *disaster* district. (Before council amalgamations, Kilcoy had its own shire council which was part of the Redcliffe *disaster* district.)

The district co-ordinators of these disaster districts have arrangements for co-ordinating disaster responses in these locations where disaster districts and police districts overlap. The practical difficulties which can occur, and the means by which they are presently managed, were demonstrated during the 2010/2011 floods, in the case of Kilcoy. Kilcoy police sent requests for assistance to the Moreton Bay local disaster management group, which informed them to direct their requests to the Somerset local group. It was not activated, however, or in a position to assist. Following liaison between the Redcliffe and Ipswich district co-ordinators, the Redcliffe district group responded to requests from Kilcoy until the Somerset local group was operating.[295]

The O'Sullivan Review considered the issue of disaster district boundaries.[296] It recognised that changing disaster district boundaries was not a simple task and needed to take into account a range of factors. It also observed that in times of disaster flexibility in disaster district arrangements was necessary to allow an effective response to the 'nature and geographic spread' of a disaster.

Section 28A of the *Disaster Management Act 2003*, inserted in the recent amendments to the legislation, provides this flexibility. It allows for the creation of a temporary district disaster management group when a disaster affects (or is expected to affect) two or more disaster districts. Consideration was given to using this innovation during the 2010/2011 floods, but it was not adopted because many district groups were already operating. Certainly, creating a temporary district to suit the confines of a disaster would overcome difficulties created by anomalous boundaries. However, its utility may be limited in a large-scale disaster affecting most of the state.

While issues which resulted from non-alignment of boundaries of police districts, on the one hand, and disaster districts and local governments, on the other, were able to be managed during the floods,[297] the situation could be improved. However, better alignment is not possible in the short-term, and certainly not before the next wet season. Future re-alignment of police district boundaries should take into account the desirability of conformity between the boundaries of police districts, disaster districts and local government regions.

Figure 5(c)

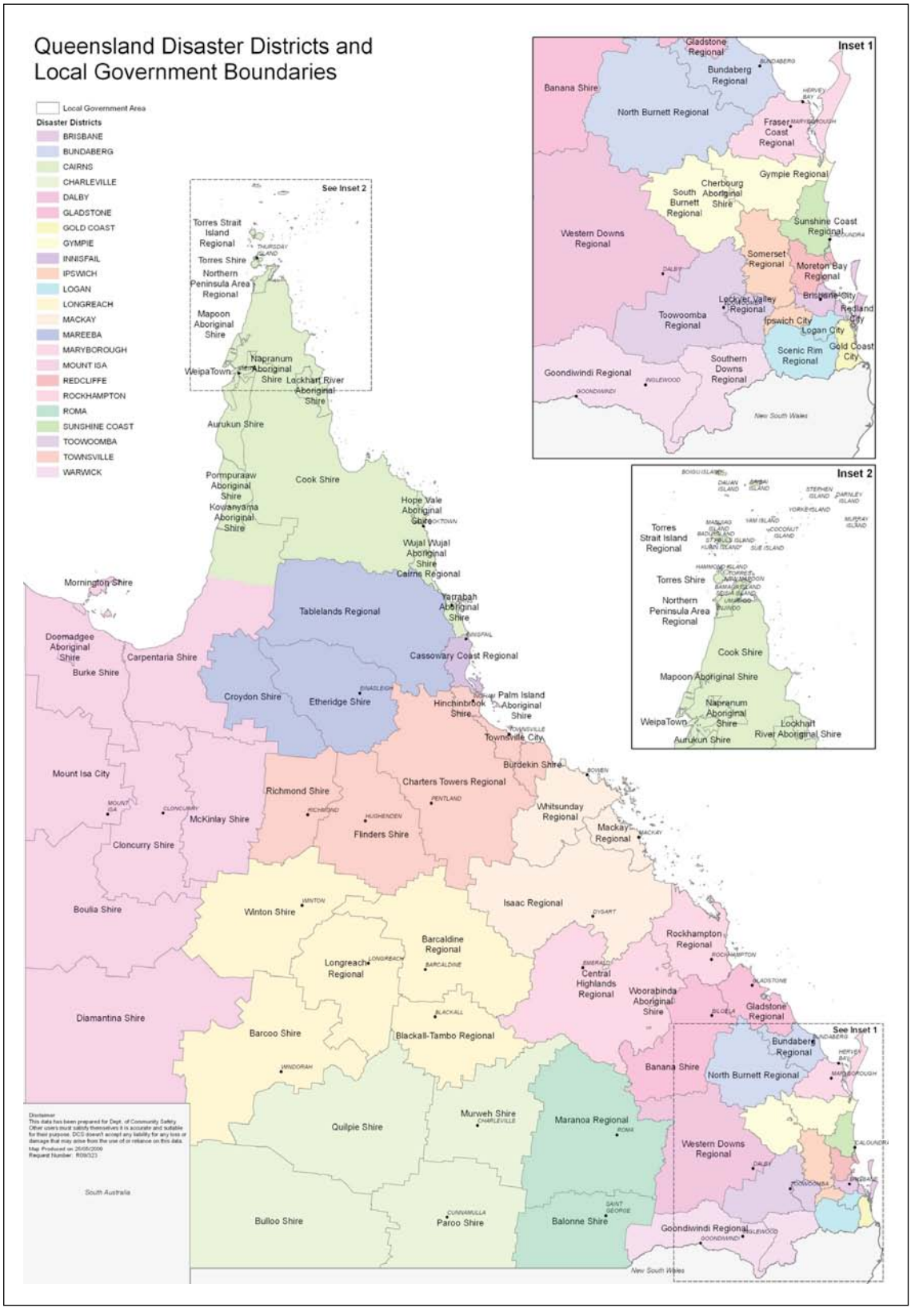
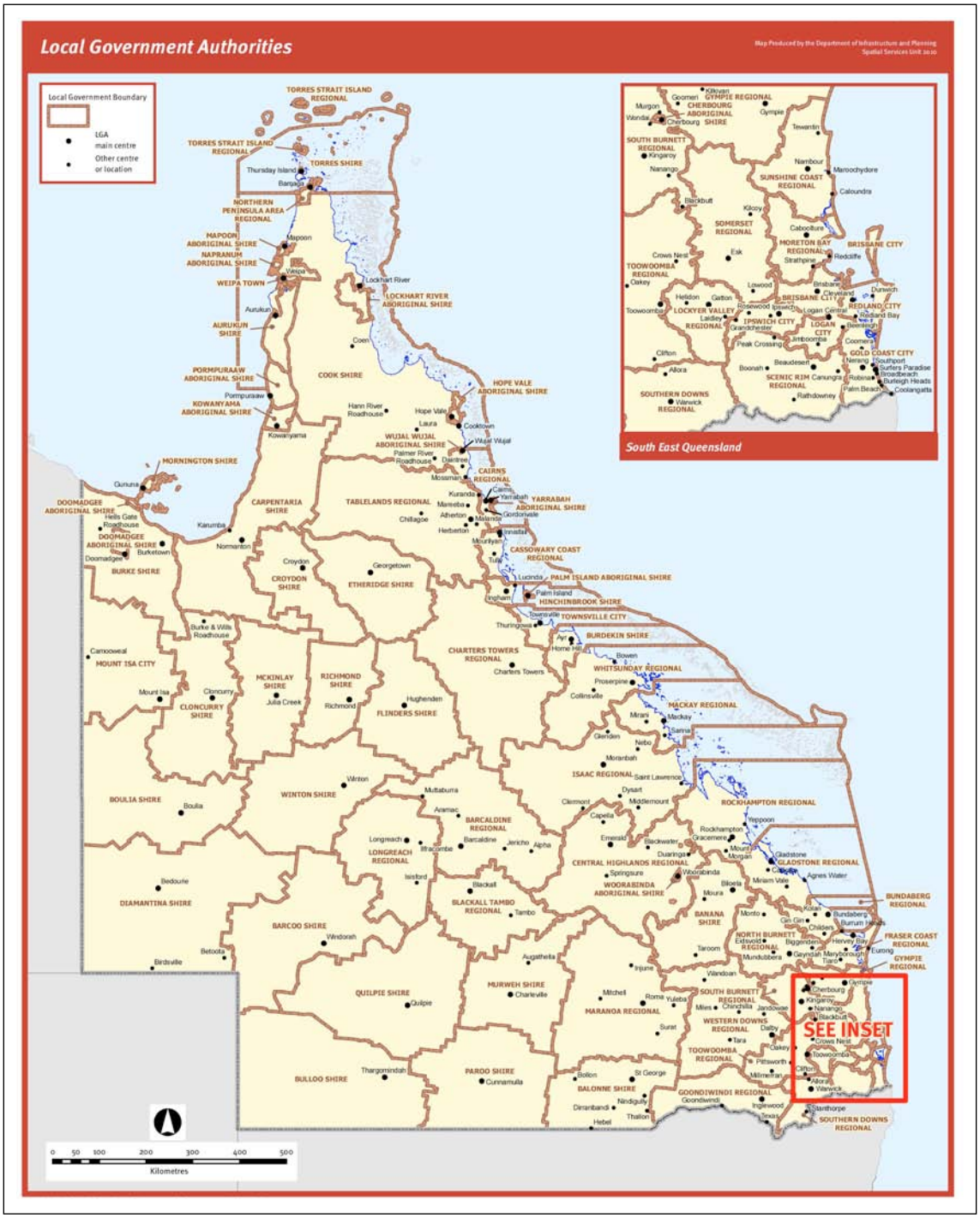

Queensland Disaster Districts and Local Government Boundaries
Local Government Area
Disaster Districts
BRISBANE
BUNDABERG
CAIRNS
CHARLEVILLE
DALBY
GLADSTONE
GOLD COAST
GYMPIE
INNISFAIL
IPSWICH
LOGAN
LONGREACH
MACKAY
MAREEBA
MARYBOROUGH
MOUNT ISA
REDCLIFFE
ROCKHAMPTON
ROMA
SUNSHINE COAST
TOOWOOMBA
TOWNSVILLE
WARWICK
See Inset 2
Torres Strait Island Regional
Torres Shire
Northern Peninsula Area Regional
Mapoon Aboriginal Shire
Napranum Aboriginal Shire
Weipa Town
Lockhart River Aboriginal Shire
Aurukun Shire
Pormpuraaw Aboriginal Shire
Cook Shire
Kowanyama Aboriginal Shire
Hope Vale Aboriginal Shire
Wujal Wujal Aboriginal Shire
Cairns Regional
Mornington Shire
Tablelands Regional
Yarrabah Aboriginal Shire
Doomadgee Aboriginal Shire
Carpentaria Shire
Burke Shire
Cassowary Coast Regional
Croydon Shire
Etheridge Shire
Hinchinbrook Shire
Palm Island Aboriginal Shire
Townsville City
Burdekin Shire
Mount Isa City
Richmond Shire
Charters Towers Regional
Whitsunday Regional
McKinlay Shire
Flinders Shire
Mackay Regional
Cloncurry Shire
Isaac Regional
Boulia Shire
Winton Shire
Barcaldine Regional
Rockhampton Regional
Longreach Regional
Central Highlands Regional
Woorabinda Aboriginal Shire
Gladstone Regional
Diamantina Shire
Barcoo Shire
Blackall-Tambo Regional
Quilpie Shire
Murweh Shire
Maranoa Regional
Bulloo Shire
Paroo Shire
Balonne Shire
Western Downs Regional
Goondiwindi Regional
Inset 1
Gladstone Regional
Bundaberg Regional
Banana Shire
North Burnett Regional
Fraser Coast Regional
Gympie Regional
South Burnett Regional
Cherbourg Aboriginal Shire
Sunshine Coast Regional
Western Downs Regional
Somerset Regional
Moreton Bay Regional
Brisbane City
Lockyer Valley Regional
Toowoomba Regional
Redland City
Ipswich City
Logan City
Scenic Rim Regional
Gold Coast City
Goondiwindi Regional
Southern Downs Regional
New South Wales
Inset 2
Torres Strait Island Regional
Torres Shire
Northern Peninsula Area Regional
Cook Shire
Mapoon Aboriginal Shire
Napranum Aboriginal Shire
Weipa Town
Aurukun Shire
Lockhart River Aboriginal Shire
See Inset 1
Bundaberg Regional
Banana Shire
North Burnett Regional
Western Downs Regional
Goondiwindi Regional
New South Wales
South Australia

Figure 5(d)


Local Government Authorities
Local Government Boundary
LGA main centre
Other centre or location
TORRES STRAIT ISLAND REGIONAL
TORRES SHIRE
NORTHERN PENINSULA AREA REGIONAL
MAPOON ABORIGINAL SHIRE
NAPRANUM ABORIGINAL SHIRE
WEIPA TOWN
AURUKUN SHIRE
LOCKHART RIVER ABORIGINAL SHIRE
COOK SHIRE
PORMPURAAW ABORIGINAL SHIRE
KOWANYAMA ABORIGINAL SHIRE
HOPE VALE ABORIGINAL SHIRE
WUJAL WUJAL ABORIGINAL SHIRE
CAIRNS REGIONAL
YARRABAH ABORIGINAL SHIRE
TABLELANDS REGIONAL
CASSOWARY COAST REGIONAL
PALM ISLAND ABORIGINAL SHIRE
HINCHINBROOK SHIRE
TOWNSVILLE CITY
MORNINGTON SHIRE
DOOMADGEE ABORIGINAL SHIRE
CARPENTARIA SHIRE
BURKE SHIRE
CROYDON SHIRE
ETHERIDGE SHIRE
BURDEKIN SHIRE
CHARTERS TOWERS REGIONAL
WHITSUNDAY REGIONAL
MOUNT ISA CITY
MCKINLAY SHIRE
RICHMOND SHIRE
CLONCURRY SHIRE
FLINDERS SHIRE
MACKAY REGIONAL
ISAAC REGIONAL
ROCKHAMPTON REGIONAL
BOULIA SHIRE
WINTON SHIRE
BARCALDINE REGIONAL
LONGREACH REGIONAL
CENTRAL HIGHLANDS REGIONAL
GLADSTONE REGIONAL
DIAMANTINA SHIRE
BLACKALL TAMBO REGIONAL
WOORABINDA ABORIGINAL SHIRE
BUNDABERG REGIONAL
BANANA SHIRE
FRASER COAST REGIONAL
NORTH BURNETT REGIONAL
GYMPIE REGIONAL
BARCOO SHIRE
QUILPIE SHIRE
MURWEH SHIRE
SOUTH BURNETT REGIONAL
MARANOA REGIONAL
WESTERN DOWNS REGIONAL
TOOWOOMBA REGIONAL
BULLOO SHIRE
PAROO SHIRE
BALONNE SHIRE
GOONDIWINDI REGIONAL
SOUTHERN DOWNS REGIONAL
SEE INSET
South East Queensland
SUNSHINE COAST REGIONAL
SOMERSET REGIONAL
MORETON BAY REGIONAL
BRISBANE CITY
REDLAND CITY
LOCKYER VALLEY REGIONAL
IPSWICH CITY
LOGAN CITY
GOLD COAST CITY
SCENIC RIM REGIONAL
0 50 100 200 300 400 500
Kilometres

Recommendation

5.74 Alignment of police district boundaries, disaster district boundaries and local government boundaries is unlikely to be feasible in the short-term. However, where police district boundaries are being re-assessed for other reasons, conformity between boundaries of police districts, disaster districts and local government regions, should be a major objective.

5.7 Re-supply

5.7.1 Re-supply delays

During the 2010/2011 floods, there were claims from disaster management groups in the Western Downs that the arrangements required by Emergency Management Queensland for re-supply with private aircraft caused delays.

In the Darling Downs town of Tara, there were complaints that food re-supply trips were delayed because Emergency Management Queensland had to approve the use of private aircraft.[298] Emergency Management Queensland disputed the proposition that it had purported to have any role in clearing the use of aircraft.[299] It was evident, at the least, that there had been some failures of communication.

The Roma district disaster co-ordinator took steps before the 2010/2011 floods to prepare for potential re-supply and assistance operations. In March 2010, the Balonne River catchment endured a significant flood. Afterward, the Roma district disaster co-ordinator decided to act before any future disaster and consulted with local helicopter operators about the capacity and operational costs of their aircraft, obtaining valuable information before the 2010/2011 floods.[300] As a result, the re-supply of isolated communities in the Balonne region was carried out more efficiently.

Emergency Management Queensland endorsed this approach, asserting that taking practical steps for re-supply before potential disasters would assist both Emergency Management Queensland and the local disaster management group by providing efficient re-supply.[301]

5.7.2 Re-supply of isolated communities and individuals

Given the size and scale of the 2010/2011 floods, the re-supply of isolated communities and rural landowners was managed well by local disaster management groups.

The Central Highlands local disaster management group successfully adopted and applied Emergency Management Queensland's 'Queensland Re-supply Guidelines' despite their introduction in late November 2010, just before the wet season.[302] The local group was generally effective in the re-supply of isolated residents in its region.[303] As was the case elsewhere, however, some food drops to isolated areas were delayed as increasing areas of Queensland became affected by floodwaters, causing difficulty in obtaining supplies and aircraft.[304] This situation led to individuals having to use their private aircraft to assist isolated residents.[305]

Recommendation

5.75 Before the 2011/2012 wet season, all local and district disaster management groups should formally adopt the Queensland Re-supply Guidelines and have arrangements in place for the prompt re-supply of towns, properties and residents isolated by floodwaters.

5.7.3 Fodder drops

Before the 2010/2011 floods, the Department of Employment, Economic Development and Innovation was assigned the role of co-ordinating fodder drops as part of the National Disaster Relief Arrangements.[306] As the floods worsened on New Year's Day 2011, the Department began to co-ordinate fodder for stranded livestock.

AgForce, a rural agricultural lobby group with a wide range of contacts in rural Queensland, was also included in the co-ordination process.[307] AgForce was able to provide the Department with a wide range of contacts to facilitate

the fodder drop process, identifying farmers needing assistance, producers who could provide fodder and aircraft to deliver the fodder. AgForce was also able to use its large member base to spread information quickly about the fodder drops.

The Department's response, however, was heavily dependent on the energy and commitment of a single individual. It would be prudent for it to have in place for the future a set of procedures to enable the work readily to be carried out by whoever takes the role.

An issue also raised with the Commission was that some farmers were unsure about the arrangements for the payment for fodder drops. (This was because fodder drops were provided free of charge in previous floods.)[308]

Recommendations

5.76 The Department of Employment, Economic Development and Innovation should establish, preferably with the assistance of AgForce, procedures to co-ordinate fodder drops to isolated landowners in future flood events.

5.77 The Department of Employment, Economic Development and Innovation should ensure rural communities are aware of the processes and the payment arrangements for fodder drops.

5.8 Local road maintenance

Floodwaters badly affected the condition of roads across Queensland. In some areas, local roads were impassable. People living on rural properties could not make their way to their nearest town and agricultural producers could not transport supplies or livestock to or from their properties.[309]

The Central Highlands Regional Council has a policy which allows amelioration of these problems by self-help. It permits landowners whose road access has been lost or impaired by flood damage to undertake temporary repairs to public roads where the council is itself unable to carry out the repairs.[310]

The council considers each request on the basis of photographs of the damage and the explanation of the repair needed provided by the landowner via email.[311] Many rural landowners have the equipment to carry out the repairs and reimbursements are made for basic materials and machinery operation costs.[312] The repairs are temporary and the quality of the road surface is later checked by council staff for official restoration.

Recommendation

5.78 Local governments should investigate the feasibility of permitting local landowners to carry out temporary repairs on flood-damaged public roads to allow access to their properties.

5.9 Co-ordination of cross-border emergency responses

In south-west Queensland, there are some arrangements between local authorities on either side of the Queensland and New South Wales border to cater for the needs of residents who live near the border. The arrangements are often made through the Border Regional Organisation of Councils, which includes local councils from both sides of the border.[313] They include, for example, a memorandum of understanding for ambulance services in Goondiwindi to assist nearby residents in New South Wales who require immediate medical attention.[314]

The Goondiwindi and Southern Downs regional councils (both situated on the border) raised concerns about the co-ordination of emergency responses between councils and government agencies in Queensland and New South Wales. Emergency response agencies were at times confused about who was responsible for assisting residents close to the Queensland/New South Wales border.

On 12 January 2011, at the request of Emergency Management Queensland, the Goondiwindi local disaster management group arranged for a rescue helicopter to assist residents stranded by floodwaters on the roof of their home in the Texas area. An hour after arranging the flight, this despatch was cancelled by Emergency Management Queensland on the grounds that the house was on the New South Wales side of the border and the rescue should be

handled by SES members from New South Wales.[315] However, the Goondiwindi local disaster management group was informed the next day that the residents had still not been assisted because of the confusion over the location of the house and which agency was to be responsible for the rescue.[316]

In another instance, residents evacuated from Boggabilla, just over the border in New South Wales, were returned to their houses by their local council. Residents of Boggabilla generally depended on the Goondiwindi hospital for medical attention given its close proximity to the town. However, at the time when the residents were returned, the Goondiwindi hospital had been evacuated and road access between the towns was extremely limited.[317]

Recommendation

5.79 Local governments and the Queensland Government should work with their New South Wales counterparts to set up procedures for co-ordinating emergency responses in the region of the Queensland/New South Wales border.

(Endnotes)

1 Section 4A(c) and (d), *Disaster Management Act 2003 (Qld)*.

2 Section 80, *Disaster Management Act 2003 (Qld)*.

3 Section 30(f), *Disaster Management Act 2003 (Qld)*. Section 15 defines 'disaster operations' as 'activities undertaken before, during or after an event happens to help reduce loss of human life, illness or injury to humans, property loss or damage, or damage to the environment, including, for example, activities to mitigate the adverse effects of the event'.

4 Submission of the State of Queensland, 11 March 2011 [p 5].

5 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1628: line 40].

6 Exhibit 449, Statement of Superintendent Garth Pitman, 9 March 2011 [p3-4].

7 Somerset Local Disaster Management Group Minutes, Debrief Meeting, 6 April 2011 [p2,4,7]

8 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2424: line 1].

9 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1629: line 5]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 21(c)]; Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2423: line 20]; Exhibit 449, Statement of Superintendent Garth Pitman, 9 March 2011 [p11].

10 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1589: line 55; p1608: line 55]; Exhibit 322, Statement of Anthony Jacobs, 9 May 2011 [para 14(a)]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 17(b)].

11 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2429: line 37; p2432: line 54].

12 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1594: line 35]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 7(b)]; Exhibit 322, Statement of Anthony Jacobs, 9 May 2011 [para 8(b)].

13 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1593: line 1]; Exhibit 322, Statement of Anthony Jacobs, 9 May 2011 [para 13(a)].

14 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1594: line 48]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 15(a)]; Exhibit 322, Statement of Anthony Jacobs, 9 May 2011 [para 10(c)-(d)].

15 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1593: line 35]; Exhibit 322, Statement of Anthony Jacobs, 9 May 2011 [para 13(b)-(d)].

16 Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 7(e)].

17 Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [para 21(f)].

18 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1596: line 1]; Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2418: line 40].

19 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1595: line 55].

20 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1626-1627].

21 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1596: line 8].

22 Section 47, *Disaster Management Act 2003 (Qld)*.

23 Transcript, Michael Wallis, 9 May 2011, Brisbane [p1509: line 49]; Transcript, Sergeant Jason Renwick, 9 May 2011, Brisbane [p1504: line 25]; Transcript, Graham Peall, 9 May 2011, Brisbane [p1584: line 1].

24 Transcript, Dr Bruce Flegg, 5 May 2011, Brisbane [p1344: line 15; p1350: line 20; p1351: line 10].

25 Transcript, Graham Barnard, 5 May 2011, Brisbane [p1324: line 55].

26 Transcript, Councillor Margaret de Wit, 5 May 2011, Brisbane [p1331: line 14; p1336: line 47; p1337: line 1].

27 Major General Peter Arnison AV, CVO (Retd), Mr Robert Gotterson QC and Emeritus Professor Colin Apelt, *Independent Review of Brisbane City Council's Response* [p9]; Brisbane City Council Flood Response Review Action Plan [p17].

