Transcript of Proceedings

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THE HONOURABLE JUSTICE C HOLMES, Commissioner

MR JAMES O'SULLIVAN AC, Deputy Commissioner
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IN THE MATTER OF THE COMMISSIONS OF INQUIRY ACT 1950

COMMISSIONS OF INQUIRY ORDER (No. 1) 2011

QUEENSLAND FLOODS COMMISSION OF INQUIRY

BRISBANE

..DATE 18/04/2011

..DAY 7

THE COMMISSION RESUMED AT 10.00 A.M. AT TOOWOOMBA

COMMISSIONER: We might run through the appearances again for this morning. So, Mr Callaghan, you appear?

MR CALLAGHAN: If it please, Madam Commissioner, my name is Callaghan, initials PJ, Senior Counsel, with my learned friend Ms Wilson. We appear to assist the Commission.

COMMISSIONER: Ms McLeod?

MS McLEOD: Yes, Madam Commissioner, my name is Fiona McLeod and I appear with Ms O'Gorman for the Commonwealth.

COMMISSIONER: Mr Rolls.

MR ROLLS: In this matter, I appear for the State of Queensland. My name is Rolls, R-O-L-L-S, initials JB, with my learned friend Mr MacSporran of Senior Counsel, and Ms Brash.

COMMISSIONER: Thank you. And then coming along this way, Mr Gibson?

MR GIBSON: Thank you, Madam Commissioner, my name is Gibson, initials G J, and I appear with my learned friend Mr Stewart Ure of counsel for the Local Government Association of Queensland Limited on behalf of Toowoomba Regional Council.

COMMISSIONER: Thank you. That's all the appearances, isn't it? Mr Callaghan?

MR CALLAGHAN: Ms Wilson will make an opening statement, if it pleases the Commission.

COMMISSIONER: Thank you. Ms Wilson?

MS WILSON: Madam Commissioner, in Toowoomba and the Lockyer Valley, the 10th of January this year started like many other days of the summer of 2010/2011. It was raining. However, along the South East Queensland coast, a sequence of thunderstorms was forming and moving slowly inland towards the mountain range. The thunderstorms were increasing in intensity and hit Toowoomba and the Lockyer Valley with catastrophic consequences. Streets in the middle of Toowoomba turned into fast flowing powerful rivers that overwhelmed anything in their way. What has been described as an inland tsunami hit the Lockyer Valley. In its wake, it left destroyed properties, injured people, and a saddening death toll. Twenty-one people died and there are still three people declared missing. Whilst this day showed the power of nature at it worst, it also showed the very best of people and the communities they live in. On this day and the days that followed, ordinary people performed extraordinary feats to help save lies and help a system of response and recovery of their community and those of others.

The Commission has received many statements from eye-witnesses and also submissions from the public and government agencies concerning these flood events in Toowoomba and the Lockyer Valley. Further, the Commission has already held community consultations in Grantham and Murphys Creek. Some of the issues raised in these community consultations, along with many others, will be examined here in these public hearings in Toowoomba.

Over the next two weeks, the Commission is sitting in Toowoomba for five days, and will consider the flooding that occurred in Toowoomba, Oakey and the Lockyer Valley with particular emphasis on the catastrophic events of 10 January 2011.

An interim report is due by 1 August 2011 on matters associated with flood preparedness to enable early recommendations to be implemented before next summer's wet season. Accordingly, the focus of these hearings will be directed at any issues where practical recommendations can be made for the next summer.

Whilst each town or region may have issues particular to that area, there are some matters that may have widespread interest, not only in Toowoomba and the Lockyer Valley, but also across the State. We will raise three such issues now.

First, an important issue is how the various levels and arms of government deal with disaster management. Legislation in the form of the Disaster Management Act sets out the structures and responsibilities for various local and State Government agencies. Although this legislation has been in place since 2003, significant amendments concerning the roles of local councils, the Queensland Police Service, the QPS, an Emergency Management Queensland, the EMQ, the two main agencies involved in disaster management, were only enacted on 12 November 2010. So, this past wet season was the first time these changes were practically implemented across the State.

The catastrophic flooding that occurred on 10 January 2011 in Toowoomba and the Lockyer Valley was a true test of disaster management: flash flooding with no or little warning; widespread destruction of property; unimaginable death toll, many missing; limited or no essential services; and isolated communities. Under the Disaster Management System, the local council has the lead role in responding to such catastrophic events. If it needs assistance, there are two levels above it, the district level, in this case the Toowoomba Disaster District, and the State level to provide resources and support. Questions have been raised as to the adequacy of the Lockyer Valley Regional Council's response to these events. Thus, the actions of this council to prepare and inform the community of their plans for disaster management leading up to 10 January 2011 and the response to the flood events will be examined.

However, broader questions arise from the events in the Lockyer Valley as to the ability of local governments to

manager disasters when they occur on a large catastrophic scale and, in this case, with no warning, and whether in such events it is appropriate that they carry their primary responsibility. The Act, it is to be noted, does not make any allowance for the disparity in size and resources between councils throughout the State. These are matters that are ultimately relevant for every regional council throughout the State and they will be examined in further detail when we resume hearings in Brisbane.

Second, in Toowoomba and the Lockyer Valley, the issue of an early warning systems is of particular importance. The matters raised in these hearings will also have relevance across the State for present and possible future application.

Third, comment has been made by residents west of Toowoomba that the amalgamation of smaller local governments into larger amalgamated councils has meant that around the flooding events of 9, 10, 11 January 2011, communications and warnings to smaller communities were lacking as a result of the change in government's geographical focus. The purpose of these hearings is to understand what worked well, what can be improved, and what didn't work to assist in making recommendations so that Queensland is better prepared for the next wet season and for seasons to come.

As stated previously, the Commission has received many submissions and has spoken to many witnesses and taken statements. The Commission has also received footage of the flooding that so graphically demonstrated the magnitude of the events that we are dealing with. This footage was captured by CCTV camera, some by rescuers, some by the media, but most by people just stunned by what was before them. They captured it using whatever means they had. Some of this footage will be shown during these hearings. Some may just be tendered so that visual evidence of these extraordinary events will always remain on the public record.

There are many witnesses to these events in Toowoomba and the Lockyer Valley. However, at these hearings, it is not possible to call every witness or every person who's provided a submission or statement. Some witnesses will be called to describe their observations of either the flood events or the response that occurred on the day or on the days that followed. There are countless stories from residents in the Lockyer Valley detailing the lack of warning they received about the wall of water that hit them and the rise of Sandy Creek and their observations of the event and their escape and rescue from the disaster. You will hear from some of these people over the next two weeks but there are many others who have provided statements to the Commission and whose circumstances may be considered. These circumstances may also advise the Commissioner and Assistant Commissioners in formulating their recommendations for the State Government in August 2011 and in January 2012.

There are also stories of great sadness involving those who did not survive. We will also hear, if they wish, from the

relatives of those who died. This is an important part of this Inquiry's process.

Witnesses will be called from various State and Commonwealth Government agencies and also from the Toowoomba and Lockyer Valley Regional Councils detailing the planning and preparation for the 2010 wet season and the response to the flood events and their immediate recovery.

A list of witnesses that we are proposing to call is on our website and we do not propose in this opening statement to detail the evidence to be adduced from each of these witnesses. Further, most of these witness statements that will be tendered are also available on our website and the issues that they raise are often self-evident.

The following witnesses or categories of witnesses highlight just some of the issues that will be canvassed in these public hearings. As stated previously, early warning systems will be examined. Mr Jim Davidson, from the Bureau of Meteorology, will be called as a witness. As the regional director for the Bureau in Queensland, he will explain the weather events that hit the region on the 10th and 11th January 2011 and will detail the warnings that were provided.

It is of note that bloggers on a weather watching internet site predicted the Grantham would be hit by flash flooding some time before the event, and issues are raised as to whether there were any constraints on warnings being given by the Bureau, the interplay between the Bureau and more localised warning systems, and how emerging weather information is relied to emergency services, local councils, and the public. The question also remains what do we do with that information and what types of early warning systems can be implemented to warn residents of impending disaster caused by flood?

We may also hear evidence from experts whose evidence may assist the Commission to understand provision of early warnings, the engineering of the drainage system in Toowoomba, and the hydrology of the areas flooded. Although appreciating that no two floods may ever be the same, we need to know in this instance where the wall of water came from and why it hit communities with such intensity. For example, in Grantham, issues have been raised about the lack of culverts in the railway line and whether this contributed to the devastating effect of the rising water.

The Commission has retained an independent expert, Dr Phillip Jordan. He will give evidence, amongst other matters, about the Bureau of Meteorology warnings in Toowoomba and the Lockyer Valley, the hydrology of the Lockyer Valley, the overflow of the Cooby Dam dam and whether the dam contributed or curtailed the flood waters and flooding west of the range.

Neil Collins, an expert retained by the Toowoomba Regional Council following the events of 10 January 2011, has also

provided a report to the Commission that will outline the rain event on this day. This report also discusses the prior weather conditions, circumstances and layout peculiar to Toowoomba resulting in the flooding of 10 January 2011, the flood event itself, previous and future flood studies, flood mitigation works in the region, and limitations to warnings for future flood events.

Numerous senior police officers will be called in relation to the planning and preparation of QPS and also the response by QPS to these flood events. For example, Assistant Commissioner Steve Gollschewski will detail how he determined that these events required a major agency response from the police and that the normal disaster management arrangements that have worked effectively in the region prior to this were not appropriate and the situation required direct involvement of the regional management. The structure that he developed were the chief superintendent overviewing disaster response and recovery, and another chief superintendent managing the delivering of normal police services was then adopted in the planning and preoperation for Cyclone Yasi in northern Queensland. Whether such a structure could or should be incorporated in disaster management warrants consideration.

These senior police witnesses provide an important insight into disaster management generally and specifically in the context of the events of Toowoomba and the Lockyer Valley. They will give evidence about how these events required the involvement of various government agencies, including the police, EMQ, The Australian Defence Force, volunteers, and local council. These police officers will talk about the events themselves, the immediate response, the search and rescue, and the lengthy recovery process. Some of these police officers will also provide an assessment of what worked well and what, if any, improvements could be made to disaster management.

For example, Superintendent Brett Schafferious, the Toowoomba District Coordinator, is of the opinion that the local disaster management group of the Lockyer Valley Regional Council was overcome with the enormity of the tragedy which occurred in the Lockyer Valley. He states that the dedication and commitment of the elected members was never in doubt. However, there is a need for appropriately trained and experienced individuals to work with local councils to set up structures and plans for recovery. The suggested solution is to have a fly-in team available to immediately deploy to an area to get recovery operation underway quickly, working with persons holding local knowledge. These recommendations and others will be explored.

The Commission will also hear evidence about triple 0 calls made by Donna Rice and her son Jordan, who died in flash flooding just streets away from this courthouse. Donna Rice rang police and Senior Constable Wheeler, who was working in the Toowoomba Police Communications Centre that day, took this triple 0 call. He will appear to give evidence. On the basis of call records, Jordan Rice then rang triple 0 approximately

seven minutes later and spoke to a Fire Coms Call Centre operator who actioned the call. These calls were recorded and we will play these calls. It has to be said that the content of these calls is distressing. The appropriateness of Senior Constable Wheeler's behaviour will be examined.

That which occurred invites a wider examination of the way in which triple 0 calls are allocated and responded to by emergency services generally in Queensland. There will also be evidence from senior communications staff within the QPS to discuss training of triple 0 call operators and the process by which triple 0 calls are received and diverted to communication centres outside the specific region from where the call is made in times of disaster when there is an unanticipated spike in emergency calls for assistance.

As discussed earlier, we will hear evidence concerning the planning, preparation and response of the regional councils. This is a significant issue due to the important role that regional and local councils must perform in disaster management pursuant to Disaster Management Act. The mayor of Toowoomba, Mr Peter Taylor, and the chief executive officer, Mr Ken Gouldthorp, will be called to outline the planning and preparation for the 2010/2011 wet season and also the council's response to the flood events.

Oakey and Cooby Dam are also within the responsibility of the Toowoomba Regional Council and we will examine the warning and communication provided by the council to Oakey residents following the flood events on the 10th of January, which inundated properties west of the Range on the 11th of January 2011.

Steve Jones, the mayor of the Lockyer Valley Council, Regional Council, will also be called. He will give evidence about the planning and reparation of the council for the wet season and the response by the council to the catastrophic events of 10 January. Comment has been made as to the ability of the council to respond to the enormity of the tragedy that occurred in Lockyer Valley. For example, residents of Murphys Creek state the first time they saw representatives from the council was on the 13th of January, some three days after the flooding occurred, and no significant council presence was established in their area until 21 January 2011.

Further, the issue of evacuation centres will be examined. Many residents in the Lockyer Valley did not know where the excavation centres were situated and where to go in the time of the disaster. This appears to be a common issue in flood-affected areas across the State.

Comment has been made concerning the nomination of evacuation centres in the Lockyer Valley. Previously, with localised, slow-rise flooding, people have always been able to get to Gatton, which is well equipped to house evacuees and there has not been the necessity to nominate other places. After the events of January 2011, residents were isolated in a way in which they had not been before, exceeding the contemplation of

the local government and forcing the opening of smaller centres until people could be moved to larger evacuation centres with better facilities and resources. The community itself often responded by establishing their own evacuation centre.

For example, in Postmans Ridge, there was no designated the evacuation centre, so the residents established their own evacuation centres and these residents ultimately were moved to Gatton. In Murphys Creek, it appears that no-one knew where the evacuation centre was. The school, which was initially nominated for the community to congregate, got completely flooded. The community themselves set up the local tavern as a community centre which then became the response and recovery centre for the residents of Murphys Creek.

David Fraser, the area director of the Southwestern Region of EMQ, and Robert Bundy, the regional director of the Southwest Region for EMQ, will be called to detail the planning and preparation response to these events by EMQ. EMQ has the responsibility for the SES and also the rescue helicopters that were deployed in Grantham. We will hear from Mark Kempton, an EMQ helicopter pilot, whom, in what could only be described as difficult conditions in fading light, plucked 28 people from their roofs and treetops of Grantham, who explained the difficult conditions that they were operating and the rescues that they performed.

The coordination of helicopter assistance to respond in such events will be examined. For example, Brett Hall, a helicopter pilot, makes comment on a possible lack of coordination between agencies that may constrain helicopter pilots from responding to disasters in a timely way.

The QFRS not only deals with bushfires, but has an all hazard approach to disaster management. However, comment has been made by some surrounding specific events of 9 and 10 January 2011 in Grantham where QFRS representatives were advised not to utilise fire trucks and equipment in flood waters as this was a natural hazard to be responded to by the State Emergency Services only. This issue will be examined.

We will also hear from members of the QFRS concerning the planning, preparation, response to these flood events. An issue has been raised for the planning of the placement of the QFRS infrastructure. In Murphys Creek, for example, the QFRS building got swept away in the floods, thus losing important rescue equipment. A wider issue in that respect is that although the building may have been well placed for fire, it was not for flood, and if the all hazard approach is to be truly encompassed, our agencies need to be prepared for all disasters that may present themselves.

As can be seen, these flood events required the rapid deployment of all levels of government agencies to cope with the disasters. The coordination of these government agencies with each other and the community is important. One of the issues that has arisen in this area is the lack of

communication between different government departments and the community. For example, Peter Souter will give evidence that at Murphys Creek residents were asked multiple times from different agencies the same questions to elicit the same information. He suggested better coordination of information gathering by government agencies.

Another issue raised by Grantham residents is the coordination of government agencies when it comes to the compilation of missing persons following the disaster. Examples have been given of people being contacted by friends and family nominated as missing when they had provided their details to numerous official persons and the list had not been crosschecked or monitored in a uniform way. This caused much distress to people, and an examination of the way in which this was done and how this information was compiled and exchanged will be undertaken by the Commission.

Grantham residents also raised issues concerning a lack of communication. They have asked why their community was cordoned off to the extent that it was. They have complained about the inability to access homes, to inspect property, machinery, livestock and pets. Police officers and others who had the responsibility of the immediate response and recovery process after the event of 10 January will give evidence and respond to these matters.

After the flood events, the supply of essential services, like electricity, water and telecommunications, to the Lockyer Valley were cut. Telecommunications are essential in the recovery phase of a disaster. However, in Murphys Creek there is limited mobile phone coverage at the best of times. Optus and Telstra have provided a submission to the Commission, and telecommunications may be examined at hearings in Brisbane.

These submissions which addressed issues specific to the Lockyer Valley, especially communication in the Murphys Creek and Spring Bluff region and also steps taken by communication companies after the 10 January flood event to improve communications, are on the Flood Commission website for public perusal.

The Australian Defence Force contributed heavily to the response, search and rescue and later recovery process throughout Queensland, especially in the Lockyer and Brisbane Valleys. One of the communities assisted by the ADF was the region of Forest Hill, that after a separate rain event on 11 January was subject to a rapid rise in flood waters that necessitated the evacuation of the community. A senior representative from the ADF may give evidence before the Commission in Brisbane dealing with issues particular to all regions State-wide.

It is clear that there are many issues to be examined in these hearings in Toowoomba. What we have outlined is just a selection. The Commission's work does not stop after these hearings are concluded in Toowoomba. These public hearings

are only one part of the Commission's process. If there are matters that need further clarification or investigation, this will be done after these hearings within the time constraints of meeting report deadlines.

Madam Commissioner, if we could adjourn for 10 minutes before we call the first witness in the Toowoomba hearings, Mr Ken Gouldthorp, the chief executive officer of the Toowoomba Regional Council?

COMMISSIONER: Right. Adjourn for 10 minutes, thanks.

THE COMMISSION ADJOURNED AT 10.27 A.M.

THE COMMISSION RESUMED AT 10.37 A.M.

COMMISSIONER: Yes, Ms Wilson.

MS WILSON: Thank you, your Honour, Madam Commissioner. It is envisaged, Madam Commissioner, that Mr Ken Gouldthorp, who is the Chief Executive Officer of the Toowoomba Regional Council has a presentation that may assist the Commission and he will give that presentation from the Bar table because he will need to be able to see the television. It is anticipated that Mr Gouldthorp will be called as a witness later in the day or tomorrow.

COMMISSIONER: We don't need him sworn at this stage?

MS WILSON: We don't need him sworn now.

COMMISSIONER: All right. Go ahead with that then.

MS WILSON: Madam Commissioner, have you and the Deputy Commissioners been given a map of the Toowoomba central business district that has some markings on it?

COMMISSIONER: No, I don't think so, but we are now.

MS WILSON: Your Honour, I tender the presentation, the slideshow presentation, that will now be given by Mr Gouldthorp.

COMMISSIONER: Is that on a disc somewhere?

MS WILSON: It is on a USB.

COMMISSIONER: USB, thank you. That will be Exhibit 66.

ADMITTED AND MARKED "EXHIBIT 66"

MS WILSON: Perhaps it would be convenient now for Mr Gouldthorp, when he is ready, to give his presentation.

COMMISSIONER: Thank you. Thanks, Mr Goulthorp.

MR GOULDTHORP: If the Commission doesn't mind, I will remain seated so I can see the screens material in front of me. To commence the presentation, I would like to first give an overview of the Toowoomba Regional Council area. The name Toowoomba, of course, associates very closely with the city of Toowoomba but the region covers an area much greater than that. I will go on to show some of the public radar BOM information that our people were monitoring at the time of the event and then move on to some of our security cameras from our CCTV, which is predominantly used for security purpose in

the city centre proper. But the advantage of the CCTV stills that we will be able to see is that they are time stamped and give us a very good understanding of the timing of the event and also the speed of the event.

We then have about a two-minute short video from, again, the CCTV and that has been supplemented with some other material to show some of the water volumes flowing back into the creek system within Toowoomba. I will then go to look at our geographical information system which is the software system that council has used to consolidate and compile much of the information both throughout most of the Local Disaster Coordination Centre Operations and after that as we have moved into the recovery phase.

So if I can commence just by pointing out that the Toowoomba Regional Council covers an area of just under 13,000 square kilometres. It has a population of just over 160,000 people of which approximately two-thirds or just over two-thirds are within or in the immediate area of Toowoomba city and the balance is spread throughout the region.

The Toowoomba Regional Council came to being in March 2008 following the amalgamation of eight former local government areas. It extends from Millmerran in the south to Yarraman in the bottom of the South Burnett region in the north. It is bordered on the east by the Range and on the west, it comes within 10 kilometres of the township of Dalby. Over that distance there is considerable variation in topography as well as considerable variation in urban densities.

Throughout the course of December and January, I would suggest that we saw what could be categorised as three almost distinct events, albeit that they were interrelated. In particular, through the later stages of December, from the 20th through to 27th of December, we saw significant rains down around the Condamine flood plains down in the southwest, or in the bottom left-hand side of that screen. On the 10th of January we saw the catastrophic event in Toowoomba itself and then approximately 24 hours or a day later we saw the events that took place with the Oakey township being flooded and also flooding through Jondaryan and other small townships to the west.

It is important to note as we look at that diagram the variation in topography. As we move to the left and to the bottom of that screen we're in flood plain areas - very, very flat country over long distances. Back in Toowoomba itself, we're some 700 metres above sea level and that is one of the remarkable things about this event. We're 700 metres above sea level at the peak of the Range but have quite undulating topography through the city itself. It drops from the peak of the Range for about around 700 metres down to the CBD, over a distance of about two and a half kilometres, and it drops to around 580 metres. So, about a 100 metre drop across that relatively short distance.

What you see there in blue, and I will come back to this a

little bit later on, the area in blue is the Gowrie Creek system. The bottom left fork is West Creek. The bottom right fork is East Creek. They converge within the CBD or just a matter of metres north of the CBD and then the water flows from the bottom of the screen in the south to the north, which is the top of the screen, and ultimately heads west and south of Oakey and joins the Condamine River system.

If we can move now to look at the Bureau of Meteorology radar. I just point out here that prior to this event in mid-2010, the dams within the Toowoomba Regional Council area were as low as nine or 10 per cent. We had put in place emergency water supply arrangements and arrangements to supplement our potable water supply. Throughout the later stages of 2010 they were still very low. It wasn't until about December 2010 when we started to get some significant inflows into our dam systems, which are just to the north of Toowoomba city. And even as late as mid-December, we still had dam water volumes of no more than around 50 per cent.

The radar imaging that you are seeing, and I'll just let it run through and come back to the start, this starts from around 11 a.m. on Monday the 10th of January and it was being monitored on a 24-hour basis by our dams events management people, who had activated at that stage as a result of the water that was now flowing into our dam system. The interesting thing from our perspective is nothing in this radar imagery provided us with particular concern. Obviously there were large storm events occurring, they were fairly widespread. You can see there from the amount of blue that was it was predominantly shown as light rain. The areas in yellow were moderate rain. Then as we go into the oranges and light reds, you will see some very small isolated spots of heavy rain. So whilst the weather conditions were such that it was raining and raining reasonably heavily at different times throughout that 48-hour period, there was nothing from that that our dam event management people picked up that would suggest to them the event that was about to unfold here in Toowoomba.

