# Transcript of Proceedings

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THE HONOURABLE JUSTICE C HOLMES, Commissioner

MR JAMES O'SULLIVAN AC, Deputy Commissioner
MR PHILLIP CUMMINS, Deputy Commissioner

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MS E WILSON, Counsel Assisting

IN THE MATTER OF THE COMMISSIONS OF INQUIRY ACT 1950

COMMISSIONS OF INQUIRY ORDER (No. 1) 2011

QUEENSLAND FLOODS COMMISSION OF INQUIRY

BRISBANE

..DATE 26/10/2011

..DAY 51

THE COMMISSION RESUMED AT 10.00 A.M.

COMMISSIONER: Mr Callaghan, I might just take the appearances for this round and then I will ask you to open the session. So you are appearing with Ms Wilson and Ms Kefford?

MR CALLAGHAN: Yes.

COMMISSIONER: Mr MacSporran?

MR MacSPORRAN: If it please the Commission, I appear for the State of Queensland. My name is MacSporran. I appear with Mr Rolls and Ms Brasch.

COMMISSIONER: Mr Dunning?

MR DUNNING: May it please the Commission, with my learned friend Mr Porter, for the Brisbane City Council.

COMMISSIONER: Mr Flanagan?

MR FLANAGAN: With Ms Brien for the Ipswich City Council.

COMMISSIONER: I have got Mr Ashton.

MR ASHTON: Yes. May it please the Commission, I appear for the Insurance Council of Australia. They have previously been given leave by the Commission.

COMMISSIONER: Yes, thanks, Mr Ashton. Ms McLeod?

MS McLEOD: If the Commission pleases, I appear for the Commonwealth with Ms O'Gorman.

COMMISSIONER: And Mr O'Donnell, you are back for-----

MR O'DONNELL: Seqwater, your Honour, with Mr Pomerenke.

COMMISSIONER: I am sorry?

MR O'DONNELL: With Mr Pomerenke.

COMMISSIONER: Thank you. Yes, Mr Callaghan?

MR CALLAGHAN: Thank you, Madam Commissioner.

On the 19th of September we flagged intention to examine all aspects of the so-called Q100, and drew attention to the important position it occupies in the Queensland Government's State Planning Policy.

Since then we have received evidence about the implementation and administration of that policy, and heard from witnesses, such as Ms Peta McCulloch of Auchenflower, herself a town planner, who explained that she made a decision to renovate by

reference of her understanding of the Q100. Ms McCullough then shared with us her experiences of 13 January 2011.

It seems to us that, on the strength of such evidence and other materials now before us, the question is squarely raised: is it time to move away from the Q100 mentality and towards a different approach to risk management?

The Q100 mentality was, in fact, challenged by the Joint Flood Taskforce which reported to the Brisbane City Council in March of this year. That report is relevant to this part of the Commission's investigations, as is the ongoing update of the Wivenhoe manual in which Seqwater is now engaged.

Nevertheless, the Commission's terms of reference have directed us to our own consideration of the Q100 concept.

This begins, logically enough, with an examination of its history, and, in particular, its history since the completion of the Wivenhoe Dam. The estimation of Q100 flood heights has been, since that time, contentious. Best estimates have ranged from 3.16 to 5.34 metres at the Brisbane City Port Office gauge, and at Ipswich between 15.28 metres and 18.65 metres.

Against that background, an independent hydrologist, Mr Mark Babister, was briefed, within the constraints of time and resources available to the Commission, to provide his own assessment of these two Q100s. His reports have provided the basis for the process that followed. The Brisbane report was given by the Commission to two other recognised experts, Dr Rory Nathan of Sinclair Knight Merz, and Dr Michael Leonard from the University of Adelaide.

Mr Babister's report was also provided to all parties with a relevant interest in this topic. Brisbane City Council, Ipswich City Council, and the Insurance Council of Australia took up the invitation to obtain further reviews. As a result, reports have been received from an additional five experts: Professor Colin Apelt, Mr Drew Bewsher, Erwin Weinmann, Mr Neil Collins, and Dr Sharmil Markar.

All of those hydrologists named then took up the further invitation to attend a private conference independently facilitated by Mr Peter Davis SC. A list of questions about the Brisbane Q100 and the concept generally was provided to this group in order to supply a focal point for the discussion.

Following their first conference on Sunday a second meeting was held yesterday and it was there that a joint statement was signed by all eight experts in attendance.

I tender that statement.

COMMISSIONER: Exhibit 881.

ADMITTED AND MARKED "EXHIBIT 881"

MR CALLAGHAN: A similar procedure has been conducted in relation to the Q100 at Ipswich. The experts have drawn attention to the fact that additional complexities are involved in any study of the Ipswich area by reason of the interaction between the Brisbane and Bremer Rivers and the influence of backwater on flood levels in Ipswich.

These additional complexities make it appropriate that the question of flood studies for Ipswich and surrounding areas receive separate and special consideration, and this was given during an extra private conference with Mr Davis on Monday. From that conference another joint statement was produced yesterday referable to the Ipswich Q100, and I now tender that statement.

COMMISSIONER: Exhibit 882.

ADMITTED AND MARKED "EXHIBIT 882"

MR CALLAGHAN: Madam Commissioner, the eight experts are now present and available for questioning. Given the nature of this evidence, it is proposed that they testify concurrently, such that at some stage, at least, each expert is in a position to provide the Commission with his opinion on any given subject.

We suggest that we deal first with the issue insofar as it relates to Brisbane - all eight experts will contribute to that - and we suggest there should then be another session addressing the Ipswich issue, which will involve five of those eight.

Madam Commissioner, it seems to us that the results of the private conferences must inform the approach which should now be taken to this issue. One conclusion which might be drawn from the propositions advanced in the joint statements is that the variation in the figures which have been proffered as a Q100 could be the inevitable consequence of the manner in which these figures were required to be provided. That is, such a figure is only produced in response to a request in the form of a question, and the content of and, in particular, the time allowed for the response to such a request has, necessarily, obviously, affected the answers given. Any differences between those answers must be understood in the light of the process by which they were created.

And in some our attention is now drawn not so much to the results, but to that process, and it is to what actually should occur in such a process that the experts have turned

their attention and reached agreement.

There is now accord between the eight who have gathered for this purpose as to that which must be done in order to complete a comprehensive flood study. There is agreement on the need for a central repository of all available data, agreement on that which is required by way of hydrological and hydraulic modelling, and agreement that a factor relevant to any such study will be climate change.

Importantly, Madam Commissioner, these gentlemen also agree that without doing the work that all now agree must be done, it is inappropriate to set a figure corresponding to Q100 for any purpose at the present time.

In the light of that agreement, we shall, in this part of the hearings, examine whether to this point requests for a Q100 figure have ever been accompanied by a requirement that such a rigorous study take place before the figure was provided.

We will see whether it has been part of any request for a Q100 figure that the scientists adopt and implement what is known as the Monte Carlo method of analysis. This is relevant, given that some reports which have answered requests for, or reviewed a finding of a Q100, have been qualified by reference to the desirability of the issue being approached in this way. And we should note that the Commission's request to Mr Babister was accompanied by no requirement for Monte Carlo analysis, nor was Mr Babister requested to do much of that which the panel now agrees is an essential prerequisite to the delivery of a Q100 figure.

As to those requirements, we are hopeful that in the evidence that you will receive today it will be open to the panel to elaborate upon and emphasise aspects of that which has already been agreed, such that the Commission can, with some confidence, make recommendations as to the manner in which this issue should be approached from hereon.

But having addressed these fundamental considerations, we must then return to the wider question to which I alluded earlier, about the use to which a Q100, however calculated, is put. The experts on the panel have also agreed that characterising flood behaviour over the full probability domain is an essential requirement for sound, risk-based planning and management, a task that is not performed by hydrologists. The issues raised extend beyond the realm of science and into the area of social policy and government process.

In that regard, we shall, in the week after next, examine the use which has been made of flood risk information by the Brisbane City Council. This is not an exercise in merit assessment of decisions made some time ago; rather, we look to Brisbane and to the Brisbane situation, and we look to that in order to examine the process by which flood studies are obtained by council, assessed within council, and used in planning schemes. That is to be done in order to determine whether its methods might be instructive to other councils in

Queensland.

Furthermore, we anticipate that relevant risk-based planning options will be canvassed in some expert evidence also to be received in the week commencing 7 November.

In the meantime, Madam Commissioner, the format probably demands that we adjourn briefly to rearrange the courtroom before the panel evidence commences.

COMMISSIONER: All right, thank you. We will adjourn for as long as that takes.

THE COMMISSION ADJOURNED AT 10.13 A.M.

THE COMMISSION RESUMED AT 10.23 A.M.

COMMISSIONER: NOW, are we ready for the - I don't even have a counsel at the moment. There you are. This is very hard to keep track of. Are we ready for the experts to take their place?

MR CALLAGHAN: Almost. I thought I might tender some materials first, and then I propose to call them one by one so that they can be sworn individually, if that's appropriate.

COMMISSIONER: Yes, okay.

MR CALLAGHAN: Initially, I will tender a folder which contains an index to the common expert reading lists for Brisbane and Ipswich, and a USB which contains the content outlined in the index.

COMMISSIONER: That will be Exhibit 883.

ADMITTED AND MARKED "EXHIBIT 883"

MR CALLAGHAN: I can indicate that contains all the expert reports reviewed by the panel. I tender also a statement of Roderick Nathan, dated 4 October 2011.

COMMISSIONER: 884.

ADMITTED AND MARKED "EXHIBIT 884"

MR CALLAGHAN: And a statement of Scott Abbey, dated 4 October 2011.

COMMISSIONER: Exhibit 885.

ADMITTED AND MARKED "EXHIBIT 885"

MR CALLAGHAN: I now might call each of the experts to be sworn. I will first call Dr Michael Leonard.

COMMISSIONER: You are prudently doing this in order of seating, are you?

MR CALLAGHAN: I am.

MICHAEL LEONARD, SWORN

MR CALLAGHAN: I call Mark Babister.

MARK BABISTER, AFFIRMED

MR CALLAGHAN: I call Roderick Nathan.

RODERICK JOHN NATHAN, AFFIRMED

MR CALLAGHAN: I call Erwin Weinmann.

ERWIN WEINMANN, SWORN

MR CALLAGHAN: I call Colin Apelt.

COLIN APELT, AFFIRMED

MR CALLAGHAN: I call Drew Bewsher.

DREW BEWSHER, SWORN

MR CALLAGHAN: I call Neil Collins.

NEIL COLLINS, SWORN

MR CALLAGHAN: And I call Sharmil Markar.

SHARMIL MARKAR, AFFIRMED

MR CALLAGHAN: Gentlemen, for the record, I will go down the line again and get you each to state your full name and occupation. Dr Leonard?

DR LEONARD: My name is Michael Leonard, from the University of Adelaide. I am a research associate.

Mr Babister?

MR BABISTER: Mark Kenneth Babister. I am a flood hydrologist.

MR CALLAGHAN: Dr Nathan?

DR NATHAN: Roderick John Nathan, known as Rory, and I also a flood hydrologist.

MR CALLAGHAN: Mr Weinmann?

MR WEINMANN: I am Peter Erwin Weinmann, known as Erwin Weinmann, and I am a flood hydrologist working as a private consultant.

MR CALLAGHAN: Thank you. Professor Apelt?

PROF APELT: I am Colin James Apelt, a retired Professor of Civil Engineering from the University of Queensland in the field of water engineering.

MR CALLAGHAN: Thank you. Mr Bewsher?

MR BEWSHER: I am Andrew Bewsher. I am a Flood Risk Management consultant and a hydrologist.

MR CALLAGHAN: Mr Collins?

MR COLLINS: I am Neil Ian Collins. I am the principal hydraulic engineer at a consulting firm BMT WBM.

MR CALLAGHAN: And Dr Markar?

DR MARKAR: Mohamed Sharmil Markar, principal engineer with a water resources engineering consulting firm.

COMMISSIONER: Gentlemen, thanks very much for your attendance today, and also for your efforts over the last few days, which I gather have been very considerable and have probably shortened what we need to do today very considerably.

The process that we'll adopt is this: those barristers who wish to cross-examine will do so, starting with Mr Callaghan. They will ask those of you whom they have questions, whatever questions they have.

I do want to get the input of all of you, but I think, given the numbers, I won't ask you to interject or to indicate in the process of the evidence that you have something to say.

What I will ask you to do is to note anything with which you take issue along the line, any point that you want to make later, anything that with which to disagree. You may find that in the process of the giving of evidence, your point is superceded, you no longer need to ask it, but at the end of all of the questioning, I will come to each of you and see what it is, anything that you want to add, any point that you want to make.

Have you all got some means of making a note, either electronically or physically? Because we have spare bits of paper and pens for anybody who doesn't.

PROF APELT: I would welcome some more paper.

COMMISSIONER: All right. We will see to that at once. If you prefer lined paper I think we can achieve that, too, actually.

PROF APELT: This is fine, thank you, Commissioner.

COMMISSIONER: Is everybody comfortable with that process? Thanks. I will ask Mr Callaghan to start.

MR CALLAGHAN: Thank you. Gentlemen, as we know, you have all signed a statement which outlines a considerable number of matters on which you agree. I'm assuming or hoping that you all have access, again either electronically or otherwise, to a copy of that statement because I propose that my questions really follow sequentially through the paragraphs in the statement, not all of them, and I want to begin with paragraph 11 and direct a question to Professor Apelt. Professor, you would have heard me a moment ago give some prominence to the challenging statement made by the Joint Flood Taskforce and repeated in your report as to the need to move from the Q100 mentality.

PROF APELT: Yes

MR CALLAGHAN: And I was wondering whether that should or that statement should be read in conjunction with paragraph 11 and whether we are talking about the same or the concepts are related and whether you'd care to elaborate upon the matters raised both in that part of your statement and in that paragraph of the joint statement.

PROF APELT: The whole of the answer to question 6, which 11 is the preliminary, really covers the concerns that I expressed or we expressed in that recommendation, and 11 really sets a little bit of the context for that

MR CALLAGHAN: All right. Can I move, then, to paragraph 16 and the joint statement there sets out three factors to be taken into account in a comprehensive flood study. Some of the questions that I will ask will be elementary because we do have a wider audience, and I will just ask Dr Nathan in this regard to briefly explain how each of those factors is used in a flood study.

DR NATHAN: Yep. The - I guess can I put my answer towards a Monte Carlo kind of study, or are you wanting just in general terms?

MR CALLAGHAN: Really general at this stage.

DR NATHAN: Or very high level? There are three factors, one is data and that relates to the sort of data that's required that defines the shape of the river, how much flow it can hold, the topography around it, rainfall data, stream flow data. These are all things that are required to calibrate and inform our models. We then need a hydrological model, which is a model used to convert rainfall to stream flow, and then we need a hydraulic model which is a model used to convert stream flow to an inundation level and extent.

MR CALLAGHAN: Thank you. Yes. There is a microphone in front of Professor Apelt which I understand will amplify. It's not a recording microphone. Could I ask that it be passed to whoever is speaking because I am told that certainly at the back of the room, given that you're all to one side, the amplification is not good.

Well, gentlemen, can I take you to paragraph 17 and following in which you have informed us of the frustration that you collectively feel about the lack of a central repository for available data. Can I direct this one to Mr Babister? Can you, Mr Babister, give us some examples which are alluded to, I think, at the end of paragraph 19 of date that you have had difficulty in obtaining?

MR BABISTER: There's been quite a few examples and I wouldn't want to - anybody to imply that the one I mention means it's the only one, but like access to some of the DERM data on the simulation of the dams really would have helped inform the process on how the pre-dam to post-dam behaviour occurs, and that's frustrated earlier studies and certainly frustrated my attempts to try and find this behaviour, but there's been quite a few examples where data's been held in different locations and it hasn't been able to all been compiled and put together, whether it's rating - rating and gauging information, and the central repository would make this so much easier or at least access by all parties to information, and even people knowing information is available means work will be more efficient and there will be savings for the State.

COMMISSIONER: Is that microphone actually working? Can some random person up the back - Ms Rolf, can you tell me is it working all right? You can hear? Thank you.

MR CALLAGHAN: Dr Nathan, do you have any examples to add to this topic?

DR NATHAN: One example might be, say, LIDAR data which is used - which is very high resolution data that describes a topography. Now, probably all the agencies within interest along - with an interest in the river would be able to use that data and you can imagine that's another type of data set that would be of use to several agencies and people who work for them.

MR CALLAGHAN: Just to assist us, which sort of agencies, which different government agencies might use-----

DR NATHAN: I would imagine any of the municipal planning, certainly Brisbane City Council, Ipswich Council, Seqwater, they're agencies that would have access and use for detailed information on topography.

MR CALLAGHAN: And again perhaps in high level general terms just explain how that is actually used in a flood study?

DR NATHAN: The main point - the main purpose of that data from a hydrologist perspective would be to define the potential for the flood plain to absorb flood run-off, and would also - allows you to define how much - what's the carrying capacity of the river for flood flows for hydraulic modelling purposes.

MR CALLAGHAN: And the effect of what you are saying is that

if such information was available to Local Governments and their consultants that could reduce the costs of obtaining data for a flood study?

DR NATHAN: Yes, that would share - if they could share the costs and, therefore, share availability, and I should have mentioned a very obvious point there is that it also allows you to estimate the extent of flooding once you know the levels.

MR CALLAGHAN: While you have the microphone, can I ask you to turn to paragraph 20 subparagraph F or point F, "Dam Operations Discharges and Level Data."? What sort of dam operations data would you seek to obtain?

DR NATHAN: There's two types of dam data that's relevant to a study like this. One would be information on how you operate the dam during the flood, the operating rules. Historic information on inflows and outflows from the dam are also very important for looking at behaviour in the catchment. The second major use of dam operation - dam information is longer term behaviour of dam - of dam levels over time which allows you to look at likelihood of the dam being at certain levels at the onset of a flood.

MR CALLAGHAN: Is there any specific example that you can point to and the manner in which data, historical data perhaps, might have been useful?

DR NATHAN: Well, certainly in previous - any previous flood study that tried to take - that tried to look at the influence of the dam on the flood - flood outflows would have been requiring access to that data.

MR CALLAGHAN: Can I take you - just hang to the microphone for a moment, because since I'm asking you to give some general explanations, I will take you to paragraph 22 where the panel endorses a Monte Carlo approach to hydrologic modelling. Now, the Commission was introduced to this concept during the first part of the year and, as I say, I suspect we now have a new audience. So, could you, please, for the record give us an explanation as to what is involved in the Monte Carlo approach as best you can for lay people?

DR NATHAN: I will try. Monte Carlo is a technique that - the mathematics involved in its execution is quite complex, but the actual concepts underlying what we are trying to do are really quite - quite simple, and really it provides a means for - to use a computer to sort of mimic the behaviour of natural variability of flood producing processes. So, in essence, Monte Carlo mimics mother nature. So, what you might do is it allows for all the factors that go into producing a flood to be - its particular focus is how they randomly come together to actually produce a flood. So, for instance, you might have in one event the rainfall might occur for upstream for dams, like it did in 1893 or the 1955 flood. Another time you do a simulation the rainfall might fall below the dams as it did in '74, or it might fall in the middle of the catchment

as it did in January of this year. Each time you simulate an event like that, you then also look at what are the other factors that combine towards producing a flood, and it might be did the rainfall all occur in the first 24 or 36 hours, did it occur in one peak or two peaks like it did in January, did it occur over a five day period, was the catchment wet before the rainfall fell? When you look at all these factors - what was the initial level in the reservoir. When you look at all these factors, there were a lot of different things happening and the best way to understand flood behaviour downstream of the dams is to actually consider all those factors altogether, and so it means you might end up running - undertaking many hundreds or actually many thousands of simulations to capture that flood behaviour, and then you analyse results and it gives you the Q100, it gives you the Q500 or the Q1000 or the Q50.

MR CALLAGHAN: Mr Babister, you recommend the use of the Monte Carlo approach in your report to the Commission as well as your response to the peer reviews. You see it as the appropriate way forward?

MR BABISTER: It's definitely the most appropriate way forward to characterise flood risk in Brisbane and Ipswich

MR CALLAGHAN: Dr Leonard, your peer review notes that the Monte Carlo approach is the only way to address these issues. Why is it the only option?

DR LEONARD: Because it relies on - you can't just use one event, it relies on understanding those random combinations, and it's really a combined effect. So, how rainfall in various catchments, the Bremer, the Lockyer and above Wivenhoe would all contribute, and, yeah, those patterns - rainfall is highly variable, so those patterns will vary each time.

MR CALLAGHAN: While you have the microphone, can I take you to paragraph 22D which speaks to the potential variability of operating procedure and physical operating conditions? Can you just explain that and indicate how that might be incorporated into a Monte Carlo analysis?