28 See, for instance, sections 23(k), 30(j) and 80(1)(c), *Disaster Management Act 2003 (Qld)* and *State Disaster Management Plan* [p10: para 2.2.6], available at www.disaster.qld.gov.au/publications

29 See, for example, Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1268: line 45; p1275: line 5]; Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2418: line 25].

30 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2418: line 40]; Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1595: line 40].

31 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2418: line 55; p2419: line 1].

32 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2429: line 40; p2432: line 40].

33 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2432: line 49].

34 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2420: line 20, 50; p2432: line 45; p2422: line 55].

35 Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2420: line 25; p2422: line 1]; Exhibit 449, Statement of Superintendent Garth Pitman, 9 March 2011 [p5].

36 Transcript, Anthony Trace, 20 May 2011, Ipswich [p2376: line 57; p2395: line 9]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p62: para 234]; Exhibit 446, Supplementary statement of Anthony Trace, 19 May 2011 [p82: para 315]; Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2425: line 50 p2426: 40]; Transcript, William Wilkinson, 25 May 2011, Emerald [p2610: line 10]; Exhibit 481, Statement of William Wilkinson, undated [p18]; Exhibit 484, CHRC LDMG Response to DDC debrief – table of issues [p3]; Somerset Local Disaster Management Group Minutes, Debrief Meeting, 6 April 2011 [p18-19].

37 *State Disaster Management Plan* [p10-11: para 2.2.7].

38 Exhibit 459, Statement of Councillor Brad Carter and Gavin Steele, 1 April 2011 [p18]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2674: line 40].

39 Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1269: line 1]; Exhibit 267, Statement of Inspector Mark Stiles, 11 March 2011 [p12-13]; Transcript, Deputy Commission Ian Stewart, 13 May 2011, Brisbane [p2007: line 7]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2682: line 1].

40 Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1269: line 10]; Exhibit 267, Statement of Inspector Mark Stiles, 11 March 2011 [p16].

41 Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1269: line 1].

42 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland*, August 2009 [p52]; see also [p53].

43 *State Disaster Management Plan* [p10: para 2.2.5].

44 *State Disaster Management Plan* [p31: para 8.3.2].

45 Transcript, Anthony Trace, 20 May 2011, Ipswich [p2375: line 35]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p12: para 48-50]; Exhibit 446, Supplementary statement of Anthony Trace, 19 May 2011 [p82-83:

para 314-317]; Exhibit 450, Ipswich District Disaster Management Group, *Report on debrief outcomes for flooding events: December 2010 and January 2011* [p18-19]; Exhibit 458, Rockhampton District Disaster Management Group, *Final Report of Rockhampton DDMG to SDC regarding December 2010 and January 2011 Flood Event* [p22-23]; see also Transcript, Deputy Commissioner Ian Stewart, 13 May 2011, Brisbane [p2007: line 20].

46 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland,* August 2009 [p68-69].

47 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2658: line 20; p2661: line 10].

48 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2674: line 12].

49 Statement of Inspector Mark Stiles, 11 March 2011 [p12, 16] and Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1268: line 20]; Transcript, Collin Head, 23 May 2011, Rockhampton [p2487: line 33]; Submission of Local Government Association of Queensland, 11 March 2011 [p4]; Transcript, Gregory Hoffman,13 May 2011, Brisbane [p1978: line 30]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2659: line 23].

50 Submission of Local Government Association of Queensland, 11 March 2011 [p4]; Transcript, Gregory Hoffman, 13 May 2011, Brisbane [p1978: line 45]; see also: Transcript, Collin Head, 23 May 2011, Rockhampton [p2487: line 44; p2488: line 5].

51 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2659: lines 22-49]; State Disaster Management Group, *Ordinary Meeting Minutes*, 2 March 2011 [p8].

52 Queensland Fire and Rescue Service, Executive Briefing Note – Swift Water Rescue Review Committee, 4 March 2011.

53 Queensland Fire and Rescue Service, *Foundations of the Queensland Fire and Rescue Service,* 2008 [p27]; Queensland Fire and Rescue Service, *Statistics*, 2011, www.fire.qld.gov.au/about/.

54 Queensland Fire and Rescue Service, *Foundations of the Queensland Fire and Rescue Service,* 2008 [p9]; Submission of the State of Queensland (Department of Community Safety), attachment 'DCS-05'.

55 Exhibit 349, Queensland Fire and Rescue Service Incident Directive – Rescue (Technical Rescue) Swiftwater (INCDIR 24.1.5).

56 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p3: para 17].

57 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p3: para 16].

58 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p3: para 15].

59 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p6: para 33].

60 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p6: para 34]; Transcript, Stephen Smith, 12 May 2011, Brisbane [p1844: line 3].

61 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p7: para 36]; Transcript, Stephen Smith, 12 May 2011, Brisbane [p1854-1855].

62 Exhibit 328, Statement of William Dundas, 6 May 2011 [p4: para 13, 15]; Transcript, William Dundas, 10 May 2011, Brisbane [p1634: line 17; p1642: line 19]; Transcript, Ian Bland, 10 May 2011, Brisbane [p1670: line 10]; Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1691: line 57]; Transcript, John Burrows, 12 May 2011, Brisbane [p1896: lines 30-51].

63 Statement of Stewart Lange, 2 June 2011 [p1]; Statement of Scott Beasley, 9 June 2011 [p1]; Regional Performance Review – Swift Water Rescue (draft for the south eastern region) [p5].

64 Transcript, William Dundas, 10 May 2011, Brisbane [p1635: line 54 – p1636: line 40; p1648: lines 10-18].

65 Statement of Anthony Guse, 2 June 2011, [p3].

66 Exhibit 328, Statement of William Stewart Dundas, 6 May 2011 [p6-7: paras 26-27]; Transcript, William Dundas, 10 May 2011, Brisbane [p1636: line 20].

67 Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 5 (Mark Haddow) [p1-5].

68 Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 4 (William Dundas) [p4-5].

69 Statement of Scott Beasley, 9 June 2011 [p1].

70 Exhibit 330, Statement of Geoffrey Dixon, 5 May 2011 [p2: para 3 and p3: para 7].

71 Statement of Scott Beasley, 9 June 2011 [p1].

72 Exhibit 332, Statement of Ian Bland, 9 May 2011 [p6: para 16].

73 Exhibit 332, Statement of Ian Bland, 9 May 2011 [p3: para 7].

74 Exhibit 333, Addendum Statement of Mark Stephenson, 29 April 2011 [p3: para 9, 10].

75 Exhibit 350, Regional Functional Plan 2010/11 South Eastern Region, Operations Management Swift Water Rescue Operational Plan [p10-11].

76 Exhibit 328, Statement of William Dundas [p4: para 13, 15]; Transcript, William Dundas, 10 May 2011, Brisbane [p1634: line 17; p1642: line 19]; Transcript, Ian Bland, 10 May 2011, Brisbane [p1670: line 10]; Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1691: line 57]; Transcript, John Burrows, 12 May 2011, Brisbane [p1896: lines 30-57].

77 Transcript, William Dundas, 10 May 2011, Brisbane [p1642: line 13 – p1643: line 31]; Transcript, John Burrows, 12 May 2011, Brisbane [p1896: lines 30-57].

78 Exhibit 329, Fire Communications Centre Directive – Rescue Water All Types (FCCDQ-3.13), [p1-2].

79 Transcript, William Dundas, 10 May 2011, Brisbane [p1634: line 54 – p1635: line 4].

80 Exhibit 349, QFRS Incident Directive – Swiftwater (INCDIR 24.1.5), [p2: para 4.2(c)].

81 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1839: lines 46-51].

82 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1840: lines 39-43].

83 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p7: para 37].

84 Statement of Scott Beasley, 9 June 2011 [p2: para 4].

85 Transcript, Graham Cooke, 20 April 2011, Dalby [p731: lines 4-54; p734: lines 6-39].

86 Exhibit 330, Statement of Geoffrey Dixon, 5 May 2011 [p4: para 8]; Transcript, Geoffrey Dixon, 10 May 2011, Brisbane [p1659: line 42].

87 Exhibit 328, Statement of William Dundas, 6 May 2011 [p9: para 34].

88 Statement of Scott Beasley, 9 June 2011 [p2: para 4]; Statement of Lange, 2 June 2011 [p1: para 5]; Statement of David Woods, 1 June 2011 [p2: para 7].

89 Statement of Scott Beasley, 9 June 2011 [p2: para 4].

90 Transcript, Graham Cooke, 20 April 2011, Dalby [p734].

91 Transcript, Graham Cooke, 20 April 2011, Dalby [p737].

92 Exhibit 333, Addendum statement of Mark Stephenson, 29 April 2011 [p2-4]; Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1692: line 14].

93 Transcript, John Gresty, 12 May 2011, Brisbane [p1863: lines 31- 39].

94 Exhibit 330, Statement of Geoffrey Dixon, 5 May 2011 [p1: para 3].

95 Transcript, John Gresty, 12 May 2011, Brisbane [p1869: line 10].

96 Exhibit 333, Statement of Mark Stephenson, 3 March 2011 [p7: para 48].

97 Statement of Scott Beasley, 9 June 2011 [p4: para 9].

98 Transcript, Peter Beauchamp, 12 May 2011, Brisbane [p1876: line 4]; Exhibit 208, Statement of David Caughley, 8 April 2011 [p2: para 12].

99 Exhibit 328, Statement of William Dundas, 6 May 2011 [p3].

100 Exhibit 328, Statement of William Dundas, 6 May 2011 [p6]; Statement of Mark Haddow, 2 June 2011 [p1: para 1].

101 Exhibit 328, Statement of William Dundas, 6 May 2011 [p11-12]; Transcript, William Dundas, 10 May 2011, Brisbane [p1637: line 47 - p1638: line 14; p1644: line 53 – p1645: line 12]; Statement of Mark Haddow, 2 June 2011 [p2: para 7].

102 Statement of Mark Haddow, 2 June 2011 [p1: para 2]; Transcript, William Dundas, 10 May 2011, Brisbane [p1637: line 47 – p1638: line 14].

103 Exhibit 210, Statement of David Crighton, 28 January 2011 [p1: para 6].

104 Exhibit 354, Transcript of interview with John Burrows [p87: line 96]; Transcript, John Burrows, 12 May 2011, Brisbane [p1891: lines 33-51].

105 Exhibit 330, Statement of Geoffrey Dixon, 5 May 2011 [p2].

106 Transcript, Geoffrey Dixon, 10 May 2011, Brisbane [p1653: line 52].

107 Memorandum of Understanding between Queensland Fire and Rescue Service and Emergency Management Queensland Helicopter Rescue (draft).

108 Exhibit 354, Transcript of interview with John Burrows [p99: line 37]; Exhibit 328, Statement of William Dundas, 6 May 2011 [p10: 38]; Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 5 (Mark Haddow) [p3].

109 Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 8 (Darryl Williamson) [p2].

110 Transcript, William Dundas, 10 May 2011, Brisbane [p1639: line 50]; Statement of Scott Beasley, 9 June 2011 [p5: para 10].

111 Transcript, William Dundas, 10 May 2011, Brisbane [p1639: line 10].

112 Transcript, William Dundas, 10 May 2011, Brisbane [p1640: line 26].

113 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p5: para 27].

114 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1853: line 35].

115 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1847: line 37].

116 Exhibit 354, Transcript of interview with John Burrows [p99]; Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 2 (John Burrows) [p18].

117 Exhibit 328, Statement of William Dundas, 6 May 2011 [p9-10].

118 Submission of the United Firefighters Union of Australia, Transcript of interview Firefighter 1 (Ian Bland) [p16].

119 Exhibit 332, Statement of Ian Bland [p8: para 20]; Transcript, Ian Bland, 10 May 2011, Brisbane [p1674: line 48].

120 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1848: line 6]; Transcript, William Dundas, 10 May 2011, Brisbane [p1640: line 45].

121 Transcript, Stephen Smith, 12 May 2011, Brisbane [p1848: line 29; p1857: line 38].

122 Statement of David Woods, 1 June 2011 [p2: para 9].

123 Exhibit 348, Statement of Stephen Smith [p5: para 31].

124 Statement of Scott Beasley, 9 June 2011 [p2: para 5; p5: para 10].

125 Transcript, Ian Bland, 10 May 2011, Brisbane [p1675: line 39]; Exhibit 332, Statement of Ian Bland, 9 May 2011 [p7: para 19]; Statement of Scott Beasley, 9 June 2011 [p2: para 5].

126 Transcript, Ian Bland, 10 May 2011, Brisbane [p1676: line 2].

127 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p5: para 32]; Transcript, Stephen Smith, 12 May 2011, Brisbane [p1854: line 1].

128 Statement of Scott Beasley, 9 June 2011 [p6: para 11]; Transcript, Geoff Dixon, 10 May 2011, Brisbane [p1652: line 16; p1666: line p22]; Exhibit 333, Addendum statement of Mark Stephenson, 29 April 2011 [p6: para 29]; Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1695: line 25].

129 Transcript, Geoff Dixon, 10 May 2011, Brisbane [p1664-1666].

130 Exhibit 348, Statement of Stephen Smith, 5 May 2011 [p9: para 51]; Transcript, Stephen Smith, 12 May 2011, Brisbane [p1849: line 14; p1861: line 9].

131 Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1697: line 45].

132 Transcript, Ian Bland, 10 May 2011, Brisbane [p1681: line 41].

133 Transcript, Ian Bland, 10 May 2011, Brisbane [p1681: line 50]; Transcript, Mark Stephenson, 10 May 2011, Brisbane [p1697: line 45].

134 Exhibit 332, Statement of Ian Bland, 9 May 2011 [p7: para 18]; Transcript, Ian Bland, 10 May 2011, Brisbane [p1682: line 2].

135 Exhibit 332, Statement of Ian Bland, 9 May 2011 [p8: para 21]; Transcript, Ian Bland, 10 May 2011, Brisbane [p1672: line 27].

136 Transcript, Peter Beauchamp, 12 May 2011, Brisbane [p1877: line 21].

137 Queensland Rural Fire Service, *Volunteer Learning & Development Framework,* www.ruralfire.qld.gov.au/Volunteering/Training.

138 Exhibit 143, Statement of Stuart Damrow, 8 March 2011 [p2-5].

139 Exhibit 142, Statement of Vivienne Jamieson, 1 February 2011 [p2-6]; Transcript, Vivienne Jamieson, 27 April 2011, Toowoomba [p830: line 55; p831: lines1-15].

140 Transcript, Vivienne Jamieson, 27 April 2011, Toowoomba [p830: line 50].

141 Exhibit 142, Statement of Vivienne Jamieson, 1 February 2011 [p4]; Exhibit 357, Statement of Daniel Maguire, 5 March 2011 [p10].

142 Exhibit 386, Statement of Peta Miller, 4 May 2011 [p2: para 5(e)- 5(l)].

143 Exhibit 142, Statement of Vivienne Jamieson, 1 February 2011 [p6: para 27].

144 Exhibit 386, Statement of Peta Miller, 4 May 2011 [p3: para5(k) (i)-(iii)].

145 Transcript, Vivienne Jamieson, 27 April 2011, Toowoomba [p834: line 20].

146 Submission of the State of Queensland, 11 March 2011, Department of Community Safety [p15].

147 www.emergency.qld.gov.au/ses/join/ses.asp (viewed on 25 May 2011).

148 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2663: line 22].

149 Transcript, Stuart Holley, 11 May 2011, Brisbane [p1719: line 8].

150 Exhibit 122, Statement of Christopher Artiemiew, 7 April 2011 [p7: para 51]; Transcript, William Kearney, 3 May 2011, Goondiwindi [p1170: line 35].

151 Transcript, William Kearney, 3 May 2011, Goondiwindi [p1171: line 1].

152 Transcript, Collin Head, 23 May 2011, Rockhampton [p2484: line10]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1607: line 50].

153 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2671: line 48].

154 Exhibit 123, Statement of Philip Berting, 18 April 2011 [p1: para 6]; Transcript, Philip Berting, 20 April 2011, Dalby [p790: line 51]; Transcript, Raymond Brown, 20 April 2011, Dalby [p799: line 50]; Transcript, Wendy Newman, 4 May 2011, St George [p1246: line 44]; Transcript, Desmond Howard, 24 May 2011, Emerald [p2536: line 51]; Statement of Anthony Jacobs, 5 April 2011 [para 5(d)]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1607: line 41].

155 Transcript, Desmond Howard, 24 May 2011, Emerald [p2536: line 57]; Transcript, Scott Norman, 4 May 2011, St. George [p1291: line 19]; Submission of L. Green [p2].

156 Transcript, Sergeant Jason Renwick, 9 May 2011, Brisbane [p1505: line 15]; Transcript, Michael Wallis, 9 May 2011, Brisbane [p1510: line 30].

157 See, for example: Exhibit 123, Statement of Philip Berting, 18 April 2011 [p1: para 6]; Transcript, William Kearney, 3 May 2011, Goondiwindi [p1171: line 10].

158 Exhibit 493, Statement of Gary Taylor, 24 March 2011 [p2: paras 12-13].

159 See, for example: Exhibit 111, Statement of Sylvia Nayler, 30 March 2011 [p1-2: paras 3-7]; Transcript, Sylvia Nayler, 20 April 2011, Dalby [p706: line 30]; Exhibit 258, Stanthorpe Sub-Group, *Incident Control Centre Debrief*, 17 January 2011 [p5].

160 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2670: line 15]; Transcript, Gregory Hoffman, 13 May 2011, Brisbane [p1988: line 55]; Transcript, William Kearney, 3 May 2011, Goondiwindi [p1171: line 14]; Local Disaster Management Group, Goondiwindi Regional Council, *Debrief Meeting*, 31 January 2011 [p4: para 6(b)].

161 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p3: para 10-11].

162 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p3: para 11].

163 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p4: para 15; p5: para 23; p8: para 33, 36].

164 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p5: para 24].

165 Transcript 26 May 2011, Brisbane [p 2634; line 20]. Exhibit 363, Queensland Emergency Helicopter Network Tasking Guidelines, Draft, effective 2011.

166 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p4: para 16; p5: para 21].

167 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p4: para 16; p5: para 19]. The Queensland Emergency Medical System Co-ordination Centre is also known as the "QCC".

168 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p5: para 23].

169 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p8: para 37].

170 Exhibit 180, Statement of Mark Kempton, 17 February 2011 [p8: para 72]; Transcript 29 April 2011, Toowoomba [p1069: line 50].

171 Exhibit 491, Statement of Dr Mark Elcock, 17 May 2011 [p18: para 77]; Transcript 29 April 2011, Toowoomba [p1069: line 45].

172 Exhibit 491 Statement of Dr Mark Elcock, 17 May 2011 [p17: para 72].

173 Exhibit 387, Statement of Wayne Thompson, 8 April 2011 [pp7-8: para 13-15].

174 Transcript , Dr Mark Elcock, 26 May 2011, Brisbane [p2636: line 25].

175 Transcript, Dr Mark Elcock, 26 May 2011, Brisbane [p2636: line 25].

176 Exhibit 388, Third Submission of Telstra Corporation Limited, 15 April 2011.

177 Exhibit 388, Third Submission of Telstra Corporation Limited, 15 April 2011 [p6: para 25].

178 Exhibit 343, Statement of Glenn Walker, 18 April 2011 [p4: para 15].

179 Exhibit 343, Statement of Glenn Walker, 18 April 2011.

180 Exhibit 345, Statement of Edward Middleton, 18 April 2011.

181 Transcript, Kelli Docherty-Tanaskovic, 11 May 2011, Brisbane [p1782, line 30].

182 Exhibit 346, Statement of Robert William Waugh, 18 April 2011 [Appendix 1, Police Communications Centres Call Taking Standards (Client Service)].

183 Exhibit 346, Statement of Robert Waugh, 18 April 2011 [p14].

184 Transcript, Sergeant Robin Coleman, 19 April 2011, Toowoomba [p639].

185 Exhibit 339, Statement of Senior Sergeant Julie Cooling, 8 April 2011 [p6].

186 Exhibit 347, Statement of Superintendent Grant Pitman, 9 March 2011 [p13, Tab 9 'Number of Triple Zero call presentations – 10 January 2011', Tab 10 'Triple Zero calls received at QPS PCCs state-wide on 10 January 2011 – detailed call analysis', Tab 11 'Triple Zero Calls Presented to Toowoomba PCC and Answering PCC Details – 10 to 12 January 2011', Tab 14 'Triple Zero call answering performance 10 January 2011 – Toowoomba PCC].

187 Exhibit 347, Statement of Superintendent Grant Pitman, 9 March 2011 [Tab 15 'Toowoomba PCC Triple Zero Calls – Presentations Required to answer – 10 January 2011'].

188 Exhibit 339, Statement of Senior Sergeant Julie Cooling [p6]; Transcript, Julie Cooling, 11 May 2011 [p1758: line 45].

189 Exhibit 339, Statement of Senior Sergeant Julie Cooling, 8 April 2011 [p7].

190 Transcript, Sergeant Robin Coleman, 19 April 2011, Toowoomba [p645: p646].

191 Transcript, Glenn Walker, 12 May 2011, Brisbane [p1794].

192 Transcript, Glenn Walker, 12 May 2011, Brisbane [p1794].

193 Transcript, Glenn Walker, 12 May 2011, Brisbane [p1795].

194 Exhibit 341, Statement of Kelli Docherty-Tanaskovic, 18 April 2011 [p3].

195 Exhibit 97, CD containing audio file of the first 000 call made by Donna Rice, and transcript of call; Exhibit 100, Finalised details-Despatch Notice relating to 000 call of Donna Rice.

196 Transcript, Senior Sergeant Julie Cooling, 11 May 2011, Brisbane [p1753: line 20].

197 Transcript, Senior Sergeant Julie Cooling, 11 May 2011, Brisbane [p1756: line 20].

198 Exhibit 100, Finalised details-Despatch Notice relating to 000 call of Donna Rice.

199 Section 77(1)(c), *Disaster Management Act 2003* (Qld). Mandatory evacuation occurred in Theodore and Condamine. See also evidence of Assistant Commissioner Queensland Police Service about voluntary and mandatory evacuation processes at Transcript, Stephan Gollschewski, 27 April 2011, Toowoomba [p822: line 2].

200 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland*, August 2009 [p111].

201 Transcript, Mark Holmes, 11 May 2011, Brisbane [p1710: 54]; Exhibit 334, Statement of Mark Holmes and Mark Larney, 25 March 2011 [p12: para 21]. Note that Mark Holmes states that he received the guidelines on 11 November 2010: [para 21].

202 Emergency Management Queensland, *Queensland Evacuation Guidelines for Disaster Management Groups, Consultation Draft,* October 2010 [p22-31].

203 Emergency Management Queensland, *Queensland Evacuation Guidelines for Disaster Management Groups, Consultation Draft,* October 2010 [p14: para 5.3]. See also Paul Tully recommending evacuation mapping: Transcript, Paul Tully, 20 May 2011, Ipswich [p2362: line 40]. An example of flood zone mapping being undertaken is in Ipswich City Council, which is working on a pilot program based on the Coastal Evacuation Framework to explore the concept of flood zones: Transcript, Anthony Trace, 20 May 2011, Ipswich [p2386: line 1].

