SUBMISSION

TO

QUEENSLAND FLOODS COMMISSION OF INQUIRY

SECOND SUPPLEMENTARY SUBMISSION

by

Greg McMahon

30 May 2011

TERMS OF REFERENCE

UNDER the provisions of the *Commissions of Inquiry Act 1950*, Her Excellency the Governor, acting by and with the advice of the Executive Council, hereby appoints the Honourable Justice Catherine Holmes to make full and careful inquiry in an open and independent manner with respect to the following matters:-

a) the preparation and planning by federal, state and local governments; emergency services and the community for the 2010/2011 floods in Queensland,

b) the performance of private insurers in meeting their claims responsibilities,

c) all aspects of the response to the 2010/2011 flood events, particularly measures taken to inform the community and measures to protect life and private and public property, including

- immediate management, response and recovery
- resourcing, overall coordination and deployment of personnel and equipment
- adequacy of equipment and communications systems; and
- the adequacy of the community's response.

d) the measures to manage the supply of essential services such as power, water and communications during the 2010/2011 flood events,

e) adequacy of forecasts and early warning systems particularly as they related to the flooding events in Toowoomba, and the Lockyer and Brisbane Valleys,

f) implementation of the systems operation plans for dams across the state and in particular the Wivenhoe and Somerset release strategy and an assessment of compliance with, and the suitability of the operational procedures relating to flood mitigation and dam safety,

g) all aspects of land use planning through local and regional planning systems to minimise infrastructure and property impacts from floods,

h) in undertaking its inquiries, the Commission is required to:

- take into account the regional and geographic differences across affected communities; and
- seek public submissions and hold public hearings in affected communities.

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ABBREVIATIONS

Australian National Committee on Large Dams	**ANCOLD**
Brisbane City Council	**BCC**
Department of Harbours and Marine	**DHM**
Department of Local Government	**DLG**
Department of Mapping and Surveying	**DMS**
Department of Mines and Energy	**DME**
Department of Natural Resources Management	**DNR**
Department of Primary Industries	**DPI**
Gold Coast City Council	**GCCC**
Institution of Engineers Australia	**IEA**
Interagency Advisory Committee on Water Data in the US	**USIAC**
McMahon Original 11 March 2011 Submission	**REF A**
Probable Maximum Flood	**PMF**
Probable Maximum Precipitation	**PMP**
Queensland Public Service	**QPS**
Real Time Flood Model	**RTFM**
SEQ Water Report	**REF B**
Somerset Dam and Wivenhoe Dam	**SDWD**
Water Resources Commission	**WRC**

SUPPLEMENTARY SUBMISSION TO THE COMMISSION OF INQUIRY

References:

A. ***Submission to the Queensland Flood Commission of Inquiry***, by G McMahon dated 10 March 2011 and *Supplementary Submission* dated 30 March 2011

B. ***January 2011 Flood Event***, Report on the Operation of Somerset Dam and Wivenhoe Dam, by SEQWater dated 2 March 2011

C. ***Manual of Operating Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam***, Revision 7, by SEQWater dated November 2009

D. ***Brisbane Floods January 1974***, Report by Director of Meteorology, Australian Government Publishing Service, Canberra 1974

E. ***Guidelines for Evaluating Hydrologic Hazards***, US Bureau of Reclamation, June 2006

F. ***Coping with Probable Maximum Flood – An Alliance Project Delivery for Wivenhoe Dam***, Chandler K, Gill D, Maher B, Macnish S and Roads G, ANCOLD Conference on Dams, October 2003

G. ***Wivenhoe Dam Flood Security Upgrade***, Gill D, Cooper B, Maher B, Macnish S and Roads G, ANCOLD/NZSOLD Conference, 2004

H. ***A Framework for Characterization of Extreme Floods for Dam Safety Risk Assessments***, Swain R, Bowles D and Ostenaa D, Proceedings of the 1998 USCOLD Annual Lecture, Buffalo New York, August 1998