The other interesting thing from this footage is you will see that immediately after the event on January the 10th, it actually clears for a short period of time and then the rain event continues for approximately the next day and a day and a half. The system that was causing that event seemed to be travelling down from the Sunshine Coast along the Range. On the day of the 10th the storm event was just on the west of the Range and caused extreme localised flooding here in Toowoomba. Over the next 48 hours that system seemed to continue but it was just east of the Range. We continued to monitor that very closely in the Local Disaster Coordination Centre because had that event or had that system moved only a matter of hundreds of metres or a small number of kilometres to the west of the Range, we could have seen a repeat of what happened on the 10th of January and, of course, at that stage we had a large number of people carrying out recovery exercises and trying to repair the CBD in Toowoomba.

If we can move from there now and look at the CCTV time lapse, but just before we do I'll just refer people to that document that was handed out and we have it on the screen for the public. The stills that we're going to see again have been dictated by where our security cameras are located close around the CBD but just to orientate people, the Herries Street bridge, West Creek, is just down there on the left and that's a matter of several hundred metres south of the confluence of West and East Creeks near the railway station. Just above Herries Street is the corner of Margaret Street and Station Street, very close to the Grand Central Shopping Centre. You will see still footage from there. Further up closer to the confluence of the two creeks is a camera situated viewing Ruthven Street and Chalk Drive and then just slightly back, a camera that's viewing Neil Street and Chalk Drive, just to help people gain their bearings. That the's Court building where we're located at the moment.

The area in between, so from the Court building to the north, is the main CBD area. So the main CBD there, really the intersection of Ruthven Street and Margaret Street. Margaret and Ruthven, that intersection there, are the two major streets in town. But you can see how the CBD is surrounded on both sides effectively, by West Creek on one side, East Creek on the other. Really, it forms a valley where it drops from the Range, the height of the top of the Range to the east and also from a ridge line to the west. Also for reference, the corner of James Street and Kitchener Street or the corner of the Warrego Highway and East Creek where two individuals tragically lost their life is just to the bottom right-hand side of the screen.

If we can move now and look at the time lapse footage. This is at 1.26 p.m. on Monday, the 10th of January. You can see there, bottom left-hand screen is the corner of Herries Street and - is the Herries Street bridge which is where Herries Street crosses West Creek. The top left-hand is at Margaret Street and Station Street. Top right-hand side, Neil Street and Chalk Drive. And bottom right-hand side, Ruthven Street and Chalk Drive. That is 1.26 p.m. on Monday, 10th of January. You can see there from the raindrops on the cameras and the mist it's obviously raining and raining fairly heavily. But the water at that stage is well below the Herries Street bridge. So it's contained within the creek system, although you can see at Margaret Street and Station Street there had been significant overland pooling of water on roadways and other places in some locations. But, by and large, the roadway system is largely clear.

Just toggle through now. Again, 1.32 p.m., the water is still contained below the Herries Street Bridge. Again, you can see there the volume and velocity of the water now flowing along West Creek. You can see some wave action up against that bridge, but I would also point out the quantum of water on the roadway where the water is running down off the ridge system into the creeks. But again at this stage the roadways, by and large, are fairly clear.

We continue through there and we're now at 1.40 p.m. These are at two-minute intervals. We will keep moving through. You can see there the traffic is continuing to move around the CBD but relatively low volumes. You will see shortly the quantum of traffic increases considerably as people try to move outside of the CBD.

You can see there at 1.42 in the bottom right-hand side of the screen, at that stage the camera operator has scanned that camera from Ruthven Street and Chalk Drive around to view the car park on Ruthven Street. I understand at that time or from approximately 1.20, the camera operators were in contact with the police station. The police station has a lead from the security cameras, and had been asked by the police to scan that camera or pan that camera around to look back towards the creek system. It is worth noting that that's at 1.44 because in about eight minutes, when he pans back to look at the creek system you can see the significant difference.

If you just go back one again, you can see there at this stage that roadway at Ruthven Street and Chalk Drive is clear at 1.42 p.m. Again, the water, while wave action is bringing it up level with the road, is still running under the bridge system. 1.48 it's getting very close and depending on debris and waves is just touching at the top of the bridge. You can see at the top left-hand side, that's in Margaret and Station Street, significant water now accumulating over the road. That's the big "M", McDonald's sign, for people to get their bearings. Then at 1.52 p.m. you can see the water in Herries Street is now just touching at the top of the bridge. So in a space of about 10 to 15 minutes, water has gone from a stage where it is flowing under the bridge system to basically touching at the top and starting to overwhelm or to come outside of the creek system.

At 1.56 you can see traffic continuing to flow over the Herries Street bridge and at that stage water is coming from the creek across the roadway.

At 1.58, some eight minutes after the camera on the bottom right there at the corner of Ruthven Street and Chalk Drive moved around at the instruction of the police to look at the car park area, it comes back to look at the roadway and you can see there whereas before it was completely cleared, in the space of eight minutes the water has risen and has now completely covered that road. That gives an indication of just how quickly that water came up. You can also see there on the bottom left-hand side the Herries Street bridge. The water is now at a very high velocity, starting to travel over the road and you can see a four-wheel drive there and other vehicles still passing across that bridge. The incredible speed with which the water came up, of course, and the fact that the CBD is caught in on both sides by West and East Creek and it was a normal business day has caught a lot of people and a lot of traffic inside the creek system.

That's at 2 o'clock in the afternoon. You can see a pedestrian walking across the bridge notwithstanding that

water is now flowing from the Creek system across the road. You can see there in the top left-hand side in Margaret and Station Street, which is very close to the heart of the CBD proper, the quantum of water there and both cars occupied and unoccupied that are now being caught in the water. Bottom right-hand side you can see the extent of the water, which is now flowing across the top of Ruthven Street and Chalk Drive.

Bottom left-hand side you can see the speed of the water again at 2.02 p.m. Again, on the top left-hand side, I believe in Margaret Street and Station Street, that's a bus that's just travelled through, I believe, the crossing either to drop people off or picked them up, and we still have vehicles trying to clear the creek system to move outside of the CBD.

If we continue to flow, you can see the water coming up. That short of Margaret Street and Victoria Street in the top left-hand side will probably help people gain their bearings. That's the railway intersection, Myers at the Grand Central Shopping Centre. Just to the left of that shot is an observation deck where people were rescued in a few moments' time by the fire services. You can see there at Herries Street at around 2.12 water continuing to travel across the road. People are still moving around the CBD, although the quantum of traffic there has reduced substantially.

We're now at 2.12. There is rescues occurring by both the public, self-rescues, and there's Queensland Fire Service personnel in action at 2.14 at the corner of Margaret and Station Street trying to assist the public.

Continuing on, it's now 2.20. Remember, this footage only started at 1.26, so less than hour from the commencement and less than 30 minutes from when the water was starting to touch at the bridge system. It is not unusual for water within the Toowoomba CBD to very quickly rise from being relatively dry to just under that bridge system. The difference here is that it overwhelmed the creek system and started crossing the roads. You can see there on the top left-hand side a gentleman that has come caught in the creek system is hanging on to the tree and I believe was later rescued by Queensland Fire Swift Water Rescue staff.

2.22 - I'll keep moving on - again, rescues occurring. You can see there in the top right-hand side just the velocity of the water and the turbidity of the water and the wave action that was generated through the CBD. Again, in the bottom left-hand side we still have cars crossing over the Herries Street bridge; one coming into town, interestingly, and one going out.

2.26 p.m. we have rescues going on at Margaret Street and Station Street, which again is only a matter of several hundred metres north of the Herries Street bridge where those cars are crossing. You can see those vehicles in the right-hand side of the Margaret Street and Station Street are still there that have been completely covered in water. On

the right-hand side you can see members of the public presumably rescuing themselves from in or around that vehicle.

2.28 p.m. Now, 2.30 and I'll just hesitate there, you can see in the bottom left-hand side there is a vehicle that has been washed down the creek system and trapped against the bridge. But between 2.30 and 2.40, I believe, is when the system peaked. So from around 1.56, where the water topped the bridge system at Herries Street through to around 2.30, so in a space of around 35 minutes, the water came from being below the bridge system to peaking and we will see in the rest of this it then reduced again over the space of around 50 minutes. So the whole event from start to finish seemed to take place within about a two-hour window. And significantly less than that for the water to overwhelm the creek system, rise suddenly, trap people and then decline.

The bottom left-hand side gives an indication of the power of water and, again, this is at its peak between 2.30 and 2.35. You can see people there observing. That's a good shot at the bottom left-hand side just to give you an idea of the extent of the water that's now flowing down through the CBD area. That's the car park at the back of the Myer centre and Grand Central Shopping Centre, just there.

We've now lost some one of our cameras for a short period of time. I will show you some stills shortly to give a clearer indication of the height of some of that wave action that's happening through the water. It is now 2.55. The water is starting to subside. You can see people moving around or coming down to have a look. Water is going down quite quickly. You can see in the bottom left-hand side Herries Street bridge is now relatively clear. Some of the aftermath of the vehicles that were caught in the event. Likewise, the water is continuing to drop and continuing to drop quickly. We have fire services and police active there. You can see there at 4 o'clock the water is now well below Herries Street bridge.

I will go on now to show some CCTV video excerpts that show that real time. I'll just hesitate for a moment there. This footage gives a clearer indication of the velocity of some of the flow. But some of this footage also shows the speed with which water was travelling overland from the ridges from the top of the Range down into the creek system both from the west and the east. And it is very important to note it is not just the water that's travelling from south to north along the creek system that's causing the turbidity; it is actually the water flowing down from right angles at speed and coming into the creek system. If you look there on the diagrams that were handed out and, Paul, I'll get you to toggle across.

Just to the top right-hand side of this screen here, we have Campbell Street running in - perpendicularly from the top of the Range down to the creek system. We will show footage of water - of water flowing down there constantly 40 or 50 metres above the creek system, flowing down there into the creek, and, likewise, we have footage of water flowing down Gough Street from the west down into the creek system. So, this is really a depression or what was referred to as the old swamp years ago - I am talking in the 1890s - and water is flowing to there, not just along the creek system but from the east and from the west at high volumes and at speed.

That is a pedestrian bridge where somebody's just inspecting it at the moment. It runs between our library and Grand Central. That bridge is washed away shortly.

You will recognise some of the stills that you saw a short while ago, that Herries Street, and vehicles crossing over that. The water hasn't yet capped the bridge. A pedestrian walking across it, knee-deep water, and vehicles moving through it.

This is at 1.46 p.m.. You can see there the fire services have pulled up and starting to prepare for rescues and we have vehicle clearing that intersection - vehicles clearing that intersection.

We see there on the left - this is at 2.05 p.m. - a vehicle has become trapped against the bridge and we have vehicles crossing the bridge. This is Margaret Street, where rescues were taking place. The fire services are in there moving about and setting up for rescues. That's a vehicle moving through and past.

Now, if we can hesitate there, this footage is Campbell Street. This is water flowing down at right angles from the creek system over a space of no more than two kilometres. You can see the volume and speed of the water running down into the creek system, not along the creek system, but finding its way to the creek system as overland flow.

This is that pedestrian bridge you saw a short time ago which will be struck by a rainwater tank that's been caught in the flow and removed from its footing shortly. This is Gogg Street that I mentioned previously, again water flowing down in higher volumes and at high speed. You would be struggling to keep your footing if you were walking in that. And that's coming down at right angles to the creek.

So, a lot of the debris and lot of vehicles and other things that were caught in the creek system were washed down from well outside the bounds of the creek by overland water flow, and you can see why the water at the bottom there raised just so quickly when it's coming in from all directions.

That's fire and rescue, the Swift Water Rescue Services. You can see that's that observation area, just outside the

Myer Centre that I said before. Now, my understanding is that people - and they're not necessarily these individuals - but people walked to that observation deck early in the event to observe the creek, and then that overland flow that was coming down from the right angles perpendicularly has come down behind them and trapped them in that observation deck where they were later rescued.

This is where that pedestrian bridge was taken out. You will see - yes, a rainwater tank hits the bridge, just takes it straight off its footings. It gives some idea of the power of the water flow, and I will show the size of that structure that's been taken out very shortly in a still photo.

Again, you can see there the breadth of the - and speed of the flow across a creek system that's normally no more than about 10 metres wide. Again, a good broad shot of the creek system and the volume of water. You see there from the turbidity, water is coming in from all angles.

The water there - again, we have now moved on to 3.07 - and the water - the water is cleared, or is clearing. The car there on the right has turning into a flooded street, and looks like a bit - it has swerved away.

So, that's toggled back to the beginning. I will go on now and look at some of our GIS records. This shot, you can see each mark there on the screen shows where the Local Disaster Coordination Centre received a phone called and a request for information or assistance from each of those properties that were marked. Throughout the course of the operations at the Local Disaster Coordination Centre, we had this software available which allowed us in real time to be entering or locating - linking any requests we had to the properties from which they were coming so we could get a very clear picture all the time about, you know, where the activities were taking place.

Now, what you are seeing in front of you was a collection of calls over one week, but you can see around the City of Toowoomba itself just how widespread those calls were, well outside the creek system. There was damage to property, there was calls for assistance from people that were caught up in that overland flow 50 to 100 metres above the - above the creek system, right throughout the City.

The area to the left where the cursor is now pointing is Oakey, where we received a number of contacts for assistance, and you can see the spread of calls up through - up along the northern area, north of Toowoomba in particular where we suffered significant road damage.

The photo there shows the extent of some of the damage to our water and sewage infrastructure. The sheer volumes of water that were flowing, large amount of water infiltrated the sewage system so we had sewage surcharges Which could have happened in people's yards or on occasions in people's houses. You will see that the track of water infrastructure in

particular there along the Gowrie Creek system, that's more a reflection of the fact that that's where a lot of our trunk water pipes run, more than anything else, but you will also see the damage is well outside of the CBD area, both to the north and south, and there's damage recorded out at around Oakey to water and sewage infrastructure.

At the outset of this event, one of the main issues that the local Disaster Coordination Centre faced was maintaining potable water supply. I will show a photo shortly but just immediately to the north there along Gowrie Creek is where our main - two main water trunk mains come into City. One of those was severed at both ends, and I will show a photo of that shortly. That halved our capacity to get potable water into the City. We had lots of water pressure on the western and higher parts of the western side of the City but fortunately with the quantum of potable water we had in our reservoirs we were able to maintain water supply to the vast majority of the residents. Our water and sewerage staff were activated very quickly and were able to gain - get a work around to ensure that we maintained water supply. We are also providing potable water supply at this stage to Western Downs and also provide access to potable water to the Lockyer Valley shortly after this. But we were, again, mindful of that. We had lost one of only two water trunk mains. The other trunk main had been significantly undermined, so we were monitoring that closely in order to maintain water supply.

This next shot shows - each of those blue marks are the - make up the 50 worst damage that we've had to public infrastructure from - over that December and January event, and, again, it gives an indication of whilst the focus has been on Toowoomba and the very severe high volume water that we had flowing through the CBD, in fact, we have had widespread flooding and impacts right across the region.

Our first response immediately post this event was an expectation that the infrastructure damage within Toowoomba itself would be significantly more than what has - it's actually turned out to be, and the damage in this region is significantly less, but, as it's eventuated, there's certain public infrastructure right around the region.

This shot here was taken about a week ago. It shows the conditions of our roads, and this is publically available on our website. Each of those roads there that are highlighted were at one stage in red which means they were closed or impassable. The different colours there show in red, again, they are still closed, others were either temporary or permanent repairs and they're either opened altogether or opened with caution or opened with limitations on vehicle size, but you can see even at this stage we still have significant impairment to our road network and, again, the bottom right-hand screen shows really around the Condamine flood plain incident area, the area around Toowoomba happened throughout either December or in January around the 9th and 10th of January Toowoomba itself and some damage to the - to the western areas around Oakey.

To go on to have a look at the event's photos, this particular shot shows the height of some of that water. It puts into perspective that some of these waves coming through were above head height coming down the creek system, and just depicts the power and the turbidity of that water. That's the railing of the Herries Street bridge and this wave is well and truly above that - above that railing height. I expect that that would have been taken somewhere between 2.30 and 2.40 at its peak.

We will continue just to move through these photos to get a view of the damage. This is Neil and Thomas Street looking east. Again, you can see water coming in at right angles to the creek system. The depth of water around Allied Mills, just to the south - this truck wasn't trying to move through the water, I understand, I understand that the truck driver here had pulled in to the water to try to assist people that were caught on the other side.

That last photo was actually the corner of James Street, which is the Warrego Highway and Kitchener Street, or the intersection of the Warrego Highway and East Creek where two people unfortunately lost their lives, but you can see here the quantum of traffic that are backed up. This is an extremely busy national highway. It links back to the Gore Highway, the New England Highway, and also, of course, the Warrego Highway heading west through Dalby and the Surat Basin, has significant freight movements and truck movements, and you can see the quantum of traffic that's, therefore, been backed up by that event.

All this furniture has been washed out or blasted out through the windows of the furniture shop over the road and you can - again, that's Grange Street running down at right angles into West Creek, so you can see the volume of water that's actually flowing and the heights of that water coming down above the creek system and flowing into the creek, not water coming from the creek, flowing up.

That's our car park for the town library. That's the back of Grand Central Shopping Centre, Allied Mills who received significant damage, just north of the CBD. This is now outside of Toowoomba, out at Crows Nest, Jellico Street Bridge, just to the north of the CBD, looking at the aftermath and debris, which gives an indication of some of the road damage. This is on the Esk Hampton Road connection.

We will stop at this photo. This is the water pipe that I was talking about before. Now, that is a 750 millimetre diameter ductile steel pipe and it's supported across this Gowrie Creek by a very significant steel bridge structure. Now, we found out - and this is the trunk main that was severed that caused us problems with water supply in the CBD, but, again, severing a 750 millimetre diameter pipe at both ends, you can just imagine the force of the water and the material caught in that water.

We are told by eye-witnesses that there was either a tank similar to, say, a petrol tank or a gas tank that you'd see moved on a semitrailer, we understand that was caught in that creek system. An eye-witness has told us it washed down the creek, it hit that pipe and steel bridge structure that supports the pipe, bounced back once, hit it a second time and severed it at both ends, and the power of that is just mind boggling to me.

Again, this is at Cambooya, well outside of Toowoomba. We are now back into Toowoomba itself. That's from McDonald's, right in the - pretty well in the middle of our CBD. Some of the damage and debris or furniture that's been washed out. You can see the damage to cars. This is outside of the creek system, but where water has come through.

This one here, I will just stop for a moment because people might be interested. There was a lot of public footage and news footage of a blue Subaru that got caught in the creek system and got washed down the creeks. That was repeated for a number of days after this event. That's where it was caught and Herries Street bridge and you can see there again the power of the water that's just crushed and wrapped that car around the bridge structure. Just to its left there as well is a JJ Richards waste dumpster and you can see there that it's been crushed against that concrete structure and just peeled back.

Again, some of the damage. This is where a wall was washed away from a building in the heart of the CBD. A vehicle's caught along East Creek in close to the CBD area. Again, this 9, 10 kilometres north west of Toowoomba. Greenmount, some 25 kilometres south of Toowoomba. We will stop there, because this is the pedestrian bridge structure that you saw that fellow walking over that was struck by the rainwater tank and removed from its foundations, and you can just see there the size of those steel girders. It was a very substantial pedestrian bridge structure and the power to knock that off its foundations is, again, quite phenomenal.

It's interesting to note, we showed throughout that footage, it was quite surreal, the fact that this happened so quickly, 30-odd minutes for the water to come from under the creek system to be moving, flowing across the roads, people trying to get outside of the CBD, peopling crossing those bridges, almost ambivilous to what was actually happening around them and the danger that they may have been in.

This is person who's coming down to have a look at the road damage where that's a wash-out. You might notice the cracks in behind where they are standing. This is the wash-out on the New England Highway, just north of Toowoomba. Toowoomba was completely cut off from all directions immediately following this event. That was a substantial landslide.

Again, this is at Oakey, some 27 kilometres west of Toowoomba. We are now back into Queens Park and some of the damage to

footpaths and roadways. You can see there the aftermath and the furniture and that that's been washed out and caught in the main street.

This is an interesting photo in that that's at the bottom of the Range on the Warrego Highway. You are looking back up the Range and that is the upward leg of the divided road, which has just become a river.

Some of the damage, again, back into the CBD. This was all cleaned up in the space of about 24 to 48 hours. Our staff worked throughout the night of the 10th of January and, again, well into the night of the 11th of January and the CBD by and large was relatively well cleaned up and functioning again within a space of about 48 hours.

This is Gowrie Creek outside of the CBD. You can see some of the material that's been washed out there.

This is the Oakey Creek Sewerage Treatment Plant. This was construe at the beginning or during the Second World War by the Americans and it's well inundated with water. It's just a shot of one of our dams.

That's out at Cambooya to the south of Toowoomba. That's damage to the road to Cressbrook Dam. It's very hilly territory to the north along the Range and the volumes of water flowing down off the edge of those hills caused significant damage. Again, there is that very flat country to the south and west at Greenmount.

So, just bringing this presentation to conclusion, as a way of a summary, Toowoomba Regional Council covers a fairly vast area, some 13,000 square kilometres, and the events that we at the council experienced through December and January were wide spread, they weren't purely in Toowoomba proper, and the damage and recovery action that we are now taking place covers that whole area.

When we look at Toowoomba itself, the event happened with no notice. It happened very quickly, the water came from being contained within the creek system to peaking in a period of to more than about 40 minutes, and then reduced again within the space of another 40 minutes to one hour. So, the whole event occurred and it largely moved on within a space of two hours. Importantly, the water flow that caused damage and put people at risk wasn't just within the creek systems, but there was high volume overland flows coming in at right angles for the creek systems. I know personally of a number of people that were rescued from properties well outside of creek systems, because of the volume of water, overland water flow.

Thank you very much.

COMMISSIONER: Thanks, Mr Gouldthorp.

MS WILSON: Thank you, Madam Commissioner. Mr Gouldthorp, two statements have now been received in relation to the evidence

of the chief executive officer of the Toowoomba Regional Council, and he will be called later in these hearings.

I now call Dr Phillip William Jordan.

COMMISSIONER: Did you want a morning break or not? Given that we had a short one before, you may not but I will leave it to you.

MS WILSON: There is a lot of nods in my direction. Yes, Commissioner.

