

Transcript of Proceedings

Issued subject to correction upon revision.

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 17/05/2011

..DAY 23

THE COMMISSION RESUMED AT 10.04 A.M.

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PETER HUGH ALLEN, CONTINUING:

MR O'DONNELL: Mr Allen, could I take up the subject we finished off with yesterday which was Mr Babister's two comments that revisions of the manual over nearly 30 years have not, one, been based on updated hydrology modelling or information and, two, only cope with design assumptions of a flood not more extreme or real life flood situations. Can I take those up?-- Yes, well, as I said yesterday the - certainly the hydrology has been reviewed very extensively twice both in the 1992, '95 period when the then State Water ran a project which I was involved with reviewing all the hydrology and setting up the real time flood model and that was, you know, involved 27, I think it was, reports which went together to form a whole report so it was a very extensive study. Again, in - when the auxiliary spillway was being considered there was a very extensive review of all that hydrology again. Now, in terms of the real time events I know - I am not so sure about the 2003/4 hydrology studies but certainly in the 1990s we extensively modelled the historical floods at the time. There were a whole range of those floods, including the 1893, the 1974, a couple of others in there but, you know, all the calibrations were calibrated for those events, they were all routed through the dam.

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That was done after the 1999 flood?-- The 1999 flood, all performed very well in terms of the hydrology. So much so that I remember the - we knew about 36 hours in advance what the level of Wivenhoe would be within about 200 millimetres so there was good calibration on all those hydrology models and that was - there was no need to further calibrate them after that event. But, I know the calibration of the models is one of the things the flood engineers consider a fair bit in their modelling exercises associated with flood events.

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All right, do you have the Wivenhoe Alliance September 2005 document. I handed it up-----?-- ?-- That's the one Designed Discharges and Downstream Impacts?

That is the one, Exhibit 402. Can I take you to some of the pages so members of the Commission will know which are the relevant pages to see the updated design hydrology, I will do it fairly briefly. In the bottom right-hand corner, page 9 of 93, the third paragraph on that page?-- Page 9?

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Yep?-- Is that the one titled Previous Flood Studies? I might have a different version of the report. I think I left the one you handed out on top of the table here yesterday.

No, I am going to the 2005 document?-- That's the one I have got.

That's it?-- I have page 9 which is Previous Flood Studies. 1

Page 9 is mine is called Introduction?-- That is page 8. I have an old version. It is my version.

I see?-- So if someone could give me-----

Yes, we have got one here. Page 9, third paragraph?-- Yes.

Page 10 the first few dot points. A identifies the hydrological models together with the model parameters. They are set out in appendix A. Appendix B deals with the development and calibration of the models. Page 11, it gives the history of previous flood studies including a history of your revision of the hydrology in the 1990 study you mentioned. We see that particularly in the third and fourth paragraphs?-- Yes. 10

We also see in the fifth paragraph that the Bureau of Meteorology updated the probable maximum precipitation estimates for the Wivenhoe catchment in 2003, in other words-----?-- Yes, that was the main driver for the auxiliary spillway. 20

The rainfall?-- The increase in the probable maximum precipitation.

Then the hydrology studies were based on that updated rainfall?-- Yes. 30

Using the models developed during your 1994 study, do we see that in the very last paragraph?-- Mmm.

Page 23 discusses the method of analysis?-- Yes.

The last sentence of 5.1 details of the three models are set out in appendix A. We then go to appendix A at page 58, paragraph 2.2 discusses the rainfall run-off routing model. This is the model developed in your 1990 studies. Then do we see on page 60 paragraph 2.2.2, the model calibration and testing that was done on that model as part of the 2005 exercise?-- Yes, it is fairly standard practice to review all these parameters as part of the design study like that. 40

Yes, do we see in the first sentence of 2.2.2 that the model has been calibrated against ten historical flood events?-- Yes.

Second last sentence?-- Certainly typically as part of that you - a case like Wivenhoe, if you are trying to calibrate hydrological models for Wivenhoe, you would tend to concentrate on the larger events that have occurred that you have reasonable data on. 50

The last sentence of the first paragraph, "The model has now been successfully tested against several recent flood events including the large flood in 1999."?-- Yes.

At page 63, 3.2 the rainfall has been - rainfall used in the model has been updated to the recent probable maximum precipitation estimates from the Bureau?-- Yes.

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Then on 64, paragraph 23.3, the second dot point, the design rainfalls are spatially weighted in accordance with the Bureau's recommendations for the subcatchments upstream of the dam. That is one of the matters Mr Babister raises, isn't it? He says under the 80s model of the rainfall was not - was assumed to be uniformly distributed?-- Yes.

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That-----?-- The standard practices of the 1980s have proved - evolved a bit since that time, yes.

Close that up, thank you. Do you have the Flood Report there?-- I haven't. I left that behind yesterday.

Can I see the Flood Report please volume 1, page 101. The last paragraph on page headed "Run-Off Routing"?-- Yes.

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Run-off routing is modelling the inflows to the dam, is it not?-- Well, it is modelling the flows that come off a catchment so in general terms. In this instance it was modelling the inflows into the dam, yes.

Second last paragraph on that page commencing, "The run-off routing process was calibrated using 10 historical flood events up to '94 and was used to successfully simulate operational floods at various dates from 1999 through to 2010."?-- Yes.

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Has the benefit of all these studies and testing been incorporated or been utilised in the revisions of the manual that occurred-----?-- It depends how you want them revised into the manual. Certainly the hydrological modelling is a tool that is used to accompany the manual or to be used in association with the manual and all the hydrology has certainly been updated a couple of times since Ken Heggarty's and Bill Weeks' study in the 1980s.

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One last things, Mr Tabaldi's second witness statement, Exhibit 52, bring that up, please. I am going to the first exhibit JT1 which is the Somerset Wivenhoe Interaction Study?-- Mmm, I know the one.

That's the study as to how to operate Somerset Wivenhoe so as to achieve the best-----?-- Yes, we were looking for - Seqwater was looking for a way to better - or provide a greater benefit from the operation of Somerset and Wivenhoe because they act in tandem. The way that Somerset is operated is there is an interaction line which goes some way towards balancing the risk in both dams and what we were looking for is the way to maximise the flood mitigation capability of the dams. That's why this report was done.

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Right, I just want to go to parts of the report which deal with the updating of the hydrology and the testing against a range of flood events. If you look on page 6 of the report,

please. It should be headed "2.0 Methodology". Have you got that?-- It is up on the screen.

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It is the first three dot points I am interested in?-- Yes. Yes, well, that was done as I understand it, I didn't do the work myself but I understand Terry Malone and the other flood engineers did that.

That involves taking the latest information-----?-- Yes.

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-----on expected flows in the river and testing the operation procedures under the manual as against a range of flood events?-- Yes.

Do we see also relevant information on page 10 in the first paragraph and under 3.1?-- I mean, certainly the hydrological models, in this case they are referred to as WT42 models, once you have established them and established that they reasonably model the actual events, you know, that calibration will remain reasonable. What you are looking for is new events that provide an extension of the range, if you like, of the calibrations which is something like the most recent event would provide the ability to calibrate over a greater range.

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Mr Babister says in his report at - he says two things I want to draw your attention to. Have you got the report there?-- Yes.

Page 39 paragraph 137. He says in 137, "The procedures outlined in the manual generally provide a reasonable balance between the objectives of preserving dam safety or mitigating the dam in disruption of the flooding in the downstream area." Then at 141 he says, "It must be remembered no operation procedure can reduce the optimal outcome for all floods," and repeats that at 168?-- That's certainly the case. You just have to look at the modelling of the '74 flood to the modelling of the 1893 flood. Because they arise from different parts of the catchment with different heavy rainfalls from different parts of the catchment, the response has to be different. There is a limited ability for the dams to be able to cope with an infinite variation of floods, depending on where they arise and there will be events but - are very different from past events which may require a slightly different optimal approach in hindsight. The object of the exercise, and this is why we require reports, flood reports, at the end of these events, is to examine the performance and determine whether we can do it better.

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What can we learn from the January 11 flood in terms of the operating procedures in the manual?-- I suspect this is the first time we have ever got to procedure four since Wivenhoe was built and I think there is some things we are going to have to examine. Maybe there needs to be a transition between procedures three and four. We might have to get SunWater to look at options to transition between three and four without endangering the safety of the dam. Certainly because there is a future upgrade to be had for Wivenhoe currently planned before 2035, there is - there may be some ability to

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compromise some of the safety and make it up again in 2035.

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Just explain that for me?-- Well, currently Wivenhoe can accommodate a one in 100,000 year event.

Right?-- Those probabilities are quite notional in terms of - because they are related to probability of the probable maximum precipitation. The difference between a one in 90,000 event versus a one in 100,000 event is quite, sort of, notional, if you like, and maybe if you can handle the transition between three and four in a better way it might be - you might be able to do that with, say, sacrificing the ability to pass a one in 100,000 event and drop back to a one in 90,000 event. Whatever you do, when you change those procedures there will be a cost and it is a matter of whether that cost is tolerable, if you like.

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Well, if you go to a strategy between three and four - let me take it slowly. Strategy three allows you to make releases from the dam which produce the highest flow of modelling you can have without causing-----?-- Significant damages downstream.

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----- significant flooding in Brisbane?-- Yes.

If you are going to a higher release strategy than that but without strategy four you are going to a level of releases from the dam which are likely to cause flooding in Brisbane, perhaps Ipswich, but where the dam safety isn't yet at risk?-- There is always a risk of failure. It will always be finite. It is a matter whether it is tolerable or not. No dam is 100 per cent safe. It will always be hopefully 99.999, sort of, per cent safe. But when you do vary the procedures you will generally have to sacrifice some of the safety of the structure to benefit other parts of the full flood regime, if you like. As I say, if it can currently carry a one in 100,000 event, and by putting some of the transition in between three and four, you may have to pay the price that it can then only cope with a one in 90,000 event. It is one of those things that you are going to have to look at what the costs are of providing some benefit.

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There may be another price, mightn't there? Mightn't there be people in Brisbane who say, "Well, look, my home was flooded because the engineers went to strategy between three and four, my home has been flooded when the safety of the dam didn't require that level of releases."?-- That's certainly a risk. It is a matter of what assumptions are made, effectively, to determine the safety of the dam. What you can't do is infringe on those assumptions, if you like, because I mean, like in the January event, the two peaks were 30 hours apart or thereabouts. What happens if it had of continued raining? Because the forecasts aren't precise you have to use some judgment in what, sort of, recognition you give those forecasts and work out how you are going to pass the event. So, realistically, it is - you don't want to infringe on the safety of the dam in case there is something coming along that, you know, or the same mechanism that is sitting there

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just becomes more efficient and draws more moisture in and just keeps raining. The Bureau, you know, is good at predicting general weather patterns but they can't model it terribly reliably on the small weather patterns that caused this event. Whereas if it was a big rain depression they would have far more reliability on it and you would be able to trust the judgment or trust the forecast a lot better.

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You mean like a slow rain depression?-- A slow rain depression, one that is moving slow, that is broad scale, you know, the flood engineers would have far more confidence in those forecasts and would be able to, sort of, go closer to the limits, if you like.

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Dealing with forecasts, you discuss this in several passages in your witness statement. I have noted down 84, 87 and 140(b). Do I gather the thrust of your opinion is that the extent to which engineers, dam engineers, should rely on forecast rainfall in making operational decisions is best left to the engineers on duty at the time?-- Yes, it is very hard to make a hard and fast rule prior to the event. The flood engineers have access to the Bureau of Meteorology forecasters, they go and talk to those guys and get a feel for what confidence they place in those forecasts. They are the best positioned to be able to do that. You can't do that remotely for, you know, any potential event in the future.

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Mr Babister has a suggestion in his report. If you have it there. Look at paragraphs 146 to 148 on page 44. He raises in 146 for consideration incorporating predicted rainfall in the decision making process but perhaps applying a discount. He has a suggested form of words in 148?-- Yeah, you can potentially do that but you are going to have to do it with great care because you don't want to lock yourself into an event like the '99 event where we had 7,000 cubic metres a second coming in and the forecasters might have been predicting - I don't remember the actual details of the event but the forecasters might have been predicting more rain to come and you would have had to have then made some more releases which would have gone above the 1800 cubic metres a second we were releasing and then the rain didn't come. So by relying on the forecasts, and if they don't happen, you are then caught by creating damage or inconvenience that you didn't necessarily have to cause. So, I know I have seen reports that the flood engineers tend to underestimate the releases that they have to make or be fairly conservative in that line and 99 per cent of the time that is go to pay off because, you know, the event won't - you won't need to get into procedure four and you won't need to make bigger releases so it is a real balancing exercise as to what is the optimum for any particular event.

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You've got another problem. If you look on page 41 of Mr Babister's report, he has got Table 5 which sets out the extent to which forecasts prove correct or are an underestimate or overestimate?-- Mmm.

If we look on the crucial days from Saturday the 8th through to Tuesday the 11th, the four critical days-----?-- Yes.

-----on the first three days, the estimates were - underestimated the rain that actually fell by a large margin, and on the 11th they overestimated the rain that fell by a large margin?-- Yes.

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And some of the engineers have given evidence that when they were managing the dams on those days, they knew that the rain was widely different from the forecast and therefore were reluctant to rely on the forecasts?-- Yeah, I----

Is that a consideration that bears upon whether there should be some sort of prescriptive formula such as Mr Babister suggested?-- I think you've got to be very, very cautious about using a prescriptive formula, and you've just got to look at those sorts of results and then say, "What would have happened" - now, this is something that I haven't done - "What would have happened if they had have relied on the forecasts?" I understand the flood engineers have done that sort of work, but I haven't seen all of the results.

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You yourself address this on page 27 of your witness statement, paragraph 87, in the third dot point?-- Third dot point on page 27?

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Yes, "If forecasts instead of actual rainfall had been used as a major decision-making criteria, the releases could have been lower than they actually were in the early/middle part of the event and greater in the latter part of the event. The net effect would have been to worsen the peak flood in urban areas."?-- Yes, I mean, that's entirely possible. I haven't quantified what that effect might have been, but, you know, that's something that might have to be thought about. I just think you've got to be very, very careful about relying on every forecast that the BOM make. Certainly for the big events, they'll get it far more reliably than they will for these sorts of smaller, intense events.

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Right. Mr Babister makes a number of suggestions for the manual or raises a number of matters for consideration in the manual review, I should say. Assuming that had all been in place in January during the flood event, is it your view that even with those changes, the volume of inflows to the dam were such that it would have been inevitable that there would have had to have been very large releases from the dam causing the downstream flooding?-- I haven't given every one of Mr Babister's suggestions a huge amount of thought, but I think they all need to be considered, and considered on their merits. So, you know, it's one of those things that, you know, we'll have to consider all these options and say, you

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know, "Is this reasonable under the circumstances? Will this provide an overall benefit for most floods?", because you can only say for most floods, because every flood will be different and it may not work for some floods.

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Yes. My point was would it have made a huge difference in the January event?-- Well, I'd have to go through them one by one. I'm not in a position at the moment to say that. But, you know, it's really a case, when we review the manual, I think we need to review those sorts of things. I suspect that Mr Babister hasn't necessarily got a vast operational background in Wivenhoe, and he might benefit from some of that.

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Mmm?-- But, you know, maybe the thing to do is to talk to him post event and we'll see what we can draw off it.

Thank you.

COMMISSIONER: Can I just check with you, Counsel Assisting had previously raised the same thing as you which is the possibility of a transitional strategy between three and four?-- Yes.

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What have you got in mind? Just that it enables you to release more than 4,000 CUMECS without necessarily having to stabilise the lake?-- Well, the problems seem to have come primarily from the big increase in discharges that they had to make on that second peak, so maybe the way to go is to either work in a maximum rate of increase in discharge, or, say, start off, you know, Procedure 4 earlier, but limit the rate of increase that you can have.

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You could remove the imperative of stabilising the lake, I suppose?-- Well, it would be all part of it, because you'd still have to pass the big events through there and say, "Are they okay under that procedure?" But what I think is needed, or what seems to be needed is some sort of avoidance of this rapid increase that occurred. Now, that hasn't been thought of before. I know in the really big events, you have to start Procedure 4 a lot lower than 74, but then in those really big events, you've got about, you know, 40,000 cubic metres per second coming in, which is about four times the size of this event. So you know something really significant is going on, so you'd probably have to trigger Procedure 4 very early on in the piece, but you'd have to phase all that in in any review of it to - you know, you'd know something really big was happening, and you'd have to just get your warnings out and people would have to wear it, because, I mean, everyone would be subject to a sort of real flood wave, if you like. It would come up very, very quickly. Even places like Brisbane it would come up very, very quickly. Now, that's - a lot of it depends on what other floods or other rainfall is occurring in the Brisbane Valley catchment. There might even be, you know, substantial local flooding in Brisbane at the same time, as happened in '74, and that was one of the causes for a lot of the damage in '74 - it was the local flooding which coincided with the flood peak from down-----

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You're getting off track a little. I did just want to know what you meant by transitional strategy?-- Yes.

And it is a greater flexibility, essentially, not having to do that dramatic-----?-- Yes, I think potentially there is some room for that, but I think we'll have to examine it and see what the benefits are, see what the costs in terms of risks and things like that are.

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Right, thank you.

MR O'DONNELL: Can I explore that a little further? You were talking about a situation where you - the rate of acceleration of releases is smoothed off or lessened, but you are still going to have substantially the same volumes released?-- Yes, you are still going to have the same volume. There will be more time to give the warnings downstream and things like that of really big events.

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There has been some evidence where the flooding downstream is as much a factor of the volume that's released as it is the rate of flow?-- Yes, it is a combination of both.

So, if you've still got the same volume, but you've got less acceleration in the rate of releases, what's going to be the effect of that on downstream flooding?-- It is a matter of how the flood peak attenuates downstream, I think, a lot of the time, because in the 2011 event - January event - they had to accelerate the discharges up to 7,000 - 7,450 cubic metres per second - they held it there for three hours and then they dropped it right back down, and when you look at the head waters there, that really matched a lot of what was coming in, because there wasn't much additional flow stored or much storage in that time. The head water didn't rise much and it didn't fall much from that peak. So, they matched it relatively well. The thing is, though, that peak was a fairly short, sharp peak. It was big, but it was - didn't occur over a very long period of time, so that would have attenuated far more than if you had have let go, say, 6,000 cubic metres per second for three times as long. So, it's a matter of how those peaks attenuate as they move downstream. Now, certainly the closer you were to the dam, the more impact those big peak rises would have had. So, places like Fernvale would have - it would have gone up and down very quickly as a result of that. Places like Ipswich it wouldn't have been as bad from the peak, and Brisbane, which is further downstream again, more would have attenuated due to the storage effects that are in the river and things like that that would naturally tend to mitigate those sorts of things.

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But given the contributions to the river flooding from the Bremer and the Lockyer, downstream of Moggill, is there going to be a great difference in the flooding downstream of Moggill if you produced a rate of acceleration of the releases but the volume was still the same?-- Well, that's one of the issues that you'd have to look at when you are examining these transitional phases, if you like, or stages in the releases,

and see whether - you know, how much difference it would make, and obviously when you're doing - looking at those events, you would look at the past historical events and one of them will be the January 2011 event.

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So, that's a matter for manual review?-- Yes, I believe so.

Thank you, Commissioner.

COMMISSIONER: Mr Ambrose?

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MR AMBROSE: Mr Allen, I appear for SunWater?-- Mmm.

Yesterday, you were asked some questions by Counsel Assisting about Exhibit 391; that's DS 5.1, the Flood Mitigation Manual for Dams?-- Yes.

And, in particular, at page 4, you were referred to the passage where the action officer would be regarded as having to consider guidelines which exist when evaluating a manual of operation. Typically, guidelines such as that produced by ANCOLD titled "Guidelines on Dam Safety Management" would be an example of the guidelines you - that document refers to?-- Yes, certainly, yes.

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And, similarly, the Commonwealth Attorney-General has a guideline described as "Emergency Management Planning For Floods Affected By Dams"?-- Yes, we're aware of that. We contributed to that.

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Yes. So, they're the sort of guidelines that your action officer would be aware of?-- Yes, there are a lot of industry guidelines. ANCOLD has produced a number of those, and certainly there's a lot of discussion in the industry on emergency planning and things like that.