I. ***Wyaralong Dam Design Flood Hydrology Summary Report***, Sunwater, September 2007

J. Probability of Occurrence of Extreme Rainfalls and Floods, by Kennedy, Pescod, Pearse, Laurenson, Canterford, Hall, Murley and Cummins, AWRAC Research Project P86/33, Department of Primary Industries and Energy, 1989

K. Report to the Queensland Flood Commission of Inquiry Final Report, by M Babister, May 2011

L. Witness Statement of Robert Arnold Ayre, Queensland Flood Commission of Inquiry, dated 23 March 2011
M. Witness Statement of Peter Hugh Allen, Queensland Flood Commission of Inquiry, dated ####### 2011
N. Transcripts Day 2 to Day 6, Queensland Flood Commission of Inquiry, 11-15 April 2011
O. Transcripts Day 22 to Day 24, Queensland Flood Commission of Inquiry, 16-18 May 2011

BACKGROUND

I seek to provide information and advice, further to my original 11 March 2011 submission and 30 March 2011 Supplementary Submission ["**REF A**"], relevant to concerns that further flood events may occur in the forthcoming wet seasons, and that more might have been done in the past, and can be done in the future, to avoid and/or mitigate loss of life and damages from those events.

This submission is provided in the public interest and may be made a public exhibit. It should be read and understood against the unexpurgated contents of my original and supplementary submissions which have also been requested to be made public exhibits.

This additional submission responds to the evidence given at hearings of the Queensland Flood Commission of Inquiry by selected officers of SEQWater and DERM and other technical experts and stakeholders invited to give evidence. These hearings had not been commenced at the time of my original and supplementary submissions.

I have now analysed certain of the statements of evidence and statements made at the hearings on selected aspects of the SEQWater Report ["**REF B**"], and I believe that it is important to make this SECOND supplementary submission in the public interest.

SUMMARY

Further assistance is offered to the Commission in understanding certain technical issues that appear to be primary to any preparations for management and control of flooding through the Wivenhoe and Somerset Dams.

Clear thinking may not have been achieved in the totality of statements offered and explanations provided during the hearings about these issues.

Those issues may be:

1. Use of rainfall forecasts in operating the Wivenhoe and Somerset Dams Sytem
2. A recommended rationale for decision-making during major flood situations
3. The size of the January 2011 Flood

Further comment is made in support of positions made in ref A, using the evidence that has come before the Commission since the time of writing of ref A.

Use of Rainfall Forecasts.

SEQWater's preferred adoption of the 'No Further Rainfall' results from flood modeling, in lieu of the flood predictions derived from modeling assuming the BOM estimates of future rainfalls, may have remained problematic for the Commission to resolve.

SEQWater's 'consolidated' position, namely,

1. That using the 'No Further Rainfall' case constitutes the use of a forecast of rainfall – versus, say, Mr Rangiah's assertion that this case is an avoidance of a forecast, and
2. That the level of inaccuracy of the BOM's rainfall forecasts justifies a technical judgment not to use these forecasts (or not to use the flooding forecasts derived from the BOM rainfall forecasts), and to use the purported 'No Further Rainfall' 'forecast' in lieu,

may have been sustained during examination and cross-examination, it may appear.

SEQWater may have been able to sustain this position because legal questioning may have sought to undo the SEQWater position while keeping the argument within the framework for this argument selected by SEQWater. That framework was the comparison

of the BOM forecasts of rainfall with the actual rainfalls that were subsequently recorded at rainfall stations located in the catchment.

Clearer-thinking might be available if the argument was moved to a different framework.