204 Exhibit 441, Statement of Colleen Engel, 20 April 2011 [para 17]; Transcript, Colleen Engel, 20 May 2011, Ipswich [p2347: line 1]; Exhibit 459, Statement of Councillor Brad Carter and Gavin Steele, 1 April 2011 [p36]; Transcript, Brad Carter, 23 May 2011, Rockhampton [p2456: line 11]; Transcript, David Peff, 23 May 2011, Rockhampton [p2448: line 20]; Exhibit 481, Statement of William Wilkinson, undated [p17: para 13(g)]; Brisbane City Council, *Flood Response Review Action Plan* [p11]; Transcript, Peter Martin, 6 May 2011, Brisbane [p1469: line 32]; Exhibit 450, Ipswich District Disaster Management Group, 'Report on debrief outcomes for flooding events, Dec 2010 and Jan 2011' [p20]; Submission of Ipswich City Council [p40: para 10.27-10.30]. See also Submission of Save the Children Australia, concerning security and mental health issues in relation to children (for example, screening volunteers, segregating children and families, and providing counselling for children). Transcript, Paul Siljac, 9 May 2011, Brisbane [p1572: line 1]

205 Transcript, William Kearney, 3 May 2011, Goondiwindi [p1160: line 18]; Exhibit 232, Goondiwindi Regional Council Disaster Management Plan [p39].

206 Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [p8: para 13(b)]; Exhibit 324, Somerset Regional Council Local Disaster Management Plan [p268-282 of exhibit].

207 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1590: line 11]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1604: line 7].

208 Transcript, Ian Stewart, 13 May 2011, Brisbane [p1992: line 26]. See also evidence given about the trigger levels in Goondiwindi by the district disaster co-ordinator: Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1136: line 40; p1139: line 20; p1142: line 2].

209 Transcript, William Kearney, 3 May 2011, Goondiwindi [p1168: line 20]; Transcript, Graeme Scheu, 3 May 2011, Goondiwindi [p1197: line 40].

210 Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1167: line 3; p1198: line 5].

211 Exhibit 469, Statement of James Kelly, 24 May 2011 [p7].

212 Exhibit 481, Statement of William Wilkinson, undated [p8], [p16: para 12(c)].

213 Transcript, Wendy Newman, 4 May 2011, St George [p1244: line 54]; Exhibit 264, Statement of Wendy Newman, 19 April 2011 [p3: para 9].

214 Transcript, Stuart Holley, 11 May 2011, Brisbane [p1716: line 1].

215 Exhibit 459, Statement of Brad Carter and Gavin Steele, 1 April 2011 [p11-12 of exhibit].

216 Transcript, Anthony Jacobs, 9 May 2011, Brisbane [p1590: line 11]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1603: line 50; p1604: line 7].

217 Exhibit 259,Warwick Flood Debrief, 6 January 2011 [p2].

218 Transcript, Janet Carpenter, 9 May 2011, Brisbane [p1576: line 15]; Exhibit 319, Statement of Janet Carpenter, 15 April 2011 [p4: para 25]. See also evidence from another council region, Western Downs Regional Council, in Exhibit 111, Statement of Sylvia Nayler, 30 March 2011 [p4: para 12].

219 Transcript, David Greenwood, 20 May 2011, Ipswich [p2358: line 20].

220 Transcript, Senior Constable Darren Rumbelow, 9 May 2011, Brisbane [p1561: line 20]; Transcript, Constable Constable Daniel McCoombs, 9 May 2011, Brisbane [p1547: line 40]; Exhibit 316, Statement of Daniel McCoombs [para 23]; Transcript, Sergeant Jason Renwick, 9 May 2011, Brisbane [p1503: line 26]; Exhibit 308, Statement of Sergeant Jason Renwick, 13 April 2011 [p4: para 11-12].

221 Transcript, Graham Peall, 9 May 2011, Brisbane [p1585: line 15]; Exhibit 320, Statement of Graham Peall, 20 April 2011 [para 22-26].

222 Transcript, Colin Jensen, 5 May 2011, Brisbane [p1394: line 50]; Transcript, Greg Goebel, 6 May 2011, Brisbane [p1492: line 20]; Transcript, Ken Gouldthorp, 19 April 2011, Toowoomba [p589: line 40]; Transcript, Ken Gouldthorp, 19 April 2011, Toowoomba [p608: line 50]; Transcript, Anthony Martini, 9 May 2011, Brisbane [p1528: line 50]; Exhibit 312, Statement of Anthony Martini, 8 May 2011 [p5: para 30].

223 Transcript, Ken Gouldthorp, 19 April 2011, Toowoomba [p590: line 25]. See also Mr Jones' evidence that people could have been endangered travelling to some of the centres identified by the Lockyer Valley Regional Council had they been published: Transcript, Steven Jones, 28 April 2011, Toowoomba [p921: line 45].

224 Transcript, Ken Gouldthorp, 19 April 2011, Toowoomba [p590: line 1]. See also Transcript, Steven Jones, 28 April 2011, Toowoomba [p972: line 28].

225 Transcript, Colin Jensen, 5 May 2011, Brisbane [p1394: line 50]

226 Transcript, James Kelly, 24 May 2011, Emerald [p2526: line 12].

227 Transcript, Collin Head, 23 May 2011, Rockhampton [p2495: line 30].

228 Transcript, Deputy Commissioner Ian Stewart, 13 May 2011, Brisbane [p2002: line 17; p2012: line 1].

229 Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1604: line 35].

230 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1529: line 10]; Exhibit 312, Statement of Anthony Martini, 8 May 2011 [p5: para 31]. Note that Anthony Martini states that the Moreton Bay Regional Council will undertake further discussion about the merits of publishing the evacuation centre locations on the website.

231 Transcript, Desmond Howard, 24 May 2011, Emerald [p2541: line 51].

232 Transcript, William Wilkinson, 25 May 2011, Emerald [p2627: line 28].

233 See for example evidence of Greg Goebel about the importance of communication systems to advise residents and travellers of evacuation centre locations during a disaster: Transcript, Greg Goebel, 6 May 2011, Brisbane [p1491: line 4].

234 Rockhampton Regional Council, *Rockhampton Regional Council Disaster Management Plan, Part XI 'potential evacuation centres';* Exhibit 237, Evacuation Centre – Assessment of Potential Sites Goondiwindi.

235 Exhibit 465, Banana Shire Council - Banana Shire flood debrief, 17 February 2011 [p7].

236 Transcript, William Wilkinson, 25 May 2011, Emerald [p2622: line 53].

237 For example at the Toowoomba Grammar School (Exhibit 212, Statement Kevin Wruck, 16 April 2011 [p6: para 27-28]) and the Redbank Primary School (Exhibit 441, Statement of Colleen Engel, 20 April 2011), among many others.

238 As well as specific examples mentioned, other examples include Goondiwindi Regional Council (see Exhibit 230, GRCLDMG Action Plan - Projects List [p1]. Brisbane City Council is reviewing its evacuation centre planning as set out in its Flood Response Review Action Plan [p11]; Note also that the Queensland Police Service is conductig a review of evacuation issues: see Statement of Ian Stewart 20 May 2011 [p8: para 45].

239 Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p58: para 223(a)]; Transcript, Anthony Trace, 20 May 2011, Ipswich [p2389: line 30]; Transcript, Paul Tully, 20 May 2011, Ipswich [p2365: line 35]. Mr Schafferius stated, similarly, that his experience was that people preferred to evacuate to a place where they could be close to home: Transcript, 27 April 2011, Toowoomba [p856: line 12].

240 For example, Information received from Somerset Regional Council, *Somerset local disaster*

management group debrief meeting minutes, 6 April 2011 [p12].

241 For example, Southern Downs Regional Council identified in its flood debrief a problem with having bedding for evacuation centres on both sides of the river: Exhibit 258, Stanthorpe Sub-Group Incident Control Centre Debrief, 17 January 2011, 'Warwick Flood debrief, 21 January 2011' [p3]. Ipswich City Council is liaising with the State Government Procurement Agency to ensure it has the capability to source essential supplies such as bedding, food and water for evacuation centres: Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p59: para 223(c)(iii)]; also see generally Submission of Ipswich City Council [p43-45: para 10.39-10.43]. Similarly Banana Shire Council identified the difficulty of not having adequate resources in evacuation centre in advance of the disaster: Transcript, Collin Head, 23 May 2011, Rockhampton [p2495: line 32]. See also Mr Pitman's suggestion of having a 'start-up kit' for evacuations to ensure resources such as bedding would be available quickly: Transcript, Superintendent Garth Pitman, 20 May 2011, Ipswich [p2431: line 3].

242 For example, Mr Michael Wallis gave evidence of the limited facilities that had been available at Woodford Town Hall and what has since been done to cater for future floods: Transcript, 9 May 2011, [p1509: line 1]; Exhibit 309, Statement of Michael Wallis [p1]. See also on this topic, Exhibit 240, Statement of Peter Stewart [p5: para 13]; Exhibit 470, Statement of Desmond Howard, 1 April 2011 [p6: para 21].

243 Transcript, Assistant Commissioner Peter Martin, 6 May 2011, Brisbane [p1477: line 10]; Submission of Ipswich City Council [p48: para 10.59]. See also comments of Ian Stewart, at Transcript, 13 May 2011, Brisbane [p2002: line 55]; Transcript, Paul Tully, 20 May 2011, Ipswich [p2365: line 56]. Transcript, Patrick Ryan, 9 May 2011, Brisbane [p1500: line 22].

244 Transcript, Councillor Margaret de Wit, 5 May 2011, Brisbane [p1337: line 1]; Transcript, Assistant Commissioner Peter Martin, 6 May 2011, Brisbane [p1477: line 20]; Exhibit 303, Statement of Assistant Commissioner Peter Martin, 3 May 2011 [p3-4: para 6-8]; Exhibit 289, Third Statement of Colin Jensen, 19 April 2011 [para 1.18]; Transcript, Anthony Trace, 20 May, Ipswich [p2373: line 11; p2413, line 53; p2415: line 42]; Transcript, Anthony Jacobs, 10 May 2011, Brisbane [p1605: line 26].

245 See for example evidence of Graham Barnard, Transcript, 5 May 2011, Brisbane [p1324: line 56]; Exhibit 278, Statement of Graham Barnard, 21 April 2011 [p4: para 20] ; Exhibit 282, Submission of Dr Bruce Flegg, 11 March 2011 [p7-9].

246 For example: Transcript, Colleen Engel, 20 May, Ipswich [p2347: line 41]; Transcript, Councillor Margaret de Wit, 5 May 2011, Brisbane [p1331, line 13]; Transcript, Dr Bruce Flegg, 5 May 2011, Brisbane [p1342: line 21]. Graham Peall gave evidence of difficulty obtaining food delivery in Wivenhoe Pocket that resulted in the community sourcing a private helicopter to do a food drop: Transcript, Graham Peall, 9 May 2011, Brisbane [p1584: line 17].

247 For example, Sergeant Renwick in Woodford gave evidence that he was unable to obtain mattresses when he requested them from the local disaster management group. Michael Wallis was able to obtain them from the correctional facility, with delivery facilitated by the council: Transcript, Jason Renwick, 9 May 2011, [p1504: line 20]; Transcript, Michael Wallis, 9 May 2011, Brisbane [p1509: line 50].

248 Exhibit 450, Ipswich district disaster management group, Report on debrief outcomes for flooding events: December 2010 and January 2011 [p21: para 11(3)]; Submission of Ipswich City Council [p48:para 10.59-10.64]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2678: line 28].See also Transcript, Paul Tully, 20 May 2011, Ipswich [p2365: line 53]. See also: Transcript, Jason Renwick, 9 May 2011, Brisbane [p1505: line 10]; Transcript, Dr Bruce Flegg, 5 May 2011, Brisbane [p1348: line 17].

249 Transcript, Assistant Commissioner Peter Martin, 6 May 2011, Brisbane [p1469: line 25; p1471: line 6].

250 Transcript, Anthony Trace, 20 May 2011, Ipswich [p2370: line 56; p2388: line 28]. Submission of Ipswich City Council [p48: para 10.61].

251 Submission of Ipswich City Council [p39-40: para 10.26].

252 Transcript, Anthony Martini, 9 May 2011, Brisbane [p1530: line 38].

253 Transcript, Robert Whalley, 6 May 2011, Brisbane [p1412: line 45]; Exhibit 294, Glamorgan Vale Flood Emergency Management Group Newsletter No 1 [p1].

254 Transcript, Colin Jensen, 5 May 2011, Brisbane [p1396: line 55].

255 Statement of James Barnes, 24 March 2011 [p5-6: para 14-15].

256 Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p3-5: para 15-23; p11: para 64]. Mr Goebel states that training is particularly important because of the different needs of people evacuating to these centres, including counselling needs and the needs of people with mental disabilities. On this point see for example, Transcript, Brad Carter, 23 May 2011, Rockhampton [p2456: line 25].

257 Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p5: para 24].

258 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1487: line 50]; Statement of Greg Goebel, 18 April 2011 [p6: para 25].

259 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1488: line 10].

260 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1489: line 50]; Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p9: para 47].

261 Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p10: para 54]. Mr Goebel gives evidence about the importance of early notification at: Transcript, Brisbane 6 May 2011 [p1487: line 15]. See also Submission of Ipswich City Council [p45-46: para 10.44-10.49] and Anthony Trace, Transcript, 20 May 2011, Ipswich [p2391: line 11] about confusion as to when Red Cross resources could be made available to the Ipswich City Council. See also Paul Siljac at Transcript, 9 May 2011, Brisbane [p1572: line 13].

262 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1487: line 29]; Transcript, Colin Jensen, 5 May 2011, Brisbane [p1393: line 56].

263 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1490: line 1]; Exhibit 306, Statement of Greg Goebel, 18 April 2011 [9: para 47; p13: para 75].

264 Transcript, Gregory Hoffman, 13 May 2011, Brisbane [p1986: line 55]. Ipswich City Council is one council which is currently negotiating a memorandum of understanding with the Australian Red Cross: see Transcript, Anthony Trace, 20 May 2011, Ipswich [p2391: line 9]. Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p59: para 223(c)(i)]. Banana Shire Council is another: Transcript, Collin Head, 23 May 2011, Rockhampton [p2494: line 51].

265 Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p8: para 35-36]; Information received from Australian Red Cross, *Partnership agreement between the Queensland Police Service and the Australian Red Cross*, 18 August 2009.

266 For example, see Transcript, Detective Inspector Brett Schafferius, 27 April 2011, Toowoomba [p856: line 35]; Transcript, Bronwyn Darlington, 27 April 2011, Toowoomba [p880: line 10]; Exhibit 153, Statement of Bronwyn Darlington, 20 January 2011 [p9: para 73]. See also evidence of Greg Goebel, Transcript, 6 May 2011 [p1488: line 26] that Australian Red Cross was not operating in the Lockyer Valley during the initial stage but is aware of people seeking people's personal information by posing as part of the American Red Cross.

267 Transcript, Greg Goebel, 6 May 2011, Brisbane [p1488: line 57].

268 Exhibit 306, Statement of Greg Goebel, 18 April 2011 [p15: para 82]; Transcript, Greg Goebel, 6 May 2011, Brisbane [p1489: line 6].

269 Transcript, Stuart Holley, 11 May 2011, Brisbane [p1715: line 47]; Exhibit 337, Statement of Stuart Holley, 9 May 2011 [p16 of exhibit] (Mackay Regional Council, *Emergency Action Guide for surviving natural disasters,* 2010-2011 [p6]).

270 Exhibit 478, Statement of Councillor Peter Maguire, 13 May 2011 [p101 of exhibit] (Central Highlands Regional Council, *Emerald and Gemfields Region Preparing and Responding to Disasters A Residents Guide* [p 13]).

271 Exhibit 450, Ipswich district disaster management group, 'Report on debrief outcomes for flooding events: December 2010 and January 2011' [p20]; Exhibit 258, Stanthorpe sub-group incident control centre debrief , 17 January 2011 [p6] (Southern Downs Regional Council); *Bundaberg District Disaster Management Debrief*, 3 March 2011 [p8].

272 Examples of evacuation of aged care facilities include: Lowood – see Transcript, Darren

Rumbelow, 9 May 2011, Brisbane [p1553: line 27]; Exhibit 317, Statement of Darren Rumbelow, 19 April 2011 [p5-6: para 20 and 21]; Emerald – see Transcript, William Wilkinson, 25 May 2011, Emerald [p2619: line 44]; Exhibit 481, Statement of William Wilkinson, undated [p9]; St George – see Exhibit 270, Statement of Scott Norman [para 12]; and Riverview in Ipswich – see Transcript, 5 May 2011, Brisbane [p1341, line 1].

273 For example, see Transcript, Jennifer Beattie, 20 May 2011, Ipswich [p2325: line 3]; Exhibit 481, Statement of William Wilkinson, undated [p16: para 12(f)].

274 For example, see Exhibit 264, Statement of Wendy Newman, 19 April 2011 [p 4: para 12]; Transcript, Wendy Newman, 4 May 2011, St George [p1245: line 41].

275 Emergency Management Queensland, *Queensland Evacuation Guidelines for Disaster Management Groups, Consultation Draft,* October 2010 [p11: para 4.3]. See also Transcript, Bruce Grady, 26 May 2011, Brisbane [p2657: line 38].

276 For example, Ipswich City Council stated that some aged-care facilities left residents at evacuation centres without sufficient medical supplies or carers: Submission of Ipswich City Council [p41: para 10.34]; Transcript, Anthony Trace, 20 May 2011, Ipswich [p2390: line 22]; Exhibit 450, Ipswich district disaster management group, Report on debrief outcomes for flooding events: December 2010 and January 2011 [p20].

277 See for example, Mr Scheu's evidence supporting improved cooperation between aged care facilities and Queensland Health: Exhibit 245, Letter provided by Graeme Scheu, dated 10 March 2011, comprising a submission, 10 March 2011 [p2: para 6].

278 Transcript, Inspector Gregory Morrow, 3 May 2011, Goondiwindi [p1150: line 1]; Exhibit 221, Statement of Penni Roberts, 3 May 2011 [p1; p5-6]; Transcript, Inspector Gregory Morrow, 3 May 2011, Goondiwindi [p1141: 30]. See also Exhibit 245, Letter provided to the Queensland Floods Commission of Inquiry by Graeme Scheu, 10 March 2011 [p2]; Transcript, Graham Scheu, 3 May 2011, Goondiwindi [p1201: line 38].

279 Transcript, Gregory Morrow, 3 May 2011, Goondiwindi [p1149: line 39]; Transcript, Penni Roberts, 3 May 2011, Goondiwindi [p1152: line 22]; Exhibit 221, Statement of Penni Roberts, 3 May 2011 [p4].

280 Exhibit 221, Statement of Penni Roberts, 3 May 2011 [p4].

281 Transcript, Penni Roberts, 3 May 2011, Goondiwindi [p1155: line 28]. The chair of the local disaster management group stated that Kaloma will be included in local disaster management group meetings for floods: Transcript, William Kearney, 3 May 2011, Goondiwindi [p1169: line 22].

282 See, generally: Submission of Anti Discrimination Commission Queensland [p3-11].

283 Emergency Management Queensland, *Queensland Evacuation Guidelines for Disaster Management Groups, Consultation Draft,* October 2010 [p11]. See also Exhibit 258, Stanthorpe Sub-Group Incident Control Centre Debrief [p7], in which Therese Crisp, from Granite Belt Support Services, comments that the service contacted families twice a day during the 2010/2011 flood, and recommends that a single person contact agencies and service managers. See also Submission of Anti Discrimination Commission Queensland [p11: para 3.1.3] which recommends that home-care services develop systems to ensure their clients have appropriate care during a disaster.

284 Emergency Management Queensland, *Queensland Evacuation Guidelines for Disaster Management Groups, Consultation Draft,* October 2010 [p12]; Exhibit 306, Statement of Greg Goebel [p14: para 75(c)]; Transcript, Greg Goebel, 6 May 2011, Brisbane [p1491: line 4]; Transcript, Greg Hoffman, 13 May 2011, Brisbane [p1988: line 2]; Transcript, Bruce Grady, 26 May 2011, Brisbane [p2658: line 8]. See also Submission of the Multicultural Development Association. See also Submissions of Anti Discrimination Commission Queensland, Australian Communication Consumer Action Network, and Ethnic Communities Council of Queensland.

285 Exhibit 259, Warwick Flood Debrief, 6 January 2011 [p2].

286 Submission of Multicultural Development Association [p5].

287 Submission of Anti Discrimination Commission Queensland [p13: para 3.2.1].

288 For more information see Submission of the Australian Communication Consumer Action Network.

289 Submission of Anti Discrimination Commission Queensland [p13: para 3.2.2].

290 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2657: line 43].

291 Submission of Mark Townsend, CEO of RSPCA Queensland [p1-2]; Submission of Ipswich City Council [p46: para 10.50]; Exhibit 459, Statement of Brad Carter and Gavin Steele, 1 April 2011 [p193]. See also Statement of Maryanne Brandon, 18 February 2011 [p4: para 25].

292 Transcript, Councillor William Kearney, 3 May 2011, Goondiwindi [p1172: line 29, 46]; Transcript, Inspector Gregory Morrow, 3 May 2011, Goondiwindi [p1134: line 17]; Exhibit 245, Letter of Councillor Graeme Scheu [p2]; Transcript, Anthony Trace, 20 May 2011, Ipswich [p2392: line 52]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p62: para 233]; Exhibit 447, Ipswich City Council Submission on Flood Preparedness [p67].

293 Exhibit 257, Statement of Inspector Mark Stiles, 11 March 2011 [p4-5]; Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1263: line 1].

294 Exhibit 449, Statement of Superintendent Garth Pitman, 9 March 2011 [p11]; Exhibit 450, Ipswich District Disaster Management Group, *Report on debrief outcomes for flooding events: December 2010 and January 2011* [p5]; Exhibit 307, Statement of Superintendent Patrick Ryan and Redcliffe District Disaster Management Group, Minutes of extraordinary meeting 2011 flood debrief.

295 Transcript, Superintendent Patrick Ryan, 9 May 2011, Brisbane [p1499: line 15]; Transcript, Anthony Martini, 9 May 2011, Brisbane [p1531: line 15]; Exhibit 307, Statement of Superintendent Patrick Ryan and Redcliffe District Disaster Management Group, Minutes of extraordinary meeting 2011 flood debrief.

296 Jim O'Sullivan AC, APM and the Consultancy Bureau Pty Ltd, *Report on a Review of Disaster Management Legislation and Policy in Queensland,* August 2009 [p87-89].

297 Exhibit 257, Statement of Inspector Mark Stiles, 11 March 2011 [p5]; Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1263: line 18].

298 Transcript, Douglas Bougoure, 20 April 2011, Dalby [p767: line 57].

299 Transcript, Christopher Artiemiew, 20 April 2011, Dalby [p775: line 53].

300 Transcript, Inspector Mark Stiles, 4 May 2011, St George [p1263: line 32].

301 Transcript, Bruce Grady, 26 May 2011, Brisbane [p2679: line 11].

302 Transcript, William Wilkinson, 25 May 2011, Emerald [p2607: line 15].

303 Transcript, Councillor Peter Maguire, 25 May 2011, Emerald [p2591: line 11].

304 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2562: line 34].

305 Exhibit 472, Statement of Max Mayne, 10 May 2011 [p3: para 9].

306 Transcript, Kenneth Murphy, 23 May 2011, Rockhampton [p2505: line 48].

307 Transcript, Danielle Hogarth, 24 May 2011, Emerald [p2550: line 17].

308 Regional Meeting Notes – 28 March 2011, Rolleston.

309 Regional Meeting Notes – 22 March 2011, Surat.

310 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2569: line 31].

311 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2569: line 49].

312 Transcript, Councillor Gail Nixon, 24 May 2011, Emerald [p2570: line 26].

313 Transcript, Peter Stewart, 3 May 2011, Goondiwindi [p1195: line 15].

314 Transcript, Peter Stewart, 3 May 2011, Goondiwindi [p1195: line 27].

315 Exhibit 222, Statement of Councillor William Kearney, 3 May 2011 [p1].

316 Exhibit 222, Statement of Councillor William Kearney, 3 May 2011 [p1].

317 Transcript, Peter Stewart, 3 May 2011, Goondiwindi [p1194: line 44].

6 Essential services

6.1 Essential services in the disaster management framework

Essential services encompass the provision of electrical power, drinking water and telecommunications. The large-scale distribution of fresh food and produce, which is facilitated by the Rocklea Markets, is discussed separately in *6.3 Rocklea Markets* below.