DR LEONARD: Well, the rules for operating a dam, I understand, are fixed, but I think that depending on how the forecasts look, there might be, in fact, a little bit of variability there, and so the point of a Monte Carlo analysis is to combine all of the sources of variability, and that point there, point D, is to say that there may be a little bit of variable. It may turn out that that variability is not a significant factor in the end, but it's important to consider that it is a source of variability.

MR CALLAGHAN: All right. Mr Babister, paragraph 23 of the joint statement deals with the issue of validating the hydrologic model against historic data; is that right?

MR BABISTER: Yes.

MR CALLAGHAN: Why is that so important?

MR BABISTER: Well, the Monte Carlo process can capture and replicate all of this observed variability, but the items listed under 23, they're all about then validating that the model is exactly reproducing the observed variability and like D, we'd really want to make sure that the Monte Carlo process gets all the variability and tributary flows, because - in their timing, because that's very crucial to the operation of any dam.

MR CALLAGHAN: You'd see that - of the matters listed there in A to E inclusive in paragraph 23, you identify tributary flows as being of particular importance?

MR BABISTER: Oh, it is particularly important but the other ones are pretty - of similar importance.

MR CALLAGHAN: Dr Nathan, do you have any comment on that?

DR NATHAN: No, I would agree with that.

MR CALLAGHAN: While you have the microphone, can I take you back to paragraph 22 and to the first point of subparagraph A, which relates to temporal and spacial patterns of rainfall? Do you have a particular view about the importance of that?

DR NATHAN: Look, I think for a catchment - sorry, for a catchment the size of Brisbane River, it's actually the way rainfall falls On the catchment, particularly as the dam is midway down the catchment is of particular importance. So replicating the space/time characteristics of that rainfall is particularly important for this catchment.

MR CALLAGHAN: While you're there and we're looking at paragraph 23 and the features identified there, you have got in B and C reference to flood volume and peak flow frequency and distribution. Are these matters about which you'd have an observation to share?

DR NATHAN: They're both important, but at different locations in the catchment. So upstream of the dam it's particularly important to get the combination of volume of the hydrographs as well as the peak because the dam is obviously very dependent upon how much flood storage is available, whereas in the tributaries downstream of the dam it's probably more important to get the peaks right, but by and large it is - what we're talking about here is demonstrating the model has an ability to reproduce the observed flood behaviour in the catchment in a probabilistic sense, because that's the - it's that ability that determines whether or not it's fit for estimating something like a Q100.

MR CALLAGHAN: Moving on from the concept, which you allude to, of the area from which information is obtained, paragraph 25 speaks to the pooling of regional information where considered relevant and appropriate. Mr Babister, can you just elaborate on that and explain what you meant by-----

MR BABISTER: Ys. Look, with our short record in Australia - and 100, 200 years is relatively short, and many of our gauges records are much shorter - we can gain extra information by looking at other gauges or other surrounding catchments or their behaviour or their statistical properties. So, by pooling information, recognising we have a short record, we look at nearby hydrologically similar regions and take information from those regions, or use that information from those regions to look at the behaviour we're observing to make sure it is appropriate. So, we effectively can generate something equivalent to a longer record by replacing time for space.

MR CALLAGHAN: Dr Nathan, am I right in that you used regional information for the 2003 SKM report?

DR NATHAN: Yes, in 2003 we used some information from other flood gauges to help inform the shapes of the probability distributions that we were using.

MR CALLAGHAN: Can I move, then, to paragraph 31? This is probably a self-evident point, but, Mr Babister, it points or it speaks to the probability of - a joint probability of river flooding and ocean levels. Logically enough it would seem this arises because of Brisbane's proximity to the ocean.

MR BABISTER: Yes, this is a problem all along the coast and it's probably that's only became tractable for us to deal with in recent time. The synoptic system that causes a flood will often cause elevated ocean levels on top of the normal tide, and it's really important to understand how they interact, because in a place like Brisbane it will have - make quite a difference to the flood levels, and there's now a framework to understand that complex joint probability.

MR CALLAGHAN: Thank you. If I move to paragraph 32 under the heading of, "Other Comments.", and there is a reference there to relevant stakeholders. Dr Nathan, can I ask you in the context of that paragraph who are the stakeholders?

DR NATHAN: Well, from a hydrologist's perspective, I think the stakeholders for the lower Brisbane are going to be Seqwater, Brisbane City Council being the main ones, Bureau of Meteorology, and depending on where your focus is, Ipswich Council.

MR CALLAGHAN: How are they differently involved throughout the process of a flood study?

DR NATHAN: Well, Seqwater obviously have most of their focus on how they operate the dam for both water - water conservation and flood security, and so they have most information about the upper parts of the catchment. The Brisbane City Council have most information about the topography and the impacts of flooding and the hydraulics associated with flood behaviour in the lower reaches. The Bureau of Meteorology is central to providing - assisting with

the provision of rainfall information during - during an event and also flood forecasting. Ipswich City Council has the same role as BCC, but in a more restricted - due to geography.

MR CALLAGHAN: And while you're there, paragraph 34, there's a reference to climate change. So we know, can climate change be included in a Monte Carlo analysis?

DR NATHAN: Yes, it, can. I think there is obviously uncertainly about what attributes of climate change are important. I think we have got probably a reasonably good handle on sea level rise. We have less understanding of how climate change impacts on the intensity of rainfalls, but these are things that can be explored in the Monte Carlo framework and the uncertainty rising from that can be accommodated in - for planning purposes.

MR CALLAGHAN: Dr Leonard, does the uncertainty related to climate change compare with uncertainty related to other factors?

DR LEONARD: Yeah, I think that it probably needs to be said that there is lot of uncertainty already without climate change just trying to understand rainfall patterns, but certainly I think climate change is another order of magnitude of uncertainty. So, I would have thought that you would do a Monte Carlo study without - comprehensively without thinking about climate change as a status quo, and then climate change would be additional factors

MR CALLAGHAN: All right. Well, gentlemen, the joint statement sets out what should now be done in a comprehensive flood study. Can I just get a bit more information about exactly how such a study might proceed? I think we have identified obvious stakeholders. Is there a comment that can be made about the part of the work which must be done or which should be done first? Dr Nathan?

DR NATHAN: You will see in the joint statement that we have identified a lot of issues that need to be considered and I think we're all in agreement that these issues are all potentially quite important. One of the aspects of this that we didn't have time to consider was the relative importance and quite possibly at this point in time it's too difficult to determine whether one factor is going to be more important than the other. So, this is something that we haven't really discussed or commented on in the report, but my personal view, I think, to get a handle on this, that the best way to proceed would be to perhaps put in place an initial Monte Carlo simulation. The objectives of that would not be to come up with a Q100 to rely on, but to come up with an estimate that people could see was based on reasonable assumptions, and you could use that as a vehicle to then determine what are the factors - what are the factors of uncertainty that are most important in driving that Q100 estimate. So, having first come up with an integrated framework for assessing flood risk, you can then use that for exploring which factors - the uncertainty and which factors having most influence on that.

You would then be able to, I think, prioritise investigations such that you could then prioritise investigations and focus them on the ones that are most important to that outcome and incorporate them back in the Monte Carlo analysis and come up with a refined estimate.

MR CALLAGHAN: All right. We might attest the approach of the panel at this point. Dr Markar, do you have a comment on what Dr Nathan just said?

MR MARKAR: Yes, I do. The importance of assembling all the data, especially for the most recent event, get it altogether, and understand what really happened during the event and better understand flood behaviour, and not only that recent event, maybe 1974 and some of the past events as well, that will help us understand variability, proper understanding of the variability of the various floods and understand how the system, the river system behaves. So that should be one of the first things I would have thought before - and I agree with Rory that some preliminary analysis has to be done, but a proper understanding of that flood behaviour is also an important part of the process.

MR CALLAGHAN: Mr Collins, your thoughts on what has to be done first, in addition to anything that's been said?

MR COLLINS: I don't disagree with either Mr Markar or Dr Nathan, but you can do multiple things equally at once, and one of the most critical tasks, in my view, is to complete and expand the complete - the survey work that's underway on the rivers, the streams, the tributaries, and also some of the flood plains, because the changes in those systems in all the major tributaries, all the rivers, has been enormous due to the flood. The amount of sediment lost from Lockyer Valley was incredibly large. That needs high level survey. I understand that a lot of that work is underway, if not some of it's already completed. I think the bathymetric survey of the river might be completed of the Brisbane River, and I'm not so sure about all the other key parts of the tributaries that we need that data. So, that has to be fast tacked. That's a fairly long lead time item that will affect the duration of any of these investigations.

MR CALLAGHAN: Mr Bewsher, you were nodding during Mr Collins' Answer. Does that-----

MR BEWSHER: Yes. I would agree with the comments of Dr Nathan, Dr Markar and Mr Collins. I would say the first priority would be the data, and I'd agree with Mr Collins' comment about some of that may take some time to collect, and I would agree with Dr Nathan's comment that initial Monte Carlo will help then focus the remainder of the study and identify the areas where most attention is needed, that might initiate some further data issues as well.

MR CALLAGHAN: Professor Apelt, anything to add?

PROF APELT: I'm not clear what question I'm answering at this stage.

MR CALLAGHAN: The question I put to Dr Nathan was, in essence, what should be done first. Now, it may be a question that oversimplifies the issues, and I think Mr Collins has identified it's possible to do more than one thing at once-----

PROF APELT: Yes, yes.

MR CALLAGHAN: -----but we were attempting to see whether there was anything which should be prioritised, I suppose.

PROF APELT: I see, okay. Well, now, I agree with what has already been said, particularly in respect to gathering the data-----

MR CALLAGHAN: Yes.

PROF APELT: -----because without that you're really not being able to develop models at a level that one would hope that they would be developed for accuracy, and if I could just expand a little bit? There was a comment in among this about stakeholders. I think the stakeholders are part of this picture and my view about the importance of having the stakeholders involved in all of the process is that it's not just - they each have sources of information that are somewhat different. They may not all agree in detail. These need to be worked out at that stage. They also need, I believe, to be involved to be able to accept the results of what's been done instead of getting into some disagreement, and I'd like to add that another stakeholder not mentioned is the State Government.

MR CALLAGHAN: And I was going to come to that sort of thing in a moment but since you're there and developing that, we are interested in your views on that, and you say the "State Government", are we talking about DERM here or other agencies as well?

PROF APELT: Well, DERM and other aspects of the State Government. Well, there are statutory authorities that answer to ministers-----

MR CALLAGHAN: Yes.

PROF APELT: -----and, for example, the QWC obviously is a part of the whole system that would need to be involved in this.

MR CALLAGHAN: Okay.

PROF APELT: So at this stage I would not be able to give you, shall we say, an exhaustively list.

MR CALLAGHAN: No, I wasn't asking for a list-----

PROF APELT: No.

MR CALLAGHAN: -----but that is a topic on which we are interested in your views.

PROF APELT: Yes.

MR CALLAGHAN: Is there anything you would care to add in case we miss-----

PROF APELT: Well, this is perhaps - well, this is certainly outside my area of expertise, but my understanding is that ultimately decisions are made at State Government level about matters that are particularly involved with substantial amount of money and it's not going to be found just from individual sources, so I would think that for this process to actually work the State Government needs to be part of that and actually, in a sense, agreeing with it, if not fostering it.

MR CALLAGHAN: And, again, you might say this is out of your expertise, but do you have an opinion as to the manner in which that should happen?

PROF APELT: Well, I know some of the organised stakeholders are very concerned that this should take place, and, again, I know that they realise that they cannot do it themselves so some of them are actually trying to develop the initiative through a collaborative approach, so I - as I said, it's outside if my field, I'm talking very much as a layman here, but I would hope that ultimately these various stakeholders would talk together and come to an agreement to proceed with this.

MR CALLAGHAN: Thank you. All right. Well, I will bring it back to the question that we started with, which now goes to Mr Weinmann, and it was the perhaps oversimplified question of what part should be done first that I started off with Dr Nathan, and you've heard the responses made along the line, do you have anything to add?

MR WEINMANN: Yes, and I think that the data is the priority but beyond that the Monte Carlo simulation approach really aims to go beyond the range of observed data, observed events. We have a very limited number of large events that we're particularly interested in, and the purpose of the Monte Carlo simulation is to extend that range by using all the relevant

information and putting it together in a statistical probabilistic framework. For that to work we need to make first sure that the models that we are using can work in reproducing observed - actual observed events. In other words, the few large events that we have experienced. So that will - after the data is available for doing that, then that needs to be our first step, before we then start to vary the inputs to these models to produce this extended range of - well, simulated observations.

MR CALLAGHAN: Okay.

MR WEINMANN: So I see that as an important step, and again I think those results then need to be exposed and discussed and interpreted to make sure that we're happy with what's been produced.

MR CALLAGHAN: Okay. I might send it down to Dr Leonard then, back this way.

DR LEONARD: My emphasis is a little bit different from the other experts and I suppose I would probably most agree with Dr Nathan but I would take it further. I think all of the things we have listed are important but you're asking a question about priorities and I think all of these things are important to be able to sign off on a final result and say that it's defensible, robust and all of those things. I think, though, that if you're asking to construct a study and it's going to be involve a few iterations and what's the first step of that study, I would suggest that understanding the statistical behaviour of the dam and the rainfall patterns that are incident on it, and the other catchments, that that is the key thing that needs to be done. So you will note from our analysis that we use terms like, for flood frequency, "pre-dam" and "post-dam" or "with dams" or "without dams". So the analysis gets done as if the dams weren't there, and I would say that there's a strong agreement on what happens there. But then when you try and take - consider the influence of the dams, I think that that is the area where there is the main challenge, and so I would say that that is the main priority.

MR CALLAGHAN: Well-----

DR LEONARD: Not withholding the other things but-----

MR CALLAGHAN: No. We know about work being done in the update of the Wivenhow and Somerset Dams' manual. Does the other work have to wait until after those procedures are set?

DR LEONARD: No, I don't think so. I tend to take an iterative view to things-----

MR CALLAGHAN: Yes.

DR LEONARD: -----that what you want to do is you want to tease out what are the biggest sources of variability and uncertainty in our understanding, and you can do that as a

first pass with a Monte Carlo study where the data may not be perfect, but then with that understanding and with new data and with better hydraulic models you can then combine it into a final study.

MR CALLAGHAN: Mr Babister, remembering we're starting back with the question that I-----

MR BABISTER: There's not really much more I can add-----

MR CALLAGHAN: No.

MR BABISTER: -----I agree completely with what everybody's said and certainly with Michael and Rory's emphasis on understanding the key variability in some of these items in an initial Monte Carlo work. One thing that I would add, though, is we talked about getting hold of all the data, it's also important to actually understand the assumptions that people have used in collecting data as well, and probably getting some of the different agencies to understand why they've got slightly different interpretations because they've made different assumptions, and that's an important stakeholder task.

MR CALLAGHAN: All right. Dr Nathan, I'll give you the final word, seeing as we started with you. I'm not going to start - I'm not going to go down the line again but do you have any-----

DR NATHAN: Possibly one last point that I would like to make, and again there's nothing I've heard that I wouldn't agree with, is that to make the point that what we're talking about here is developing a model to define flood risk for planning purposes or to evaluate the benefits of different operating procedures or different potential mitigation options. The issues that we've been talking about here aren't particularly relevant to flood forecasting operational purposes-----

MR CALLAGHAN: No.

DR NATHAN: -----so I just wanted to - I think that's something we provide in a statement that hasn't yet come up.

MR CALLAGHAN: All right, thank you. Well, as you know, we will be having a separate session about Ipswich but we can't probably divorce the concepts completely and I would at least like to get some comment in this session, perhaps starting with you Mr Babister, about whether the work - how the work recommended by the joint expert statement for Brisbane fits in with the work needed for Ipswich. Presumably the work that needs to be done for Ipswich is fairly reliant upon what happens for Brisbane; is that right?

MR BABISTER: That's exactly correct. The Brisbane work will form the overall framework and Ipswich is, I guess, a special case of the overall Brisbane work, Brisbane River work, and Ipswich has a couple of particular issues with these two flooding mechanisms having such a dominant influence on flood

levels at Ipswich that it needs to be treated as a little bit of a special case once the Brisbane works progress to a suitable point.

MR CALLAGHAN: All right. I'll leave the balance of that and those interested in Ipswich can comment on it during the Ipswich session. Mr Babister, while you are there, can I ask you about Australian Rainfall and Runoff Project. Can you tell us, first of all, what it is.

MR BABISTER: Yes. Australian Rainfall and Runoff is the national guideline document on how we do things like flood studies and calculate flood risk, and the current document was last published in 1987 so it's considerably out-of-date. There is an update afoot but it's pretty much got to the halfway point and run out of funding and there's an application for funding into the Federal Government for about $5 million to finish that task. I might add, too, that a large number of people at this table work on that project with me, and largely in a voluntary capacity, but if we don't get funding that document will be delayed for several years.

MR CALLAGHAN: And with funding?

MR BABISTER: With funding it will be out in a couple of years and some of the things that will be in it will be things like Monte Carlo analysis, so this will be a lot more approachable for industry.

MR CALLAGHAN: All right. Mr Babister has indicated that a number of you are involved in that. If there was any particular one of you who wanted to add any particular comment to what he said. No? All right. Well, as we know, you've all agreed on that which ought to be done by way of work addressing the Brisbane situation but can you give us some indication of the time frame which might be regarded as reasonable for the completion of all the work that you've recommended for the Brisbane River, and I appreciate there are going to be a number of variables, but, Mr Babister, do you have a-----

MR BABISTER: Look, realistically if you rush that whole process I don't think you could do it in two years, it's probably a three-year study with all the stakeholder involvement and getting all the agencies to sign off, but that would sort of - you'd need to see a project plan to sort of have a more robust estimate.

MR CALLAGHAN: All right. I don't know that we need to attempt to reach a final figure on this, but, Dr Nathan, do you have a view on the range of time that might be available - might be required, rather?

DR NATHAN: I think there are two different aspects. I agree with Mark, with Mr Babister that it might take two or three years to fully evaluate different options that might be considered for alternative operation or mitigation actions. I think you could probably refine - come up with a firmer

understanding of flood risk in a much shorter space of time but only as a starting point, to then look at the other matters that are of interest. So, again, my answer there is bias as being a hydrologist, I think you can characterise flood risk fairly early on in the process and then use that to help inform the decisions and the processes that then follow.

MR CALLAGHAN: All right. But in terms of - well, can I ask you this: those who have no background in this area would have no idea about the costs of these things, and of course costs are not just professional fees, but for all we know the work that you've proposed - well, we have no idea as lay people what we're talking about here, it could be hundreds, it could be millions, it could be hundreds of millions. Can you give us some context for the sorts of costs that were involved in the professional fees that would be involved in this - in the work which the joint panel is recommending?

DR NATHAN: So, I think, very specifically just talking about the professional fees associated with the hydrological components to do this investigation, they're of the order of some hundreds of thousands, not several millions.

MR CALLAGHAN: All right. That's probably all we needed to know. And, presumably, the time frame would be affected by any number of variables, including the level of cooperation of the parties.

DR NATHAN: Yes, that's certainly relevant, and I think Mr Bewsher made the point earlier that the stakeholding engagement was very important. I think part of that is it allows then people doing the analysis or being involved in the analysis to actually get their understanding of the local catchment, and it's the agency people who have that best understanding of sources of data, the assumptions behind it, how things happen, so I think there's a certain amount of time required to engage everybody's perspectives and understanding of the catchment behaviour in the process, so - and that - just by virtue of the fact you're dealing with a number of agencies, that kind of slows the process down but I think adds a lot more value to the outcome.

MR CALLAGHAN: Coming back to the joint statement. Dr Leonard, can I direct this one to you in relation to paragraph 37, where you collectively point to the importance of salient assumptions upon which assessment being based being clearly stated and significance explained. Can you give us an example of the type of assumption that might not clearly have been stated in any of the reports with which we've been concerned?

DR LEONARD: I think that stating assumptions is a critical step in the process and I would say, having reviewed the documents, that with the 2003 expert panel that they had some assumptions about the dam that were hard to tease out, so I think that that's one example. Another example would be in the Ipswich report, which I don't think is being discussed today but Mr Babister has used the figure of point 6 as an

area to sort of factor flows, and what's needed is an assessment of whether that figure is appropriate and what the range of variability might be in it.

MR CALLAGHAN: And when you spoke about the 2003 report and the assumptions about the dams, what specifically are you talking about, which assumptions?

