

QUEENSLAND FLOODS COMMISSION OF INQUIRY

FIFTH STATEMENT OF ROBERT ARNOLD AYRE

QUEENSLAND TO WIT

I, **ROBERT ARNOLD AYRE**, of c/- SunWater Limited (**SunWater**), Level 10, 179 Turbot Street, Brisbane in the State of Queensland do solemnly and sincerely declare as follows:

INTRODUCTION

- 1 This statement is a further supplementary statement to my four statements previously provided to the Commission of Inquiry on 23 March 2011 (**my first statement**), 29 March 2011 (**my supplementary statement**), 8 April 2011 (**my third statement**) and 11 April 2011 (**my response to Michael O'Brien's submission**).
- 2 This statement responds to the Commission's request for a response to the document entitled 'List of suggested work to be done to review the Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam' dated 17 May 2011 (**the Proposed Review**).
- 3 The opinions that are contained in this statement are my own. I do not provide this statement on behalf of Seqwater.
- 4 I will provide any further information or explanation required by the Commission of Inquiry.
- 5 Documents referenced in this statement can be provided on request.
- 6 The definitions used in this fifth statement are the same as the defined terms in my first statement.

BACKGROUND TO MY RESPONSE TO THE PROPOSED REVIEW

- 7 The multi-functional nature of Wivenhoe and Somerset Dams needs to be considered in determining possible alterations to the W&S Manual. Those functions are:
 - (a) Water supply security;
 - (b) Flood mitigation;

- (c) Hydro-electric power generations; and
- (d) Recreation.

- 8 Any amendment to the W&S Manual in respect of these functions requires policy decisions in respect of setting the priorities and/or capacity for each of the specific functions.
- 9 While there is a framework in place for the water supply function of Wivenhoe Dam no such framework exists for flood mitigation function. The flood mitigation service is provided to a number of downstream communities including Brisbane, Ipswich, Lowood and Fernvale. These communities are represented by three local governments. It may be thought that these communities are best placed to define the flood mitigation objectives of Wivenhoe Dam. They represent the community risks of economic, social and safety. These communities will, at times, have some conflicting objectives based on the many permutations of the possible events that could occur and their consequences.
- 10 A moderator, equivalent to the SEQ Water Grid Manager, might reasonably be identified to negotiate and set the final flood mitigation service standards. The service standards will need to be negotiated with Seqwater as the dam owner so that consideration can be given to the limitations of the facilities. It is sensible for the moderator to be a separate entity to the current SEQ Water Grid Manager due to the potential conflict between flood mitigation and water supply objectives.
- 11 The Dam Safety Regulator is concerned with the compliance with dam safety standards and legislation. Although the Dam Safety Regulator approves the flood operations manual, this is from the perspective of the safety of the Dam, not from the perspective of the flood mitigation service provided.
- 12 In my respectful opinion, the first step in a review of the flood operations manual is to establish the framework outlined above and set clear accountabilities. The second step is to establish an agreed set of flood mitigation objectives for the dam. The third step then is for the dam owner (with appropriate peer review) to develop and test the operating rules. This will necessarily involve a number, if not all, of the investigations proposed by the Commission and responded to by me in **Annexure A** to this statement. The fourth and final step is to document the rules in the flood operations manual with the appropriate technical and legal oversight.

DESIGN FLOOD HYDROLOGY

- 13 A second point that I wish to note relates to the Design Flood Hydrology and past reviews of the W&S Manual.
- 14 I note that the existing operational strategies for Wivenhoe Dam, whilst being postulated by Hegerty and Weeks in 1985, have been tested against a range of design floods and actual flood events (April 1989, February 1999, February 2001, October 2010 and December 2010) since their inception.
- 15 The existing procedures have been shown to be robust and practical to apply. The procedures have achieved the stated objectives effectively, including during the January 2011 Flood Event.
- 16 The following design flood hydrology revisions for Wivenhoe Dam have been conducted:
 - (a) IWSC – Hausler and Porter (1977);
 - (b) QWRC – Weeks (1983);
 - (c) BCC and QWRC – Hegerty and Weeks (1985);
 - (d) DNR – Ayre and Ruffini (1993);
 - (e) Wivenhoe Alliance - Roads (2004); and
 - (f) Seqwater – Malone (2009).
- 17 Each of these revisions has utilised, at the date of completion, the latest design rainfall estimates and techniques.
- 18 The last revision, conducted in 2009, was based upon current BoM guidelines for extreme rainfall estimation (Probable Maximum Precipitation) and it also incorporated regional design rainfall estimates using CRC-Forge techniques and the procedures from Book VI of Australian Rainfall and Runoff (2001).
- 19 Therefore, in my opinion, the strategies currently used in the W&S Manual have been thoroughly tested and shown to be viable; however, It is important that the strategies be reviewed after each flood event, in particular after a flood of the magnitude of the January 2011 Flood Event.