6.1.1 Power

Electrical power is distributed to people in Queensland by Energex Limited and Ergon Energy Corporation Limited. Energex supplies power to customers in south-east Queensland (including the regions of Brisbane, Ipswich, Gympie and the Lockyer Valley), while Ergon supplies power to the rest of the state.[1] Under the *Electricity Industry Code*, both entities were obliged to prepare and submit Summer Preparedness Plans for the 2010/2011 summer season, which had to address various matters including measures to minimise power outages and improve emergency responsiveness.[2] These plans were complemented, in the case of Energex, by Corporate Emergency Management, Business Continuity and Flood Risk Management Plans,[3] and by Disaster Management and Regional Emergency Management Plans in the case of Ergon.[4] Furthermore, both organisations have formal understandings in place for reciprocal use of each other's contact centres and sharing resources in response to severe weather.[5] Trials and simulations designed to test these plans occurred prior to the 2010/2011 wet season.[6]

Having considered those facts, the Commission is satisfied that Energex and Ergon prepared appropriately.

In response to the 2010/2011 floods, both Energex and Ergon pre-emptively disconnected power to buildings and customers in areas where flooding was expected to occur.[7] This was done for reasons of safety and to assist in the later reconnection of power supplies by reducing the potential for damage to electrical infrastructure. Where possible, movable plant and equipment were withdrawn before flooding, so that power supplies could be re-connected more quickly once the floodwaters subsided.[8] The Commission appreciates the necessity of these actions in areas where flooding is anticipated. It also understands the need to balance the desirability of earlier disconnection, to allow sufficient time for critical equipment to be removed, against that of later disconnection, to minimise public inconvenience.

However, particular community concern was expressed regarding the practice of pre-emptive power cutting when it affected areas that were not flooded.[9] Power disconnection in this circumstance most often occurs when the electricity supply comes from, or passes through, an area that is flooded and has had its electricity cut off.[10] Power can be restored to areas that are not flooded only if the necessary power lines remain undamaged and the flood-affected part of the network is capable of being switched off or isolated. Isolating such an area itself depends on there being switching equipment in place that is physically accessible to the technicians performing the relevant work.[11]

There is no doubt that the community suffers an additional burden when areas that are not flooded lose their power. Minimising this type of inconvenience could be achieved by carefully reviewing the available network switching options and by taking steps to protect vital electrical infrastructure from damage caused by flooding.[12] The Commission understands it is feasible for Energex to review its network switching arrangements before the next wet season. However, measures to protect major equipment, such as substations, must be for the longer term, because of the technical and financial constraints involved. Power distributors are encouraged, nonetheless, to examine what protective steps can be taken.

A related concern that emerged during the Commission's proceedings was the loss of power in communities that were isolated, but not inundated, by floodwaters. This occurred, for example, in the far western suburbs of Brisbane, including Bellbowrie, Karana Downs and Moggill. Deploying generators in such locations is a means of overcoming this problem, with the generators acting as temporary sub-stations, separate from the network, until regular supply is restored; but, of course, it requires that the equipment be in place before isolation occurs.[13] Although Energex was aware that isolation was a possibility in Brisbane's far western suburbs, the loss of power there was not reasonably to be expected because electricity is supplied by five separate high-voltage feeders. By the time all of these transmission lines were damaged, floodwaters prevented access to the area to install a generator.[14]

Good decision-making about pre-emptive power supply cuts depends, largely, on the availability of timely and accurate flooding forecasts. Ergon conducted daily disaster management committee meetings in its flood-affected regions to review flood levels. Decisions about the disconnection of supply were made by operational staff based on flood forecasts, patrols and consultation with local disaster management groups.[15] In Ipswich and Brisbane, Energex primarily relied on information from the Bureau of Meteorology and the Brisbane City Council about expected flood levels, and prepared disconnection plans accordingly.[16] However, during the course of Tuesday 11 January 2011, the predicted flood levels were revised upwards throughout the day, culminating in a warning from the Brisbane City Council that a flood peak similar to that of 1974 was to be expected in the early hours of Thursday.[17] The opportunity to remove critical equipment in Ipswich was much more limited, because of the rapid and earlier flood peak there.[18]

The Commission considers that plans for the pre-emptive disconnection of power should be communicated to disaster managers and the general public as quickly as possible. For this to occur, power distributors should be involved in disaster management group meetings at an early stage, and their media and communication strategies should be in place, so that they are ready to inform the public of developments. Although Energex released a media statement at 5.00 pm on 11 January 2011, and maintained both a broad public information campaign and an operational call centre over the following days, it did not attend its first state disaster management group meeting until Wednesday 12 January 2011, by which time the pre-emptive disconnection of power had commenced in both Ipswich and Brisbane. The Commission notes that Energex's attendance at this meeting was by invitation.[19]

By comparison, it seems that Energex attended various disaster management group meetings during and after the flood peaks in Ipswich and Brisbane. This enabled information to be shared, and priorities more clearly identified, concerning the restoration of power within these communities.[20] The efforts to restore power involved many extra crews, made up of private contractors and personnel from other electricity providers, being sent to the flood affected areas.[21]

The Commission considers the responses of the power distributors to the 2010/2011 floods were appropriate and effective given the circumstances faced by each of them. For the future, however, power distributors' early involvement in disaster management group meetings could give them a better understanding of what electrical infrastructure is likely to be affected by flooding.[22] That information, passed to the wider community, would allow better preparation for any power disruptions to follow. The meetings themselves would provide a forum for communicating information about the restoration of power supplies.

6.1.2 Water

In south-east Queensland, the delivery of drinking water to the communities in the region involves a three-tiered structure which is collectively known as the Water Grid. At the time of the 2010/2011 floods, Seqwater (which operates major dam storages and water treatment plants) and WaterSecure (which operated desalination and water recycling plants)[23] each supplied bulk water to LinkWater, which transports the water around the grid through a network of bulk pipelines. The water is delivered by way of the grid to three water distributors: Queensland Urban Utilities (which supplies customers in the Brisbane, Ipswich, Lockyer Valley, Scenic Rim and Somerset council

areas), Unity Water (which serves customers in the Sunshine Coast and Moreton Bay council areas) and Allconnex Water (which supplies customers in the Gold Coast, Logan and Redlands council areas).[24]

Each of these entities comes under the regulatory framework governing the operation of the Water Grid, including the Market Rules.[25] The rules require the Water Grid Manager to prepare and maintain an overarching emergency response plan that provides all of the grid participants with guidance in responding to emergencies affecting the grid. As well, each grid participant is obliged to have its own emergency response plan that aligns with that of the manager. The plans must be approved by the Water Grid Manager and reviewed at least annually.[26] Queensland Urban Utilities also has business continuity plans to assist with recovery after an emergency or disaster.[27] Prior to the 2010/2011 wet season, these arrangements were complemented by various forms of training.[28] LinkWater also conducted a series of risk assessment workshops, which resulted in the development of contingency plans designed to mitigate the effects of particular hazards, including the loss of water supply from treatment plants or a reduction in water quality.[29]

Against this background, the Commission is satisfied that the existing emergency and disaster planning framework was adequate, and the preparations appropriate. However, the Commission notes that the Market Rules also require the Water Grid Manager to prepare a Water Grid Risk Management Plan designed to allow particular risks to the operation of the water grid to be identified and mitigated. While a draft plan was submitted to the Queensland Water Commission, as the rules administrator, for approval on 14 May 2010, the administrator requested changes on 21 January 2011, which are still the subject of negotiation. This plan should be finalised, so that all the water grid participants can then formulate their own corresponding risk management strategies, as required by the rules.[30]

During the 2010/2011 floods, the supply of drinking water was maintained to meet the demands of the water distributors in south-east Queensland. This was achieved despite the flooding of the Mt Crosby Water Treatment Plant's East Bank raw water pump stations and the interruption of water treatment operations at both Mt Crosby West Bank and North Pine dam due to water turbidity and other problems.[31] The daily drinking water requirements of the greater Brisbane area are significant, and the supply constraints caused by the suspension of water treatment operations at Mt Crosby and North Pine dam constituted a major challenge, especially given the volume of treated water ordinarily produced by Mt Crosby.[32] Extensive modelling, and adjustments to the level of production at other water treatment plants, allowed available drinking water to be moved around the grid to meet system demand while water treatment operations at Mt Crosby and North Pine dam were being restored.[33] Although water supplies were lost to various townships in the Lockyer Valley, and parts of western Brisbane and the Somerset region, these were progressively restored, with Queensland Urban Utilities providing alternative water supplies in the meantime.[34]

The quality of drinking water supplies in south-east Queensland was generally maintained during the floods. Within the system of bulk water pipelines, in-built instrumentation allowed water quality to be tested remotely. This form of monitoring remained fully operational during the floods, but was verified by physical sampling where access to the bulk water pipelines was possible. Appropriate water pressures were also maintained through careful monitoring.[35] No positive *E.coli* test results were returned for water in the grid's bulk transportation pipelines.[36] However, contamination was detected in some local drinking water supplies, which were not connected to the bulk distribution network. This occurred in some communities in the Ipswich, Somerset and Lockyer Valley council regions. Queensland Urban Utilities responded to these threats by issuing 'boil water' notices in these places. It also supplied bottled water to affected parts of the Lockyer Valley and Somerset regions.[37]

The Commission considers that the response demonstrated by those involved in the provision of drinking water in south-east Queensland was appropriate in all the circumstances. It is worth noting that a key feature of the ability to maintain bulk drinking water supplies during the floods was the continuous operation of LinkWater's control room. Representatives of the Water Grid Manager and Seqwater relocated to LinkWater's premises on Wednesday 12 January 2011 after they evacuated their own premises because of flooding.[38] (LinkWater's premises have many practical features which make it an ideal centre of operations, including its elevated location in Spring Hill and access to electrical power that is separate from Brisbane's central business district grid.[39]) Those premises became the hub of water grid operations for the duration of the response to the floods in south-east Queensland.[40] Having representatives at the one location is thought to have enhanced the coordination of the response.[41]

In areas outside south-east Queensland, councils are responsible for the provision of drinking water to residents in main population centres. The ability of regional councils to maintain this service during the 2010/2011 floods was mixed. Some councils managed the crisis appropriately, as in the case of the Central Highlands. Its preparations included identifying water pumps vulnerable to flooding and putting in place barriers to protect them, filling all

reservoirs in Emerald to capacity prior to the floods, and establishing additional or alternative water supplies for outlying communities such as Rolleston, Springsure and Duaringa.[42]

The Western Downs Regional Council experienced difficulties once the Dalby water treatment plant was flooded. Faced with two days' remaining water supply, the council responded by imposing severe water restrictions which it communicated to residents by a series of emergency alerts, obtaining (with state-level assistance) additional water by tanker from surrounding towns, and activating a reverse osmosis plant to replenish water stores.[43] In Chinchilla, *E.coli* was found in the water. A 'boil water' alert was prematurely withdrawn before full testing had been completed, but as it happened, the water was safe to drink. The Commission notes that the council is ensuring that in future appropriate testing procedures are completed before the withdrawal of any warning.[44]

Other councils experienced water quality problems, rather than supply constraints. Southern Downs Regional Council advised its residents to boil their drinking water after several of its water treatment plants became inoperable and were unable to be quickly repaired because of their isolation by floodwaters.[45]

Despite these difficulties, it appears that water supplies were maintained. Where water quality was affected, it was restored as quickly as possible after floodwaters receded.

6.1.3 Telecommunications

Telecommunications services take multiple forms comprising fixed line (or land line), mobile (or wireless), radio, data and satellite mobile networks.[46] The continued operation of these services, and their speedy restoration where they have been lost, is critical to the community's ability to respond and recover in the event of disaster.

During the 2010/2011 floods, interruptions to telecommunications services were mostly caused by the loss of mains electrical power to network components or damage as a result of telecommunications equipment being flooded.[47] Depending on the nature of the disruption, telecommunications providers were able to respond in a variety of ways. In some cases, generators were used to keep power supplied to telephone exchanges and mobile base stations. In other cases, temporary mobile base stations and telephone exchanges replaced lost services, or telecommunications traffic was re-routed. In some of the worst affected areas, such as Murphys Creek and parts of the Lockyer Valley, satellite phones and base stations were used to provide mobile coverage.[48]

Effective response required adequate information about network functioning, the existence of power outages and the location of flooding. Other practical concerns included having the authority and means to get service technicians and back-up equipment into the flood-affected areas that were experiencing telecommunications problems. Where these issues could be addressed quickly, the response was better.

Telstra has an established emergency management framework, and recognises that a key factor in its successful operation is the organisation's ability to co-operate with government and emergency services. The company has an emergency services liaison officer, who works closely with Emergency Management Queensland, and its regional director of service delivery liaises with the state disaster management group. With these arrangements in place, Telstra found that it was better able to direct its response in accordance with state group and emergency services priorities.[49]

In contrast, Optus found that during and immediately after the floods, it was difficult to obtain information from various government agencies so that it could assess the extent and severity of flooding and its potential impact upon its telecommunications infrastructure. It was instead reliant to a large extent on media reports. However, once Optus became aware that it could participate in state group meetings, it did so regularly, enabling it to provide updates and gather critical information. For the future, such information would, Optus said, allow it to predict more readily the likelihood of an outage and to reconfigure its network components to limit the extent of any outage.[50] Moreover, Optus suggested, active participation at state level could speed its access to affected areas and allow it more quickly to procure specialised equipment, such as heavy machinery and aircraft from the state government or the Australian Defence Force.[51]

The Commission notes that the state disaster management group has recognised that the earlier essential services providers were included in its meetings, the better placed they were to respond effectively.[52]

Recommendations

6.1 Local, district and state disaster management groups should include essential services providers in their disaster planning and preparation and in their meetings at an early stage during disasters.

6.2 Power distributors should review network switching options before next wet season (to optimise switching arrangements) so that, where possible, power is disconnected only to those who are flooded.

6.3 Power distributors should consider pre-emptively installing generators in areas known to become isolated (but not inundated) during flooding, if the power supply cannot otherwise be maintained.

6.4 The control and coordination centre for Water Grid operations should be located where, at the least, it is not susceptible to flooding or to its power supply being interrupted.

6.2 Communications and assistance between essential services providers

The maintenance of power supply is critical to the continued operation of all essential services. Telecommunications were disrupted in many locations by reason only of the loss of power, and not as a result of any direct impact by flooding. Telstra lost mains power to 375 of its network sites. Optus's fixed home and internet services were interrupted in parts of Brisbane and Ipswich primarily as a result of power outages to components of its fibre cable network.[53] Queensland Urban Utilities also recognises that its services are highly dependent on the provision of power.[54]

When essential services providers were informed about prospective power outages, they were able to protect and restore services more effectively. Better information about the location and duration of proposed mains power outages would have assisted Optus to deploy generators and provision its network to cater for the outages. It would also have facilitated the faster restoration of services.[55] Similarly, Queensland Urban Utilities considers that a more formal relationship with Energex, including a co-ordinated approach to emergency planning, would be advantageous in responding to disasters.[56]

The Commission also notes that some essential services providers drew on resources from other industry members to minimise disruption to services. For example, Energex and Ergon have an established memorandum of understanding which outlines how resources are shared during severe weather events. Under this agreement, Energex provided support to Ergon prior to the Brisbane flood. Following the flooding of the Brisbane and Bremer Rivers, Ergon employees, along with crews from interstate electricity entities Energy Australia, Integral, Jemena and Country Energy, assisted Energex to reconnect power in Brisbane and Ipswich.[57] In the same vein, Queensland Urban Utilities received significant assistance from Allconnex, Unity Water and Sydney Water under the Mutual Aid Guidelines for the water sector. The guidelines are designed to speed the process of requesting, co-ordinating and despatching additional specialist personnel and equipment during emergencies and disasters.[58]

Recommendations

6.5 Essential service providers should continue to develop ways to share available resources within their respective industries during disasters.

6.6 Essential service providers should formalise arrangements to share information about the status of services during a disaster.

6.3 Rocklea Markets

The Brisbane Markets at Rocklea (Rocklea Markets) occupies a 77 hectare site which accommodates 51 primary wholesaling businesses and another 100 ancillary tenant businesses. It constitutes Queensland's wholesale marketing and distribution hub for fresh fruit and vegetables, with an annual turnover in excess of 600 000 tonnes of produce valued at over $1 billion. As Rocklea Markets businesses supply some 65-70 per cent of the wholesale fresh produce consumed in Queensland, the food distribution services provided at the site constitute an essential service to the broader community.[59]

On Tuesday 11 January 2011, Brisbane Markets Limited, the owner and manager of the Rocklea Markets, monitored both the Bureau of Meteorology website and the Brisbane City Council's text message warning service in relation to predicted flood levels. Early that morning, the available information suggested that moderate levels of flooding around the lower parts of the site could be expected, while higher parts, such as the covered unloading area and selling floors, would not be affected by floodwaters. The magnitude of the impending flood was not properly understood until late Tuesday morning, when the Premier made a televised announcement to the effect that severe flooding could be expected similar to that which was experienced in 1974. Up until this time, Brisbane Markets Limited and its tenants had found it difficult to interpret the forecast information and to grasp the likely impact on the site.[60]

Brisbane Markets Limited issued warnings to its tenants throughout the morning consistent with the information available to it, and made preparations for the possible inundation of the site. It removed some equipment, ordered replacement components for electrical distribution boards and engaged contractors to assist in any necessary recovery operation. However, by the time the flood projections changed to severe, market tenants had limited opportunity to respond. The situation was further complicated by the fact that many tenants start work early in the day and finish work at about midday, so that by the time the magnitude of the flood event became known, few people were left on site. Before leaving, many tenants had moved vehicles and produce to the covered unloading area, believing it would not be flooded. Return to the area became increasingly problematic as the day progressed, with road access to the markets cut off from the early hours of Wednesday morning. Transport vehicles needed to remove equipment from the site became virtually unobtainable as demand for them spiked across the city.[61]

Flooding at the Rocklea Markets reached a level of approximately 9.17 metres. The entire site was inundated; the selling floor areas, which are located at the higher part of the site, were immersed to a depth of approximately 1.5 metres.[62] All tenant businesses were flooded; they lost produce (in excess of 10 000 tonnes), and their vehicles (more than 300 of them, including 200 forklifts) and infrastructure (offices, cold rooms and other equipment) were submerged.[63] Most, if not all, food holding areas and food stock, machinery and equipment were significantly water damaged, with floodwater movement within the site dislodging and scattering produce across many hectares.[64] Consequently, the site was rendered incapable of functioning, so that ordinary business activity was completely disrupted.

The Rocklea Markets remained under water from the night of Tuesday 11 January 2011 until Friday 14 January 2011.[65] It seems that the significance of the markets as an essential service was well appreciated by all those involved in the response that followed. Brisbane Markets Limited and numerous local and state agencies, as well as Australian Defence Force personnel and volunteers, mounted a co-ordinated effort to clean and repair the site so that at least limited trading activities could recommence as quickly as possible.[66] On Monday 17 January 2011, within 60 hours of the floodwaters receding, operations on the selling floor resumed, enabling the receipt and distribution of fresh produce once more.[67]

Re-locating the Rocklea Markets is not considered to be a feasible option in the short to medium term, given its estimated cost ($300-$350 million).[68] The site is low lying, and is consequently unsuitable for residential use, but it has been regarded as ideal for warehousing because of the size of its land area, its proximity to Brisbane and major freight routes and its capacity to conduct round-the-clock operations with little impact on surrounding residential areas.[69]

In reacting to the flood, Brisbane Markets Limited considered re-locating trading floor operations to a temporary site. However, the possibility was rejected, having regard to the unsuitability, for various reasons, of the alternative sites proposed, and the critical assessment that partial operations could be restored at the Rocklea Markets site in a reasonable time, particularly as the raised selling floor offices had not been flooded.[70] The company has recognised

the importance of making contingency plans for priority access to alternative sites, although it has yet to identify any suitable locations.[71]

Brisbane Markets Limited is considering a range of possible flood mitigation strategies in the future management and development of the Rocklea Markets site. Some of these measures, (such as raising an access road and commissioning a flood assessment study to evaluate, among other things, the potential of levees or raising parts of the site) would need the involvement of and financial contribution from government.[72] These are longer-term plans outside the compass of this report.

For the short term, the Commission understands that a flood mitigation channel constructed following the 1974 flood, running across the western side of the site, has over time become layered with debris. It should be cleaned in order to maintain its effectiveness as a mitigation channel.[73]

Because of the Rocklea Markets' importance in food supply, it should be a focus of emergency planning by local and state government and given priority (as it was on this occasion) in the making of response arrangements.[74] Where flooding is expected, Brisbane Markets Limited and the Brisbane City Council should be in regular contact with each other about the flood risk to the markets site.

Recommendations

6.7 Brisbane Markets Limited should contact the Brisbane City Council on a regular basis in the lead-up to and during flooding to seek local flood information. In response, the council should provide readily understood information which, as far as possible, explains the level of flooding to be expected at the Rocklea Markets site.

6.8 The Brisbane City Council should attend to the clearing of the flood mitigation channel on the western side of the market site before the next wet season.

(Endnotes)

1 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p1: para 6; Attachment CJA-1]; Submission of Ergon Energy, 11 March 2011 [p4: para 3.4; Schedule 1].

2 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p9: paras 67-68]; Submission of Ergon Energy, 11 March 2011 [p6: para 4.13; Schedule 6].

3 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p8-13].

4 Submission of Ergon Energy, 11 March 2011 [p6: paras 4.8-4.12; Schedules 4 and 5].

5 Submission of Ergon Energy, 11 March 2011 [p10: para 6.4].

6 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p9: para 70]; Submission of Ergon Energy, 11 March 2011 [p10: para 6.8].

7 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p3: para 17]; Submission of Ergon Energy, 11 March 2011 [p8: para 5.6].

8 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p3: paras 18-23].

9 Exhibit 447, Submission of Ipswich City Council, 23 March 2011 [p31: paras 9.61-9.62]; Exhibit 445, Statement of Anthony Trace, 6 April 2011 [p36-37: paras 126-127].

10 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p18: para 133]; Transcript, 13 May 2011, Brisbane [p1971 line 58 – p1972 line 7].

11 Exhibit 366,Statement of Christopher Arnold, 5 April 2011 [p18: paras 134-135].

12 Exhibit 366,Statement of Christopher Arnold, 5 April 2011 [p22: paras 180, 183-184]; Transcript, 13 May 2011, Brisbane [p1961: line 36 – p1963: line 34; p1965: lines 19-39; p1967: lines 40-45].

13 Exhibit 366,Statement of Christopher Arnold, 5 April 2011 [p19: paras 150-151]; Transcript, 13 May 2011, Brisbane [p1965: lines 29-47].

14 Exhibit 366,Statement of Christopher Arnold, 5 April 2011 [Annexure CJA-6, *Energex Flood Risk*

Management Plan 2010/11, p11]; Transcript, 13 May 2011, Brisbane [p1967: lines 1-38].

15 Submission of Ergon Energy, 11 March 2011 [p8: para 5.6].

16 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p4: paras 24-27, 77]. See also: Transcript, 13 May 2011, Brisbane [p1965: line 1].

17 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p4: para 28];

18 Exhibit 367, Statement of Christopher Arnold, 29 April 2011 [p1: para 11(a) and footnote]; Transcript, 13 May 2011, Brisbane [p1970: line 41].

19 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p4-5: paras 30-33; p10: para 70(e); pp13-16: paras 99-121]; Transcript, 13 May 2011, Brisbane [p1963 line 56 – p1964 line23; p1973 line 57 – p1974 line 27]; Exhibit 368.