DR LEONARD: Well, to get from a case where you don't have dams to a case where you do have dams you have to say what the effect of those - of what the dams are going to do, and so there's some factor, attenuating factor there, but it's not just an assumption of what the factor is but also the variability about that factor, what it could likely be, so it's not just one number it's a whole range of possible numbers, and the critique of the number that is - has been used, whether the people think it's sensitive or not.

MR CALLAGHAN: You say that didn't come through clearly in the-----

DR LEONARD: No, I - so - there are statements there, and an engineering report, it's point is to list the assumptions and discuss the analysis, but I think that assumptions need to be clearly stated, and I found it difficult to tease out some of those assumptions in that expert review report.

MR CALLAGHAN: I suppose the question which is left hanging by paragraph 37 is how do we determine what is a salient assumption. Is that the sort of thing on which you are ever going do be able to reach-----

DR LEONARD: No. I mean, you can assume that one plus one equals two, so you can be exhaustive to the point of ridiculousness-----

MR CALLAGHAN: Yes.

DR LEONARD: -----but - I think it's apparent that you can - when you - to construct an estimate you can list all of the most significant, and you can probably even prioritise what you think the most significant assumptions are and have a brief discussion to say why one factor - you have to sort of sort them out, so that way anyone reviewing it can clearly see where the authors think that their most - their weaknesses or their weaker areas are and where the strengths - strengths are.

MR CALLAGHAN: Thank you.

COMMISSIONER: Mr Callaghan, have you got some time to go with-----

MR CALLAGHAN: Look, I do, and I was just about to move on to a significantly different topic-----

COMMISSIONER: Shall we take a break?

MR CALLAGHAN: It might be as good a time as any.

COMMISSIONER: All right, we will come back at 25 to.

THE COMMISSION ADJOURNED AT 11.19 A.M.

THE COMMISSION RESUMED AT 11.34 A.M.

MR CALLAGHAN: Dr Nathan, can I just go back to the question that I asked earlier about the costs involved in that which has been recommended by all of you in your joint statement. The figures that you gave us were referable just to the hydrological work involved, is that correct?

DR NATHAN: Yes, thanks for the question. I think, yeah, my focus in that answer was on the effort required to refine the estimate of the Q100. I think the natural next step after that is obviously to convert that to flood inundation and extent. I think there is a certain amount of the survey information required to do that, and to map that across the sensitive areas would require, you know - that's where the costs would start getting into the low numbers of millions, I think, just required to get the information on surveys. So my answer was more around hydrologic risk rather than inundation extent.

MR CALLAGHAN: All right. Thank you for that. Now, can I move to paragraph 39 of the joint statement? And it is stated - or the effect of that is that the panel found it impossible to conclude whether certain particular estimates of the Q100 were appropriate. Now, some of you gentlemen were involved in those studies, and I just want to confirm that which is probably obvious on the face of them, but that there were limitations, qualifications placed upon those estimates at the time they were given. First, Dr Nathan, you were involved in the SKM Bremer River Flood Study Report in 2003?

DR NATHAN: That's correct.

MR CALLAGHAN: And, gentlemen, for your assistance I think it is number 6 on your expert reading list, which I am told you all have available to you in one form or another. The short point being, Dr Nathan, that this study did not involve the - did not involve all of the work that the joint panel now suggests is necessary for a comprehensive flood study. That's correct?

DR NATHAN: That's correct.

MR CALLAGHAN: And one obvious reason is the time-frame within which this report had to be completed?

DR NATHAN: That's correct.

MR CALLAGHAN: What was that time-frame?

DR NATHAN: The time-frame was about - it was about a one to two-month period was available for doing the analysis. That was then submitted for peer review by the independent reviewers.

MR CALLAGHAN: Is it the case that you were also required to produce draft reports?

DR NATHAN: Yes. Because of the tight time-frame, it was slightly unusual that we issued a number of draft reports. The information that report - the quantitative information regarding flood magnitudes did not vary in those successive drafts, but our ability to kind of describe how we got there, and justify it, and put the colour around it that makes it easy to understand and interpret was happening successfully over a period of time.

MR CALLAGHAN: All right. Now, do you have that report-----

DR NATHAN: Yes.

MR CALLAGHAN: -----in front of you? I will just take you to some parts of it where the limitations of the study were reflected. And if there are others to which you wish to draw our attention, by all means do. But on page 3 you - or the report notes that "the flood mitigation potential of the dams is affected by operating procedures, initial dam levels, spacial and temporal patterns of rainfall"?

DR NATHAN: Correct.

MR CALLAGHAN: And then say that, "The most sophisticated way of dealing with these matters is by way of Monte Carlo analysis", is that correct?

DR NATHAN: Correct.

MR CALLAGHAN: Of course, this study did not involve a Monte Carlo analysis. At page 5, where the best estimate of Q100 is given, you note that based on the current level of investigation, it is clear that there is uncertainty in any estimate of the 1:100 AEP flood event, is that right?

DR NATHAN: Correct.

MR CALLAGHAN: Page 6 there is a further recommendation for the Monte Carlo framework to be adopted?

DR NATHAN: Correct.

MR CALLAGHAN: Page 9, you set out the data that was used for the statistical flood frequency analysis. This is data that we gather was received from the Bureau of Meteorology and what was then the Queensland Department of Natural Resources and Mining, is that right?

DR NATHAN: That's correct.

MR CALLAGHAN: Were there other agencies from whom you would have liked to - or put it this way: now, in accordance with what's agreed ought to be done, were there other agencies from whom data ought to be collected in a comprehensive study?

DR NATHAN: I am comfortable at the time, they were the agencies that had the most relevant data sets for us at the time.

MR CALLAGHAN: Now, would there be others that-----

DR NATHAN: Of course, now you'd need to involve Seqwater, and I think - depending on the scope of the investigation, you also expect Brisbane City Council, obviously, to be heavily involved in that, as they were in this study.

MR CALLAGHAN: All right. Still on page 9, it is noted that the data sets were taken as provided. We infer that means there was no independent verification undertaken as part of this study?

DR NATHAN: That's correct.

MR CALLAGHAN: Would that be something that would be done in what's now suggested as the preferred way forward?

DR NATHAN: Yes. You will see in the joint statement we have prepared that one of the problems that have beset most people undertaking studies is you tend to have a starting point that relies on information from previous studies, and as these studies are often separated by long periods of time, it can sometimes be quite difficult to find the relevant information and to understand the assumptions behind that data and how it was used. So you end up being presented with data that you end up having to take and use and it would take quite considerable effort sometimes to understand the source and the assumptions used to derive that data.

MR CALLAGHAN: Okay. If we could move to page 31, the section on hydrologic modelling. It is stated there the models which were used. So no model was created from scratch?

DR NATHAN: That's correct.

MR CALLAGHAN: Again, is that a different process from that which is now suggested by the panel?

DR NATHAN: Yes. We feel that it would be quite important to - at the commencement of this process to develop either a new model or model that takes advantage of the modelling capability and understanding that's been developed over that intervening period.

MR CALLAGHAN: All right. Page 31 also it is noted that the model runs were undertaken only for the 1:100 AEP flood event. Does this mean not across the range of probabilities from 50 per cent to a PMF - probable maximum flood?

DR NATHAN: That's correct, yes.

MR CALLAGHAN: Again, that's something that the consensus now should be done?

DR NATHAN: That's correct.

MR CALLAGHAN: Page 36, towards the bottom of the page, comparison of Q100 estimates. Such a comparison is part of the work suggested by the joint expert statement now, is that right?

DR NATHAN: Yes, that's correct. An example of that.

MR CALLAGHAN: There was a difference in the Q100 result obtained using those two methods?

DR NATHAN: That's correct.

MR CALLAGHAN: You say at the bottom of the page there that the difference indicates that there are underlying factors which have not been adequately addressed to date, is that right?

DR NATHAN: That's correct.

MR CALLAGHAN: On page 37 you have a list of those factors?

DR NATHAN: Correct.

MR CALLAGHAN: And, once again on page 37, there is reference to the fact that a Monte Carlo framework would enable at least the first four factors to be dealt with?

DR NATHAN: That's correct.

MR CALLAGHAN: All right. Again, this is something that's now within the scope of what's recommended by the joint expert statement, I think paragraph 22 to 24?

DR NATHAN: That's correct.

MR CALLAGHAN: Can I take you to page 40 of the 2003 study? It is noted that it didn't - the study didn't investigate - this is right down the bottom - "didn't investigate partial catchment storms on the lower Brisbane, Bremer and Lockyer catchments"?

DR NATHAN: That's correct.

MR CALLAGHAN: That is work of a kind which would be undertaken if the effect was given to the joint expert statement?

DR NATHAN: That's right. So the issues raised there would be naturally accommodated within a Monte Carlo framework.

MR CALLAGHAN: And that's - the reference to Monte Carlo occurs again twice on page 42, is that right? The second paragraph and the last paragraph on that page?

DR NATHAN: That's correct.

MR CALLAGHAN: On page 44 there is a reproduction of the table which contains a plausible range, and it is immediately followed by another qualification that the hydraulic modelling did not take tidal level variation into account, is that correct?

DR NATHAN: That's correct.

MR CALLAGHAN: Is that something which would now be addressed?

DR NATHAN: Yes.

MR CALLAGHAN: Page 46 of your conclusions, you say that the - this is in the second full paragraph, "The boundaries of the plausible range are reasonably broad. This reflects significant sources of uncertainty", and so on?

DR NATHAN: That's correct, yes.

MR CALLAGHAN: And further down that page there is another reference - this is in the third paragraph from the bottom - another reference to the Monte Carlo framework, is that right?

DR NATHAN: That's correct, yeah.

MR CALLAGHAN: Further references to the Monte Carlo framework on page 48?

DR NATHAN: Yes.

MR CALLAGHAN: Okay. So there may be other qualifications and limitations. As I say, if there were any in particular to which you wished to draw our attention, please do, but in some the - this study was - or this report was delivered in circumstances where the data capture and analysis was not that which is now recommended as should be done?

DR NATHAN: That's correct.

MR CALLAGHAN: The hydrological modelling was not done on a Monte Carlo basis?

DR NATHAN: Correct.

MR CALLAGHAN: And the hydraulic modelling was not completed with the level of rigour which is now suggested by everyone sitting near you?

DR NATHAN: That's correct.

MR CALLAGHAN: The limitations weren't just stated in the report, is that right; you made the council aware of them during this study?

DR NATHAN: Yes. There was interaction with Brisbane City Council and the independent review panel during the course of the study.

MR CALLAGHAN: Your statement is Exhibit 884, and in paragraph 45 you speak there about some discussions with representatives of the Brisbane City Council and the Independent Expert Review Panel. These are discussions in which your view about the desirability of the Monte Carlo method was expressed, is that right?

DR NATHAN: Can you just refer again - this is paragraph-----

MR CALLAGHAN: I am sorry, paragraph 45.

DR NATHAN: Of my witness statement?

MR CALLAGHAN: Of your statement.

DR NATHAN: Yes, that's correct. It is, yes.

MR CALLAGHAN: And you made the point also, I believe, that a meeting of the Independent Expert Panel, the minutes of that meeting are attached to your statement as annexure 31. Can I refer you to those? The last page of those minutes in the box headed number 6, the second paragraph of that box. We can read what it says. "Much discussion as to how this can be developed to assist in the main task", and so on. The last words, "six weeks, ie TOO LONG", in capital letters. Can you put that in context for us, the "too long"?

DR NATHAN: As I said, there was about a one to two-month period available to do the investigations that this report is based on, and during the study it became evident about - it became evident to us how important this issue of variability was to consider, and while it was recognised during the course of the study that Monte Carlo approach would address that, it was also recognition that there was no way that that approach could be implemented within the available time period.

MR CALLAGHAN: It all came back to the time-frame?

DR NATHAN: Correct.

MR CALLAGHAN: Okay. Can I take you to the draft report dated the 8th of August 2003? That was a draft report provided to the Independent Expert Review Panel. Page 4 of that report - that's number 5, gentlemen, on your expert reading list, and I am taking you to page 4 -where the significant - the sources of uncertainty that could affect the Q100 estimate are identified. Can I ask you are these the sorts of things that are going to be - would be eliminated following the adoption of the approach suggested by the panel?

DR NATHAN: Look, they would be. The lists - the source of uncertainty on that page specifically relate to the flood frequency analysis, that is the statistical analysis of historic data. This would be - it is a kind of a special subset of the broader issues addressed in the joint statement.

MR CALLAGHAN: I probably don't need to take you to it but the SKM draft report of 22 August 2003, which is number 4 on the

reading list, you can take it from me that on page 1 of that report there is also a reference to the fact that the most appropriate way to deal with the study is to undertake Monte Carlo analysis?

DR NATHAN: That's correct.

MR CALLAGHAN: The point was made repeatedly, in other words. Okay. Can we move then to the Independent Expert Review Panel Report, which is number 1 on the reading list. Professor Apelt and Mr Weinmann, you were both part of this panel which was to review the estimates of Q100 given by Sinclair Knight Merz. So I will address my questions to either or both of you. But the panel's work, you'd agree - well, it was a review, but even allowing for that, it is probably obvious that the panel's work did not extend to all of the work that is required for a comprehensive flood study as now set out in the Joint Expert Statement?

MR WEINMANN: I will start off.

MR CALLAGHAN: Do I have to choose?

MR WEINMANN: Yes, I think that's quite correct. The basis of it was the work that was presented in these draft reports.

MR CALLAGHAN: And Dr Nathan has explained the limitations on that?

MR WEINMANN: Dr Nathan has explained and the discussions that took place during that process, there were some other stakeholders involved. We had presentations from Brisbane City Council and we had presentations from DERM representatives at the time. But it was mostly based on the detailed analysis, or the analysis that was reported in this draft report.

MR CALLAGHAN: Can I ask you this: what was the time-frame within which you were required to prepare this report?

PROF APELT: We had five weeks from our first - the first meeting was probably telephone or email meeting until the presentation of the report which was a little bit after the date the council initially set, which was 25th of August.

MR CALLAGHAN: Right, okay. And, look, again, the - your report stated clearly the limitations - its own limitations, and I will just take you to (i) in the executive summary. The second paragraph from the bottom indicated "there is an inevitable degree of uncertainty in any estimates of this kind."?

PROF APELT: Yes, that's correct, yes.

MR CALLAGHAN: And, indeed, you indicate that the uncertainty could be reduced with further investigation as outlined later in the report?

PROF APELT: That's correct, yes.

MR CALLAGHAN: Page 19, I think, you set out a number of areas of remaining uncertainty. We can read them for ourselves but that was all included as a qualification on that which was being proffered by the report, is that correct?

PROF APELT: That's certainly correct, yes.

MR CALLAGHAN: Yes. And, as I say, we can check those for ourselves. On page 20, down towards the bottom of the page under the heading 4.8, Best Estimates, there is reference in that paragraph to spacial distributions of the design storm which was used to calculate the Q100 and was regarded as critical, is that correct?

PROF APELT: Yes, that is correct.

MR CALLAGHAN: That was not something - I am sorry-----

PROF APELT: Mr Weinmann might want to add to that?

MR WEINMANN: Yes, I think this was undertaken as a sensitivity analysis; in other words, to determine how the variability in this particular factor affected the results. That's quite different from a Monte Carlo analysis in its scope but it is the sort of thing that I think Dr Nathan suggested that should be done at the outset of his new study to assess sensitivity to various factors.

MR CALLAGHAN: Yes. You made recommendations at the end of the report - well, if I can take you to page 22, paragraph 5.2(a)? There was a recommendation for Monte Carlo analysis in respect to storm variability. You strongly recommended that such a study be done. In the last sentence at paragraph (a) there, is that right?

MR WEINMANN: Could you just state that one?

MR CALLAGHAN: Page 22.

MR WEINMANN: Yes.

MR CALLAGHAN: Paragraph 5.2.

MR WEINMANN: Yes.

MR CALLAGHAN: Subparagraph (a).

MR WEINMANN: Yep.

MR CALLAGHAN: The last sentence of that paragraph you made a strong recommendation?

MR WEINMANN: Yes. Yeah, that's quite correct, yeah.

MR CALLAGHAN: Okay. There are further recommendations contained in there?

MR WEINMANN: Yeah.

MR CALLAGHAN: The obvious point being that for the reasons I think Dr Nathan has identified, which obviously obtain to what you were doing as well, namely time limitations, these things were not done?

PROF APELT: That is correct. I think also it is worth adding that within that paragraph we were looking at before, SKM were working under very difficult time constraints and the independent review panel likewise, but also asking SKM to do further work-----

MR CALLAGHAN: Yes.

PROF APELT: -----it was very much a challenging process to get to the result we did, and we have underlined the uncertainty attached to all of the recommendations because of the incompleteness of the analysis.

MR CALLAGHAN: You did.

MR WEINMANN: Can I just add something? I think perhaps the executive summary on page (i), at the bottom paragraph, perhaps puts this a bit more into context. In other words, what the panel directly found and what it recommended then needed to be done beyond that.

MR CALLAGHAN: Yes. Was there communication about these topics beyond that which is contained in the report or was the report a document which spoke for itself?

MR WEINMANN: Yes, that was it.

PROF APELT: When you say communication, between the panel and SKM or-----

MR CALLAGHAN: No, to the council?

PROF APELT: No, there was a further presentation of Independent Review Report to the council. I was certainly there present - I don't think all members were there - but one of the points we had recommended and which I emphasised here was that what we had done was the best estimate on - with the information available, but that the existing defined flood level which was higher, we strongly advised them not to lower it.

MR CALLAGHAN: All right, thank you.

PROF APELT: And that recommendation was accepted.

MR CALLAGHAN: Yes. And finally in this exercise, Mr Babister, your report is number 7 on the expert reading list. And that responded to a request to give an estimate of the Q100 key locations on the Brisbane River and to estimate the magnitude of the January 2011 flood event. You were given

approximately one month to complete that report?

MR BABISTER: Yeah, probably slightly less than a month.

MR CALLAGHAN: Okay. In that report you qualify answers that you gave to some of the questions. In paragraph 2 you identify problems with the data set, is that correct?

MR BABISTER: Yes, particularly with the rating and also not being able to sort of confirm some of the assumptions.

MR CALLAGHAN: And, indeed, made recommendations around the resolution of those issues?

MR BABISTER: Yes. The conclusions section has some quite extensive recommendations, and the sort of work that I did here would be like one small part of the study we have described of the experts, and at one location when you do this sort of work at multiple locations.

MR CALLAGHAN: All right. And if we move to page 41 and paragraphs 147 to 149, they are some of the recommendations that you refer to, and there is also a qualification about the uncertainty for the rating curve at the Port Office gauge, is that correct?

MR BABISTER: That is correct.

MR CALLAGHAN: Well, gentlemen, can I ask you all to turn to the joint expert statement and to paragraph 43 of that statement, because as I conclude I will direct this question and ask for a response from each of you, because we read paragraph 43 and I'd suggest to you that if a member of the public came upon this paragraph in isolation, without any of the context which we have enjoyed over the last few days, but someone reading this paragraph in isolation would be curious as to the practice adopted or at least what was being done by hydrologists in the past, because the fact is that requests for an estimate of the Q100 have been met, questions posed to hydrologists on this topic have been answered, and it might well be asked why, having not done the work you now recommend, hydrologists have been willing to give estimates of the Q100 to Local Governments, and I will invite comment from all of you. I might begin with Dr Nathan. Do you have an observation or a response to that proposition?

DR NATHAN: I do feel there are sort of two parts of this - probably three parts. I think it's important that - for the studies that have been undertaken to date hydrologists do talk about there's no dam situation and current dam, and I appreciate for nonhydrologists you'd think the former consideration was pretty irrelevant, but to a hydrologist it's actually really vitally important to be able to understand what that no dam Q100 estimate is and - because it really reflects the flood risk due to nature, it's the natural flood risk, and the only way of getting a handle on that or the best way of getting a handle on that is through a long - a long period of record, and we have actually got that in the Brisbane River, and what we will see over the last few decades of studies, most people have come up with an estimate that is about the same. So, I think that is an estimate that's reasonably robust, and Mr Babister in his most recent work, I think, importantly showed that even if we take account of the January 2011 event occurring, that doesn't change our understanding of what that natural flood risk is in the catchment. So, very - and I think all the experts would agree that we're about right on that.

Where we fall down in the process, then, is converting that to current conditions. I think the good news is we don't need to wait 160 years of - to get data to actually understand that, but - the problem is quite tractable, but it is complex. So, I think when you're asked a question as an engineer you will try and come up with an answer within the given constraints - I think that's, if you like, a differentiation of engineering from science - and we then qualify that answer with our concerns around uncertainty, and so I think we have provided answers within the time constraints, we have qualified our answers, and I think possibly what we haven't done a good enough job of - job probably as a profession is truly communicating what that uncertainty is and what the implications of that uncertainty are for future decisions.