You were also referred to Exhibit 29, the "Manual of Operational Procedures For Flood Mitigation At North Pine Dam"?-- Yes.

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And you were asked yesterday whether, on the issue of pre-releases from North Pine Dam, whether such pre-releases would happen before a flood starts. Do you recall that discussion?-- Yeah, I can't remember exact details of it, but, yeah.

I wonder if you could have a look, please, at Exhibit 29? Do you have a copy of it?-- No, not in front of me. It's right on the screen.

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If I can take you first of all to page 2, and the definition of Flood Operations Engineer, and it means a person designated to direct flood operations at the dam?-- Yes.

And that's in accordance with section 2.4 of the manual, and 2.4 of the manual refers to when there's a flood event, and a

flood event is defined as, "A situation where the duty flood operations engineer expects the water level at the dam to exceed full supply level"?-- Mmm.

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So, it's where there's a risk of the dam overflowing that the flood operations engineer has a role to play, and not before?-- Yes, that's the way it's set up.

All right. Now, I want to take you to 8.4 of that document, and you'll see that that's titled "Flood Operations Strategies"?-- Yes.

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So, the strategies to be adopted during flood operations, and about three-quarters of the way down that page, it refers to, "Departures from the tables shown in Appendix C are allowed in the following circumstances:"?-- Yes.

And the first one is the one that you were taken to yesterday: "Subject to the provisions of 2.8, pre-release of water is allowed to reduce the risk of dam overtopping."?-- Yes.

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Now, first of all, dealing with the words "departures from the table shown in Appendix C", if we go to Appendix C, we'll see that they refer to the gate and valve settings?-- For given head waters.

So, there may be departures from those tables in certain circumstances?-- Yes.

The first one is, albeit, subject to the provisions of 2.8, pre-release of water to allow - is allowed to reduce the risk of dam overtopping. Now, the provisions of 2.8 relevant to this discussion, I suggest to you, are those matters of 2.8 where the senior flood engineer has to seek consultation with the Chief Executive and discuss what he intends to do?-- That tends to be the case, yes.

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So, it is subject to those provisions being complied with-----?-- Yes.

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-----there may be a pre-release of water?-- Yes.

All right. So, in that context, the pre-release of water is a pre-release as against those settings set out in Appendix C?-- Yes, that's basically it. I mean, if they need to accelerate the release of water for a given head water, they can under that. Effectively you're releasing more than is necessary for that level.

All right. So, if we then go to what exercises that discretion to have a pre-release or a different release strategy to that set out in Appendix C, we look at 2.4, I suggest to you. I beg your pardon, 2.8. That's at page 8. If you can just go to that, please?-- Yes.

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"If in the opinion of the senior flood operations engineer, it is necessary to depart from the procedures set out in this manual" - and these are the important words I want to direct

you to - "to meet the flood mitigation objectives set out in section 3", then there's a discussion about what the senior flood engineer has to do. In other words, what exercises the discretion is the matters that are needed to be taken into account to meet the flood mitigation objectives?-- Yes.

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Do you accept that? If we then go to those flood mitigation objectives in section 3, we see it over the page at page 9, at 3.1, the objectives, listed in descending order of importance are - and there are four of them - the first one being to ensure the structural safety of the dam, and then there are others about minimising impacts?-- Yes.

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So, I suggest to you that what motivates the exercise of a discretion are these matters that are set out in 3.1?-- Yes.

And only those?-- They're the - very much the primary consideration, but certainly when you look at those objectives, minimising the disruption to the community in areas downstream of the dam really kicks in when there are very small releases from North Pine, because it inundates Youngs Crossing. Youngs Crossing is also inundated by discharges from Lake Kurwongbah and Sideling Creek Dam, so it really kicks in at small levels so that the - ensuring the structural safety of the dam is really the predominant one for the whole releases, yes.

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I understand. But the point I'm making to you is that the exercise of the discretion and the pre-release strategies that might be adopted only occur when there is a flood event?-- Yes.

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It can't occur before there's a flood event?-- Yes, that's the way it's set up.

That's the first thing. And the second point is that the objectives for flood mitigation do not include a consideration of the water supply security?-- No.

Thank you.

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COMMISSIONER: Mr Dunning?

MR DUNNING: Thank you, Commissioner. Mr Allen, my name is Dunning, I appear on behalf of the Brisbane City Council. I've just got a couple of questions for you, and they're really aimed at putting some content around the practical consequences of moving between strategies - I'm interested in the Wivenhoe strategies - and, in particular, this prospect of some alteration of current arrangements in that area between W3 and W4. Now, my learned friend Mr Callaghan and Mr O'Donnell have asked you a number of questions. I don't want to return to the detail, I want to talk about the practical consequences. Can I start with a couple of propositions, and you'll excuse me if they're a little elementary, but I sort of need to lay the groundwork. On the

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whole, a flood engineer executing Wivenhoe strategy will, absent being in a region where dam security is an issue, be endeavouring to keep releases as low as practically possible, would you agree with that?-- That's the general aim, yes.

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Because increased releases mean increased dislocation downstream. So, your aim is to remain as low a strategy as is reasonably possible?-- Yes.

And within that strategy keep the releases as low as possible?-- That's the idea, yes.

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Yes. And, really, the exception to that general proposition is where there is a compelling case that something dramatic is happening and is going to continue to happen, so that you might move more rapidly within a strategy or change to a higher strategy than the lake level itself would suggest; you'd agree with that?-- Yes, that can happen.

Thank you. Can I then move to the topic of precautionary releases. As lower strategies - W1 - and at the beginnings of W2 and W3 - there's little, if any scope for utility in precautionary releases, are there, because there's still plenty of flood mitigation capacity left in the dam?-- Yes, certainly there's substantial volume available under those circumstances.

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So, it would be - whilst no doubt, theoretically, we could conceive of circumstances of a rain event that was unfolding that was of such magnitude and we were so certain of it that we'd engage in precautionary releases in W1 and the early stages of W2 and 3, it's, for present purposes, academic, agreed?-- Yes.

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All right. So there's no practical place for precautionary releases for that point, agreed?-- Yes.

Okay. We then move to - and this probably has similar application to W2, but let's focus on W3 - when we get to the execution of W3, as we've earlier agreed, the aim of a flood engineer expediently executing a task is to keep those rates of flow low, agreed?-- Yes.

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Because once you are in W3, you are at damaging rates of flow?-- You are tending to get there, yes.

And the higher you move up towards 4,000 CUMECS, the greater the damage that's unfolding?-- That's right.

Right. So that once you get to the point that you're considering releases in that 3 to 4,000 CUMECS range, whilst executing W3, you have on your hands a now significant event that's unfolding, agreed?-- Yes.

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All right. And with each decision to incrementally increase the rate of releases, you are necessarily incrementally increasing the damaging floods downstream?-- Yes, and I'd suggest that the dam engineers are very aware of that.

Yes, and it is for that reason that they are - "conservative", I think, is the expression you've used - cautious to only increase the rates of flow when they think circumstances absolutely demand it?-- Yes.

And that's a practice that you would consider appropriate?-- Yes.

All right. And in speaking about this, you sit here today speaking - wearing, so to speak, your hat as the Regulator of Dam Safety, but, in reality, you've been involved in Wivenhoe, man and boy, so to speak, professionally?-- Yes.

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So, you have got a good understanding of its flood mitigation potential as well, not just its issues of safety, agreed?-- Yep.

Well, if we get to the stage - if I can call it, the later stages of strategy W3 - where, let's say, we're talking of releases, 2,500, 3,000, through to its maximum 4,000 CUMECS, you've already observed to me that the flood engineers will be mindful of the damage that is already being caused; now, that's, as you understand it, part of the reason that flood engineers typically set their strategy according to the rain that has fallen to date, rather than the predicted rainfall into the future?-- It will depend very much on the event. As I've said, if it is - the rain is resulting from a very general, broad-scale event, they will have far more confidence in those predictions, so they will be able to make far more - or be far more confident about the releases they're making.

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Yes?-- But if it's in a very small, you know, intense event - I mean, when you realistically think of that second peak, and if you move the rainfall, you know, 30 kilometres east, it would have been hitting the upper reaches of North Pine. If you had have moved it 30 kilometres south, any releases that you made from Wivenhoe would have been aggravating the flooding downstream. So, you've got to treat each individual case on its own merit.

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And that point that you've just illustrated for us is really the danger in precautionary releases, isn't it?-- Yes, very much so.

Because let's take the three options that you posited: one is that it was 30 kilometres away and it landed outside the catchment?-- Yes.

You would have - precautionary releases in those circumstances would be code for precautionary flooding downstream, wouldn't they?-- Would have caused a lot of potential damage downstream.

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That otherwise would have been avoided?-- Yes.

Or let's take your second - or the third of your options, and that is that the rain would have fallen directly over those

areas that were to be flooded as well, you would have, in fact, exacerbated the 2011 flood?-- Yes.

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If we go back then to the first of the positions you posited, as I understand your evidence, Mr Allen, you say that precautionary releases would have made minimal impact on the outcome of the 2011 flood?-- That's what I've determined to date, yes.

And would you say that that really is a - the illustration you've just given me, and I've just reflected back to you - is that a fair representation of why precautionary releases are something only to be contemplated in exceptional circumstances?-- They're something that you've got - if you do take them on, you've got to be very, very careful about them.

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Yes, very good. If I can then move to - or we've discussed the prospect of precautionary releases in W3 to avoid W4. Can we then talk about the prospect of some intermediate position between W3 and W4, and that seems to be either having a - let's call it three uppercase As - which is either a higher rate of discharge than 3 - 5 or 6,000 CUMECS, let's just say - or, alternatively, as the Commissioner outlined to you a little earlier, the prospect that you are unlimited in your level of release, but you're not bound, as the flood engineers presently are, to have that rate of discharge such that it's stabilising the lake level and in fact bringing it down. So, that's what we're talking about now, is one of those two options. If we can go to the first one, and that is that there is some option that doesn't oblige you to bring the lake level down, but would entitle you to go above 4,000 CUMECS. Now, above 4,000 CUMECS, we are talking of generating a major flood in the areas underneath Wivenhoe, agreed?-- Yes, we are starting to get to that real damage phase of it, yes.

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Without trivialising for anybody who might have avoided a flood, even if it is just one residence, the fact is if you were to look at that sort of strategy in the 2011 event, that is permission to go to 5 or 6,000 CUMECS you really would be looking down the barrel of a similar magnitude of event as the one that unfolded; would you agree with that?-- Yes, , certainly, that's the risk the dam operators run by pre-releasing. If the forecast rainfall doesn't come then they are in serious trouble from people saying that, "You know, you flooded my house when you didn't have to."

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Certainly. Do you see that a strategy of 3(a) that contemplates going up to a higher rate of at least 5 or 6,000 really suffers from the same sorts of practical vices that a pre-release strategy does?-- Yeah, it is - the sorts of events that I would suggest that you could probably significantly increase target discharges or, you know, say a target discharge at Brisbane, would be something like the '74 flood where there was already damaging flows out of the Lockyer and Bremer. That really sets the benchmark which you might be able to aim for. So, if that peaked at a discharge of something like 5,900 or something in Brisbane, you would then have a target for level three of 5,900.

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You would be, in effect, be chasing the flood that had already happened-----?-- Yes.

-----because you wouldn't be doing any additional damage?-- Yes, that is right. That would be the typical sort of circumstances you would be looking for.

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So when we then understand your idea of transition, what you are really speaking of is providing some discretion for releases above 4,000 in a particular set of circumstances; that's really the only exception you are promoting?-- I think you have to examine a lot of alternatives but that is certainly one alternative that would suggest that sort of operation.

All right. And finally, does your last answer indicate that really before you looked at changing any of the current operating procedures you would wish to exhaustively test against historical data what their practical consequences would be?-- I think you have got to.

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You, for example, wouldn't recommend making any alterations, certainly of any substance, between now and next summer because you won't - without at least the opportunity of having-----?-- Well, I mean, you would certainly look to do as much of that modelling this year as you could.

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Yes?-- If you do identify something that could mitigate some of the potential damages. I mean, it is unlikely-----

Sorry before you move past that, you would act to that if you discovered something?-- Yes, if you can identify something that is definitely going to definitely benefit you, you know, you would certainly implement that-----

Yes, but-----?-- -----as part of the manual before next wet season.

Short of satisfying yourself of something like that you wouldn't recommended a change?-- Well, I think you have to demonstrate a benefit.

Yes, Mr Allen, thank you for your attention to my questions. Thank you, Commissioner.

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COMMISSIONER: Mr Rangiah?

MR RANGIAH: Thank you, Commissioner. Mr Allen, I act for the Fernvale residents. Now, you approved revision 7 of the manual in November 2009?-- It was December that gave the decision.

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All right, and Seqwater gave you some notes in support of amendments to the manual?-- Yes.

You approved the amendments that Seqwater suggested in those notes?-- Yes.

The notes are attachment PHA07 to your statement?-- Yes.

Could you turn to that, please? Do you have that?-- They are on the screen.

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So you, on the first page there is a heading "Approved Operational Descriptions". I will give you a moment to read the paragraph that follows to familiarise yourself with the context?-- Which paragraph is that, sorry? Is that the one up on the screen?

I can't see it from here but it is the first page heading that says "Approved Operational Descriptions" and the paragraph after that begins, "Flood events impacting the Wivenhoe."?-- Yes.

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So what was being suggested there was a more practical approach to dam operations. Then in the next paragraph the third sentence there is - it says, "The strategy chosen at any point of time will depend on the actual levels in the dams and the following predictions which are to be made using the best forecast rainfall and stream flow information available at that time."?-- Yes.

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See that? After the dot points it continues, "The strategies are likely to change during a flood event as forecasts change and rain is received in the catchments." See that?-- Yes.

In the last sentence, "Strategies change in response to changing rainfall forecasts and stream flow conditions." Now, those words were included by you in revision 7, weren't they?-- Yes.

Page 22. Now, if you go to paragraph 87 of your statement. You said, "In terms of gate operations once the event has begun forecasts are a very important part of determining gate operations." See that?-- Yes.

The view you expressed in paragraph 7 is consistent with the words that were added to your revision 7 of the manual at page 22, aren't they?-- Yes, they are.

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In the first dot point you then set out the reasons why forecasts are an important part of determining gate operations. In particular, taking into account the rain that is forecast normally provides significant warning of incoming floods?-- Yes.

So I want to suggest to you that revision 7 does require flood operations engineers to take into account forecast rainfall when making decisions about releases of water from Wivenhoe?-- It is a matter of taking into account forecast river flows which they get from the hydrological models, and giving due consideration to the forecast rainfalls. So there is two different components of forecasts in there. Certainly there is much more reliability on the forecast river flows that come into the dam and come into the tributaries downstream. There is far less reliability on the rainfalls.

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Under provision 7 of the manual flood operations engineers are entitled to take into account forecast rainfall when making decisions?-- Yes but it is their discretion as to how much account they take into it when they consider it. From what I understand, they certainly consider them but it is a matter of, yeah, particular events as to how much consideration they give them.

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But it would be a breach of the manual to ignore predicted rainfall?-- Yeah, to totally ignore it but, as I understand it, they consider it.

Then ignored it?-- They have considered it.

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All right. Now, in paragraph 87 in the third dot point - you acknowledged, I think, in your earlier evidence that you made that comment without having done any modelling; is that correct?-- Without having done any detailed modelling, yes. I haven't personally done it.

No. Now, the manual sets out various strategies, of course, for releases of water which are described as strategies W1 to W4?-- Yes.

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As the strategy changes the primary consideration changes?-- Yes.

So it is important for a flood operations engineer to know exactly what strategy is engaged at any given time, isn't it?-- Yes.

In revision 7 the trigger point for the W4 strategy is the dam height of 74 metres AHD?-- Yes.

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That is correct, isn't it? And that 74 metre trigger point was first included in revision one of the manual in 1992; is that right?-- Yeah, I have got the details in my statement.

Yes, certainly. Can I suggest to you that you say that?-- Okay.

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You suggest that-----?-- I know it was fairly early on.

-----at paragraph 61 of your statement. That trigger point hasn't changed since it was first included?-- No.

Now, there was a major upgrade to Wivenhoe in 2005?-- Yes, it was completed.

That was designed by the Wivenhoe Alliance?-- That is right.

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If you go to paragraph 77 on page 23 of your statement. About halfway through that paragraph you talk about - you say, "This meant that the original dam only had a capacity to pass about a one in 30,000 annual exceedance probability flood event prior to 2005."?-- Yes.

You talk about the upgrade so that the spillway capacity is up to 80 per cent of the required acceptable flood capacity?-- Yes.

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Now, you also said just earlier that the acceptable flood capacity is the probable maximum flood?-- That is right, that's the theoretical maximum potential flood that can be postulated for that site.

So the present capacity is 80 per cent of the probable maximum flow?-- Yes.

That is to be upgraded to 100 per cent by 2035?-- Yes.

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A different way of describing it is that Wivenhoe now has the capacity to withstand a one in 100,000 annual exceedance probability flood?-- That is right.

That's more than at three-fold increase in the level of structural safety as a result of the 2005-----?-- Well, it is not a three-fold increase in the magnitude of the flood. It is a three-fold decrease in the probability of it occurring. Now, they are not, you know, you don't - a 100,000 isn't three times the magnitude of a one in 33,000 event.

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Is this accurate then: to say it is a three-fold increase in the failure risk of the dam?-- Yes.

Now, when you go to the W4 strategy, the primary focus is on the structural safety of the dam?-- Yes, the integrity of the dam, yes.

Just because the water level reaches 74 does not then mean the dam is structurally unsafe?-- No.

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You've been taken earlier to the document entitled Design Discharges and Downstream Impacts of the Wivenhoe Upgrade?-- Yes.

That modelled the impacts of the upgrade to Wivenhoe in 2005?-- Yes.

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The report noted that one of the changes that have been made was that the embankment crest had been raised to 80 metres?-- That is right.

That was from the previous level of 77 metres?-- That is right.

So, potentially then it increased the storage capacity by three metres?-- That is right.

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With the fuse plugs and auxiliary spillway the dam was then much more structurally safe than it had been before?-- That is right. It could handle a far bigger flood event than it could before.

So what I want to ask you about then: is there then potentially three metres more of capacity above 74 before the structural capacity of the dam becomes an issue?-- That's the intent. In effect, what happens, though, is the increase - or the risk of failure gradually increases and it just has a sudden rapid increase once it gets above the EL80 type criteria.

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Between 74 and 77-----?-- There would certainly be an increased risk of failure but it would be a very minor increased risk of failure.

Is it the same risk of failure as there was at EL74 before the upgrade?-- There would be a slightly higher risk of EL77.

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All right. Has any study been done to quantify that risk, that increased risk?-- There have been risk assessments done on Wivenhoe. Certainly one of the studies we are talking to Seqwater about at the moment is the interaction of Wivenhoe and Somerset and that addresses some of those sorts of risks and update that data.

Somewhere above 74 metres there is no increased risk in raising the water level compared to before the 2005 upgrades?-- Oh, yeah, that would be right, yes. There is an event - before the 2004 upgrade there would be an event you would almost have 100 per cent risk of failure and that elevation is much lower than that would be for today's arrangement of the dam.

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What I am asking you then is there is the potential for increasing the level at which strategy W4 is engaged to a level above 74 metres?-- Oh, you would have to be very

careful of that.

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Certainly?-- You need to pass those big flood events and to do that you need to engage strategy W4 at least at 74, if not earlier, to pass those floods. We are talking about a flood with an inflow of about, was it 49,000 cubic metres per second, four and a-half, five times the size of the January event.

If you are talking about the potential, something approaching the potential probable-----?-- That is right, that is what the probable maximum flood is.

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Has consideration or was consideration given prior to approving revision 7 to whether the trigger for W4 could safely be raised?-- Not at that time but certainly I think in a review now we would have to think about it, some of those sorts of things. Certainly I know in the one in 100,000 event I put through in that paper that was distributed yesterday, I had to trigger procedure 4 down at about 72 and a-half, 73 to be able to pass the one in 100,000 event. They are big flood events. They can happen. They are a very low probability but they can happen.

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Now, the approval of the manual lasts for not more than five years?-- Yes.