20 Statement of Christopher Arnold, 29 April 2011 [p1: para 10; p7: paras 37-39]; Transcript, 13 May 2011, Brisbane [p1965: line 50 – p1966: line 9]; Exhibit 495, State Disaster Management Group, *Ordinary Meeting Minutes*, 2 March 2011 [p9-10, 13].

21 Exhibit 367, Statement of Christopher Arnold, 29 April 2011 [p4-5: paras 27-28].

22 Exhibit 366, Statement of Christopher Arnold, 5 April 2011 [p22: para 185].

23 On 1 July 2011, WaterSecure merged with Seqwater, so that Seqwater now owns the Western Corridor Recycled Water Scheme and the Gold Coast Desalination Plant: Submission of Seqwater, 11 March 2011 [p16: para 59].

24 *See*, generally: Statement of Peter McManamon, 13 May 2011 [p5-9: paras 17-34].

25 Submission of Queensland Urban Utilities, 11 March 2011 [p2: paras 8, 10 and 13]; Statement of Robin Lewis, 4 May 2011 [p3: paras 13, 15].

26 Submission of Queensland Urban Utilities, 11 March 2011 [paras 27-36]; Statement of Robin Lewis, 4 May 2011 [p5-7: paras 26-33].

27 Statement of Robin Lewis, 4 May 2011 [p7-8: paras 40-42].

28 Statement of Robin Lewis, 4 May 2011 [p8: paras 43-45; p10: para 57].

29 Statement of Peter McManamon, 13 May 2011 [p11-15: paras 41-54].

30 Statement of Robin Lewis, 4 May 2011 [p7: paras 34-38].

31 Statement of Peter McManamon, 13 May 2011 [p24-25: paras 87-89]; Submission of LinkWater, 11 March 2011 [p7: para 4.2]; Supplementary Submission of Seqwater, 4 April 2011 [p17: para 65].

32 Statement of Peter McManamon, 13 May 2011 [p22-23: paras 81-84]; Supplementary Submission of Seqwater, 4 April 2011 [p17: para 66].

33 Statement of Peter McManamon, 13 May 2011 [p25: paras 90-91]; Submission of LinkWater, 11 March 2011 [p7: paras 4.3-4.4]; Supplementary Submission of Seqwater, 4 April 2011 [p17: paras 67-70; p20-21: paras 91-95].

34 Submission of Queensland Urban Utilities, 11 March 2011 [paras 75-77]; Statement of Robin Lewis, 4 May 2011 [p12-13: paras 77, 79]; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [p7: para 8(m)].

35 Statement of Peter McManamon, 13 May 2011 [p26-27: paras 93-98].

36 Statement of Peter McManamon, 13 May 2011 [p27: para 100].

37 Statement of Peter McManamon, 13 May 2011 [p27: para 99]; SEQ Water Grid, *Situation Report 8*, 17 January 2011; Exhibit 321, Statement of Anthony Jacobs, 5 April 2011 [p7: paras 8(n) and 8(o)]; Exhibit 449, Statement of Superintendent Garth Pitman, 9 March 2011 [p4].

38 Submission of LinkWater, 11 March 2011 [p6: para 3.10]; Statement of Peter McManamon, 13 May 2011 [p27: para 101].

39 Submission of LinkWater, 11 March 2011 [p6: para 3.12]; Statement of Peter McManamon, 13 May 2011 [p28-31: paras 106-107(a)-(k)].

40 Statement of Peter McManamon, 13 May 2011 [p28: para 102-103 and 105].

41 Statement of Peter McManamon, 13 May 2011 [p35: para 125(c)].

42 Exhibit 481, Statement of William Wilkinson, undated [p10: paras 8(b)-(d), (f) and (g)].

43 Transcript, Senior Sergeant Simon Chase, 20 April 2011, Dalby [p740 line 43 – p741 line 30].

44 Transcript, Philip Berting, 20 April 2011, Dalby [p787: lines 1-39].

45 Exhibit 249, Statement of Rodney Ferguson, 14 April 2010 [p3: paras 28-30].

46 Exhibit 215, Supplementary Submission of Telstra Corporation Ltd, 8 April 2011 [p2: para 9; p8: para 38].

47 Exhibit 215, Supplementary Submission of Telstra Corporation Ltd, 8 April 2011 [p9: para 41]; Exhibit 213, Submission of Optus, 4 April 2011 [p7: para 3.9].

48 Exhibit 215, Supplementary Submission of Telstra Corporation Ltd, 8 April 2011 [p9: para 44; p19: para 74; p20: para 77(b)]; Exhibit 213, Submission of Optus, 4 April 2011 [p6-7: para 3.8; p8-9: para 3.10]; Exhibit 463, Statement of Collin Head, 5 April 2011 [p11: para 8(b)(ii); p23: para 17(e)].

49 Exhibit 215, Supplementary Submission of Telstra Corporation Ltd, 8 April 2011 [p12-14: paras 58-65; p20: para 77(a)].

50 Exhibit 213, Submission of Optus, 4 April 2011 [p10: paras 4.4-5.3].

51 Exhibit 213, Submission of Optus, 4 April 2011 [p10-11: paras 5.6-5.7 and 5.10].

52 Exhibit 495, State Disaster Management Group, *Ordinary Meeting Minutes*, 2 March 2011 [p3; p10-11: section 5].

53 Exhibit 215, Supplementary Submission of Telstra Corporation Ltd, 8 April 2011 [p15: para 67; p9-10: paras 42-45]; Exhibit 213, Submission of Optus, 4 April 2011 [p8: para 3.9].

54 Statement of Robin Lewis, 4 May 2011 [p34: para 137; p12: para 73].

55 Exhibit 213, Submission of Optus, 4 April 2011 [p10: paras 5.3-5.4; p11: paras 6.2-6.3].

56 Statement of Robin Lewis, 4 May 2011 [p34: para 137].

57 Submission of Ergon Energy, 11 March 2011 [p10: para 6.4; p11: para 6.9]; Exhibit 366, Statement of Christopher Arnold, 29 April 2011 [p4: para 27(c)].

58 Statement of Robin Lewis, 4 May 2011 [p29: paras 106-109].

59 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p1: paras 1-4].

60 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p3: para 29; p5: para 45]; Transcript, 5 May 2011, Brisbane [p1370: line 40; p1371: lines 10-28].

61 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p2: paras 16-19; pp3-4: paras 24-26, 28, 30-33]; Transcript, 5 May 2011, Brisbane [p1370: lines 35-58].

62 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p2: para 14]; Transcript, 5 May 2011, Brisbane [p1370: line 20].

63 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p4: paras 34-38].

64 Exhibit 338, Statement of Air Vice-Marshal Kevin Paule, 10 May 2011 [p13: para 55].

65 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p2: para 15]; Transcript, 5 May 2011, Brisbane [p1372: line 50].

66 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p5: paras 47-48; p6: 52-56]; Exhibit 289, Statement of Colin Jensen, 19 April 2011 [pp44-46]; Exhibit 302, 303, Statements of Peter Martin, 9 March 2011 [paras 46, 72 & 76] and 3 May 2011 [paras 59-62]; Exhibit 338, Statement of Air Vice-Marshal Kevin Paule, 10 May 2011 [p14-15: paras 56-61].

67 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p5: para 49]; Transcript, 5 May 2011, Brisbane [p1372: lines 20-30].

68 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p7: paras 59-61 & 63].

69 Exhibit 287, Statement of Andrew Young, 14 April 2011 [pp6-7: paras 57-58].

70 Andrew Young, Transcript, 5 May 2011, Brisbane [pp1373 line 50 – 1374 line 31].

71 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p9: para 76]; Transcript, 5 May 2011, Brisbane [pp1374 line 38 – 1375 line 3].

72 Exhibit 287, Statement of Andrew Young, 14 April 2011 [pp7-9: paras 66-71, 73-75]; Transcript, 5 May 2011, Brisbane [p1375: lines 5-11].

73 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p8: para 72]; Transcript, 5 May 2011, Brisbane [p1375: lines 13-25].

74 Exhibit 287, Statement of Andrew Young, 14 April 2011 [p9: para 77].

7 Lockyer Valley and Toowoomba

7.1 The December/January floods in the Toowoomba region

7.1.1 The region

Toowoomba city is located on an escarpment on the western side of the Great Dividing Range, approximately 700 metres above sea level. The local government region of Toowoomba (12 973.3 square kilometres in area) is situated to the west of Brisbane and the Lockyer Valley.

The Toowoomba Regional Council was formed on the amalgamation, in March 2008, of the Toowoomba Council with seven other local councils: Cambooya, Clifton, Crows Nest, Jondaryan, Millmerran, Pittsworth and Rosalie. At 30 June 2010, the population of the council area was estimated at 162 057.[2]

The city of Toowoomba is drained by Gowrie Creek and its tributaries, East Creek, West Creek and Black Gully. The catchments of the four creeks cover an area of approximately 56 square kilometres within the

Figure 7(a)

Toowoomba local government area[1]

Toowoomba regional council area. The Gowrie Creek system flows into the Condamine River, which then flows into the Murray-Darling system. East and West creeks flow through the southern part of the city and meet north of the central business district. Black Gully joins Gowrie Creek approximately two kilometres downstream of where East and West creeks converge. Gowrie Creek and its three tributaries have steep channel gradients and catchments that are also steep. In consequence, the Gowrie Creek catchment is likely to respond swiftly to heavy rainfalls, and the rise of the water in the waterways of the creek system is also likely to occur quite quickly.[3]

7.1.2 Toowoomba Regional Council disaster preparation and planning

The Toowoomba Regional Council's local disaster management plan and evacuation and welfare management sub-plan were adopted in December 2009. By mid-2010 they had been distributed to all members of the local disaster management group and its evacuation and welfare committee and had been posted on the council's disaster management website for public reference.[4] Other information about emergency contacts, disaster preparation, and the state of the dams supplying Toowoomba was also displayed on the website, the existence of which was publicised in the council's quarterly newsletters.[5] Public education programs were delivered, with talks to schools and community groups. In July 2010, standard operating procedures were approved for the Toowoomba disaster coordination centre.

The Toowoomba local disaster management group met three times over the course of 2010, with most members attending each meeting. The local disaster management group took part in two exercises (Ember and Orko) in October and November 2010, designed to simulate activation of the disaster coordination centre and to test its software and communication links with other agencies.[6]

The evidence indicates that the Council had taken proper steps (both as required of it by the disaster management legislation and in meeting its broader local government responsibilities) for natural disaster preparation before the 2010/2011 floods.

7.1.3 December 2010/early January 2011 floods

In December 2010, most areas in the Toowoomba region experienced significant rainfall, with local media reporting that it was the wettest December in 68 years. North Toowoomba recorded 544 millimetres; East Toowoomba 517 millimetres; Pittsworth 434 millimetres; Yarraman 332 millimetres; Crows Nest 307 millimetres; Millmerran 325 millimetres and Oakey 304 millimetres.[7] The rainfall in Oakey was more than three times the average December rainfall of 93 millimetres.[8] The high rainfall caused flooding in Millmerran to the west, and northern areas of the region including Yarraman.[9] Cecil Plains and Tummaville were isolated by flood waters.[10]

Toowoomba receives much of its water from the Cooby, Perseverance and Cressbrook dams. In the recent past those dams were at extremely low levels. However, as a result of the rainfall that the city experienced over December, the combined dam levels between 20 and 27 December 2010 reached 53.2 per cent.[11]

A similarly high level of rainfall occurred in early January 2011. On 3 January 2011, 46.8 millimetres was recorded at Toowoomba airport; on 6 January, 67.8 millimetres of rainfall was recorded at Toowoomba airport, while 54.6 millimetres was recorded at Middle Ridge.[12] Media reports provided to the Commission show localised flooding across Toowoomba's central business district on 6 January 2011 as a result of this sustained rainfall.[13]

The large volumes of rain in early January 2011 left the Toowoomba catchment saturated.[14] The combined dam levels rose to 75.2 per cent in the 12 days ending 9 January 2011.[15] A milestone was reached, in that both the Cooby and Perseverance dams individually reached 100 per cent capacity.[16] By the end of 10 January 2011 the combined dam level had risen to 127.2 per cent.

On 10 January 2011, between 9.00 am and 9.30 am, two intense thunderstorms crossed the south-east coast of Queensland.[17] The storms joined together to form one concentrated storm at about 11.00 am;[18] it continued in a south-westerly direction towards the Toowoomba range. The rainfall intensities continued to increase between 11.48 am and 12.36 pm.[19] Those high rainfall intensities were observed on both sides of the Great Dividing Range, with runoff being generated to the east and west of the range. The runoff on the eastern side of the escarpment flowed into the upper tributaries of the Lockyer Creek in the Lockyer Valley; that which fell on the escarpment itself flowed into the catchments of the Gowrie and Oakey creeks to the east and west of Toowoomba.

7.1.4 Flooding in Toowoomba on 10 January 2011

On 10 January, the Gowrie Creek catchment experienced intense rainfall between 1.00 pm and 2.30 pm. In the city of Toowoomba itself, heavy rain began falling at about 12.45 pm, and peaked between 1.45 pm and 2.15 pm.[20] The most severe rain fell in a northeast - southwest band that covered the middle and lower parts of East and West creeks, where they crossed Toowoomba's central business district.[21] This concentration of rain in the East Creek and West Creek catchments continued for approximately 60 to 90 minutes. It had largely ceased between 2.15 pm and 2.45 pm.[22]

The intense rainfall over the catchment of the three creeks caused a severe flash flood in the city between 1.30 pm and 2.45 pm. Closed circuit television footage provided by Toowoomba Regional Council shows water rising at extraordinary speed and flowing over the roadways. It also demonstrates the speed with which the water rose. It is clear that this was not a situation in which any agency could have effectively warned residents of what was to come.

Water covered all the roadway crossings of East, West and Gowrie Creeks, making them impassable to pedestrians and vehicles. The rapidity of the flooding caught people by surprise: in city streets they found themselves surrounded by water, or were trapped in their vehicles. A woman and her teenaged son lost their lives when their car was caught in the flooding in a city intersection. A number of buildings in and around the city were extensively damaged, and numerous parked cars were swept away or inundated by the flooding.[23]

7.1.5 Toowoomba Regional Council and other agencies' response to events

The extent of the rainfall in the preceding days had caused the Toowoomba Regional Council to call a meeting at 1.00 pm on 10 January to consider activating the local disaster management group and coordination centre. Representatives from the Toowoomba council, Queensland Ambulance Service, Queensland Police Service, Queensland Fire and Rescue Service, Emergency Management Queensland, Telstra and the ABC were present. During the course of the meeting the attendees received numerous calls about the torrential rain and flash flooding in the city. Because of the unexpectedness and the speed of the flooding, the immediate response as events unfolded was handled directly by the Queensland Police Service and Queensland Fire and Rescue Service.

The local disaster management group and the disaster coordination centre were activated in order to commence the response in the aftermath of the flash flooding. An operational monitoring and support group chaired by the council's chief executive officer was set up, and met twice daily to monitor local disaster coordination centre activities and to ensure efficient deployment of council resources. The local disaster management group met every morning in the week following 10 January 2011, and the local disaster coordination centre operated 24 hours a day.[24]

The council (and through it the local disaster management group and the disaster coordination centre) operated as a single point of coordination to direct emergency services personnel in responding to calls for help. An evacuation centre was established at the Toowoomba Grammar School. There were difficulties in providing assistance across the region immediately after the events of 10 January, because flooding had closed road access from the east and the severe weather prevented fixed-wing aircraft and some helicopters from flying into Toowoomba until 12 January.[25] The council issued a number of media releases dealing with road and council building closures, emergency procedures to be observed by the community, emergency numbers to call and flooding west of the range in and around Oakey.[26]

7.1.6 Oakey

Oakey is a small town located on the Darling Downs approximately 27 kilometres north-west of Toowoomba and 160 kilometres west of Brisbane. It was located within the Jondaryan Shire until, with the amalgamation of Queensland councils, the Toowoomba Regional Council was formed in 2008.

Oakey Creek bisects Oakey through the centre of the town. Westbrook Creek runs south of the town until meeting with Oakey Creek downstream of the Oakey bypass. Tributaries further upstream – Cooby Creek, Meringandan Creek and Gomaran Creek – feed into Oakey Creek.

Between 10 and 11 January 2011, Oakey experienced flooding as Oakey Creek burst its banks. On 10 January, water levels rose and fell twice. On 11 January, water levels peaked at 7.5 metres, with both the bridge on Bridge Street and the railway bridge overtopping. One hundred and twenty-eight homes were inundated by flood water; the town's industrial area was also affected.[27]

As a result of the flooding, Oakey residents were evacuated initially to the Oakey Cultural Centre which was set up as an assembly point. The first evacuees arrived at around 10.30 am; because of difficulties in procuring food, bedding and staff, residents unable to find alternative accommodation (about 60 of them) were evacuated by bus to the Toowoomba Grammar School. They were able to return to their homes in Oakey on 13 January 2011.[28]

7.1.7 Cooby Dam

Background

Cooby Dam is one of the three dams which Toowoomba Regional Council owns and operates for urban water supply (the others being the Cressbrook and Perseverance dams[29]). Cooby Dam is located on Cooby Creek, upstream of Oakey, with any overspill feeding back into the creek. In addition to the inflow from Cooby Creek, Cooby Dam receives the flows of Geham, Klein and Reedy creeks, as well as capturing runoff from the west of the Dividing Range.

The dam has an ungated spillway whose dimensions govern the otherwise unrestricted outflows of flood waters during flood events. Unlike Wivenhoe Dam, Cooby Dam is not operated for flood mitigation purposes and its outflows cannot be modified during a flood event. Nonetheless, during a flood event the dam does provide some flood mitigation benefit to communities downstream.[30] (See *4.1.4 Warnings about dam spillway outflow* for an explanation of dams that have flood mitigation capacity.)

Toowoomba Regional Council has an emergency action plan for Cooby Dam to identify emergency conditions which could endanger the dam's integrity. The plan prescribes procedures the council should follow in the event of an emergency. A primary focus is 'to provide timely warning to appropriate emergency response and management agencies, to allow these agencies to implement protection measures for downstream communities'.[31]

The impact of the Cooby Dam on downstream flooding in January 2011

The heavy rain which fell in south-east Queensland in early January 2011 saturated creek catchments. The Oakey area recorded its most intense rainfall between 9.00 am on 9 January and 9.00 am on 10 January 2011.[32] On 11 January 2011, the Cooby Creek rainfall gauge recorded its highest rainfall since it was installed in 1990.[33]

The Commission received evidence from a farmer living 10 kilometres east of the Cooby Dam, who believed that spillway overflow from the dam had caused significant flooding on his property on 11 January 2011. He did not receive any prior warning of the flooding from the council, emergency services or the Toowoomba local disaster management group.[34] (Other residents of Oakey and the Oakey district similarly complained of a lack of warning that their properties would be inundated.[35] However, on 10 January 2011, Toowoomba Regional Council did issue a media release regarding possible flooding in Oakey: 'Toowoomba Regional Council is advising Oakey residents to take precautions against possible flooding in the town. Flooding may occur due to significant rises in Gowrie and Oakey creeks caused by heavy rain. Residents should regularly check any water on their property to ensure that water levels are not rising.'[36])

The Commission engaged an independent hydrological expert, Dr Phillip Jordan, who investigated whether Cooby Dam increased the impact of flooding on downstream residents. He found (in simple terms) that although unregulated outflows from the dam occurred during the flood events of 10 and 11 January 2011, the peak rate of outflow from the dam was less than the peak rate of inflow; it followed that the dam had mitigated the flow of water to residents downstream.[37] Neil Collins, a hydraulic engineer who prepared a report for the Local Government Association of Queensland,[38] reached a similar view. The Commission accepts their conclusions.

Compliance with the Cooby Dam's emergency action plan

Under the dam's emergency action plan, once the water level reaches 0.5 metres above the spillway crest, stage one of the plan is activated.[39] The dam operators (the individuals who physically operate and oversee the dam on the Toowoomba Regional Council's behalf) must, through a reporting chain, advise the council of the overflow. The council in turn, through its disaster coordination committee coordinator, alerts all residents within five kilometres downstream of the dam wall. (Only two properties fall within this category.[40])

At approximately 9.00 pm on 9 January 2011, the dam's water level reached 0.5 metres above the spillway crest and downstream residents within five kilometres were notified.[41] One of those residents confirmed that a council officer maintained regular contact with him, advising the heights of the dam from 9 to 12 January 2011.[42]

Dam levels again exceeded the spillway by 0.5 metres with a minor peak in the early hours of the morning on 10 January 2011, reaching 1.3 metres above the spillway at approximately 4.30 pm on 10 January 2011.[43]

On 11 January 2011, at 7.13 am, the dam level reached 1.52 metres above the spillway, peaking half an hour later at 1.55 metres above the spillway (approximately three metres below the crest of the main dam embankment and almost four metres below the crest of the wave wall[44]).

Under the dam's emergency action plan, the dam operator, upon a reading exceeding 1.5 metres above the spillway, is to advance to stage two of the plan by sealing the dam intake tower door, and regularly reporting dam levels to the council. The council is to take a number of steps, which include requesting closure of access roads to the dam and notifying residents downstream of expected flood levels. Having reviewed the dam's status, it must, 'if required', advise the police and State Emergency Service (SES) to evacuate residents of the downstream floodplain.[45]

However, as the dam level began to stabilise and then recede within a few minutes of the peak, falling to 1.46 metres by 9.15 am,[46] and council officers saw there was no significant rainfall expected in the dam's catchment,[47] the decision was made that stage two of the plan would not be activated. That decision, and the consequent non-fulfilment of the requirements of stage two of the emergency action plan, were reasonable in the circumstances.

If the dam level exceeds 0.5 metres above the spillway crest, it is probable that other catchments are saturated and that residents beyond the five kilometre point can expect flooding from upstream creeks and waterways.

Recommendation

7.1 The Toowoomba Regional Council should consider amending stage one of the Cooby Dam emergency action plan to extend the five kilometre limit for alerting residents downstream of the Cooby Dam.