MR CALLAGHAN: Okay. Dr Leonard?

DR LEONARD: I think anything I have to say is really just

going underscore exactly what Rory said, that we provide estimates, best estimates, we do our best, because that's what's required and that's the job of an engineer, but quite often there are significant limitations and maybe they're best estimates but also they're not as good as what we'd like, and so they get flagged with all of the caveats and qualifications, and I think perhaps a weakness has been to clearly communicate how crucial or how important some of those limitations really are.

MR CALLAGHAN: We might bring the microphone right down to Dr Markar and take it down.

DR MARKAR: Thank you. I agree with what has been said before, but I would also like to add that the methodology, the models, tools, that's been available for these type of studies has evolved and improved over time, so it's probably not fair to criticise all the work that's been done in the past, because they have been based on the best available tools and methodologies available at the time. For example, even Monte Carlo methods, even though it's been talked about and said maybe in the last 10 years or so, the tools to do that type of modelling have not been freely available to hydrologists until recent times, and the other factor, obvious factors, is the limited scope given to hydrologists and the limited time available to come up with results. That's been probably a factor and some of the limitations in the previous work as well.

MR CALLAGHAN: Thank you. Mr Collins?

MR COLLINS: Well, the first thing I'd say is we don't actually know yet whether the previous studies were wrong

MR CALLAGHAN: No.

MR COLLINS: So, we have got to do the detailed studies to determine that

MR CALLAGHAN: That's not really what's being asked, though.

MR COLLINS: Well, let me continue in a different vein then. One thing that is different from the previous studies is that the January 2011 flood, it changed conditions so substantially in the river systems that completely new models are required, both flood and hydrologic models, and that is a significant change and that change alone may explain some differences, at least in flood levels, that have been experienced, and just supporting what Dr Markar said, the Monte Carlo analysis has certainly been used in cyclone work for some decades, but its use in flood work in the general industry and in practice, and Rory will correct me if I'm wrong, I would have thought probably the early 2000s was when it was really starting. So, whilst that's a little while ago, it's not that long ago in the bigger scheme of things.

MR CALLAGHAN: It was certainly being recommended by Dr Nathan and the panel in 2003.

MR COLLINS: I acknowledge that

MR CALLAGHAN: Mr Bewsher?

MR BEWSHER: I think we need to be aware that hydrology is an inexact science and models are only approximations of real world behaviour and it's always possible by more effort to get a better or alternatively to reduce the uncertainty in the answer provided. The recommendations that this group has come up with in their answer to question 6 in the joint report flows from a large amount of work done by the eight individuals at this table, the benefit of information from the 2011 flood. I'd agree in relation to Monte Carlo that the actual Monte Carlo approach is - it's a reasonably straightforward approach, the methods have been available for a long, long, time, but to application in a river flood study like the Brisbane River, I'm not aware that that has been undertaken to date, and I'd certainly agree that one of the issues is the computing power needed to actually do that. So, as time has gone on, some of these techniques, the ability - although we knew those techniques existed, the ability to practically apply them has changed over time. Yes.

MR CALLAGHAN: Thank you. Professor Apelt?

PROF APELT: I would agree with what has been said. I particular endorse what Mr Collins has said about changes to the system requiring a reanalysis now. I have a slight footnote to what Mr Nathan said about the pre-dams flood frequency analysis. I accept what he says and agree that that's the conclusion that comes out of what has been done. I have - would like to see myself a closer study of the estimates of the actual flood flows that are - form part of that flood flow analysis. It may have already been done at a sufficient level of accuracy to satisfy me, but I haven't seen that evidence.

In terms of - turning to the question of the - answering the Q100 from the point of view of post-dam situation, I agree, again, with what has been said in terms of the answers were given that were possible within the constraints. I would like to make a point of a general kind, and it was touched on by one of the others, that models don't describe reality, they provide a basis for judgment. The estimate of the Q100 might be simply about that's their best estimate for what might happen. Where I think the - we could have done better was actually making sure that the people who were going to make judgments on those estimates did it in the context of a flood risk analysis coming back to the point we've made about not just fixated on the Q100.

MR CALLAGHAN: Yes.

PROF APELT: But that's - you know, shall we say that's a bit of rear vision situation because the approach throughout the profession and generally has been developing and there's always a catch-up issue, and my final comment would be, sure,

we recommended in 2003, and others did, of a Monte Carlo analysis. It would have been a much huger undertaking then than it would be now, because of the growth in computational power.

MR CALLAGHAN: Okay.

MR WEINMANN: Yeah, I would like to add something about how uncertainty is treated. The revision of Australian rainfall and run-off that Mr Babister referred to previously will strengthen the - will really ask practitioners to much more clearly identify uncertainties and state them than has been asked in the previous guidelines, and there are actually - the recommendation is also to use risk management based approaches, and there are approaches that can use this information on uncertainty as a basis for decision making. So, it's - the point, in fact, I make is that both the best estimate and the statements on uncertainty can be used for decision making, so that they're not - it's not just the best estimate that that's of interest in the decision making process.

MR CALLAGHAN: Right. Is that something that you think has been clearly enough communicated in the past?

MR WEINMANN: I think that's been an area that has evolved in this period of time and I think this - the developments within this Australian rainfall and run-off guideline reflect that. So, I think that's been an important change in this period.

MR CALLAGHAN: Mr Babister, I will give you the last word.

MR BABISTER: There is really not much more I can add to my colleagues' comments. I think they have covered nearly all the issues, and just to reiterate, hydrology is an inexact practice and there will always be some uncertainty and - what we're called on to do all the time is really to make best estimates in complex situations, and the technology - we might have had Monte Carlo analysis in this field for nearly 10 years, but even defining this problem to get the volume and the peaks and the timing correct is quite challenging and it might not even be the total answer. I would suspect that the actually the PhD that Michael's - Dr Leonard's recently finished probably will show a new way forward in five or 10 years once we get a better radar database to parameterise that work, so there be still be some residual uncertainties after all this work.

MR CALLAGHAN: Thank you. Thank you, Madam Commissioner?

COMMISSIONER: Thank you.

MR CUMMINS: I have got three questions.

COMMISSIONER: Deputy Commissioner Cummins has some questions.

MR CUMMINS: I have just got three questions. The first to Mr Collins: you have referred to the changes in the hydraulic

environment due to sediment movement in the recent floods. Do you have a methodology for including that sedimentation movement in the next one per cent flood?

MR COLLINS: One of the recommendations in our joint report has been to do field investigations to collect more geomorphologic data on sediment movement, and the hydraulic models that are available now have inbuilt capabilities of moveable bed hydraulics; that is, during the flood the cross-sections - the actual flow carrying channels change. The challenge is actually getting enough information on pre and post floods to be able to calibrate those models, but with the computational power now available, whilst I don't believe it's feasible within the framework of the Monte Carlo simulation, some sensitivity testing can be done, and because of the changes that occurred in the 2011 floods in the major water ways and because we had surveyed before the flood and now after the flood, there is a reasonable proposition of actually being able to calibrate those models.

MR CUMMINS: The second one I am not sure about, perhaps Mr Babister. In section 20F of the joint report you refer to dam operations. Do you think that might be - we might be better to clarify that a little bit by referring to the need to take into account both human risk issues and gate operation - gate reliability into that?

MR BABISTER: That's right. I agree, there are two components to that. One is human decision making type aspects and the other part is operational behaviour and just what occurs

MR CUMMINS: And that they need somehow to be incorporated into the model?

MR BABISTER: Yes

MR CUMMINS: Okay. And the final one to Professor Apelt is that is it correct that we would need to do a something similar but perhaps scaled down version of the Bremer study into each of the other major tributaries within Brisbane, particularly, say, the Oxley Creek?

PROF APELT: The kind of study would be somewhat different. Yes, scaled down, but the dimensions of it would be somewhat different, because they - Oxley, for example, is a much simpler interaction, even though it's a very complicated catchment, than what happens between the Bremer River and the Brisbane and the dam. So, yes, but conceptually there will be some differences, not just scaled down.

MR CUMMINS: Thank you, Commissioner.

MR CALLAGHAN: We did propose to rearrange at the Bar table because of visibility issues.

COMMISSIONER: I will just check where we're going first. But Mr MacSporran, I think you'd indicated you hadn't questions?

MR MacSPORRAN: Yes, that's currently the case. We had agreed at the Bar table, if it was convenient to you, Commissioner, that Mr Dunning goes first.

COMMISSIONER: All right.

MR MacSPORRAN: And then we will see what happens after that, but I certainly have none at the moment.

COMMISSIONER: Okay. Do you propose to swap with Mr Dunning, Mr Callaghan?

MR CALLAGHAN: We can.

COMMISSIONER: How are you placed, Mr Dunning? Can you talk from there?

MR DUNNING: Commissioner, provided it's acceptable to everybody and the experts use the microphone I have no difficulty staying here.

COMMISSIONER: All right. Before you begin, can I suggest to you that most of the questions outlined in respect of most of them you have really won the point without firing a shot already, haven't you?

MR DUNNING: Well, Commissioner, I really wouldn't - I probably wouldn't adopt necessarily that language, but the points that were critical to me I would expect on the basis of Exhibit 881 must inevitably now be resolved in favour of the argument we put.

COMMISSIONER: All right. Can I work through some of them with you perhaps?

MR DUNNING: Of course, Commissioner.

COMMISSIONER: The Terms of Reference - this is the Commission's Terms of Reference to Mr Babister.

MR DUNNING: Yes.

COMMISSIONER: I will hereby make the admission on the part of the Commission that he was asked to do something which was just unrealistic and that the result in consequence is based on an examination which isn't of the sort of robustness which would ever lead you to rely on the result. Sorry, Mr Babister, but I think we may have wasted your time, although the end result is probably worthwhile because of the examination it's caused.

MR DUNNING: Certainly, Commissioner. May I interrupt - I am reluctant to interrupt - but I hope we haven't not conveyed any sense of the pejorative in the way we've approached it.

COMMISSIONER: No, not in the least. I am simply being straightforward about this and saying you're right about one effectively.

MR DUNNING: Yes.

COMMISSIONER: Topic 2, the Q100 number without dams, I suppose there might be some sort of live issue there, although there seems generally to be acceptance of the 12 to 13,000 CUMECS figures.

MR DUNNING: Perhaps, Commissioner, if I may reflect this back to you and perhaps it will speed it up. It seems that anybody, even somebody like me with no scientific background, provided they nominated a number between about 11 and 14,000 couldn't actually be told they were wrong. We put the position no stronger than this: for the reasons we have articulated, you would not presently move from the 12,000, that is the current theory, to the 13,000 that's propounded in Mr Babister's report, but it's accepted that it's a matter that will be the subject of a full review. That's the extent of what we want to make about point 2.

COMMISSIONER: I think we're ad idem on that.

MR DUNNING: Very good, Commissioner.

COMMISSIONER: Topic 3, Mr Babister with the other experts recommends the Monte Carlo approach. We pushed him into a situation where it couldn't be applied, so I don't know that it's worth labouring that point.

MR DUNNING: Yes. Commissioner, on the issue of dam attentuation, may I make this point, and - sorry, I hope I am not interrupting you.

COMMISSIONER: No, not at all.

MR DUNNING: The point that we most want to illustrate in relation to this topic of dam attentuation and to the extent, in our respectful submission, is not fully appreciated yet, at least in a broader public sense, is that, if I can perhaps be a little inelegant about it, but if you view the vessel as a dam - the dam as a vessel, it has a certain capacity. During the flood events of a limited magnitude it will have good attentuation results. During an event of enormous magnitude it will have ever-decreasing attentuation results, so that you don't get this linear relationship between peak inflows and peak out flows, rather you get a curve that indicates exactly that, during events of lesser magnitude you achieve greater attentuation and greater magnitude, lesser attentuation, to potentially the point where you are achieving virtually no attentuation because the dam is now full to its capacity.

Now, there are a number of other complicating factors in relation to that in relation to things like temporal space and distribution of rainfall and other - I am oversimplifying it, but the point that we do think is important to illustrate is that the nature of dam attentuation is a curve, so that ultimately everybody, the public included, will come to understand that during a smaller event you will get good -

excellent attentuation, in fact. In 1999 most people probably didn't realise we had a flood.

COMMISSIONER: All right. Look, essentially you want to ask some questions about that.

MR DUNNING: Yes.

COMMISSIONER: Fine. Topic 4, the unreliability of Mr Babister's calculated Q100 levels. It is academic, isn't it, given that we all accept that a different approach is needed anyway?

MR DUNNING: Yes, provided that's accepted, yes.

COMMISSIONER: I am not giving anything away that I shouldn't be here, Mr Callaghan?

MR CALLAGHAN: No, I thought that was fairly - if it wasn't flagged clearly enough in that which has transpired already, I don't think that's controversial.

COMMISSIONER: All right. Topic 5, I wasn't quite sure what you were getting at there, Mr Dunning. I didn't notice that there was a particular characterisation of the previous studies, I thought it was more just a setting out of the history of them without much in the way of analysis.

MR DUNNING: Look, there's some commentary that surrounds the - those studies around the period of 1999 and they produce those three high estimates of the Q100 number, and the point ultimately we want to make is - and, in effect, they're critical in provoking the inquiries that lead to Dr Nathan and SKM's report in 2003 and the expert panel review in 2003, and what it demonstrates is the three high Q100 numbers that have been arrived at were plainly wrong. Our concern is that Mr Babister's report, and we understand that the concessions that are being made and the utility of doing so, nonetheless remains an historical record and for that reason needs to be understood in its context. I naturally take the full force of the intimation that you are making to me that we not traverse points that have become sterile because of where the parties have got to.

COMMISSIONER: All right. I am not quite sure yet just exactly what you want to cover there but I think we might cross that bridge when we come to it.

MR DUNNING: Very well, Commissioner.

COMMISSIONER: Topic 7, Mr Babister's estimates are premature.

MR DUNNING: That correct.

COMMISSIONER: Well, that's clearly so given that a much more exhaustive approach is needed.

Topic 8, I didn't really notice again that Mr Babister had

criticised the SKM 2003 hydrological model.

MR DUNNING: Commissioner, I think I'd have to in light of the concession I made though from the previous one - I am happy to develop the point if you want me to - but it's difficult to see that that isn't a matter that isn't squarely within the purview of the study that everybody recommends, is to properly reassess the - properly reassess the models and, indeed, as Mr Collins pointed out a little earlier, we won't actually know whether these things are right or wrong until that process has been undertaken. So, that's not the point that I need to press.

COMMISSIONER: All right. Well, having streamlined it thus far, if you want to proceed on that basis then?

MR DUNNING: Thank you, Commissioner. Commissioner, may I tender, please, three documents? If I may I will pass them up to you as a bundle, and copies for your Deputies, Commissioner, and a spare copy for the record. I have handed copies to all of our learned friends. Commissioner, the first of those is really just a glossary of some terms which we thought might be useful. I have asked Professor Apelt to have a look at them. I will get him to refer to them specifically, but subject to one minor qualification it's a glossary he would adopt. I thought it might just be useful for later reading the evidence.

COMMISSIONER: Do you want it as an exhibit or - I don't mind either way.

MR DUNNING: I was content to make it an exhibit but I'm in your hands, Commissioner.

COMMISSIONER: All right. Eight eight six.

ADMITTED AND MARKED "EXHIBIT 886"

MR DUNNING: Commissioner, the second document is an illustration that Professor Apelt's prepared over the last couple of days. I'll get him to speak to it in due course but perhaps it's convenient if I tender it now.

COMMISSIONER: That will be 887.

ADMITTED AND MARKED "EXHIBIT 887"

MR DUNNING: And, finally, Commissioner, there's an exchange of correspondence. My solicitors wrote to the Commission to qualify an aspect of Mr Babister's report that we assumed but we're not sure of. The Commission kindly responded confirming that to us and we prepared a table that reflects that. We will - can I tender that now, but we will give Mr Babister, obviously, an opportunity to look at it and see whether he is happy with it.

COMMISSIONER: Exhibit 888.

ADMITTED AND MARKED "EXHIBIT 888"

MR DUNNING: And we will have a bundle circulated to each of the experts now, if that's convenient, of those three exhibits.

Gentlemen, for those of you who don't know me, my name is "Dunning". I appear on behalf of the Brisbane City Council. Can I perhaps start from the proposition that our learned friend Mr Callaghan finished on, and that is this question, no doubt I'm hoping to illuminate for the public, why it is these numbers are not set in stone?

Can I suggest some context, and I will ask each of you about it, but can I suggest to you that the appropriate context in which to look at an analysis of Q100 over the period with which we are particularly concerned is this: you have a flood in Brisbane - a river flood in Brisbane in 1974. It promotes

the construction of major dam in the form of Wivenhoe that's finished in around 1984. There is obviously a good deal of engineering that goes into the design and construction of that dam. That produces the study in 1984 by Weeks that Mr Babister refers to in his report and strikes this metric of Q100. But it necessarily does so to the backdrop of the work that had gone into designing the dam that was just finished.

There are a number of additional studies that Mr Babister records in his report during the 80s and into the 90s. In 1999 you have a flood in which the dam is able to attenuate with complete success. Controversy arises at the end of 1999, or at least by the end of '99, as to whether a higher Q100 figure should be settled upon. A number of figures are posited. The response to that is to, in 2003, engage SKM to consider the topic of an appropriate number and to then have that reviewed by the expert panel, which, upon doing that, does not find a justification to depart from the number that had - or around the number that was then being used and had then been adopted.

At about that time Monte Carlo becomes a viable option to consider riverine flooding but the capacity to use Monte Carlo is vastly enhanced in that period really between 2000 through to the 2011 flood by the great increase in computation power and then you have the 2011 event which brings with it the changes and the new information to Mr Collins has adverted, and, in effect, you have a coincidence in terms of time of the new data that comes as a result of 2011 - the 2011 event coinciding with the capacity to exploit Monte Carlo because of the enhancements in computation in a way that wasn't the case 10 years or possibly even five years before.

Now, perhaps, Dr Nathan, if I can start with you - a long question, I appreciate - but is that a fair comment in which to consider the question upon which our learned friend Mr Callaghan finished?

DR NATHAN: In summary I'd agree. I think we're better placed now to address this more comprehensively than we would have been 10 years ago, and I think probably particularly with respect to the space:time correlations associated with the extreme rainfalls.

MR DUNNING: All right. And can I just ask you to elaborate on why we're better equipped when it comes to the space:time correlation.

DR NATHAN: I think our understanding of how to take advantage of information that we've gained out of radar information and there's been quite a bit of statistical work by Dr Leonard and others who have been able to characterise the behaviour of extreme rainfalls in a way that you could employ very usefully in Monte Carlo. So I think we would be in a position to employ that in a more sophisticated and more robust fashion today than we would have been five or 10 years ago

MR DUNNING: Thanks, Dr Nathan. Perhaps we might go down to Dr Markar and then just work our way back up.

DR MARKAR: I agree with what Dr Nathan said and not a lot more I can add except that, as I said before, the tools, the computing power available to-----

MR DUNNING: Excuse me, Dr Markar, could I ask you to talk a little closer to the-----

DR MARKAR: Sorry.

MR DUNNING: That's all right.

DR MARKAR: I agree with what Dr Nathan said before and the tools and the computing power we have to better analyse the hydrology of the Monte Carlo method has certainly improved and that will make it - that will enable us to assist these - look at these things in a more comprehensive manner and reduce the level of uncertainty we would have had otherwise a few years ago.

MR DUNNING: Thanks, Dr Markar. Mr Collins.

MR COLLINS: I don't really have a lot to add. I thought the summary I agreed with from my understanding of what's happened. I have seen some Monte Carlo work on flooding done earlier, that is in the early 2000s, but it was on much simpler systems. I mean, we've got two major river systems, we've got two dams, we've got a very complicated system, dam flood mitigation, we've got a large number of significantly contributing tributaries, it just adds to the complexity of the problem, so I suspect when Rory Nathan - I suspect he would actually have a better answer on what would actually be physical - more technically-feasible at the time but even now it's a fairly challenging task.

MR DUNNING: Mr Collins, perhaps if you could, a number of you, yourself included, have spoke to this increasing power of computation in relevantly recent years. For those of us who are not engineers can you try and give some practical examples of what a computer can do now compared to what, say, a qualified engineer would have had to do manually a nominated period before?