That's a requirement of section 371(3) of the Water Supply Safety and Reliability Act 2008?-- Yes.

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Is there an obvious reason for this time limit is that a number of factors affecting flood mitigation factors can change over time?-- Certainly. I mean, the technology has changed over the years. The arrangement of the dam has changed. There are things that change over time which, you know, you will notice that not all the manuals have been reviewed on a five yearly basis. Some have come ahead of time because of some of these changes. Certainly there were a couple of extra versions of the manual around the time of the auxiliary spillway so, you know.

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Apart from the matters you mentioned, some of the changes can be dam upgrade?-- Yes.

Better flood modelling software becoming available?-- That is right.

Better forecasting technology becoming available?-- That is right.

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The previous five year revision was in December 2004, wasn't it, when there was revision 6 issued?-- Yes.

Revision 7 was the first revision since the 2008 Act was introduced?-- Yes.

The notes given to you by Seqwater in support of the revision don't contain any assessment of whether the real time flood

modelling software was still appropriate?-- Not specifically. However, I know when it was first produced, it was world class type software. It hadn't been done too often before. Certainly the Bureau of Meteorology has used or Environmon has come out of the software developed for - in the 90s which is one of the Bureau standard packages and, you know, the software is evolving all the time and certainly at the moment I know Seqwater are looking at Deltara's software which is basically a framework that allows all these models to come together. They are looking at that at the moment with a view to introducing, you know, it next year perhaps.

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What I asked you was, I think you might have confirmed, that the notes given to you recommending changes to the manual didn't contain any assessment of whether there was - the present software was still appropriate or whether there was anything better?-- Certainly there is a Flood Preparedness Report produced each year which does mention those sorts of things. I can't remember exactly what the 2010 one said about the real time flood model.

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We are talking about the 2009 at the moment?-- Yeah, I know, but that's done every year. It is one of those things that there are constant developments in the area and certainly the current system of modelling does seem to work.

But the constant developments are one of the reasons why there is a requirement for-----?-- Certainly, yes.

What I am suggesting to you is that you didn't make any investigation of whether the real time flood model could be assisted or augmented by any other software?-- The real time flood model is basically a framework that brings all these models together. The models themselves are calibrated and have been recalibrated a number of times since they were first developed. So it is really a framework to bring it all together. What the reality is, is that the software of the real time flood model is just getting a bit dated. It still works.

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COMMISSIONER: I think you were just asked whether you looked at the time at whether there was anything better?-- Well, I maintain a general awareness of what is out there in the industry and, you know, there is certainly developments in the area and I know Seqwater are investigating those developments.

I think you have gone way off track, Mr Allen. You were just asked at the time of the last revision whether you looked then. I gather your answer is you always know the state of affairs, is that right?-- I keep track of what is going on.

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MR RANGIAH: Were you aware of, for example, Deltara's software where you approved revision 7?-- I am not sure specifically whether I was aware specifically of Deltara's but I know of - that sort of software is generally around at the moment and it is - the issue is more does it provide an immediate benefit to it.

Sure?-- I don't necessarily see that at the moment.

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All right, but I am just asking you-----?-- Yes.

-----whether you made any independent investigation as to whether the software could be improved?-- There will always be able to be minor benefits. What I do is maintain an awareness of what software is out there.

COMMISSIONER: So is that, no, you didn't make a particular investigation at that time?-- I didn't make a particular investigation but I maintain a general awareness of what is out there.

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MR RANGIAH: The Wivenhoe Alliance used software called MIKE 11-----?-- Yes.

-----to test the improved structural safety of Wivenhoe Dam, didn't it?-- They used MIKE 11 to model the river flows coming out of - MIKE 11 is a one dimensional software package that can model river flows.

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It is what is called a hydrodynamic model that monitors river flows?-- That is correct.

It takes into account water levels, flood flows and velocity of the water?-- Yes.

To predict flood levels in a flow network?-- That is right.

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The real time flood models simply relies on flood volumes?-- The real time flood model has access to a model called RUBICON which does exactly the same thing.

As?-- As MIKE 11.

Now-----?-- The mechanics of it may be a bit different and a bit dated now but it does the same thing.

Would you accept that use of MIKE 11 or similar software in a hydrodynamic model might improve the ability to assess the effective flows from Wivenhoe?-- It all depends on the calibration of that model and issues like that as to whether, you know, it is a matter of garbage in garbage out. If you don't use the right discharges, the right calibration for the particular events, in other words what tends to happen is you model historical flows and say, "Does this model represent what actually occurred during that event? Can I then extend it up to the increased discharges of this new event?" But certainly, you know, RUBICON could do that exactly the same way as MIKE 11 can do it because they are basically the same systems. MIKE also has MIKE 21 which deals with two dimensional overland flow and that is coming on but there would probably be very little benefit of putting that in the real time model because there aren't too many places that would require something like MIKE 21. There are a number of packages around to like MIKE 11 and certainly - I mean, one of the key benefits that probably could happen in the Brisbane

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system is that Seqwater and their flood engineers, the Brisbane City Council, the Bureau of Meteorology all use the same calibrated model. That would have got over some of the potential problems that the Bureau seemed to be having in predicting river heights in Brisbane.

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MIKE 11 software is used by the Brisbane City Council?-- Yes.

It was used by the Wivenhoe Alliance you said?-- Yes.

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Flood operations engineers in this event didn't have access to that software?-- I understand they got access to it at the end of the event.

Now, under the Act you have the power to seek advice from an independent advisory committee when you are considering approving the manual?-- Yes.

That hasn't been done since the Water Act was introduced in 2000, is that right?-- No, when you consider the way that the manuals were approved back in the 1980s and 90s, they were put forward by Seqwater's predecessors who didn't have any staff of their own so the origins of those technical advisory committees they drew them off, for instance, the precursors of DERM and SunWater and put them together and a technical committee to advise the people approving the manual. But the reality is that now Seqwater has a lot of those staff themselves and there is no need to or not nearly as much need to generate their own technical advisory committee because they have the inhouse capability to do that.

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The question I asked you was to confirm that an independent advisory committee has not been appointed since the Water Act in 2000. Feel free to answer "yes" or "no"?-- No, I am not aware of one being generated.

Certainly you didn't appoint an independent advisory committee?-- No.

What you did was that you relied on Seqwater to make investigations and recommendations about appropriate changes to the manual?-- Yes, I did.

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What you then did was make a decision as to whether to accept the suggested or recommended changes?-- That is right.

Now, you made no independent investigation as to whether any other changes, that is other than those suggested by Seqwater, were required or necessary or appropriate?-- I am quite happy to accept any sort of recommendation that your people or whoever might put forward to us. At the time there was, you know, we were virtually in a drought last time that I approved the manual and there was no call at all from anyone to change any of the procedures.

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So, you relied on the fact that nobody complained about it and Seqwater had suggested some minor changes - relatively minor changes to the manual, and you approved those changes?-- Yes, I did.

You didn't suggest any additional changes that might be made to improve the system?-- Oh, we certainly had a fair bit of toing and froing between us and Seqwater about some of the details of things, but nothing major. The procedures that were there had stood the test of time at the time.

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Yes?-- It's only after major flood events such as this that you would really identify - or that anyone would really identify potential changes to the manual.

All right. So, you don't see it as your job - as part of your job - to look for what improvements might be able to be made ahead of major flood events in five year reviews?-- Oh, it certainly is part of my job to think of those sorts of things and, as I said, I maintain a general awareness of what is out there and what can be done.

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Now, you'd accept that the manual is an important document because it directs the actions of flood operations engineers who have the lives and livelihoods of many people in their hands?-- Yes.

And it has to be clear and unambiguous, doesn't it?-- Yes.

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If you have a look at the manual and turn to page 29, which deals with strategy W4?-- Yes.

And in the box dealing with conditions, the first dot point is, "Wivenhoe storage level predicted to exceed 74 metres AHD"?-- Yes.

Do you see that?-- Yes.

And in the second paragraph under the box, it is indicated that, "This strategy normally comes into effect when the water level in Wivenhoe Dam reaches 74 metres AHD." Do you see the contradiction-----?-- There is potential contradiction, and certainly next time around we'll have to clarify it.

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And do you know which of the two is correct?-- My - yeah, I would tend to go for the detail in the paragraph and trigger it at 74, unless there was a reason to cause any change in it.

And do you see that that ambiguity might make it quite unclear for someone reading it as to at what point W4 is to be triggered?-- Yeah, but I don't think that there was any ambiguity amongst the flood engineers.

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COMMISSIONER: Mr Allen, can I tell you, you don't really need to go into bat for them every time you're asked something?-- No, I don't, but I know that they seriously consider what they do.

You're just doing it again?-- Sorry.

When Mr Rangiah asks you a question, you can just answer it without advocating for the flood engineers?-- All right.

MR RANGIAH: Now, you accept that there's an ambiguity there, but you still approved the guideline?-- It's been pointed out to me since that time.

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Didn't Mr Guppy point that out to you at the time?-- We had a lot of discussions with Seqwater as to what was intended and we came to a consensus.

So, you reached some agreement as to what it meant, but why didn't you change the manual so that it was clear?-- We didn't consider at the time it was all that significant. We've since learnt that it could be interpreted a fair bit differently.

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Now, you, as I think you've said, were a flood operations engineer for many years?-- I was flood operations engineer for four years, yes.

And the manual was reviewed in 2009, principally by John Tibaldi, John Ruffini, Terry Malone and Rob Ayre?-- Yes.

They've all been flood operations engineers for years as well?-- No, they hadn't all been flood operations engineers for years. Certainly Rob Ayre and John Ruffini have been.

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I see. And all of them were employees of Seqwater or SunWater or-----?-- DERM.

Is that right?-- Mmm.

And really they were people who were a bit like your colleagues, in the sense that you'd been a flood operations engineer and they were flood operations engineers?-- I knew them all fairly well - or, I knew certainly Rob Ayre and John Ruffini well, and I'd known John Tibaldi when he was working at SunWater. I haven't known Terry for all that long, but, you know, it's - it's one of those things that you've really got to know what you're talking about.

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Yes. But there's a sort of closed shop, isn't there, among flood engineers. There's a limited number of them?-- There's certainly a limited number of them.

And your view is this manual had withstood the test of time so that only minor changes were required in Revision 7?-- At the time, yes. Certainly that's why the flood reports are required after the event so that we can reassess them.

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And the only input that came as to what changes were required came from the people that we've just been talking about, the flood operations engineers?-- And ourselves, yes.

And certainly there's no outside assistance or consideration of whether there might be other changes that would be prudent or appropriate?-- There was no push at the time for anything like that. As I said, we were just coming out of drought. What the pressure was on was actually could they raise the full supply level of Wivenhoe.

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Well, the push, if it came, had to come from you, didn't it?-- No, the push to raise it was coming from people like the Queensland Water Commission, and we were certainly in discussions with them.

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Look, did a culture of complacency develop under which you and the other flood operations engineers think that, as the system had coped before, there was no need to have any significant investigation as to whether there could be significant improvements in the system?-- There was a fairly significant reassessment of everything back in the 90s when we did everything, reviewed all the hydraulics and hydrology of the system. So, there has - it hasn't been static, and certainly the people who originally developed the system knew a fair bit about the system, too. That's where all the limits came from. There's been no incentive to change them for no reason.

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Well, did a culture of complacency lead you to effectively abrogate your independent responsibility for reviewing the manual to Seqwater?-- I don't believe so. I don't believe so.

You gave some evidence yesterday about the twin peaks of the inflows into Wivenhoe and Somerset?-- Yes.

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Now, it's not uncommon for there to be two closely-spaced flood events, is there?-- Certainly the requirement in the manual to drain within seven days reflects some, I think, of what you're talking about.

Yes?-- But for them to be two very sharp peaks the way they occurred, I would suggest that's fairly uncommon.

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You say "fairly uncommon", but, as we know, it is entirely possible?-- Oh, totally, yes.

And something that flood operations engineers have to anticipate and prepare for?-- Yes, but until you've actually seen a case of it, you may not - you may not have specific preparations for it because there is a - there is an infinite variation out there of where the floods come from.

Right. Now, just finally, what the Commissioner was interested in was had there ever been any training or a simulated exercise involving how to deal with flood levels at the 1893 type level?-- What sort of flood exercises are you talking about?

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Well, are there any simulated exercised performed by flood operations engineers to see what-----?-- I know there have been exercises done in the past. I believe - you might have

to ask Seqwater about the details of it, but I know there have been events where that training has gone on - they've interacted with people like, you know, the emergency services people and things like that.

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Thank you. I've nothing further.

COMMISSIONER: We might take the morning break before we come to you, Mr Murdoch. We'll come back at 5 to 12.

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THE COMMISSION ADJOURNED AT 11.39 A.M.

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THE COMMISSION RESUMED AT 11.55 A.M.

PETER HUGH ALLEN, CONTINUING EXAMINATION:

COMMISSIONER: Mr Murdoch?

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MR MURDOCH: Mr Allen, I represent the Mid-Brisbane River Irrigators Association. When the Commission of Inquiry was at its early stages, my learned friend Mr Callaghan in opening gave a description of some of the key characteristics of the Wivenhoe Dam, and he said in relation to the upper part of the dam, which is dedicated to flood mitigation, a number of things. One of them was that the volume dedicated to flood mitigation is 1,420,000 megalitres, or 710,000 Olympic swimming pools. He went on and said, "This volume is reflected by the distance between 67 metres AHD and 79.1 AHD." Do you agree with that description of the flood mitigation capacity of Wivenhoe?-- I wouldn't call it necessarily flood mitigation capacity, what I'd call it is flood storage capacity, and I would probably go up to EL8.

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I beg your pardon?-- I would probably go up to EL8, in that it has been designed to retain water to EL8.

All right. Now, if that be the case, can I ask you to explain the correlation between that flood storage or flood mitigation capacity that we've discussed and the operation of the fuse plugs? The first fuse plug triggers at 75.5 metres; is that right?-- Oh, I think they allow to 75.7, but, yeah, essentially that sort of level.

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All right. And when we say the fuse plug triggers, does that mean, in effect, that that engineered plug blows from the structure, permitting water to outflow?-- That's right, yes.

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And the consequence of a fuse plug blowing is that after the event, the fuse plug needs to be reinstated?-- Post-event, yes.

What sort of capital cost range are we talking about to reinstate a fuse plug?-- You'd have to ask Seqwater that.

But you've been involved in the design-----?-- Oh, it would probably be in the millions, but-----

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All right. It's not in the hundreds of thousands, it's in the millions?-- It probably would be, yes. It depends which fuse plug. Certainly fuse plug 3 is bigger than fuse plug 1, for instance.

And in your statement, you've said that - near the end of paragraph 77 - and I'll read it to you - "However provision was included in the 2010 version of the manual to enable

earlier releases to avoid triggering a fuse plug if the predicted peak head water level in Wivenhoe was just going to exceed the trigger level."?-- Yes. 1

Now, in a practical sense, does that mean that the engineers involved in the operation of the dam would strive to prevent the water getting to the 75.5 or 75.7 level?-- Not in all circumstances, but if the flood was going to just get above the limit and require a small increase in flow - not to the magnitude that would go through the fuse plug - it would be an option to consider. 10

Look, in a de facto sense, has the installation of the fuse plugs, particularly the first fuse plug that blows at 75.7 metres, reduced the flood mitigation capacity of the dam?-- No.

Well, in the event that the first fuse plug blows, the consequence of that is there's water flowing out the spillway gates as well as out the fuse plug aperture?-- Yes, but you can also reduce the flow out of the spillway gates, if need be, so that the incremental effect of the fuse plug may not be significant at all. 20

But if the fuse plug's blown, why would you bother about reducing the flow out of the spillway gates?-- To limit the incremental flow out of the dam.

Well, doesn't this bring us back to what I asked you earlier, isn't it - it appears the practice - that the engineers would strive to avoid the fuse plug blowing?-- No, not necessarily. 30

Not necessarily?-- No, because if the fuse plug is going to breach, or to trigger, and you had to increase the flow out of the gates by another, say, 2,000 cubic metres per second to prevent it from breaching, why would you increase the flow out of the spillway when you're going to get 1,600 out of the fuse plug.

Well, then, we've got the second fuse plug at, what, 76.4 or thereabouts?-- Yes, yes. 40

And then we've got the third fuse plug at a little over 77 metres?-- What - the reality is is that once you get above the trigger for procedure W4, the safety of the dam is the primary criteria under which you're operating, so then it becomes a case of how do you manage the flood by increasing the discharge to ensure the safety of the dam. You're not necessarily in the flood mitigation category at that stage. You're not in Procedures 2 and 3. So, you're really looking after the safety of the dam. You're not necessarily in the flood mitigation criteria phases, what you're trying to do is ensure the safety of the dam so that you have to increase the discharges to maintain, you know - or ensure that the safety of the dam isn't compromised. So, it is part of a planned phase of upgrades of releases. If you get the 1 in 100,000 year event through there with 35,000 cubic metres per second coming in, you will need every bit of discharge capacity that 50

you can get hold of to pass that flood, and that's why the fuse plugs are in there. It's recognised that those floods don't come along all that often, and that you will have to rebuild fuse plugs post-event.

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Well, in the light of what you've said, it appears somewhat artificial, does it not, to speak of the flood mitigation capacity of the dam being the height of the dam from 67 metres to-----?-- I haven't made that statement.

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I beg your pardon?-- I haven't made that statement.

No, I'm just asking you?-- What - it's the flood storage capacity that's there. It enables still to store the water temporarily. The flood mitigation capacity will certainly drop-off as you get into that flood storage - or above Procedure 4, so it may be - it's probably an error to cause - to say the flood mitigation capacity exists all the way up, but it never did.

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Sorry, if it ever did?-- It never did.

It never did?-- Because Procedure 4 was always there-----

I see?-- -----that the responsibility when you got Procedure 4 was to open the gates as much as necessary to cater for the safety of the dam.

Well, look, if the flood mitigation volume is not 1,420,000 megalitres, what is it?-- It's a mistake to call it a flood mitigation volume. It's a flood storage capacity.

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Well, what is the flood storage capacity?-- 1.45 million plus.

Even though, as you've demonstrated, it is a dam which now has the built-in capacity with the three fuse plugs to prevent it reaching anywhere near the 80 metre height?-- Oh, if you get a 1 in 100,000 through, it will certainly test that 80 metre height, and you've just got to remember that that is only 80 per cent of the size of the probable maximum flood, so the probable maximum flood would overtop Wivenhoe Dam and cause massive consequences downstream. There would be 240,000 people downstream who would be at risk if that ever happened.

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Well, could I take you back then to an earlier comment you made. At what height does the integrity of the dam structure-----?-- The risk of failure increases and significantly increases once you get up towards that EL80.

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Of what?-- Well, risk of failure increases.

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Well, 80 is the top, isn't it?-- Well, there is a possibility at the moment that it will overtop that now. There is - once it gets overtopped there will be an conditional probability on the dam failing as a result of erosion at that stage so there will be the probability of getting to EL80 and the probability of failing once you get there.

Given what you explained about the operational objective of not having the fuse plugs blow-----?-- No, there is no operational objective to not having the fuse plugs going. It is a consideration - when you are in procedure four, there is an option, I think it is under 4A which allows you if it is going to be just above the 75.7 trigger value - you know, if it was going to be 75.75 or whatever there may be an option to get rid of a bit more water through accelerated releases further down from, say, 75 to 75.7 that might avoid you going just over that limit. That would be the only time it would be considered to accelerate the discharges. Now, that may not be as explicitly spelled out in the manual at the moment and we are certainly going to have to clarify that.

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When the alterations to the dam were commissioned in 2005 would it not have been appropriate at that time to review the manual to reflect the presence of the fuse plugs?-- That's what the version in 2004 was all about.

But it didn't drop the crossover levels from stage 1 to stage 3?-- No, because the flood - the hydrology for the upgrade was all done on the basis of the existing manual provisions.

30

So, again with the benefit of hindsight, there should have been new hydrology done to enable the operators to be appropriately informed post the commissioning of the alterations to the dam?-- But there was new hydrology done for that, as part of that design work.