COMPARISON OF ACCURACY OF BOM & SEQWATER RAINFALL FORECASTS						
DATE/TIME of Forecast	ERROR	SEQWater Forecast	ACTUAL RAINFALL	BOM Forecast	ERROR	Which is MORE ACCURATE
11.36, 3 Jan 11	-5	0	5	8	3	BOM
16.00, 3 Jan 11	-4	0	4	15	11	SEQWater
11.30, 4 Jan 11	0	0	0	15	15	SEQWater
16.00, 4 Jan 11	-2	0	2	10	8	SEQWater
10.03, 5 Jan 11	-26	0	26	25	-1	BOM
16.00, 5 Jan 11	-44	0	44	40	-4	BOM
10.21	-38	0	38	40	2	BOM
16.00	-43	0	43	25	-18	BOM
10.03	-26	0	26	25	-1	BOM
16.04	-6	0	6	25	19	SEQWater
10.03	-28	0	28	40	12	BOM
16.00	-80	0	80	40	-40	BOM
10.03	-149	0	149	50	-99	BOM
16.00	-125	0	125	65	-60	BOM
10.03	-120	0	120	75	-45	BOM
16.00	-129	0	129	38	-91	BOM
10.13	-51	0	51	100	49	BOM
16.00	-12	0	12	75	63	SEQWater
10.03	-2	0	2	10	8	SEQWater
16.00	-1	0	1	5	4	SEQWater
14.25,	0	0	0	5	5	SEQWater
16.00	0	0	0	5	5	SEQWater

Table 3.1 is offered as a useful change in the framework for analyzing this issue. The figures in Table 3.1 are taken from M Babister at ref K.

Table 3.1 simply compares the 'No Further Rainfall' case with the actual rainfall that subsequently fell onto the catchment, and adds this comparison to the comparison of BOM forecast v actual rainfall being advocated by SEQWater.

Clearly, the BOM forecasts outperform the 'forecasts' used by SEQWater during all periods of significant rainfall. The SEQWater 'No further rainfall' decision is only more accurate than the BOM forecasts where the actual rainfalls are very small [< 13 mm]. These rainfalls have comparatively little impact upon the extent of the threat posed by the January 2011 flood.

Mr Dunning worked Mr Babister, during examination of Mr Babister's evidence, to the following words expressing Mr Babister's qualification to the use of the 'No further rainfall purported 'forecast' –

> ***… with the only qualification being … you would introduce a greater element of probability in there if you could be shown to have advantage upon proper study.'***

I submit Table 3.1 constitutes ***a proper study*** sufficient to show an ***advantage*** (of accuracy) over the 'No further rainfall' purported 'forecast', and thus should satisfy Mr Babister sufficient for him to activate his qualification and amend his conclusion.

Technical Note: Observe that, using tipping bucket pluviographs to measure rainfalls, as is reportedly the case for the Wivenhoe and Somerset catchments, the choice of the 'No further rainfall' set of rainfall figures for modeling the impending flood is a choice for the only set of rainfall figures that we know to be definitely wrong. This is so, even in the remarkable event that the rainfall stops immediately upon the running of the flood model.

The rainfall figures are wrong, even in this remarkable coincidence, because of the rain that has already fallen and has been caught by the tipping bucket, but has not been recorded because it remains in the partly filled as yet untipped bucket on all or nearly all of the pluviograph rainfall measurement stations.

Having regard to the pattern of results in Table 3.1 above (and to the above Technical Note), I can not agree with your independent consultant, Mr Babister on the following views that he expressed to the Commission:

1. That using the 'No further rainfall' case is 'not unreasonable'
2. That use of the BOM rainfall forecasts could also employ a 'discount' from the BOM figures

If accuracy is the criteria that SEQWater has chosen to evaluate the BOM forecasts, it must also be the criteria with which to judge their own selection of rainfall 'forecasts' to use when forecasting future probable Dam water levels. If SEQWater is held to their own criteria, it is unreasonable for them to choose a less accurate 'forecast' that a more accurate forecast, I submit. Mr Babister is either not aware of the inconsistency in SEQWater's 'consolidated' view, or he has been too forgiving for reasons not obvious in his evidence, it appears from Table 3.1.