MR COLLINS: Well, I will put it in context of my particular expertise, which is in hydraulics. I'm not a hydrologist and others can comment on that, but when I started practise in the early 80s you could run a model that might have had several hundred computational points. By the 90s we were running tens of thousands to hundreds of thousands. We can now run models with millions of points and in oceanographic models multiple layers, so tens of millions of points, and it's all governed by - in a practical sense by being able to do the runs in a reasonable time frame, and that rule hasn't changed significantly since the early 80s, from a practical sense, in that unless you can get runs to run overnight models really are very hard to use except for very specific purposes. The

computational power is going up so quick we can run tens of millions of point model now relatively - relatively quickly with supercomputers

MR DUNNING: Now, does that - does that bear upon the explanation you gave to me a little earlier that the instances of Monte Carlo you could think of sort of 10 years ago related to simpler systems than the Brisbane-Bremer system?

MR COLLINS: Well, again I would respect the evidence of some of the other experts who are more qualified in that area than me but from other studies I've done that's certainly the case.

MR DUNNING: All right, thank you. Mr Bewsher.

MR BEWSHER: Yes, I'm not sure I can had too much. I just say, and I think the 2011 flood itself has added information and I'm by no means an expert in what all of that information is and haven't followed the conduct of this Commission as closely as others, but issues relating to human factors, double-peaked event, better rainfall information, information about how the river itself can scour during the event. I mean, it's not only the computational power, the 2011 itself has also added information.

MR DUNNING: So, Mr Bewsher, just before you take the microphone away, does that mean that inevitably there will be some learning as a result of an event like 2011 that you cannot get without the event?

MR BEWSHER: Of course. I think that's self-evident

MR DUNNING: Right, thank you. Professor Apelt.

PROF APELT: I think your initial question was about changing in computing-----

MR DUNNING: It was really to identify, in relation to the question Mr Callaghan had last asked you gentlemen about, and that was, well, why is there this controversy, and, in effect, why have we now embarked upon this large task? It was really to set out for you whether that was - well, I set out for you, was a reasonable context in which to under the figures that have been arrived at to date.

PROF APELT: Yes. Well, I believe it is. I don't have - don't disagree with anything that's been said by my colleagues. I would like just to, shall we say, give a local example of what might be - and what might be more meaningful to people here about the effect of computational power. After the 1974 flood, when Wivenhoe Dam was built, an estimate was calculated as to the impacts of the Wivenhoe Dam on the 1974 flood if it had been in existence. That was done with a one-dimensional model, and by that we mean that the whole of the cross-section of the flood at one point was characterised by a level and an average velocity. And it was done in steady state because that was as much as computing power allowed to be done. And that, indeed, was the basis of the defined flood

level ultimately. Now, the same organisation has a two-dimensional model which is time-dependent to cover the full extent of the floodplain and is able to simulate floods, you know, over a whole range of magnitudes and behaviour. So in - just one example of how we can do things now that we would have liked to have done a long time ago. And ultimately the - the sequence that you referred to certainly accords with my knowledge of it, the only comment I'd make was that when you - there was reference made to controversy in the - would have been the late 80s - sorry, late 90s, it was more within council officers working through processes and trying to come to some understanding of what the situation was. As far as I'm aware the controversy was normally in that level of professional discussion and debate.

MR DUNNING: Yes. Yes, thanks Professor Apelt. Mr Weinmann.

MR WEINMANN: If I understand correctly you will want to explore what the feasibility and practicality of application of Monte Carlo simulation approach is.

MR DUNNING: Yes.

MR WEINMANN: Yes. Well, in the early 2000s this was part of a CRC for catchment hydrology research project that I was the project leader of and so it was a really researched stage methodology at that time and by the - by 2003 it had been proved that it could work so the feasibility was established, but there were very limited applications at the time, and since then some applications have been produced but none of that - the complexity of this particular situation, and I think we've identified that as a - still a cutting edge sort of application at the moment. Yeah, I think that-----

MR DUNNING: Thank you, Mr Weinmann. Mr Babister.

MR BABISTER: Could you repeat the question, it's been a little while and it's evolved.

MR DUNNING: I can repeat the question for you from start to finish if you wish but-----

MR BABISTER: Just the salient points

MR DUNNING: -----the salient point is that you the dam designed in '84, you strike a number that's no doubt informed by the engineering and design that went into it. That number remains relatively consistent. You see '99 flood. Within council there comes to be an issue as to what is a suitable number for Q100. In the end that goes out to Dr Nathan and then the independent panel, and you really then have this coincidence of not only the feasibility of Monte Carlo being established in the early 2000s but the capacity to apply 2011 coinciding with the 2011 event and that really goes to contextualise the question you were last asked by Mr Callaghan. Is that something you would agree with?

MR BABISTER: Yes, I certainly agree we are in a much better position to apply Monte Carlo work now-----

MR DUNNING: All right.

MR BABISTER: -----and also to understand this space:time issue. The correlation structure which is crucial

MR DUNNING: All right. Thanks for that, Mr Babister. And then finally Doctor - sorry, finally Dr-----

DR LEONARD: Leonard

MR DUNNING: -----Leonard. Sorry, Dr Leonard.

DR LEONARD: So I agree that we are in a better position now but I think that when it was recommended in 2003 that they weren't recommending stuff they couldn't do, so I think that Monte Carlo would have been feasible back then, although better and more computing power now. But also I would like to just point out that the joint statement that we've made is that a Q100 is not appropriate and a risk assessment is needed, and conducting a risk assessment means how vulnerable are in the event of a flood, and that that is not - that is - it's informed by a Monte Carlo analysis but that can be done without a Monte Carlo analysis.

MR DUNNING: The risk-based assessment can be

DR LEONARD: A risk assessment, yeah. So there's a coincidence here in being able to conduct a Monte Carlo assessment but not a coincidence in being able to conduct a risk-based assessment.

MR DUNNING: No, but - I understand why you say that but the question that was asked here was ultimately one of strike the Q100 number. Your response is to say, well, Q100 is just a number, it's what you do with it that in fact matters, if I understood you correctly-----

DR LEONARD: Yeah.

MR DUNNING: -----you agree?

DR LEONARD: Yeah.

MR DUNNING: Okay, thank you. Then, gentlemen, if I could ask you to take up Mr Weinmann's report. Do you all have that handy? And what I'm going to ask you to do - I needn't probably ask Mr Weinmann to do it - but at pages 9 to 10 of Mr Weinmann's report at point 2.3, I would like you to read the narrative and in particular have a look at figure 2. Dr Nathan-----

MR WEINMANN: Have I been asked to explain?

MR DUNNING: No, no-----

MR WEINMANN: No.

MR DUNNING: -----I haven't. Dr Nathan, have you had a chance to read that?

DR NATHAN: I was looking at figure 2.

MR DUNNING: Figure 2, and in fact the narrative that surrounds it on pages 9 and 10.

DR NATHAN: I've got some understanding of it. I didn't unfortunately just read it in that interval, sorry, but-----

MR DUNNING: That's all right. What's depicted in figure 2, is that something conceptually you agree with?

DR NATHAN: Yes.

MR DUNNING: All right, thank you. Perhaps then I might start at the end and ask Dr Markar if that - have you had a chance to read the passage I've referred you to?

DR MARKAR: Yes. I've looked at figure 2. I haven't read-----

MR DUNNING: Well, look, perhaps - I needn't - perhaps we can just focus on figure 2.

DR MARKAR: Yeah.

MR DUNNING: The principal matters that I wanted to see if you are in agreement with is that the attenuation result that you will achieve you would typically expect to be a curve, not a linear relationship?

DR MARKAR: Certainly it's unlikely to be linear. I'm not sure whether you can say it's a single curve. It's a band we are talking about here-----

MR DUNNING: Yes.

DR MARKAR: -----and there's a wide margin in that band as well. So we can see the three particular floods referred to here, February 1999, January 1974 and January 2011, and that shows the sort of variability that we can expect for different types of event.

MR DUNNING: Certainly, and in so much as it depicts this notion that you have, in effect, a range of - a plausible range of attenuation with a sort of higher and lower area in that range, does that accord with your view of how you would expect actual events to unfold? That is, some of them you will turn out to get a higher level of attenuation and others a lower level of attenuation.

DR MARKAR: That's certainly correct but then it will also depend on where the rain falls in the catchment and how much. It's not only the peak, amount of volume of water coming into

the dam. So you might have the same peak but you might have different attenuation depending on the volume of the hydrograph-----

MR DUNNING: Yes.

DR MARKAR: -----inflow coming in as well. So there are multiple factors affecting that level of attenuation.

MR DUNNING: Certainly. Thank you, Dr Markar.

Commissioner, I was wondering, it's nearly 1 o'clock. I was going to ask the others this question, and also about Professor Apelt's diagram. I might just get Professor Apelt to briefly explain it and then even if we finish a few minutes earlier would it be convenient to break a little earlier?

COMMISSIONER: Yes, by all means. Is it Professor Apelt's diagram?

MR DUNNING: Is-----

COMMISSIONER: I thought it was Mr Weinmann.

MR DUNNING: -----Exhibit 887.

COMMISSIONER: Oh, I'm sorry. The one that you tendered, yes, of course.

MR DUNNING: Yes. Professor Apelt, I appreciate that you've provided the notes to this document but not everybody in the room as got it. Would you mind just briefly explaining it to us?

PROF APELT: Well, the diagram was one that I developed to help to clarify for myself and to illustrate the point that the way in which the dam operates is very much a function of the flood inflow to the dam and that to simply describe the flood - the dam behaviour in terms of the ratio of peak outflow to peak inflow was a very incomplete picture. It's not incorrect but it's incomplete. And so what I've done there - it's conceptual accept for a few data points that I can identify - is to illustrate the ratio of the peak outflow over peak inflow as a percentage on the left-hand axis as a function of the ratio of the flood inflow volume to the actual flood storage capacity in the dam, and the - one of the important points that I wanted to make was - and it's implied in some of the other diagrams, is that if the total flood inflow volume is less than what is available for flood storage in the dam, then you have the option of having no outflow, but usually the dam operators control the outflow according to specifications. Then, as you move into a situation of larger inflow than the dam storage capacity, then you are into the position where what happens is a function of that inflow volume and how you operate the dam, and those two lines that I've - or curves that I've drawn there, the one I've indicated "maximum attenuation possible" and "least attenuation", they are very much conceptual, they probably would be better shown

as a band in each case, but it's just to illustrate there's a range between that maximum attenuation possible and what might be achieved in terms of the decisions of the dam operations.

MR DUNNING: All right.

PROFESSOR APELT: So that - and the other aspect of that general presentation was to - for myself and for others to separate the notion of ratio of peak outflow to peak inflow from the notion of attenuation. Clearly one is simply the other, taken away from a hundred per cent, but in some of the discussion they were getting mixed up, so on the right-hand axis I've shown the attenuation of the peak flow as a percentage, which is simply the reverse coming down. So, for example, if you get a peak outflow or a peak inflow of 25 per cent then you have an attenuation of 75 per cent. The other points, if you would like me to continue, is just to explain what those four plotted points are. Would you like me to do that?

MR DUNNING: Yes, I would like you to do that, please.

PROF APELT: There are two that relate to the recent January 2011 flood, and they are based on the data I've taken from the Seqwater report of March 2011 and the one - the right - the red one up in the upper part of the diagram between the green and the brownie-coloured curve is simply the ratio of the peak outflow over the peak inflow plotted against the total volume of the flood, which in fact was 183 per cent of the design flood storage capacity, and most of - I mean, those diagrams are done with the general perspective that the dam will be at full supply level but there's an exception I will make in a moment. The point I wanted to make by plotting the second data point for the 2011 was that, indeed, it was double-peaked, it was different from previous floods, and while not everybody might agree with me on this, I wanted to look at the two peaks to see how the dam was managing, and if - as I explained in my notes, I identify the first peak as the part of the flood inflow up to the point of the minimum rate of inflow to the dam before the rise began again for the second peak. So I took the volume of that first peak to work out - and also the peak outflow that occurred during that time, to calculate that point that's shown in blue in the bottom left-hand section of the diagram, which shows that the dam was being - was managing that flood, but then the second peak came, which, in fact, was slightly larger in volume and it came into a dam which had already exhausted a big part of its flood storage capacity and the end result was the red plotted point. The ones for 1999 I added to illustrate, you know, from the specific example, the point I was making, that if your flood inflow is less than the actual flood storage volume available you've got total control, and what the operators did was to limit their outflow to 1800 cubic metres a second so that the major bridges were not taken out, and so the ratio of that controlled outflow to the peak inflow is 24 per cent, and I plotted two points there, the one on the right-hand side is where I simply take the ratio of the flood inflow to the actual design storage volume, which is 85 per

cent. The reality is that in 1999 the full - the dam supply was at about 72 per cent of the full supply volume, so, in fact, there was more flood storage capacity available because of that, and the data point to the left marked "1999" is the one where I've calculated the ratio of flood inflow volume to available flood and storage capacity, taking account of that.

MR DUNNING: All right. Can I just ask you then a couple of additional questions. You, in effect, treat, in this depiction, 2011 as two floods about 30 hours apart; is that correct?

PROF APELT: That's correct, yes

MR DUNNING: Yes. Now, in terms of those two floods, can you try and give us some - in terms of the volume or the magnitude of them, sense of that by comparison to 1974, which is something that everybody has a sense of?

PROF APELT: Yes, well, I can. The first peak calculated, as I have indicated, it amounted to 80 - sorry, if I use the percentages of the flood storage compartment, that's probably easier for people to take on board - that represented 87 per cent of the design flood storage compartment. For 1974, if the dam had existed, it's inflow volume would represent 97 per cent of the flood storage volume. The second peak of 2011, as I have defined it, accounted for - amounted to 96 per cent of the available - the design flood storage volume. You have to keep making the distinction between the design volume and what was there. So they were both comparable. Each peak, as I have defined them, was comparable to 1974 alone.

MR DUNNING: So, in effect, when we talk of the 2011 event, what you are suggesting is we are really considering two 1974 floods, 30 hours apart?

PROF APELT: In a very approximate way, yes, yes. To underline that, if those peaks had been delayed by about a week between them, each would have been managed pretty well, in my view.

MR DUNNING: And can you give us some perspective on the magnitude of 1999 compared to, say, '74, or the twin peaks in 2011?

PROF APELT: 1999 was 85 per cent of the design flood storage capacity, so a little bit smaller than the 1974 but not vastly so.

MR DUNNING: Thank you. Is that a convenient time, Commissioner?

COMMISSIONER: Yes, 2.30.

THE COMMISSION ADJOURNED AT 1.02 P.M. TILL 2.30 P.M.

THE COMMISSION RESUMED AT 2.29 P.M.

COMMISSIONER: Yes, Mr Dunning?

MR DUNNING: Thank you, Commissioner. Now, Dr Markar, did you have a chance to have a look at Professor Apelt's illustration over lunch as well?

DR MARKAR: You are talking about this document?

MR DUNNING: I am, yes. You did have an opportunity to have a look at it over lunch?

DR MARKAR: I did have a look at it over lunch but I understood what-----

MR DUNNING: Oh, you understood it, all right. But having listened to Professor Apelt's explanation of it, is it an illustration and the points that it seeks to make ones that you agree with?

DR MARKAR: Yes, I do.

MR DUNNING: Thank you. Mr Collins, if I could direct your attention again to Professor Apelt's explanation and his illustration, and also to the - perhaps if I start there. You heard Professor Apelt's explanation?

MR COLLINS: Yes.

MR DUNNING: Are the matters he identifies and that he illustrates in that illustration ones that you agree with?

MR COLLINS: Yes, it's a good illustration, which, I guess, is a very useful and simple way of trying to demonstrate the uniqueness of the event.

MR DUNNING: All right, thank you. Can you just elaborate what you - sorry, do you mind speaking just a little closer to the microphone - elaborate a little bit by what you describe as the uniqueness of the event?

MR COLLINS: Well, firstly, the two peaks with so much volume, and the proportion they take of the available storage capacity - so that's at the - well, it appears to be trending to the upper end of the scale, which was what Erwin Weinmann's figure also was suggesting. I mean, they're both qualitative illustrations.

MR DUNNING: Yes. And we won't be able to do anything more than qualitatively illustrate it until the study that we all agree is necessary has been done. Is that a fair comment?

MR COLLINS: Yes.

MR DUNNING: Does it follow then, Mr Collins, that you are also in agreement with the illustration - or the conceptual illustration set out in figure 2 of Mr Weinmann's report page 10?

MR COLLINS: Well, for the purpose that it was produced, I agree with it conceptually, and I agree with it in that it shows certain trends. The purpose it was produced was clearly to see whether there was a bias in the analysis that Mr Babister was undertaking, and to show that perhaps - perhaps there was a little bit of bias to the conservative side. Where the actual lines end up, there is insufficient data available to actually determine that without the more detailed study.

MR DUNNING: Yes, yes. And it makes that clear in the text of them?

MR COLLINS: It does, yes.

MR DUNNING: Yes, thank you, Mr Collins. Mr Bewsher, again, I am really asking you to look at those two illustrations and tell the Commission whether they are matters you agree with or not?

MR BEWSHER: Yes, I am happy with Professor Apelt's diagram, the two conceptual lines, the plotting of the points, and I am generally happy with Erwin Weinmann's figure 2. I might have drawn some things slightly differently, but generally I am happy with it.

MR DUNNING: Right. When you say you might have drawn things slightly different, that's your impression at the moment of where those conceptually identified lines will ultimately lie?

MR BEWSHER: Correct.

MR DUNNING: Thank you. Yes, Dr Nathan? You have already commented, I think, on Mr Weinmann's figure 2. May I ask you, please, to comment on Professor Apelt's illustration?

DR NATHAN: Yes, no, I am very comfortable with it. I think it needs to be interpreted as a band of opportunity, if you like, for the dam to absorb the flood volume, and it is a - it will have a - depending on where the rain falls in the catchment, it will or will not take advantage or move between those lines.

MR DUNNING: Thank you. Mr Babister? You have had an opportunity to look at figure 2 in Mr Weinmann's report?

MR BABISTER: Yes, I have.

MR DUNNING: All right, thank you. And do you share the view expressed by your colleagues in relation to it?

MR BABISTER: Not exactly, no. I think Erwin's - what - Mr Weinmann has plotted up three events; the 2011, the '74 and

the 1999. The 1999, in the same vein as my figures, the 1999 I only plotted data where the dam was full or essentially full. That's a very different event. The dam was down a long way and pretty much absorbed the whole, and that's quite unique, probably more unique than the 2011 flood, in that studies done in the past have shown that the dam in nearly every case would be full or nearly full. So it is a bit of an outlier. The other comment I would make about that-----

MR DUNNING: Can I just interrupt you there? One point in relation to that I would like to make. Do I mind if I do it now?

MR BABISTER: Certainly.

MR DUNNING: You describe '99 as an outlier because the typical result is that you'll only have the weather pattern that will produce a flood in circumstances where there has been sufficient rain already to have the dam at around full supply level?

MR BABISTER: Yeah, around. I wouldn't say always at full supply.

MR DUNNING: But of that sort of order?

MR BABISTER: Yes.

MR DUNNING: And insomuch as Mr Weinmann depicts February 1999 as sitting underneath or outside his conceptual line for large attenuation, that would be consistent with your descriptor of it as an outlier?

MR BABISTER: Yeah, but I'd actually argue, too, that that blue line he's fitted - or the 50 per cent line, or the blue line, takes no account of the operation of the dam. The operation of the dam through W1, 2 and 3 actually tries to constrain the flow. So you would expect that graph to be relatively flat for quite some time when you're in those modes and the flow's constrained, and then you would expect, once you kick into W4 for that graph to kick up.

MR DUNNING: Yeah, and continue to get steeper?

MR BABISTER: Yes, and then start to level off.

MR DUNNING: And then start to plateau, effectively, as you-----

MR BABISTER: Well, not plateau off, but go at a fixed shape.

MR DUNNING: Yes.

MR BABISTER: So I think a trend line through three points, one of them is very different to the other two, I think is a very simplistic assessment of the data. And the other thing is up near that 2011 event is our best interpretation based on SKM's work of the 1893 event, the other big event we know

something about.

MR DUNNING: Something, there was something else you were going to say?

MR BABISTER: I think I have said enough.

MR DUNNING: What about Professor Apelt's illustration?

MR BABISTER: Look-----

MR DUNNING: Do you share your colleague's view of that?

MR BABISTER: Look, it has some use, I don't doubt that, but I have a few issues with it.

MR DUNNING: Sure, but just for the moment my question was do you share the views expressed by your colleagues-----

MR BABISTER: Only some of them.

MR DUNNING: You can tell us which ones you do and which ones you don't?