Sorry, I misunderstood. I thought you said there wasn't new hydrology done to enable an appropriate revision of the manual to reflect -----?-- No, the hydrology was done on the basis of the existing manual. There wasn't any variations to the procedures as far as I am aware, but the Alliance may be able to tell you differently. Sorry if I got your question wrong.

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As far as going to stage 4 or level 4 under the manual is concerned, that's at 74 metres, is it not?-- Yes.

Would it be the case that normally when you got to 74 metres you would also have an eye to the fact that the first fuse plug blows at 75.7 and you have only got 1.5 or 1.7 metres to go before you blow a fuse plug?-- Yes, but there is a fair bit of storage and a fair bit to go on before you get to that level.

50

So, is it the case that the inclusion of the fuse plugs is a factor that you believe ought to be incorporated in the review of the manual you foreshadowed?-- Certainly, it could be

looked at again. It has been considered and it can be considered again.

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Well, with respect, you seem a little dismissive when you say it has been considered and it can be considered again?-- Well, in the current version of the manual there was the provision built into it that if the event was just going to increase the head water to a level that would just trigger it and not go much above that, there was provision to increase your discharges so that that didn't happen. You know, I mean, the situation you are trying to guard against is increased discharges over and beyond what would happen if the fuse plug triggered. That would be your measure.

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How would that be calculated or ascertained?-- By routing all the inflow floods in on the modelling work that the flood engineers would do as part of that process. They would look at it and say, "All right, this is what is forecast to run off. If I increase the discharge by a couple of gate openings here and there I can get it so it just comes in under that level."

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During your time as a flood control engineer in relation to Wivenhoe, was there a Risk Management Plan for the dam in place?-- What sort of thing do you mean by Risk Management Plan?

Well, you never heard of a Risk Management Plan?-- Certainly I have heard of Risk Management Plans but there are a couple of different varieties in terms of Risk Management Plans. In terms of risk management for the gate operations?

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The dam proper and all of the risks that are associated with its operation?-- The point is there are a huge number of risks with the dam. The - the ones we are talking about now are risks associated with dam operations and things like that. When I was involved, risk management in Australia on dams was only just starting to come into prominence. The first ANCOL guideline had been approved in, was it 1994.

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COMMISSIONER: No good looking at Mr Cummins, he will not tell you?-- Sorry, it was updated, the current version is 2003, I played a part in that one. You know, it has come to the fore since that time. Certainly the risk assessment for Wivenhoe that SKM did was in 2000 so it has all come about since my time as a flood engineer.

MR MURDOCH: You do, however, have an important role in relation to the vetting of amendments to the operations manual, don't you?-- Yes.

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Would you not, when proposed amendments are put to you, test them against the risk management plan for the dam?-- In Queensland there are - you can either do things on a standards based approach or risk management approach.

On a what?-- On a standards based approach.

Standards based, yes?-- Which is what the traditional engineering has been based on. A risk management approach, which is coming far more to the fore now and you will find that most of the dam work now is, sort of, intrinsically bound up in risk assessments but that wasn't the case back in 2000 or before 2000 and the changes that have been made to the manual have been largely based on what sort of event it can cope with. Given that it can't cope with the full probable maximum flood. A dam such as Wivenhoe with its extreme consequences requires that the highest possible standard, whether it be done on risk assessment or whether it be done on standards based, and Wivenhoe is therefore assessed against that. When I was looking at the upgrades to the manual that is done in the light of the fact that it can't handle the peak floods that can occur, it is in a transition phase until it is required to be upgraded to the full level. So it is considered in that environment. So it is a matter of getting the maximum potential spillway carrying capacity or flood carrying capacity that is possible.

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Just to try to simplify this, the most recent amendments to the manual were those in early 2010, were they not?-- That is right.

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You were involved in-----?-- Yes.

----- vetting those amendments and in the approval process?-- Yes.

When you were vetting those proposed amendments as part of the approval process what did you vet them against; standards or risk management?-- Would have been primarily standards but in the back of my mind would have been the risk assessment you take into account in any of those sorts of decisions.

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Well, when you say the risk assessment, which risk assessment?-- One that - well, there was the formal one done in 2000 but it is a matter of having those issues in your head all the time. That is what you live and breathe.

40

Mr Allen, you know that a risk assessment is quite different from a Risk Management Plan, don't you?-- You produce a Risk Management Plan to implement the findings or control the findings of the risk assessment.

All right, can we cut to the chase? It appears there is no Risk Management Plan for Wivenhoe?-- I don't necessarily have one. I don't know about Seqwater.

But as the person who vets the changes one would surely expect that if there was a Risk Management Plan you would have it as part of your process of vetting and approving, wouldn't you?-- The Risk Management Plan that I have is the dam can't handle the probable maximum flood. This is a stage in getting to that capability.

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Well, where do you see the Risk Management Plan will emerge as we go through this stage?-- The risk management - well,

putting the auxiliary spillway in was part of the Risk Management Plan. It is reducing the risks that are there to the general public of having a spillway inadequacy. That is part of the management plan. It is putting in structures, in this case at the dam, to be able to handle a much bigger flood. Isn't that part of a Risk Management Plan?

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Mr Allen, I don't want to be tedious but you said putting in the spillway was part of a Risk Management Plan. Is this a plan in some sort of notional unwritten sense, is it?-- No, it is a plan - it is a plan to manage the risks of the dam.

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All right?-- There is acceptable flood capacity guidelines the State has produced now. They were produced in 2007 which require that all referable dams in Queensland - there is a table in there that says there is a schedule of all the spillway upgrades in Queensland. That is a Risk Management Plan.

You were monitoring closely the operation of Wivenhoe Dam during the events that occurred in the first half of January this year, weren't you?-- I was looking at the lake levels and things like that. I only had several discussions with the flood engineers.

20

Who were you liaising with at the dam during that period?-- I didn't have any discussions with the dam. The dam is controlled by the flood engineers of Brisbane.

All right, you were liaising with the flood engineers in Brisbane?-- They rang me a couple of times.

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All right?-- That was it. It is expected to be operated independently of the regulator.

I just wanted to establish the role, if any, that you had and when you were contacted what was the purpose of the contact? Was it to approve particular measures?-- I didn't play an operational role in the January 2011 event. I was rung on the Monday night and there were contacts that I have detailed in my statement. They were the only contacts that I had with the flood engineers and I have the outcomes of those in my statement.

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As far as the areas that my clients are concerned with, they are concerned with the area between Wivenhoe Dam and the Mt Crosby weir. You were very familiar with the dam, its environs and that stretch of the river, aren't you?-- I am relatively familiar with it. I wouldn't say very familiar with all the ins and outs of it.

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You know that facing the dam spillway is a seven kilometre stretch of the Brisbane River which is relatively straight?-- Yes, down around Wivenhoe Pocket or down to Wivenhoe Pocket, is that the bit you are talking about?

When the waters are released from the spillway, we will take a peak event such as that which occurred at peak on the Tuesday,

what are you able to say in relation to the height from which the waters descend from the point of release and the pressure that the waters are subject to prior to release, and the velocity that results when they are released?-- I would expect that much of the energy that is contained within the stored waters upstream of the dam is dissipated in the energy dissipator. It then comes a case of how much energy is needed to drive that discharge downstream and there will certainly be a head loss in the river as it dissipates this energy in turbulence and things like that as it goes downstream, as it moves downstream. Now, that is just basic hydraulics. Any additional energy it has residual from going through the dissipator will be quickly dissipated as it moves downstream.

When you say it would be quickly dissipated, it will still be travelling at high volume, would it not, for at least the first seven kilometres?-- I don't know whether it would be as much as seven kilometres, I haven't done the hydraulic modelling to see. What you would have to do is do a - get a calibrated hydraulic model and feed it in or do the analysis without the dam in place and see what would happen in the area in question and then do the dam - do the model with the dam in place and see what would happen with the model - with the dam in place and look for comparisons. It will generally be - it will tend to be assitodic (?) to the natural state of the river.

COMMISSIONER: What does that mean, I have no idea?-- It will approach - the two will very definitely approach each other in an assitodic way. They might be that far apart and progressively get together.

MR MURDOCH: As far as the area around Lowood and Fernvale is concerned is it the case that when there is a peak outflow from the dam such as occurred on the Tuesday of the event, that the farm land on either side of the river becomes an overflow which takes the water being released from the dam?-- It would be part of the - I didn't - personally didn't see the discharge down there so I am only quoting from - I am only going from guesstimation as to what I think might have happened. But, you know, the stage discharge relationship for the river in that part of the world will - to pass say 2,000 cubic metres a second you would need a certain level. As the level goes up you would pass greater discharges on the rating curves for those sites but it all depends on the slope of the river and how much energy is available to drive that discharge. So you would need to do a full hydraulic analysis of it. Certainly the energy available - any excess energy available from the dam would be very quickly dissipated, I would estimate.

So, if it is not energy from the dam that caused the overflow into the areas around Fernvale and Lowood was it simply a matter of volume?-- It is a matter of discharge. Certainly you need the energy to drive that discharge but the issue that you talking about - if you have say 7 and a-half thousand cubic metres a second going through Fernvale.

Yes?-- The - what you have to look for is what it looks like with the dam in place and what it would look like without the dam even there. Because even if you have got - you know the difference between the two may be negligible because you do dissipate an enormous amount of energy in the dissipator.

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You refer to the dissipator when you are talking about the curve structure at the foot of the dam wall?-- The curve is the flip bucket. The dissipator is the pool downstream of it. That has been modelled physically in a hydraulics laboratory and that the observance of the flow down there, it has been shaped to provide maximum energy dissipation.

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You carefully used the expression maximum energy dissipation. I think from your earlier comment you are uncertain how much energy is dissipated?-- I can't say that so many million horsepower have been generated but there will be some additional energy at the tail of the dissipator but that will dissipate as it moves downstream. Now, I don't know just how long it will take to dissipate. You have to do separate models or - hydraulic model studies to determine that.

20

If one were to put in place a full Risk Management Plan for Wivenhoe Dam, factors such as the effect on the communities within the immediate vicinity downstream of the dam would need to be factored in, wouldn't they?-- I would suggest that, yes.

When one looks at the operations manual currently in place for Wivenhoe there are references, are there not, to impacts of releases for the dam - from the dam on communities in the lower reaches of the Brisbane River, aren't there?-- Yes.

30

But it would appear that the impacts that the persons writing the plan had in mind were the impacts so far as Brisbane and Ipswich were concerned?-- I have no doubt that was the original basis for it. It is - Fernvale and areas like that have only really taken off in the last five to 10 years and maybe now they - it needs to be reconsidered.

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Those areas have been centres of agriculture for over 100 years, haven't they?-- It becomes a matter of who - how do you provide maximum benefit to those downstream? So if you have 200,000 people in Ipswich and Brisbane what you have to try to do, perhaps, is to balance some of those risks and maybe there is room to consider more of areas like Fernvale.

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And currently, from what you've said, that's happening without the guidance of a risk management plan for the dam?-- I just don't know exactly what a risk management plan would necessarily add to that. I mean, I'm not sure that I understand your risk management plan philosophy. Certainly there is room - once you've got the discharge, you've got to release it. It then becomes a matter of mitigating the impacts of that release downstream. So, whether the issue is to provide more warning or better warning, it's a matter of how that might be done.

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Isn't it also an issue of whether you release water earlier in anticipation of the peak event?-- You've got to be very careful of releasing water earlier. What can happen if you - you know, for instance, in the last event, if you had have released water earlier, you might have got to the stage where you were trying to control the damage in areas downstream and held the - or closed the gates up too much. Then you would have had to have opened them significantly as Procedure 4 came along, so you would have still had that rapid rise at some stage along there. So, it's not a simple matter to build all that into it. Now, I'm not saying it perhaps shouldn't be done, but it's not a simple matter to do it.

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So far as the residents downstream of the dam - and I mean between Wivenhoe Dam and Mt Crosby Weir are concerned - the current Operations Manager seems to only contemplate their interests when it comes to keeping bridges and crossings open; that's the case, isn't it?-- That's primarily the case, I believe, in Procedure 1.

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And the actual levels 1 and 2 do seem to put a lot of emphasis on the availability of those downstream bridges and crossings, don't they?-- Yes. If you can at all keep them open, they do, as I understand it.

And that's been a feature of the manual right from Version 1, hasn't it?-- Yes.

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The need to keep those downstream bridges and crossings open wherever possible is an inhibition on the operation of the dam, isn't it?-- In 99 per cent of floods, it will be the way to go, because what you are trying to - you know, those floods won't be bigger - they won't trigger Procedure 4 when those sorts of criteria are effectively sort of reduced in magnitude - or in importance relative to the need to maintain the integrity of the dam.

But we're talking at the moment in the lower levels?-- Yes.

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In the ones and the twos. I just asked you whether that need to keep the downstream bridges and crossings open is an inhibition when it comes to the release of water levels when they exceed the full supply level?-- Sorry, yes, it is certainly the criteria for primarily Procedure 1, but it does hang over into Procedures 2 and 3 when you can maintain them open.

And during your time of involvement with the management of the dam and design of engineering features associated with the dam, are you able to say whether there's ever been a program or tentative program for the elevation - the lifting of those bridges or crossings to remove that inhibition on the operation of the dam?-- I would love that to happen, but it's not in my control.

I know that?-- Mmm.

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Has it ever been factored into the planning for the dam and its overall operational methodology?-- Not as far as I'm aware.

It would make a lot of sense, wouldn't it?-- It would be very helpful to dam operations.

So, no-one in your Department or other-----?-- The Department doesn't control bridges downstream.

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No, I know that, but it can make proposals to other departments of Government, can't it?-- There would be a significant cost involved, and it would be a Government decision, I dare say.

But, in any event, it seems to be a matter that's never been on the agenda, so far as you know?-- Not as far as I'm aware.

Nothing further, thank you.

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COMMISSIONER: Thank you. Ms Brien, did you have anything?

MS BRIEN: I have nothing for this witness, thank you.

COMMISSIONER: Ms McLeod?

MS McLEOD: Just a couple of things, thank you. Mr Allen, I appear for the Commonwealth. Just a couple of questions about your evidence yesterday about the second peak and the prediction of the second peak, and you said that the Bureau hadn't predicted before 4 a.m. on the 11th the second peak in the floods?-- It wasn't modelled until 4 a.m.

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Okay. I understand what you're saying and what you said this morning is that when the rainfall is so localised, the Bureau can't predict a second or subsequent peak until that water actually hits the ground and flows into the systems?-- I understand there are greater difficulty when that happens.

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And one of the difficulties is that you'd need to see that peak actually begin to form before you can predict how it will flow downstream?-- Pretty well, yeah, that's the way I understand it, yes.

Very well. Now, I just want to clarify something you said

yesterday afternoon which might be misinterpreted as the Bureau having, somehow, a role in making operational decisions about releases from the dams. You were asked this yesterday afternoon - or your evidence yesterday afternoon was - talking about the second peak - "The Bureau didn't really forecast it. When they rang me on the Monday night, they said it's going to come over and just go over the 74" - level - "for a short period before it drops away. We don't want to go to Procedure 4." Mr O'Donnell then asked you who "they" was, and you said, "The flood engineers." Now, just to be clear, the flood engineers is not the Bureau hydrologists; is that correct?-- That's correct, yes.

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So, the reference to the conversation on Monday night, was that with dam operations engineers or Bureau hydrologists?-- No, it was with dam operations engineers.

And to be absolutely clear, the Bureau does not provide advice about which stage or when or whether to go from one procedure to another?-- No. I understand the flood engineers talk to the Bureau, but, you know - and they form their operational decisions on the basis of those discussions, but I'm not a party to them.

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So, certainly the Bureau hydrologists are giving advice about what they expect?-- Yes.

And the flood operations engineers are making decisions which incorporates as best they can-----?-- Consideration of those, yes.

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Thank you.

COMMISSIONER: Mr Cummins, I think, might have some questions.

MR CUMMINS: Mr Allen, I just wondered, do you know what the probability of a dam crest flood from elevation 74 is?-- Do you mean a flood event that hits 74-----

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No?-- Sorry, a flood that reaches EL74.

Sorry, with the reservoir at EL74, what is the probability of a dam crest flood?-- No, I don't know.

In other words, a flood that's on the point of failure?-- No, I don't that.

So, we don't have a measure on the risk we're taking at EL74?-- I don't know specifically. There may be a number somewhere. I'm not aware of it.

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A second aspect of that is, having got a single flood, do we have a knowledge about the probability of a second flood, given that the meteorological conditions change relatively slowly?-- The concept of the second event coming has been in - well, was in the operation of Somerset Dam before Wivenhoe

was built. What it relies on is things - historical events like, you know, the 1893 flood when they had three events in two weeks, or about a week apart. The 1974 event, when there was another cyclone just off the coast a week later, and that's why the drainage period is in there for seven days. That's the primary reason for that. So, I don't think it's been allocated a specific probability. It would be nice if it could, but I don't think the regional modelling of the Bureau is up to that sort of - you know, ability to get a full week in advance.

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Okay. Now, it's true, isn't it, that as the volume of the flood increases, our ability to mitigate the flood decreases?-- Yes.

So that at very large floods, virtually no mitigation occurs?-- Yes.

Perhaps I shouldn't use that. The mitigation is - compared to the damage downstream - is actually relatively slight?-- Yes.

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Do we have an understanding at these - at the relatively low levels - when we're passing around the 4,000 CUMECS downstream, do we have a methodology for balancing the risks of certain damage - the certain damage that could be caused - that will be caused by raising that, against the larger damage that may occur downstream if we get an event similar to what we got this year, and I'm not suggesting we should have used hindsight as a method of planning at that stage-----?-- Yes.

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-----but do we have a balance of those risks?-- No, we don't at the moment, and certainly that might well be a good consideration to take into account. You would need to do a fairly close examination and discussion with the Bureau to try to come up with some of those sorts of risks, as to how they might be best managed, what might forecast something like that happening, things like that.

And the other aspect, I think, is the risk that we're exposed to of a fuse plug fusing. Do we have a feeling of the costs of that as opposed to the costs on the community of increasing the downstream discharge?-- When the fuse plug goes, it depends entirely on what is happening around it, as to whether you can, in fact, close the gates to virtually say there is no incremental effect of the fuse plug going. So, there's no hard and fast rules, if you like, associated with that. It will depend on what else is going on around at the same time, as to whether the flood is still increasing in magnitude - I mean, the paper that was handed out yesterday modelled the 1893 flood, and it was a case of - with starting out at full supply level in both storages, it just triggered the fuse plug, but it was a very short, sharp peak. You were able to - well, I found you were able to close the gates down so that that short sharp peak wouldn't have gone very far downstream, if you like - it would have been attenuated very quickly.

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Perhaps I was asking you to confirm for me, Mr Allen, that the - while the fuse plug has to be reconstructed, the cost of

losing the first fuse plug may not be much different to inundating 10 houses?-- That might well be the case, yes.

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Okay. Thank you, Mr Allen.

COMMISSIONER: Mr MacSporran?

MR MacSPORRAN: Thank you, Commissioner. Mr Allen, just a housekeeping matter, since signing your statement, have you noticed a number of reasonably minor errors in it?-- There are a number of editorials, if you like, yes.

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All right. And did you do an addendum just to draw those together and correct them?-- Yes.

Would you look at this, please? That's your addendum?-- That's my addendum, yes.

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Commissioner, perhaps I should tender that for completeness. Perhaps it can be part of the other exhibit - the statement exhibit?

COMMISSIONER: All right. I'll just check what that was. It can be part of Exhibit 397.

MR MacSPORRAN: Thank you. Mr Allen, I want to ask you something briefly about the use of forecast rainfall. If we assume for a moment that the flood operation engineers are working within strategy W3, firstly, W2 allows discharges up to a maximum - or not to exceed 3,500 CUMECS. Under W3, they're not to exceed 4,000 CUMECS?-- Mmm.

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Operating within W3, you have the option of having discharges from 3,500 up to the maximum 4,000 CUMECS; is that so?-- W3 and W2 virtually overlap each other, and they're almost interchangeable. It depends a lot on what's coming out of the Bremer as to whether you choose W2 or W3.

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Yes. But wherever you are, there is an ability to increase the discharges up to - for W3, up to a maximum 4,000?-- Yes - that model.