The suggestion that a discount might be utilized upon the BOM forecasts, so as to reduce them, also appears to be influenced by the bias in the framework of the SEQWater argument. BOM estimates show a usual pattern of underestimating large rainfalls. This may be because the BOM forecasters may suffer from the same concern as the SEQWater SDWD System controllers – what if we decide the larger forecast and the larger forecast does not occur. The BOM forecasts are also expressed as a range of rainfalls, and are expressed as a constant intensity for 24 hours (or for the longer period of the particular rainfall forecast) - there is thus no 'peaking' of this rainfall as usually occurs in real catchments, tending to lessen the peak of the resultant flood, unless the modeler imposes a temporal pattern upon the BOM rainfall forecast. In both these respects, there may

already be some forms of conservatism in how the BOM rainfall forecasts are applied for the modeling exercise.

The total operation needs to know where any conservatism is being applied, rather than having each step in the process impose its own conservatism upon its part of the decision. This does not give visibility to the total overview of the total process.

The alternative is for the probable range of the rainfall forecasts to be published, with any expected value also nominated from within this range of rainfalls. These two or three values can all be modeled with a choice of temporal pattern, thus constituting a scenario (or narrow sensitivity) analysis for the limit intensities of the range of rainfalls that BOM forecast. Then is the time to apply any conservatism, if legitimate reasons for such a conservatism are present.

The concern, parallel to the use by SEQWater of the 'No further rainfall' purported 'forecast', is whether or not the public and the stakeholders in the flood control system had knowledge that this was the 'forecast' that SEQwater was using.

Rationale for Decision-making.

The SEQwater engineers, managing the development of the SDWD Operating Manual and controlling the January 2011 flood, have engaged in what is termed 'What if' analysis when it came to developing a basis for decision-making on releases from Wivenhoe Dam.

Mr Allen, in evidence given orally as well as paragraph 89 of his statement, actually used the term 'What if …' in describing the difficulties that he saw for the task of operating the SDWD System

It is submitted that ‘What if’ thinking is a flawed approach to rational decision-making in situations where factors at issue are uncertain – in what is termed by other professionals as decision-making in ‘fog’ situations.

Decision-making in ‘fog’ situations is a much experienced and well studied management scenario, especially in military warfare – the ‘fog’ of war. The Profession at Arms has developed methods for making considered decisions, as well as quick decisions, when faced by a ‘fog’ of information and of possibilities – say, what threat will happen, where, when, and in what strength?

Teaching military tactics to officers in their first command position will usually require effort by the tactics instructors to train such officers out of the tendency towards ‘What if’ analysis. I can state this from two decades of experience as a tactics instructor at premier tactics schools within the military.

The approach taken by that Profession to the challenges of decision-making in the ‘fog’ of war , in simple terms, is to determine (a) **the most likely threat** and (b) **the most dangerous threat**. Planning and decision-making is then based upon the most likely threat, but with a consideration as to what action will be taken if the most dangerous threat occurs.

An abbreviated analysis of the application of the military tactical decision-making regime, to the situation faced by the operators / controllers of the SDWD System during the subject flood, might clarify the error made by the operators/ controllers in adopting the ‘What if’ regime advocated by Messrs Ayre and Allen, and accommodated to some extent by Mr Babister.

Such a demonstration of analysis might also suggest the source for developing a better planning and control regime for any future flood control operations.

I submit that in the case of the January 2011 flood, 'the most likely threat' in terms of rainfall (and subsequent flood flow volumes) was that forecast by BOM.

The 'No further rainfall' 'forecast', by comparison (if this is to be admitted as a kind of 'forecast' rather than an avoidance of any forecast), may be the most unlikely threat. This is particularly the case if one looks out the window, during the time to conduct a model run, and sees that it is still raining.

The most dangerous threat is an assessment to be made from the various threats described to date during your Inquiry. These appear to include:

1. Releasing water from Wivenhoe Dam, say, in the range of 3500 cumecs, in response to the BOM forecast, but the rainfall forecast by BOM does not occur – minor levels of flood damage may then occur, where this damage could have been avoided by using a forecast less than the BOM forecast
2. Releasing water from Wivenhoe Dam, say, in the range of 3500 cumecs, in response to the BOM forecast, and this release coincides with high levels of flooding from Lockyer Creek and Bremer River (or the rain falls downstream of the Dam rather than upstream of the Dam, both situations) causing moderate flooding at Ipswich – in this instance too, using forecasts lower than the BOM forecast would have led to lower release rates from Wivenhoe and thus lower flood damage rates at Ipswich
3. Keeping releases from Wivenhoe Dam, say, in the range of 2000 cumecs, so as to avoid the possible threats at 1 and 2 above, but the BOM forecasts eventuate, Wivenhoe Dam fills into the W4 Strategy scenario, and the Dam must thereafter have to release 7500 to 9000 cumecs causing major flooding to Ipswich and to Brisbane.