MY RESPONSE TO THE PROPOSED REVIEWS

- 20 I have provided my responses to the Proposed Reviews in Annexure A **attached**.
- 21 As a general comment in relation to the Proposed Reviews, I do not endorse any process of revision to the current W&S Manual without a rigorous and robust assessment.
- 22 Further, if a Proposed Review relates to a review of the wording in the W&S Manual, I do not agree that these types of revisions should form part of any interim or short term review. This is because in the short term, that is, between August 1 and the start of the 2011 wet season, the W&S Manual does accurately reflect the strategies applied by the Duty Flood Operations Engineers during a flood event.
- 23 If, however, the proposed revision relates to a longer term review, I agree that issues, such as wording and clarification of ambiguity of any terms in the W&S Manual, could form a part of that review.

AND I MAKE this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of the *Oaths Act 1867*.

Affirmed and Declared at Brisbane)

this 30th day of May 2011 in the)
presence of:)



Solicitor



Signature of the declarant

ANNEXURE A

LIST OF SUGGESTED WORK TO BE DONE TO REVIEW THE MANUAL OF OPERATIONAL PROCEDURES FOR FLOOD MITIGATION AT WIVENHOE DAM AND SOMERSET DAM

| | PROPOSED REVIEW | AGREE/DISAGREE WITH PROPOSAL | REASON FOR AGREEING/DISAGREEING WITH PROPOSAL |
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| A. Interim review of the Manual (before 2011/2012 wet season) | | | |
| 1 | Should an interim review of the Manual resolve the confusion over non-damaging flows, target flows and corresponding levels downstream with respect to flows at Moggill (taking into account impact of tides, influence of downstream tributaries, effect of maintaining discharges for long periods)? | Disagree | <p>To the extent there is ambiguity in the W&S Manual on these matters, then I agree that the W&S Manual ought to be written to avoid this ambiguity.</p> <p>However, I do not agree that this review should be done in the short term as there is no confusion on the operation of the W&S Manual by the Duty Flood Operations Engineers who currently manage flood events.</p> <p>My other concern is that the wording may be amended following an interim review without sufficient consideration having been given, causing confusion amongst the Duty Flood Operations Engineers and other stakeholders, such as the Councils.</p> |
| 2 | Should an interim review of the Manual involve operational/technical writers writing the content and organising the material in the Manual to properly reflect the strategies as applied by the flood engineers? | Disagree | <p>I agree that the writing of the W&S Manual by operational/technical writers may assist in clarifying and organising the W&S Manual in a way to reflect the strategies applied by the Duty Flood Operations Engineers.</p> <p>However, this process must be overseen by the Duty Flood Operations Engineers to ensure their interpretation and application of the strategies is properly captured when writing the W&S Manual.</p> <p>I do not agree, however, that this review should be part any interim, because in the short term the W&S Manual does properly reflect the strategies applied</p> |



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| | | | by the Duty Flood Operations Engineers. |
| 3 | Should an interim review of the Manual ensure the Manual is internally consistent? | Agree | <p>If this is simply a reference to, for example, a consistency in the language in the W&S Manual, then I agree that it should be part of the interim review. The example I can think of is to have consistency in the language for "predicted [lake level]" or "likely [lake level]".</p> <p>However, if the term "internal consistency" means something else, then consideration should be given as to whether it is appropriate in an interim review to make amendments to the manual which should, in fact, be part of a long term review.</p> |
| 4 | Should an interim review of the Manual involve lawyers to check working of Manual and potential effects on liability and immunity? | Agree | The W&S Manual is an operational document and it should remain focussed on the operations. However, the W&S Manual does also serve as a legal document and so if it would assist the review, I would support a legal review of the W&S Manual before it is submitted for approval by DERM. |
| B. Longer term review of the Manual | | | |
| 5 | Should a longer term review of the Manual include a review of the design hydrology? | Agree | <p>The nature/characteristics of the January 2011 Flood Event are significantly different from previous historical flood events and design flood events that have been analysed. Therefore, in light of the January 2011 Flood Event, a review of the design flood hydrology should be undertaken for all three dams.</p> <p>This is the approach that has been adopted for previous post-event reviews, and I consider that it is appropriate to continue to do so with each new event.</p> |
| 6 | Should a longer term review of the Manual include a review of the design hydrology and, if so, should such a review of the design | Agree | Subject to my comments below I agree the work needs to be done but disagree that it needs to be done in the course of a review of the W&S Manual. The W&S Manual ought to reflect the studies that have gone before |