When you're looking at whether you will increase the discharges or keep them as low as you can within W3, you might consider, for instance, the forecasts for rainfall south of the dam?-- Oh, very much so. You don't want to be releasing - you know, the time-span between the dam and, for instance, the junction of the Bremer River is typically somewhere around about 15 hours. In bigger events, it might be a little bit shorter; in smaller events, a little bit longer in terms of time taken to get there. So, that's what you've got to look for in the future as to what might happen to cause the Bremer to produce additional discharge downstream, and take that into account. Now, that may mean that you are forced to - instead of going to the 4,000 limit, you know, which would probably be considered fairly aggressive, you might say, "All right, if

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I'm going to get an extra 500 out of the Bremer, maybe I target 3,500 and allow for that extra 500 to come and raise the levels."

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So, an assessment of a prediction that rainfall might fall south of the dam closer to Brisbane might be a reason to not ramp up the discharges to the maximum under W3, for instance?-- Yes, you'd have to look at it in the context of the overall flood event, but certainly that might be an option to consider.

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And if you made that decision, you would, in fact, be taking into account the forecast rainfall, wouldn't you?-- You would have to take what might occur into account.

And is that an example of what the manual seems to indicate by the need to take into account forecast rainfall?-- Yes, that would be one consideration.

That's one example?-- Yes.

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Similarly, if you lose a fuse plug, the question of whether you can close the gates fully or partially to limit the flow of the fuse plug discharge might depend upon forecast rainfall south of the dam, amongst other considerations?-- Yes, that would be - you know, it's really a balancing between what's coming in upstream versus what is going on downstream.

All right. Now, am I correct that in the events in January, the flood operations engineers did not use hydrodynamic modelling?-- That's what I understand.

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Is there a limitation in the use of that modelling in terms of the time it takes to run a model?-- It certainly takes - physically takes, you know, 15 minutes, half an hour to run each model, so you can't use it as extensively as you might like to do in hindsight.

Because when the events are changing rapidly, as they were here, you can't afford the time-----?-- Yes.

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-----15 minutes, half an hour to run such a model?-- It's not even so much the time it physically takes to run the model, it's the time that it takes to assemble the data, the flow forecasts and things like that that go into it as well.

All right. Now, you said when there was consideration given to lowering the full supply level of Wivenhoe, you weren't consulted?-- Oh, that was before Christmas. Yeah, I didn't realise that was on.

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Would it be - was it an unusual situation that you wouldn't be consulted when the consideration was being given to lowering the level?-- Lowering the level is a far simpler dam safety exercise than it is in raising the level.

And if you lower the level, you increase the flood mitigation capacity?-- It improves the dam safety and improves - yeah,

the flood mitigation capability.

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So, lowering the full supply level is not something you'd ever object to?-- Yeah, I wouldn't object to that in any way. It improves things from a dam safety perspective. The penalty is from a water supply security perspective.

Whereas any suggestion that the full supply level might be raised would be a matter that would be directly of concern-----?-- Yeah, I would get very concerned, and certainly when the consideration of raising it to 68 and a half was being discussed, I was fairly heavily involved in that because I wanted to know how the gates were going to be operated during a flood event.

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All right. That's all I have, thank you, Commissioner.

COMMISSIONER: Mr Callaghan?

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MR CALLAGHAN: Just one topic, Mr Allen, which has been touched upon, and that's on the seven day drawdown requirement. Looking ahead to some review of the manual, is that something where there might be some room for flexibility, especially, say, in circumstances where there was a confident forecast of fine weather for a foreseeable period?-- That's always been on the cards. I know in the '99 event, we extended the drainage by a day or two then to do that. It's within the scope of the duty engineers to do that.

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And there's going to be more confidence, perhaps, about a forecast of fine weather than there would be about the amount of rain that might fall?-- Certainly, yeah.

That's all I have. May Mr Allen be excused?

COMMISSIONER: Yes, thanks, Mr Allen. You're excused.

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WITNESS EXCUSED

MR CALLAGHAN: I call Kenneth Morris. As I do so, can I just say this, Madam Commissioner: that Mr Morris prepared two statements. Unfortunately, one of them was only circulated to some of the parties this morning. It would be appropriate, in my submission, if all parties were allowed to reserve their position in respect of anything arising out of material that they're only seeing-----

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COMMISSIONER: All right, they can have the lunch break to consider it further if they want to.

MR CALLAGHAN: There's a fair bit of volume there, but, in any case, I propose to proceed to call him and take things as far

as we can. If something does arise, the scope may be there for concerns to be addressed in writing or in some other way.

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KENNETH JOHN MORRIS, SWORN AND EXAMINED:

MR CALLAGHAN: Mr Morris, can you tell the Commission your full name and occupation, please?-- My name is Kenneth John Morris. I'm a Principal Engineer in the Water Environment Section, City Design, Brisbane City Council.

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You've prepared two statements for the purposes of this Commission; is that correct?-- That's correct.

I'm just going to have copies of that shown to you. They're statements with a number of attachments to them; is that right?-- That's correct.

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Just take a quick look at each of those?-- Yep.

I tender that those - or I tender that one.

COMMISSIONER: Do they have different dates? I'll make them separate exhibits, I think.

MR CALLAGHAN: They do. The date of the first will be 5th of April 2011.

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COMMISSIONER: That will be 403.

ADMITTED AND MARKED "EXHIBIT 403"

MR CALLAGHAN: And the second is the 3rd of May.

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COMMISSIONER: That will be 404.

ADMITTED AND MARKED "EXHIBIT 404"

MR CALLAGHAN: Mr Morris, you were consulted, were you, as the representative of the Brisbane City Council for the purposes of the seventh edition of the Operations Manual for the Wivenhoe Dam?-- Yes.

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What was the nature of that consultation?-- It was more to let us know what was being changed.

It was just to let you know what was being done?-- And to see

if I had any objection to that.

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All right. You didn't make any positive contribution or suggestions to anything?-- No.

We understand that in approving that manual, Mr Allen took account of the lack of adverse comment from parties such as the Brisbane City Council. Was any comment invited when you were given the manual?-- The way it went was that they were making some minor changes to the model, so we really only discussed those minor changes.

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Now, in your first statement, there's an exhibit KJM3. Can you take a look at that?-- Yes.

It's the Phase 3 Damage Mitigation Feasibility - Feasibility and Final Report for Brisbane Valley Flood Damage Minimisation Study?-- That's correct.

Can you just tell us what that document is?-- It's a document whereby, as a result of a number of things that had been happening about the Brisbane River and about Wivenhoe, we decided that what we needed to do - we were getting more information about - we had a flood study done of the Brisbane River. We had a lot more information than we had when the first manuals were ever done, and we felt it was time to revisit those operations to see if we could come to some conclusion as to whether they could be operated a different way, based on new information about - that we had that would help flooding in Brisbane.

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And so when was this done?-- 2000 and - I think it started in 2005 to 2007, I think.

All right. So, is any of the content of this document in fact reflected in the current edition of the manual?-- No, I don't think it is.

All right. I want to - you can put that aside now, thanks. I want to ask you some questions about the flood information centre?-- Yes.

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And in your first statement, I think you say - I think it's at paragraph 15 - that the role of the flood information centre is, in effect, to interpret the information that's received from the Bureau of Meteorology to inform the LDCC and to directly inform the public through the call centre; is that right?-- That's correct.

Can you just elaborate a little on how the public is informed through the call centre?-- We have a system whereby anybody who rings up the - sorry, can I go back to why it was done that way?

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Sure?-- In 1974, what happened there was that all the people heard about was the Bureau of Meteorology forecast for the City gauge, and one of the things that happened in that particular flood was that nobody knew what effect that was

going to have on them, and there was a lot of confusion by the public, so this was a way of attempting to get past that to be able to inform the public directly to what was happening at their property. So, this system was created that interpreted the Bureau of Meteorology forecasts - we got the Bureau of Meteorology to forecast not just for the City gauge - but for five other gauges - so, six gauges in total along the river - which we could then adopt a profile for that particular flood and then align it to each property via what we call flood cells. That information was stored in a database, together with the information about each property, so when somebody rang up the Council and said, "I live at such and such a street at such and such a place.", a call centre operator who was not a flood operator could press some buttons on the screen and tell the person what was going to happen at their place in terms of depth over the lowest part of their property and depth over the highest part of the property and when that was likely to happen.

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Is that the only means by which the flood information centre directly informs the public if they call in?-- That's the only means at this point, yes.

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In terms of public announcements or broadcasts, that's an LDCC?-- Yes, all the rest of the information goes to the LDCC and that goes out from there.

All right. Now, can I ask you about some communications with - and in the Flood Information Centre on the 11th of January this year? The centre was in contact with the Bureau and specifically with Mr Baddiley; is that correct?-- Yes.

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And just going by reference to Mr Baddiley's statement, he suggests that there were discussions with the Flood Information Centre - and I'm reading from 129(d), page 32 of Mr Baddiley's statement - I don't think it has been tendered yet, but the parties have it - and I'm only referring to it for the purposes of suggesting that there was conversation at 1.40 p.m. and perhaps another at 2.15 p.m. on the 11th. Are you familiar with that?-- I had lots of calls.

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All right. Well, what I'm suggesting to you is that - by no later than 2.15 p.m. anyway, it was suggested by Mr Baddiley that the wording that was intended to be used in the next flood warning was that the flood level would be as high as January 1974 on the coming Thursday?-- Yes.

Do you recall that?-- Yes.

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Do you recall that?-- Yes.

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If we look at your second statement and the attachments to them, if I take you to page 437 of those?-- 400 and?

Thirty-seven?-- Yes.

That is an email from you to the LDCC which, in effect, passes on that information or paraphrases it in your communication to the LDCC; is that right?-- That is correct.

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You can stay in that volume and turn over two pages to 439. There was another email at, it seems, almost exactly 3 p.m. again to the LDCC, where you advised that on the basis of what you had been told by the Bureau the peak flood levels were actually going to exceed 1974 because the previous one had been similar to; is that right?-- That is correct.

That would appear to reflect a further conversation which you had with Mr Baddiley at perhaps 2.55 p.m., just before this was sent?-- Correct.

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Okay, and relevantly, I think you have included or exhibited to your statement then the bomb alert which issued at 3.25 p.m., that is at 441?-- Yes.

I think the only other document of relevance at this stage is the situation report you sent to the LDCC at 3.30 p.m. I don't think that's in the material you have but we have a copy to show to you. Turn to the second page. That is not a particularly good photocopy, I'm sorry, but you can at least read the words which say it was created at - on the 11/1 at 3.30 p.m.; is that right?-- Yes.

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This is what you sent to the LDCC?-- It was sent from my area.

Yes, all right, what you the Flood Information Centre sent to the LDCC?-- That is correct.

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All right. Now, are you aware of anything I have missed in terms of relevant communication as to the prediction of the level of the expected flood? Communication between yourself and BOM or yourself and the LDCC?-- One of the things that we do as far as the operation of the LDCC is concerned and their requests of us, is that not only do they want to know what the predictions are but they want to know what likely changes could occur, could it get any bigger and, if so, by how much. Not they would send that off to the public but they would then be prepared for some eventuality that could occur in the future. That is what we were talking about in the 12,000. So one of the discussions we had with the Bureau of Meteorology was, you know, if the worst came to the worst and things happened that we weren't really expecting, and rainfalls were heavier than we thought, how high could this thing go, we got the number of 12,000 CUMECS which we related then to the LDCC and we even got them to pull out those maps to have a look and see what would happen if that was the case.

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You are at the moment explaining the entry on the cover sheet of the document I've just shown you?-- Sorry.

Is that what you are doing at the moment?-- Yes, I am.

All I was asking you, though, was whether there were any other relevant communications that I might have missed, because there are a lot of them, either between yourself and BOM or yourself and the LDCC on the 11th which touched upon the predicted level of the flood?-- Well, I can't remember. Could have, I don't know.

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I tender that.

COMMISSIONER: Exhibit 405.

ADMITTED AND MARKED "EXHIBIT 405"

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COMMISSIONER: Is that a convenient time?

MR CALLAGHAN: That is a convenient time, Madam Commissioner. Thank you.

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THE COMMISSION ADJOURNED AT 1.05 P.M. TILL 2.30 P.M.

THE COMMISSION RESUMED AT 2.30 P.M.

KENNETH JOHN MORRIS, CONTINUING:

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COMMISSIONER: Could somebody give Mr Morris a hand with that jug? I must say the jugs here are diabolical, I can't work mine either.

MR CALLAGHAN: Mr Morris, before we adjourned you made mention of the fact that the flood information was set up by reason of difficulties in communication experienced during the 1974 floods; is that right?-- That is correct.

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One aspect of those difficulties is that a prediction of a height at the Brisbane City gauge doesn't necessarily mean much to the people in the other parts of Brisbane; is that right?-- That is correct.

Of course, that information is still necessary?-- It is.

That's why it is included in the sit rep such as the one that you sent on the 11th of January at 3.30 p.m.-- Yes, what I meant by that is it doesn't mean much to the general citizens. It does mean a lot to the people who know what it means.

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That is right. But one thing that does mean a lot to the general population is a phrase such as "1974" or now "2011", and we know that that was in the language used by Mr Baddiley to you between 1.45 and 2.15, I think it was, on the 11th. What I am interested in is the first occasion on which that term, "1974", was used in communication issued by the council. Now, your difficulties here may be you can't say what the LDCC said; is that right?-- That is correct.

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But what you can say is that you forwarded that email at 2.45 p.m. which used that language, similar to 1974, is that right?-- That is correct.

You don't know what they did with it after that?-- No.

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The other problem might be that is that sort of language anything that would be used by the call centre?-- No. The call centre would have just responded to the information that is in the Bender. They have a script which doesn't have that sort of language in it.

No, so if the phrase 1974 was use in the communication issued by council it wasn't something of which you would necessarily have knowledge?-- No, I wouldn't.

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With the call centre information can you tell us anything about the speed with which that's updated?-- Yes, the Bureau of Meteorology provide us by phone generally with the levels, the predicted levels, and that is followed shortly after by an official communicae from the Bureau of Meteorology with those levels on it. Sometimes even before we get the official communicae we have already entered that information into what has been termed the Bender. That is checked by the assistant controller in the control room to make sure that the information has been entered correctly. From that point on it is just a button press which transfers that information on to the database. Once that happens it is available to the call centre. It all happens within 20 minutes of receiving the advice.

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You've addressed the concept of the Bender in your second statement; is that right?-- That is correct.

And explained a bit about that. But the simple question about that, I suppose, is; would information from more gauges improve its accuracy?-- In a third way. In a third party way, if you like. More gauge information would imply there was more information on which to base a model and make the model more accurate. The Bender information is then based on that model.

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The question was probably badly worded. Would it make it more informative, more helpful to the wider population, I suppose

if there were more?-- I don't know of anybody was actually using the Bureau of Meteorology forecasts for Jindalee and forecasts for Moggill as part of their decision making process. All I know is that on a property to property based bit of information we would have taken a profile, bent it to fit the Bureau of Meteorology's forecast and then used that as an interpolating procedure to work out what the flood levels were along the river between those two points and applied that.

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What I am getting at is we have a gauge at Jindalee?-- Yes.

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A gauge in the city?-- Yes.

And none in between, is that right?-- We do have other gauges. We have a gauge at the mouth of Bulimba Creek, we have a gauge at the mouth of Breakfast Creek, we have a gauge at the mouth of Oxley Creek.

Breakfast Creek and Bulimba would be-----?-- Downstream of the city gauge. Oxley Creek is between the city and Jindalee.

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The question - I may not be making it clear - if there were more gauges between Jindalee and the city, would the information yielded by those gauges be helpful in providing information about which properties are likely to be inundated by flood water?-- Very marginally.

Marginally only?-- Yes.

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Why is that?-- Just it would help refine the model a bit.

Yes. All right. If I could turn to your dealings with the Flood Operations Centre. There has already been a bit said about communications with the Flood Operations Centre and the whole question of whether the limit for damaging flows was 3,500 or 4,000, are you aware of that?-- Yes.

You addressed that in your statement at paragraphs 81 to 95, is that right?-- Do you want me to look? I will assume what you are saying is correct.

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All right. The only things I wanted to ask you about that were - two aspects of it. One is Mr Malone didn't have a copy of the damage curve, do you recall referring to that conversation?-- I do recall it, yes, I do recall it, remember that.

Is there any real need for someone in his position to have a copy of the damage curve or is it just really something that might be useful background?-- I think it was more useful background.

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Because presumably what he needs to know is reflected in the manual already?-- Yes - oh, yes.

All right. The other point about these communications is that you record the fact that at paragraph 108 that you had a

strong view about the desirability of allowing the fuse plugs to activate; is that right?-- Yes.

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Can you just share that, and your reasons for it, with us?-- When we were told - we had a meeting up at Wivenhoe with members of - various members of the State Government telling us about the fuse plug spillways and asking us if we had - it was before the fuse plug spillways were built, it was during their design. At that time we were told that the fuse plug spillways wouldn't be coming into operation until something like around about a one in 5,000 year event. That was fixed in my mind that's when the fuse plugs spillways would be starting to be activated. We gave our approval for - did not object to that sort of system of securing the dam because in a 5,000 year event all hell would be breaking loose down in Brisbane anyway and no-one would notice a slight bit of extra flood as a result of the fuse plug breaking. What I was surprised about was this was nowhere near a one in 5,000 year event and suddenly a fuse plug was mentioned so I was surprised about that and I said, "Don't let it happen."

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Whilst on that part of your statement down at paragraph 115 you were talking about the drawdown - sorry, you were in communications with the Flood Operations Centre during drawdown phase?-- Yes.

You were interested to know whether that could be extended a little to assist with the clean up, is that right?-- That is correct.

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Could you elaborate on that for us?-- I was at the LDMG meeting that was discussing about the problems happening with the clean up. By that stage the clean up was underway. People had been moving into some properties and cleaning them up and having them reflooded with the high tide and part of that reason was because there was the flow that was sitting on top of the high tide that was raising the tide higher than it normally would have been. That would have been helped had there been less flow coming down from the dam to combine with the high tide. So I rang up the State Government off my own bat to see if they could lower that flow so there would be less impact during the clean up operation.

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Your response was an emphatic no; is that right?-- That is correct.

Did you feel that that was an unnecessary sort of-----?-- Not at all. The - we are, sort of, third in line of all the information. We just deal with the information we get. If the State Government said no, they had very good reasons as to why they said no and I wasn't going to debate that with them. That is their control, not mine.

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Nevertheless an extension of that period might have been helpful to you?-- It would have been helpful otherwise I wouldn't have asked but if it wasn't to be, it wasn't to be.

You also - I won't reverse what is already in your statement

about what you say about Bender and Flood Wise but can you tell me this: are you aware as to whether other councils use those programs?-- Flood Wise has been provided to every council in South-East Queensland including Tweed Heads.

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The Bender program?-- Just the Brisbane City Council.

Do you perceive that is for reasons of cost or-----?-- No, it is specific to - the Bender - other councils could use a program similar to the Bender but they would have to put their own data in it. They could use something very similar to Bender but Bender is only for Brisbane City Council.

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Do you know, though, whether other councils do use something similar to Bender?-- I believe the Gold Coast - it is not exactly the same as the Bender but the Gold Coast City Council use as system using GLS to do the same sort of thing.

That's the only one of which you are aware?-- That is the only one of which I am aware.

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Thank you.

MR POMERENKE: Mr Morris, you were asked some questions about attachment KJM3 to your statement?-- Yes.

Could you turn that attachment up, please?-- Yes.

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You were asked what this document was about and you said it was about revisiting the operations in the manual. The manual you were referring to there was the Manual of Operating Procedures for Wivenhoe and Somerset Dam?-- That is correct.

When you say "revisiting the operations" you were concerned to determine whether the operating rules set out in the manual should be changed?-- That is correct.

Just for the benefit of the Commission do we see the purposes of the study reflected on - if we look in the bottom right-hand corner of this document there should be page numbers, page 5 of 15?-- Yes.

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You see section 3.0, "Project Purpose"?-- Yes.

"It was anticipated" - this is the second sentence - "that this could lead to the modification of the operating rules for Somerset and Wivenhoe Dams and thus minimise potential damage."?-- That is correct.

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Section 4.0, "Project Objectives". In particular the second dot point. Does that reflect the objective of determining whether the operating rules could be changed?-- Yes, it does.