Threat 3 above appears to be the most dangerous threat from these three threats.

In this simplified analysis, the decision to make releases from the Dam so as to manage the most likely threat, is also the decision that will best deal with the most dangerous threat, it is submitted.

A similar use of the most-likely-threat-/-most-dangerous-threat military appreciation technique would assist the SDWD System operators / controllers to make a best decision on whether or not to use the fuse plugs once the water level has risen into the W4 Strategy compartment of the Dam storage.

Training for SDWD System Operation.

The training techniques adopted by the military to train for planning and decision-making in situations of the 'fog' might also be emulated by flood control authorities. The functioning group is termed a 'command post' in the military, and command post exercises test the functioning and decision-making of people assigned to duties in the command post. Thus a group of say 40 persons will exercise the, say, 20 persons operating the command post. This is done by feeding information over realistic timeframes testing the response to pre-planned operational scenarios. These exercises can be run from 3 days to 30 days.

Decision-making is thereafter evaluated, or is evaluated progressively during exercise halts, in a continual improvement environment.

Size of the January 2011 Flood.

I draw the attention of the Inquiry to selections of the evidence that it has received about the sizes of floods in the flood history of the Brisbane River catchment:

1. That a model run of the 1893 flood through the SDWD System using the current Operating Strategies resulted in the flood level in Wivenhoe Dam initiating the first fuse plug – from evidence given by Mr Allen
2. That the flood necessary to initiate the first fuse plug had an Annual Exceedance Probability of 1in5000 or was a 1in5000 year flood, according to various witnesses and reports from SEQWater and the consultants working for SEQWater and / or for DERM
3. That the January 2011 Flood was of the order of 1in1000 year to 1in2000 year flood or was associated with rainfalls of this frequency, asserted in various reports and statements of evidence from SEQWater and DERM.

These points of evidence in total are tending to suggest that the last 120 years of flooding in the Brisbane River catchment contains both a '1in5000year' and a '1in2000year' event (to use the descriptions of SEQWater and DERM engineers) – and this does not include reference to the 1931 flood that appeared to be a little bigger than the January 2011 flood.

This is an incredible strike rate for a river, to receive such a sequence of very rare floods in such a short window of its history.

In 1841, it appears, there was a flood that was even larger than any of the more recent floods, including being bigger than the apparent '1in5000 year' 1893 flood.

The other possibility is that SEQWater and DERM have been greatly over-estimating the frequency of these floods

It was the expectation that the size of these floods would be over-estimated by SEQWater and DERM that I forwarded to the Commission a copy of the Report on Flooding in Flat Rock Creek.

This was the flooding situation where the authorities had been claiming that the Creek has received the 1in50 year flood three times in four years. This claim was also most

unlikely, and the Report sent to the Commission describes that the claim was proven subsequently to be untrue.

I am disappointed that the Commission has not yet included this report with my submissions on QFCI website for public viewing.

In the case of Flat Rock Creek, however, the consultants responsible for the error were the professionals who came forward with acknowledgement of the error.

The Commission has the benefit of the report from Mr Babister, selected by the Commission, to the effect that the 2011 flood appears to be on the cusp of a 1in100 AEP flood. Other hydrologic experts in Queensland have reported to me that they have also reached the opinion that the 2011 flood is less than a 1in100 AEP event – for their own reasons they have decided not to put submission on this finding to your Commission. I am informed but have not read myself that one of the consultants has also held to a 1in100year estimate of the size of the January 2011 Flood.