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| | <p>hydrology:</p> <ul style="list-style-type: none"> (a) Use a stochastic, Monte Carlo or probabilistic approach rather than a deterministic approach? (b) Take account of observed variability in temporal and spatial patterns of rainfall? (c) Take account of observed variability in the timings of inflows from the dam and downstream tributaries? (d) Account for how dam levels and discharges are influenced by downstream tributary flows? (e) Be of similar size and scale to the Brisbane River Flood Study completed between 1990 and 1995? | | <p>and not be included as part of the review of the W&S Manual itself.</p> <p>The review of design flood hydrology should be conducted in accordance with the procedures defined in Australian Rainfall and Runoff, A Guide to Flood Estimation (2001).</p> <p>The use of stochastic or Monte Carlo methods would be a matter for the practitioner undertaking the review.</p> <p>It is recommended, however, that critical assumptions regarding the temporal and spatial distribution of rainfall be carefully considered and advice obtained from the Bureau of Meteorology regarding these matters for this specific catchment(s). Factors, such as concurrent flooding of downstream tributaries, partial area effects, areal reduction factors and starting water levels, need to be accounted for in the analysis.</p> <p>A crucial factor in the determination of how suitable different operating strategies are likely to be will depend on how closely the design approach reflects the use in actual operation. The assumption regarding planning horizon needs to be determined and incorporated into the adopted assessment process.</p> <p>The study will be whatever size is necessary to get a satisfactory outcome and that relates to how rigorous the testing of the operations strategies is likely to be. My expectation is that it would be a major undertaking that will take at least twelve months to complete.</p> |
| 7 | Should a longer term review of the Manual test the usefulness of installing more ALERT gauges at high elevations in the catchment? | Disagree | The inclusion of additional ALERT rainfall gauges will have little overall impact on the W&S Manual per se. More gauges in representative locations within the catchment should improve the RTFM performance and it should, |



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| | | | <p>mean that operational decisions are based on more reliable model results.</p> <p>However, this issue does not necessarily translate directly into effectiveness of the W&S Manual.</p> <p>The selection of additional sites for gauges relates more to an optimisation assessment of the monitoring network and should involve multiple agencies who have an interest in using the information such as the BoM, DERM, Seqwater and the relevant local authorities. A recognised hydrometric data provider should be engaged to provide advice/assistance in refining the data collection network and assisting in aspects of telemetry and network maintenance.</p> |
| 8 | Should a longer term review of the Manual involve a bathymetric survey of all significant creeks and rivers upstream and downstream of the dam relevant to flood modelling? | Agree | Regular bathymetric surveys of the river system after major flood events are considered very useful as large flood events are the type of event that change channel characteristics and hence modify responses in the river system. It is an essential data collection activity associated with calibration of a hydrodynamic model. |
| 9 | Should a longer term review of the Manual update the hydrodynamic (hydraulic) model using up-to-date bathymetry and LIDAR (light detection and ranging optical remote sensing technology)? | Agree | <p>I am aware that Seqwater has engaged SKM to re-calibrate the Wivenhoe Alliance MIKE-11 model of the Brisbane River. This is being done on the existing model cross-sectional representation and was commenced by SunWater, on behalf of Seqwater, shortly after the flood event.</p> <p>A re-survey of the topographical data used as the basis of the model should enable a comparison between the topographical data sets which will assist in identifying the changes in the river channel that have occurred as a result of the January 2011 flood event.</p> <p>A re-survey will enable discrepancies in the re-calibration of the</p> |