Also over the page, section 5.0, the second dot point, that again reflects your purpose was to try and determine whether the operating rules could be changed in the manual?-- That is

correct.

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Now, the study was conducted in stages; is that correct?--
Yes.

Focusing just for the moment on phase 2 which we see at the bottom of page 6 of 15, phase 2, "Damage Assessment", I am interested in understanding precisely what it is that you were measuring or estimating. Do we see in the last paragraph on the page a reference to potential direct flood damage?-- Yes, that is correct.

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Is that what you were estimating or measuring in this study?-- It was the easiest one to estimate. The indirect damages were much harder and more ethereal, if you like, so we would rather have something that is fairly concrete to say, "This is definitely going to happen therefore we should try and minimise that."

So the answer is yes that is what you were seeking to estimate?-- Yes, that is correct.

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The potential direct flood damage, do we see that comprises internal, external and structural damage?-- That is correct.

Three different categories?-- That is correct.

I want to show you a document that deals with those three categories of damage. If Mr Morris could be shown this document and I have copies are for the Commission.

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COMMISSIONER: Does everyone else have copies?

MR POMERENKE: The Commission was notified about this document this morning. I am not sure if everyone else does.

COMMISSIONER: So it is WRM Water and Environment Brisbane City Council City Design, Brisbane Valley Flood Damage Minimisation Study From 2006 so everybody knows what we are all looking at.

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MR DUNNING: Could I trouble Mr Pomeranke to speak up a little bit, because I am obviously paying particular attention to this evidence and it is a little hard to hear.

MR POMERENKE: Mr Morris, have you seen that document before?-- I have.

Was that part of a review of the study that council was conducted?-- It was part of the study we were conducting. We didn't have the expertise to do this sort of work so we hired WRM to provide expertise for us.

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Very good. Could you turn please to page 3 of the document, in particular section 2.1.1. Do you see there a heading "Direct Damage"?-- Yes.

About halfway down the page do you see the paragraph

commencing, "Direct damage is divided into three categories, internal, external and structural damage."?-- I do.

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Could you read for me please, just to yourself, the description of those three categories of damage that are set out in that paragraph?-- Yep.

Do you agree with those?-- I do agree with those.

Those descriptions. So they describe what it is that was being estimated or measured in this study?-- That is correct.

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Just focusing on external damage for the moment. We see that it refers to damage occurring in items external to the main building including fences, gardens and so on. That would include, wouldn't it, damage that occurs on people's properties before the water reaches the floor boards of the dwelling?-- Yes.

Returning then to attachment 3 to your statement please, Mr Morris. In particular, if I could direct your attention to page 10 of 15. Do we see on page 10 of 15 the damage curve to the Brisbane area?-- Yes.

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Is it fair to say that at the commencement of this exercise what you had anticipated was that this curve that we see in the centre of the page would show or might possibly show a distinct step up or an increase in the damage before you got to 4000 cubic metres per second?-- That is correct.

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If you wish to explain?-- No.

This, on page 10 sets out the results of the study and it is an accurate reflection of the results of the study?-- It is.

We see that it shows no such distinct step up or increase before flows reached 4,000 cubic metres a second per second, instead we see a smooth working through that flow rate?-- That is correct.

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The consequence of that, I suggest, was that the study was halted at that stage?-- Not because there wasn't any step up. We actually did a little bit further than that.

Yes?-- What we were looking for was - before we started - the second phase of the study was quite a detailed modelling exercise. It was, in fact, more than half the cost of the total study. We didn't want to go down that track if there was no value in going down it. So there was a lot of lively discussion amongst all the participants to see - because there was no step, to see whether there was any way of reducing the outflow from the dam to what it currently was. We were looking - we were discussing with members of the State about any possibility of changing the operating rules to make, say, a 6,000 CUMEC flow into a 5,000 CUMEC flow or something less. It was quite a long discussion. There were many challenges that I was certainly throwing at them saying, "I don't believe you, let's see if we can do something better," but at the end

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of the exercise it was decided there was really nothing that could be changed out of the operating rules that would help lower the damages from what we currently had. So at that stage we drew the line and said we will stop this particular study.

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Can I take you please back to page 7 of 15? You should see a section 6.3, "Phrase 3 Damage Mitigation Feasibility"?-- Yes.

We see in the first paragraph, the second sentence, "Discussion of the project HALT being incorporated at this stage."?-- Yes.

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"Given there are no clear damage threshold points identified on the flood damage curves."?-- That is correct.

In the note it says, "It was agreed by the steering committee the damage curves derived did not indicate an opportunity to target changes in the dam operations in order to avoid a damage threshold."?-- That is correct.

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So at this point you've reached the decision that there is no opportunity to target changes in the manual?-- That is correct.

So in consequence there was no suggestion by the council that the manual would be changed?-- That is correct.

Could I tender the WRM report?

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COMMISSIONER: Exhibit 406.

ADMITTED AND MARKED "EXHIBIT 406"

MR POMERENKE: Finally, Mr Morris, you were asked some questions about the consultation process in relation to the manual review, the most recent manual review. I think you said that you were asked whether you objected to any changes that were proposed?-- Yes.

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You were invited to have input at that stage. At that stage if you had thought changes were justified to the manual, you had the opportunity to say so, would you agree?-- I would, yes.

If you had thought a change was justified you would have suggested it?-- Yes.

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Thank you, Mr Morris.

COMMISSIONER: Mr Ambrose?

MR AMBROSE: No questions.

COMMISSIONER: Mr Murdock, I think you might be next.

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MR MURDOCH: No questions, thank you.

MR MacSPORRAN: No questions, thank you.

COMMISSIONER: Ms O'Brien?

MS O'BRIEN: No questions, thank you.

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COMMISSIONER: Ms McLeod.

MS McLEOD: Just a couple, thank you, Mr Morris. Paragraph 31 of your first statement concerns the technical workings and the development of the protocol?-- Yes.

I should say I appear for the Commonwealth. Just to clarify, the technical meetings involved the Bureau, Seqwater and the Brisbane City Council engineers and hydrologists?-- That is correct.

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Do you agree? Those were meetings that discussed technical details and the various roles of each of the players in terms of how they would operate together during floods broadly?-- Yes.

Would you agree with that this? But it was not a role of those technical meetings to develop the protocol, do you agree with that?-- The protocol came out of those meetings.

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Well, the protocol followed those meetings, did it not, but the protocol was developed by a State Government committee chaired by DERM?-- That is correct.

Can I ask you about paragraph 64 of your statement, that first statement. You are referring to a telephone call there with a representative from the Bureau and some advice you say you had from the Bureau at that time. By Sunday the 9th of January you were aware that the Flood Warning Centre had been providing flood warnings for the Brisbane River Basin since Thursday 6 January?-- And longer, yes.

40

Yes, certainly and before that time but at least in terms of this rain event, if we like, since the 6th of January?-- I didn't personally look.

Before 9 January?-- I didn't look at the site to see if there were.

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You say you had a call from the Bureau that informed you heavy rainfall was forecast, they were not sure whether it was going to cause a flood. Can I suggest the only uncertainty in the advice from the Bureau at that stage related to the expectation of flooding in the lower Brisbane River below Moggill?-- Yes, that is correct.

Flood warnings were already current for upstream areas, were they not?-- Yes, they were. 1

So the 10.55 warning on the 9th of January indicated, for example, that moderate flooding was expected in Mt Crosby on the Monday?-- What time was it?

10.55 p.m. on the Sunday night?-- I would have to have a look. 10

You may not remember that but you do remember that warnings for lower Brisbane, including perhaps Moggill, Jindalee and Brisbane City were not in the flood warnings by that time because they were below the reporting thresholds, if you like?-- That is correct.

The model results for the Brisbane River had been continuously published to the Bureau website and were updated, as you say, from prior to 6 January but at least from 6 January and 8 January, 9 January and so on; do you agree with that?-- That is correct. 20

Okay. Still on that paragraph. Do you recall phoning the flood warning centre on the 8th of January, this is the previous evening, and a number of times during the evening on the 9th of January in the evening of the 9th of January?-- I remember more than the 9th of January.

Okay. During those calls, as was the usual case, the flood warning hydrologists provided briefings on the Brisbane River flooding which was developing at that time?-- The call that stands out in my mind was the call I made specifically looking for a model result as a result of the latest South-East Queensland water warnings saying they are now increasing the flow to 4,000. 30

Which was on 11 January?-- No, which was on the 9th.

On the 9th?-- Yes. 40

You were aware there was flood mitigation from the operations of the Wivenhoe Dam?-- Yes.

A number of emails were routinely provided to you updating you on the weather situation?-- Yes.

The flood warning predictions?-- Yes.

And the likely releases from Wivenhoe as far as the Bureau were aware of them?-- Yes, we were getting the same sort of emails the Bureau were getting. 50

So, in paragraph 64 where you say, "At this stage," that's the time of the Sunday evening call "the Bureau had not started their modelling process." Do you mean they hadn't on that evening of the 9th started their evening models?-- No, I told you I didn't - I didn't look at the Bureau site before that

because there wasn't any forecast of any flood for us so we were - if there was no forecast of the flood for us we weren't doing anything about it.

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Were you aware in your communications with the Bureau which I think you already agreed with me that there were flood publications about the Upper Brisbane?-- That is correct.

You certainly were aware of the rainfall predictions?-- Yes.

10

Do you remember the emails that came very early in the morning of the 10th of January, 12.36 is the first, and then 1 a.m. copied to you on 10 January?-- I will have to have a look. I was getting lots and lots of emails from the Bureau of Meteorology.

The 12.36 a.m. one just to remind you, indicated that minor flood levels were possible on the high tied at the Brisbane City gauge through Tuesday and Wednesday, again predicted the heavy rain but then at 1 a.m. predicted water levels exceeding the threshold of damaging discharge in urban areas within 24 to 48 hours?-- Yes.

20

You may not have specific recollection of these?-- I don't have specific but we would have discussed that with the Bureau as well.

Okay, in fact, at something close to 5.30 a.m. the follow day on the 10th you had a telephone conversation with Mr Baddiley?-- Yes.

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Where he updated you on the situation?-- Yes.

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Paragraph 77, do I understand that this paragraph, if you read it together with 76, that this paragraph relates to some time after you received the 9 p.m. situation report?-- That's correct.

By this time, you had the Bureau models published just before 7 p.m., I presume?-- They could have been. I didn't look.

Okay. If you had looked at those models, they would, as per usual, have included predicted heights and flows in the model runs?-- They wouldn't have included the prediction of the 2100 figures, so that was new information. The new information that came out was that there's the change in strategy that the dam operators were using to lift it to 4,000, so we didn't have - so that was new information to me. I presumed it was new information to the Bureau of Meteorology and that's why I rang the Bureau of Meteorology to find out what that was going to do to their model runs.

10

Are you saying that you weren't aware until 9 p.m., after receiving the situation report, that there was the change in release strategy from Wivenhoe?-- That's correct.

20

And if those - if that information had been published on the Bureau website, are you saying it had not been brought to your attention, or you hadn't seen it?-- I would be surprised if it was. I thought we were getting E-mails at the same time.

You certainly were having ongoing discussions with the Bureau at that time - phone calls with the Flood Warning Centre?-- Yes, yes. Some people were. I mightn't have been doing all of them. We had other people working in the Flood Information Centre at that time. So, we had a 24/7 operator who was a young engineer who was doing the duties of the FIC 24/7 part of the operation, which is just a monitoring activity in case something happens.

30

Okay. Can I invite you to look at your second statement then, paragraph 3.24 and 3.25? You're talking about running the Bender model and feeding in the Bureau forecast data for the six gauges into that model?-- Yes.

40

At the end of 3.25, the last sentence, you say, "The information of warnings provided on Tuesday morning were already overtaken by events on Tuesday evening." Is that a reference to the new awareness about the releases by Wivenhoe that were changed-----?-- Changed.

-----significantly on Tuesday afternoon?-- Yes.

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Okay. I think that's as far as I can take it with Mr Morris in terms of the material that's been provided to us and I'm hopeful Mr Baddiley can resolve the rest of it, otherwise we'll have to reserve our position.

COMMISSIONER: All right. Thanks, Ms McLeod. Mr Dunning?

MR DUNNING: Thank you, Commissioner. Mr Morris, just one matter: I would like to ask you just a few questions so you might explain, on a practical level, what the consequences of the different flow rates are for the city of Brisbane itself. Now, can you tell the Commission, please, at about what level - sorry, when we talk of flow rates in Brisbane, what are the sources of that water that we're concerned with?-- The water that's coming from either the Bremer River, the Lockyer River, or across Wivenhoe.

10

Now, what that will be in a particular instance is governed by where the rain is falling, obviously?-- That's correct.

But if we talk of those combined flow rates, can you tell the Commissioners, please, at about what level do you start getting flows in Brisbane that cause difficulties?-- And we only learned about it the year before last, so on a very low level, at 1,000 CUMECS we've found that that starts picking up debris and having it floating down the river and causing an interruption to our ferry services. So, right down at 1,000 CUMECS, as long there hasn't been a flush beforehand, then debris starts floating down the river and causing the Council to stop running its ferry services which disrupts a whole range of people trying to get to or from work.

20

All right. Then beyond 1,000 CUMECS combined flow, what's the next level of interruption or dislocation to Brisbane?-- The next level is generally below the City gauge. It's to do with flows that are sitting on top of the high tide. So, if there's no big tide, there's not going to be much consequences, but we're talking about 1,500 CUMECS and upwards where, on top of the high tide, it starts affecting properties and roads and parked cars, so we get places like Victoria Street and Sandgate Road that gets cut with salt water, and people have left their cars in those locations during the day to go to work, to come back to find that their car had been inundated with salt water. Some businesses can't open their doors because the water is stopping them from getting into their offices.

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All right. At about what range are we talking? 1,500 to-----?-- Yeah, 1,500 it starts. It gets worse as it goes up.

40

All right. Thank you. And then after those - are they relatively isolated incidents?-- They are isolated pockets along the lower part of the river.

All right. Then after - what is the sort of next jump from those isolated pockets?-- The next jump is the 3,500 or thereabouts. That's where we start getting inundation into properties and start affecting people's homes and, as it goes up, it starts to get about floor level. So, once we get to 4,000, we are above floor level in certain houses.

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Yes, certainly. Thanks, Mr Morris. Thanks, Commissioner.

COMMISSIONER: Mr Callaghan?

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MR CALLAGHAN: No, I have nothing further. May Mr Morris be excused?

COMMISSIONER: Thanks. Mr Morris, you're excused. Thank you very much.

WITNESS EXCUSED

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MR CALLAGHAN: I call Mark Babister.

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MARK KENNETH BABISTER, SWORN AND EXAMINED:

MR CALLAGHAN: Could you tell the Commission your full name and occupation, please?-- Full name is Kenneth - Mark Kenneth Babister, and my occupation is a civil engineer.

Mr Babister, at the request of the Commission, you prepared a report dated 11 May 2011; is that correct?-- Yes.

10

Do you have a copy of that with you?-- Yes.

Is it the case that there are three amendments that you'd like to make with respect to some minor corrections in that report?-- Yeah, four minor amendments I'd like to make.

Four?-- Four, sorry.

20

Okay. I know about three. I know about paragraph 94; is that right?-- Yes.

And what's the correction there?-- Just replacing the date January '10 with January '11.

And then there's paragraph 151?-- Just replacing the word "closing the loop" with "closing the water balance".

Delete "loop", insert "water balance"; is that right?-- That's right.

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COMMISSIONER: Is there a copy that's going to be tendered as an exhibit, because it might be worth just making those changes if they're small ones.

MR CALLAGHAN: I think - is the copy that you've got there marked?-- Yes.

Not the copy of the corrections, the copy of the report?-- It is marked.

40

Okay, all right. We'll get you to mark the copy that you've been given with those amendments. If you could amend paragraphs 94 and 151? Sorry, have you done those two?-- I'm just doing it. Yes.

And then there was paragraph 155; is that right?-- That's right.

50

And how would you amend that?-- I would like to - to the words "the manual does not provide any guidance", change that to "the manual only provides limited guidance".

All right, could you amend that? And there's a fourth amendment you would like to make; is that right?-- Yes, in paragraph 106, I've neglected to include the Lockyer Creek.

I beg your pardon?-- I've neglected to include the term "Lockyer" - or it adds clarity by adding "Lockyer Creek".

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Lockyer Creek?-- Yes. So - it did say, "It releases from the dam and flows in the Bremer River." It should say, "It releases from the dam and flows in the Bremer River and Lockyer Creek."

All right?-- It really just adds clarity, though.

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All right. Can you just insert that. All right. I tender the copy that's been amended by the witness.

COMMISSIONER: Exhibit 407.

ADMITTED AND MARKED "EXHIBIT 407"

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MR CALLAGHAN: Now, the parties have that document, Mr Babister, so I don't intend to take you through it. I just want to get you to comment on one other document, which is Exhibit 395, described as a draft study proposal. You've reviewed that document; is that correct?-- Yes.

And is one concern you have about it that there's no intention yet flagged to advance - to address advances in technology and especially in so far as the hydrology is concerned; is that right?-- That's correct.

30

All right. Can I show you another document, a document titled, "List of suggested work to be done to review the manual of operational procedures for flood mitigation at Wivenhoe Dam and Somerset Dam". For reference, this is the document, the existence of which I announced yesterday afternoon. Mr Babister, you've reviewed that document; is that correct?-- That's correct.

40

And is it fair to say that it addresses - or at least identifies, I should say, the subject matter which you feel should be addressed in any review of the manual?-- It does.

And just to be clear, not everything here is something that you've identified. There are ideas from other sources?-- There are, correct.

But the suggestions which you would make are incorporated in this document; is that correct?-- Yes.

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Yes, all right. I might tender a copy of that document.

COMMISSIONER: 408.

ADMITTED AND MARKED "EXHIBIT 408"

MR CALLAGHAN: And in anticipation of the possibility that a number of other documents might be referred to in the course of the evidence of this witness, I'll tender a report of Rory Nathan dated 11 March 2011.

COMMISSIONER: 409.

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ADMITTED AND MARKED "EXHIBIT 409"

MR CALLAGHAN: A report of Colin Apelt, dated 9 March 2011.

COMMISSIONER: 410.

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ADMITTED AND MARKED "EXHIBIT 410"

MR CALLAGHAN: An apparently undated report of Brian Shannon.

COMMISSIONER: 411.

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ADMITTED AND MARKED "EXHIBIT 411"

MR CALLAGHAN: A report of Leonard McDonald.

COMMISSIONER: 412.

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ADMITTED AND MARKED "EXHIBIT 412"

MR CALLAGHAN: A report of Greg Roads, that's R-O-A-D-S.

COMMISSIONER: 413.

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ADMITTED AND MARKED "EXHIBIT 413"

MR CALLAGHAN: And a report of Brian Cooper.

COMMISSIONER: 414.

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ADMITTED AND MARKED "EXHIBIT 414"

MR CALLAGHAN: And in view of the time constraints, Madam Commissioner, I won't ask the witness any further questions at this stage.

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COMMISSIONER: Thank you. Mr O'Donnell?

MR O'DONNELL: If I can deal with some preliminary matters, Mr Babister. You've identified in your expert report that there's a tension within the dam, given that it is used for contradictory purposes, one is retention of water to meet South-East Queensland's water needs, another being flood mitigation?-- Yes.

20

There is an inherent tension between the two?-- Yes.

You've also referred to the fact that the manual specifies the number of objectives to be achieved in management of the dam, and there is attention between those?-- Yes.

And you've made the point that the manual attempts to balance the competing objectives set out in it?-- Yes.

30

And you say in paragraph 137, in your view it provides a reasonable balance?-- Yes.

You've made some suggestions in your report for things to be considered, such as reliance on rainfall forecasts and so on, which we'll come to in more detail, but as I understand your report, they are things you are suggesting to be considered in the course of a review of the manual?-- That's true.

40

You're not banging your fist on the desk and saying these need to be in the manual?-- No, I'm saying for rainfall forecasts, for instance, they should be investigated and their utility determined.

Yes, and that goes for all of your suggestions for all matters to be included in the manual?-- Yes.