COMMISSIONER: So, we do want a break?

MS WILSON: Yes.

COMMISSIONER: We will make it 15 minutes.

THE COMMISSION ADJOURNED AT 11.24 A.M.

THE COMMISSION RESUMED AT 11.41 A.M.

PHILLIP WILLIAM JORDAN, SWORN AND EXAMINED:

COMMISSIONER: Yes, Mr Gibson.

MR GIBSON: I rise because media outlets have expressed interest in being provided with a copy of the USB stick of the presentation of Exhibit 66. The council does have copies of that stick available to distribute to the media but would not do so, of course, without the permission of the Commission.

COMMISSIONER: There is no obvious obstacle that I can think of, but I will just ask counsel.

MR CALLAGHAN: No, it is in the public domain.

COMMISSIONER: Yes. No problem at all.

MR GIBSON: Thank you.

COMMISSIONER: Yes, Ms Wilson.

MS WILSON: Thank you, Madam Commissioner. Is your full name Dr Phillip William Jordan?-- Yes, it is.

Are you a senior hydrologist currently employed by Sinclair Knight Merz?-- Yes, I am.

Do you have a Bachelor of Engineering?-- Yes, I do.

And Doctor of Philosophy?-- Yes, I do.

And was your PhD thesis on the effect of flood modelling of rainfall variability and radar rainfall measurement error?-- Yes, it was.

Have you previously been employed by the Bureau of Meteorology?-- Yes, I have.

And that was for 18 months between July 2001 and December 2002?-- Yes, that's correct.

And your role with the Bureau at that time was to perform research on the application of dual polarisation weather radar to quantitative rainfall measurement and flood forecasting?-- That's correct.

And from January 2003 you have been employed with Sinclair Knight Merz?-- That's correct, yes.

You now you have written a report for this inquiry?-- Yes, I have.

That report entitled Hydrological Advice to Commission of Inquiry Regarding 2010/11 Queensland Floods?-- Yes, it is, that's correct.

Is that report dated the 12th of April 2011?-- Yes, it is.

Thank you, Commissioner, I tender that report.

COMMISSIONER: It can be Exhibit 67.

ADMITTED AND MARKED "EXHIBIT 67"

MS WILSON: Now, you referred in your report to many documents and I will just take you some of those documents. Did you refer in that report to a submission by Anthony Corneilus, a submission that he provided to the Queensland Flood Commission report?-- Yes, I did.

Your Honour, I tender that report.

COMMISSIONER: Sorry, that's the actual submission or-----

MS WILSON: That is the submission.

COMMISSIONER: Of Mr Corneilus. That will be Exhibit 68.

ADMITTED AND MARKED "EXHIBIT 68"

MS WILSON: Your report also refers to the Insurance Council of Australia: The Nature and Causes of Flooding in Toowoomba 10 January 2011?-- Yes, it does, that's correct.

Commissioner, I tender that report.

COMMISSIONER: That report will be Exhibit 69.

ADMITTED AND MARKED "EXHIBIT 69"

MS WILSON: And your report also refers to the Insurance Council of Australia: Flooding in the Brisbane River Catchment January 2011 Volume 4, Flooding in Lockyer Valley Regional Council LGA?-- That's correct.

Commissioner, I tender that report.

COMMISSIONER: Exhibit 70.

ADMITTED AND MARKED "EXHIBIT 70"

MS WILSON: Now, can I take you to Exhibit A in your report. That will come up on the screen shortly. Exhibit A refers to radar scans produced by the Bureau of Meteorology at the time of the 10th of January 2011?-- Yes, it does, that's correct.

We will just get that up on the screen soon. So that is the scans that are referred to in Exhibit A?-- Mmm-hmm.

Yes, Dr Jordan?-- That's correct, yes, appendix A. That's correct.

Now, these are the scans that are available to the public on the Bureau of Meteorology website?-- That's correct.

Now, these scans show differing colours as a weather event?-- They show different colours of what is known as reflectivity, and reflectivity is a quantity that is returned by a weather radar. It basically measures the intensity of the radiation that's backscattered from whatever that - the radar beam happens to hit in the atmosphere.

So from your experience, is the Bureau of Meteorology just working on the colours or do they have additional information to assist them in forecasting?-- From my experience, the values that are returned from the radar are actual - as I said, a quantity called reflectivity. That reflectivity value is measured in a unit called dBZ and those values typically range between about 10 and 60 and so those collar ranges actually relate to quantitative measurements of reflectivity.

In layman's terms, is that - what we can see on that radar screen can be converted by the Bureau of Meteorology into a rainfall rate?-- That's right. So there is a - there are equations that allow the reflectivity to be converted directly to a rainfall intensity. Those equations depend upon the raindrop size distribution. So there is not a one to one conversion, if you like, that is appropriate in all situations. But the rainfall intensities that are calculated from the reflectivity values can be corroborated by ground-based rain gauges that would have been observing the event as well.

Well, put aside the rain gauges for one moment?-- Yep.

If you can just maintain on the rainfall rate?-- Yep.

Why is it important to have an appreciation of the rainfall rate?-- So the rainfall rates, obviously the higher the

rainfall rates are the more likelihood or the higher the runoff will be that will be generated from catchments where that rainfall actually intercepts the ground. So understanding where high rainfall intensities are is important. It is also important to understand the spatial and temporal distribution of that rainfall as it moved across the catchments of Toowoomba and the Lockyer Valley.

So in the preparation of your report did you have that data of the conversion of the reflectivity into the rainfall rate?-- No, I didn't have the values that would allow me to directly convert the rainfall. The image is to rainfall intensity values. I was relying on some older information that the Bureau used to provide around the conversion between the colours to reflectivity values.

Would that data assist you in providing more detailed information to the Commission?-- It would assist me greatly, yes.

You talked about rainfall gauges just previously?-- Mmm-hmm.

Why is it important in terms of having the information that you get from rainfall gauges?-- So the rainfall gauges provide a validation of what the radar is telling you. As I said, there's a - the conversion from reflectivity to rainfall rate depends a lot on the meteorological conditions that exist at the time having information from the rain gauges allows more certainty in that conversion.

So is it the case that the rainfall gauges can corroborate what you have just seen on the radar?-- That's correct.

For example, if you are looking at a radar image and you are seeing a rain event pass an area, then you can look at what the rainfall gauges have recorded to see if that is in the same terms as what you're seeing on the radar?-- That's correct.

Now, if I can direct your attention to these four images that are on the first page of appendix A. Can you take us through the information that you're getting from that first radar image, which is - if you could just give me the time of that?-- 11.30 a.m.

So we have four radar images on that page: one from 11.38 and one finishing at 11.48?-- 11.30 a.m. is the first image.

Yes?-- They are at six-minute interval, that's correct.

Okay?-- So what we have here is an intense thunderstorm that - intense thunderstorms that are moving from the north-east to the south-west. Those thunderstorms had crossed the coast approximately two hours earlier in the area up near - near Maroochydore and were moving in a south-westerly direction. The important thing is really to concentrate on the areas that are in the yellow colours, the yellow, orange and red colours in this image, and the estimated intensities in those areas

are - well, I've estimated that we're looking at intensities of in excess of 20 millimetres an hour in areas where those areas that are coloured are yellow, orange and red. So by looking at successive images we can establish the direction of movement and the speed of movement of the storm and we can also estimate what the rainfall intensities were doing at the time.

Okay. Now, in your report the radar scan at 11.48 assumes some importance?-- Yes, it does, because the first - the scan at 11.48 is starting to show convergence between - I'll just refer to my report. Yes, so at 11.48 we have a storm cell that has - we've had two storm cells, one moving from the west and one moving - sorry, one moving from the east in a westerly direction has converged with a cell moving from the north-east in a south-westerly direction into this large cell. The maximum intensities at that time were - we're probably looking at reflectivity values of about 45 dBZ which can translate into intensities of up to 100 millimetres an hour. The intense part of the storm, so that yellow area in the storm, covers an area approximately 40 kilometres in diameter and it was moving at approximately - by looking at successive scans we can see that it was moving at approximately 30 kilometres an hour in a south-westerly direction at that time.

And so, in terms of warnings that could be provided, in your report you say that the 11.48 is an important scan that the Bureau should have acted upon?-- Well, I guess it's at that time in point that there was evidence not only from the 11.48 scan but from the preceding scans that there was an intense thunderstorm with intensities of, well, it varied across the storm but somewhere between 20 and 100 millimetres an hour, moving at - as I said, it was 40 kilometres across moving at about 30 kilometres an hour. And so, those intensities were at a level that was certainly above what a rainfall rate that would be comparable with a one in 10 year rainfall event for a one-hour duration. So that sort of rainfall event occurring on already saturated catchments would or could reasonably be expected to cause concern for outer bank flows and potential flash flooding at that point.

Now, when the Bureau of Meteorology would see an 11.48 scan, do they receive that information then or is there some time lapse before they receive the full information?-- So there is a small lag in terms of the time that it takes for that - for the radar to complete its scan and for some basic quality control to be performed and for the data to be transmitted. Typically, that time is no more than a couple of minutes and it certainly is almost always less than 10 minutes. So the data that's flagged on that scan would - I would have expected the Bureau would have had access to that before midday.

At page 59 of your report you take into account that lag, that time-lag, to some degree and you say, "An experienced meteorologists could reasonably have been able by 12.15 p.m. to predict that rainfall intensities would increase as the rainfall approached the Toowoomba Range due to orographic enhancement and Doppler radar data demonstrating the likely

presence of strong updrafts on the south-eastern side of the storm from radar scans available at the time"?-- That's correct.

You've come to that conclusion from viewing the radar scans that were available on the Bureau of Meteorology's site?-- Yes, I have, that's right.

You also say on page 59 that, "On the basis available", and that is your looking at, effectively, those four scans, "to severe weather meteorologists by sometime between 12 noon and 12.15 on Monday 10 January, they should have been alerting the Flood Warning Centre and local authorities with responsibilities under current arrangements for flash flooding of the meteorological situation"?-- That's correct.

Now, the Bureau of Meteorology, if you can just assist us with just the structure of the Bureau of Meteorology, it has almost two components, doesn't it?-- So my - my understanding is of the way in which the Bureau is internally organised is that, firstly, the Bureau operates at a regional level. So there are regions set up basically on state boundaries. In this case we're talking about the Queensland regional office. Within the Queensland regional office the - there is a Flood Warning Centre that is responsible for non-flash flood warning and a severe weather - severe weather forecasting desk that is responsible for providing severe weather - severe weather forecasts.

At page 60 of your report you then say that at 2.35 p.m. on the 10th of January the Bureau of Meteorology, using its current systems and procedures, should have been in a position to issue a flash flood warning for Grantham?-- Yes, I - what my observation was is that there was a rapid rise in the water level at the Helidon streamflow gauge between 2.30 and 2.53 p.m. The water level rose at Helidon from approximately four metres gauge height to more than 12 metres gauge height. So that was an increase of eight metres in a period of 23 minutes. At 12.53 p.m. the Helidon streamflow gauge failed or it malfunctioned and failed to return any more data for a period following that. But given that there was a - that strong rise in water level over that 23-minute period, my expectation would be that the Bureau could reasonably have been looking at that data and by - at some stage during that period, and I picked a time of about 2.45 p.m., have been aware that there was a rapid streamflow rise going on at Helidon which would have enabled a warning to have been made for Grantham and other communities downstream.

If I can take you to another topic that you have raised in your report and that is the annual exceedance probability, AEP. Can you tell us what AEP means?-- Yes. So the annual exceedance probability is the probability that an event might be exceeded - exceeded in any one particular year. So, for example, we often talk about an annual exceedance probability of one in 100, which means that in any given year there is a one per cent chance or a one in a hundred chance of that flood level being equalled or exceeded.

Okay. Now, have you examined the AEP of this rainfall event in Toowoomba and the Lockyer Valley? Have you done those calculations?-- I've done what I was able to do with the available data. The ground-based rain gauges - there are - few gauges in the Lockyer Valley catchment that were actually able to capture the highest intensities of the rainfall event as it passed over. The best sited gauges to capture the high rainfall intensities that were observed were in Toowoomba and were the gauges operated by the Toowoomba Regional Council.

One gauge at Prince Henry Drive recorded - recorded a rainfall intensity of 94 millimetres over a period of 60 minutes, and that translates into an annual exceedance probability of the rainfall event of 1 in 370.

So, that's one in 370 years?-- One in 370 years, that's correct.

Okay. What about in relation to the Lockyer Valley? You said that you have had some difficulties there. Can you provide us any assistance with an AEP in the Lockyer Valley?-- So, in the Lockyer Valley, the only - or the gauge that is most likely to have caught the highest rainfall intensities was located - was a Queensland Rail recording at a place called Holmes near Spring Bluff that recorded 93 millimetres in a period of an hour, which would correspond to an AEP of one in 250. It is possible, and I would say likely, that severities of rainfall at other locations that occurred between the rainfall gauges were higher than that.

Now, your report provides a hydrological description of flooding in the Gowrie and Oakey Creek catchment?-- That's correct.

And your report also examines the influence of the Cooby Dam on the flooding of Oakey?-- That's correct.

Now, what did you conclude in relation to the influence of the Cooby Dam in relation to the flooding downstream?-- Okay. So, Cooby Dam is located on Cooby Creek, which is a tributary of the Oakey Creek. Cooby Dam, the catchment area upstream of Cooby Dam, represents 28 per cent of the total catchment area of Oakey Creek at Oakey. The Cooby Dam, the peak outflow recorded at the dam was - and I'm now quoting Mr Collins' report that I perused last night - was 258 cubic meters per second, which would relate to a flow over the dam spillway of 300 cubic meters per second and is estimated to be a one in 50 year flood at the dam site. The flood modelling that's been performed previously for Cooby Dam shows that the dam would have attenuated the peak flow for a one in 50 year event from approximately 600 cubic meters per second to approximately 300 cubic meters per second. So, it's certainly the case that Cooby Dam mitigated the flows occurring down Creek and into Oakey Creek at Oakey. It's also the case that we know from the radar rainfall imagery that flows were coming from the rest of the Oakey Creek catchment, they were coming from the other tributaries of Oakey Creek and from the catchment after Oakey Creek itself, and so the fact that there was run-off and rainfall and flows being generated over that catchment area means that Cooby Dam mitigated the flows, but it certainly wasn't the only place where flow was coming from that would have been caused flooding in Oakey.

Now, the Cooby Dam, have you done an analysis of what is the Cooby Dam built to withstand in terms of AEP?-- I believe, and I don't have it in front of me, that the dam can withstand - sorry, I have looked at it but I don't have the document in front of me to actually corroborate that. It's something in

excess of 1 in 100,000.

Now, you have also referred in your report to the Insurance Council Australia report on the flooding in the Lockyer Valley?-- Yes, I have.

Now, can I take you to that report, and can I take you to figure 8.1 at page 44?-- Am I waiting for it to come up on the screen?

Yes, it will come up on the screen?-- Yes.

While we're waiting for that to come up on the screen, you did a hydrological analysis of if we can call it path of the waters as it hit the Lockyer Valley?-- I did, that's correct.

And you can, with reference to the map, take the inquiry through to your opinion as to the path of this water?-- Yes, I can.

Okay. We will just wait for the map to come up on the screen?-- Okay. So, we can see on the map a number of - I need a pointer or something, don't I? There are a number of tributaries in the Lockyer Valley in the western part of the - can I manipulate this any way or have a pointer just so I can point to-----

You want?-- I just want to be able to document areas on the screen where I'm pointing to, I suppose.

Yes, but if you point on the screen it won't go on that bigger screen?-- Okay.

COMMISSIONER: You can point at the bigger screen?-- I can point up here?

MS WILSON: Yes?-- Okay. That appears to be working. So, there is a number of tributaries in the upper Lockyer Valley. Alice Creek, which is labelled, flows in in this area down here, catchment up here, Murphys Creek up here, and Fifteen Mile Creek - Alice, Fifteen Mile and Murphys Creek all join just downstream of the town of Murphys Creek. Further downstream, this is Rocky Creek, which itself has a number of tributaries, and then further downstream of that there's a creek called Monkey Water Holes Creek. The rainfall event or the storm, the intense part of the storm, was moving in a southwesterly direction from up here to - from southwest - sorry, from northeast to southwest, and would have started to - based on the radar imagery, that imagery that shows the yellow part of the storm with the highest intensities would have started to enter the subcatchments of the Murphys Creek, Alice Creek and Fifteen Mile Creek at approximately 12 noon on the 10th of January. The rainfall then would have gradually extended across the catchment, so that by - certainly by 1 p.m. there would have been intense rainfall occurring across most of these - the catchments in most of these creek systems. Initially there would have been run-off generated due to the fact that the catchments had been saturated by rainfall that

had occurred over several days previous to the event. The catchments would have been saturated prior to the event, so run-off would have started to occur virtually immediately the event - the intense rainfall started to occur, and that would have flowed into those creek systems. There's a stream flow gauge on Murphys Creek at Spring Bluff here that captures a very small catchment up the top here, 18 square kilometres in area, and that stream flow gauge which - returned data that was only available after the event, well and truly after the event had been completed, showed that water level rise started to occur at 1.20 p.m. and by 1.40 p.m. it peaked at a level of 4.6 metres - 4.96 metres gauge height, and the Insurance Council of Australia have estimated that the peak flow at that time was 360 cubic meters per second. The one in 100 peak flow estimated for that catchment from a regional frequency analysis is 167 cubic meters per second. So, the peak flow at that gauge was more than double the magnitude of the one in 100 peak flow. Obviously there was run-off - there was one-off being generated from all of - as I have mentioned earlier, from all of those - from all of the subcatchments of the upper Lockyer Creek, and so there was flow coming down these upper tributaries, initially through Murphys Creek, continuing down Lockyer Creek, and then with flow coming in from the - from Rocky Creek joining the flow that was already coming down - the flood that was already coming down Lockyer Creek, and then just downstream of Helidon Monkey Water Holes Creek contributes flow, and that joins the flow coming down through Helidon as well. Once again, referring to the Insurance Council of Australia report on the Lockyer Valley, the estimated peak flow just downstream of Helidon was between 3,500 and 4,000 cubic meters per second and that occurred at approximately 3.30 p.m. on the 10th of January. Yep. And then that flow obviously then continued downstream through Grantham. There were - there was amateur video captured approximately halfway between Murphys Creek and Helidon at a railway bridge crossing, which the timestamp on the video shows that the event started - that there were - the event was already running out of the bank at 1.59 p.m. and the video claims that the flood peaked at approximately 2.21 p.m. at that location. In this case, the movement of the storm did cause the flood peak to be large, or very large, because the movement of the storm was such that peaks from these catchments here in the northern part of the upper Lockyer Creek catchment occurred, were flowing downstream. They were then joined at virtually a coincidence - at a - almost coincident time from the peak coming in from Rocky Creek, and then at - again peaks coinciding from Monkey Water Holes Creek and Lockyer Creek as the flow continued downstream.

You referred to some figures that the Insurance Council of Australia had done. Have you done your own analysis on those figures?-- I haven't been able to do any further analysis to corroborate their figures.

But based on those figure, you can calculate and describe for us the path of the water?-- Yes, I have, yes, and the figures look plausible.

Okay?-- Yep.

Now, the next question is: we have looked at the path of the water. Why did it hit these communities with such intensity?-- It really hit these communities with such intensity simply because the rainfall intensities were so large and it was a combination of those high rainfall intensities occurring on steep, saturated catchments that generated run-off so quickly, that caused the flooding to be at such large flow rates, high velocities and large depth of the flow.

Your report also looks at the possible influences on the water velocity and direction by infrastructure and other possible matters like the quarry?-- Yes.

I am going to take you through a few of those?-- Yep.

Could you tell us, if any, what was the influence on the water velocity and direction caused by vegetation in the creeks?-- So, in general, my assessment would be that the magnitude of this event was so large that it stripped a large amount of vegetation from the creek bed and banks. It also stripped vegetation from flood plain areas and even areas that would be considered outside of normal waterways and flood plains due to land slips and those sorts of things that have - are documented to have occurred within the catchment. The vegetation, once it's mobilised within the stream, will move downstream with the water flow. Some of that vegetation was found on structures such as culverts and bridges during the flood event.

Does that have an influence when it hits these culverts and bridges?-- It will have a local influence when it hits those culverts and bridges, so any vegetation or debris that gets caught against a culvert will have some effect in backing up water behind that structure. The hydraulic influence depends on how much - how much vegetation is caught and depends on the flow rates and the hydraulics, the other hydraulic parameters that govern that crossing.

So, is it your opinion that any vegetation that were in creeks or waterways had little influence on the direction of the water?-- It's - the vegetation that was removed from the creeks or waterways would have been removed very early in the flood event. It would have contributed along with other vegetation that was stripped off areas that are not normally considered waterways, so it would have had - would have contributed to some extent, but it's difficult to establish how much the - how much the vegetation that was stripped out of the waterways contributed compared with vegetation that was removed from other areas. I think, though, it's fair to say that the magnitude of this event was so large that the relative impact of - in general, the relative impact of vegetation stripped from the creek bed and banks is - would be minor compared with the - all of the other debris that was washed down during the event.

Okay. Another matter that you looked at is the quarry in Grantham?-- Mmm-hmm.

Did that have any influence on the velocity and direction of the water?-- So, it's difficult - it's difficult for me to give you a definitive answer to that without a detailed calibrated hydraulic model of the Grantham area.

Okay. Can I just stop you there?-- Mmm-hmm.

Have you done that?-- No, I haven't.

And how long would that take to do?-- That would be several months' work of detailed analysis.

So, can you provide any opinion without having done that model?-- I can provide an opinion that the flood waters broke out of the banks of the creek to the south of the processing plant at the quarry, and the flood waters also broke out to the north of the quarry and at their peak would have sounded the quarry. The quarry has a number of buildings and material stockpiles there, but their influence would be minor. A summary of the situation would be that their influence would be a very local influence, that may have had a - caused a marginal increase in flood levels in the immediate vicinity upstream of that point, but really would have - unlikely to have any significant significance downstream of that point.

Now, you have also looked at the railway line that goes through Grantham?-- Yes, I have.

And have you examined whether the lack of culverts in that railway line had any contributing effect to the flooding that occurred in Grantham?-- Yes, I have.