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| | | | hydrodynamic model to be examined and hopefully improve the overall performance of the model. |
| 10 | Should a longer term review of the Manual assess the reliability of forecast rainfall? | Agree | <p>I agree that any review of the W&S Manual should include a review of the reliability of forecast rainfall. I note that Mark Babister has indicated in his testimony that he was aware of quantitative rainfall forecasts of between one and three days duration that may now be sufficiently reliable for use in operational decision making. The Commission should obtain details of this work and consider whether to engage the research/operational organisation utilising this technology and adapt it for use in South-East Queensland.</p> <p>In my experience (which accords with the evidence of Dr Rory Nathan, CSIRO and the BoM), there are no agencies using quantitative rainfall forecasts as the basis of operational decisions for flood mitigation dams.</p> <p>Caution should be exercised in relation to this review, as the risk of unnecessary closure of bridges, community isolation and inundation of property will need to be quantified using this approach. The use of quantitative rainfall forecasts in operational decision making implies that the warning time available be reduced. Care will need to be exercised because if there are too many instances of premature (and possibly unnecessary) adverse impacts, communities may not consider this type of decision making appropriate.</p> <p>The reliability of quantitative rainfall forecasts should be assessed by an appropriately qualified agency such as the BoM or CSIRO.</p> <p>I have previously examined the reliability of the 24 hour QPF for the January 2011, February 1999 and February 2001 Flood Events and have concluded that they are not reliable. This data should be re-analysed and any other</p> |

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| | | | forecasting model results assessed to determine how it could be used in the future. |
| 11 | Should a longer term review of the Manual run simulations to test the robustness of relying on forecast rain? | Agree | <p>I do agree with this proposition, however, to the extent that this question implies that it is <u>only</u> necessary to test by "simulations" I disagree. If it can be established that quantitative rainfall forecasts are indeed reliable, then these forecasts should be tested in an <u>operational</u> scenario.</p> <p>As said in response to question 10 above, caution should be exercised as the risk of unnecessary closure of bridges, community isolation and inundation of property will need to be quantified using this approach. The use of quantitative rainfall forecasts in operational decision making implies that the warning time available be reduced. Care will need to be exercised because if there are too many instances of premature (and possibly unnecessary adverse impacts) communities may not consider this type of decision making appropriate.</p> <p>This could have implications for the indemnity of the owner and operator of such infrastructure and also ramifications for household insurance.</p> |
| 12 | Should a longer term review of the Manual consider the ability to pre-release on the basis of forecasts? | Disagree | <p>This implies the W&S Manual, which comes into effect only when there is a risk of a Flood Event, could also be used prior to a Flood Event. Such a course might be taken outside and before the operation of the strategies contained within the W&S Manual but does not, in my view, properly form part of the operations under the manual being investigated. Pre-releases in the circumstances of possible flood events are a matter of policy, not a matter that should be decided by the Duty Flood Operation Engineers. The ability to pre-release is intrinsically linked with forecast horizon and reliability of prediction.</p> |

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| | | | <p>The effectiveness of the pre-release depends upon the time it takes to empty the storage to the required level and what impact you are willing to accept in doing so. For example, I understand that the drawdown in February 2011 took nine days to achieve a 300,000 ML reduction in capacity at a rate of approximately 350m³/s. This release inundated Twin Bridges, Savages Crossing and Colleges Crossing.</p> <p>I do not think mid to long term (three to seven days) quantitative forecasts are reliable enough at this time.</p> |
| 13 | Should a longer term review of the Manual consider potential triggers for such pre-releases? | Disagree | <p>In my view, this is not a matter for the Duty Flood Operation Engineers or the W&S Manual as the W&S Manual only comes into effect after the commencement of a Flood Event.</p> <p>Pre-release on the basis of seasonal outlook is not feasible because seasonal outlooks simply provide an awareness of the likelihood of rainfall. They do not quantify the amount, timing or specific location of the rainfall. Therefore it is difficult to understand how the level of drawdown, frequency of drawdown and duration of drawdown can be established.</p> <p>A long term quantitative rainfall forecast would need to be used. On the evidence of the SILO Access model (three and five day durations) such forecasts are very volatile and not reliable at this time.</p> |
| 14 | Should a longer term review of the Manual consider the ability to incorporate information from weather radar? | Agree | <p>I am aware of some pilot studies being conducted by Alan Seed (BoM) and Dr Philip Jordan (SKM) in Victoria that have shown promise, but I am unaware if this technology has yet been used in an operational mode. Developments in this area should be monitored and, if shown to be viable, they should be considered for incorporation into the RTFM.</p> |