MR BABISTER: The problem is once again we've put two events in this graph, one that's an extremely large event and one that's got an extreme drawdown, and there is plenty of other events we could populate this graph with. If we look at some of the data points, like the 2011 event, the red one, we know that the operators were very close to triggering the next set of gate operations, and a reasonable interpretation of the operating manual could have. So it could jump up quite substantially above there, above Professor's least attenuation line. So I think that line's got a few questions about it. The other thing is that we know from some of the modelling work done if the dam was drawn down by 17 per cent, it would make no difference to the peak outflow because of the way the operation uses the storage earlier on. So that line could move across very simply with a drawdown, and there are a couple of points. I guess the third point I'd make is the first and second peak of that event were generated by single synoptic system. It is somewhat - it is - I don't think it is particularly fair to separate them into two events. It happened as one, and there is then questions if you try and separate them, what happened to the extra volume that would have been in the recession of the first peak, which I don't think the Professor has properly taken account of, which would shift that point again.

MR DUNNING: All right, thank you. Now, can I ask you, Mr Babister, to take up your report, your September - sorry, your final report, September '11. May I ask you, please, to go to page 22 of that? Now, can we just agree a few things to start off with? The green line between 5 and 6 metres AHD, that is the 1974 result and obviously an unattenuated result, agree?

MR BABISTER: Yes, other than Somerset.

MR DUNNING: Sorry, yes. Unattenuated by Wivenhoe, quite correct. If we then go to the purple line, that is the result at City gauge in 2011?

MR BABISTER: Yes.

MR DUNNING: Whilst there is controversy as to the precise magnitude of the 2011 event, it seems to be common cause that the 2011 event was greater than 1:100, agreed?

MR BABISTER: Agreed.

MR DUNNING: Now, what we can then - I think you will agree with me safely - sorry, what we can then safely deduce, can't we, is that the attenuated result, or the post dam flow past the City gauge is something less than that 4.27/4.46 figure. Agreed?

MR BABISTER: That would be a best estimate. It would be somewhat less than 4.46, yes, but there is a lot of uncertainty, as we have discussed this morning.

MR DUNNING: Indeed. But what we can say with a good degree of confidence is that if that's the level you achieve in an event greater than 1:100, the 1:00 number is going to be something below that. As to what it is, that might be controversial but you would expect it to be below?

MR BABISTER: Look, the answer is we would expect, yes. It doesn't mean it is a certainty.

MR DUNNING: I think we can agree you would reasonably expect it to be below that?

MR BABISTER: Yes.

MR DUNNING: Okay. Now, if we go back to the 1974 figure - so that is the unattenuated by Wivenhoe result of 5.45 metres - bear in mind the point of inquiry ultimately is the amount of attenuation being achieved by Wivenhoe - it would be uncontroversial, wouldn't it, that there would be at least some marked - there would be some noticeable attenuation by Wivenhoe agreed?

MR BABISTER: In the dam was in place when '74 occurred, yes.

MR DUNNING: How does 1974 compare to a 1:100 event?

MR BABISTER: I think on the best information we have it is less than a 100 year event.

MR DUNNING: Thank you. So if we then take that information - and we know that the 1974 unattenuated, less than 1:100 is that 5.45, the 1:100 after attenuation, whatever it might be, you would expect to be somewhere, at least noticeably under the 1974 line, agree?

MR BABISTER: Yes. Under the green line, yes.

MR DUNNING: Yes, all right, thank you. And noticeably so?

MR BABISTER: Certainly under the green line, yes.

MR DUNNING: Thank you. Can I suggest to you that once you have a look at the Q100 estimates that are plotted in your figure 7, it is apparent in 2011 that those figures of heights of 4.70, 5 and 5.34 we would reasonably expect to be above 1:100?

MR BABISTER: Reasonably, yes, but we haven't explored the full uncertainty of all the variability and stuff, but reasonably.

MR DUNNING: All right. So that when anybody was - had those figures promoted to them, say in 1999, a reasonable response would have been to have expected that they would be overstating the 1:100 result, agree?

MR BABISTER: I think particularly with the high ones, but I think, say, something like 4.7 is not very far away from.

MR DUNNING: Well, do I take that to be an answer-----

MR BABISTER: I would suggest that the high ones, that's a very reasonable argument, and that argument becomes less reasonable as you move closer to 4.7 and those values, given all the uncertainties.

MR DUNNING: Yes, thank you. Can I just have one moment, Commissioner? Can I just address a couple of matters very briefly - and perhaps, Dr Nathan, you're the best person to start with on this. When it comes to the application of the Monte Carlo, it is right, isn't it, that mastering the data is critical to a successful outcome?

DR NATHAN: Yes.

MR DUNNING: Because its power comes from the sheer volume of iterations or alternatives that you feed into it to develop an area where you would expect events to occur with a certain probability?

DR NATHAN: Yeah, that's correct. It is particularly the distribution and the correlations between those input data.

MR DUNNING: All right. It means, then, that you can't - you cannot effectively achieve satisfactory outcomes from Monte Carlo unless you have, in reality, mastered the necessary input data?

DR NATHAN: That's correct.

MR DUNNING: Okay, thank you. Does anybody else on the panel express a contrary view to that, rather than go through and ask you?

MR BABISTER: I wouldn't express a contrary view but I would phrase what you stated differently. You have to understand the data. But I think what Rory said, in my view, is you have to understand the distributions of the data and the correlations structure between the data, not necessarily the data. They are much more important.

MR DUNNING: Right. Would this be fair then: you need to, first of all, understand the nature of the data that you need to assemble? Agreed?

MR BABISTER: Yes.

MR DUNNING: You need to find and obtain from the various sources holding that data access to it? Agreed?

MR BABISTER: Yes.

MR DUNNING: Then you need to assemble it?

MR BABISTER: Yes, but you then need to do those two other steps. You need to look at the distribution that data is telling you about, the relationship of any of the variables, like losses or drawdowns of things, and, more importantly, for a system like the Brisbane River you need to understand the correlation structure between different variables. You can't just have them all random because they are not completely random. When one thing happens, something else is more likely to happen, or less likely to happen, and that's the key.

MR DUNNING: Then would I be right in understanding you, Mr Babister, to be saying there is - it is not simply a mechanical exercise of collecting this data; there is a great deal more sophistication required to being able to assemble the data-----

MR BABISTER: A very sophisticated analysis, yes.

MR DUNNING: Does anybody else on the panel disagree with that statement by Mr Babister? All right, thank you very much. Finally, may I ask this - and, again, perhaps, Dr Nathan, I might start with you on this topic: in terms of going forward, is there much futility, in your opinion, in a further detailed analysis of what flood studies have been done in the past and why?

DR NATHAN: Only to the extent that they might yield some data that's irrelevant to the future study.

MR DUNNING: But beyond the data that might be contained in them, no?

DR NATHAN: No.

MR DUNNING: Right. Gentlemen, does anybody else have a contrary view to that expressed by Dr Nathan? Gentlemen, thank you for your attention to my questions. That's - excuse

me one moment, your Honour. Mr Babister, over - just as we were breaking for lunch we showed you a table that has been made Exhibit 880 something. Have you had a chance to have a look at that over lunch?

MR BABISTER: The question is to me?

MR DUNNING: It is, yes.

MR BABISTER: Yes, yes, I have, and I think we probably need to talk a little bit. I think you've misinterpreted things. I don't think you've taken advantage of my supplementary response to Dr Nathan and Dr Leonard, where I explain probably what you've been struggling with for the last few days. There is a simple table in that document that suggests how far below the 2011 flood levels I would expect my estimate to be.

MR DUNNING: Can you give us a reference to that?

MR BABISTER: Sorry?

MR DUNNING: Can you give us a reference to the table you are referring to?

MR BABISTER: The document's dated the 7th of October, and the table is table 2.

MR DUNNING: All right. And you say that that accurately records the adjusted figure-----

MR BABISTER: No, no, no, it sets out how much you should subtract from the 2011 flood, if you want to. My original estimate was based on some data that I got from the joint taskforce report. I thought it was observed flood levels because it said "subject to validation". I thought that meant it had been surveyed from actual flood debris and it would be validated later on, when, in fact, it was generated by computer model at council - not an unusual procedure to do that to understand flood profiles - and I used that in my analysis and made some conclusions, which this document I am talking about addresses. Those conclusions clearly needed to be adjusted in the light of new data.

MR DUNNING: And you have identified where we'll find the adjusted figures?

MR BABISTER: I haven't had access to your data. The better information on the flood levels achieved - the flood levels in 2011, that council, I understand, surveyed. But if you took that information that council's collected and subtracted these values in the table on the screen from them, you would get my answer.

MR DUNNING: Okay. That's all I wanted to know. Thanks, Mr Babister. Thank you, Commissioner.

COMMISSIONER: Just before we go on, I just wanted to ask you all a prosaic question, and that's about who is to be the

repository of data. Does anybody have a view about what type of agency is best to do it, and has anybody experience in another State where there is such a central repository? Mr Babister, you are from out of town, can you help?

MR BABISTER: I have struggled with the same question as well, because whoever does that needs to have funding, and ongoing funding to do that. So that's not clear. It probably would be the lead water agency in the State but it is not really that clear. Another possibility would be for somebody just to maintain a database and everybody to agree to data sharing, instead of actually going through the central repository. Sort of having the actual holding of the information distributed, it is not an easy question. The Bureau of Meteorology are essentially doing that on a national basis, which wouldn't be appropriate for this, but - so I guess I would look at how they're doing things. There would be some good leads from that. I think that's all I can add.

COMMISSIONER: Does anybody else have a view on it? Mr Bewsher?

MR WEINMANN: In Victoria, moves for a common user database started 25 years ago, and was implemented to some degree, but in the more specific situation of flood information, there was a project done about ten years ago that assembled all the flood information from the various agencies, and put them into a database that's maintained along similar lines as has been suggested in this joint expert report.

COMMISSIONER: So who actually maintains it?

MR WEINMANN: Who maintains it?

COMMISSIONER: Mmm.

MR WEINMANN: I think it is the State agency that's tasked with flood plan management, which is our equivalent of DERM here, I think. DCE, Department of Conservation and Environment. But then it is the catchment management authorities that then really use and supplement the information that's on that database.

COMMISSIONER: Thanks. Mr Bewsher, did you have a view about it?

MR BEWSHER: Only briefly, Commissioner, and I support the view that possibly the bureau would be the right agency. The sort of problem that has been discussed about agency cooperation, sharing data, it is a common issue in any large valley, I think the benefit of having a Commonwealth agency involved is significant provided they have the funding.

COMMISSIONER: Mmm. I expect that's woken Ms McLeod up. There may be more questions. Mr Flanagan, I don't think you'd identified any cross-examination?

MR FLANAGAN: No, because of the joint report that was

received, but may I just follow on from - I was going to ask the very question that you asked, Commissioner. May I follow on from that?

COMMISSIONER: By all means.

MR FLANAGAN: Gentlemen, in relation to the data that goes on the central database, you have identified in your joint report the need to, in effect, calibrate that data; that is, it is data from all different sources that may have its own internal limitations, its own internal uncertainties. Quite apart from the body that maintains and updates the central database, have you thought about or identified a body who will be responsible for, in effect, calibrating the data that is to be entered on that central database? Professor Apelt?

PROF APELT: Well, I am thinking on the run a bit but I would think that it would work best if it was the same authority looking after that, and I was reflecting about the Commissioner's question, recognising that this is a Statewide issue, not just - I mean, obviously we focus on the Brisbane River - I would think a State authority would need to be the repository for that data, and DERM, in a sense, is a fairly natural identifier, but it would need to be set up in such a way that that activity was quite separate from the ongoing other aspects of DERM.

MR FLANAGAN: And would the calibration of the data, as the initial step to entering it on the database, require a panel of experts, for example?

PROF APELT: Well, here again - I am thinking as I go - I would think not. I think some expert review of the work rather than, you know, a panel working on it, there would be people, I would envisage, who would develop the skills to do what's required, but be subject to review by external, you know, experts from time to time.

MR FLANAGAN: Thank you.

MR WEINMANN: I think this is a matter for technical expertise, and a lot of these questions on data, for instance, in relation to rainfall are not just Australia specific. The world meteorological organisation has a whole set of standards and clear indications on what constitutes proper data collection, proper data storage collection, and in relation to flood - sorry, stream flow data and flood data, a similar sort of set of guidelines exist, and in Australia there is a hydrographers' association that sets technical standards in relation to these things. So many of those standards exist, and some of them might need to be modified, perhaps, or expressed more clearly for a specific situation, but most of the ground work is there.

MR FLANAGAN: May I take you then, perhaps, Dr Nathan, to paragraph 17 of the joint report, where you suggest that access to this central database is by all relevant stakeholders, and, Professor Apelt, you have identified with

others who are the stakeholders. Do you see that statement in the joint report as suggesting that access to the central database be limited only to those stakeholders, or can it serve a wider purpose; for example, in relation to a flood expert doing a report for a particular development in a particular area along the Brisbane River or the Bremer River?

DR NATHAN: When we wrote that, it was very much with that point in mind, that we're expecting that to be - I mean, with the - there needs to be some governance around that data, and I think it would be, if you like - access to the data should be through the auspices of the stakeholders who manage it.

MR FLANAGAN: Thank you.

DR NATHAN: But could I just add a slightly different view to my colleagues? That I actually feel in terms of the governance around the data, that the more localised that governance is kept, the more, if you like, passion and interest in its integrity and maintenance. One of my fears if it went to a Commonwealth or even State agency is you lose that sense of local ownership and sense of importance of what that data represents. So my personal view is that I think it would be better trying to find an agency that had a responsibility for Brisbane as a catchment and that that was shared within the catchment.

MR FLANAGAN: Would there need to be a protocol - Dr Nathan, would there need to be a protocol in relation to how the central database is updated? For example, if one writes a report at a certain date, you use the data that's available to you on the date you write your report. If the central database is subsequently updated, to understand the report you've previously written one needs to understand the data it is based on, is that correct?

DR NATHAN: That's correct.

MR FLANAGAN: So the updating of the data for the central database would need to ensure that data at particular times are still maintained so that one can refer back to it for the understanding of uncertainties in any particular report?

DR NATHAN: Absolutely.

MR FLANAGAN: Does the panel agree that such a protocol should be in place in relation to the maintenance or updating of the central database? Thank you. With your indulgence, Commissioner, may I ask one more question of slightly different topic. May I direct it to Mr Collins? A number of your reports, indeed a number of the historic previous reports in relation to both the Brisbane River and the Bremer River have relied on the MIKE-11 modelling. May I ask has the 2011 flood event informed the panel as to the degree of uncertainties in the MIKE-11 model itself? May I start with Dr Leonard in that regard - sorry, with Mr Collins then we'll go to Dr Leonard?

MR COLLINS: The 2011 flood has certainly focussed on another review on that MIKE-11 model and using the data from that flood has allowed us to further investigate some of its shortcomings, which wouldn't have been apparent without the flood. For example, significant level differences along the river for the 2011 flood compared to those predicted by the Mike-11 model for the same event.

So, the answer to the question, I guess, is yes and how much an independent review earlier might have uncovered on the Mike-11 model is a little difficult to say, because without the 2011 flood data to focus the attention, there wasn't really a lot of - a lot of reason to drill into that model. We had a long period of drought, so to invent a new flood model in the middle of a drought perhaps might have been wise in hindsight, but there certainly wasn't a lot of funding around for that type of activity.

MR FLANAGAN: Dr Leonard, did you wish to comment?

DR LEONARD: I don't have anything to add.

COMMISSIONER: Any other member of the panel?

PROF APELT: Well, I would certainly agree with what Mr Collins has said, and for my reading the description of the Mike-11 model, it certainly needs to be extended beyond its present coverage to be able to simulate better what's happening between Wivenhoe Dam and Moggill and, indeed, up the Bremer River.

MR FLANAGAN: Thank you, Commissioner.

COMMISSIONER: Mr Ashton?

MR ASHTON: May I be permitted just one clarification in relation to this central repository idea, Commissioner? Thank you. Gentlemen, perhaps it will assist if I state what I understand your report to be saying and ask one question and then you can comment on my statement and answer the question, if you would. I'm correct, I think, aren't I, that you have in mind in relation to this central repository not merely raw data or data of the kind, for example, which you might assemble for a Monte Carlo analysis, you go beyond this and you would see this repository containing people's work product where they use that to carry out various studies or whatever might be the case, and the results of those studies would be available. I correctly understand that. I think that's implied in what you say in paragraph 18, perhaps it's not even implied, it's expressed. In paragraph 27, you talk about site specific investigations and the obvious theme there is achieving uniformity, and I presume that's best achieved by some cross-connection with this repository. I'm wondering is there - this is my question. If I have incorrectly stated any of my assumptions so far, please tell me. I am wondering is that a crossover to mapping and flood prediction where it seems that the - what's undertaken is rather of a regional character and somewhat diverse in the approaches and yet in the result it's the main interface with the stakeholders, the ultimate stakeholders, the citizens and the town planners and the nasty old insurers and everybody else, is there a place for that? Is there an avenue to move to that sort of coordination through such a repository? I don't mind who tackles that question.

MR COLLINS: I will have a go. That ties in a little with something that we haven't talked a great deal about today, which is it's all very well predicting flood levels or flood flows, but the ultimate end requirement for a variety of reasons, including town planning, is mapping, and the mapping's fundamental as an outcome to any of these investigations, and to get to the mapping there's another level of detail which we haven't really gone into, which is fine scale - potentially fine scale hydraulic modelling and then GIS mapping, so the whole thing's integral, as you suggested.

We're already seeing mapping coming out from the Queensland Reconstruction Authority and, indeed, draft codes for development associated with that process. So, a possible vehicle for all this data management could be as an adjunct to that type of process back with the State Government, but you're quite right, unless the mapping's coordinated in the same manner that the data management is, because it's the ultimate end product that's used by the planners, well, we're missing an important part of the investigations.

MR ASHTON: Thank you, Mr Collins.

DR MARKAR: I agree with what Mr Collins said, but can I also add something that related to the previous question or the data repository and what is contained there. One of the things we have identified in the joint report associated with that data, the source of that data and the methodology used to obtain that data should be also specified so that whoever is using that data for any analysis would - can review and assess how reliable the data is or how much reliance one should place on that data as well.

MR BEWSHER: So, just in relation to the earlier question about the data, and I think you asked whether the results of the analysis would be part of the repository as well, and I think the way it was put it implied there was agreement from all of us that that should be the case. I am not sure that we actually expressed that view in the joint report.

MR ASHTON: I had in mind particularly, Mr Bewsher, on that point paragraph 18.

MR BEWSHER: Yes, and so you're - you're the Insurance Council, you're representing - I am just thinking in terms of mapping information for individual properties, that's a very sensitive piece of information and my view is that that needs to be carefully controlled, that doesn't necessarily mean it's entirely restricted, but that the assumptions that are in that data are very clear, and usually the Local Government authority is probably the right body to control the release of that data, particularly because when there are issues arising for Mums and Dads they have got to wear the flack and explain it as well to people. So, I just wanted to put that qualification there in terms of 17 and 18, that I wouldn't necessarily support that fine scale mapping of flood

risk on individual properties being in a central repository.

MR ASHTON: Well, I am not sure that I was proposing that, or anything in particular.

MR BEWSHER: Okay.

MR ASHTON: In fact, I am sure I wasn't, but 27, paragraph 27 perhaps suggests a compromise you might have in mind; that is to say, it seems to suggest that the central control and modelling and so on would perhaps form site-specific investigations and perhaps influence a uniform approach.

MR BEWSHER: Yes. I fully support that.

MR ASHTON: So, for example, in relation to Local Government mapping, whether it's going to be the Local Government area or the catchment, which is the better, which is the more appropriate, ought to be the subject of consideration perhaps beyond the reaches of any particular council?

MR BEWSHER: Yes, yes, I agree with that

MR ASHTON: Thank you. Thank you. Anybody else? Thank you, gentlemen. Thank you, Commissioner

COMMISSIONER: Ms McLeod, I didn't mean to suggest before you were anything other than your usually attentive self, but the Bureau did suddenly surface there.

MS McLEOD: Yes. Thank you, Commissioner. I don't have any specific questions for the panel but can I indicate, given the scope of data that's been identified this morning and this afternoon and the range of features, local features and so on, operation of dams and so on that are considered relevant, our submission would be that this is a matter for policy consideration that goes beyond the Bureau, so it would be more appropriate for us to make a submission about it rather than ask the panel about it.

COMMISSIONER: Certainly. Mr O'Donnell?

MR O'DONNELL: Thank you. I have a questions for you, Mr Babister. I have a narrow focus. If you turn to your 18 September report, please? Page 10, paragraph 46. You comment there on the maximum height reached in the river at the Port Office gauge during the January '11 event. You refer to the second sentence that there were two different gauges on opposite sides of the river, one recorded 4.27, one recorded 4.46.

MR BABISTER: Yes.

MR O'DONNELL: And elsewhere in your report you comment on the importance of arriving at the correct maximum height reached at the Port Office gauge, it being important to analyse flood

frequency analysis.

