QUEENSLAND FLOOD COMMISSION OF INQUIRY

RESPONSE TO THE SUBMISSION OF MICHAEL O'BRIEN

WITNESS STATEMENT OF ROBERT ARNOLD AYRE

QFCI

Date: 11/4/11

Exhibit Number: 20

QUEENSLAND FLOODS COMMISSION OF INQUIRY

DRAFT RESPONSE TO MICHAEL O'BRIEN'S SUBMISSION

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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 three statements previously provided to the Commission of Inquiry on 23 March 2011 (**my first statement**), 29 March 2011 (**my supplementary statement**) and 8 April 2011 (**my third statement**).

2 This statement responds to the O'Brien Submission to the Commission of Inquiry entitled, '*Brisbane Flooding January 2011, An Avoidable Disaster*', by Michael O'Brien dated 16 March 2011 (**the O'Brien Submission**).

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 further supplementary statement are the same as the defined terms in my first statement.

RESPONSE TO THE O'BRIEN SUBMISSION

7 I have attempted to respond to the issues discussed in each of the relevant sections of the O'Brien Submission. I have, therefore, adopted Mr O'Brien's section headings and responded to each of those sections accordingly.

8 I believe that the O'Brien Submission is based on incorrect facts and draws incorrect conclusions that are not reasonably open.

THE O'BRIEN SUBMISSION SECTION 1 - INTRODUCTION

9 The O'Brien Submission '*solely addresses the period 4th to 14th January 2011*'. This period does not encompass the entire duration of time that releases were being made from Wivenhoe and Somerset Dams. Releases from the Dams were made from Friday 7 January 2011 to Wednesday 19 January 2011.

10 The O'Brien Submission also states that it '*reviews the apparent release strategy adopted for Wivenhoe and to a lesser extent Somerset, and its impact on flood mitigation and dam safety.*' The actual release strategy was documented in the Wivenhoe and Somerset Dams Flood Report 2011 and also in my first and supplementary statements to the Commission of Inquiry.

11 Mr O'Brien further indicates that '*the objective of this submission is to provide an accurate analysis of the events and demonstrates that the conclusions are broadly valid.*' Mr O'Brien asserts that there are three areas of importance:

- '*The volumes of water involved in the event.*
- *Based on the available information, did the system have sufficient capacity to manage the event?*
- *Did the system perform to its capabilities?*'

12 Mr O'Brien further states that:

'*This submission does not attempt to apportion responsibility but poses a series of questions about the event and decisions made leading up to the event that could be usefully investigated by the Commission.*'

13 I note, however, that Mr O'Brien draws conclusions and makes assertions about the performance of the operation of the Dams to which I have responded to in this statement.

14 I respond to the '*series of questions about the event*' in this statement.

THE O'BRIEN SUBMISSION SECTION 2 - CONCLUSIONS

2.1 Specific Event Related

'The flooding in Brisbane could have, and should have been substantially avoided'

15 Mr O'Brien asserts that, '*the flooding in Brisbane could have, and should have been substantially avoided.*' I reject this assertion completely.

16 This issue is covered in section 8 of the Wivenhoe and Somerset Dams Flood Report 2011 entitled 'Preliminary Assessment of Event Magnitude', and specifically

in section 8.10, 'Wivenhoe Dam and Somerset Dam flood mitigation in Brisbane City'. I also refer to this issue at paragraphs 371 to 377 of my first statement.

17 In order to illustrate the performance of Wivenhoe and Somerset Dams during the January 2011 Flood Event, results of hydrologic modelling undertaken after the event have been summarised in section 8 of the Wivenhoe and Somerset Dams Flood Report 2011.

18 Of particular relevance is Case 2, which demonstrates what flows would have occurred downstream of Wivenhoe Dam if the Dam could have retained all of the water, which flowed into Lake Wivenhoe, bearing in mind that Brisbane would still be affected by flooding from downstream tributaries (that is, the Lockyer Creek and Bremer River) and also rainfall in the Brisbane catchment area.