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| | | | The FEWS framework being developed by Seqwater has the ability to assimilate data from a range of sources. It would be necessary to ensure that the new system can accommodate the integration of such data with ground based point estimates. |
| 15 | Should a longer term review of the Manual involve obtaining information from the Bureau of Meteorology on its ability to provide ensemble forecasts (multiple predictions based on different initial conditions)? | Agree | I understand from Dr Rory Nathan's evidence that progress is being made on ensemble forecasts. A watching brief should be kept to see if these techniques warrant further consideration. I think CSIRO have a study that is reaching completion which could be investigated. |
| 16 | Should a longer term review of the Manual consider the ability for the flood engineers to use such ensemble forecasts? | Agree | <p>This review depends upon the review referred to in question 15 above.</p> <p>Ultimately the Duty Flood Operations Engineers need to make a judgement, in the course of an event, upon the information at hand. There can only be one gate opening, or closing sequence adopted and this sequence will vary during the course of the event. So therefore the process will gradually vary in accordance with the prevailing circumstance. Codifying this decision process by the inclusion of a statistical assessment or discounting system (as suggested by Mark Babister as a consideration) may not necessarily be the optimal way to proceed.</p> |
| 17 | Should a longer term review of the Manual involve modelling to cover a range of potential Full Supply Levels with different operating strategies? | Agree | <p>I agree that a long-term review should consider the impact of adopting different FSLs with different gate operating strategies.</p> <p>However, the adoption of any new FSL or gate-operating strategies is a policy decision which interacts with considerations of other functions of the dam.</p> |
| 18 | Should a longer term review of the Manual assess the performance of different operation strategies against property floor levels in all | Agree | Refer to my response at 19 below. |

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| | urban areas downstream and upstream of the dam and likely damages? | | <p>The choice of particular target flows adopted in the strategies is linked to resultant flood levels in impacted rural and urban areas.</p> <p>To affect this relationship, you will need a calibrated hydrodynamic model which in turn can produce inundation profiles and extents or flood profile surfaces that in turn are connected to a damage model.</p> <p>I would recommend that this analysis be done as a refinement of the final strategy selections and not as part of assessing every conceivable option. The cost and time to assess every possible option would be prohibitive.</p> <p>There may be some utility in using existing systems such as those used by the Brisbane City Council and Ipswich City Council.</p> |
| 19 | Should a longer term review of the Manual develop damage versus water level or flow relationships for different types of damage including monetary, life safety, social and environmental damage? If so, who should do this task? | Agree | <p>This question (and also question 18 above and those which follow), illustrates the mistake in the approach discussed in my statement dated 30 May 2011 accompanying these responses.</p> <p>The W&S Manual merely follows the chosen path of satisfying the needs of clients for water supply and those for flood mitigation. Once that joint need is identified, the studies that are necessary to know how best to operate the dam safely, and in a manner to meet those needs, can be written. The error lies in thinking the writing of the W&S Manual or the "review of the Manual" comes first, whereas the policy decision, as to the objectives to be met, should come first.</p> <p>This is part of the overall decision matrix that has been suggested. This is the high level process that would be utilised by the Steering Committee to evaluate the different options.</p> |



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| | | | <p>This analysis may best be performed by the relevant local authorities as they possess the relevant data, (House floor levels, damage curves etc). However, I suggest that an independent Chair of the Committee be appointed to coordinate the investigation.</p> <p>Relevant stakeholders would need to rank or weight each of the considerations (parameters) in the matrix.</p> |
| 20 | Should a longer term review of the Manual develop a probability distribution for the time between flood peaks in the catchment using historical records? | Agree | <p>Use of historical information would be useful to assist in informing whether the adoption of a seven day drainage period is appropriate.</p> <p>The seven days came about because that is the typical time interval or sporing period between successive tropical storm (cyclone) events.</p> <p>However, it should be noted that the actual drainage phase of an event will be influenced by the prevailing conditions at any particular time.</p> |
| 21 | Should a longer term review of the Manual resolve the confusion over non-damaging flows, target flows and corresponding level downstream with respect to flow at Moggill (taking into account impact of tides, influence of downstream tributaries, effect of maintaining discharges for long periods)? | Agree | <p>Refer to my response to 18 and 19 above.</p> <p>The damage study helps inform the appropriate (tolerable) target flow.</p> <p>The target flow, coupled with the threshold levels in the dam, determine the effectiveness of each strategy.</p> <p>The wording in the W&S Manual should be changed to reflect what this target value represents – that is '<i>the upper limit of strategy W3</i>' (or similar words to that effect).</p> <p>It is impracticable to consider tide levels in release strategies as it is not</p> |