And can you give us your opinion on that, please?-- So, the railway is located along an embankment section that is on the flood plain in Grantham. The flood waters - the railway embankment would have impeded the passage of flood waters as they came out of Lockyer Creek, and those flood waters, if that railway embankment had not been there, would have naturally flowed to the north. During the event, the flood waters - anecdotal evidence is that the flood waters rose to a level above the top of the embankment and spilled over the top of the embankment, and it was noted in the ICA hydrology panel report that a 1,100 metre long section of the railway embankment was being repaired by QR National following the event, which is an indication that there was flow over that portion of the embankment during the event. There are also - was - would have been flow through the bridge crossing in Grantham, the bridge crossing that - where the railway crosses over Sandy Creek, just upstream of where Sandy Creek joins with Lockyer Creek, and - and so it is fair to say that if there had been - had have been more culverts or had have been additional culverts in the railway line, that would have allowed more flood waterer to travel from the southern area of - from the southern side of the railway line to the northern

side of the railway line.

So, how many culverts, in your opinion, would be required to - for this to have some mitigating effect on Grantham?-- So, as I said, it's difficult for me to give a definitive answer without - to that without a detailed hydraulic model of Grantham, which I don't have and which I haven't had the opportunity to set up, but the flow rate - the estimated flow rate at Grantham was between 3,000 and 3,500 cubic meters per second. To get an appreciable flow rate through the embankment to reduce flood levels, you are talking about having to pass hundreds or maybe a thousand cubic meters per second through the embankment, which would have required hundreds - hundreds of culverts or a very large area of waterway opening to provide the ability for that flow to travel underneath the railway line.

Now, you just discussed there that you haven't done a hydrological model in relation to Grantham?-- That's correct.

How long would that take to do?-- We established earlier, several months.

That would be in the same category as-----?-- Would be the same model.

Okay. And that was the one that you were talking in relation to the hydrological model in relation to the quarry-----?-- That's correct.

-----near Grantham?-- That's correct. The same model would cover the entire domain from just - well, from just upstream of the quarry to well downstream of the Grantham.

Now, in your report, you have many conclusions and recommendations. I am not going to take - I am not going to take you to them all. However, just in relation to early warning systems, can you tell us your recommendation in relation to the system of early warning systems that would be required to assist in the forecasting of flash flooding?-- Yes. The existing arrangements that are in place for flood warning within the Bureau of Meteorology have been set up on the basis of being targeted around nonflash flood warning situations. For an effective flash flood warning system to be provided, I have noted in my report and I have referenced the - I have referenced a recent review that has been conducted by Hapaurachi et al who work for the Water Information Research and Development Alliance. That is a joint research and development project of the Bureau of Meteorology and CSIRO. I will just go to some of the detail, if you give me a moment. So, based on their review, which is a more general international review, and also my assessment of what might be required to provide a more effective flash flood warning system for Queensland, Australia and the Lockyer Valley, the system would require a greater degree of automation than the existing nonflash flood warning system, so it would require - because there are hundreds or thousands of catchment that would need to be modelled, that system would need to be

automated in a computer system so that those model runs can be initiated quickly, without - at a regular frequency without any forecast or intervention. The system would need to consider, therefore, a potential implementation of a different hydrological modelling framework to the one that the Bureau of Meteorology currently run, which is the URBS modelling framework. An important feature would be that requires spatially and temporally detailed quantitative rainfall estimates, which are most likely to be obtained from a combination of the existing weather radar network and reporting rain gauges. It then also requires insertion of forecasts of quantitative rainfall with limited or no manual intervention, and then finally the system would need to be able to provide automated pro forma forecasts and warnings for specific locations that would then allow an experienced forecaster to review those forecasts and approve those warnings prior to them being issued.

From where we are now, are we within reach of having such a system?-- So my assessment would be that we have a lot of data collection elements in place to implement that system, at least on a trial basis for some catchments. The areas that would need investment would be in development of the computer and modelling systems, and also in providing the right number of trained staff to operate and maintain that system.

Who, in your opinion, would be the best organisation to do that?-- So, I have stated in my report that I believe that the Bureau of Meteorology are the best placed within Australia to provide that service. Given that it requires the data that needs to be collected from multiple sources, including the weather radar and also the expertise that would be required from meteorologists and hydrologists to operate that system, my opinion is the Bureau would be the best place to do that.

Thank you, Madam Commission. That is the evidence of Dr Jordan.

COMMISSIONER: Thank you. Mr Rolls, are you doing the questioning for this State, or is Mr MacSporran?

MR ROLLS: Yes. No questions, Commissioner.

COMMISSIONER: Thank you. Ms McLeod?

MS McLEOD: I just wonder if I might need a microphone for the transcript. I can certainly speak up. Thank you. Dr Jordan, my name is Fiona McLeod, and I appear for the Commonwealth, including the Bureau of Meteorology?-- Mmm-hmm.

Just to clarify some things, some general comments about your report, Dr Jordan, you have expressed that your expertise in hydrology. You are not a meteorologist. Do I understand that?-- That's correct.

And, in fact, you acknowledge in your report and you mentioned a few of the matters to Counsel Assisting that you based a number of meteorological aspects of your report on others' reports; in other words, it's second-hand knowledge?-- That's correct.

Yes. Some of the data, although you didn't mention it, is taken from the Bureau's reports and from their website also?-- That's correct.

Okay. Now, I understand that you worked as a researcher for the Bureau approximately nine or 10 years ago?-- That's correct.

And your comments about internal communications within the Bureau, are they based on your assumptions based on the timeline of events on the 10th of January, or are they based on your experience a decade ago?-- They are based on both of those aspects.

Okay. Does that mean that you have no personal knowledge of those matters?-- Yes, it does.

Okay. You did not work within the Flood Warning Centre a decade ago?-- No, I didn't.

Okay. And I think you acknowledged that your analysis of the meteorological conditions in your report is informed by a post-event analysis?-- Yes, it is.

And a number of the readings that you referred to for the upper Lockyer Creek, for example, are all readings that were not available to the Bureau on the 10th of January; is that a fair comment?-- Some of those are, so the Spring Bluff stream flow gauge was not available to the Bureau on the 10th of January, but data from the Helidon gauge was.

Right. We will come to the specifics in a moment, but a number of gauges you understand, rainfall gauges, operate in real time, that is, they report hourly data through to the Bureau, or whoever else owns them, it might be the State Government by way of DERM or it might be Seqwater?-- That's correct.

Some of those do not report at the time?-- That's correct.

Okay. In terms of your comments about the generic nature of the warnings, you make a comment that it would be more useful

to make reference to specific locations in Bureau warnings?-- Yes, I do.

Are you aware that the Bureau issues forecasts and severe weather warnings by reference to the regions or catchments?-- Yes, I am aware of that.

For example, if we look at the warning on Monday, the 10th of January at 5 a.m. and then again at 11 a.m., which was incidentally reissued at 11.05 a.m., there was severe weather warnings issued by the Bureau for heavy rainfall - I wonder - that's coming up on the screen, Dr Jordan?-- Sorry, yes.

Yes. So, we see warnings issued by the Bureau 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. So, at 5 a.m. and at 11 a.m. the Bureau had warned specifically of heavy rainfall leading to localised flash flooding and worsening of the flood situation for the eastern parts of the Darling Downs and Granite Belt district. So, do you say that's not a sufficient reference to location?-- Yes, I do.

There had been a number of warnings you're aware for the region on the 9th of January as well?-- Yes, I'm aware of that.

One of your comments is that people in inland cities and towns do not identify with the coastal regions but the description in the warning I just read to you, I suggest, of the eastern parts of the Darling Downs and Granite Belt district obviously include Toowoomba, do they not, as the largest city in that district?-- So my comment was more the - yes, I'll agree that eastern parts of Darling Downs is sufficiently clear but the - I would argue that the South-East Coast District is not - that it would be - it's potentially misleading for people, for example, in the Lockyer Valley to identify that they are part of the South-East Coast District.

Do you assume, therefore, they don't identify with the eastern parts of Darling Downs or Granite Belt either?-- That's right, they're not in the Darling Downs.

Are you aware, Dr Jordan, that if you go to the link that is specified in each of these warnings you can click through to maps of these regions?-- Yes, I am aware of that.

And you're aware that if you click through to the Bureau maps for the south-east coastal region it goes right up to the border of the Ranges here above Toowoomba, does it not?-- I'm aware of that when you reference it on the Internet, that's correct.

Are you aware that the warnings do contain the link for further information by reference to the Bureau maps and other details?-- I am aware of that but I, once again, would argue that in a warning situation, very often these warnings are not communicated by the Internet, they are communicated via radio or television and people who are receiving the warnings may well not have access to that information at the time.

Are you familiar with the local media warnings that were given by the Bureau on the 10th of January?-- I'm only aware of the warnings that are attached in your statement. So, I'm not aware of those.

Are you aware, just staying with the website for a moment, that you can click on maps and have an interaction, basically, with the information that's on the website?-- Yes, I am aware of that.

So there is a multimedia focus from the Bureau's point of view, do you agree, which enables you to seek more details and more information than that just contained in the weather warnings and forecast?-- Yes, I agree with that.

Now, the flood warnings issued on the 10th, for example at 1.44 a.m., 6.13 a.m., 10.53 a.m. - this is the flood warnings - all refer to the Condamine and Balonne River systems and, of course, there were warnings for those river systems issued before these as well, and for the Lockyer and

other river systems east of the Ranges from at least 10.28 a.m. on the 10th. The Bureau, as you understand, warns for these large river systems and not the individual creek systems that you have just referred to?-- Yes, I agree with that.

And do you accept that in the headwaters of these creeks and rivers there is very little monitoring at least to the east of Toowoomba?-- Yes, I do.

Just staying with the flood warnings for a moment and an example at page 539 of appendix D, that is a flood warning for the Lockyer Creek and other creek rivers in the catchment. This was a flood warning that was issued approximately four hours before the heavy rainfall produced the flash floods that we know, four or five hours before then?-- Has that come up on the screen?

Yes, I hope so. Thank you?-- Sorry, yes.

That that warning notes the moderate to major flooding in the Lockyer Creek. Details for the creek are listed and high levels are possible as rainfall continues. Then there's a listing of specific gauge readings and the trend for each of those gauges on the following page?-- Mmm-hmm.

So in those flood warnings there are references to specific locations; you accept that?-- Yes, I do.

Are you aware of the Bureau's role in the briefing of local councils not just through the media but directly through the State Emergency Coordination Centre?-- Yes, I am.

Are you aware that certain councils, in fact all councils can call in at any time asking for more detail and more information?-- I'm aware now that you've told me that.

Thank you. And that some councils historically are better than others at doing so?-- That would be logical, yes.

As council assisting referred to in her opening, some better resourced than others in terms of their capacity to do that?-- That's correct, yes.

If the Bureau were to provide warnings at a micro scale, that is down to the township level, that would require, do you agree, a capacity well beyond its existing operations?-- Yes, I agree with that.

You're aware that the Bureau does not issue flash flood warnings; that its systems are not designed for that?-- Yes, I agree with that.

Now, we know that an extraordinary volume of rain fell very quickly in Toowoomba and the upper creeks of the Lockyer Valley which led to the flash flooding events of the 10th of January?-- That's correct.

You note in your report that it's likely the runoff from those streams occurred within minutes of the rainfall falling on and near Toowoomba and east of the Ranges because of the saturated conditions from the previous week?-- That's correct, yes.

Are you aware that a number of places in the Lockyer Valley that were subject to the flash flooding on the 10th, there was in fact higher rainfall intensity the following day that did not lead to flash flooding? Have you looked at the 11th or other days?-- No, I haven't looked in detail at the 11th.

My point of asking about that is to point out and to ask if you agree the potential for flash flooding does not just depend upon rainfall volume, does it?-- No, it depends on a number of factors including the spatial and intense distribution of the rainfall.

Yes?-- And it depends on the antecedent wetness condition of the catchment.

Yes. So it is the intensity of the rain, the temporal or spatial distribution and the conditions or the hydraulics on the ground?-- That's correct.

Flash flooding, would you agree, usually results from a relatively short, intense burst of rainfall and it can occur anywhere in Australia but it's a particularly serious problem in urban areas where there's been infrastructure changes and very small creeks and streams? Would you agree with that broad proposition?-- I would agree with the proposition that it can occur virtually anywhere in Australia. The urban areas are susceptible but there are also rural areas that are susceptible to flash flooding as well.

You would agree that they tend to be quite localised and that it is difficult to provide effective warning because of their rapid onset?-- I would agree that using the current systems that it is difficult, but that there is - that systems could be developed that would enable a much better job to be done for flash flood warning.

So that there is scope for further development of flash flood warning systems beyond the scope of the work that the Bureau currently undertakes?-- Yes.

Okay. Now, typically, we talk about a flash flood as being one that occurs within six hours of rain to flood time; is that right?-- That's correct.

Although, that can vary considerably at a given location of course, can' it, depending on rainfall distribution, intensity and the other matters that you mentioned?-- So six hours is generally the accepted definition.

And that is the criteria or the definition that the Bureau have consistently used through their planning and program activities; you're aware of that?-- I would aware - I am aware of that through the planning and programming activities. I

think that the information given publicly by the Bureau does not actually - or at least on the website, I could not find any locations where there's actually specific reference to the six hours.

Well, they do provide information on the website about the floods?-- Yes.

And flood warnings. There is no reference to flash floods, is there?-- There is a definition of "flash flooding" in the glossary on the Bureau of Meteorology's website.

I obviously haven't printed out the right pages then because I haven't found that. But, certainly, the Bureau does not assert any responsibility for warning for those flash floods in localised areas; you'd agree with that?-- Oh, I agree with that.

A flash flood warning service would generally require a specific network of monitoring stations that are pretty closely spaced; would you agree with that?-- No, I would not necessarily agree with that.

Do you say that a sparse or less dense network of rainfall gauges in a larger river system can pick up the small scale rain events such as the storm or, rather, the cell of the storm on the 10th of January?-- Not on its own and my point is that - but my point is a combination of remote sensing from weather radar and the existing network could pick up a storm like that.

Okay. Your view is that the Bureau is best placed to issue the flash flood warnings because it has access to this network of real time rainfall and river height data; is that the point?-- No, my point is that the Bureau has access to that data in addition to the weather radar network; in addition to the hydrological and meteorological expertise that is unlikely to be possessed by local authorities.

But it does not have, you've already agreed with me, the local information of conditions on the ground. Do you agree with that?-- Well, it has limited information, that's correct.

Now, when you make this recommendation, I understand you are not attempting to analyse the legislative or even constitutional arrangements between governments about who is responsible for these things. You're just trying to indicate this should be done and this is how it could be done?-- Exactly.

Is that fair?-- Correct, yes.

You discuss the radar in your report and the importance of the radar and I think you note that the radar may lead to an error in the estimation of rainfall - the radar returns, rather, can lead to an error in the estimation of rainfall by a factor of three or four?-- It can, yes.

Now, as I understand it, and correct me if I'm wrong, the Doppler capacity of the radar makes no difference to that margin of error because it is measuring the speed of movement of the precipitation?-- That's correct, yes.

In lay terms, the margins of errors with radars are to do with the reflectivity of raindrops or whatever the objects are in the path of the electromagnetic radiation and the size and distribution of that object; is that fair?-- That's correct, yes.

Now, whichever equation you prefer for the calculation of rainfall rate, there is still a need to verify the radar returns using rainfall gauges on the ground?-- Yes, there is.

You mentioned corroboration or validation. I think that's what Mr Davidson calls ground truthing?-- Exactly, yes.

Why is it important that you have that corroboration or validation?-- Well, as we have established to date, there can be an error or an uncertain - an error of three to four times in direct conversion of reflectivity to rainfall rates. But with that corroboration and validation using ground-based data, that error can be substantially reduced, back to workable - workable numbers of perhaps 10 to 20 per cent.

So you went to appendix A in your report?-- Yep.

And the radar image for 11.48?-- Yep.

Which is the one you said was pointed to the convergence of the storms?-- Yes, that's correct.

Can I just ask you while you I'm on that the time. I think you said in your report that 11 a.m. was the time of the convergence of storms in a couple of places?-- Sorry, yes, you are correct. The convergence of the two storms occurred at approximately 11 a.m.

So I think it was page 1 and 17 you say 11 a.m., but looking at that radar return it is definitely 11.48?-- Well, at 11.48 the storm had intensified to that point. There was a - there was a history of movement from 11 o'clock to 11.48 that would be - would have established the direction and movement of the combined cell and the intensity - and it intensified to a point where it was providing those high reflectivity returns.

Now, the cell, it doesn't stay a constant size, does it?-- No, the cell - the size of the cell does evolve over time.

And it doesn't stay in a particular linear path either, does it?-- It may not, no.

So for this storm, for example, when we saw it cross the coast and move in from the Sunshine Coast hinterland towards Toowoomba, it actually took a bit of a veer to the south. Is that what you observed looking at the radar?-- Sorry, can you repeat that question, please.

The storm cell that you see at 11.48 is heading broadly south-west?-- Yes, it is.

And then it veers a little south as it approaches Toowoomba?-- Yes, it appears to.

I don't have the colour appendix in front of me but I think you can accept that that's what it shows-----?-- Yes, no, that's correct and it's either veering that way or it's been - there's orographic enhancement of the rainfall that's increasing the intensities on that side of storm as it approaches the Toowoomba Range.

Under the path of this storm as it went past or to the north of Wivenhoe Dam, most of the creeks and streams under the cell, including Cressbrook and Redbank for example, are flowing north or in a north-westerly direction generally, aren't they?-- Yes, that's correct, yes.

Until the storm is sitting immediately to the east of Toowoomba and then it flows in a northerly-easterly direction those creeks and streams?-- That's correct, yes.

It passes over an area with very few weather stations on the east of the Divide?-- That's correct, yes.

Now, if you accept that those stations are mostly not returning alarming rates of rain as it passes from Esk towards the Range, I'll just ask you to accept that for a moment, what we see on the radar is that yellow/ orange pattern in the centre of the cell?-- That's correct.

And some specks of red popping up?-- That's correct, yes.

Those specks of red are very small and they are shifting, relatively I should say?-- Yes, that's correct.

Yes. And the red indicate what, that it's moving into heavy rainfall or is it at the top end of moderate?-- Well, it is heavy on this scale.

Right?-- Yep.

And moderate is the yellow/orange broad patch that we see in the centre?-- Well, that's - that's the way it's labelled on this scale. My - the - my estimations, once you get into those yellow and orange colours you are already above 20 millimetres an hour.

Which gauges do you say were available to the Bureau to verify the radar returns which should have alerted them to a risk of a flash flood in the upper Lockyer Creek on the 10th of January?-- In terms of verification of the radar returns, the - there are a large number of reporting gauges that are available to the Bureau in the - in the catchments to the north-east.

As you've said, they are the creeks that flow to the north and north west?-- That's right. And there are rainfall gauges even in the - even in the areas that - so in the upper Brisbane catchment and also even in the Pine and Caboolture river catchments and to the north of that, even in the Maroochydore catchment.

So which are the ones that are in the upper Lockyer Creek that were able to verify radar returns to the south of that range?-- The only - the only gauge in the Upper Lockyer Creek that would have returned - that I'm aware of would have been the gauge at Sandy Creek, Upper Sandy Creek.

You know why the gauge is up at the top of the Sandy Creek?-- Because it is flash flooding potentially-----

Because there has historically been flash flooding in Sandy Creek?-- That's correct.

And the Sandy Creek gauge, let me just put to you some returns from Sandy Creek. We had at 11 a.m. on Monday the 10th, 0.9 mil for the hour; at 12 p.m., 4.6 millimetre for the hour; and then at 1 p.m., 29.8 millimetres; at 2 p.m., dropping back to 6.7 millimetres. So nothing particularly alarming about the Upper Sandy Creek readings; would you agree with me?-- I would agree with you on that because the Upper Sandy Creek gauge missed the most intense part of the storm.

Yes, and you would agree with me that the most intense part of the storm passed into an area where there were no gauges, leaving aside Helidon for the moment, that could verify those radar returns?-- That's correct.

What we did have verification of was a call from a spotter at Cressbrook. Are you aware of that?-- Mmm-hmm, yes.

Yes. And that prompted the call by the Bureau to the State Disaster Coordination Centre at 1 o'clock?-- That's correct, yep.

And then later when the Bureau became aware of the flash flooding in Toowoomba, the data was retrieved for Helidon. Are you aware of that?-- That's correct, yes.

So to I take it from your evidence that you're accepting that there were no gauges in the relevant area available to verify the flash flooding potential for the upper Lockyer Creek?-- No. My argument would be that the gauges that captured the storm as it passed into the - over the streams that flow - the upper Brisbane catchment, the Pine, Caboolture, Maroochydore catchments would have provided the Bureau with the potential to calibrate and verify the conversion of reflectivity to rainfall intensity as the storm approached. I do accept that there are no gauges - there weren't gauges that would have caught the storm as it was dropping rainfall on the catchment.

You're talking about rainfall gauges in the hinterlands, the Sunshine Coast hinterlands?-- That's correct, yes.

Where there were massive rainfalls on the 10th of January?-- That's correct.

And are you aware that the rainfall was petering out as it approached Esk in terms of the volume of rain?-- I'm not aware it was - well, it would have been petering out as the - as the storm went over the top of it and then moved on.

I'm sorry?-- Sorry.

But you're saying that the readings from the hinterland area, Sunshine Coast hinterland, should have alerted the Bureau to the risk of flash flooding in the Lockyer Creek?-- It should have alerted the Bureau to the - it should have allowed the Bureau to provide some - well, it should have allowed the Bureau to provide some corroboration of the rainfall intensities being returned from the radar. That would have provided some alert of the prospect for flash flooding in Lockyer Creek.

In the Lockyer Creek specifically? I mean, this is before the storm had turned south before it had progressed across Esk?-- So what - what time are you referring to?

Well, when do you say those readings, relevant readings, came from-----?-- So they would have been occurring from approximately 9 a.m. through to 11.40 - through to midday.

And you say the storm converged at about 11.48. Prior to that time, it was difficult to predict the path of it?-- That's correct, yes.

So what readings after 11.48 are there that you say should have alerted the Bureau?-- Of the - of the rainfall intensities?

Yes?-- There would be very little after that time.

Okay. As well as the rainfall data that we've been discussing - that is rainfall volume, intensity, distribution and so on - I just want to talk for a moment about how we improve the system in the future?-- Mmm-hmm.

The information you need to know about local conditions can include detailed knowledge about land features and infrastructure?-- That's correct.

Do you accept that?-- Yep.

Drain, culverts, embankments, bridges, levees, urban development - all of those things that are going to impact upon the hydraulic flow of water?-- In some places they will, yes.

In some places there may be nothing. There may just be farms, paddocks, empty, undeveloped land?-- That's correct.

Another impact you said which contributes to a degree is the removal of vegetation either by the passage of the storm water or debris - because of debris in the waterways?-- That's right.

You also need to have knowledge, do you not, about how the water is expected to flow about the landscape and that can include the impact of dams, channels, depressions and historical flows?-- It can, yes.