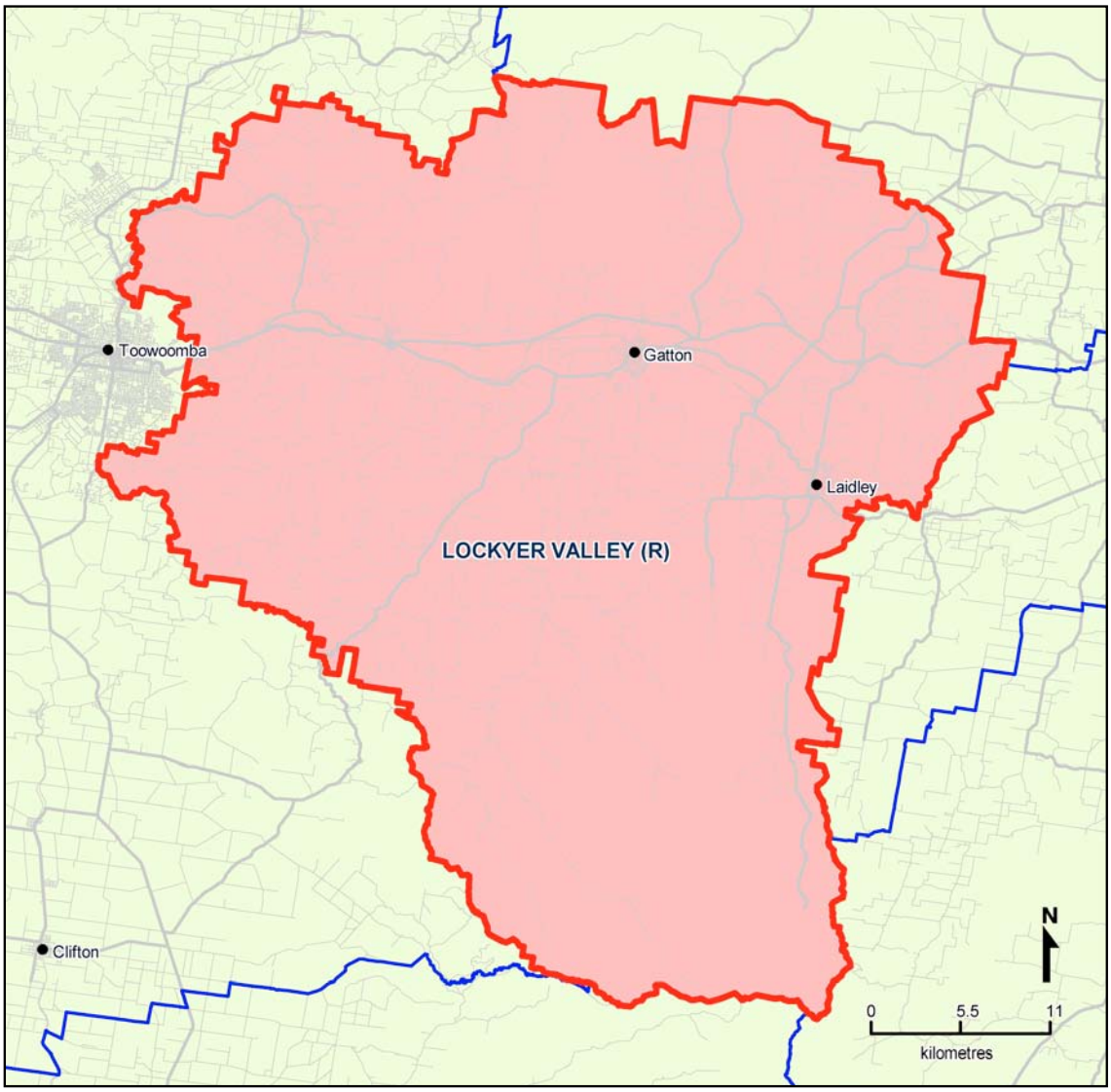
7.2 The December/January floods in the Lockyer Valley region

7.2.1 The region

The Lockyer Valley is situated to the east of Toowoomba and west of Brisbane. The Lockyer Valley Regional Council was produced by the amalgamation in 2008 of the shire of Gatton and the shire of Laidley, covering a land area of 2272.3 square kilometres.
At 30 June 2010, the estimated total resident population of the Lockyer Valley regional council area was 36 591.[48] Lockyer Valley region towns include Murphys Creek, Laidley, Helidon, Withcott, Grantham and Gatton.

The Lockyer Valley drainage network comprises Lockyer Creek and its tributaries. Lockyer Creek generally flows east and enters the Brisbane River at Lowood. It is the largest tributary of the Brisbane River and has a catchment area of 2,600 square kilometres. Its northern tributaries include Murphys Creek, Fifteen Mile Creek and Alice Creek, while to the south it is joined by Flagstone Creek, Ma Ma Creek, Tenthill Creek and Laidley Creek.

Figure 7(b)



Lockyer Valley local government area (2008)[49]

7.2.2 Lockyer Valley Regional Council preparation and planning

The Lockyer Valley Regional Council has seven elected councillors, including the Mayor and Deputy Mayor. It employs between 340 and 350 staff, about half of whom were available over the Christmas break in 2010/2011.[50]

In accordance with the *Disaster Management Act 2003*, the council, after amalgamation, set up a local disaster management group and in September 2009 adopted a local disaster management plan. The general impression from the evidence, however, is that once the plan was adopted, little more was done in the way of disaster planning for some time thereafter.

According to the Lockyer Valley Regional Council Mayor and chair of the local disaster management group, Stephen Jones, he became aware when he attended a Local Government Association of Queensland conference in May 2010 of impending changes to the disaster management legislation which would require an upgrading of disaster preparation and a revised disaster management plan. Soon after that conference, he said, the council began to focus on disaster preparation, and began to work on revision of its disaster management plan.[51]

In July 2010, the council gave responsibility for its disaster planning to its engineering services department and its director, Gerry Franzmann (who was eventually appointed as local disaster coordinator), and a disaster management working group was set up. On 15 July 2010, Mr Franzmann attended a meeting with the area director of

Emergency Management Queensland, at which the council's disaster management plan was discussed. On 5 August 2010, representatives of the Lockyer Valley Regional Council attended a four hour session run by Emergency Management Queensland in which the changes to the amended legislation were discussed, including the role and membership of disaster management groups and the necessary alterations to disaster management plans.[52]

Mr Franzmann conducted a disaster management working group meeting the following day. The minutes note that changes were to be made to the existing disaster management plan, after which it would be reviewed by Emergency Management Queensland, which would advise on any further changes needed. The subject of sub-plans, including evacuation plans, was raised; it was noted that Emergency Management Queensland would assist with their development, and that the Red Cross might give advice in relation to the evacuation plan.

On 22 September 2010, a council meeting considered the report of a member of the disaster management working group, who pointed out that 'since amalgamation little work [had] been done to improve [Lockyer Valley Regional Council] LVRC's disaster response capability'. There had been no disaster management meetings for 12 months; the disaster management plan required updating; there were no sub-plans for emergencies; the council had not established a dedicated disaster response command centre; and there was no contingency planning for the possibility that key staff would be away on leave or physically unable to attend in the event of a disaster. The council resolved to note his report and to amend the council's budget to include $65 000 for disaster management operations.[53] (A large part of the money was earmarked to develop a control centre for emergencies at Gatton.[54])

The council's response to the issues raised in the report was not otherwise recorded, but a local disaster management group meeting was held the following day.[55] It was the first, on the material produced by the council, since 18 September 2009, although section 30 of the *Disaster Management Act 2003* requires meetings at least once every six months. At that meeting, a revised version of the disaster management plan was distributed, noted in a table to have been updated in July 2010 (although the changes made from the September 2009 document seem to have been minor). The participants were invited to review it over the following fortnight. The plan, with minor changes, was next reproduced on 26 October 2010.

In early November 2010, Lockyer Valley Regional Council participated, with four other councils, in Exercise Orko, conducted by Emergency Management Queensland. The exercise, which involved the simulation of a major flood and storm event over a three day period, was designed to test disaster preparation in the region. Later that month, Mr Franzmann attended a district disaster management group meeting; his notes record some concern that the council would need training from Emergency Management Queensland to get its plans 'up to speed'.[56] In early December, a council staff member attended a flood planning workshop at which Emergency Management Queensland and the Bureau of Meteorology made presentations.

The revised draft disaster management plan remained in draft form for the remainder of 2010. On 23 December, in light of forecasts of intense rainfall, it was circulated to members of the local disaster management group in anticipation of the group's possible activation.[57] By email on 24 December, Mr Franzmann advised councillors and staff where sand bags could be obtained, provided telephone numbers to contact in the event of road blockages, and informed them of where the local disaster management group would establish its co-ordination centre if it were activated. Flooding in fact began on the night of 26 December. On 5 January, when the crisis was perceived to have passed, the area director of Emergency Management Queensland held a debriefing meeting with representatives of the district disaster management group and the council.

The disaster management plan had still not received council approval. According to Mr Jones, however, a final version was produced on 6 January and circulated with a 'flying minute' (no copy of which is available) to councillors. It was then in some way adopted, receiving formal ratification on 23 February 2011.[58]

Evacuation plans

Section 58 of the *Disaster Management Act 2003* requires a local disaster management plan to be consistent with disaster management guidelines, which are made under section 63 of the Act. The *Queensland Disaster Management Planning Guidelines for Local Government 2005* nominate evacuation plans among a list of plans which should be prepared in the response phase 'to detail arrangements for functional support'.

The council had not, prior to the flooding at the end of 2010 and the beginning of 2011, prepared any evacuation plan. It possessed a pro forma document into which some inconsequential details had been inserted; but no information of substance, such as the location of possible shelters or centres, had been included.[59] The council in

fact relied on the Gatton hall as its sole evacuation facility, although Mr Jones acknowledged that it was not possible for all those in the council region needing accommodation to make their way there.[60] That certainly proved to be the case in the January floods, when informal centres emerged in communities isolated by the events.

Mr Jones proposed, for the future, the nomination of collection points at which people could assemble for transport to a central evacuation centre with facilities for their accommodation over days or weeks. The details of both the collection points and the evacuation centres should, he accepted, be formally recorded in an evacuation plan.[61]

It must be noted that Lockyer Valley Regional Council was by no means the only council which had not met its obligations under the disaster management legislation, and that it was not a wealthy or well-resourced council. Had the council met the legislative requirement to hold disaster management group meetings at no greater than six month intervals, acted more expeditiously to review and endorse its disaster management plan or produced an evacuation plan, it would not have prevented the tragic deaths of early January 2011. However, better planning and preparation would have assisted in the response to the disaster (see recommendations about evacuations in chapter *5 Emergency response* and section *7.2.5 Lockyer Valley Regional Council response*).

7.2.3 December 2010/early January 2011 floods

Around 26 December 2010, Laidley, Forest Hill and Grantham were flood affected. As a result the local disaster management group was activated on 27 December 2010. The Gatton evacuation centre was also activated on the evening of 27 December; between 10 and 20 people were registered there. It was closed the following morning, with bedding kept on site in case of further evacuations.[62]

On 28 December 2010, a number of properties at Brightview, Glenore Grove and Lockrose in the Lockyer Valley were isolated by road closures. Aerial re-supplies were needed for residents on Black Duck Creek Road and East Haldon Road, and seven people were evacuated by air from Black Duck Creek.[63]

Localised flooding in the region was significant enough to activate the Lockyer Valley's local disaster management group and disaster coordination centre on 6 January 2011 and again between Friday 7 January and Sunday 9 January.[64]

The council and police coordinated road closures, while the SES and rural fire fighters carried out sandbagging work. In response to rises in Sandy Creek, some Grantham residents were evacuated on 9 January 2011, but were able to return to their homes soon after.[65] The disaster coordination centre closed at 3.30 am on the morning of 10 January 2011 and reopened a little after noon the same day.[66]

Flooding in the Lockyer Valley on 10 January 2011

Weather radar data shows that intense rainfall would have started in the northern parts of Fifteen Mile Creek, Murphys Creek and Alice Creek at approximately 12.00 pm. Because that catchment was in steep terrain and was already saturated from earlier rain, runoff and overland flows in those watercourses may have commenced within minutes. By approximately 1.00 pm, all catchments in the Upper Lockyer Valley would have been experiencing extremely heavy rainfall.[67]

The rainfall produced flash floods in Murphys Creek, Rocky Creek and Monkey Waterholes Creek, and the upper and middle reaches of Lockyer Creek, which gained width and velocity as they moved downstream. Upstream of Helidon, Rocky Creek delivered its flows to Lockyer Creek, while immediately downstream of Helidon, Monkey Waterholes Creek added its flows. This flash flood then moved downstream towards Grantham.[68]

There are no flood warning rainfall stations in the upper Lockyer Creek catchment, such as in the tributary creek areas of Murphys Creek, Six Mile Creek and Rocky Creek. The radar information for the day suggests that the higher rainfalls and rainfall intensities occurred between the top of the range and the Helidon area, missing the rain gauge network.[69]

There were gauges operating at Spring Bluff and Helidon, but none in between. That paucity of gauge information makes it difficult to establish at exactly what time the flash floods struck each township. In Spring Bluff, the streamflow gauge recorded water levels rising at 1.20 pm, peaking at 4.96 metres by 1.40 pm. A resident there described seeing the creek in flood in the early afternoon. She lost both her parents when part of their house, near hers, was swept away. That witness recalled the water knocking down and swallowing up massive gum trees; bits of shed were washing down the creek.Water was also coming with force down the hills and down the road.[70]

Floodwaters at Spring Bluff, near Murphys Creek, 10 January 2011 (photo courtesy the Matthews family)

The Department of Environment and Resource Management (DERM) owns the Spring Bluff stream flow gauge and records its data, but the gauge is not telemetric (it does not report automatically). Consequently, the data was not available to either DERM or the Bureau of Meteorology while the flood was actually happening.[71]

At the township of Murphys Creek, flooding began between approximately 1.45 pm and 2.00 pm. A witness who lived at Upper Lockyer near the town said that at about 1.47 pm he saw a wave of water in the creek breaking in the distance; the force of the approaching water was ripping out trees in its path.[72] The level of the creek rose about 12 metres in 12 minutes. By 2.51 pm, the water level had receded significantly.[73]

A resident in the Murphys Creek township said that at about 2.00 pm, water started coming down the road carrying rain water tanks and other large items.[74] Two people drowned at Murphys Creek.

At about the same time (between 1.45 pm and 2.00 pm) Withcott, at the base of the Toowoomba range approximately 11 kilometres south of Murphys Creek, was beginning to experience flooding of sufficient strength to carry cars with it.[75]

At Postman's Ridge, flooding began at approximately 2.00 pm. A witness there described seeing Murphys Creek escape its banks at a bend, sending water along the road and into her house.[76] Two houses near the bridge at Postman's Ridge were washed away in the flash flood, killing two people.

At Helidon, there is a telemeter gauge and an ALERT gauge. Both began to record fast water level rises at about 2.20 pm, when the creek was at four metres. At 2.50 pm the Helidon telemeter gauge failed, with a reading of 12.66 metres. The ALERT gauge failed at 2.53 pm with a peak of 12.7 metres. DERM undertook a survey in the weeks following the flood event, concluding that the Helidon peak was approximately 13.88 metres and occurred about 3.10 pm.[77] The Warrego Highway near Helidon was flooded by fast-flowing water, and the driver of a car, with his family, was swept away. His wife and son were rescued; he was lost.

Residents suggest that flooding in Grantham occurred between approximately 3.20 pm and 4.00 pm. The flood appeared as a wave, sweeping from the Lockyer Creek across the paddocks and through the town. In the opinion of hydrologists consulted by the Insurance Council of Australia,[78] the floodwaters were about two to two and a half metres deep. At an estimated rate of rise of 12 metres per hour they would have taken only 10 to 15 minutes to reach full depth. They were moving at an estimated two to three metres per second.

Emergency calls were made; just after 4.00 pm the police communications centre directed helicopters to perform rescues at Grantham. A rescue helicopter left Archerfield airbase at 4.28 pm and arrived over Grantham at 4.48 pm. It rescued a number of people from roofs and trees. Some residents were able to make their way to safety at the local school, on the higher side of the town. Others were later retrieved from their homes by front end loaders and taken to the evacuation centre at Helidon. Ten people, adults and children, are known to have lost their lives to the torrent of water. Two others have not been found.

In Gatton, the telemeter gauge indicated there was a water level rise of about seven metres at approximately 5.00 pm. The gauge failed around 7.00 pm. The Bureau of Meteorology advises, on its reconstruction of flood data, that it is likely that the water level peaked around 8.00 pm, reaching approximately 14.38 metres.

On the following day, significant flooding occurred in Sandy Creek around Forest Hill and in Laidley Creek around Laidley.[79] Two hundred and fifty nine people were evacuated from Forest Hill and 75 from Laidley.[80]

7.2.4 Lockyer Valley disaster response – agency response

Rescue

Immediately following the Lockyer Valley floods, a number of agencies responded to the disaster; in particular, Emergency Management Queensland helicopter rescue, Queensland Police Service and the Australian Defence Force.

Emergency Management Queensland helicopter rescue employees performed rescues over Grantham from 4.48 pm on 10 January until approximately 6.15 pm, when the aircraft exhausted its fuel.[81] By the time the pilot and crew returned to Archerfield, they had winched 28 people and one cat to safety from rooftops and other locations around Grantham. Another crew in a second Emergency Management Queensland helicopter took over the task and performed 15 rescues over Grantham before fading light and low fuel supplies forced them to finish for the day at 7.30 pm.[82]

On 11 January 2011, Australian Defence Force helicopters evacuated over 400 people from the Lockyer Valley and Toowoomba regions, including the entire population of Forest Hill when the town was evacuated due to rising flood waters. In the course of the day they completed 24 hoist recoveries. Army trucks were also involved, taking 75 people from Laidley Hospital to the Plainland Hotel on the Warrego Highway.[83]

Grantham resident and dog on rooftop awaiting rescue, 10 January 2011 (photo courtesy Wendy Friend)

The search for missing people

One of the most important aspects of the response in the Lockyer Valley was the search for people missing after the floods swept through. Hundreds of Queensland police officers, with assistance from the Australian Defence Force, the Federal Police and the SES, were involved in the search. On 13 January 2011 approximately 120 defence personnel came to Grantham to help; because of the size of the task, a further three platoons were requested and arrived in Grantham on 15 January 2011.[84] The search area included over 663 square kilometres and 131 kilometres of creek line.[85] It covered Spring Bluff to Grantham; the greater town area of Grantham; and the area east of Grantham to the Brisbane River. Defence force members walked the entire 131 kilometres of creek line on three occasions.[86] The defence force provided search helicopters and machinery for use in the search. One area of debris which had to be searched was described as being at least 2000 square metres in area and several metres deep.[87] In addition to foot searches, air and boat searches of sections of the Brisbane River and Moreton Bay were carried out; but all those found were located by searchers on foot.[88]

Members of the Australian Defence Force at Grantham assisting in the aftermath of the floods, 13 January 2011 (photo courtesy Geoff Purton)

7.2.5 Lockyer Valley Regional Council response

The Lockyer Valley Regional Council's response, through its local disaster management group, to the flash flooding disaster in its region on 10 January 2011 was the subject of a number of criticisms. The most serious of these were that it had failed to give warning of the flash flood in Lockyer Creek to downstream residents, that it had inadequately responded to the disaster in smaller, isolated valley communities, particularly Murphys Creek, and that it had failed to identify and establish evacuation centres.

The absence of warning

Once the disaster co-ordination centre was re-opened just after midday on 10 January, the local disaster management group's running log indicates that it received reports of general flooding at Forest Hill, Laidley, Grantham and Withcott and anticipated that evacuations would be needed. Forest Hill was a particular concern; at 1.45 pm the local area commander for the Queensland Fire and Rescue Service undertook to have doorknocking carried out to warn residents there. Shortly before, at 1.35 pm, the Lockyer Valley Mayor, Mr Jones, had reported heavy rain at Withcott, and by 2.20 pm, flooding of such proportions that it was carrying cars away.[89] It does not seem that he (or the disaster management group) attributed any wider significance to the Withcott event; he thought it the product of an isolated cloudburst.[90]

At 2.30 pm, the SES controller directed the Gatton SES group to undertake doorknocking at Grantham, in the expectation that flooding there would be of the type the town had been experiencing intermittently in preceding weeks. They left Gatton for that purpose at 2.50 pm, stopping to warn one household on the Gatton side of Grantham as to the possibility of water rises, but then found themselves unable to get into Grantham because of the rising water.[91]

There is a 2.10 pm note in the running log of advice from the district disaster management group of a house flooded at Spring Bluff; that 'people may be stuck', and that rescuers (presumably Queensland Fire and Rescue Service swift water rescue) were 'unable to get to it'. At 2.45 pm, the district disaster coordinator contacted the local disaster group to advise of cars being swept away in Toowoomba and asked whether anyone was missing from Murphys Creek.[92] There was further confirmation from an unknown source, relayed to the local disaster group at 3.30 pm, of two houses at Postman's Ridge having been swept away.[93] It does not appear, though, that any detailed information about the state of Lockyer Creek was conveyed to the local disaster group or the council. In particular, there is no record of their being alerted by anyone who saw the rapid rise in the creek at Helidon.

Flash flooding in Grantham, 10 January 2011 (photo courtesy Geoff Purton)

The Lockyer Valley Regional Council received three-hourly river height bulletins from the Bureau of Meteorology. The 3.30 pm bulletin for the Brisbane River and its tributaries gave the heights of the Lockyer Creek at Helidon as 12.66 metres R (for rising) at 2.50 pm and 12.68 metres at 3.02 pm. The local disaster group's running log shows that at about 3.40 pm the rise in the Helidon levels had been observed on the Bureau's website. A more percipient disaster management group might earlier have deduced that flooding of the proportions experienced in the Murphys Creek waterway had serious implications for Lockyer Creek, and made efforts to keep abreast of exactly what was happening along the creek. Against that, it should be said that the disaster management group was, it is evident from the running log entries, trying to respond to flooding reports from numerous sources.

The next running log entries show that at 3.45 pm, doorknocking by council staff was arranged for Gatton. At 4.07 pm, the local area commander of the Queensland Fire and Rescue Service offered to direct the local rural fire brigade to doorknock Grantham. That, of course, was too late for Grantham.

Three Grantham residents paying close attention to the Bureau of Meteorology website said they noticed the sharp rise reported there in the level of Lockyer Creek at Helidon. One was uncertain of the time at which he did so. In disbelief he logged off the site and logged on again to see if the reading (over 12 metres) was still there, as it was. He and his family had not enough time to do more than assemble some personal effects before the water swirled into their yard.[94] Another had the reading reinforced when his daughter told him she had heard of a vehicle being washed off the road at the Helidon bridge. That made him think that flooding levels at Grantham would be similar

to those reached in the 1974 flood. He and his daughter set about moving their vehicles to an area which on that assumption would be beyond the flood's reach. He had stopped to talk to someone about the expected flooding when they both saw the water approaching across the paddocks. He was washed away in his utility, but was eventually able to get into a tree where he stayed until the waters receded.[95]

The third resident watching the website telephoned the council to ask if the gauge was broken and spoke to someone unknown in the council office, who said it was the Bureau of Meteorology's concern (assuming, apparently, that it was simply a faulty gauge). That resident established by a call to a local councillor that there had been serious flooding at Withcott, and a family member driving towards Helidon confirmed that there was a great deal of water coming. Her family had time to shift their vehicles to what they thought was a safer area in the town before the water came rushing into their yard and house.[96]

Other Grantham residents received warnings of the water coming down the Lockyer Creek through telephone calls from friends and relatives at Helidon; a number were told to expect a 'wall' of water. Many reacted by trying to move their belongings higher and their vehicles to safe ground; some assembled belongings with the intention to leave; others went to warn neighbours. The common experience was that no-one had time to do much before the water arrived; it was then a fight for survival.[97]

The Lockyer Valley disaster management group made one unsuccessful attempt to warn Grantham residents of imminent flooding (sending SES volunteers at 2.40 pm). It does not seem to have occurred to it to contact residents there by telephone. It expected that any flooding would be problematic, not catastrophic. It is unfortunate that it was not better informed, but given the patchy nature of the reports it received, the many incidents to which it was attempting to respond, and the fact that there was no precedent for the Lockyer Creek to surge through Grantham as it did that day, it is not surprising that the disaster management group did not appreciate the real nature of the emergency. An effective warning would have been one which told Grantham residents that they should flee at once to preserve their lives. The Commission does not consider that the local disaster management group, or the Lockyer Valley Regional Council, should now be regarded as culpable for failing to recognise how dire the risk was, or to give such a warning.

Two deaths occurred at Spring Bluff and two deaths at Murphys Creek, both communities very close to the eastern side of the Dividing Range. Given the speed and strength of the water rise there, it does not seem likely that any warning could have been given in time to people living there. It is noteworthy however, that these communities, and other communities within the Lockyer Valley such as Black Duck Creek, have very little internet or mobile phone access.

Recommendation

7.2 Lockyer Valley Regional Council should investigate the feasibility of installing alarm-activating gauges in the creeks at Spring Bluff, Murphys Creek and other communities where communication systems are poor and there is a risk of rapid and unexpected water rise.