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| | | | possible to pulse releases from the dam to coincide with tide cycles. |
| 22 | Should a longer term review of the Manual incorporate a hydraulic model in the Real Time Flood Model to increase confidence in downstream flood estimates? | Agree | <p>First, the RTFM originally had a hydrodynamic model incorporated into it, but as Seqwater had already commenced developing a new modelling platform, the RUBICON 1D hydrodynamic model was not ported to the Linux platform due to cost and resource limitations.</p> <p>There seems to be some misunderstanding, however, as to the usefulness of hydrodynamic models in flood operations. The model incorporated into the RTFM will only provide accuracy as good as the calibration. There is no guarantee that the model will be necessarily more reliable than even the use of a peak stage correlation or hydrologic models.</p> <p>For example, during the January 2011 Flood Event, the levels downstream of Wivenhoe Dam extending to Mt Crosby Weir, were higher than the January 1974 flood event levels. Therefore even if the RUBICON 1D hydrodynamic model had been operational there are no guarantees that it would have necessarily provided any more accurate information compared to the hydrologic models that were used, as it would have been operating in an extrapolated range of the calibration.</p> <p>Secondly, another consideration is the time needed to properly run a hydrodynamic model. Post-event calibration of the Wivenhoe Alliance MIKE-11 1D hydrodynamic model indicated that it took 15 man-days to achieve a satisfactory calibration to the recorded peak levels obtained in January 2011 as there were a number of model instabilities that had to be rectified before sufficient confidence could be placed in the model results.</p> <p>Computational time for the re-calibration of the MIKE11 1D hydrodynamic model also indicated a run time of between 15 to 20 minutes for a simulation</p> |



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| | | | <p>period of 20 days. It should be noted that this model covers approximately 200km of river channel.</p> <p>As stated in paragraph 397 of first statement, I suggest that additional personnel be present in the FOC during a flood event. Namely, I propose that the following personnel be in the FOC during a flood event:</p> <ul style="list-style-type: none"> • A Duty Flood Operations Engineer (who has the responsibilities listed in the W&S and NP Manuals); • A trainee Duty Flood Operations Engineer (whose primary responsibility would be to conduct modelling – including hydrodynamic modelling); and • Technical assistants (who are responsible for reviewing and monitoring data). <p>These run times do not include model initialisation (population of input data) or result compilation. This is somewhat more time consuming than the one minute suggested by Mr Babister in his evidence (see transcript day 24, page 2,199, line 40).</p> <p>Mr Babister also suggested that such models have the capability of producing maps of extents of inundation in real time. I do not endorse this approach as the time and resources to do so would be excessive and this is a function that is the responsibility of local authorities as the emergency response agency and not the FOC Duty Flood Operation Engineers. I think this suggestion is highly impracticable and not in accordance with best practice guidelines. However, if extra personnel were engaged to partake in this work, it may not distract from the important work of the Duty Flood</p> |



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| | | | <p>Operation Engineers during a flood event.</p> <p>Pre-developed flood mapping for differing flood profiles, which BCC and ICC have already produced should be used for the emergency response.</p> |
| 23 | Should a longer term review of the Manual consider the options to prioritise mitigation for smaller, more frequent floods or larger, rarer events? | Disagree | <p>In my view, the consideration and determination of the objectives to be met should be separate from the review of the W&S Manual. The objectives need to be determined by the various stakeholders (for example, State government, Councils and residents). One of the objectives that needs to be determined is the priority given to various mitigation strategies. For example, the stakeholders may determine that the priority is to keep lower level bridges open for as long as possible.</p> <p>Alternatively the stakeholders may determine that lower level bridges should be "sacrificed" by adopting an objective that will provide greater mitigation against larger events.</p> <p>If there are changes to the objectives or the weighting/emphasis applied to different objectives, then the implementation of strategies (which is determined in the review of the W&S Manual) may change accordingly. If indeed it is determined that greater emphasis should be placed on making higher releases earlier in an event (at the expense of bridge closures or community isolation or more frequent flooding in Brisbane urban areas), then target flows could indeed be higher for lower level strategies such as W1. Such a change could be contemplated to ensure that, if the event does escalate, then the ability to deal with larger floods is enhanced. The manual already includes that strategy in Section 10 "Emergency Flood Operations" which applies where there is a loss of communications with the dam operators. That schedule, in effect, provides for gate operations to be triggered at certain lake levels, and has the effect that impacts on</p> |