And you anticipate that a review of the manual will take some months, as I read your report?-- Yes, I think a proper review of the manual will take more than probably six months. It shouldn't be rushed. There are some issues, and I don't think we should fix some of those issues that potentially cause other issues. It needs to be done over a proper time-frame.

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Sure. You might need to speak more into the microphone. I'm finding you hard to hear. One comment I was interested in is

in paragraph 141 of your report. You say, "It must be remembered that no operational procedure can produce the optimal outcome for all floods." You repeat that, I think, at 168. That's a topic I wanted to focus upon. The range of flows can extend from small to medium to large, and they can be varied over time with the rainfall occurring only in the dam catchment, other events can have rainfall as well in the downstream area of the catchment, all of which can affect how you manage the dam during the event; that's right, isn't it?-- Yes.

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So, it is appropriate to have a range of strategies available to the engineers-----?-- Yes.

-----managing the event, and to give them a discretion within the strategies?-- I certainly think there should be some discretion between the strategies.

And hence you have people managing the flood event who are highly qualified and highly experienced in management of-----?-- Yes, you must have people who are highly experienced, qualified and also familiar with the catchment.

20

One event - one type of event that presents particular problems in managing a flood event is a very large event; that's right, isn't it?-- Yes.

Because there are physical limitations of what the Wivenhoe Dam can - the amount of water it can-----?-- The dam has a finite storage for flood mitigation, so if you have an event exceeding that, then your ability to manage it is very limited.

30

And, in particular, your ability to manage the flood event without having very high releases?-- Yes.

Because once you've - or the level between 67 and 74 have a finite water retention capacity. I think the manual puts it at 910,000 megalitres. So, once you have a flood event which has inflows coming into the dam substantially above that in a limited space of time, the people managing the flow event are likely to face the situation where they have no alternative but to make very large releases?-- If they can't store the water in that zone, they will have to move to a strategy which is really protecting of the dam where they're releasing water at a much higher rate.

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Yes. And that, in fact, is what occurred in this event, didn't it?-- Yes. But they do have the ability, depending on what you release prior to that, on how much of that space is available.

50

Yes, certainly. You make the point in - if you look at paragraph 78 of your report - you make the point that it is misleading to characterise the January event as a dam release flood. In substance, you say that the truth is that the releases from the dam were a product of the very large rainfall and the inflows into the dam?-- That's correct, the

causative mechanism was rainfall. It wasn't the dam.

1

And you also make the point in paragraph 77 that the Somerset and Wivenhoe Dams did achieve attenuation of the peak flood discharges resulting in lower levels and reduced inundation compared to what would have been the situation but for the management of the dam?-- That's right. The dam certainly did mitigate the flood to some extent.

Could I suggest we see some demonstration of that or modelling of that in the Flood Report. Do you have the Flood Report with you?-- The SEQ-----

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Yes. If you look in volume 1, page 149 - it's the figure on that page - the dark blue line represents the actual flows at the Brisbane Port Office, and the dotted ochre line, would you say-----?-- Yes.

-----represents what would have been the flow rates had Wivenhoe and Somerset not been built?-- Yeah, I think that's a reasonable preliminary estimate.

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And we see the same representation in terms of river heights on the next page, 150. The actual river heights is represented by the dark blue line and the very top dotted line, which looks to be ochre in colour, is what would have been the river heights, but for the Wivenhoe and Somerset Dams?-- Once again, that's a pretty preliminary estimate, but I think, as a guideline, that's probably about right.

30

But it conforms to your opinion that the operation of the dams did achieve attenuation both in terms of flows in the Brisbane River, and in terms of peak heights reached?-- Yes.

And the extent of flooding?-- Yes.

Thank you. From the management of the flood event in January, can I suggest there were a number of features of the event which presented particular problems. One was the sheer volume of inflow into the dam - some 2.65 million megalitres?-- Yes.

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That, in itself, put it into an extremely large category, didn't it?-- It did.

Larger than anything in living history?-- I'm not quite sure how the comparisons with 1893 go, and our information on that is a bit sketchy, but it is certainly up there with the largest or second largest volume that we know about.

It was also a situation where not only was there extensive rainfall within the catchment leading to inflows into the dam, but there was also extensive rainfall below the dam catchment and contributions to the river below the dam catchment from the Bremer and Lockyer?-- Yes.

50

Which were occurring quite independently from the new releases from the dam?-- I'm not sure what you mean by "independently", but they were occurring at the same time.

Yes?-- The same storm mechanism contributed to them.

And the further problem was that the inflows to the dam came in two separate peaks, both very steep?-- Yes, the double peak nature of the event certainly increased the difficulty in dealing with it.

And the rate of inflow over those crucial three days of the 9th, 10th and 11th?-- Yes.

10

So, you agree it was a very difficult event to manage?-- It was a difficult event to manage and deal with, I agree with that.

I suggest there were two other - well, a number of other matters, but there were two in particular I wanted to mention. Can we look at Mr Ayre's second statement, please? That's Exhibit 18?-- Sorry, what page?

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If you look at page 38, paragraphs 100 and 101. To fill you in on the timing, they're addressing Monday the 10th at 6.30 a.m.. You'll get that from back at paragraph 97 where he sets out the situation report that issued at that time?-- Yes.

You see that his evidence is on the Monday, the information - or the best information they had from the Bureau of Meteorology was that the rainfall-producing system was moving south and contracting towards the coast and therefore was moving downstream of the dam. And he says in 101, "This was a critical issue, because if we did release more water on top of the heavy rain in the downstream areas, it would have caused more damage than necessary." You accept that was an important matter for the engineers to take into account in deciding whether to increase releases on that Monday, the 10th?-- Yes, I do agree with that. I haven't looked at that particular issue in the level of detail that you're asking, but I certainly accept what Robert said and I'd concur.

30

Can I suggest the second important consideration in the management of the event - if you look in your report at page 41, you itemise there how the rainfall predictions compare to the actual rainfall, and I'm focusing on the critical days from Saturday the 8th to Tuesday the 11th. You agree they were the days when the large inflows-----?-- That's right, that's when the bulk of the rainfall occurred.

40

Exactly. And what we see is that the rainfall predictions proved to be unreliable. On the first three days, they substantially underestimated the rain that fell and on the last day they overestimated the rain that fell?-- Yes, I certainly agree with that.

50

The dam engineers operating or managing the flood event had realtime information as to what rain was falling and what the inflows of the dam were through their gauges and the real time modelling system, didn't they?-- Yes.

So, if the engineers are sitting there, they receive the Bureau's predictions every 12 hours, but they know from their realtime information that those predictions are being constantly falsified. That creates a problem in relying - or placing any reliance on those weather forecasts?-- There's a real problem with relying on forecast rain. I certainly do not dispute that. But what you're suggesting is that they should rely on no rainfall occurring from then on. That's the bit I-----

10

I wasn't suggesting that, what I was saying was in managing this event on those crucial days, it's a problem for the engineers, isn't it, if the forecasts they're getting from the Bureau, they're seeing with their own eyes to be inaccurate by reference to the realtime information they're getting on the system?-- Yes, but by their very nature, forecast rainfall will always have a level of inaccuracy as well. You can't look for a perfect forecast. That's probably just by chance. There's going to be a level of uncertainty in all forecast rain.

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Certainly is but if you are actually seeing during the rain event that the forecasts are proving inaccurate that would heighten your reluctance to place reliance on it, wouldn't it, as you manage the event in real time?-- To a certain extent, yes. I would be reluctant to put emphasis on - too much emphasise on forecast rain until I had done a testing of its robustness. In this instance, they really hadn't had that opportunity to do that. They hadn't really had an event since this sort of rainfall product had been around, a large event so this was the first time, to my knowledge, the first large scale use they had of this information and I would have - if I was an operator I would be naturally cautious as well about using it.

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Particularly if you saw that during the event itself the rainfall being quite different from what the forecast was?-- All of those - those first few, four or five or six forecasts were an underestimate by the order of 50 per cent in rounded terms. I think after several forecasts with a similar level of inaccuracy you might be, sort of, thinking that it is not going to be too much trouble if I use those forecasts and I should be possibly factoring that into some of my decisions because you are not going to - if the area is persisting where you are 50 per cent under what is occurring in broad terms.

20

Yes?-- So you could, it would have proved incorrect on the last two forecasts but you could have formed the view there was some utility in that rain for those forecasts.

You accept that is a judgment call for the engineers?-- That is a complex judgment call and we without prior studies to determine the robustness of that sort of rainfall it would be a very difficult call to make.

30

Thank you. We will come back to rainfall shortly. Let's go to something else in the meantime. Could I take you to something else in your report? Would you look please at 104? You say there that in the second sentence, "The flow releases from Wivenhoe Dam were the major component of the flood peak."?-- Yes.

40

You repeat that again at 164. You don't produce any modelling as part of your report?-- No, I was reluctant at this stage without access to slightly more robust models to attribute absolute proportions. It is also a bit difficult because two hydrographs merge attributing components to each. You either have to work out which part contributed to the peak, or what contributed to the volume so it is very hard to use, like, a percentage because it is the peak flow that normally causes the damage and it is how those two or three sources of flow interact. That is something I guess we might later on find how complicated it is. The major component really did come from the dam.

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What modelling have you done to determine that?-- I've - to this point in time I have really looked at everybody else's modelling and gone through different people's results and worked out the contributions. I haven't done some modelling

where we could look at the sensitivity of these different components and how they've added together. All the modelling I have seen to date is really based on simple routing models that don't really add the components together in a particularly robust way.

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Well, does that mean then you can't say from your own work that releases from Wivenhoe were the major-----?-- I can say they were the major because the majority of the volume, the largest amount of water came from the dam, but in terms of getting more detail about the percentage or the component it is rather difficult.

10

If we look at the Flood Report for a moment, please? If we look at page 150. That's a model based on hydrologic analysis?-- Yes.

You call it run off?-- A simple routing model, yes, the terms are interchangeable.

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If you look at the lowest line on the page, on that figure, the red line, that's a modelling of the Wivenhoe releases only and what impact they would have had on the river height?-- Yes.

Then the one just above that which is a purple line, would you say? Case number 2, anyway?-- Yes.

It is the model of what would have been the river heights achieved if there were no releases from Wivenhoe?-- Yes, using a relatively simple tool.

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In other words, suggesting the combination of water in the river, inflows from the Bremer, Lockyer and general rainfall would produce that?-- Elsewhere, yes.

That, on its face, suggests that the releases from Wivenhoe would have produced a river height which was less than the river height that would have been produced with-----?-- That certainly suggests it if you put it that way. If the question is whether the releases from Wivenhoe were more than everything else or were the Wivenhoe releases the dominant cause compared to any other cause - I am not sure which of the questions you are asking.

40

I was really challenging your statement that the releases from Wivenhoe were the major component of the flood peak. The flood peak is the river height?-- Down at that level in the river there is a whole lot of hydrologic components going on, hydraulic components with the tide and this model doesn't account for those either. So I don't think you can even make a determination off this tool. Like, it doesn't really properly account for that sort of behaviour.

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I am not following?-- The model doesn't really account for some of the processes that are occurring in that part of the river.

That may be so but you haven't done any modelling to demonstrate something else is the true situation?-- No.

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So you really can't make that statement you do in 104, the second sentence?-- I guess you've challenged me on that, yes. I don't know if this modelling really proves it either but I certainly have the view compared to any other cause releases from the dam are the most significant.

You haven't done any modelling to say whether the releases from the dam on their own would have produced greater flooding than all the other causes?-- I don't - I don't think this is a very sensible way to look at it either, though. It is not as if you can ever have a flood where it only came out of the dam and there was nothing else happening elsewhere. It is how all those individual bits add together.

10

Maybe so. I am just challenging whether there is a factual foundation for your statement in 104, second sentence?-- I want to see, sort of, more robust modelling in a range of locations.

20

I am suggesting for you to have made that statement you should have had modelling which supported it. You don't, do you?-- I don't at this stage, no.

Let's turn to 140. At 140 you say, "With the benefit of hindsight it is clear that an earlier escalation of the dam outflow rate would have reduced the ultimate peak release discharge downstream of Moggill including at the Brisbane CBD." Now, you make that statement but you produce no modelling to support the accuracy of that statement, do you?-- That is correct.

30

Can we take it you have done no modelling?-- I have done no modelling to specifically show that but certainly if you have an earlier and lower discharge you will, under some circumstances, get a lower flood level and much of the work that has been done in the past suggests that as well. It is not just based on my opinion. There is lots of earlier work or some earlier work suggesting that if you release water earlier in these large events then you can have a lower flow level.

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That may be so as a general proposition but is that early work referable to the January event?-- Specifically? I think it gives a fair bit of insight into earlier releases, yes.

Was it work done in respect of the January-----?-- No.

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It wasn't?-- No.

You've done no modelling in respect of the January event to compare the effects of earlier releases on the downstream peak flows?-- I have done no modelling at this stage.

Have you seen Mr Malone's second affidavit where he does modelling on this topic?-- I have but I don't know how

familiar I am with it at this stage.

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It is in the material brief to you, isn't it?-- Yes.

So you did have it when you came to prepare your report?-- I have been through a large number of documents.

In a fairly short time?-- In a relatively short time, yes.

Could I just show to you briefly, this is Exhibit 33, Mr Malone's second witness statement, paragraph 3. What he considers, you will see this particularly in 3C, if releases on Sunday the 9th at about 9 a.m. were increased to - from 1,450 CUMECS to 3,000 CUMECS by midnight that night and continued until the Tuesday at 3 p.m. Then on the next page he has a figure showing what were the actual releases from Wivenhoe in the solid blue line as against what would have been the modified releases on that hypothetical basis in the dotted line. The modified releases get to a much lower rate of release, only about - just below 5,000 CUMECS. Then he models on the third page the impacts of those two different rates of release, both at Moggill and at the Brisbane Port Office and finds in summary that there is not a great deal of difference?-- That's one release scenario. There is a multitude of scenarios and different ways you could release the water.

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Quite, but my point is you make that statement at 140 but you haven't done the modelling to support it?-- I agree.

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That's true, isn't it?-- Yes.

So you should withdraw that until you have modelling to support it, shouldn't you?-- I do believe that is what I have stated is the case but if it needs to be proved I am happy to do the work to support it.

You haven't done it to date?-- I haven't done the work to date, no.

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You can close that up, thank you. Would you turn to 119, please? In 119 you are addressing the developments of the model - sorry developments of the manual since it was originally produced in the 80s. You address some limitations on the original manual from the Hegarty and Weeks publication and in 119 you say, "They are important limitations and the recommendations have not been sufficiently addressed as part of subsequent revisions of the manual which invariably involve fine-tuning of the existing overall strategy without critical review of various aspects of the underlying analysis and methodology." You go on to emphasise in 120 that the five yearly reviews of the manual should involve reconsideration of things such as design, hydrology, methodology, updating of models and inclusion of new historical data."?-- Yes.

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Where do you get that from, that those things have not occurred?-- Well, they've occurred to a limited extent-----

I asked you what is the factual basis for your assertion those things have not occurred in the subsequent revisions of the manual.

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COMMISSIONER: He says they have not been sufficiently addressed as opposed to not occurred as all.

MR O'DONNELL: No, the last sentence of 119 said, "Without critical review of various aspects of the underlying analysis methodology."-- I would have expected in those reviews that some of the operational trigger points and those things would have been investigated as well and how the trigger points that are currently used with different events would have occurred as the ability to test more events and we had more computing power occurred, but there has been no work to my knowledge that I could find where any questions have been asked about whether the operation triggers and some of those components are correct - correct is not the right word - whether they're the right or better trigger levels could be achieved or performance or testing or how well the design methodology matches some of the historical events. There has been limited work. I could not find anything really seeing - testing whether the current operation which hasn't changed really significantly is the most appropriate operation. In fact, I couldn't even find in any historical document outlining it in detail, alternative methodologies. It is like we have one.

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Let me take you to some documents. If you look at Exhibit 402, please. If you look at page 9, please. I need to take you to several selected passages from this. This is the 2005 report when there was an upgrade to Wivenhoe to introduce the spillway in the fuse plugs. The third paragraph. Then page 10 the first two dot points. Page 11 there is a discussion of previous flood studies. Look particularly at the third paragraph to the end of that page. You see in the third paragraph that rainfall routing models were developed during the 1990 to 1994 work?-- Yes.

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Then in the next paragraph that, "The Bureau of Meteorology was requested to provide up to date probable maximum precipitation estimates in the catchment." The next paragraph we see those estimates were provided in 2003. The report also provided the latest information on temporal patterns, and spacial rainfall weightings to be used with the new PMP data?-- Yep. The PMP data is really looking at the extreme upper end of the dam's behaviour and that has constantly changed as our understanding of probable maximum floods has changed. I don't think that is particularly relevant to the operation of the dam in any of its ordinary modes and this report looked at fuse plugs and redid some of the hydrology but it didn't make any significant changes or didn't investigate the gate operations, it just looked at how fuse plugs which were necessary for dam safety would change things.

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But it updated the hydrology?-- It did update some of the hydrology but this report from my review of it didn't actually go back and compare the changed rainfall and the aerial reduction factors to the flood frequency analysis so I am not

even sure whether it did a better job on the hydrology than the previous '92, '93 work. It seems to have a bit of a disconnect with some of the earlier work.

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Let me take you to some other passages. Page 58, 2.2 addresses the rainfall run off routing model. So it took the model developed in 1994 and then we see at page 60 that model has been calibrated by reference to historical flood events. Under the heading "Model Calibration and Testing", the last sentence says, "It has been successfully tested against several recent flood events." Then the last paragraph is important. Page 63, 3.2 identifies they have used the updated BOM rainfall, PMP situation. Page 64, 3.3 second dot point says the rainfall has been spatially weighted. If you go back to paragraph 118 of your report you quote there from Weeks and Heggarty with their three limitations. The first limitation was calibration of the downstream model. Now, this records that has been done here, hasn't it? Downstream model is discussed at 58 to 60 of this report, the model upstream and downstream, all catchments have been modelled, haven't they? Then that model has been updated in terms of calibrations as we see at page 60?-- Yes.

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So work has been done on that?-- I am not arguing that no work has been done. I am arguing that some of the tools - that the hydrologic model has clearly had several updates and it has clearly been recalibrated a couple of times.

Well, it is a new model. There was a new model introduced in the 90s?-- There was a refinement of the earlier one was my understanding.

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Wasn't it a new model when the real time flood information was introduced?-- That is - from my understanding that was an implementation of the prior code with some adjustments. I don't know whether you could call it new. It was an evolutionary change to the existing model is my reading of the reports. It certainly has more calibration done. Some of the problems have been addressed.

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Well, I don't understand then in paragraph 119 you say, "Without critical review of various aspects of the underlying analysis and methodology." If you accept the designed hydrology methodology has been updated, and there has been updating of models and there has been the inclusion of new historical data, aren't they the three things you are referring to-----?-- They were the, sort of, three core things that Weeks and Heggarty identified, yes.

Yes?-- I don't - I am not too sure whether the durations have all been satisfactorily looked at for more frequent floods. Certainly the durations have been looked at for probable maximum floods. There is probably a little bit more room to explore on that, the more frequent than the 100 year. The PMP work looks at very and very rare events and it ran out to five days or something but the - some of the work around the 100 year event really looked at - just mainly focussed on two or - 36 hour and 48 hour events and not longer events and longer

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events do have - appear to be quite critical for this dam and its operational procedure.

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Have a look at page 64 of the 2005 report. Doesn't that address events out to 120 hours?-- What page was it?

Sixty-four?-- If you could scroll up slightly. It certainly does for 200 year style floods, yes.

It is not right to say that the design methodology was confined to just 48 hour events?-- I will concede that.

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Then at 120 of your report you say that, "The limitations in the design hydrology have led to a set of procedures that are optimised for design flood assumptions but are susceptible to real floods that deviate substantially from the design assumptions." What are the limitations in design hydrology?-- The design hydrology approach that has been used essentially uses one temporal pattern to describe the flood's behaviour. So you can only get the peak of the rainfall occurring in one location, whether it is the front, the middle or the back or something. So by using one pattern you are going to - you don't really get a full understanding of the variability of real storms. Like the one we had recently was double peak, you could get one with a peak at the back or one with a peak at the front. Unless you have a process that looks at all these quite plausible temporal patterns how the rainfall will occur you are not going to get a good understanding of how this operation will work.