I submit that the magnitude of the difference in the estimates of size of flood, namely that given by SEQWater and DERM, versus that given by Mr Babister after formal consideration, should be troubling to the Commission. The lower size was predicted by ref A after a simple observation of the historical record, and has been analysed as lower than 1in100 by other authorities known to me.

Again I submit that the public and the stakeholders in SDWD System are entitled to greater reliability in the reasonableness and accuracy of such important estimates from authorities responsible for public safety.

The Commission, I submit, should be concerned that SEQWater and DERM appear to be resisting the weight of evidence against their estimates on such technical matters

Public Information & Reporting to Stakeholders

Attention has herein been drawn to concerns about the public information aspects of actions by SEQWater and DERM to:

1. Use the 'No further rainfall' 'forecast' in its published Situation Reports
2. Promote the January 2011 Flood as a rare flood with a size / frequency up to a '1in2000year' flood

It is submitted that the QFCI might also be troubled by the definitions that SEQWater is using for terms like 'forecasting' (to mean modeling without the forecast rainfall), and 'Real Time Flood Modeling' (to mean modeling without a hydrodynamic model). It might be ascertained by the QFCI whether the public and the organisational stakeholders with an interest in the flood control operations were aware that the forecast flood levels that they were receiving were based on the assumption of 'No further rainfall'.

Note too the use by Mr Allen of both the 'probabilistic' description of rare floods and also the proportion-of-the-PMF description of the same flood. Thus did Mr Allen describe the design flood for Wivenhoe Dam as both:

1. The 1in100,000 AEP flood, and
2. The 80% of Probable Maximum Flood.

It is submitted that the first of these rare flood descriptors is based upon flawed manipulations of probability theory, as set out in ref A. It may also portray to the public and to the stakeholders in the flood control operations that any occurrence of this event must be a long way off, well past our lifetime and perhaps past the lifetime of civilisation to date.

Perhaps this low risk of occurrence contributed to decision-making that led to the lack of preparations for dealing with the control of flooding threatening the capital city of Queensland.

The second descriptor, by contrast, is simple in concept, but importantly it is correct as it has been applied to that concept. Further, it is expressed in terms of flood flow, and may suggests to the public or stakeholder that a flood of this size may occur. 'They can happen', Mr Allen stated in oral evidence

Rating on Overview of the SDWD System

In earlier submissions (see **ref A**), it was proposed that the **SDWD** may only be at a '**PLANNED**' level of development.

This rating was given against the structure of possible assessment ratings (numerically 1-5) of:

1. Ad hoc;
2. Planned;
3. Managed;
4. Integrated; and
5. Optimized,

Within the scale for the '**PLANNED**' rating [numerically 1.5 to 2.5], it was suggested that the **SDWD** may only be at the 40% level, with a score a 1.9.

It is further submitted that apparent deficiencies in the planning and management of the **SDWD** system may tend to undermine, for critical flood events, the capacity of the operating system to achieve a higher rating as an effective flood mitigation regime.

Two analyses were specified in ref A and recommended for the insight that they may bring to the capabilities of the **SDWD** system for mitigating floods.

An assessment of this rating of **'40% Planned'** may be available from the evidence given by others to the Inquiry.

Mr Babister has provided independent opinion and summaries to the Commission, and Mr Allen appears to have conceded on particular criticisms of the SDWD System, including how it was managed during January 2011. Attention is brought to how these opinions and concessions appear to support or contradict the **'40% Planned'** rating offered of the SDWD System in **ref A**.