You understand - let's take Toowoomba for an example. It may be that the conditions in the town are conducive to flash flooding because of the convergence of the two streams, various-----?-- That's correct the question.

-----retention basins, things like that?-- Yes, yes.

You also need to know about how saturated the soil is?-- That's correct, yes.

And you need current information about the volume of water in existing creeks and waterways?-- That's correct.

That knowledge, all of it packaged together about local conditions would assist with creating a detailed hydraulic model for each local area, would they not?-- They would, yes.

And even then, the relationship between river height and rate of flow is uncertain and nonlinear once rivers breach their banks; do you accept that?-- Yes.

Now, you make a reference to the CSIRO research in the area and I note for the Commission's interest that the CSRIO have filed a submission that addresses in part this topic. The aim of the CSRIO research work is to incorporate the physical characteristics of the land such as wetness, moisture and so on into models and simulate stream flow. Are you aware of that work?-- I am broadly aware of what's going on in that research program, yes.

That work is in its research and development phase, is it not?-- It is, yes. Yes, it is.

Now, for the Bureau to have a capacity to look at - I withdraw that. You need to know those local conditions and have developed local models before the flash flood occurs, do you not?-- Yes, you need - you need models that represent - that represent that, yes.

It's no good trying to do it on the run, if you haven't prepared information about your local conditions, when you just see a storm coming?-- No.

Okay. You likewise can't be trying to work out the soil saturation or the creek volumes for a particular town as that rain approaches, can you?-- No.

If you want the warning to be timely?-- No.

You emphasise three critical elements of all warnings which I understand you've taken from the Bureau website?-- Yes.

They have to be accurate?-- Yes.

They have to be understandable?-- Yes.

And they have to be timely?-- Yes.

And you note in your report at page 32 that, "For a warning to be effective, it must satisfy all three criteria. That a failure in any one of the three performances severely undermines the effectiveness of the warning"?-- Yes, I do.

You would with agree that statement?-- I do, yes.

In the context of flash flood warnings they must also be location specific, mustn't that?-- ?-- Yes.

And which, as we've noted, requires knowledge of the local features and the likely impact?-- Yes, it does.

Now, accepting the Bureau does not have that local knowledge and it can't warn for flash floods at specific locations at the moment, is the heart of your criticism about the timeliness of the Bureau call to the State Disaster Coordination Centre that it should have come earlier?-- I believe it could have come earlier and I also, I guess, am - believe that it could have been disseminated more widely than what it was.

So that depends on the relationship or the understanding that the Bureau has about how the State Disaster Coordination Centre, will react and disseminate information, does it not?-- Yes, it does.

And if the Bureau relies upon that level of dissemination, it doesn't try and do that itself, then you have no criticism I presume?-- No, although, as I think we did discuss a little earlier, I'm not sure that the - if there is separate functions within the Bureau, for example severe weather warning and flood warning, I wouldn't see it is the State Disaster Coordination Centre to communicate between those two parties.

So we need to understand, do we not, what the mechanisms of communication sharing are between various agencies and bodies in order to be able to answer that question?-- Yes.

Timeliness of the issue of flash flood warnings, would you agree, depends on your knowledge of the event, your ability to verify the information and predict that a flash flood will occur?-- Yes, it does.

To ground truth the radar information with rainfall returns under and beneath the storm cell after the rain has fallen, that's important?-- Well, as the rain is falling that's

correct, yes.

Yes, sorry, under and after?-- Yes.

And you have noted that the Bureau does not have access to the Toowoomba weather stations?-- Yes, it doesn't. It doesn't have access to that data.

It has access to two weather stations. One is down at that the airport principally for aviation purposes which is a weather station?-- Mmm-hmm.

And ALERT station owned by Seqwater on North Pine?-- That's correct, yes.

If you accept that the Bureau does not have a role in flash flood warnings and had already warned these districts of severe weather conducive to flash flooding, what you are really saying, I suggest to you, is that the Bureau should have on the 10th of January taken on an additional responsibility of predicting a warning against these specific flash flood events?-- I'm not saying that they should have. What I am saying is that they could have taken that role.

Thank you. Even though that is something that is currently beyond their charter and it is not something they're required to do at the moment?-- No, that's - that's correct.

Are you aware that the Bureau did in fact create an extraordinary flash flood warning on the 10th of January as soon as they could when they became aware of the flooding event through the media?-- I'm aware that the Bureau prepared a warning at 5 p.m. on the 10th of January.

This document which was described as a flash flood warning that was issued around 5 p.m., as you say, on the 10th of January was not something the Bureau had ever done before. Are you aware of that?-- Yes, I am aware of that.

It was a creation or a reaction to the significance of the events that were unfolding?-- Yes, that's correct.

They prior to that time had pulled up the data from the failed Helidon gauge for verification and you are aware, are you not, that that data had been marked as void or as an anomaly because the readings were jumping around and they couldn't get the intervening values to verify?-- Yes, I am aware that that data was flagged as erroneous.

That was an automatic process, it wasn't something that involved any human intervention?-- Yeah, I agree with that, yes, yep.

COMMISSIONER: Ms McLeod, how much longer do you think you will be? I am not pressing you.

MS McLEOD: I am almost finished.

COMMISSIONER: We will go ahead.

MS McLEOD: If you will bear with me a few moments that might be convenient.

COMMISSIONER: Certainly.

MS McLEOD: Once the Bureau issued that warning, that flash flood warning, would you accept that they're then not in the best place to tell people where to evacuate, what specific action to take other than general advice about avoiding flood waters?-- Yes, I agree with that completely.

Can I just ask you what are the consequences of issuing information and warnings that are not verified and are inaccurate?-- So the potential consequences would be - could be that people might take action when they might otherwise not - not be required to take action.

Yes?-- And I guess there is a potential of people being - of a phenomena called overwarning where if people are - if there's - if there's enough crying wolf, people start to ignore warnings.

Okay. So, can I package that up this way: at the very least, it's an inconvenience because you make people move when they don't have to?-- That's correct.

At the worst, you might panic somebody or send them into danger?-- Potentially, yes, and potentially you might - people might start to ignore subsequent warnings.

Yes. In the case of false alarms, we see this phenomenon - for example, arising in evidence in the bushfires commission - but I am just going to package it up this way-----?-- Yeah.

You can see the development of mistrust in the community in the reliability of warnings generally?-- Yep.

Okay. Is it as a general statement if we were to look at an automated or fully automated flash flood warning system, is it your view that accuracy should be a secondary consideration to

timeliness or should they till rank equally?-- No, I think you need to apply a different standard and I - you would reasonably expect that you would drop the level of accuracy to improve the timeliness.

And in order to have those automated systems working, one of the things that needs to be done is you have to finesse the algorithms to ensure that the data and the modelling is as accurate as possible?-- Yes, that's correct.

Okay. Are you aware of some simple flash flood end to end warning systems in place in various local councils around Queensland?-- I'm not aware of the specifics of those systems.

Perhaps I will ask Mr Davidson about them, but there's one in Ipswich, there's one for Brisbane, and that's one at the Logan City Council, I understand, which are simple examples of end to end flash flood warning systems?-- Okay. Yep.

Thank you, doctor.

COMMISSIONER: Can I just check, Mr Gibson, if you will have questions of Dr Jordan?

MR GIBSON: I have no questions.

COMMISSIONER: And do you have re-examination?

MS WILSON: No, I do not.

COMMISSIONER: Well, that being the case, you can be excused, Dr Jordan?-- Thank you.

WITNESS EXCUSED

COMMISSIONER: How are we going for time? Is 2.30-----

MS WILSON: Perhaps if we could reconvene earlier, Madam Commissioner?

COMMISSIONER: 2.15?

MS WILSON: Yes.

COMMISSIONER: All right. Adjourn till 2.15.

THE COMMISSION ADJOURNED AT 1.03 P.M. TILL 2.15 P.M.

THE COMMISSION RESUMED AT 2.15 P.M.

COMMISSIONER: Yes?

MS WILSON: Thank you, Madam Commissioner. I call Christopher Skehan.

CHRISTOPHER PHILLIP SKEHAN, SWORN AND EXAMINED:

COMMISSIONER: Thank you, Mr Skehan. Yes, Ms Wilson?

MS WILSON: Thank you, Commissioner. Is your full name Christopher Phillip Skehan?-- Yes.

And are you of the owner Of the Big Picture?-- Yes.

And that is an audio visual insulation company?-- Yes.

And that operates at 183 Ruthven Street, Toowoomba?-- Yes.

Now, have you given a statement in relation to the events that occurred on the 10th of January 2011?-- I have.

We will provide you a copy of that statement in due course. If I can just take you through some matters from that statement? You say there that the Monday, the 10th, was rainy in general?-- That's correct.

And you were going out to do a job?-- Correct.

And then what time do you think that was about?-- 2 o'clock-ish, I'm-----

And you say that the rain had suddenly got extremely heavy?-- It had, just before I left, yep.

And at that point in time, did you check the radar images on the Bureau of Meteorology site?-- I did, yes.

Why did you do that?-- I just regularly check it, I just - whenever there's - it's just a habit.

Can you recall what you saw on the BOM site?-- I just remember seeing lots of yellow, huge yellow over Toowoomba, which was strange, different than what I have ever probably noticed, and I have been looking at it for years, I suppose. I just went, "Wow, that's huge."

Okay. So, after checking the BOM site, you then left to go on to do your job?-- Yep.

And you were driving along Kitchener Street?-- Yes.

And at that stage, water was flowing heavily along the road?-- Yes.

And the water was starting to cover the left-hand lane?-- Correct, yep.

And how did cars deal with that?-- Everyone had just basically merged into the right. There wasn't really anyone driving in it.

Was the East Creek area at this point in time in overflowing?-- I can't 100 per cent say, I just know - I don't know whether it was water from the creek or water just going along the road.

Then you came to the intersection of Kitchener and James Street?-- I pulled up before Kitchener and James. I didn't make it that far.

Then you pulled up before the intersection but then you proceeded by foot to the intersection of Kitchener and James?-- Yeah.

Why was that?-- Well, I could see ahead there was a couple - there was about three or four cars initially ahead of me where I pulled up, and so I got out of the car to help and then after helping another lady I could see a car up at the intersection, there was a man trying to get to the car and I could see he was struggling, so I thought, look, I will go up and help.

Okay. Now, on that day, you assisted two cars that were in that intersection?-- Yes.

Okay. And one of those cars contained Donna Rice and her two sons?-- That's right.

Now, you went out to assist Donna Rice and her two sons?-- Yes.

And you bought back, piggy-backed Blake back to safe ground?-- That's correct.

And then when you went back out, the water speed had grown - that it was faster?-- Yes, yep.

And more powerful?-- Yes.

And you had a rope tied around you?-- There was a rope from the pole to the car, so I - no, I was just hanging on to a rope.

Okay. And when you got back out to the car, the car started to move away?-- Within a couple of minutes, yes.

And you eventually gained safety by holding on to a post?--

That's correct.

Okay. Mr Skehan, we have found your statement now and I will show this statement to you. Is that the statement that you have made?-- Yes.

That details what you did on that day?-- That's correct.

And that details your assistance that you provided to the people in that intersection?-- That's correct.

Your Honour, I tender that statement.

COMMISSIONER: It will be Exhibit 71.

ADMITTED AND MARKED "EXHIBIT 71"

MS WILSON: I won't go through in detail what you have got in your statement, but I would just like to show you some photos?-- Okay.

Now, we have got the first photograph up on the screen now. What does that show to you?-- I was to the left of that. That's looking from the southwest corner of Kitchener and James and I was - would have been to the left downstream of that lady in the car.

And was that how the water was on that day when you were there?-- Yes.

Was it like that the whole time?-- No, it got - it got - obviously rose obviously and initially it was - you know, nowhere near that, and then - until we gave it - just kept going basically, yeah.

Okay. In that photograph, you see a truck?-- Yes.

And then you also see a white car there?-- Yep.

Do you recall seeing that white car with that person there?-- Yeah, definitely. I actually had graves fear for that lady in that car. I actually - two reasons, I thought that car was going to come around the intersection because I was just to the left of that and take us out, and also for lady, I have got no doubt that that car moved from - probably where the truck is, and that truck saved her life, I have got no doubt. I watched the car move and it was going to keep going. The truck pulled in - into the water.

So, you saw the truck drive out there to save that-----?-- I saw the truck driving in the water, yes.

Can we have a look at the next photograph, please? That's another photograph of that truck-----?-- Mmm.

-----that had moved out there to assist that car?-- Yep.

Can we have a another - see the next photograph? Can you recognise anyone in that photograph?-- Yes, yep.

Who can you recognise?-- The fellow with the orange jacket I actually know through social reasons, coincidently enough. There's an old man there with yellow hat on. He walked up to the intersection with me initially, and you can see Blake there with a blue hat just. I don't know which one of them is Warren, I'm not sure.

Okay. So, this was after you had rescued Blake?-- Yes, yes. I was - oh, we were - must have been gone by that stage. I must have been on the pole, yes. Can't see the car.

Perhaps if I can have a look at the next photograph?-- Sort of the same.

That's a close-up of that previous photograph?-- Yeah, clearly see Blake there and Christian. I don't know the other guys' names.

Okay. Do you recall seeing the water like this at the intersection?-- Yes, for sure.

And when was that? Was that at the beginning or-----?-- No, that was - that was well and truly into it. I would have been just to the right of that photo, because I remember looking across to this van that's - or van - it's a van parked in to that tree - I mean, the van floating down hitting the tree, and at its peak that water was going over the top of that and I was looking across, directly across at it, so that was my reference to when the water was going down go.

Okay. Can we have a look at the next photo, please?-- I don't know who they are.

Okay. The next photo? That's it. Mr Skehan, have you got anything else to add that's not contained in your statement?-- No, not at all.

Thank you, Commissioner. That is the evidence of Mr Skehan.

COMMISSIONER: Mr Rolls?

MR ROLLS: No questions, your Honour.

COMMISSIONER: Ms McLeod?

MS McLEOD: No questions.

COMMISSIONER: Mr Gibson?

MR GIBSON: No questions.

COMMISSIONER: Any re-examination?

MS WILSON: No, Madam Commissioner. May Mr Skehan be excused?

COMMISSIONER: Thank you, Mr Skehan. You are excused.

WITNESS EXCUSED

MR CALLAGHAN: I call Barbara Gosley.

BARBARA ANN GOSLEY, SWORN AND EXAMINED:

MS WILSON: Is your full name Barbara Ann Gosley?-- Yes.

And can you tell me your occupation?-- I'm an occupational officer at the Queensland Health.

Okay. On the 10th of January, were you at work?-- I was.

And where were you working that day?-- I was working at the Inara Community Centre which is at the front of the hospital.

And can you tell me where that's situated, on what street's that situated?-- That's situated on Peachy Street.

Now, at around 10 to 2, did you observe that there was heavy rain outside-----?-- Yes, yes.

And how did you - where did you go to observe this rain?-- I left my office and walked out to the northern part of the building and there's a window there and I observed down in James Street and Peachy Street at the intersection to see what was happening.

Okay. What did you see at that point in time?-- At that time, the water was coming down off the streets and flooding the intersection, but there was still cars going through the main street in James Street and Peachy Street.

And how long were you there?-- Probably about five to 10 minutes.

Okay. You saw a wall of red muddy water coming down?-- Not then.

When did you see that?-- I left that area of the hospital facing north and went back and - went down a corridor to an exit which faces out on to the Street, across to the parkland, which is east of the hospital.

Oh, yes. Then can you tell me when you went out there, what

you observed?-- The water was still flooding the area. There's two ponds out the front of the hospital that were quickly filling up with the rain and overflowing on to the footpath at that time, and then I viewed across the park on to Water Street and West Creek and at that time the cars were still going through into Water Street and there didn't seem to be any severe flooding at that time, and I viewed the West Creek also and there was no flooding whatsoever in West Creek at that time.

Okay. At some stage you went also to the top of the hospital?-- That was after I observed a wall of water which - while I was looking out across the parkland, I then looked up to the south towards Long Street and I observed a huge big wall of water coming down on to Water Street and it was as - a - red muddy water with debris in it and it was very frightening and I just couldn't believe it, and I stood and watched it for about five to 10 minutes and it flooded the whole parkland in front of the hospital within about five minutes.

Okay. It was after that that you went?-- It was after that then I decided to go up on to the sixth floor of the hospital, which you can view the whole area up on the southside and the east side.

Now, you prepared a statement of your observations that you saw that day for the Inquiry?-- I did.

Can you have a look at this document, please?-- Yes.

That's your statement that you prepared?-- It is.

You have signed that statement?-- I have.

And that statement's true and correct?-- There are a couple of things that I found out after that are not correct, but I have adjusted them with the Inquiry.

Okay. Are they adjusted on that statement?-- No, I don't think so. There's one there I can see and - yeah. Yeah, one - there's two there that I haven't-----

Perhaps you should just for clarification just point those matters out?-- My occupation is not a nurse, which is stated up the top.

Yes?-- There was one there where it said I was viewing across - at the intersection of Water Street, but that was also wrong because there's no intersection in Water Street. The other one was where I contacted Channel 10 about two days after the flood to tell them what I'd seen, and they told me that they would contact the Regional Council and have it investigated, and that was all that was said.

Okay. Madam Commissioner, I tender that statement.

COMMISSIONER: Exhibit 72.

ADMITTED AND MARKED "EXHIBIT 72"

MS WILSON: Now, you are also aware some photographs were taken by a person who was also in that building that day?-- Yes. I did not know until after I'd given my statement, though, yes.

Okay. Perhaps if we can have a look at these photographs?-- Mmm-hmm.

Now, can you tell us what this is a photograph of?-- That's a photo of the two ponds. As to where I was standing, I could see the two ponds there and they were starting to fill up obviously. They weren't overflowing there, by the look of it.

And so when would this have been in relation to the rain event that you saw?-- That would have been about the time I would have come out on to that veranda on the eastern side.

Okay. Can we have a look at the next photo, please?-- That one would have been taken when the flood water had come down from up where I said on the southern side - it's flowing down very swiftly and flooding the whole park, yes.

Okay. Can we have a look at the next photograph?-- That is the water coming down - just over there on the right is where I saw the wall of water coming down before it hit down here and taking all in its path, just up on the corner there.

When you were pointing, you are pointing to the upper left-hand side of this photograph?-- The right-hand side.

The upper right-hand of that photograph?-- Yes, yes. That's where I saw that dirty, mucky water coming down.

Okay. Perhaps if you can look at the next photograph?-- Yes, that's - that looks like when it's all come down.

The water has now come down?-- That's right.

And the next?-- That would have been taken at 3 o'clock. I did observe that, when I went down - when I finished work and went down to the corner there. That's the corner of James and Prescott and Peachy Street and it was well and truly flooded and no traffic was coming through.

Okay?-- Yes.

Did you observe scenes like this?-- No, I didn't see that, I'm sorry.

Nor that?-- No. Wait on. That's James Street, isn't it? Yes, I did observe that, because that was the bridge that goes

across James Street up - up James Street, and that was at 3 o'clock. I would have seen that, yes.

Thank you?-- I did see that too.

What is that?-- Mmm.

If you could explain?-- Yes, at 3 o'clock when I went up, I looked over the right to that Ideal Electrics and they had that door opened and the water was flowing about halfway up coming out, yes. I did observe that, mmm-hmm. That's much the same.

Yes?-- Yes. That's the sign at the intersection there, just as you come around to the hospital, which I would have seen.

Okay?-- Yes, I did observe that.

Where would you be standing to observe that?-- I was standing over on the left hand side of Peachy Street, up on the big built up area where the shopping centre is, which give us a beautiful view straight across there and down James Street, mmm-hmm. I didn't see that.

Okay. Now, Madam Commissioner, I can indicate that the photographs will be tendered as a bulk exhibit at the end of the hearings here in Toowoomba.

COMMISSIONER: Thank you.

MS WILSON: Ms Gosley, thank you for giving evidence. I have got no further questions of you?-- Thank you very much.

COMMISSIONER: Hold on a second. We will just see if anybody else does. Mr Rolls?

MR ROLLS: Commissioner, no, we don't have any question.

COMMISSIONER: Ms McLeod?

MS McLEOD: No questions, thank you.

MR GIBSON: No, thank you.

COMMISSIONER: Thanks, Ms Gosley, you really are finished?-- Thank you.

WITNESS EXCUSED

MS WILSON: I call Edward Spark.

EDWARD ROBERT WILLIAM SPARK, ON AFFIRMATION, EXAMINED:

COMMISSIONER: Thank, Mr Spark. Take a seat.

MS WILSON: Is your full name Edward Robert William Spark?-- Yes.

And are you currently employed as a meatworker?-- Yes.

And on the 10th of January 2011 were you caught in flood waters on Dent Street?-- Yes, I was.

And have you provided a statement to the Queensland Floods Commission of Inquiry in relation to those events on that day?-- Yes, I have.

Did you also provide a statement to the police about what occurred that day?-- Yes.

And about how you got caught up in the flood waters?-- Yes.

Could you have a look at those statements, please? Are they your statements, Mr Spark?-- Yes, they are.

Are they true and correct?-- They are true and correct.

Commissioner, I tender those statements.

COMMISSIONER: The statement to the Inquiry will be Exhibit 73, and that to the police will be Exhibit 74.

ADMITTED AND MARKED "EXHIBIT 73 AND 74"

MS WILSON: Thank you. Now, Mr Sparks, I am not going to take you through the details that are contained in those statements because those statements go through what occurred that day in detail. However, I am going to show you some images, okay, and perhaps if you could offer any comments?

VIDEO PLAYED

DURING THE PLAYING -

MS WILSON: Could you just stop it there, please? What we just saw there was a van hit a tree and push that tree over and the van hit another tree. Do you recall just seeing that?-- Yes, I did.

Now, you were hanging on to that second tree, weren't you?-- Yes.

And that's where you were when you were caught in those floods, flash floods in Dent Street?-- Yes, I was.

You are not a strong swimmer?-- No, I'm not.

Okay. And you made a decision that you were just going to stay there and try not to swim for safety?-- Yes, just stay at the tree.

Can we keep on playing the video? We saw some swift water rescuers getting prepared to go out to the water. You were rescued by swift water rescuers?-- Yes.

Okay. Just stop there for one moment? That's you still hanging on to the tree and being rescued?-- Yes.

And being provided assistance by the swift water rescuers?-- Yes.

Okay. Continue. We will just pause it there. Perhaps if we can go to the next image? That's you being assisted by the swift water rescuers-----?-- Yes.

-----to safety?-- Yes.

Thank you. Mr Sparks, have you got anything to add to your statement?-- No, I don't.

Have you got anything to add after seeing those videos?-- No.

Mr Sparks, they are all the questions I have got for you?-- Thank you.