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What makes you say that those things have not been looked at?-- Well, I didn't find them in the detail in this study. It is certainly not the way I would like to see them looked at. I found some recommendations in an earlier report of 2003 suggesting it should be carried out and to my knowledge I have not found it anywhere where it has been looked at. A lot of this stuff I am suggesting I guess is relatively new. It has really been only entering practise in the last five years. Practises are changing so we look at an ensemble approach particularly for things where we have complex operations so instead of using single patterns you could look at a range of patterns to get an idea of how something will perform.

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A range of rainfall patterns, you mean?-- Temporal patterns, spacial patterns. A lot of the variability that you see in real events you want to try and incorporate them in your modelling process.

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Is your evidence then you are not critical of the previous revisions of the desired hydrology and testing it against-----?-- No, I am not particularly critical-----

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-----updated models, you are saying there has been new developments for the last five years, do you say?-- Yes, and I am critical that the gate operation has not really been looked at in detail over that period.

What do you say the gate operation has not been looked at?--

I have seen very few reports or information looking at different trigger levels or changes. There seems to be an absence of any real information on whether the right operation or alternatives should be considered or have been considered and discarded.

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That doesn't mean it hasn't been considered, it is only that you haven't seen documentation?-- Well, I guess that's true. If there is documentation I would like to see it.

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Is really what you are say you have inferred it hasn't been considered because there has been no whole-scale changes to the gate operations in different provisions of the manual?-- Not because there has been changes. I haven't seen any reports looking at possible changes other than minor changes to things like FSL triggers and alternative strategies.

Sorry your voice is dropping away?-- Sorry, I haven't seen any reports looking at alternative strategies or major modifications or trialling of anything else. There seems to have been no evolutionary change, significant change to the gate operation change since Heggarty and Weeks. Even Heggarty and Weeks didn't really detail alternatives. We seem to have one operation that has been with us since 1985 and no real documentation on why we have adopted that and Heggarty and Weeks made it quite clear that they thought people would operate in larger floods using discretionary power as well which leads me to believe that they thought there was reasons to vary from that procedure.

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So, by "gate operations", do you mean the four strategies?--
The strategies, yes.

And the trigger at which each strategy is introduced?-- Yes.

But if this - the revisions of the design hydrology we've been looking at have been known to those who have reconsidered different revisions of the manual and the updating of models with rainfall and so on and testing the models against historical events, then if that information is known to those who have been considering revisions of the manual, it might well have been taken into account in deciding whether to change the strategies in the manual?-- It certainly could have been considered. I just would have expected over that period it would have been documented.

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All right. Would you open up the Flood Report as well, please? If you look at page 101, there should be a heading in the corner of the page "Runoff-Routing"?-- Mine's got "Flood Model Validating Performance". 101?

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Yes, if you go to the foot of the page?-- Yes.

There's a subheading, "Runoff-Routing", which is modelling the inflows to the dam; that's right, isn't it?-- Yes.

If you look in the second paragraph, it says, "The runoff-routing process was calibrating using ten historical flood events up to 1994 and was used to successfully simulate operational floods from various dates in 1999, 2001 and 2010." That suggests, doesn't it, that the model has been regularly tested against flood events as they have occurred?-- Yes, and I agree with you it has.

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Which is correct practice?-- Yes.

And that would inform someone considering the revision of the manual whether the strategy levels ought to be changed or be left the same?-- No, that gives them a modelling tool to test strategy levels - a good, well-calibrated modelling tool. There doesn't seem to be any information on whether they've used it in the way that you're suggesting.

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Well, you haven't seen any documentation?-- I haven't seen any documentation.

That's as far as you can take it, isn't it?-- Sorry?

That's as far as you can take it?-- Yes.

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All right. You can close that up, thank you. Sorry, can I just show you one other document on this topic? Can you look at Mr Tibaldi's second statement? That's Exhibit 52. Do you have that there?-- No, I don't have that one with me.

COMMISSIONER: It's on the screen, Mr O'Donnell.

MR O'DONNELL: Annexure JT1.

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COMMISSIONER: And which part of JT1?

MR O'DONNELL: I was going to go to the first page first. It would be easier to use the paper. I had asked that the documents be ready for all of this.

COMMISSIONER: Well, I'll get my staff to snap to it, Mr O'Donnell. Do we have a paper copy? Mr Callaghan, do you know?

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MR CALLAGHAN: Just digging one up, your Honour.

COMMISSIONER: All right.

MR O'DONNELL: On page 1, you will see this is the Wivenhoe-Somerset Interaction study. Then if you turn, please, to page 6, if you read the first three bullet points, please?-- Sorry, you would like me to read them?

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Yes, please?-- Out loud-----

No?-- -----or just-----

Yes, please?-- Okay.

That's the sort of work you were referring to in your report?-- Yes, this study really just looked at the interaction of the two dams and getting the right balance between the two dams.

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That's right. But then they tested it against a range of flood events?-- Yes, but it didn't really look critically at the operations. It just looked at trying to get this balance right between the two dams. I think this is a good study, a sensible study, but I don't think it's really looked at detail - in detail at whether the operation - and how it works downstream is quite correct. It is just a balancing between the two dams.

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But then testing it against a range of flood events?-- Yes, design flood events.

Part of the analysis of how the interaction of the two dams would perform in a range of flood events?-- Yes.

That's part of the things that you say ought to be done?-- It's part.

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Thank you. You can close that up. Would you mind turning in your report to paragraph 142? Could I suggest what you say there is an overstatement?-- I'll have to pull out Robert's-----

You say that forecasts were only used to provide possible insight into the operational situation. There was an example we looked at before in his witness statement, paragraph 100,

where he said, "On the 10th of January they took into account the weather forecasts that the rain system was moving south downstream of the dam and they took that into account in deciding what releases to make on that date." That would be an example of taking forecasts into account and making operational decisions about the management of the flood event?-- I don't think that decision changed the activity on that day very much.

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I didn't ask whether it changed it. I'm asking you it is an example of taking into account forecasts in the management of the flood event?-- I think that's a very subtle thing you're suggesting there. I do not believe that the use of forecasts was really going to change any operational decision in the way they managed the dam.

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I didn't ask you what you believed. I'm putting to you that your statement in 142 is an overstatement?-- It might be a slight overstatement.

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Could I suggest another example, discussed in Mr Malone's first affidavit, Exhibit 45, paragraph 57 - and you can look at it if you wish to - he says on the morning of Tuesday, the 11th, just before they moved to W4 strategy, they did a model run about 7 o'clock. They checked with the Bureau of Meteorology whether the existing rainfall system causing the then falling rain at Wivenhoe, was that going to stop or would it continue. They advised it would continue and they took that into account then in making the decision to move to a W4 strategy. If that's correct, that would be another example of taking rainfall into account - rainfall estimate into account in making an operational decision?-- I think by that stage they had already - it was pretty inevitable that W4 was going to be enacted, or getting very close, is my understanding-----

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So, you disagree with me?-- I don't think that information substantially changed their decision - influenced their decision. I'd have to check the timing. But my reading of the timelines is that it didn't - the forecast didn't change their decisions.

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Let's move to something else. If you're looking at your witness statement or your report, paragraph 47, it's the last sentence. I'm referring here to forecasts from the Bureau of Meteorology. The last sentence you say, "It's only in recent times that the information value in these forecast products have had enough utility for it to be considered in a quantitative way in decision-making." Now, by a "quantitative" way, do you mean - or could I give an example of what you mean? The situation where you get a forecast from the Bureau of, say, 50 millimetres of rain falling in the next 12 hours, and you're contemplating the flood engineers using that information that there'll be 50 millimetres falling in the catchment in determining what releases to make from the dam?-- In determining a change in the operation or a change in a release, yes.

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Right. And you also address this in 143 of your report. You

refer to the quality of forecast information getting more reliable over time. And again at 170 - on page 29, 170 - the second sentence, you say, "Short term rainfall forecasts have only recently become sufficiently reliable that it - should it be that it be appropriate to consider using the operational decisions." What's the basis for your saying that there's been this recent improvement in forecasts so that they can now be considered sufficiently reliable to be used in making quantitative decisions about the operation of a flood event?-- Five years ago, from my discussion with a range of meteorologists and researchers in this area, the forecasting tools were a thing they used-----

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Sorry, I can't hear?-- Five years ago, these tools were of limited use and their skill or ability to accurately predict rainfall was quite low. The science and the research in that area by the Bureau and other organisations has come a long way in the last five years. I had a recent statistic where the three day - some three day forecasts are now as accurate as the one day forecasts. That's not in Brisbane. There's been a significant increase in their robustness or utility-----

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Is this what you've been told by someone from the Bureau?-- I've spoken to researchers from a range - a range of meteorologists and people working actively in this area, not just the Bureau, and it's been debated by different water authorities and other organisations for - you know, it is an active area of discussion. The Bureau is now moving into forecasting stream flows three months out and in other areas they're about to roll out some new products.

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Have you read Mr Baddiley's witness statement?-- I have.

It was provided to you, wasn't it?-- Yes.

Do you have it there?-- No.

Can it be brought up, please?

MR CALLAGHAN: Which one?

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MR O'DONNELL: The first. He's the Regional Hydrology Manager for Queensland from the Bureau and he addresses this at page 5 - pages 5 to 6. If you look on paragraph 20, the last sentence regarding the QPF calculations for specific catchments and apparent reliance on some QPF estimates, "The Bureau has continually and openly advised of the uncertainty of these catchment estimates." 21: "The Bureau has, over a long period of time, advised Seqwater of uncertainty in rainfall forecasts over a small space and time scales, such as catchments." In 22, towards the end of that paragraph, he particularly addresses the difficulty of predicting the actual location of the heaviest rain, even on a few hours' notice. And in 24, he quotes from an earlier advice from the Bureau. If you look at the last three lines of that quote, "The forecasts themselves do not provide a definitive basis on which to make operational decisions on releasing flood waters from the dams." Can you contradict that?-- I'm of the view

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that the Bureau do not provide guarantees and it is their role to provide information, it is actually for the users of the information to decide the utility of that and how that information is used. The Bureau is a very conservative organisation, and I think a statistical analysis should be used of what utility is in those rainfall estimates and that should be the basis of making a decision. Is their information content of use? I would much rather use a statistical approach to look at their robustness than wait for the Bureau to tell you the forecast rain is the right thing to use.

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Right, well I'm addressing your assertion in your report that in recent times, the information in forecasts has become sufficiently reliable to be used in a quantitative way in making decisions about management of a flood event?-- It's to be considered, I think. You were quoting from my text. I think we might have lost-----

Sure?-- I think I said to be considered in a quantitative way.

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Yes, in decision-making?-- Yes, I didn't say it should be, I think it should be considered.

You might have to explain the subtlety of that for me?-- We need to look at how robust these estimates are. We probably don't have a very big sample. We need to see whether there's information content that's useful in making operational decisions or we need to work out when they're going to be sufficiently robust to make operational decisions. So, there's information value in these forecasts. The Bureau - they'll never be perfect. It's a simple - relatively simple statistical analysis of the information content and how well it can inform decisions or how often you would get them wrong if you used it. So, I'm really just saying they've now got to a point where we should be considering using them and working out whether they are at that point, or whether they need to get a little bit more robust before we start using them.

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The best information as to whether they are sufficiently reliable to be considered would come from the Bureau?-- I think somebody who owns a large piece of infrastructure has a responsibility upon them to also assess that independently.

How could someone who is not from the Bureau assess the reliability of the Bureau's forecasts, apart from their actual experience of using them?-- I think up until this recent event, there's probably a very limited sample set to use, but you need to look at how robust they were in previous events and maybe in other locations and maybe different synoptic systems, but an analysis should be carried out of how robust they are and what information content exists. I'm surprised the Bureau have not published very widely on this particular aspect. A number of people have looked to try and find information on it.

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Sorry, what sort of analysis are you talking about?-- Just a

relatively simple analysis on the reliability of these estimates, how much they over and underestimate, what the sort of variance from a perfect prediction is, and then, more importantly than just looking at then how that would affect operational decisions, if you did try and use it, would you get it wrong more often than right, or can you discount them to get some value out of them? There are a range of different ways, but these forecasts have some information content that is worth using - well, potentially worth using, as long as the benefits are greater than the downside. It should be tested.

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You just want to work out whether statistically they get it more right than they get it wrong?-- Well, in simple terms that's what you would be doing, and how that would affect your decisions, and how that would affect outcomes. If you could make better operational decisions 80 per cent of the time and less bad - worse operational decisions 20 per cent of the time, it might be worth using in an operational sense, because currently what you're doing is you're assuming at the time you make a run, no further rain will occur, and that's often very unrealistic as well.

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But it might be unreliable to make decisions to actually increase releases or reduce releases on forecasts which the Bureau themselves say are not sufficiently reliable to form the basis for decision-making in a narrow area such as rainfall catchment?-- This is a reasonably large catchment. The problem with some of these forecasts is they miss the catchments or they're working out exactly where the rainfall will occur. Sometimes the problem is not so much that they get the rainfall wrong, it's that they get the location slightly wrong.

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All right, thank you. You can close up Mr Baddiley's witness statement. Can I suggest that in the forecasts that are currently available or were available on January 11, there are some limitations on what the Bureau issues. The QPF seems to be regarded as the most reliable 24 hour forecast. Do you agree with that?-- Yes.

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And you've seen the QPF that actually issued during this event - they're reported in the Flood Report. You would have seen frequently that there is a range of rainfall estimates, 50 to 100 mils, or greater than 100 mils. It's often a degree of uncertainty in the forecasts themselves. There's an unreliability in terms of the spacial - that is, where the rain will fall - there is a degree of unreliability in the location of the rainfall?-- Yes.

You don't know where within the area the rain might fall. The rain might fall one side of the dam or the other, or downstream of the dam, and there's a degree of unreliability in the timing of the rainfall that's predicted?-- Yes.

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Will it tall in the first hour of the 24 hours or spread evenly over the 24 hours or in the last few hours?-- There's also a potential level of conservatism in how their information is put into the modelling system as well. If you

get a 24 hour estimate you are pretty much stuck with assuming that rainfall occurs over 24 hours and, if you make that assumption, then you're probably going to lose more to the loss process than if it occurs over a-----

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Sorry?-- If you make that assumption, which is the only assumption you could really make with a 24 hour forecast, that it occurs uniform over that 24 hours, your modelling process will actually take more out as losses than if it occurred over an hour. So there is - in using that rainfall estimate in a modelling framework, there is a level of conservatism where not as much of that rainfall will be tending to run off anyway, so that also needs to be factored into the factors you're listing. So, that's one on the opposite side of the ledger where it's any real rainfall - even if it is the same amount, it's likely to produce slightly more run off.

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Mmm. The system that's operated to date is to effectively leave it to the flood engineers as to what reliance they place on the rainfall forecasts in their day-to-day management of the flood event?-- Yes.

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And we would agree that that is one approach?-- Yes.

And it has the advantage that you can modify your - the exercise of your discretion depending on the particular rain event, how reliable the engineers perceive the forecast to be. If it's a slow-moving rain depression, they might place more reliance on it than other rain events, and you would regard that as sensible?-- Yes, different synoptic systems are bound to produce different levels of reliability.

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You have a suggestion in your report - if you look at 148 - where you would incorporate reliance on weather predictions with a discount factor?-- Yes.

As I understand 148, you're only suggesting that that's a possibility?-- That's just an example in a risk framework where once you've assessed the reliability of these forecasts-----

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Mmm?-- -----you could then use them to inform decisions, but because there's an uncertainty associated with them, you might not make the decision on the same level. You might only make the decision if it predicts a higher level or something like that. It needs to be done in some sort of risk management approach.

All right. So, you're only putting that forward as something to be considered in the course of the manual review?-- Yes, I'm not really - I don't think I'm really critical of not using forecasts. They're a relatively new thing. The quality of them has not really been tested that much, but, going forwards, I think at some point no doubt they'll have sufficient liability that we should be using them and we should be working out in some sort of risk management framework how to use them, and we might just determine that, until they get to a certain accuracy, they're probably not

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used.

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In that context, you also raise the question of what you call an ensemble of different weather models. This is in 49 of your report?-- Yes.

And you suggest that if that was available from the Bureau, then the modelling could use a - is it a stochastic method?-- Yes, if you got eight forecasts based on different weather models, whether they were some of the Bureau's or some other organisation's that the Bureau has access to, if all eight models are giving similar estimates, then you're a lot more confident that that estimate is probably right. If the eight models are all completely different - they've got the rainfall falling in different locations - then it's telling you that we're not really sure. So, running an ensemble lets you get some understanding of the uncertainty of that forecast and whether you should be taking it on board.

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But that depends on the Bureau issuing a range of weather forecasts?-- Yes.

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Which they don't currently do?-- At the moment that's not an option.

No?-- But I understand that it is quite a possible option. It's possible, and certainly quite likely in the future.

Yes. So, if that wasn't produced by the Bureau, then you could look at a stochastic method?-- Yes.

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Do you have the SKM report there? It should be Exhibit 409?-- Yep.

I understand from your report you agree with the SKM report?-- Largely, yes.

Look on page 9. Now, they talk about the stochastic approach in the second paragraph on page 9 on the basis that it uses multiple model simulations?-- Yes.

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And they qualify that in the next paragraph by saying that, "The deterministic modelling is the accepted paradigm in current flood estimation practice.", and it is the deterministic modelling which has been used-----?-- To date.

-----by Seqwater to date?-- Yes, as an industry, we're in the process of moving from a deterministic modelling approach to a stochastic modelling process. We are in that transition now. It is not general practice, but it is used sometimes for things - large pieces of infrastructure like dams, and it's pretty much agreement at the sort of standard - the guideline level that we need to move to this framework in the future for most complex decisions to get a better understanding of some of the uncertainties and the range of variability.

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The last sentence of that paragraph says that, "The possibility of moving towards a more stochastic framework

should be seen as an opportunity for future improvement, and should not be interpreted as a criticism of current practice." You would agree with that?-- Yes.

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So, you're raising the stochastic as something for the future, depending upon the Bureau introducing a range of weather models?-- Yes, there's two things in here. One's about the design methodology, a stochastic framework, and the second part is really about how to use forecast, and I'm suggesting them for both. For the design methodology, you're looking at flooding events on the catchment, we should be using a stochastic methodology. The last part of this SKM report is suggesting something similar with ensemble forecasts, but they are not necessarily linked.

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Can we look at in your report, 125, please. You say in 125, "The current way of forecasting models doesn't include a functional hydrodynamic model." The current models used by Seqwater are hydraulic, hydrologic?-- That is my understanding.

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You refer to them in 126 as rainfall run-off routing models?-- Yes.

Is that right? You say at the end of 126 that, "A rainfall run-off routing model should therefore be retained but should be assessed against results from a calibrated hydrodynamic model." In other words, keep your hydrologic model but you should test their reliability?-- Yes, I think we should be moving to a hydrodynamic model but I am not suggesting we throw out the rainfall run-off models. They have lots of use. They are fast. They are a little bit more stable and robust so they have lots of uses and they are very good for rapid assessment of lots of information. But we should be looking at hydrodynamic models like we have had in the past for looking at how the interactions occur downstream. They are a much more reliable tool but with some extra overhead.

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There is no objection to having a hydrodynamic model and being able to test the hydrologic model against it?-- No problems.

There is a reservation, though, about the actual use of the hydrodynamic model during an actual flood event?-- By some of the operators?

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Yes, well, there are some concerns about a hydrodynamic model, how practical it would be to use during an actual real time flood event?-- Some of these products are very mature products and have been around for 15 years and are used in forecasting systems all around the world. They are pretty much off the shelf purchases now. They are quite useful software to go with them to help collate all the information, set up all the information, make them easy to use as part of a forecasting tool and my understanding is that SEQ is probably moving that way with one of these products.

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COMMISSIONER: Mr O'Donnell, will you be much longer? If it is not going to be long I will get to you finish.

MR O'DONNELL: I will be a little while, your Honour.

COMMISSIONER: We will adjourn until 10 a.m. tomorrow.

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THE COMMISSION ADJOURNED AT 4.32 P.M. TILL 10.00 A.M. THE FOLLOWING DAY