MR BABISTER: I think it's very important for the flood frequency analysis and I think it's very important future, even 50, 100 years time, that there-----

MR O'DONNELL: Sorry, you will have to speak up.

MR BABISTER: Even for the future. If somebody is trying to look at this in 50 or 100 years time we really need to resolve this problem so they don't get confused like we were when I was writing that report.

MR O'DONNELL: The problem being whether the most reliable measure is 4.46 or 4.27.

MR BABISTER: Exactly.

MR O'DONNELL: Thank you. On the top of page 11 you comment that someone had spoken to Marine Safety and Marine Safety suggested that the other guy's gauge, the Seqwater gauge, had some mechanical problems.

MR BABISTER: Yes, and that was certainly what was indicated at the time, but I didn't feel it was my role to sort of take a vote one way or the other. I was really waiting for the two agencies to sort it out, and the information I have been supplied since from Seqwater makes it very clear that their gauge was working perfectly and they verified it during the flood event and the issues are probably with the other gauge.

MR O'DONNELL: So, on the basis of the information you have since seen, is your opinion that the 4.46 is the more reliable indication?

MR BABISTER: It is.

MR O'DONNELL: Right. Can we just identify the information you have seen since? Is it the two affidavits of Mr Malone?

MR BABISTER: Yes

MR O'DONNELL: So, the third affidavit?

MR BABISTER: The third and the fourth affidavit, and specifically one of those affidavits has some information showing that they actually went out and manually looked at the gauge during the event and validated the reading, between the automatic and the manual board.

MR O'DONNELL: Someone went out and physically looked at the Seqwater gauge during the event?

MR BABISTER: Yes

MR O'DONNELL: To see whether the reading it was giving matched the physical water level?

MR BABISTER: That's right, yes. I might add too that these sort of problems - I am very glad this one's been resolved - are not unusual in floods. I have seen them on many occasions. I have been on site on the gauges where there are two gauges nearby all on the same bridge and they record different results, because these gauges don't get tested at high flows very often. That's unfortunately when they often give spurious results.

MR O'DONNELL: All right. And if you had had that information when you were preparing your report, would you have expressed the view that 4.46 was the appropriate level for the maximum height the water reached at the Port Office?

MR BABISTER: Yes

MR O'DONNELL: Thank you. Thank you, Commissioner.

COMMISSIONER: Thank you. Mr Callaghan?

MR CALLAGHAN: No, I don't have any further questions.

COMMISSIONER: I had indicated, though, at the start that we would go through and find out whether anybody had any further comment. I might get you to do that.

MR CALLAGHAN: Yes, very well. I can do that and we might do it down the line. Or I might start at this end.

Dr Markar, you heard the Commissioner at the outset indicate that we might make a note if there was anything in particular that arose in the course of this session upon which you wished to join issue or make comment.

MR MARKAR: Not really. Just a little thing. We were talking about data collected by different organisations. One of the experiences I had was the rainfall data collected by different organisations eventually ends up in the database the Bureau has put together. That did seem to include some of the data collected by some councils, especially the Toowoomba City Council collected some data. I haven't seen that data being collected within the Bureau's database. I am not sure whether there are any other sources of data that's not been in the system as well. I thought I would just make comment on that.

MR CALLAGHAN: All right. Thank you. Mr Collins?

MR COLLINS: The only comment that I would like to add is there was the discussion on the timing - time required and the cost-----

MR CALLAGHAN: Yes.

MR COLLINS: -----of the study we have specified, and I don't disagree with what Dr Nathan said in that I think we ended up with a figure of - by the time we get through the flood

mapping - of in the low millions of dollars and perhaps three years. However, I think it is worthwhile saying, and I am sure that there could be comments from others on this, whether they agree or disagree, that there are some definite key outcomes that would be useful as intermediate steps in such a study. It could be done quicker than three years. For example. The first major output would be a thorough analysis of the existing situation with the dam rules that are coming out of the optimisation - Dam Optimisation Study or even the current operating rules. That could be done first. Secondly, then review those dam operating rules and, finally, the consideration of climate change which in itself leads to a lot of analysis. The technical studies certainly don't - wouldn't take three years for the first component. What seems to take a long time on these studies is getting them off the ground, getting the appropriate management structure and technical teams underneath them moving and sometimes that seems to take longer than the actual technical studies. But my personal view of it, it would be feasible to get that first step complete in 12 to 15 months would be my suggestion. Now, that's a challenge to everyone else, I guess. Sitting here it is a big challenge. That would involve - it would involve moving very quickly on setting up the structure to get those studies moving.

The other thing that is in our favour is from the best of my knowledge much of the bathymetric survey data and a fair amount of LIDAR survey that's required has already been gathered and I have been trying to very hard to find out exactly how much has been gathered, but I - I heard this morning that the bathymetric survey up to the tidal limits in the Bremer and the Brisbane River has been completed. I already know also from other discussion at least the LIDAR of the Lockyer Valley has at least been completed to allow studies of the lower reaches. They are obviously additional data requirements that take time and considerable sums of money, but I still think given that we have got the data that the technical studies could move relatively quickly if they're allowed to.

MR CALLAGHAN: Well, just going back, I suppose, to the first part of the point you were making about the time that it might take, it's probably axiomatic that that time would be reduced by cooperation between relevant government agencies and involved parties; is that right?

MR COLLINS: Yes, and it may also be that some pressure in terms of an overall-arching program could be applied and it's amazing how quickly things can be increased when they have to increased.

MR CALLAGHAN: Can you be more specific? I mean, this is a Commission which will be making recommendations. We can only do that on the basis of evidence, but you're in a position to give us-----

MR COLLINS: I will just stick with the numbers I said. I would have thought that with the right incentives-----

MR CALLAGHAN: Sorry, I wasn't asking you to refine the timeframe, I was perhaps looking for more guidance about what specifically should be recommended by way of cooperation and between whom?

MR COLLINS: Well, the key lead agencies in that study is DERM, Seqwater, Brisbane City Council and Ipswich City Council. They're the primary groups that are responsible and affected, I guess.

MR CALLAGHAN: And specifically the cooperation should be in respect of?

MR COLLINS: Well, first of all, designing a work specification, a project specification, and then managing it and then turning that specification into discrete work packages that are either done by the various stakeholders or outsourced through consultancies, and that - that part of the exercise is often time-consuming, and that's the area that needs a lot of attention. When I look at - because I'm a professional consultant and have been all my working days, but getting to the point where you get a brief that you answer to is often perhaps the easier part. I'm not denigrating the work that has got to be done, but actually carving it up and working out how best to implement it quickly is what can often take a lot of time, so it actually needs a fairly level of technical expertise in that management and setting it up and how that structure works amongst the agencies is something that perhaps needs some thought.

MR CALLAGHAN: Okay. Is that the extent of your-----

MR COLLINS: Yes

MR CALLAGHAN: -----additional contribution? Thank you. Thank you. Mr Bewsher?

MR BEWSHER: I don't think I have anything further to add.

MR CALLAGHAN: Thank you.

COMMISSIONER: Professor Apelt?

PROF APELT: No, I have nothing further to add.

MR CALLAGHAN: Thank you. Mr Weinmann?

MR WEINMANN: Nor me.

MR CALLAGHAN: Dr Nathan?

DR NATHAN: Just one small point, sorry, to follow on from Mr Collins' comments. I share - I share the concern around - in one sense if you look at the - our joint report there's a large list of things to do and I guess I just wanted to emphasise what I was saying earlier that I'm concerned that it's a large - it's a large scope of work and if you have a

structure in place where everybody looks at that scope of work with particular expectation to what they want out of it, it - you certainly could end up - it would be quite difficult to control how that proceeds in time, and I do feel it would be really useful for the agencies concerned to sit down and think about how can we stage this so that we can adjust the scope as we move forward in time and as we learn more, and I think that sense of doing some initial work to identify where's the best return on effort and how can we best shape our efforts to get the returns we needed as we move forward in time, because I think we're not going to - it's difficult to do that at this point and I don't think it's possible to sit down and write a whole suite of briefs now and get the agencies working on it unless we do that, that approach. So, I just wanted to make that point.

MR CALLAGHAN: Should that be under the control - should that of itself be under the control of one agency or-----

DR NATHAN: No, I think - yes, no, I think that needs - it needs a cooperative approach to determine that

MR CALLAGHAN: Mr Babister?

MR BABISTER: Other than endorsing Dr Nathan's last comment, I have got no further comment

COMMISSIONER: Finally, Dr Leonard?

DR LEONARD: I just wanted to make a few comments on Professor Apelt's diagram and Erwin Weinmann's diagram because I wasn't given the opportunity

MR CALLAGHAN: Yes.

DR LEONARD: I would like to say hydrographs are like people because they come in all shapes and sizes and I think that the 2011 event was unusual but I don't think it's helpful to say that it's unique, because the next flood event, when it comes you don't want it to - you don't want to always be saying, "Oh, it's unique, it's unique, it's unique.", so - it will have some characteristic we didn't think of. So, I think that's why we need this comprehensive analysis, so the random patterns can help us decide with either of these diagrams - we can argue over whether one of them is more unique than other, but what's needed is this Monte Carlo analysis so we can decide how the distribution over many, many events would lie.

MR CALLAGHAN: All right. And apart from that, was there anything else?

DR LEONARD: Apart from the that, I suppose my - so that's needed for statistical robustness and defensibility of any future estimates that comes up. But short of that, we're making subjective statements and I suppose my feeling about either of those pictures is aligned closer to what Mr Babister has said, but I think that the line would be biased higher, partly because of the attentuation of the dam for larger

floods diminishes, but I don't think I can really add any more than that.

MR CALLAGHAN: Okay. Apart from the figures, was there any other matter upon which you had any further comment?

DR LEONARD: No

MR CALLAGHAN: Thank you. Unless the Commissioner or the deputies had anything further, I think the appropriate step now would be for Mr Weinmann, Professor Apelt and Mr Bewsher to be excused and perhaps for a short adjournment so that we can unplug computers and things and we configure for the Ipswich session.

COMMISSIONER: So, Mr Weinmann, Mr Bewsher and Professor Apelt, you are excused, but before anybody goes can I just thank you all very much not just for what you have done today, but for the work that's been done in the last few days, which I know was done under considerable pressure in not particularly good physical surroundings, with a lot of demands, and we've ended with this extremely constructive approach and, I hope, an outcome that will do us all a lot of good. So, thank you again.

PROF APELT: Can I just ask one simple silly question?

COMMISSIONER: Yes.

PROF APELT: The summons that I and others received covered today and tomorrow. Is this being excused-----

COMMISSIONER: Being excused means don't come back.

PROF APELT: Thank you very much. That is what I was hoping to hear.

WITNESSES EXCUSED

COMMISSIONER: We will adjourn. Sorry, Mr Dunning?

MR DUNNING: Can I tender the document that you and were discussing at the outset? It just seems the transcript won't be comprehensible-----

COMMISSIONER: Oh, just to make sense of that, yes.

MR DUNNING: Yes.

COMMISSIONER: By all means. That's your list of cross-examination topics.

MR DUNNING: It is. It was entitled Brisbane City Council Flood Frequency Concurrent Evidence Topics For

Cross-Examination.

COMMISSIONER: Exhibit 889.

ADMITTED AND MARKED "EXHIBIT 889"

MR DUNNING: Thank you, Commissioner.

THE COMMISSION ADJOURNED AT 3.25 P.M.

THE COMMISSION RESUMED AT 3.33 P.M.

COMMISSIONER: Yes, Ms Wilson.

MS WILSON: Thank you, Madam Commissioner. Madam Commissioner, Mr Babister, Dr Leonard and Dr Markar and Mr Collins have all provided a report in relation to the Bremer River and a river flood frequency study. Dr Nathan has not provided a report, however the five experts, including Dr Nathan, have all signed a joint expert statement on the Bremer River flood frequency dated the 25th of October 2011, which is Exhibit 882.

Gentlemen, a lot of the content that is contained in the Brisbane River Flood Frequency Joint Expert Statement is repeated in the joint expert statement for the Bremer River Flood Frequency Report. There are some significant differences and I will be addressing some of those issues this afternoon.

If we could start at paragraph 13 of the joint experts' statement. And this sets out that there are additional complexities that are added to the study of the Ipswich area by the interaction between the Brisbane and Bremer Rivers leading to the influence of backwater. The complexities in relation to determining Q100 are set out in paragraph 48, and if we could just get a bit more detail around those complexities. Have we all got paragraph 48? The first of those is the interaction between the two rivers. Dr Nathan, this is what has been referred to in paragraph 13 as the "backwater influence"; is that the case?

DR NATHAN: That's correct

MS WILSON: Can you just briefly describe to us in general terms why it is so significant that there is a backwater influence of the Bremer - of the Brisbane on the Bremer.

DR NATHAN: It means for a given flow down the Bremer, the level that that flow reaches is dependent upon what flows are going down the Brisbane River. So to understand inundation levels in an area influenced by backwater you need to understand what's happening at the - in Brisbane River.

MS WILSON: The joint experts' statement sets out that flooding in the Ipswich area can be caused by the Bremer River alone, backwater from the Brisbane River, a combination of backwater from the Brisbane River and the Bremer River. Is that one of the issues in determining the flood levels in Ipswich taking into account those three possibilities?

DR NATHAN: That's exactly correct

MS WILSON: Number (a) then, it seems, feeds into (e), which is the need for the explicit consideration of joint hydrologic inputs; is that the case?

DR NATHAN: That's correct.

MS WILSON: And that is really what a large part of this report covers in dealing with getting a comprehensive study dealing with the Bremer River and the Brisbane River.

DR NATHAN: That's correct.

MS WILSON: While I've got - while you've got the microphone, if we can just now go to (c), which is impact of the dams. Now, that is a consideration that is also applicable to any flood study in Brisbane?

DR NATHAN: That's correct

MS WILSON: And the work that is done in Brisbane will be able to be used in relation to the Bremer River and Ipswich in relation to impact of the dams.

DR NATHAN: That's correct. So that implies the sequence that you need to understand the impact of dams along the Brisbane before doing some of these elements of work.

MS WILSON: Mr Collins, if I can take your attention to the significant variation of flood levels. Why is there a significant variation of flood levels?

MR COLLINS: It's driven by the topography of Ipswich and there's a significant variation of flood levels, particularly in the section of Ipswich that's affected by the Bremer River, bearing in mind that there's a large part of the Ipswich that directly is affected by Brisbane River flooding, it fronts the Brisbane River, but the section that's affected by Bremer River flooding is subject to very large variations in flood levels because of the constraints of the topography. The river's relatively constrained. So on many coastal systems when you get higher flows the water breaks out of the main river channel, spreads across the floodplain, it has a very wide area to dissipate over and therefore the water levels rise with increasing flow, drops off very quickly. In the case of Ipswich it's very constrained so as the flow goes up the levels just keep going up. There is a limit, of course, but the ranges from the historic floods are up to 25 metres and "major flooding" is defined as being, I think, above 11, so it's a huge range.

MS WILSON: Is it a factor in the variation of flood levels that we do have these various influences, that is the backwater from the Brisbane River, the Bremer River and the combination of both, and depending on where - what is the source of the flood may depend on the variation of the flood levels?

MR COLLINS: That's true. The dominant levels are due to very large Brisbane River flooding with a significant event in the Bremer, which is what we saw in 2011, but you can still get significant floods in Ipswich City from Bremer River flooding where there's only moderate flooding in the Brisbane River, so

it is quite complicated. Similarly with the dams. I mean, the release of the dams can have a significant effect on flooding in Ipswich City but conversely there can be events where no - the dams have no effect on the flooding in Ipswich, they're lower catchment events.

MS WILSON: And that is acknowledged in the report that flooding can occur in Ipswich with or without flooding caused by the dams-----

MR COLLINS: Yes

MS WILSON: -----and influenced by the dams.

MR COLLINS: Yes

MS WILSON: And one of the other complexities, or the last complexity that's set out there, is (d), which is the "wide uncertainty bounds". Dr Leonard, can you assist us with this issue of the "wide uncertainty bounds"?

DR LEONARD: So the issue here is because you've multiplied the number of factors. Not only have you got one river to deal with, you've got two, and then, in terms of modelling, you've got the correlation in rainfall that can land on either of them, and because you've got more factors there's more variability in the output answer that you will get, and so whatever uncertainty you had for the Brisbane River is going to be multiplied for Ipswich.

MS WILSON: If we can now go back to paragraph 13 and just - the last part of that paragraph sets out the proposition that flooding can occur without influences from the operation of the Wivenhoe and Somerset Dams. The report goes on, and specifically at paragraph 16, talks about "any comprehensive approach may involve detailed analysis of other local tributary catchments". Now, can flooding occur in Ipswich due to local tributaries alone, and perhaps Mr Collins if you could answer that?

MR COLLINS: The answer is, "Yes, it can." There are a number of tributaries that can cause significant flooding without Brisbane River flooding, for example. Those tributaries are generally above the tidal influence and above the backwater influence of the Brisbane River, but, of course then there's other combinations to consider. Such as you can have a flood of moderate size in the Bremer River affecting the backup into creeks, so there's a backwater effect from the Bremer that is remote from the backup effect from the Brisbane River, which still affects creek flooding, and the purpose of that point was that those factors are more readily dealt with in a more traditional or - I think we used the word "standard" technique for flooding assessments because it's not subject to the same uncertainties in the combinations of the two river systems interacting.

MS WILSON: Flooding caused by local tributaries, can that be influenced by backwater?

MR COLLINS: It can but that statement was specifically dealing with local tributaries that are beyond the backwater influence of the Brisbane River, but then you can have Bremer River causing effects on local tributaries right up through the system, but you've then taken out one of the uncertainty factors, which is how does the Brisbane River interfere with it, because once you're above the backwater influence of the Brisbane River the whole interaction issue and joint probability issue of those two rivers is taken out of it. There's another joint probability issue which is how do you combine the creek flooding with the river flooding, but that again is, I think, generally dealt with by what we call "standard techniques" not requiring the level of complexity with the Monte Carlo simulations.

MS WILSON: Without undertaking the comprehensive study, that is as recommended in this report, can we determine which tributaries are influenced by backwater or not?

MR COLLINS: We can determine which ones are influenced by backwater based on current flow estimates, but, of course, until we know what the actual flow and actual levels from Brisbane River and Bremer River floods are based on the comprehensive study we don't exactly know the extent of the backwater but to a degree we can because, irrespective of that, if you're several metres above the backwater influence in your local creek then it seems unlikely that you would have a major effect, so at least as an interim measure those creek investigations could be done separately to some major investigation that we've suggested is required.

MS WILSON: And that's where I was leading to, about what studies could be done now and what studies had to wait until after the Brisbane report, and with the issue of the tributaries there are some that are clearly not influenced by backwater and they can begin now?

MR COLLINS: Yes, and I think some of them have already been done and are underway, some of those studies, but I'm not - I can't give you a comprehensive list.

MS WILSON: The hydrological modelling is set out in paragraphs 23 to 27, and again matters are repeated in this joint expert statement that have already been set out in the Brisbane River report. However, Dr Nathan, if I can take you to paragraph 25(f) and that is - what is set out there is unique to Ipswich?

DR NATHAN: That's correct. So this - this is really getting the model to demonstrate that it's able to reproduce the level frequency behaviour, so how often levels are exceeded in that Ipswich area, and it relates to the earlier point that that - flood levels in the Ipswich level can be the result of either the Bremer or the Brisbane, so it's an important to thing to demonstrate that we've got those correlations right, that we can reproduce the level frequency. That's an additional consideration that's not present in the Brisbane River only.

MS WILSON: Again with the hydraulic model, it also repeats matters that have been set out in the Brisbane report and we can see that at paragraphs 28 to 33. However, in "Other Comments" it is noted that the experts agreed, at paragraph 36, that the interaction between flood levels in the Brisbane and Bremer Rivers need to be carefully and precisely modelled. Mr Babister, can you tell us what may be required in relation to the development of a separate, more detailed model?

MR BABISTER: It's hoped that the model developed for the whole valley will model this sort of interaction quite well but we're really flagging that if it doesn't model it, if there are some deficiencies in the, sort of, Ipswich area, then it might be necessary to set up a more detailed model to accurately reflect that behaviour instead of making some compromises elsewhere in the modelling. So we'd hope that you didn't need to set up a separate model but we're flagging that that might be necessary if you want to get the Ipswich results right.

MS WILSON: So that's just a flag for the future when people are looking at the guidelines that you've set out, you may have to set up a separate model if it doesn't - if you can't do in the larger model.

MR BABISTER: In the larger, exactly.