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| | | | <p>downstream communities is not considered.</p> <p>Accordingly, I disagree with the proposal that objectives for flood mitigation should form part of the long term review of the W&S Manual. In my opinion, the objectives need to be decided first and then the strategies for the W&S Manual will be determined, based on those objectives.</p> <p>Further, it is my opinion that it ought never be the role of the Duty Flood Operations Engineers during a Flood Event to be required to do any more than comply with the strategies set out in the W&S Manual, which have been predetermined by policy</p> |
| 24 | Should a longer term review of the Manual consider the level of discretion to be given to flood engineers during flood operations? | Agree | <p>In my view the use of discretion has broader applications in the lower level strategies of W1 to W3 that deal with disruption to rural life, and maximising protection to urban areas. I agree with Mark Babister that some more examples of the use of discretion could be incorporated in the W&S Manual.</p> <p>Once the strategy concerned with dam safety is invoked (W4) then apart from considerations of trying to prevent the initiation of a fuse plug (if feasible) the Duty Flood Operation Engineer should not have too much latitude because the potential consequences of dam failure are very dire.</p> |
| 25 | Should a longer term review of the Manual consult with all stakeholders, including Seqwater, Brisbane City Council, Ipswich City Council, DERM, Somerset Regional Council and local residents to determine risks and benefits of different strategies? | Agree | <p>Refer to my suggestion regarding the conduct of the review framework at paragraph 12 of my statement dated 30 May 2011.</p> <p>In my view, a Steering Committee consisting of Senior Officials or elected representatives of the relevant stakeholders should determine the relative weightings of objectives and hence associated strategies.</p> |



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| 26 | Should a longer term review of the Manual, having undertaken all of the above, perform modelling to assess possible changes to the existing strategies? | Agree | Any amendments to the operational objectives and associated strategies should be rigorously and thoroughly tested on a range of historical and design flood events. |
| 27 | <p>Should a longer term review of the Manual include performing modelling to assess possible changes to the existing strategies and, if so, perform the modelling in the following order:</p> <p>(a) Perform initial simulations using a rainfall runoff routing model;</p> <p>(b) Assess the most promising options using they hydrodynamic model;</p> <p>(c) Have independent experts reviewing the modelling.</p> | Agree | <p>Initial assessment needs to filter possible options and help inform the decision matrix ranking or weighting.</p> <p>Once preferred options have been short listed more rigorous testing using the hydrodynamic model and damage assessments can be undertaken in both simulations and small operational circumstances.</p> <p>I recommend that independent reviewers assess each of the modelling elements.</p> |
| 28 | <p>Should a longer term review of the Manual in particular, model the outcomes of:</p> <p>(a) A stepped change from W3 to W4?</p> <p>(b) Moving to a higher rate of release earlier in W1?</p> <p>(c) Bypassing W1?</p> <p>(d) Altering maximum release rates under W3?</p> <p>(e) Situations in which initiating a fuse plug may be preferable?</p> <p>(f) Altering the FSL, either permanently or temporarily?</p> | Agree | All options should be considered, but again, the review framework referred to above needs to be done first, in order to determine the objectives to be achieved before the strategies are determined to achieve those objectives. |

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| | (g) For each potential FSL level, new operating strategies to release water as soon as the dam level rises above FSL? | | |
| 29 | Should a longer term review of the Manual, having undertaken all of the above, develop potential new operating strategies without reference to the current strategies in the Manual? | Disagree | <p>The process for the longer term review, including the matters in 28, will automatically include reference to the current strategies in the W&S Manual.</p> <p>The current strategies have been tested on design flood hydrology and historical flood events and have been shown to be effective, including during the January 2011 Flood Event. If the objectives do not change significantly, then it is likely the future strategies will remain similar to the current strategies.</p> <p>If objectives are changed or the weighting/ emphasis of an objective is changed then new strategies will necessarily have to be considered. Refer to Q23 above.</p> |
| 30 | <p>Should a longer term review of the Manual finalise the working and structure of the Manual by:</p> <p>(a) Engaging operation/technical writers to write the content and organise the material in the Manual to properly reflect the strategies decided upon in earlier investigations?</p> <p>(b) Ensuring Manual is internally consistent?</p> <p>(c) Engaging lawyers to check wording Manual and potential effects on liability and immunity?</p> | Agree | Refer to my response in questions 2, 3 and 4 above. |
| C. Future reviews of the Manual | | | |