COMMISSIONER: We will just see if anybody else have has any questions. Mr Rolls?

MR ROLLS: No, Commissioner, I have no questions.

COMMISSIONER: Ms McLeod?

MS McLEOD: No questions?

COMMISSIONER: Mr Gibson?

MR GIBSON: No questions, thank you.

COMMISSIONER: Thanks, Mr Spark. You are excused?-- Thank you.

WITNESS EXCUSED

MR CALLAGHAN: Madam Commissioner, I call James Thomas Davidson.

JAMES THOMAS DAVIDSON, CONTINUING:

COMMISSIONER: Yes, Ms Wilson?

MS WILSON: Thank you, Madam Commissioner. Mr Davidson, you have given evidence in the hearings that occurred in Brisbane last week?-- Yes, I did.

And at those hearings, your statement was tendered?-- That's correct.

Which is Exhibit 37. There was also a report from the Bureau of Meteorology, which is provision of meteorological and hydrological information, which is Exhibit 38, and there was also another report, entitled The Meteorological and Hydrological Overview, Rainfall and Flooding, which is Exhibit 39?-- Yes.

There is one further report that the Bureau of Meteorology has completed in relation to these proceedings, and that is the report to the Queensland Floods Commission of Inquiry provided in response to a request for information from the Queensland Floods Commission of Inquiry received by Bureau of Meteorology on the 4th of March 2011?-- Yes, that's right.

And this report is dated the 4th of March 2011?-- That's correct.

Would you have a look at this report, please. That is the complete report and with the attached exhibits and appendixes?-- Yes, it is.

Commissioner, I tender that report.

COMMISSIONER: Exhibit 75.

MS WILSON: Now, Mr Davidson, you're a meteorologist?-- That's correct.

You are not a qualified hydrologist?-- I am not.

So you cannot assist this inquiry here today with any issues raised in relation to, one, hydrology?-- That's correct.

Two, flood warnings?-- That's generally correct.

You can provide some general overview on that?-- Some general overview, yes.

But we can't go down into the minutia of the flood warnings that the - you can talk about the mechanics of the flood warnings but you can't talk about the detail of them; is that the case?-- That's right, yes.

To this end, in terms of matters of hydrology, a report is being undertaken by Mr Peter Baddeley from the Bureau of Meteorology?-- A witness statement?

Yes?-- Yes, yes.

Also, you have received Dr Jordan's report?-- That's correct.

And you were in Court here this morning when Dr Jordan gave evidence?-- That's right.

And you've read his report?-- I have read it but only once.

Okay. Now, Dr Jordan makes various recommendations in that report?-- Yes, I appreciate that.

As I understand it, these recommendations are being considered by the Bureau of Meteorology?-- They're in the process of being considered. It's - it's too early yet, you know, to plan ahead. But we certainly are very conscious of the merit of some of the recommendations that the doctor made and we'll certainly be looking at them.

Thank you.

COMMISSIONER: Could I interrupt you for a moment. That last exhibit my associate thinks went in as part of Exhibit 37, Mr Davidson's statement.

MS WILSON: I'm instructed that may very well be right.

COMMISSIONER: Well, we don't want to clutter up the place with multiple copies of things so I might delete it as Exhibit 75 in that event.

MS WILSON: Thank you, Madam Commissioner. Now, if I can take you to Dr Jordan's report, which is Exhibit 67, have you got that in front of you?-- No, I haven't.

We can provide a copy of that. But I can also - we can also get on the screen where I wish to refer you to and that is appendix A. If it assists, Mr Davidson, I can provide you with a hard copy. Would it assist?-- I'm willing to look at the screen or a hard copy.

Now, these are four radar scans that appeared on the Bureau of Meteorology website on the 10th of January 2011?-- Yes, they are.

It is this type of information that is available to the public on the website?-- That's correct.

There is greater information that the Bureau of Meteorology has in relation to these radar images - that is, the rainfall rate that can be calculated?-- But there is no more information, really, than what is on that website because the light, moderate and heavy are defined rainfall rates and - so it is available to the general public.

Yes, but there is more data that the Bureau of Meteorology has, isn't it, that is not on the website?-- In what sense, counsel?

In the sense of the calculations that can be done for the rainfall rate?-- Oh, the algorithms and that aren't on the website, no, counsel. And as we heard this morning, there is a degree of uncertainty with using those algorithms. We can quite often see situations where the rainfall - rainfall rate can be a two to one underestimate or overestimate or, as we heard this morning, it might be up to three or four times occasionally.

Now, in terms of we heard this morning of what the assistance that the Bureau of Meteorology receives in determining forecasts, it comes from the radar screen?-- That's right, yes.

Also the rainfall gauges?-- That's correct, and satellite imagery and the like as well. So there is extra information there.

Okay?-- But in this particular case the satellite imagery wasn't particularly useful.

Does the Bureau of Meteorology have any access to any computer program that does thunderstorm tracking?-- Yes, it does and we use that particular program in issuing severe thunderstorm

warnings.

So the information that you got from that computer program in relation to thunderstorm tracking, was that also information that was used on the day of the 10th of January?-- I can't answer that, counsel, I'm not too sure. I would need to check whether they were running that particular program at the time.

And what assistance does that program give the severe weather forecasters on the day when they're doing their warnings or forecasts?-- In this particular case it wouldn't have provided any extra information as far as the warnings were concerned. As you know, we did have a severe weather warning out which mentioned thunderstorms. The team in the forecast centre, working with the hydrologists determined that the particularly intensities we were seeing didn't warrant going any further than what we did on the day. We heard this morning that we did make telephone calls and do media and the like. But the actual program you're referring to enables us to prepare graphics and the like, but it doesn't actually provide any additional information to what the forecaster would have without running it.

Now, as we can all see, the storm depicted is coloured yellow and on some occasions red?-- That's correct.

Now, each radar image has a scale, white being the lightest and black being the heaviest?-- Yes.

Now, the event that hit Toowoomba, when looking at that scale, people looking at that scale would see a moderate or on the upper scale of moderate?-- Yes, people would see that. To an experienced meteorologist, and I had a great team on that day, they wouldn't see anything spectacular in these particular images. We were getting a consistent image from our three radars, the Marburg, the Mt Stapylton and the Gympie radar. They were all very consistently saying it was moderate rain, maybe on the high end of moderate. And when that situation arises we'd be continually monitoring it to ensure that we did have suitable warnings out, and we did on that day. So that was the story at the time.

Well, you heard Dr Jordan's evidence that he has measured, in AEP terms, the Toowoomba rainfall as one in 370?-- Yes, of course, but as Mr - as Dr Jordan also said, that data wasn't available to the Bureau on the day.

No, no, no, I'm not questioning that. You heard that, didn't you?-- Yes.

It was one in 370?-- Yes.

Now, what we're seeing there on that radar screen is a moderate rainfall?-- The upper end of moderate, yes.

Upper end of moderate rainfall?-- Sure.

Now, those two pieces of information don't seem to match.

That you have a one in 370 year event that is being depicted as a moderate rainfall - moderate to upper moderate rainfall?-- I think this really highlights the fact, counsel, that there can be real uncertainties in estimating rainfall rates from - from a radar and we found in the past that those uncertainties actually become larger for heavier convective rainfall situations such as we saw on this day. So we can't discount the validity of the rainfall recording but what we can say is it does appear as if the estimates from radar, using the algorithms that were being used at the time, didn't show the true rainfall rates, but that's not that unusual. That happens regularly, you know.

My question then is: is there any way that we can get a more accurate depiction of rainfall events?-- Yes, and we are working on a technique called rain fields. In fact, those experimental charts were available on our website that day. We put them out to the public, so not only can forecasters start looking at them but also other people with an interest in radar. Those rain field charts are not part of our standard operation procedures at the moment so they don't form part of our warning service, but I guess I can honestly say that they are showing promise. In this particular case, because of the rain fields technique, it really does require a dense rainfall observing network underneath and we've heard several times today already we didn't have this on this occasion. So the rain fields technique wasn't able to calibrate the radar as well as it might have if it had moved over, say, the Brisbane area. So for several reasons, the absence of a, I guess, satisfactory rainfall network in the upper Lockyer has played - has led us to this situation.

How that could be improved is implementing a better system of rain network on the ground?-- I think - yes. Simply, yes.

What does that entail?-- The installation of more rainfall networks. Now, how that is achieved, you know, I can't comment here in Court but - at the Inquiry, but there are ways and means. Through national programs like the National Disaster Resilience Program, you can - local governments can apply for funding to establish ALERT networks which would be rainfall and flooding - flood height recorders. A lot - quite a number of local governments have done that. We heard earlier that upwards of seven local governments in Queensland have ALERT systems running for - for flash flooding purposes.

When you are talking about ALERT systems perhaps you can assist us and take us through what that actually means when they say these local governments have an ALERT system up and running?-- Okay. I haven't got a slide with me but - if you just bear with me for a moment. It's really the hydrology people that have most to do with this, but what I can say is where there is a known flash flood threat, local agencies can operate ALERT systems consisting of a dense network of automatic radio reporting rainfall and water level stations - that's reporting by VHF - and a local computer to display and analyse and, very importantly, to alarm on the data. So it is not only the receipt of the data but triggering some sort of

alarm at the end so people can respond appropriately. And the Bureau's role as we see it, as I've said before, is to assist local agencies to develop such a system.

When you're talking about local agencies, are you talking about local councils and regional councils?-- Yes, I am, yes.

So local councils and regional councils have to take the lead on this; is that the case?-- Yes, yes, but in collaboration with the Bureau of Meteorology and with other relevant stakeholders. So as I see it, it is very much a team, a partnership effort.

Was it the case that in Toowoomba and the Lockyer Valley, no such ALERT system was there - was operating on the day?-- That's correct.

Now, is that an expensive system to implement?-- Once again, I'm not as close to that as some others would be.

Okay?-- But the funding available - what I can say is the funding available through the National Disaster Resilience Program is adequate to establish a good network. That's if it's successful of course. There is no guarantees when you put in a bid. It has to go through a process.

And what process is that?-- There's an advisory committee, for want of a better name, that looks at all the submissions that come in and it's a multi-agency group. Our hydrologist, our chief hydrologist, was a member of that group. I'm not so sure he still is. I used to be a member of the group. And what the group is charged with is just establishing priorities from, say, 50 or 100 submissions, deciding within themselves - a very multi-agency group, as I said, with a broad base of skills to decide which local governments or which - it is not only local governments of course, which - in this case though, which local governments have the best case, have the highest priority.

Is that because there is only so much money in the pot?-- I'm not in a position to answer that, counsel, but it is my understanding that each year the Natural Disaster Resilience Program does have a finite amount. That's understandable. But I - but I can't answer as to what it might be.

Now, if I can take you to the warnings that were provided by the Bureau on that day, on the 10th of January, we have already seen the warning that was provided at 11.05 that day?-- Yes.

That was an upgrade from one that had been provided earlier?-- It was - yes, five minutes earlier. It was - it was a date error or something I think. It was a small error, an administrative error, not a forecasting or warning error.

But that was not a flash flood warning, was it?-- No, it wasn't but it included, as we know, reference to heavy rainfall conducive to flash flooding, which is the warning

service that the Bureau of Meteorology currently provides.

Now, the Bureau of Meteorology does not provide flash flooding warnings?-- That's correct.

But it will to that extent include that phrase in such a warning; is that the case?-- That's right. It's not only included just in severe weather warnings but also in severe thunderstorm warnings.

Is that always included in severe thunderstorm warnings or severe weather storm warnings, the term "flash flood"?-- No. Particularly severe weather warnings, it - a severe weather warning might be issued for damaging winds and just that, damaging winds. But in the case of a severe thunderstorm warning, we're more likely to talk about heavy rain conducive to flash flooding if the storm is slow moving because if that's the case it will be over a certain locality for a longer period of time. For rapidly moving storms as we often get in the south-east, that's storms moving from west to east, we often don't include flash flooding because they've come and gone too quickly.

When you were putting out these warnings, there was no correspondence or communication with the Flood Warning Centre. That is something that is done by the severe weather forecasters?-- Well, it all depends on what the situation is. If - if the Flood Warning Centre is operational, there will be discussion. But on probably more than 50 per cent of occasions, severe weather warnings and severe thunderstorm warnings are issued with no-one in the Flood Warning Centre because there is no need for anyone to be in there.

Perhaps this might be a convenient time to talk about the internal structure of the Bureau of Meteorology?-- Yes, sure.

We've heard that there is - broadly, it is divided into two departments if we can call it that?-- Yes.

One is the severe weather warning?-- Not two departments, counsel. Two units, operational units.

Two units?-- Yes.

Two units. So one of these units is the severe weather warning?-- One of these units is the Regional Forecast Centre.

Yes?-- And if the Tropical Cyclone Warning Centre isn't operating, it is the Regional Forecast Centre which will issue severe thunderstorm warnings and severe weather warnings.

Before I leave that, that unit is resourced by Meteorologists; is that the case?-- The Regional Forecast Centre, yes.

Then there is another unit called the Flood Warning Centre?-- That's correct.

And that unit is staffed more by hydrologists?-- It's staffed

by hydrologists, meteorologists and technical officers. There are meteorologists attached to the Flood Warning Centre.

Okay?-- But that's working in a mixed capacity by them as a - as part hydrology and part meteorology.

So if I can take you to that warning on 11.05 that was issued by the Bureau, was there any communication with the Flood Warning Centre?-- At - I think the best way to way to answer this is that at between 11.00 a.m. and 11.40 a.m. that morning we had a fixed teleconference with the State Disaster Coordination Centre. Now, common practice, and it was on that day, to have the meteorologist and the hydrologist sitting side by side briefing the teleconference, the people on the teleconference. Now, we're never too sure how many are listening at the other end but on that particular day, you know, we can be fairly certain that a lot of disaster managers around the state and a lot of local governments are actually listening in to that conference. So at that time, the two people, the hydrologist and the meteorologist, were sitting side by side providing the same story.

And what were they providing the same story about; the weather event that was going to hit Toowoomba?-- Well, not necessarily here hitting Toowoomba. Now, whether or not Toowoomba specifically was mentioned-----

Toowoomba and the Lockyer Valley?-- Well, we were certainly talking about the big rainfall - the rainstorm near Esk moving towards the Lockyer - well, not moving - probably moving towards Toowoomba. But the way it works is that the meteorologist will do the first part of the briefing, set the scene from a weather perspective and then the hydrologists will then talk about what's happening on the flood scene. And that particular day, as we know, there were many rivers in flood in Queensland. So that particular teleconference went for 40 minutes, not all the Bureau of Meteorology but a good bit of that was Bureau of Meteorology.

And were you part of that teleconference, Mr Davidson?-- I was a participant - I was an observer. I sat in the background.

Was there any opinion given by the Bureau on that day about possible flash flooding in this area that we're talking about?-- What the Bureau did was just brought the attention of the teleconference to the existing severe weather warning which included flash flooding. So at that stage we - you know, we weren't isolating any particular area as being more likely to flash flood than another. Anywhere in that general path of the complex.

Now, if I can take you to the telephone call to the State Disaster Coordination Centre at 1 p.m. and perhaps if we can look at Exhibit 37, paragraph 39. Exhibit 37, Mr Davidson, is your statement?-- Yes. If I can just jump in, counsel, too. That up until this 1 p.m. phone call we were doing regular media crosses and I would just like to draw the attention of

the Commission and counsel to our 12.30 p.m. media cross with the ABC Country Hour and we have - at that particular call, if you can just bear with me one minute, we did mention - we did refer to the - if I can just be a second. Yes, between 12 and 1 o'clock there were a number of radio crosses including ABC Country Hour at 12.30 p.m. with special mention being made of heavy rainfall in the Brisbane Valley west of Esk heading inland towards the Darling Downs. So as you probably know, there is a wide audience in the Country - for ABC Country Hour; there probably was that day. So it wasn't just one particular telephone to the SDCC. It was a combination of messages but, yes. Okay. Sorry, counsel.

Now, in paragraph 39 it details the call that was made to the State Disaster Coordination Centre?-- That's correct.

Did you make that call?-- No, I didn't.

And who would have made that call?-- That call was made by a meteorologist who was in the Regional Forecast Centre working on the Severe Weather Desk. We had extra staff in that day, we planned ahead, because we knew it was going to be a busy day. So we had two people on the Severe Weather Desk that day and one of those two people made the call.

Now, does that often occur, that meteorologists would ring the SDCC?-- It actually occurred one hour five minutes before that at 11.55. The meteorologist rang the SDCC to alert them to the fact that we just issued a severe thunderstorm warning for the Downs and further north.

Yes?-- And the only reason - well, we explained at the time the reason we didn't issue - extend that severe thunderstorm warning to the eastern Downs was because we believed, a professional judgment, that the severe weather warning was covering that situation. It was mentioning heavy rainfall, it was talking about thunderstorms, so we didn't want to overlap the two. But it's - you know, it doesn't happen on a routine regular basis but when there is a need to contact the State Disaster Coordination Centre, either the meteorologist or the hydrologist certainly do. We do have a direct line as well in between the two centres, so it's relatively easy to talk to each other.

Well, clearly the Bureau saw that there was a need before 1 p.m. to make this call warning them of expected flash flooding that soon could result in calls for assistance?-- That's correct.

So the Bureau had come to the opinion that flash flooding was imminent in the Toowoomba town area; is that the case?-- That's correct. In fact, the essence of the call was that people could probably expect some flash flooding around the Toowoomba settled area over the next hour or two. And then the caller went on to say - explain why we wouldn't be issuing any separate warnings for it because a severe weather warning was sitting there on top of it.

But this is information that the members of the public who use your website would be able to clearly see and respond to?-- Yes, but we see the disaster management system in Queensland as very much a partnership and part of our standard practice is to ring the State Disaster Coordination Centre in situations such as this. It is not as if a situation as intense as this happens very often but it is a matter of advising them and then we can continually monitor it. And if - if we thought after 1 p.m. that there was a need to upgrade our warning, we would have done that. But we - we believed, using professional judgment at the time, that the warning was adequate.

The warning that you provided to the State Disaster Coordination Centre or the warning that was issued at 11.05?-- A combination of the two.

The warning that was issued - that you provided to the SDC at 1 o'clock was in far greater detail than the one that was issued, obviously, at 11.05?-- Well, yes, but it is very hard to provide that extra level of detail on all occasions. Every radio cross we do provides more detail than what's in the actual warning. The warnings are intentionally designed to a standard format. Once we do get confirmation of a flash flood or a serious weather problem somewhere, we then immediately update the weather warning, severe weather warning, to include a reference to that, to whatever report we've received. It might be a heavy rainfall report; it might be a flash flooding report or whatever. But at that stage we didn't have anything to update our warning on, any information.

Mr Davidson, the meteorology Act sets out the functions of the Bureau, doesn't it?-- Yes, it does.

And it provides that, "The functions of the Bureau are: the issues of warnings of gale, storms and other weather conditions likely to endanger life or property including weather conditions likely to give rise to floods or bushfires"?-- That's correct, yes.

You're aware of the statutory obligation?-- Yes, under the 1955 Act, yes.

Now, this information that was provided to the SDC would fall within that requirement, wouldn't it?-- Yes.

And it would have been very easy to be able to put this on the website, wouldn't it?-- Well, as I said, counsel, it is very much a partnership. We do have various avenues for - for providing information, you know, a multimedia front. The radar images are on our website for people to see. It's not standard practice when we get reports - without a confirmation, there was no confirmation, it was a belief, it was a professional judgment by a meteorologist, a severe weather meteorologist, that Toowoomba was likely to see some flash flooding. Now, in - it was the belief of the severe weather meteorologist and the supervising meteorologist on that day who, apart from myself, is our most experienced

forecaster in Queensland, that that satisfied our requirements under the 1955 Act and our standard operating procedures.

Well, we will come to that, the standard operating procedures in one moment?-- Yes.

Was it not put on the website because the Bureau does not issue flash flood warnings?

Well, I think the answer is as before, counsel, that it wouldn't be standard - it wouldn't be our practice - I won't call it a standard - our practice, to put information like that on our website. If it - if it had been a confirmation of 150 millimetres somewhere or flash floods actually occurring, we would have immediately jumped into action and provided an appropriate warning service, but this - I mean, the information provided in that telephone call confirmed, as the meteorologist on the day saw it, what they were saying in the severe weather warning.

And was this information passed on to the Flood Warning Centre?-- They're privy to - I think that's a misconception that the two centres are working apart. They work in very close proximity. Talking points are regularly prepared between the two, they're shared, they use the same computer applications, they're forever exchanging information. So, I'm not too sure how this impression arose that they're not working together.

So, Mr Davidson, is the answer yes-----?-- Yes.

-----to that question that I just asked you?-- Could you actually-----

Was this information that was passed on to the State Disaster Coordination Centre where it was told that Toowoomba town area should expect flash flooding over the next hour or two, was that also communicated to the Flood Warning Centre?-- Okay. Look, I would need to check on that.

Now, is there a formal lines of communication where these - this information is passed on, or is it done in an ad hoc, informal way?-- We see no reason a documented process for communication between the two centres. There's no reason to believe that it would serve any real purpose. The communication is always, as I have seen it, quite regular and professional and - I mean, they don't talk non-stop all day, of course, but when the need arises communicate, they do. Now, there was a fairly regular exchange of information between the two centres and, as I have said, they are in very close proximity. Now, it may not have been exactly at 1 p.m. that the meteorologist spoke to the hydrologist, but about that time there was a conversation about the situation.

Is that your assumption?-- That-----

Have you seen material that confirmed that to you?-- Well, I was in and out of the Warning Centre myself, you know, off and on during the day and I could see nothing to suggest that the meteorologist and hydrologists weren't talking, but I can't absolutely confirm that a conversation or exchange took place at a particular time. So, the answer is no.

And is there any material that could confirm that?-- I would need to check - we would need to check the detailed timelines on the day, but I have - I think we should all understand that on that particular day, it was - there were flood warnings out

for many river systems, there was a lot of activity. Not everything - not everything could be discussed even in - in detail - in detail between the two centres, because of the degree of activity. So, it's a team effort once again and a degree of trust between the two centres that they're working towards their area of expertise, but communication will take place when required.

And how physically close are the two centres?-- All that's between the two is a small media centre, which is - and it's got see-through glass, several metres, so there's several metres, about three to five metres between the two.

Now, you are aware that there were bloggers on Weather Watch that forecast the flash flooding of Grantham?-- Yes.

Now, is it the case from listening to your evidence that you say that the Bureau couldn't have provided those warnings because that's not within their scope?-- The bloggers couldn't provide?