MS WILSON: One of the issues that is raised in this report is the issue of joint probability. Now, Mr Babister, you considered the issue of joint probability, and all experts agree that this issue is a critical consideration. Perhaps if I can ask you, Dr Leonard, why is joint probability of such importance in any flood study of the Bremer River?

DR LEONARD: Because we're talking about probabilities here in setting a Q100 or some flood design level. We're talking about a probability that a level is exceeded, and to correctly estimate that probability you need to take into account the probabilities of inflows on either river and, significantly, the correlation between them, because the larger a rainfall is it could be that it coincides on both rivers and the timing is such that you can - that they can compound each other. So that's why joint probability is critical, and the alternative is ad hoc or some sort of assumption where you fix one parameter or take a certain ratio of flows on the two rivers. That would end up leading to a false sense of confidence, I think-----

MS WILSON: And-----

DR LEONARD: -----rather than the full distribution and the joint distribution.

MS WILSON: How were those assumptions done in the past?

DR LEONARD: Well, traditionally it requires you to suggest that one source is more dominant than the other or to - in consideration decide that you will - so let's say you are

after a one in 100 event, you might take a - if the Brisbane River is a more dominant flooding mechanism you might take a very extreme or rare event on the Brisbane River around the one in 100 and a more moderate flow down the Bremer of some - some value, but it is slightly arbitrary, I feel. Others might want to comment on that but-----

MS WILSON: Well, I may seek the - any comments from any other member of the panel in relation to joint probability.

MR BABISTER: It's absolutely necessary to do. I backup Michael's comment and say it's not just somewhat arbitrary, it's completely arbitrary, unless you do a joint probability assessment. Yeah, completely subjective, that's right.

MS WILSON: Mr Collins?

MR COLLINS: I don't disagree with what's been said, I just make the comment that for practising professionals the guidelines set out the methodology that was described in terms of how it was previously done before joint - before the Monte Carlo simulation was carried out. There were some other variants to that such as the Laurenson method which Mr Babister demonstrated to show that you can get quite a different answer if you apply that approach, but prior to 2000, I'll put a number on it, probably all the guidelines in this country tended to push it down the direction of the method of proportioning flows, which is a limitation.

MS WILSON: Dr Markar?

DR MARKAR: Yes, I think it's been case of horses for courses to an extent and the amount of effort, the importance, implications of creating the result. The traditional practice in the past has been based on the catchment sizes. A bigger catchment - a smaller catchment, tributary catchment flowing into a bigger catchment and there are some guidelines to decide on what sort of combinations of probability to assume. For example, if the Brisbane River we're looking at a hundred year event there. Then, depending on the size of the tributary catchment, there are guidelines, have been guidelines in the past, it has to be a 10 year event or a 20 year event, if it were a very small system it could be up to a one or two year event. For example, some of these guidelines are given in the Queensland Urban Development Manual when you look at development applications for local creek systems. What you're talking about here is because of the importance - a big town is affected like Bremer, we've got to be a bit more sophisticated, we've got to be a bit more accurate and there has to be better science involved rather than to - when we assess a flood levels. If I can add to that as well, we're talking about the interaction of rivers, there's always some backwater effect when there is interaction with rivers, and the dominance of a backwater effect depends on the size of the two systems. There are lots of other tributaries draining through Ipswich that drain into the Brisbane River but those catchments are very small, so any major flood level on Brisbane will dominate those tributary

systems and those levels will be much larger than anything - any flood level generating from the tributary alone. The Bremer is a bit different. Bremer has a fairly large catchment and it generates - produces quite large discharges and sometimes according to what is - than what is coming down the Brisbane River. That's why the Bremer-Brisbane River interaction is quite important compared to a lot of other little tributary systems. And, as we discussed in the past, it's been somewhat arbitrary combination that's been looked at. Now what you are proposing in the joint report is to proffer more scientifically-correct approach.

MS WILSON: A joint probability analysis will reduce uncertainty to some degree.

DR MARKAR: Yes, that's correct.

MS WILSON: Dr Nathan, have you got anything to add?

DR NATHAN: No, I agree with everything that has been said and have nothing to add.

MS WILSON: Well, don't give away the microphone unless, Mr Babister, you've got anything to add.

MR BABISTER: I was just going to add that this problem is compounded by Ipswich because of this large range as well. If the range was quite small, you know, you could probably get away with more of an arbitrary approach, but it sort of amplifies the problem, the large range of flood levels.

MS WILSON: It is clear that a great influence on any flood study into the Bremer has to take into account the Brisbane River. So, now, Dr Nathan, if I could ask you about the sequence of the flood study for Ipswich and the Bremer River because we have to take into account any flood study in the - for the Brisbane River. Could you assist?

DR NATHAN: Yes, because Brisbane River has such an influence you'd really need to be comfortable that you're getting that interaction between Brisbane and Bremer correct, and that would have to be demonstrated as part of the main focus on the Brisbane River, so I do think it would be sensible to wait for that study to be done before you do anything more detailed in the Bremer catchment, but I think we were also talking earlier about the number of other studies that will follow on or are part of that Brisbane River in terms of the optimisation or consideration and mitigation options, et cetera, so once the risk has been characterised I think the other studies in the Brisbane River could then continue and you could then start work on Ipswich.

MS WILSON: And how long would it take to determine the risk, as you talk about the risk being characterised?

DR NATHAN: Once the Brisbane River has been done I think satisfying yourself that you're reproducing the likelihood of flood levels in Ipswich is probably of more of the order of

months than years

MS WILSON: And that first part of characterising the risks?

DR NATHAN: I'm including that in there. I think the complication is again converting those two inundation levels and extents and that's a more complicated task, but in terms of understanding the risks and the levels associated with those that's - once the Brisbane River has been done it's a more straightforward exercise for the Bremer.

MS WILSON: So if I can establish some timeline. So working from today and say that the Brisbane River study got underway, how long are we looking for - how long are we looking to to that first part being completed and when the Ipswich can then continue?

DR NATHAN: I think that would depend on the staging of investigations which, it goes back to my last point that I made in the previous session, I think it depends on how you stage investigations in the Brisbane River, but, off the top - I mean, I'm - so I'm a little bit reluctant to put a time on that, but speculating I could imagine most of the prime effort on characterising risk in the Brisbane you'd say could be done within a - you know, a 12 month or so period, and it was after that you could then focus on the Bremer, so probably looking at a 12 to 18 month time frame.

MS WILSON: And what is the additional cost? We've spoken about cost in relation to the Brisbane River. What would you be looking at additional costs for dealing with the Bremer River?

DR NATHAN: Oh, considerably less. Yeah, the additional costs of looking at the Bremer after the Brisbane would be considerably less. The part of the cost - I don't have a particularly good feel for is how you would convert that to levels in inundation extent. I think that depends - I think a fair bit of work has been done there and I am not familiar enough with it to know how much of that needs to be revisited.

MS WILSON: Perhaps I could open that up to any other experts on the panel, if they've got a different view about the time to be taken and/or the cost?

MR COLLINS: I agree with what Dr Nathan has said. In terms of the time, there are a number of tasks that could be done in parallel, but probably not the critical ones. For example, the hydrologic model has to be updated as part of the Brisbane study, so that's not a unique extra, unless there is something specific in sub-definition that's required. The hydraulic model obviously has the Bremer River in detail required for the Bremer studies but if it required additional detail, which I think Mr Babister suggested is a possibility - but we're not clear on that until someone gets into the study - that could also be done in parallel. But there would be additional works required, which required the outputs from the Brisbane study. So I agree with the timing with regard to that. In terms of once you get the levels, the mapping exercise is really something that council can do themselves, I would have thought, in Ipswich's case, because once you know levels, it is a translation exercise on the system, and that can be done fairly quickly. So in terms of timing, I agree with the timing. It is not that much more than the Brisbane studies and it comes down to the intermediate staging. In terms of the cost, there may be some additional cost with the refined analysis but I would have thought as part of the overall numbers we were talking about earlier, it is a very small additional component, and I would have thought most of the elements would be common to the point that it would be sensible to do them as part of one overall study. It is just then a question of who contributes.

MS WILSON: Dr Leonard?

DR LEONARD: I have a little bit of reservation about saying six months. I don't think that the work is significantly more than that but the Bremer and the Ipswich region is contingent on a few things lining up. So with the Brisbane River you can sort of satisfy yourself on the hydrology and then from that point you go - you look to getting the hydraulics right. But here we need to - we can't just satisfy ourselves with the hydrology because the real key validation is using the levels in Ipswich, which to do that you need the hydraulic model. You can't just say we've got the distribution of inflows on

the Bremer right, and we've got the distribution of inflows on the Brisbane River right, you need to combine them together and convert them to levels and check them. Because of that, then it depends on satisfying yourself that the hydraulic model, whether you do or not need a detailed hydraulic model for the Ipswich region, so you can try and apply one for the whole Brisbane catchment, and then if that doesn't satisfy requirements, then you would build your detailed model, then you would use that with your hydrologic inputs to try and sign off on the whole process. And I just feel there is a bit more iteration there and a few more contingencies that might not sort of play out in a six-month period.

MS WILSON: Can you offer us a time-span?

DR LEONARD: I would have - I - I am speculating. I would have said if - so the year figure that Rory gave was to get the hydrologic inputs for the Brisbane River right, if I remember correctly, so I would have thought it was at that point that you could assess whether - whether or not they were suitable and your hydraulic model was suitable in the Ipswich region. I am not sure you can do that in parallel until you have signed off on the Brisbane flows. At that point you might need to build a detailed hydraulic model and I would have thought that that would take several months, three to six months. So I'm saying nine to 12 months.

MS WILSON: Is there any differing view from the approach that Dr Leonard has suggested? Mr Collins?

MR COLLINS: There is not a huge amount of additional cost in building a more detailed hydraulic model of the Bremer River using full two-dimensional modelling techniques we have available. Whether it is core scale or fine scale, the cost of the model construction really are not all that different. So I would suggest that you could do them in parallel and then have a nested fine-scale model within a 2D framework that you could plug in or pull out, depending on what analysis you're doing. So I still think it could be done in parallel. But, you know, I understand that where we're all firing a little from the hip here on the timing; it needs a lot more thought than that, and I acknowledge what Dr Leonard has said, there is more uncertainty in it, but I still am optimistic that you wouldn't need that additional time for the hydrodynamic additional detailed modelling.

MS WILSON: The point is that we're not talking in excess of two to three years?

MR COLLINS: No, I don't believe so.

MS WILSON: And it could be done under two years?

MR COLLINS: I believe the critical elements could be done in under two years, yes, as I said in the previous session.

MS WILSON: Unless we've got any other differing view, can we just move on to paragraph 46 of the joint experts statement,

where the experts agree that Ipswich has exceptional but not unique flooding characteristics. Mr Babister, can you explain that statement to us?

MR BABISTER: Ipswich has a couple of things that you don't see all of the time in a flood situation. It has the joint probability problem that we've spoken about; it has a very large flood range, which is not unique but it doesn't happen very often in a large city or a large population centre, and that really contributes to some of the flood management issues that you have to deal with. In a normal flood situation, a 200 year flood might be a small amount, 3, 400 mm above 100 year, or one per cent flood, but at Ipswich it is probably going to be several metres, and that means somebody who builds a house in a defined flood level, is likely - there is a reasonable chance of experiencing above floor flooding, and it is reasonably likely that that flooding could structurally damage their house. While in an ordinary situation you've really just got expensive but relatively minor flood damage as opposed to a whole new house. And it is probably one of the worst situations for a large residential area.

MS WILSON: When the experts refer - when you all refer to acute management issues being associated with floods that exceed the planning level, can you give us some more detail, Mr Babister, about those acute management issues?

MR BABISTER: Because of this probability of over-floor flooding and significant over-floor flooding, there are - instead of the traditional Q100 in Queensland, flood definition that's used for planning, it is worthwhile exploring other management issues, and that's certainly been explored in other places that are a little bit similar about making people who build the Q100 have a two-storey house so that they have some area they can raise goods, and certainly other building controls to stop structural failure. So it shouldn't be dealt with in the same way that an ordinary floodplain is dealt with.

MS WILSON: Any other of the experts in the panel got anything to add to that? Dr Nathan?

DR NATHAN: I think the emphasis from my perspective on that acute management issues is about the risk of getting it wrong. I just want to emphasise that point, if you are above that flood planning level and a flood does occur, which there is a chance, then the risk of that happening and the consequence of it are much more dramatic than what would happen elsewhere in people's experience. I think that was the emphasis we were making through this location.

MS WILSON: Emphasising the importance of the comprehensive flood study as recommended in this report?

DR NATHAN: Yes.

MS WILSON: Mr Collins?

MR COLLINS: The other acute management measures that flow is the emergency management measures for events that are larger than defined flood event where you get considerable depths of water over the floors. That then comes into evacuation management as well as emergency management and risk assessment. Fortunately, one thing that is in Ipswich's favour is that there is a reasonable amount of time for those measures, in terms of evacuation, and I think that is evident from the type of flooding that occurred and the relatively low potential for loss of life in those events. So - but there is a very strong need for emergency management planning around the results of the whole range of flood events, right up to extreme events because they may occur.

MS WILSON: Is there any management of these issues in other floodplains that you can draw the Commission's attention to so that we can see what has been done in those floodplains that you would say would have similar issues?-- Well, there are some examples in Mr Babister's report, and he might like to comment on those, but ones that spring to my mind are places like the northern beaches in the Barron Delta in the City of Cairns where extreme flood events can cause several metres additional water through properties. And they require additional emergency management measures over other parts of Cairns, for example. I don't know whether you wanted to add to that.

MS WILSON: Just before you give the microphone back, how is that managed in that area?

MR COLLINS: There is an emergency management plan in place for evacuation routes identified and evacuation centres. I would have to say that it is a work in progress, that is still being worked on, but at least it is recognised that those things are required. That risk management method is certainly being picked up by the larger councils and perhaps at a slower pace by the less sophisticated local authorities.

MS WILSON: Mr Babister?

MR BABISTER: Yeah, in the Hawkesbury and Appian at Windsor in New South Wales, this issue has been looked at. It is relatively similar, the flood range, and there have been some extensive guidelines, which I think I've drawn the Commission's attention to, on building design and subdivision layout. And some of the things that have been suggested, that I might add that have not been well received in some quarters, has been the two-storey houses for people who build at the Q100, plus whatever the freeboard amount is, and you can build a one or a two-storey further up the hill, but if you are down in the lower spots a two storey, making the bottom storey double brick. So the post flood cleanout is a cheap and easy exercise. There has also been suggestions about using marine ply for the frames of new houses. New houses tend to use plywood for the bracing and it is not marine grade, so when it gets wet, the frames aren't braced and the whole house needs to be pulled down, but a simple exercise of using marine ply, which would add a few hundred dollars to the price of a house,

can make the frame flood proof. There are also some ideas about actually letting the water into a house if it is going to flood. One of the big causes of structural failure is there is water outside the house and there is none inside, so you have got a differential water level, and modern houses, particularly project homes, are actually built remarkably watertight and they hold the water back quite well. So just having certain openings to let the water in, or even leaving the door open before you leave in an emergency, which doesn't normally make sense, can actually limit damage.

MS WILSON: Before we go on to a new topic, is there any other expert that would like to contribute? Dr Markar?

DR MARKAR: I agree with what's been said. Just a simple addition to what's been said, so when we look at the best estimate, for example, Brisbane, if you get it wrong you are talking small differences in terms of flood levels, maybe half a metre, one metre say. But in Ipswich, if the best estimate is not that good, the differences we are talking about is three, four metre differences, potentially. So the risk of getting something wrong, the impacts/implications are much greater in Ipswich compared to most other areas.

MS WILSON: If we could just now move on to the response to questions 8 and 9 which are set out at pages 15 to 16? Considering the conclusions that are reached there, if I could ask your view on the temporary local planning instrument 01/2011 that the Ipswich City Council put into place to replace the flooding and urban stormwater flow path areas - overlay map to incorporate a revised flood regulation line based on the highest known flood level from the 1:100 flood line, the 2011 flood, and the 1974 flood, so they are just looking at whatever is the highest. Would you agree that that's a sensible interim measure until this flood study that you recommend in this report can be carried out?

MR COLLINS: Yes.

MS WILSON: Mr Collins is a yes. Mr Babister?

MR BABISTER: Yes, I would like to see the study happen, though. We wouldn't want to have an interim flood level for a very long period of time. Because, likewise if it is too high, that really adds a lot to people's costs.

DR LEONARD: I agree.

DR MARKAR: Yes, I agree.

MS WILSON: Thank you, I have no further questions.

COMMISSIONER: Mr MacSporran?

MR MacSPORRAN: I have nothing, thank you.

MR FLANAGAN: No questions.

MR ASHTON: Nothing, thank you, your Honour.

MS McLEOD: No questions, thank you.

COMMISSIONER: Did everybody get to say everything they wanted to? I am sorry, yes, all right, we have some questions over here.

MR CUMMINS: Sitting here a couple of times - just one for clarification, Mr Babister. You talked about the additional - making additional expenditure on houses that are already constructed at or above the one per cent line. I just wonder whether you would like to comment on the internal rate of return for persons in such an investment?

MR BABISTER: The rate of return would be extremely high if you make some of these minor changes. The other one-----

MR CUMMINS: On a one per cent risk?

MR BABISTER: Well, over a person's life, you know, there is - there is a very low chance of somebody experiencing that on an existing house. If you are going to let the water in, that's got a good return, but I guess - but on a new house I think if the costs are very minor it is a very good investment.

MR CUMMINS: The other question I had really went to just getting in my mind the process that you were talking about for the Bremer River. I take it that you would - that there would be an agreement that the part of the Bremer River, which is above the interaction with the Brisbane River, a flood study could be commenced on that which may be informed by the rainfall frequency analysis you do and may be informed by spacial and temporal patterns but otherwise would be independent?

MR COLLINS: Yes.

MR BABISTER: Yes.

MR CUMMINS: Secondly, the Brisbane River itself, without consideration of the Bremer River, affects a lot - well, it is responsible for the majority of the flooding in Ipswich.

MR BABISTER: I think if you weigh up-----

MR CUMMINS: Perhaps that's a large percentage.

MR BABISTER: If you weigh up the two mechanisms, Brisbane is the stronger of the two.

MR CUMMINS: Yeah, but what I'm getting at is there is a Brisbane River flood study that will deal with part of Ipswich, part of the Bremer can be dealt with, and then there is a bit in the middle which may be in an elevation of a velocity head or so above the Brisbane River where there is strong interaction. Is that putting it too simply, Dr Nathan?

DR NATHAN: Yeah, I am just trying to get my head around the bit in the middle. I think it is probably a reasonably significant bit in the middle that will require thought but I couldn't quantify that.

MR COLLINS: A five metre range for a start. So it is going to be a fair length.

MR CUMMINS: Sorry, Mr Collins?

MR COLLINS: Well, at the moment it is being discussed that there is an uncertainty range and it is several metres. So several metres vertically means quite a few kilometres horizontally. So that bit in the middle is quite large.

MR CUMMINS: It is large in expansion but it is a corridor in other ways, too.

MR COLLINS: Yes.

MR CUMMINS: I am just trying to say there are things that Ipswich can do to update their flood study at the same time as the Brisbane flood study is progressing which I think was the point you tried to make, is that right, Mr Collins?

MR COLLINS: Yes.

MR CUMMINS: But that it can't be completed until - I suspect a shorter time than what Dr Leonard suggested after the Brisbane flood study is complete.

MR COLLINS: Yes. That's my view.

MR CUMMINS: Thank you, sorry.

COMMISSIONER: Is there anything any of you wanted to add? Yes.?

DR MARKAR: If I can add, Madam Commissioner? I understand there's another major study going on called the Wivenhoe and Somerset Dam Optimisation Study which is probably already underway. I suspect a number of elements we have proposed in the comprehensive study will be common to that study as well. So, I think a lot of extra work that's been done, I guess it's better to see what is - what has been proposed and make sure we don't duplicate the same-----

COMMISSIONER: I suppose that emphasises the need for agency cooperation.

DR MARKAR: Yes.

COMMISSIONER: Seqwater and those type of agencies.

MR MARKAR: Yes

COMMISSIONER: Does anyone else want to add anything?

MS WILSON: Madam Commissioner, may Dr Markar, Mr Collins, Dr Nathan, Mr Babister and Dr Leonard be excused?

COMMISSIONER: Yes. Once again, thank you very much indeed for a very positive contribution to the Inquiry's work.

WITNESSES EXCUSED

MS WILSON: Madam Commissioner, may we adjourn till 11.30 tomorrow morning?

COMMISSIONER: Yes. Adjourn till 11.30.

THE COMMISSION ADJOURNED AT 4.21 P.M. TILL 11.30 A.M. THE FOLLOWING DAY