Murphys Creek

The Lockyer Valley Regional Council remained unaware of (and does not seem to have enquired about) circumstances at Murphys Creek until 12 January 2011, when it received a report from Emergency Management Queensland.[98] Although the council sent two council employees to the township on 13 January 2011 and the Mayor, Mr Jones visited on 14 January 2011,[99] the council failed to allocate permanent staff until 21 January 2011.[100] When staff were allocated they were in an administrative capacity only and were unable to coordinate resources and personnel or act as a liaison point for the community.[101]

Because there was no effective local government presence in the Murphys Creek and Spring Bluff region in the days that followed 10 January 2011, hotel staff set up an evacuation centre at the Murphys Creek tavern, which also came to serve as a coordination centre. Within a couple of days, a resident with military experience, Peter Souter, had taken charge of coordination activities there; he developed a structure to ensure that resources and assistance provided by volunteers, private companies and government agencies reached residents.[102] The coordination centre operated with help from state government entities such as Emergency Management Queensland and the

Queensland Police Service, and support agencies like Centrelink, Lifeline and the Australian Red Cross, but it received very little assistance from the Lockyer Valley Regional Council. Mr Jones, the Lockyer Valley Mayor, acknowledged in giving evidence that in the absence of any community liaison officer from the council, Mr Souter filled the role.[103]

Witnesses observed,[104] and it is evident, that the Lockyer Valley Regional Council was overwhelmed by what it had to deal with and struggled with effective response. On a suggestion from the Emergency Management Queensland area director,[105] on 18 January 2011 the Lockyer council sought help from the Murweh Regional Council. The disaster coordinator for that council, together with five staff experienced in disaster management, came to the Lockyer Valley to assist.[106] Mr Souter and police officers involved in the response effort observed that the Lockyer council's management of resources, and particularly its contribution to managing the recovery at Murphys Creek, improved markedly after the Murweh council staff members arrived.[107]

There is no doubt that the Lockyer Valley Regional Council and the local disaster management group were put under extraordinary pressure by the scale of the disaster in the Lockyer Region, and that even better-resourced councils would have struggled to cope in the circumstances. However, notwithstanding the proportions of the disaster and the difficulties it faced in responding, the local disaster management group should have assessed the needs of communities in its region isolated in the aftermath of the flooding as a priority. In particular, it should have arranged for a liaison officer (preferably a councillor or senior council officer) to coordinate the response and immediate recovery effort in Murphys Creek, where it was known that the community had been hard-hit and that deaths had occurred. If its resources were insufficient for it to do so, it should have sought assistance from the district disaster coordinator.

The circumstances in which Murphys Creek found itself highlight the need for councils to identify in advance those communities which may be isolated in the event of a disaster and ensure a local capacity to cope.

For recommendations on this issue see chapter *5 Emergency response*.

Evacuation centres

On 27 December 2010, the Lockyer Valley Regional Council placed a notification on its website of the Gatton Hall's status as an evacuation centre. It had been necessary to open or 'activate' it before the events of 10 January 2011 because of previous flooding in the area. On 10 and 11 January, residents of Grantham and Forest Hill were evacuated to the hall. There were no other designated evacuation centres or assembly points. However, by necessity, a number of makeshift evacuation centres came into existence.

Situation reports sent by the local disaster management group to the district group in January 2011 show that by 12.15 am on 11 January, the council was aware that evacuation centres had been established in the Gatton Shire Hall, Helidon Community Centre and the Glenore Grove Hall.[108] By 5.37 am that same day Grantham State School was added to this list.[109] By 9.50 pm the council reported further evacuation centres at Laidley Hospital, Laidley State High School, Gatton Sports Centre, Woolworths Shopping Centre Plainland, Withcott Fire Station and self evacuations to the Murphys Creek tavern, Postman's Ridge Hall and the Lutheran Hall at Lockrose.[110] Some of those centres were established by community members isolated by flood waters; others – but it is unclear how many – were opened on the initiative of council, once the need arose. People housed in the centres came from Grantham, Withcott, Helidon, Murphys Creek, Glenore Grove, Forest Hill, Postman's Ridge, Lockyer Waters, Lockrose, Laidley and Toowoomba.[111]

Following the flooding of Grantham in the afternoon of 10 January, residents used the local school as an evacuation centre. A local police officer and his wife, the school principal, set up the evacuation centre using donated bedding, towels and food from residents.[112] The officer kept a handwritten record of people who took refuge at the centre. On the first night 32 people stayed at the school. The following day, 56 people were evacuated by air to Helidon. Some residents remained at the school another night and were evacuated to Gatton the next day.[113] Because the school was not an official evacuation centre it lacked essentials: showers, cooking facilities and communications equipment. There was no power; generators were obtained from locals to run water pumps, lights and other equipment.[114]After the immediate need for an evacuation centre had passed, the centre continued to be used to provide meals to displaced residents and to coordinate assistance and services for the town.[115] A marquee placed in parkland next to the school became Grantham's relief centre, where the community could meet and receive assistance from various agencies such as Centrelink, banks and counselling services.[116]

The usual congregation point for the Murphys Creek community was the local school; because the school was flooded on 10 January, the Murphys Creek tavern became a makeshift evacuation centre. The tavern provided accommodation, food and other basic necessities to residents of Murphys Creek and emergency services personnel involved in the search and rescue efforts. By 13 January, only one family remained living in the tavern; other residents were able to return to their homes.[117] Because there was no expectation that the tavern would operate as an evacuation centre, it had no back-up power to operate water pumps, lights, fridges and other necessary appliances; a local man supplied his generator. A further difficulty was that the owner of the tavern was not covered under his insurance arrangements for liability while the tavern was being operated as an evacuation centre. He was eventually able to secure insurance from another insurer.[118] (For a discussion of indemnity and insurance for informal evacuation centres see *5.5.5 Indemnity insurance for makeshift evacuation centres.)*

The Postman's Ridge Pioneer Memorial Hall was used by the community there as a short-term evacuation centre from 11 January, never having been used previously for the purpose. It does not appear that local people were aware that there was an official evacuation centre at Gatton or what government agencies they should contact. The Rural Fire Brigade provided a generator for electricity, and food and bedding was donated by local residents. The centre was used to house people who had lost their homes as well as to provide meals to other people in the community who were flood affected. People also used the centre to charge their mobile phones, the only means of communication because landlines were down. There was no official record kept of who came and went from the centre. It remained open until 13 January, when it was closed by the Lockyer Valley Regional Council and all the bedding and other material was transported to the Gatton evacuation centre. Thereafter anyone needing accommodation went to the Gatton evacuation centre.[119]

In Helidon, members of the community opened up the Helidon Community Centre on the evening of 10 January for a dozen people displaced by flooding. Overnight, evacuees continued to arrive, many from Grantham, dropped off by helicopter. At first the Helidon community provided bedding and food for those who came to the centre. The town was isolated; the local disaster group running log shows that it was trying in the early hours of the following morning to get a load of supplies through to the Helidon centre, which was said to be holding 150 people, but was prevented by road closures.[120] Supplies were flown in by helicopter, including drinking water when the water supply was later lost. The centre was suitable for use as an evacuation centre: it was large, and had showers and toilets as well as a large kitchen. However, the facilities became overburdened by the large numbers needing accommodation. By 13 January, the council had taken over management of the centre.

The Withcott State School was also briefly pressed into service as an evacuation centre to house people from the town and from the Murphys Creek area and also to accommodate motorists stranded on the Warrego Highway, which runs through the town. Its occupants were moved on to other evacuation centres once the highway was reopened on 13 January.[121]

As already observed, the Lockyer Valley Regional Council's evacuation plan was a pro forma document into which no substantial detail had been inserted. No formal nomination of evacuation sites was published by the council or circulated throughout the community other than the identification of the Gatton Hall on its website on 27 December 2010. Consequently, on 10 January, Lockyer Valley residents had no knowledge of where to congregate or evacuate to, apart from the Gatton Hall. And although it may have been the best resourced site for the purpose, it was simply unreachable for many people needing shelter after the floods on 10 and 11 January.

Communities throughout the Lockyer Valley had little option but to establish their own evacuation centres, which were not properly equipped for the purpose with necessary facilities such as power, kitchens, toilets and bedding. This lack of planning caused unnecessary confusion and emotional upset for the community. It also placed a strain on local council, emergency services, police and private enterprise to provide the makeshift centres with essential goods and services.

Recommendation

7.3 Lockyer Valley Regional Council should identify those areas vulnerable to flooding within its region, should identify appropriate evacuation collection points and centres accordingly, and consider whether it should make those known to the community.

For more information and recommendations about evacuation centres and auditing of disaster preparation by councils see chapter *5 Emergency response*.

7.3 Other issues raised by communities in the Lockyer Valley

7.3.1 The effect of debris

Lockyer Valley residents identified vegetation and debris remaining in waterways as a major concern should further flooding occur. During the January flood, items picked up by the torrents of water were a serious danger to life and property as they were carried at speed downstream, and blocked the escape of water as they were caught against culverts and bridges.

As Dr Jordan, an expert hydrologist consulted by the Commission, observed in evidence, it seems unlikely that vegetation growing in or immediately adjacent to watercourses contributed significantly to the amount of debris washed downstream as compared with the amount of debris comprised of other vegetation stripped from land beyond creek beds and banks and, of course, man-made objects.[122] In any case, clearing of existing live vegetation in waterways is not something which should be embarked on without consultation with, and any necessary approval from, DERM.

Recommendation

7.4 Lockyer Valley Regional Council should immediately develop a plan for the removal of debris, man-made and natural, from waterways in the Lockyer Valley and put it into effect so as to minimise the risk should flooding recur in the coming wet season.

7.3.2 The Grantham railway line

The Grantham railway embankment formed a barrier impeding the flow of water north from the Lockyer Creek on 10 January 2011. It was suggested by some residents that culverts under the railway line would have allowed the passage of flood water. That is undoubtedly true; the question is, to what extent they would have helped. The evidence of Dr Jordan, which the Commission accepts, was that the volume of water that flowed through Grantham on 10 January 2011 would have required hundreds of culverts or a very large area of waterway opening to be an effective flood mitigation strategy and that additional culverts would also have increased flooding to the north of the railway line at Grantham.[123]

The issue of flood mitigation through infrastructure is one which will be dealt with in the Commission's final report, but the Commission does not presently regard the building of culverts below the Grantham railway line as a feasible means of flood mitigation.

7.3.3 The Grantham quarry

Some Grantham residents raised the question of whether stockpiles, earthen banks and buildings at Wagners' quarry west of Grantham contributed to or caused the flooding of the town on 10 January 2011.[124] The Lockyer Creek broke its banks both south and north of the quarry. Dr Jordan's preliminary opinion was that the quarry and its features might have had some very local influence, causing a marginal increase in flood levels immediately upstream from Grantham, but was unlikely to have had a significant influence on the downstream flow of water into Grantham.[125] However, without further modelling it was not possible to give an unequivocal opinion.

Recognising that the question is one of real and legitimate concern to the residents of Grantham, the Commission has engaged Dr Jordan to undertake the necessary modelling to enable conclusions to be drawn for its final report.

The Commission understands that the Lockyer Valley Regional Council has commissioned a detailed hydraulic model of the Grantham area, which may also provide further information.

7.3.4 Mobile phone reception in and around Murphys Creek, Spring Bluff and Postman's Ridge

Residents in Murphys Creek, Spring Bluff and Postman's Ridge raised concerns about the lack of mobile phone reception in these areas. This was of particular concern on 10 January 2011.[126] The Commission understands from submissions provided by telecommunications providers Optus and Telstra that there is limited mobile coverage in these areas because of the terrain, and because they regard it as not economically viable to provide more base stations, given the sparsity of the population.[127]

Since the floods, Optus has placed a temporary 2G mobile base station at Murphys Creek and has committed to leaving this in place until a permanent site can be built. A new base station at Helidon is due for completion by the end of 2011 and will provide improved coverage for Helidon and Postman's Ridge. Optus has advised that once the new stations at Murphys Creek and Helidon are built it will reassess the need for a specific station to cover Spring Bluff.[128]

Telstra has had a temporary mobile base station at Murphys Creek since 20 January 2011 and this is planned to be made permanent by July 2011. It does not plan any further increases in coverage in the region in the foreseeable future.[129]

7.3.5 Grantham residents' exclusion from their properties

Grantham residents raised concerns that police had prevented them from entering Grantham to inspect their properties for eight days after the flood event. They complained that the damage was made much worse because their houses had been locked up for over a week with mud and water trapped inside.[130]

Police had secured the town following 10 January while the search for bodies continued. The police officer commanding the search activities explained that the police did not want residents to return and discover bodies; they were also concerned that allowing people to clean up their properties before the search was complete would hamper efforts to locate the missing. In addition the area was rendered unsafe by the gas bottles, farming chemicals and other debris strewn throughout it. Queensland police attended the evacuation centres at Gatton and Helidon and explained the complexity of the search to Grantham residents housed there.[131]

Police offered to photograph premises for the excluded residents, so they had at least some idea of the damage to their properties, and arranged access for some primary producers and business owners for purposes such as attending to machinery or stock. They also retrieved items such as medical equipment for some residents.[132]

Some searches of Grantham houses were performed five times. On 16 January every residence was re-searched with a view to allowing the residents to return. On that search a body was located in a residence which had previously been searched a number of times. Another body was located on 17 January 2011 in debris behind a residence.

The exclusion of Grantham residents from their properties added to the stress of an already horrific experience. It was not, however, something which the Queensland Police Service could responsibly have avoided.

(Endnotes)

1 OESR http://www.oesr.qld.gov.au/products/maps/qld-lga-2008/qld-lga-2008-toowoomba.pdf

2 OESR, 2010 – http://www.oesr.qld.gov.au/products/profiles/pop-housing-profiles-lga/pop-housing-profile-toowoomba.pdf

3 Exhibit 75, BMT WBW Pty Ltd, *Technical Report on the Toowoomba flood of 10 January 2011 – prepared for Local Government Association of Australia,* April 2011 [p2-1]; Exhibit 69, Insurance Council of Australia, *The Nature and Causes of Flooding in Toowoomba 10 January 2011*, 14 February 2011 [p17].

4 Exhibit 79, Toowoomba Regional Council Disaster Management Plan; Exhibit 80, Toowoomba Regional Council Evacuation and Welfare Management Plan; Exhibit 86, Toowoomba Regional Council Local Disaster Management Group minutes [19 August 2010]; http://disaster.toowoombarc.qld.gov.au/index.php?option=com_docman&task=cat_view&gid=48&Itemid=74.

5 Exhibit 87 'Council Connections' newsletters, Summer 2009; Exhibit 88 'Council Connections' Summer 2010.

6 Exhibit 86, Toowoomba Regional Council Local Disaster Management Group minutes, [19 August 2010, 11 November 2010, 2009/10 District Disaster Management Group Report 25 June 2010].

7 Exhibit 82, Confidential Report on the Flood Event of 10 January 2011 by Toowoomba Regional Council, 25 January 2011 [p2].

8 Exhibit 76, BMT WBM Pty Ltd, *Technical report on the Oakey flood of 10-11 January 2011 – prepared for Local Government Association of Queensland Ltd*, April 2011 [p2-1].

9 Exhibit 82, Confidential Report on the Flood Event of 10 January 2011 by Toowoomba Regional Council, 25 January 2011 [p2].

10 Exhibit 86, Toowoomba Regional Council, Local Disaster Management Group Minutes [10 January 2011, 1:00 pm].

11 Exhibit 82, Confidential Report on the flood event of 10 January 2011 by Toowoomba Regional Council, 25 January 2011 [p3].

12 Exhibit 69, Insurance Council of Australia, *The Nature and Causes of Flooding in Toowoomba 10 January 2011*, 14 February 2011 [p24].

13 Submission of Susan Murphy, 11 April 2011 [p2].

14 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p1].

15 Exhibit 82, Confidential Report on the flood event of 10 January 2011 by Toowoomba Regional Council, 25 January 2011 [p3].

16 Exhibit 82, Confidential Report on the flood event of 10 January 2011 by Toowoomba Regional Council, 25 January 2011 [p3].

17 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p17].

18 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p17].

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20 Exhibit 69, Insurance Council of Australia, *The Nature and Causes of Flooding in Toowoomba 10 January 2011*, 14 February 2011[i].

21 Exhibit 69, Insurance Council of Australia, *The Nature and Causes of Flooding in Toowoomba 10 January 2011*, 14 February 2011 [p i].

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23 Exhibit 75, BMT WBW Pty Ltd, *Technical Report on the Toowoomba flood of 10 January 2011 – prepared for Local Government Association of Australia,* April 2011 [p3-1].

24 Exhibit 77, Statement of Kenneth Gouldthorp, 1 April 2011 [p3, 5].

25 Exhibit 140, Statement of Assistant Commissioner Stephan Gollschewski [p25].

26 Exhibit 92, Toowoomba Regional Council bundle of media releases, 10 January 2011.

27 Exhibit 76, BMT WBM Pty Ltd, *Technical report on the Oakey flood of 10-11 January 2011 – prepared for Local Government Association of Queensland Ltd*, April 2011 [p3-1; p3-4].

28 Exhibit 212, Statement of Kevin John Wruck, 16 April 2011 [p4-5].

29 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p31].

30 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p21; p31].

31 Exhibit 83, Toowoomba Regional Council, Emergency Action Plan, Cooby Dam, Section 4 [p1].

32 Exhibit 76, BMT WBM Pty Ltd, *Technical report on the Oakey flood of 10-11 January 2011 – prepared for Local Government Association of Queensland Ltd*, April 2011 [p3-1].

33 Exhibit 76, BMT WBM Pty Ltd, *Technical report on the Oakey flood of 10-11 January 2011 – prepared for Local Government Association of Queensland Ltd*, April 2011 [p3-1].

34 Exhibit 94, Statement of Roy Inwood, 22 March 2011 [p3]; Exhibit 96, Submission of Roy Inwood; Transcript, Roy Inwood, 19 April 2011, Toowoomba [p627: line 34].

35 Exhibit 205, Statement of Bernard Earsman, 29 March 2011 [p5]; Submission P & C Faulkner, 11 April 2011; Submission M Jensen, undated.

36 Exhibit 92, Toowoomba Regional Council bundle of media releases, 10 January 2011.

37 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p21-24].

38 Exhibit 76, BMT WBM Pty Ltd, *Technical report on the Oakey flood of 10-11 January 2011 – prepared for Local Government Association of Queensland Ltd*, April 2011 [p3-2; p3-3].

39 Exhibit 83, Toowoomba Regional Council, Emergency Action Plan, Cooby Dam, Section 4 [p7].

40 Exhibit 189, Statement of Alan Kleinschmidt, 15 April 2011 [p3].

41 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry*, 12 April 2011 [p43].

42 Exhibit 206, Statement of Gary Peters, 10 April 2011 [p1-4].

43 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [pp43-44].

44 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p44]; Exhibit 84, Toowoomba Regional Council Emergency Event Report, Cressbrook, Perseverance and Cooby Dams Flood Event [Attachment 1].

45 Exhibit 83, Toowoomba Regional Council, Emergency Action Plan, Cooby Dam, Section 4 [p10-12].

46 Exhibit 84, Toowoomba Regional Council Emergency Event Report, Cressbrook, Perseverance and Cooby Dams Flood Event, Attachment 1; Exhibit 189, Statement of Alan Charles Kleinschmidt, 15 April 2011 [p3].

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50 Exhibit 161, Record of interview with Mayor Stephen Jones, 7 April 2011 [p39: line 1].

51 Transcript, Mayor Stephen Jones, 28 April 2011, Toowoomba [p910: line 25]; Exhibit 161, Record of interview with Mayor Stephen Jones, 7 April 2011 [p 7-8].

52 Exhibit 494, Statement of Bruce Grady, 24 March 2011, Attachment BG-6; Exhibit 168, General Flood Planning Prior to 2010 [p1].

53 Exhibit 160, Lockyer Valley Regional Council Ordinary Council Meeting Minutes, 22 September 2010.

54 Transcript, Mayor Stephen Jones, 28 April 2011, Toowoomba [p974: line 35].

55 Exhibit 159, Local Disaster Management Group Meeting Minutes, 23 September 2010.

56 Exhibit 168, General Flood Planning Prior to December 2010 [p199].

57 Exhibit 169, Flood Planning in 2010 Email Madonna Brennan, 23 December 2010 [p11].

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59 Exhibit 162, Lockyer Valley LDMG Evacuation & Welfare Management Sub-Plan, xx/09/08; Transcript, Mayor Stephen Jones 28 April 2011, Toowoomba [p920: line 20].

60 Transcript, Mayor Stephen Jones, 28 April 2011, Toowoomba [p921: line 10].

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62 Exhibit 165, EMQ Situation Reports dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 8, 28 December 2010, 1545].

63 Exhibit 165, EMQ Situation Reports dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 8, 28 December 2010, 1545; Situation Report No 12, 1 January 2011, 1300].

64 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 7 January 2011 - 9 January 2011; Exhibit 165, EMQ Situation Reports dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 1, 9 January 2011, 2330].

65 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 9 January 2011 [p6-8]; Exhibit 140, statement of Assistant Commissioner Stephan William Gollschewski [p13].

66 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 9 January 2011 [p9].

67 Transcript, Phillip Jordan, Toowoomba, 18 April 2011, [p501: line 50]; Exhibit 67 , Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p24].

68 Exhibit 70, Insurance Council of Australia – Flooding in the Brisbane River Catchment January 2011, Volume 4, Flooding in Lockyer Valley [p iii].

69 Exhibit 38, Provision of Preliminary Meteorological and Hydrological Information: Background briefing for the Queensland Floods Commission Inquiry, February 2011 [p12].

70 Exhibit 184, Statement of Sarah Norman, 13 January 2011 [p3].

71 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p24].

72 Exhibit 175, Statement of Peter Souter, 15 February 2011 [p2].

73 Exhibit 175, Statement of Peter Souter, 15 February 2011 [p3].

74 Exhibit 192, Statement of Susan Haughey, 10 February 2011 [p2].

75 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 10 January 2011 [p10-11].

76 Exhibit 178, Statement of Ruby Jensen, 23 March 2011 [p2].

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78 Exhibit 70, Insurance Council of Australia, Flooding in the Brisbane River Catchment January 2011, Volume 4, Flooding in Lockyer Valley, 20 February 2011 [piii, iv].

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80 Exhibit 338, Statement of Air Vice-Marshal Kevin Paule, 10 May 2011 [p16].

81 Exhibit 180, Statement of Mark Kempton, 17 February 2011 [p2, 5]; Transcript, Mark Kempton, 29 April 2011, Toowoomba [p1051: line 30].

82 Statement of Peter Row, 14 February 2011 [p3].

83 Exhibit 338, Statement of Air Vice-Marshal Kevin Paule, 10 May 2011 [p16].

84 Exhibit 338, Statement of Air Vice-Marshal Kevin Paule, 10 May 2011 [p17].

85 Exhibit 154, Statement of Inspector Mark Kelly, 30 March 2011 [p4].

86 Exhibit 154, Statement of Inspector Mark Kelly, 30 March 2011 [p9].

87 Exhibit 154, Statement of Inspector Mark Kelly, 30 March 2011 [p7].

88 Transcript, Mark Kelly, 27 April 2011, Toowoomba [p885: line 50].

89 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 10 January 2011 [p11].

90 Exhibit 161, Record of interview with Mayor Stephen Jones, 7 April 2011 [p28: line 42].

91 Statement of Gary Dorr, 8 July 2011.

92 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 10 January 2011 [p11].

93 Exhibit 163, Lockyer Valley LDMG Reactivation of Centre, 10 January 2011 [p12] .

94 Exhibit 179, Statement of Daniel Brian Watkins, 30 January 2011 [p6].

95 Statement of Gilbert Kilah, dated 22 January 2011 [p2, 3, 5].

96 Exhibit 153, Statement of Bronwyn Faith Darlington, dated 20 January 2011 [pp5-6].

97 Exhibit 181, Statement of Kathleen Mahon, 8 February 2011 [p5];. Exhibit 149, Statement of Martin Warburton, 20 January 2011 [p10]; Exhibit 146, Statement of Robert Wilkin, 24 January 2011 [p4]; Exhibit 181, Statement of Ian Gordon, 9 February 2011 [p2-3]; Statement of Julie Bellette, 31 January 2011 [p2]; Statement

of Gilbert Kilah, 21 January 2011 [p2]; Statement of Danyel Harman, 27 January 2011 [p2]; Statement of Wayne Geeves, 4 February 2011 [p2]; Statement of Darlene Jenckel, 20 January 2011 [p2]; Statement of Susanne Steinhardt, 19 January 2011 [p2]; Statement of Kelvin Wood, 26 January 2011 [p3]; Statement of Rebecca Sparkes, 21 January 2011 [p2]; Exhibit 153, Statement of Bronwyn Darlington, 20 January 2011 [p5]; Exhibit 179, Statement of Daniel Watkins, 30 January 2011 [p5]; Exhibit 203, Statement of Lance Richardson, 16 March 2011 [p2].