| | PROPOSED REVIEW | AGREE/DISAGREE WITH PROPOSAL | REASON FOR AGREEING/DISAGREEING WITH PROPOSAL |
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| 31 | Should all future reviews of the Manual include a more detailed review of the Manual than in the past? | Disagree | <p>This suggestion implies that each and every review of the W&S Manual should be more detailed than the review that has gone before. However, reviews should be as detailed as the circumstances require.</p> <p>In any event, and to the extent that it is implied that the reviews undertaken in the past have been insufficient, I reject that implication. In my opinion, they have been quite extensive.</p> <p>In 1990 to 1994 the design flood hydrology was extensively revised and all of the original proposed strategies tested. The design flood hydrology updated the PMP estimates using the GTSM and GSDM methods along with IFD design rainfalls from ARR (1987). Chapter 13 of ARR (1987) was used to determine the design flood estimates.</p> <p>The original gate operation strategies (Hegerty and Weeks, 1985)(Five for Somerset and Five for Wivenhoe) were re-examined. Only the most viable were reported as there seemed little point in outlining and providing results on strategies that did not perform as well as the recommended strategies. It was noted in the Executive Summary Report, that testing the viability of operating procedures is somewhat problematic as numerous assumptions have to be made, such as planning horizon, concurrent flooding etc and this may impact on the ultimate selection of the preferred range of strategies.</p> <p>After the February 1999 flood event (which at the time was the flood of record in the Upper Brisbane catchment) the manual was reviewed and as the strategies had performed to expectations no changes were recommended other than a revision of the gate sequencing for Wivenhoe Dam spillway openings.</p> <p>In 2003 to 2005, the Wivenhoe Alliance again revisited the operational</p> |

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| | | | <p>strategies and introduced a new strategy by segregating strategy W4 (now referred to as W4A and W4B) to accommodate the auxiliary spillway. An extensive review of the design flood hydrology was undertaken for Wivenhoe Dam and updated techniques were taken into account for GTSMR PMP estimates and CRC-Forge regional design rainfalls and procedures from Book VI of ARR (2001), including the assignment of the AEP of the PMP.</p> <p>In 2009, Seqwater again investigated the operating strategies in the interaction study which took into account the new design flood hydrology for Somerset Dam in particular. This led to the introduction of two new strategies for Somerset Dam (S1 to S3). The Operating Target Line was also modified to take into account the re-assessment of Somerset Dam design floods.</p> <p>In my opinion, the significance of any future review should be commensurate with the circumstances dictating the review. So, if it is simply a five yearly review and there have been no major floods in the intervening period and no change to the infrastructure or function or design flood hydrology or the relevant scientific principles, then the review would not need to start from the beginning. However, if any of these factors change significantly or another large flood event occurs then a review commensurate with the need, which may be major, would be justified.</p> |
| 32 | <p>Should all future reviews of the Manual engage a small independent expert panel to assess the operational strategies in the Manual that is nominated by various stakeholders such as Seqwater, Brisbane City Council, Ipswich City Council, DERM, Somerset Regional Council, which should:</p> <p>(a) Be comprised of flood hydrologists, but also include experts</p> | Agree (in part) | <p>All stakeholders should be consulted and any changes to their interests flagged for consideration.</p> <p>New technologies and improvements in forecasting, modelling, measurement or any other relevant tool should be contemplated.</p> <p>(a) I support an independent peer review. That reviewer can be nominated</p> |

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| | <p>on rainfall forecasting and the operation of dams (electrical and mechanical operation of gates and flood operations). If so, how many of each would be appropriate?</p> <p>(b) Determine whether changes in technology, methods or downstream risk profile warrant the updating of the hydrology, operation or forecasting?</p> | | <p>by the stakeholders. Who conducts the review, in terms of qualifications, will depend upon what has been the study the subject of the review, the number of people involved in conducting the review will also depend upon who is conducting the review. Generally speaking, the owner may require representation from hydrologists (hydrologic and hydraulic modellers), dam safety specialists, dam designers (civil, mechanical, electrical, environmental), and dam operators and maintainers. Stakeholder groups may require emergency response managers (local government, QPS, QFRS, QAS, SES, EMQ, etc), town planners/hydraulic engineers and representatives from specific (impacted) community interest groups.</p> <p>(b) It is not possible to answer this question until the results of this review are known.</p> |
| 33 | Should all future reviews of the Manual involve a person entirely independent of the process of creation or review of the Manual giving it final approval? | Disagree | <p>I think the question should be, 'should the person who has to make the final approval of the W&S Manual be a person outside the review process'. If that was the question intended, I agree. However, that person does need to have a thorough working understanding of the W&S Manual and is aware of how it is interpreted and is likely to be used. This applies especially to the clauses regarding the use of discretion.</p> |