No, the Bureau could not provide the warnings that were provided by the bloggers because that's not within their scope?-- Yes, but I should qualify that by saying the Bureau of Meteorology on the day was unaware of the events unfolding in Toowoomba and the Lockyer Valley. After that telephone call was made at 1 p.m., there were - and this appears in my - in the report, there was no communication from an external source with the Bureau of Meteorology for some hours. In fact, it was probably three and a half hours before we became aware what was happening due to seeing television footage. So, it is just that we didn't know and, I guess I should add too, the Bureau of Meteorology was unaware that Grantham could actually be flooded, seriously flooded by Lockyer Creek. It just - it was something we wouldn't have been considering anyway.

Are you talking in terms of the hydrologists who were working there?-- No, meteorologist and hydrologists. We were just unaware.

Could the Bureau have acted earlier if it had more information, like gathering information from more rain gauges in Toowoomba?-- That wouldn't have made any difference at the time. The storm would have gone through Toowoomba by the time those rainfall reports would have been received. What was really required was more rainfall registrations downstream - upstream of the rainfall complex, the rain storm, so we could actually do a forecast. If we had have had those Toowoomba reports, it would have been more hindsight, but it wouldn't have served much purpose. In fact, even if we had a severe thunderstorm warning out at the time, we only - with a severe thunderstorm warning, we only forecast what's ahead not what's behind it, so the severe flash flood through Grantham would not have even appeared on the severe thunderstorm warning, and the severe thunderstorm warning would have been cancelled at 3 p.m. just as the storm passed over Ipswich, because it had eased off by then, and so we would have been left still with

the severe weather warning. So, it's a real balance of getting a concise story out there without confusing people, and we felt we did that on the day.

Now, I have taken you to the functions of Bureau, the statutory obligations of the Bureau pursuant to the Act?-- Okay.

Now, that statute does not exclude providing flash flood warnings, does it?-- But what we must keep in mind was a Cabinet decision in 1987 where an arrangement by the three tiers of government was established. So, we're feeding off a - something since 1955, an arrangement, it's a multi-tier arrangement between the three tiers of government and it's no secret to all three tiers of government that that arrangement is in place.

So, there was an arrangement made in 1987 between local, State and Federal Governments-----?-- Yes.

-----that the Bureau would not be providing flash flooding warnings?-- Well, that's putting it very-----

Can you tell me what the arrangement was or your understanding?-- The arrangement - well, I'm not fully familiar with that Cabinet decision, but what it essentially says is the Bureau is not responsible for issuing flash flood warnings, it is very much a local government area and, of course, we know why that is, because of the need for local knowledge and local response systems. It is just not a matter of the Bureau preparing a warning, but it's a partnership with the local governments so people respond appropriately, people like - you know, alarms are triggered and the like. So, it's an end to end warning system and, I guess, that's the basis of why the Bureau of Meteorology at the moment is - its role is to assist local governments establish these systems, but not provide flash flood warning.

Okay. So, how it stands at the moment in the Bureau, it was not part of the Bureau's role to convey that information that was conveyed to the SDC at 1 o'clock to the regional councils, the Toowoomba Regional Council or the Lockyer Valley Regional Council?-- If I can just restate, counsel, what I said before, we didn't think there was anything in that information at 1 p.m. which wasn't covered by our severe weather warning, which was talking about thunderstorms and possible - and heavy rain possibly leading to flash flooding. I know it didn't specifically mention Toowoomba, but it was talking about the eastern Darling Downs. So, there wasn't anything - really all that was was a heads-up to the State Disaster Coordination Centre that what - with information that was already in - essentially in our severe weather warning.

But, Mr Davidson, you must have had more concerns about flash flooding because you had already had a teleconference with the SDC conveying the warning at 11.05 and the Bureau saw fit to additionally warn the SDC of flash flooding in the Toowoomba town area?-- Yes, well, when you say the Toowoomba town area,

the person who made - the meteorologist who made the call, I understand that he focussed on Toowoomba because it was a major population centre, he wasn't discounting the fact that flash flooding could occur elsewhere, but he was highlighting the fact that that's where most people lived and he wanted to bring attention to it. But that's not something that we'd normally follow up with an amended or updated severe weather warning, seeing it was already in the warning. There was nothing - as I said, unless we got some confirmation, it didn't - wasn't really saying a lot more than what was in the warning, and it's a partnership. So, by making that call, it's our understanding that various processes - various procedures then follow with alerting whoever, so-----

If the councils, the regional councils do not have the ALERT system, then they're on their own in relation to flash flood warnings; is that the case?-- We still provide the overview service within the sever thunderstorm and severe weather warning service, but without the local knowledge, we wouldn't normally provide a flash flood warning service. We did at 5 p.m. on this particular day. As we heard earlier, we created - we didn't even have a template for it so we had to find a template which we could convert. We did that, and the reason for jumping in at that stage was - our immediate concern was saving lives downstream of the flash flood. We forgot about the books and just jumped in and issued the warning, and, of course, at that time, we turned on the standard emergency warning signal as well.

Thank you, Mr Davidson.

COMMISSIONER: Mr Rolls?

MR ROLLS: No questions.

COMMISSIONER: Ms McLeod?

MS McLEOD: Perhaps I should go last, Commissioner.

COMMISSIONER: Yes.

MR GIBSON: I have no questions, thank you.

MS McLEOD: That's easy.

COMMISSIONER: That's you then.

MS McLEOD: Mr Davidson, can I ask you a couple of questions about preseason work that you skipped over in your slide show of last week because they related to the flash flood events? There were two slides in particular, and I won't ask you to put them up, but just really to talk about the factors that contributed to the flash floods on the 10th of January. Do you need to have the slide show handy to recall those matters?-- No, counsel. I can do that. Yes, it was a combination of the factors which contributed to that flash flood on the 10th of January and quite a number of these features, we became aware as early as the - as the middle of the previous week that the - a serious weather event was evolving over South East Queensland. So, at that stage, we did alert the State Disaster Management Group and Premier and Cabinet, and as we - and in the report it shows from the 5th of January we were issuing severe weather warnings for the southeast coast district and these continued for the next week almost. So, it was not only an intense event, but also a long lasting one. The monsoon trough at that time had dipped down over Queensland, it was lying not too far to the north of Brisbane. We had low level easterly onshore winds, which was driving very moist tropical air on to the southern coast, and, of course, the big upper level low, which we now know about, which very unusual for this time of year. I said at the previous hearing that in my 40 years of forecasting I hadn't seen an upper low at this time of year of such proportions. The very wet catchments - obvious, it's not just the wet catchments, it's all the surface water lying around as well which adds to the problem, and I guess the main - if I had to single out - besides all the synoptical or weather features favouring a fairly big rainfall event, it was the unusual southwest movement of the storm complex. We don't see storms move too often from the Sunshine Coast in towards Toowoomba and if they do, most of the rain has dropped out of the clouds by the time it gets over the - goes the first 50 to 100 kilometres. So, this was unusual in the sense it held on to its moisture content longer than what it normally would, and we heard earlier this month the steep escarpment provided uplift, and the heavier rain would have fallen just to the east of Toowoomba on the very steep slopes where there are no rain gauges to record it. Withcott, of course, we learnt later on that the data wasn't available in real time, that Withcott had 180 millimetres on that day. So, that was - counsel, that was the factors that contributed.

Thank you for that. In terms of the preseason work you did, there was an exercise conducted over the 1st to the 3rd of November carried out with Emergency Management Queensland for the Toowoomba Regional Council and the Lockyer Valley Council called Exercise Orko. Do you remember that?-- I certainly do, yes.

And in that exercise, the Bureau posed hypothetical severe weather warnings or was it a tropical cyclone warning, was it?-- It was an ex-tropical cyclone.

And then the councils responded to that warning as they would in a real-life situation; they ran through the hypothetical

event?-- Yes, they did. The exercise was organised by Emergency Management Queensland in Toowoomba. It involved, as I understand it, all the local councils, not just Toowoomba and Lockyer Valley, but maybe one or two others. The Bureau of Meteorology's role was to prepare synthetic warnings for the decaying tropical cyclone. We issued both flood warnings and severe whether warnings with flash flooding during that exercise, and being a table top exercise, those warnings were released to the participants on a normal - on a regular basis, I assume every six hours, and we also provided the additional service of - to make it as realistic as possible that the participants could ring the Warning Centre and talk to a suitable person, whether it was a meteorologist or hydrologist. What I don't know is how often calls were made to the Warning Centre, but that offer was made. So, that was a three day exercise in early November which - yeah, was not quite the same situation we saw. Of course, it was a different weather feature, but there were similarities.

The way the system works and has worked for a number of years, Mr Davidson, is that the Bureau provides information to the public, of course, but also to State and local agencies and then State and local agencies respond to that information?-- That's correct, yes

And it's for the State and local agencies to respond knowing their agencies, their capacity to respond, and their particular regions?-- That's right, yep.

Now, you have mentioned a couple of times participating in State Disaster Management group meetings, or-----?-- That's correct.

-----observing at those, and you said, I think, on one occasion you weren't sure who was calling in on the other end of the teleconference so you couldn't say, I assume, whether Toowoomba and Lockyer Valley were actually at one meeting or another?-- No.

Is there any way for that local association or Local Disaster Coordination Centre that councils can participate in those briefings and teleconferences?-- Well, the teleconferences, counsel, aren't actually hosted by the Bureau of Meteorology, they're hosted at Emergency Management Queensland, but I am sure if councils approached EMQ they can certainly join in those teleconferences. We have very good relationships with a - with quite a number of local governments in Queensland and we encourage those representatives of those local governments to ring the warning centres, either the Cyclone Warning Centre or the Flood Warning Centre during events that are particularly impacting on their area. So, we have got pretty good relationships with quite a lot of councils. That doesn't extend to all councils, but we're certainly looking towards working with those councils that we don't have strong relationships with to firm up on that.

And what's the interaction, if any, with the District Disaster Coordination Centres?-- No, there was - when I say, "No.", as

I think you said, counsel, we're never too sure who's listening in to those teleconferences.

You mentioned that some councils do contact the Bureau directly for information from time to time?-- That's correct.

Yes. On the 5th of January you participated in your second briefing of Premier and Cabinet and that was by invitation again?-- That's correct.

I am referring to your evidence last week about the first meeting?-- If it's okay with you, counsel, I just want to qualify that statement before. It's not a one way thing, councils can ring us, but the councils that have strong relationships with us, we will ring them if we see a need to talk to them about an evolving situation in their area. We will talk to them as well, so it's a two-way partnership as we see it. Sorry, counsel. Now, the-----

Okay. The Premier and Cabinet briefing on the 5th of January, did you mention the expected rainfall over the next four days?-- Yes, I did.

Do you recall that, what that was?-- I showed a rainfall forecast from our numerical analyses and it showed rainfalls of several hundred millimetres. In fact, I think the forecast was 400 millimetres or more over the next four to eight days.

And that was associated with that upper level low?-- The upper level low was the main feature causing the-----

Now, there were also regular and sometimes twice daily participations in teleconferences with the State Disaster Coordination Centre through this period in January?-- That's correct. In fact, those daily or twice daily teleconferences went from the - about the 23rd of December right through to about the 20th of January, so a month of very intense activity, and this event was sort of right in the middle of it.

I just want to explore one of the issues that Ms Wilson raised with you about specific locations. The severe weather warnings are issued for districts, aren't they?-- That's correct.

And the flood warnings are issued for river catchments broadly; is that right?-- For river systems.

River systems. Thanks. As well as the warnings that you are issuing, there are regular and multiple media appearances on television and radio?-- Yes, and we do attach great importance to our media outlets.

And media can include newspaper, radio, and online news?-- That's correct.

For Toowoomba, that would include, I understand, 4DDB, 4WK, 4GR and the local ABC radio?-- That's right. We have

arrangements with all four of the Toowoomba stations to do routine crosses between the meteorologists and the - mostly meteorologists.

Now, on the website, there is a constant updating, is there not, of Bureau information, including some unverified posting of readings and results from gauges?-- That's correct.

Could I ask you to describe in a broad sense the network of gauges in the streams upstream of Toowoomba to the north and east of Toowoomba across the other side of the ranges? Are they dense, sparse, how would you describe that network?-- Well, upstream of Toowoomba, counsel, essentially there is no gauges that we have access to. This is - yeah, upstream of the East and West Creek.

Just staying with Toowoomba for the moment, sorry to interrupt you?-- Yes.

There is-----?-- Yep.

-----a weather station at the airport-----?-- I was going to get-----

-----the Bureau has access to?-- I was going to get to that. Yes, we do have an AWS, an automatic weather station, at Toowoomba Airport, which reports - I am not sure too exactly what frequency but maybe every 10 minutes it's updated. That is the only station in the settled area of Toowoomba. To the immediate north we have Mt Kynoch, which is, I understand, an Seqwater rainfall station. We have access to those reports in real time, but that essentially is it, those two stations is it. The river systems, of course, that we're forecasting for flow westward down towards Oakey, et cetera, and the information we do receive rainfall-wise is sufficient to provide a very satisfactory warning service for those river systems. Of course, we all know by now that it's nowhere near sufficient to provide a flood warning service for Toowoomba.

I will just ask you this, that the Toowoomba City Council gauges in the CBD, do you know whether they would be suitable or useful for your purposes for forecasts, or are they there for other purposes?-- That's what we call - counsel, that's what we call a microscale network. For anything but a flash flood warning service, they would be of minimal use. They would be of some use certainly in hindsight, as they were on this occasion, to confirm the distribution of rainfall, but, generally speaking, they would be of little use. There's quite a few towns around Queensland, cities and towns, who have these microscale rainfall networks. If we do have a local office in the town, they're the ones who access that network so when they do radio crosses and that they can add those rainfall figures, but, generally speaking, it's more a local government initiative, they are of more use to local government than it would be to the Bureau of Meteorology.

Can I just show you this map which is a Bureau of Meteorology map of the Brisbane, Bremer and Stanley Rivers flood warning

network. I have only got two copies at the moment?-- Thank you.

It's attached to the preliminary report, I am told. We will just find a page number for you. That catchment map indicates where the Bureau has or has access to telemetry for rainfall and river levels, doesn't it?-- That's correct, yes.

And if you look at Toowoomba to the left of - well, it's right on the boundary of that catchment, about the middle of the page?-- Yes.

There's a blue dot for the Mt Kynoch station that you have mentioned?-- That's right, yes.

Then there is no station before Helidon to the east, is there?-- That's correct.

Now, if you look to the further south, there's a gauge, a telemetry river station at Flagstone Creek?-- Yes, that's right.

And if you look to the north, there's nothing until Mt Peachy, the ALERT station, and Mt Peachy, and there's also Ravensbourne, but those two are for rivers or streams that flow to the north or northwest, aren't they?-- Yes, that's correct.

Further to the east, there's upper Sandy Creek rainfall station?-- Yes.

On the headwaters of the Sandy Creek?-- Yes.

Which, I think, Dr Jordan confirmed or I might have put it to him - I don't remember now if he confirmed - was there for an historical reason, that the Grantham floods had historically come from the Sandy Creek?-- That's correct, yes.

Okay. So, you see that there's an area bounded by that Toowoomba ALERT station, Helidon, upper Sandy Creek and Ravensbourne where there are no gauges?-- That's right.

And it follows, therefore, that there's no flood warning system - there's nothing above Helidon until you get to the top of the Range?-- That's correct.

All right. Now, that Helidon gauge, is that there-----?-- This is, of course, reporting in real time. As I mentioned previously, there are rainfall reports out there like Withcott-----

Yes?-- -----but not received in real time, so we need to make a clear distinction what we're seeing in real time and what we're not.

You have undertaken or the Bureau has undertaken a post-event analysis of those rain gauges that you now know received heavy rainfall to the west of Helidon and to the north of Helidon?--

That's right.

And they include Murphys Creek or Holmes, Rocky Creek, Postmans Ridge and Lockyer Creek, each of which showed high rainfall on the 10th of January?-- Yes.

And none of which were available to the Bureau at the time?-- That's right.

Does the placement of the gauges relate to past flood events, the need for dams to measure inflows, or is there another reason?-- I think every situation is different, counsel. We - I am of the understanding that the two in Sandy Creek are to do with the flood - the Sandy Creek flood problem through Grantham. I am not aware of the history of all the stations in the network, not there's many in that particular area. Of course, the Bureau doesn't - the Bureau doesn't have ownership, for example, of the two Sandy Creek stations, the local government does, and Mt Kynoch, for example, is Seqwater. So, as I said, I'm not full y across - not fully familiar with the history of why certain locations were chosen and why others weren't.

The map I'm showing, Mr Davidson, is reproduced, if the Commission pleases, in Exhibit 38 to the preliminary report, which is attached to Mr Baddiley's witness statement. That's page 19 and 20, I think. So, thanks, Mr Davidson. You can put that away?-- Okay.

I want to ask you some questions about how people can communicate with the Bureau during significant events. What is the Bureau position about receiving information about events as they unfold from locals who can make direct observations, or others with concerns about the impact that weather will have?-- Yes, counsel. For many years now we've hosted or run what we call a storm spotter network. We invite people to register with us to provide on-the-site - on-the-spot reports of severe thunderstorm activity, whether it be large hail, strong winds or heavy rain. And when they register with the Bureau of Meteorology they have - they are given a booklet, a training booklet, and someone from the Bureau of Meteorology actually discusses with them what's required. They have a dedicated telephone number they can ring into the forecast centre. So they have immediate and - immediate access to the meteorologists. They can also lodge a report on the web, an e-mail is received in the Regional Forecast Centre, an alert is then triggered in front of the forecaster so they become immediately aware that a storm spotter has provided a report. A couple of years ago we had a national campaign to increase the number of storm spotters. It was partially successful. We do have nine storm spotters in the greater Toowoomba-Lockyer Valley area. On that particular day we only received one report, the one that's been referred to earlier, the Cressbrook Dam one. I'm not for one moment suggesting that the other eight didn't report for good reason. They could well have been thoroughly involved in the flood. So that there could be any reason why not or they may not have been-----

They might have been-----?-- In the wrong area or not there or whatever. So, okay, we did receive the one report. But what we need to do and we'll continue to do is encourage people with an interest in the weather to register as a storm spotter. The information is available on our website for those that may be interested.

So those weather watchers, if I can call them that, always have the possibility, and you would encourage them, to become registered storm spotters with the Bureau?-- That's correct.

Just to pick up on a couple of things you said, they then have the ability to access a direct line into the Bureau?-- That's right.

And to e-mail through reports in which you ask them to describe certain conditions?-- Mmm-hmm, that's right.

Last September you published a newsletter to all your registered storm spotters called "Cumulonimbus", appropriately?-- Mmm-hmm.

In that newsletter you gave some interesting descriptions of recent weather events as well as reiterated the issues about contact and how to submit reports?-- That's right, yes.

In terms of accessing locals or residents who've been through storms before or been through flood events before, from the

Bureau's point of view is this the best way to get that information in directly?-- It's one way of getting the information in. I guess the other way is for them to contact their local government representative or their local Queensland Police Service person. It's quite likely that those people will know the phone numbers of the warning centre, the Flood Warning Centre and the Cyclone Warning Centre. There are at least two numbers in both centres so it is not as if there's just a single number. We also provide the media and emergency services with the direct telephone number of the senior forecaster on duty on that day. So quite a few - quite a few people use that service. So there are several ways of contacting the weather Bureau. The most difficulty way of getting into the weather bureau on busy days is ringing the exchange number. If you ring the exchange number you get put in a queue and it may not be possible. That's why we've created several other options to make sure that if there are calls of an emergency nature in particular, that we can receive them. There are also mobile phones and we know that perhaps not so much the media but a lot of senior people and others in emergency services and local government actually know the mobile phone numbers of my senior officers. So there are various ways that - a number of ways that people can contact the Bureau.

Can I ask you some questions about Bureau operations generally. Ms Wilson asked you some questions about the Regional Forecast Centre and the Flood Warning Centre and you indicated that the Flood Warning Centre is staffed by meteorologists and hydrologists as well as technical officers. How would you describe the interactions and communications between those two entities in a general sense?-- Well, of course they work very closely. They need to work very closely. It wouldn't have been possible to have provided the level of service we have over the past four very wet seasons if there wasn't effective communication between the two groups. I personally attach great importance to that happening, to ensuring that happening and as the regional director, as my meteorologists and hydrologists know, I tend to go into the warning centre on busy days quite often myself and I guess not overtly but just ensure that there is one message, one story line that we're promulgating at the time. You know, the communication issue is one which I can't see it being an issue.

Just to take an example, if there was a meteorologist about to go and do a media cross, would they typically check with the Flood Warning Centre for an update before they did that?-- You'll find that - yes, counsel you'll find that the key media crosses are to, particularly, ABC outlets around 7 o'clock in the morning, the senior forecasters know that they're - they'll be the voice and just before they go on air they'll get a right up-to-the-minute update from the hydrologists as to what the river systems are doing. They don't attempt to provide any detail. What they do is make sure they know sufficient to be able to respond to media questions. It is not their job to know that the expected height is 1.2 metres somewhere and rising. But they know sufficient - they know

sufficiently about what the river systems are doing to be able to carry out media interviews. And that's not just in the early hours; that's throughout the day. We don't normally - unless the situation is particularly acute, you will find the media prefer to talk to both. They'll talk to a meteorologist and a hydrologist. But, of course, there's valid reasons for doing that; they want more detailed information on what the rivers are likely to do.

Is it just talking to each other or do you swap briefing notes as well through the day?-- Yes, we certainly do do we call talking points. We prepare a set of talking points and it is not just to make sure that the forecasters and the hydrologists are talking; it is to make sure that all our other media outlets in Queensland, too, are on the same page. I have 150 staff in Queensland and maybe there's 40 of those who actually go on air, which is a huge percentage of the workforce. So what we do is prepare talking points on a regular basis. If something is happening of course, not every day. So that when people do need to talk, not only to the media but to their local emergency managers, that the story line is a consistent one. Now, those talking points are normally crafted initially by the meteorologist, not always - it depends on the situation - but does include what the main river systems are doing. But, once again, not a lot of specific detail. Enough to get them by with media interviews and to give them an understanding of what their local river systems are doing.

To your observation and to your later knowledge, was there any compromise in the communications between the Regional Forecast Centre and the Flood Warning Centre on the 10th of January?-- The answer is no, but what I should do is qualify it that both centres were extremely busy that day.

Yes?-- And we found it difficult to - to check back as to who spoke to whom, when, where. It was just a continual operation - it was an operational environment, a very active one. There were additional people on. It wasn't a normal day. There were two or three - two extra people at least, maybe three in the forecast centre. There was another two or three extras in the Flood Warning Centre. A lot of people doing - all going about their jobs and it just wasn't possible to actually itemise exactly every item of conversation that day. But there is no reason, I guess, for me to suspect as regional director that there was a problem on the day.