98 Transcript, Mayor Stephen Jones, 28 April 2011, Toowoomba [p932: line 15].

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100 Exhibit 176, Murphy's Creek Flood Recovery Centre Operations January 2011, Summary of Operations Report [p5]; Exhibit 159, Lockyer Valley Local Disaster Management Group meeting minutes dated from 18 September 2010 to 8 March 2011[p63].

101 Transcript, Peter Souter, 28 April 2011, Toowoomba [p991: line 30].

102 Exhibit 176, Murphy's Creek Flood Recovery Centre Operations January 2011, Summary of Operations Report [p4].

103 Transcript, Mayor Stephen Jones, 28 April 2011, Toowoomba [p937: line 35].

104 Exhibit 140, Statement of Assistant Commissioner Stephan Gollschewski, 10 March 2011 [p48]; Exhibit 204, Statement of Senior Sergeant James McDonald, 14 March 2011 [p7]; Transcript, Robert Bundy, 29 April 2011, Toowoomba [p1017: line 40].

105 Transcript, Robert Bundy, 29 April 2011, Toowoomba [p1017: line 40]; Exhibit 177, Statement of Robert Bundy, 6 April 2011 [p4]; Exhibit 164, Lockyer Valley Request for Assistance Running Log, 10 January 2011 – 11 February 2011.

106 Exhibit 177, Statement of Robert Bundy, 6 April 2011 [p4].

107 Exhibit 182, Statement of Inspector Benjamin Marcus, 16 March 2011 [p9]; Transcript, Peter Souter, 28 April 2011, Toowoomba [p990, 991]; Transcript, Inspector Michael Crowley, 28 April 2011, Toowoomba [p980].

108 Exhibit 165, EMQ Situation Report dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report, No 5, 10 January 2011 2415].

109 Exhibit 165, EMQ Situation Report dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 6, 11 January 2011, 0537].

110 Exhibit 165, EMQ Situation Report dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 8, 11 January 2011, 2150].

111 Exhibit 165, EMQ Situation Report dated 28 December 2010, 6 January 2011, 9 January 2011 [Situation Report No 9, 12 January 2011, 1030].

112 Exhibit 198, Statement of Christie Minns, 27 January 2011 [p4].

113 Exhibit 199, Statement of Rodney Minns, 27 January 2011 [pp8-12].

114 Exhibit 150, Statement of Martin Warburton, dated 17 March 2011 [p4].

115 Exhibit 198, Statement of Christie Minns, 27 January 2011 [p5].

116 Exhibit 197, Statement of Julie Johnson, 8 March 2011 [p5].

117 Exhibit 193, Statement of Susan Haughey, 15 March 2011 [p3].

118 Statement of James Barnes, 24 March 2011 [p6].

119 Exhibit 178, Statement of Ruby May Jensen, 23 March 2011 [pp3-4]; Transcript, Ruby Jensen, Toowoomba, 29 April 2011 [p1040: line 40].

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122 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p53]; Transcript, Dr Phillip Jordan, 18 April 2011, Toowoomba [p503].

123 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p68]; Transcript, Dr Phillip Jordan, 18 April 2011, Toowoomba [p504-505].

124 Queensland Floods Commission of Inquiry community consultation, Grantham, 15 March 2011.

125 Exhibit 67, Dr Phillip Jordan, SKM, *Hydrological advice to Queensland Floods Commission of Inquiry,* 12 April 2011 [p27-28]; Transcript, Dr Phillip Jordan, 18 April 2011, Toowoomba [p504].

126 Queensland Floods Commission of Inquiry community consultation, Murphys Creek, 17 March 2011.

127 Exhibit 214, Submission of Optus, 4 April 2011 [p2]; Exhibit 215, Supplementary submission of Telstra, 8 April 2011 [p19-20].

128 Exhibit 214, Submission of Optus, 4 April 2011 [p3].

129 Exhibit 215, Supplementary submission of Telstra, 8 April 2011 [p19].

130 Submission of PJ Gallagher, 10 June 2011 [p3].

131 Exhibit 154, Statement of Inspector Mark Kelly, 30 March 2011 [p6-7].

132 Exhibit 182, Statement of Inspector Benjamin Marcus, 16 March 2011 [p8].

Appendices

Appendix 1: Terms of Reference

[77]

Queensland Government Gazette

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Commissions of Inquiry Act 1950

COMMISSIONS OF INQUIRY ORDER (No.1) 2011

TABLE OF PROVISIONS

1. Short Title

This Order in Council may be cited as *Commissions of Inquiry Order (No.1) 2011*.

2. Appointment of Commission

UNDER the provisions of the *Commissions of Inquiry Act 1950*, Her Excellency the Governor, acting by and with the advice of the Executive Council, hereby appoints the Honourable Justice Catherine Holmes to make full and careful inquiry in an open and independent manner with respect to the following matters:-

a) the preparation and planning by federal, state and local governments; emergency services and the community for the 2010/2011 floods in Queensland,

b) the performance of private insurers in meeting their claims responsibilities,

c) all aspects of the response to the 2010/2011 flood events, particularly measures taken to inform the community and measures to protect life and private and public property, including:
- immediate management, response and recovery;
- resourcing, overall coordination and deployment of personnel and equipment;
- adequacy of equipment and communications systems; and
- the adequacy of the community's response.

d) the measures to manage the supply of essential services such as power, water and communications during the 2010/2011 flood events,

e) adequacy of forecasts and early warning systems particularly as they related to the flooding events in Toowoomba, and the Lockyer and Brisbane Valleys,

f) implementation of the systems operation plans for dams across the state and in particular the Wivenhoe and Somerset release strategy and an assessment of compliance with, and the suitability of the operational procedures relating to flood mitigation and dam safety,

g) all aspects of land use planning through local and regional planning systems to minimise infrastructure and property impacts from floods,

h) in undertaking its inquiries, the Commission is required to:
- take into account the regional and geographic differences across affected communities; and
- seek public submissions and hold public hearings in affected communities.

3. Commission to report

AND directs that the Commissioner make full and faithful report concerning the aforesaid subject matter of inquiry, and make recommendations which she considers appropriate, feasible and cost effective to improve:
- the preparation and planning for future flood threats and risks, in particular the prevention of the loss of life;
- the emergency response in natural disaster events; and
- any legislative changes needed to better protect life and property in natural disaster events.

and transmit an interim report to the Honourable the Premier and Minister for the Arts by 1 August 2011, on matters associated with flood preparedness to enable early recommendations to be implemented before next summer's wet season, and a final report by 17 January 2012.

4. Report to be made public

AND further directs that the Reports transmitted to the Honourable the Premier and Minister for the Arts be made public upon their transmission to the Honourable the Premier and the Minister for the Arts.

5. Deputies to the Commission

Under Section 27 of the *Commissions of Inquiry Act 1950*, Her Excellency the Governor, acting by and with the advice of the Executive Council approves the appointment of Mr James O'Sullivan AC and Mr Phillip Cummins as Deputies to the abovementioned Commission.

6. Application of Act

The provisions of the *Commissions of Inquiry Act 1950* shall be applicable for the purposes of this inquiry except for section 19C – Authority to use listening devices.

7. Conduct of Inquiry

The Commissioner may hold public and private hearings in such manner and in such locations as may be necessary and convenient. The Commissioner may:

a) hold hearings constituted by the Commissioner, whether sitting alone or with one or both of her Deputies; or
b) authorise her Deputies or either of them to hold hearings or exercise powers pursuant to Section 28 of the *Commissions of Inquiry Act 1950*.

ENDNOTES

1. Made by the Governor in Council on 17 January 2011.
2. Published in an Extraordinary Gazette 17 January 2011.
3. Not required to be laid before the Legislative Assembly.
4. The administering agency is the Department of the Premier and Cabinet.

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Commissions of Inquiry Act 1950

COMMISSIONS OF INQUIRY AMENDMENT ORDER (No.1) 2011

TABLE OF PROVISIONS

1. Short Title

This Order in Council may be cited as *Commissions of Inquiry Amendment Order (No. 1) 2011*.

2. Amended Order

The *Commissions of Inquiry Order (No. 1) 2011* is amended as set out in this order.

3. Amendment of Order

At Clause 3, '17 January 2012'–

omit, insert–

'24 February 2012'.

ENDNOTES

1. Made by the Governor in Council on 26 May 2011.
2. Published in an Extraordinary Gazette on 26 May 2011.
3. Not required to be laid before the Legislative Assembly.
4. The administering agency is the Department of the Premier and Cabinet.

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Appendix 2: Leave to appear

Parties granted leave to appear at the Commission

Party	Terms of Reference granted
Seqwater	2(c) all aspects of the response 2(d) essential services 2(f) dam management, specifically for Wivenhoe and Somerset Dams
Insurance Council	2(b) performance of private insurers
Local Government Association of Queensland Ltd (representing local councils)	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(e) forecasts and early warning systems *(Balonne, Goondiwindi and Moreton Bay regional Councils)* 2(g) land use planning
Ergon Energy	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services
Suncorp Group Ltd	2(b) performance of private insurers
Brisbane City Council	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(e) forecasts and early warning systems 2(f) dam management, specifically for Wivenhoe and Somerset Dams 2(g) land use planning
Ipswich City Council	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(e) forecasts and early warning systems 2(f) dam management, specifically for Wivenhoe and Somerset Dams 2(g) land use planning
State of Queensland	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(f) dam management, specifically for Wivenhoe and Somerset Dams 2(g) land use planning
SunWater Ltd	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(e) forecasts and early warning systems 2(f) dam management, specifically for Wivenhoe and Somerset Dams
Burnett Water Pty Ltd	2(a) preparation and planning 2(c) all aspects of the response 2(d) essential services 2(e) forecasts and early warning systems 2(f) dam management, specifically for Wivenhoe and Somerset Dams

Party	Terms of Reference granted
The Commonwealth	2(a) preparation and planning 2(b) performance of private insurers 2(c) all aspects of the response 2(e) forecasts and early warning systems 2(f) dam management, specifically for Wivenhoe and Somerset Dams
Tarong Energy	2(d) essential services
RACQ Insurance	2(b) performance of private insurers
Energex Ltd	2(c) all aspects of the response 2(d) essential services
Fernvale Community Action Group	2(f) dam management, specifically for Wivenhoe and Somerset Dams
Mid Brisbane River Irrigators	2(f) dam management, specifically for Wivenhoe and Somerset Dams
Queensland Police Union of Employees	2(c) all aspects of the response
United Firefighters Union of Australia	2(c) all aspects of the response

Appendix 3: Glossary

ABC means the Australian Broadcasting Corporation.

ACCESS forecast means a Bureau of Meteorology forecast obtained from the Australian Community Climate and Earth-System Simulator.

Aeromedical services means the use of helicopters and fixed wing aircraft to assist in medical situations (e.g. to transport patients in isolated areas to hospital).

AgForce Queensland is a peak organisation representing Queensland's rural producers (adapted from AgForce website www.agforceqld.org.au).

ALERT means Automated Local Evaluation in Real-Time which is a system of monitoring and displaying rainfall and water level data. It is a combination of field stations, communications networks and data collection software.

All Hazards Information Management System is an information system that supports logistical planning and integration of major incident co-ordination, response and recovery activities.

Annual Exceedance Probability (AEP) means the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500m^3/s has an AEP of 5%, it means that there is a 5% chance (1 in 20 chance) of a 500m^3/s or larger event occurring in any one year (see ARI).

Appliance is a term used by the fire service when referring to a vehicle used in its firefighting operations. Specific types of appliances include aerial ladder platforms, pumper tankers and fire command vehicles.

Australian Bureau of Meteorology (the Bureau) is Australia's national weather, climate and water agency.

Australian Height Datum (AHD) means a common national surface level datum approximately corresponding to mean sea level.

Australian National Committee on Large Dams (ANCOLD) is an incorporated voluntary association of organisations and individual professionals with an interest in dams in Australia (taken from www.ancold.org.au).

Auxiliary firefighter is a paid part-time firefighter, located in regional communities across Queensland.

Average Recurrence Interval (ARI) means the long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.

Calibrate (with respect to a hydrologic and hydraulic model) means the checking of values derived from the model against physical measurements. This is achieved by adjusting parameters, within an acceptable range and in a consistent manner, to best fit the physical measurements.

Catchment is the land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specified location.

Cells on Wheels (COWs) are temporary mobile base stations used by Telstra to provide temporary coverage if a mobile site was lost during the 2010/2011 floods.

Co-ordination centre is a centre established at state, district or local government level as a centre of communication and co-ordination in times of disaster.

Council is a local government as defined in the *Local Government Act 2009*. The terms council and local government are used interchangeably in this report.

Councillor is an elected official of a local government (council), including the mayor.

Council of Australian Governments (COAG) is Australia's peak intergovernmental forum which comprises the Prime Minister, Premiers and Chief Ministers.

DERM is the Queensland Department of Environment and Resource Management.

Disaster district is a part of the state prescribed under a regulation as a disaster district (*Disaster Management Act 2003*).

Disaster management includes activities undertaken before, during or after an event to help reduce loss of human life, illness or injury to humans, property loss or damage, or damage to the environment, including, for example, activities to mitigate the adverse effects of the event (*Disaster Management Act 2003*).

Disaster management group may refer to the state group, a district group or a local group.

Disaster management guidelines are the guidelines prepared by Emergency Management Queensland to assist disaster groups prepare disaster management plans, and matters to be included in plans (*Disaster Management Act 2003*).

Disaster response is the taking of measures to respond to a disaster before, during and immediately after its onset including; issuing warnings, providing medical assistance, evacuating people and establishing emergency food and shelter (*Disaster Management Act 2003*).

Discharge is the rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving.

District disaster co-ordinator (district co-ordinator) is a person appointed to co-ordinate disaster operations in the disaster district (*Disaster Management Act 2003*). The district disaster co-ordinator is also the chairperson of the district group.

District disaster management group (district group) is a disaster management group established to perform disaster management activities in the district (*Disaster Management Act 2003*).

District disaster management plan (district plan) is the disaster plan prepared by a district disaster management group (*Disaster Management Act 2003*).

Emergency service unit is established in rural and remote locations and is staffed by volunteers. It performs the functions of an SES unit, fire prevention and/or fire-fighting work (*Disaster Management Act 2003*).

ESCAD means Emergency Service Computer Aided Despatch system used by the Department of Community Safety (fire and ambulance officers).

ESCORT means the Emergency Services Communications and Operational Response Tasking computer despatch system used by the Queensland Police Service.

Essential services encompass the provision of electrical power, drinking water and telecommunications.

Flash flood is usually the result of intense local rain and characterised by rapid rises in water-levels.

Flood engineer means one of the four engineers who operated Wivenhoe, Somerset and North Pine dams from the flood operations centres in flood events throughout the 2010/2011 wet season.

Flood event (with regard to Wivenhoe, Somerset or North Pine dams) means a situation where the flood engineer on duty expects the water level in Wivenhoe, Somerset or North Pine dams to exceed the full supply level.

Flood operations centre means the location used by flood engineers during a flood event to manage Wivenhoe, Somerset and North Pine dams.

Floodplain is a geological term meaning a low plain adjacent to a river that is formed chiefly of river sediments and is subject to flooding. .

Freeboard (with regard to dams) means the height between the water level at a dam and the top of a dam wall.

Full supply level (FSL) means the level of the water surface when the reservoir is at maximum operating level, excluding periods of flood discharge.

Fuse plugs are sections of embankment at a dam which are designed to erode when the water level reaches a certain height to increase releases from the dam.

Gauge is a tool which takes measurements of, for example, rainfall or river height.

Hydrodynamic (hydraulic) model uses data about the flow in streams and the terrain of a particular area to estimate flood heights, velocities and flow over time. In order to do this the hydrodynamic model solves the equations for the conservation of mass and momentum/energy.

Hydrologic model (runoff routing model) uses rainfall data and estimates of the proportion of the rainfall which turns into runoff and the time which the runoff from each part of the catchment takes to flow into the stream to estimate flow in the stream over time.

Hydrology is the term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

La Niña refers to the extensive cooling of the central and eastern Pacific Ocean. In Australia (particularly eastern Australia), La Niña events are associated with increased probability of wetter conditions (adapted from www.bom.gov.au).

Levee is a raised embankment or earthworks along the floodplain that reduce the frequency of inundation of areas adjacent to the waterway. They are designed to withstand certain river heights, and will be overtopped if floodwaters exceed this level (Office of the Chief Scientist, 2011, *Understanding floods: questions and answers*).

Local controller is the person appointed as the local controller of an SES unit (*Disaster Management Act 2003*).

Local disaster co-ordinator (local co-ordinator) is a person appointed to co-ordinate disaster operations for a local disaster management group (*Disaster Management Act 2003*).

Local disaster management group (local group) is a local group established by a local government to perform disaster management activities in the local region (*Disaster management Act 2003*).

Local disaster management plan (local plan) is the disaster plan prepared by a local government.

Local Government Association of Queensland is the peak body representing local government in its dealings with other governments, unions, business and the community (www.lgaq.asn.au).

Mobile Exchanges on Wheels (MEOWs) are portable ADSL2+ enabled temporary exchanges used by Telstra to enable the quick installation of temporary communication solutions in the 2010/2011 floods.

Major flooding leads to extensive flooding of rural areas and/or urban areas. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood affected areas may be required (adapted from the Australian Bureau of Meteorology www.bom.gov.au).

Megalitre is equal to one million litres.

Minor flooding occurs in low-lying areas next to watercourses where inundation may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged (adapted from the Australian Bureau of Meteorology www.bom.gov.au).

Moderate flooding may require the evacuation of some houses and main traffic routes may be covered. The area of inundation is substantial in rural areas, requiring the removal of stock (adapted from the Australian Bureau of Meteorology www.bom.gov.au).

m^3/s (cumec) means a rate of flow being one cubic metre per second or 1000 litres per second.

National Emergency Management Committee is a Commonwealth body that provides advice and direction on national emergency management issues and policy (adapted from the Attorney-General's Department website www.ag.gov.au).

National Registration Inquiry System is a voluntary registration system that is jointly managed, maintained and operated by the Australian Red Cross on behalf of the Commonwealth Attorney-General's Department.

Natural Disaster Relief and Recovery Arrangements is a disaster response and recovery assistance program to assist local governments restore essential public assets damaged by a disaster event. It is administered by the Queensland Government's Department of Local Government and Planning.

Natural Disaster Resilience Program is a grants program that is administered as a partnership between the Australian and state/territory governments. Its aim is to enhance Australia's disaster resilience through mitigation

works and activities. Local governments and disaster groups and agencies are able to seek funding for particular projects.

O'Sullivan Review was an independent review of Queensland's disaster management legislation, policies, guidelines and plans, as well as management and accountability in the State Emergency Service (SES). Many of the review's recommendations took effect in November 2010 through amendments to the *Disaster Management Act 2003*.

Peak (river height) represents the highest river height (in metres) reached by a river at a specified gauge site during a flood. A peak may be described as 'minor', 'moderate' or 'major', denoting its severity and the impact on nearby areas.

Probable maximum flood is an estimate of the largest possible flood that could occur at a particular location, under the most severe meteorological and hydrological conditions as they are currently understood (Office of the Chief Scientist (Qld), 2010, *Understanding floods: questions and answers*).

Pumper is a fire service vehicle primarily used for pumping water. Water may be pumped to another fire truck or directly onto flames.

Q100 is a probability-based design flood event, aimed to reflect typical combinations of flood producing and flood modifying factors which act together to produce a flood event at a specific location of interest that has a 1 in 100 chance of being equalled or exceeded in any one year (1% annual exceedance probability – AEP); it is described as having an average recurrence interval (ARI) of 100 years. It is a theoretical flood model used to inform planning and policy. (Brisbane City Council Joint Flood Taskforce Report, March 2011.)

Quantitative Precipitation Forecast for the Wivenhoe and Somerset dams catchment is a Bureau of Meteorology product which predicts the amount of rainfall in millimetres for the following 24 hours.

Rating means a estimated relationship at a particular point in a waterway between the height of the water and flow.

Real time flood model is a suite of models used by the flood engineers during a flood event to estimate water flow in the catchments of, and downstream from, Wivenhoe, Somerset and North Pine dams.

Referable dam is a dam which has been assessed as posing a risk to the safety of two or more people should it fail.

Risk register is a listing of risk statements describing sources of risk and elements at risk with assigned consequences, likelihoods and levels of risk (State Disaster Management Group, 2010, *Queensland State Disaster Management Plan*).

Roads and Traffic Authority (RTA) is a New South Wales state government agency responsible for improving road safety, testing and licensing drivers, inspecting vehicles and managing the road network.

Royal Automobile Club of Queensland (RACQ) is Queensland's peak motoring organisation, providing a range of services including roadside assistance, car insurance and finance (www.racq.com.au).

Runoff is the water flow that occurs when either (1) soil is infiltrated to full capacity; or (2) rainfall occurs at a rate greater than the rate at which it can infiltrate to the soil. The resultant 'excess' water from rain and other sources flows over the land (Office of the Chief Scientist, 2011, *Understanding floods: questions and answers*).

Rural Fire Service is the volunteer branch of the Queensland Fire and Rescue Service. It provides fire management for rural and semi-rural communities across approximately 93% of the State.

Seqwater means the Queensland Bulk Water Supply Authority, trading as Seqwater.

SES is the State Emergency Service (*Disaster Management Act 2003*).

SES member is a person appointed as an SES member (*Disaster Management Act 2003*).

SES unit is an SES unit established for a local government region (*Disaster Management Act 2003*).

SMS means short message service, or text message.

Social media allow users to communicate and share information online. Examples include Facebook and Twitter.

Spillway means a structure designed to provide for the release of water from a dam in a safe manner.

'splash page' means a single webpage which contains all of the site content on one page rather than providing further hyperlinks to subsequent web pages.

State disaster co-ordinator (state co-ordinator) is a person appointed by the chairperson of the state group to co-ordinate the disaster response operations on behalf of the state group (*Disaster Management Act 2003*).

State disaster management group (state group) is the peak disaster management policy and decision-making body in Queensland and it provides strategic direction and advice to government (*Disaster Management Act 2003*).

State disaster management plan (state plan) is prepared by the state disaster management group and articulates Queensland's disaster management arrangements (*Disaster Management Act 2003*).

State recovery co-ordinator (recovery co-ordinator) is a person appointed by the chairperson of the state group to co-ordinate the disaster recovery operations for the state group (*Disaster Management Act 2003*).

Stream / river gauging station (gauge) measures the height of the water in a river at a particular location. It may be manual or automated (Office of the Chief Scientist, 2011, *Understanding floods: questions and answers*).

Telemeter gauge is a gauge that sends river level or rainfall data at periodic intervals to a computer. Data is sent via telephone communication landline, mobile or satellite.

Turbidity relates to the amount of small particles of solid matter suspended in the water sample.

UHF means ultra high (radio) frequency

VHF means very high (radio) frequency

'with forecast' model means the hydrologic model which estimates lake level at Wivenhoe and Somerset dams taking into account both rain that has already fallen and the full quantitative precipitation forecast most recently issued by the Bureau of Meteorology.

'without forecast' model means the hydrologic model which estimates lake level at Wivenhoe and Somerset dams taking into account only rain that has already fallen and is on the ground.