It is proposed that:

1. Mr Babister's criticisms about failures to test the provisions within the Manual, including the interaction of the two Dams, the setting of trigger levels and the independent assessment of software being used during operations of the SDWD Syatem, may be tending to suggest that the SDWD System **may not merit** a rating of **'OPTIMISED'**
2. Mr Babister's criticisms about failures to update the hydrology of the SDWD System when the SDWD System and the provisions of the Operations Manual were changed, and Mr Allen's concession about the failure to adjust the Manual for the type of problems with the Manual identified by Mr Guppy, may be tending to suggest that the SDWD System **may not merit** a rating of **'INTEGRATED'**
3. Mr Babister's criticisms about failures to complete a Risk Management Plan for the SDWD System, and Mr Allen's concession that the peak of the Brisbane Flood was caused by the operation of the SDWD System during the January 2011 Flood, may be tending to suggest that the SDWD System **may not merit** a rating of **'MANAGED'**
4. Mr Babister's criticisms about some aspects of the structure of the SDWD System, such as the absence of a one dimensional hydrodynamic flood model for predicting flood levels (and velocities and heights) downstream of the Wivenhoe Dam – the subject of a ***very strong recommendation*** by the Commission's selected expert - and the absence of initiatives to raise bridges and low level crossings in these same downstream areas, may be tending to suggest that the

SDWD System **may merit** a rating of **'PLANNED', but with major deficiencies.**

I submit that the evidence of Mr Babister, Mr Allen and others supports the rating of **'40% PLANNED'** that was previously offered by **ref A**

Sufficiency of Expertise

The standard of flood engineering displayed by SEQWater and DERM, as well as the extent of planning and development of the SDWD System for protecting Brisbane from life threatening flooding situations, appears to be part of the issue to be addressed by the QFCI.

The terms of reference of the QFCI include giving consideration to preparations for any future flooding along the Brisbane River, its tributaries and its sister catchments.

The levels of expertise displayed by SEQWater and DERM may be a matter of concern for the lifting of the rating of the SDWD System from '**40% PLANNED'** to **'OPTIMISED'**.

Ref A raised an expectation that 'purple' engineering may have played a part in the poor performances achieved by the SDWD System. Evidence was given that the Manual in its original form was designed to protect the operation of the SDWD System from the interference of political forces.

In the absence of evidence of purple forces over-riding technical expertise, the sufficiency of the expertise applied to the SDWD System may arise as another possible explanation for the failures in the planning for and the management of the January 2011 Flood.

The technical issues where the level of expertise may appear to be requiring evaluation are:

1. The estimates of probability for the January 2001 Flood
2. The use of the 'No further rainfall' purported forecast
3. The failure to employ a hydrodynamic model for modeling flood conditions downstream of Wivenhoe Dam
4. An apparent element of surprise that multiple peak flood hydrographs occur with major flooding or / and should be allowed for in the analysis and management of major flooding
5. An apparent lack of appreciation of the shortcomings of the reverse analysis used for calculating the flood hydrograph entering into Wivenhoe Dam

The lack of a 1-D hydrodynamic computer model is particularly indicative. Professor Colin Apelt and I supervised the development of such a model in the late 1980s as part of a Queensland Government – University of Qld joint research development. This was organized within a forerunner organisation to DERM and SEQWater, as the core of a PhD program. The model was state-of-the-art at that time (as was the runoff-routing model developed about that time by Weekes and Hegerty, as the Commission has heard from Mr Allen in oral evidence). The 1D hydrodynamic model was used in modeling of the Nerang River, and was under consideration for flood warning purposes on that River at that time.

The evidence received by the Commission appears to suggest that the product of Weekes and Hegerty has been continued in use but with little upgrading, while the product of the Muller, Apelt and McMahon research project may have fallen into disuse, without any replacement.

These matters appear to indicate an apparent change in the expertise held by DERM and SEQWater in hydrology and hydraulics since the time of their predecessor organisations going back to the early 1990s.

Culture

In Ref A I withdrew from offering comment upon this aspect, while submitting that it merits consideration by the Commission.

I recommend to the Commission the questioning by Mr Rangiah as appearing to have the necessary insights into some of the possible impacts that this factor may have had upon the results achieved by SEQWater and DERM during January 2011.

Acknowledgement

I acknowledge the leadership shown by Mr Mick O'Brien in bringing the management of the January 2011 Flood to the attention of the Queensland public. I admit to some discomfort that that leadership came from a chemical engineer not primarily involved in hydrology and hydraulics, and not from the water engineering community in this State.