Now, in terms of the tools you used to make observations we've seen the radar loop that the Bureau posted on the website, and as I understand it, the orangey/yellow area on that occasion with the splotches of red, on that occasion represented the area of highest reflectivity?-- That's correct, yes.

And the assumption is that that correlates to the highest rainfall density. Is that right?-- Yes. It is a word we haven't used but, yes, close enough.

Close enough?-- Close enough.

You correct me; you're the expert?-- No, intensity.

Intensity?-- Yes.

But that doesn't necessarily relate to rain on the ground, does it?-- That's right, yes, yes.

Is it the case that these extreme events can be very localised in relatively small areas?-- Yes, they can, and I did mention earlier that that's when our radars are probably least reliable. When it comes to estimating rainfall on the ground from the radar returns, it is in those small scale, heavy convective situations where the underestimation or the overestimation can be at its greatest.

Is there difficulty in modelling for those very small weather events?-- What sort of modelling, counsel?

Perhaps my question is clumsy. Is it difficult to - or do you have to make allowances for further limitations in your estimates of rainfall from the radar based on the fact that it is a very small event?-- I'm not too sure how to answer that question but I guess - I won't guess. It is my understanding that the smaller the echos, and they were quite - and the heavier echos on that particular day were relatively small, it is just more difficult to know where they might go in the future, to track them because they come and they go. They're not consistent always from one 10-minute or six-minute picture to the next. So I'm not too sure whether that answers your question, counsel, but they're the more difficult days. If you get a super storm, a super thunderstorm, super cell, much easier to track and that's when we'd leap into our severe thunderstorm graphical service because we can provide a consistent path for that super cell. But with these sort of - with these what we call rain storm complexes, they don't lend themselves to that sort of analysis, to that sort of tracking. They're more diffuse. Is that a-----

Thank you?-- Okay.

Now, you heard me ask Dr Jordan some questions about the need to ground truth or verify the radar intensities with rainfall on the ground actually measured?-- Yes.

In this case there was no compromise to the radar returns in terms of the operation of the radar, was there?-- No, we had faith in the - in what the radars were telling us as far as reflectivity was concerned because our three radars in the south-east were presenting a very similar return pattern.

You mentioned to Ms Wilson that the radar returns can lead to an error in the estimation of rainfall by a factor of one or two or even three or four?-- Well, for very small, intense, convective complexes it could be three or four. Under normal circumstances, it's probably up to a factor of two for a normal rain event.

Now, I think there was a slide in your last week's presentation that talked about the radar and rainfall on the 10th of January and the low intensity radar returns for this storm complex?-- Relatively low intensity, even comparing it do the following day. I mean, we had flash flood warnings out for the following day because the radar returns on the 11th were at least the equal of what we saw on the 10th but there were no reports of flash floods. So it really needs a concentration of a number of factors in one locality at the right time for these flash floods to occur and that's why they're so difficult to - to pinpoint in advance.

When you say you had flash flood warnings out, was that the flash flood warning that you created the day before or was that the severe weather warning that mentioned the flash floods?-- That's a very good point, counsel. I withdraw what I just said. We had severe weather warnings out the next day for heavy rainfall conducive to flash flooding. We did have flash flood warnings out for a little while, of course, following that 5 p.m. warning. We kept the SEWS running and then we reverted to severe weather warnings.

I just want to focus on the 10th of January. We saw on the radar loop that the darkest section of the storm - sorry, the yellowy-red section of the storm passed over Esk, Redbank Creek, Ravensbourne generally. What direction do those creeks, the creeks around those stations flow? In what direction do they flow?-- They flow in a northerly or north-easterly direction.

So from the flood warning point of view, what is the concern of the hydrologists noting those flows and those rainfalls?-- I guess we could say our concern might be twofold: one is that water could end up in the - well, will end up in Wivenhoe but, of course, the other issue is Redbank with a rainfall of that intention, I mean, there could have been a flash flood in the creeks going north from Redbank. I'm not aware there was a flash flood. But if we're looking at that being an indicative rainfall, it's not only the upper Lockyer. It could have been other smaller creeks as well which - which we had no knowledge of.

Can I ask you to explain the relevance of one to 50 year thresholds?-- The one to 50 year thresholds, is - this is for rainfall intensity?

Yes?-- We do have a figure which we have of 100 millimetres an hour as being the average for the South-East Coast District.

Yes?-- For - as being a one in 50 year event. That will vary a little bit over the South-East Coast District. As you're getting towards the Lockyer it will be a little bit lower. But forecasters would be aware that if they see a rainfall of at least 100 millimetres an hour, that they're up in the one in 50 year range.

Are those thresholds significant because without them you can have a lot of rain but it may not be significant?-- That's

correct.

Okay. Now, on the 10th of January, as I've just noted, there was heavy rainfall in Esk and some heavy rain in Redbank on those northerly flowing streams. Can I ask about Redbank particularly where there was a return, I understand, of 75 mils to 1 p.m. Was that just under that one in 50 year threshold?-- That's correct. Seventy-five in one hour is just marginally under one in 50.

Okay?-- But I should add, counsel, if I may, that it's - it's not possible in an operational environment for forecasters to check every rainfall that comes in during an event where we've got lots of rain, high numbers, high rainfall registrations. For example, I think it was the next day Somerset Dam had 83 millimetres in an hour and there is no record of a flash flood. So that too, it is very - it is a very difficult thing to forecast and that is why we keep saying it does need an end to end warning system, those dense networks and the like, because it's just not possible to make a call on where and when a flash flood might occur without having that end to end system in place.

Another relevant station perhaps to consider is Ravensbourne, which is further south than Redbank but still the streams are flowing in a broadly northerly direction towards that upper Brisbane River. The reading as I understand for Ravensbourne for the two hours before 1 o'clock, roughly, were only nine millimetres. Now, given the volume of rain we know fell to the south of that, does that suggest that Ravensbourne was either outside the path of the storm at the time or that there may have been a malfunction in that gauge?-- There was a malfunction in the gauge, counsel, but from radar imagery we do know that the swathe of the heaviest rain was some 10 to 20 kilometres wide, so a fairly narrow channel of intense rainfall. And with a channel that narrow, unless you have a very dense rainfall gauge network, it could easily slip between the gauges as it did on this occasion.

So how far apart in a general sense are these gauges?-- It varies considerably, without a measuring stick in front of me. But, look, you know, you're looking at 20 to 50 kilometres in many cases.

If I can just pick a third one, that's Cressbrook Dam that's again to the north. There was the spotter call at 12.39 p.m. relaying information about conditions at Cressbrook?-- That's right.

Other than that, you have in your report at page 52 a table which shows the rainfall data. Do you have your report?-- Yes.

At page 52 table 6.5.1, "Rainfall Data Displayed by the Bureau Enviromon System" it's headed, we see the rain data for those various stations, Cressbrook, Helidon and so on. 1 to 2 p.m. you have Cressbrook only giving you three millimetres in the gauge, Helidon, 11 millimetres in the gauge and, in fact, it

is the hour before where you have the higher reading at Cressbrook, isn't it, 12 to 1 p.m., 54. Have you got that table in front of you?-- Yes, yes. Yes, correct. That's correct.

You see for Cressbrook 12 noon to 1 p.m., 54 millimetres?-- That's right, yes.

Going across the page, the highest we have there for any of those readings is Redbank at 75?-- That's right, yes.

Other readings on a higher side are around Roesentretters, Caboonbah and Somerset - all well to the north of Cressbrook and Esk. So what information does that tell the Bureau about the rainfall and where the likely fall of rainfall is going to occur next?-- At this stage it was a combination of what we could see on the radar and the registrations we did have which, as you say, are very sparse so it was a matter of tracking the - of tracking what we could see on radar knowing that it wasn't going to go over any rainfall stations until it got to Toowoomba, which wasn't long of course, until it got to Toowoomba but, yes. I mean, these sort of registrations we would have seen many times throughout the summer. These - to a meteorologist and a hydrologist, you know, to see figures of this magnitude, of this order aren't that exceptional.

You mentioned also before the media cross to the ABC Country Hour where you made special mention of the heavy rainfall in the Brisbane Valley west of Esk heading inland towards the Darling Downs. Was the expectation at the time that the storm would continue on that direct path or was that difficult to predict?-- Well, in a general south-westerly direction. No matter what sort of storm complex it is, you can always expect that some - some deviation could happen. But it was tracking in what we call a general south-westerly direction.

Now, the call from the spotter at Cressbrook prompted a call from the Bureau to the State Disaster Coordination Centre at about 1 o'clock and the protocols or the practice is that the Bureau call with the relevant warning information and it is for the State Disaster Coordination Centre to respond and disseminate information as they see appropriate?-- That's correct.

I just want to highlight four things about that call. First, specific mention was made of Toowoomba?-- Yes.

And the expectation of some flash flooding around the Toowoomba settled area in the next hour or so?-- That's right.

Second, there was mention of the exceptionally heavy rainfall to the west of Wivenhoe/Redbank moving towards Toowoomba?-- Yes.

The third thing was it linked the storm activity to the involvement of emergency services and police with major issues at Cressbrook at the time?-- Mmm-hmm.

And fourthly, it warns specifically of flash flooding?-- That's right.

So in terms of ground truthing, if you like, you had this direct report from - and the rainfall information from Cressbrook just before 1 p.m. What did that tell you about this particular storm?-- It tells us that some flash flooding was likely in - was occurring, actually, in the storm which corresponded to what we had in our severe weather warning.

Just while I've got my map open, I don't know if you've still got your catchment map open?-- Yes, sure.

But the Upper Sandy Creek alert station is one owned by the Lockyer Valley City Council?-- That's right.

It is a rainfall station only, is it not?-- That's right.

So it's not monitoring water levels. It was on the edge of that heavy rain and as I understand it received less than 50 millimetres in total on the Monday afternoon?-- Yes.

Now, I have put some numbers to Dr Jordan and I don't expect you to be familiar with them, but the heaviest number in terms of the rainfall reading for an hour was 29.8 millimetres at 1 p.m. on Monday the 10th?-- Okay. I'll take that as fact but I can't verify it here.

Sure. Is that a significant or insignificant number in the scheme of things for the Upper Sandy Creek?-- Well, considering the event we were having, that wasn't - that rainfall didn't trigger - set off alarm bells in the Regional Forecast Centre.

Okay?-- But the team there were continuing monitoring, searching for additional information but there wasn't anything tangible that they could - that they access which would - which would make them upgrade the current severe weather warning.

At Helidon, the rainfall gauge recorded 13 mils from 12 noon to 1 p.m. - this is rainfall - and then 11 mils from 1 to 2 p.m. This is looking at page 52 again of the report?-- Sure.

And we understand that the Helidon gauge failed at some stage. Which gauge failed, or was it both of them? River and rainfall?-- Just the river gauge.

None of the gauges that the Bureau had access to, am I correct in thinking, had sampled or recorded that very heavy rain that fell on the 10th of January?-- That's correct.

And do you know have a slide that looks like this of the heads of the creeks?-- Yes, I do.

Which indicates that the heaviest readings were at Holmes,

Rocky Creek, Postmans Ridge and Lockyer Creek rail bridge?-- That's correct.

But the point is that no information about those falls was available to the Bureau at the time, was it?-- No. And Withcott, I don't think you mentioned.

Withcott is not quite on that map but, certainly, that's the case as well?-- Yes.

This, I suggest, is where the direct ground observations from locals would be very useful; would you agree with that?-- Yes, I would.

Yes. So no doubt, I take it from your comments about spotter network, that you'd been encouraging them to sign up to that?-- That's correct, yes.

Okay. It's also the case that locals tend to watch for data for their specific areas, isn't it? They're looking for their townships or region and they can focus on those specific items of data that don't come to the Bureau's attention?-- That's right, and it's those locals that have the local knowledge and that's what we need to tap into. Even though we're not issuing flash flood warnings per se, the more local information we can get in the better. It would just bolster the value of our existing warning service.

Now, I want to ask you specifically what occurred with the Helidon River station gauge?-- Yes.

At Helidon there are two water level readings available to the Bureau from equipment that's co-located at the one installation; is that correct?-- That's right, it's in the one hut.

The one is the DERM Helidon gauge which sends data via direct telephone polling and by computer to the Bureau?-- That's right.

And then there's the Seqwater ALERTS, which sends information via the VHF radio telemetry?-- That's right, yes.

Both of those gauges are operated for purposes other than flood warnings. Is that right-----?-- That's right, yes.

So what are the purposes that DERM and Seqwater operate those gauges?-- Just bear with me for one second. I'm not-----

Please tell me if these are questions I should direct to Mr Baddeley or-----?-- Yes, I think I might have to. I don't think I've got that information, counsel. All I can tell you, they're operated for the purposes other than flood warning but I'm not aware of the specific purpose.

No doubt Seqwater is interested in the water that's going to come down the Lockyer Creek and join with the river systems ultimately to flow to water below the Wivenhoe Dam?-- That's exactly right. It's all to do with the riverine flooding, warnings and dam management and the like.

Now, both of those gauges, as I understand from the report, failed at the time of the very fast creek rises at Helidon?-- That's right. I think we should understand too that even though there's two gauges, there's only one sensor, so they're not independent data.

Okay. So, there was no way to corroborate one sensor with another sensor colocated?-- Exactly right. If they had two independent sensors, we - if the gauges had have been brought to our attention - we don't automatically look at this data because we don't need it for riverine flooding or a flash flood warning, but if we had have looked at it, knowing that it was off the one sensor, there was no way of comparing the two.

Now, is it the case that from Helidon there was some jumping around in the values recorded?-- That's exactly right, it has all the hallmarks of a faulty recording. There were missing values and a lot of jumping around.

Does that mean the Bureau computing system automatically marks them as incorrect?-- That's right. It could well be, and I think it happened on this case, that the very first registration might go out, but then quickly, once the computing system analyses that, it will say it's more than likely erroneous and marks it as such.

But they are automatically posted regardless; is that the case?-- That's right.

Yes. Is there a way the Bureau can review those algorithms in its own computer systems to encourage delivery of more correct information?-- The simple answer to that is yes. In the next few months we will have another look at the algorithms, but we have to be very careful here. A lot of - a lot of effort has already gone into those - into the development of the algorithms because we see it as quite important that a lot of false alarms, a lot of erroneous information isn't released to the public. So, it's not as if we can ease them back too much. If we do that, it could cause more harm than good. So, we - what we will do is review the existing algorithms.

Now, what caused the Bureau to go and look for that missing information was seeing media images of the flash flood in Toowoomba around or after 4.30 p.m.?-- That's correct. In fact, that's when I first became aware what was going on. I happened to walk into the warning centre at that time and I saw all the eyes in the warning centre up to the TV footage and that was when it clicked to everyone, hey, that - the Helidon recording must have been correct, because by that stage we were carefully looking at that Helidon recording, but still no confirmation from anywhere, no external source had

rung the weather Bureau to say, "We have got a problem."

So-----?-- So, we became aware when we saw the TV footage.

What happened after you saw that TV footage was a number of things, one of which was a Bureau hydrologist was live on ABC Radio at 4.50 p.m. warning Gatton to expect a flash flood?-- That's right.

A further call was made to the State Disaster Coordination Centre at about 4.55 p.m. to advise of progress of that flash flood?-- That's correct.

And the Bureau staff were creating this new document, the flash flood warning that was posted about 5 p.m.?-- That's right, yeah.

That was issued with the SEWS warning?-- Yes, it was.

Now, that's the distinctive siren or sound that's played on media broadcast and sends people a message of urgency or priority, if you like?-- That's correct.

Okay. So, it was issued with SEWS at about 5 p.m. and it stayed on for all warnings issued with the Lockyer, Bremer, Warrill and Brisbane Rivers below Wivenhoe warnings until 10 p.m. on the 11th of January?-- That's correct. We knew the following day that the catchments were even more wet and saturated with surface water everywhere, that we just left it on for the full day.

I'm sorry, I have lumped them together. It stayed on with the Lockyer Creek warnings-----?-- Yes.

-----until 10 p.m. on the 11th?-- Yes.

It stayed on those other river systems from 8 p.m., the 11th of January approximately until about 10 to 4 a.m. on the 13th?-- That's correct.

Okay. I just want to ask you some questions about the way forward in terms of flash flood. The rainfall gauge network is designed to enable the Bureau to forecast floods with a lead time of at least six hours; is that a correct understanding?-- Generally speaking, yes. I mean, there are exceptions. As I said earlier, there are some local governments with more dense networks.

I will come to them in a minute, or those that have implemented end to end flash flood warning systems?-- Okay. Sorry.

The data that the Bureau receives comes in regular intervals, doesn't it? It's not a continuous stream of data?-- Generally speaking, yes, you're right. The main reporting period is, I guess, one hourly. Some data is received more frequently than that and some data is received less frequently than that, but one hour would be the approximate standing.

Not all high rainfall events cause flash floods, do they?-- That's exactly right, yep.

What does it depend upon or what factors have to be present for there to be a flash flood out of heavy rainfall?-- That's a difficult question to answer. There's a combination of factors, including the local landscape. I mean, this was mentioned in this morning's session. It's how intense the rain is, how - for how long it lasts on the weather side, but there's all these other factors, even the escarpment, as we saw, how wet the catchments are. So, it's not a trivial exercise to forewarn on a flash flood unless you have all the systems and people in place.

Right. And the systems that you'd need to have in place include, obviously, knowledge about local conditions?-- That's right.

How water is going to flow, where it's going the flow when it hits the ground?-- That's right.

And any obstacles or impediments or dams, levees, things of that nature?-- That's correct.

You also need to have an understanding, do you not, about the way the water will flow once it moves across the landscape?-- That's right.

And we saw the slides today of detention basins that were built in Toowoomba and the creek beds, things of that nature?-- That's right. You may be leading to this, but obviously what we need is hydraulic modelling of any flash - any area that might be at risk of flash flooding, you know, we need to do it properly from A to Z.

Now, the storm that approached Toowoomba on the 10th of January, we heard, varied in shape and size, but it was approximately 10 by 40 kilometres; is that about a fair estimate?-- Yes. It's somewhere in that range, counsel.

Now, if Queensland has something around a million and a half square kilometres of land area and many flood events and weather events occurring on the 10th of January, even if you could focus on a local area, could you successfully issue a flash flood warning system without knowledge of those local conditions?-- No.

The Bureau website speaks of three critical elements of warnings that I mentioned to Dr Jordan - no doubt you heard me - that they must be accurate, understandable and timely, and if any of those things is missing from a warning, it can severely undermine the effectiveness of the warning; would you agree with that?-- Yes, that's correct

For flash floods obviously they have to be location specific?-- Yes.

Okay. Now, you have said, and it's been said a number of times, the Bureau doesn't warn for flash floods. I wanted to ask you about if you have any knowledge of the current simple systems that are in place in Logan, Ipswich and Brisbane?-- It's my understanding - once again I may not be the best person to ask that question - but it's my understanding they're all operating - and there's more councils than that, I think there might be upwards of seven - are operating ALERT systems, which is the standard that the Bureau would encourage local governments to adopt. With the ALERT systems, you have a base station and ground stations, and the base station is normally in the local government office, with the data relayed, of course, to the Bureau of Meteorology, but the base station in the local government office, and then ground stations - these ground stations are rainfall and/or river height recording stations, a fairly dense network surrounding the station, and what the Bureau of Meteorology provides as part of the package is the Enviromon software which enables the local government, if it is a local government, to operate their flash flood warning system. The Enviromon software does include an alarm, an automatic alarm when certain preset thresholds are exceeded.

So, what you'd need for a comprehensive flash flood warning system is an automated alarm that's triggered when those predefined thresholds are exceeded and that triggers a concise warning message that quickly is disseminated amongst the community?-- That's correct.

And that message would, no doubt, have to have some tailoring suggesting what advice should be taken?-- That's right, very similar, in a sense, to what we do now with our tsunami warnings. Most of the work with tsunami warnings, most of the message construction and all that is done beforehand, so if we do have to react quickly, we just push a button. Of course, we check - I mean, we don't push a button without looking first, but you need to put system in place where you can move very quickly.

Just to wrap up this topic and hopefully my questions, you also need efficient and robust ways to communicate the message to the community?-- That's right.

And you need community awareness, on the other hand, so they understand the significance of it and what action they're meant to take?-- That's exactly right.

And, as I understand your evidence, the Bureau is more than willing to assist with its area of expertise in the development of these flash flood warning systems?-- That's correct.

COMMISSIONER: Before you do wrap up, Ms McLeod, I might just ask this: Mr Davidson, you said before that you encouraged regional councils to build up a relationship with the Bureau so they could ring in and find things out and so on. Was Toowoomba Regional Council one of those that did develop that sort of relationship?-- Well, it's a council we'd certainly

like to develop a strong relationship with. I guess I can be honest in saying it isn't one of our strongest relationships, but certainly - I spoke with the mayor a couple of times already today. Yeah, we'd love to work with the council more closely.

All right. And it just wouldn't have crossed anybody's mind to ring the council and give the same advice that was given to the State Disaster Coordination Centre at 1 o'clock on the Monday, that flash flooding could be expected in the Toowoomba urban area?-- It's not something we'd do normally. I'm not saying we couldn't have done it. As counsel said and I think I said earlier, we have a reliance on that call to the State Disaster Coordination Centre, but as soon as we make that call, the machine kicks in, that-----

I understand?-- -----they know better than we do who to ring in council, which police stations to ring and the like. So, it's a team effort. I see it as a partnership.

All right?-- I am not saying that some councils we may not have rung, but we didn't ring Toowoomba on that day.

All right. Thank you?-- And if I can just add, Commissioner, once again, it was a potential for flash flooding. If we'd been more certain, we would have probably tried to contact council and whoever, but, you know, it was a possibility, it was a good possibility, but, once again, there was no confirmation that it was going to happen.

Thank you.

MS McLEOD: Thank you, Mr Davidson.

COMMISSIONER: Ms Wilson?

MS WILSON: No re-examination.

COMMISSIONER: So, Mr Davidson can be excused all together from sittings?

MS WILSON: I understand he will be recalled in the Brisbane sittings.

COMMISSIONER: All right. So you are not done yet, Mr Davidson?-- Thank you.

All right. You are excused at least to the Brisbane sittings.

WITNESS STOOD DOWN

COMMISSIONER: We will adjourn until 10 o'clock tomorrow morning.

MR CALLAGHAN: Madam Commissioner, could we make it 9.30?

COMMISSIONER: Yes.

MR CALLAGHAN: We are just a little behind, not troublingly so, but just to give us a bit of a buffer.

COMMISSIONER: Can everybody meet 9.30? That's fine then. 9.30 it is.

THE COMMISSION ADJOURNED AT 4.32 P.M. TILL 9.30 P.M. THE FOLLOWING DAY