19 The results of models under the Case 2 scenario indicate that the estimated peak flow in Brisbane City would be in excess of 6,200m^3/s with a corresponding peak height of over 2.6m AHD, which is a Moderate Flood in accordance with the BoM's classifications.

20 Therefore, at the very least, a Moderate Flood level of over 2.6m AHD would have occurred at the City Gauge during the January 2011 Flood Event from downstream tributary flows and Brisbane catchment rainfall alone.

21 Further, even if Wivenhoe Dam had been empty at the commencement of the January 2011 Flood Event, there would not have been enough capacity to store all of the water that flowed into the Dam during the event. With this in mind, the level of 2.6m AHD in Brisbane City (as per Case 2) would almost certainly have been higher even if the Dam was emptied prior to the start of the January 2011 Flood Event.

22 Therefore, assertion made in the O'Brien Submission '*that flooding in Brisbane could have, and should have been substantially avoided*' is quite clearly incorrect.

'Some 50% to 60% of the water passing the Brisbane City Gauge during the Major, Moderate and Minor flooding was water released from Wivenhoe.'

23 It is not clear whether Mr O'Brien has based this assessment in relation to the water passing the City Gauge on flood volumes or the instantaneous peak flow rate. I have assumed that Mr O'Brien has based his assessment on flood volumes as per section 7.1 of the O'Brien Submission.

[redacted]

24 In fact, the hydrologic modelling undertaking in the FOC shows that in terms of flood volumes, releases from Wivenhoe Dam for the entire event were around 2,652,000ML, whilst flood volumes from the Lockyer Creek were about 677,000ML and 433,000ML from the Bremer River.

25 In any case, hydrologic assessment of flood events is more properly dealt with by reference to rates of flow in cubic metres per second (m^3/s).

'SEQWater's own analysis indicates that flows from Wivenhoe alone would result in flows at the City Gauge during the peak of the flood of approximately 5000 cubic metres per sec. Based on the rating curve developed this would represent approximately 3.0 mAHD added to the peak of the flood peak.'

26 In Attachment 2 to the O'Brien Submission entitled 'Development of a Rating Curve for Brisbane City Gauge', Mr O'Brien has also relied on a derivation of the rating curve to draw conclusions on the effect of dam operations at the Brisbane City Gauge. Mr O'Brien refers to two correlations, which were '*developed and used for this submission*':

> *'Less than or equal to 5.11 mAHD*
>
> *Flow (cusecs) = 1649.1*River Height (mAHD) + 645.28*
>
> *At greater than 5.11 mAHD*
>
> *Flow (cusecs) = 1455.8*River Height (mAHD) + 2427.7'*

27 The adoption of a linear relationship to describe flood levels at the City Gauge is very approximate as it ignores the influence of tidal conditions (as evidenced by the scatter in the lower end values) and demonstrates a fundamental lack of understanding of river hydraulics at the upper end of the relationship.

28 A linear relationship would only be appropriate if the river channel was parabolic in cross-section and if the relationship was transformed in log-log space. This is an approach commonly used by hydrographers in extending rating curves. It is not appropriate, however, to suggest that a (stepped) linear relationship is applicable for the City Gauge.

29 Mr O'Brien states that his 'correlations', which are used to derive the rating curve in the O'Brien Submission, are based on the Brisbane River Flood Study (BCC, 1999).

The model in this study assumes a tide level at the Brisbane Bar of 0.92m AHD, which is approximately 0.7m AHD lower than actual tide height recorded during the January 2011 Flood Event and it is, therefore, not appropriate use this figure in an analysis of the January 2011 Flood Event.

30 Mr O'Brien has indicated that he omitted three data points (3.35, 2.36 and 5.02m AHD) from the study, which '*appeared to be inconsistent with the other data and were deleted from the correlation.*' In fact those data points are consistent with the fact that tidal influence is not a single linear relationship. It is, therefore, not correct to disregard those data figures on the basis on some perceived inconsistency. These figures should in fact be taken into account when deriving relationships.

31 Figure 1 below, demonstrates a more realistic relationship between gauge height and flow:

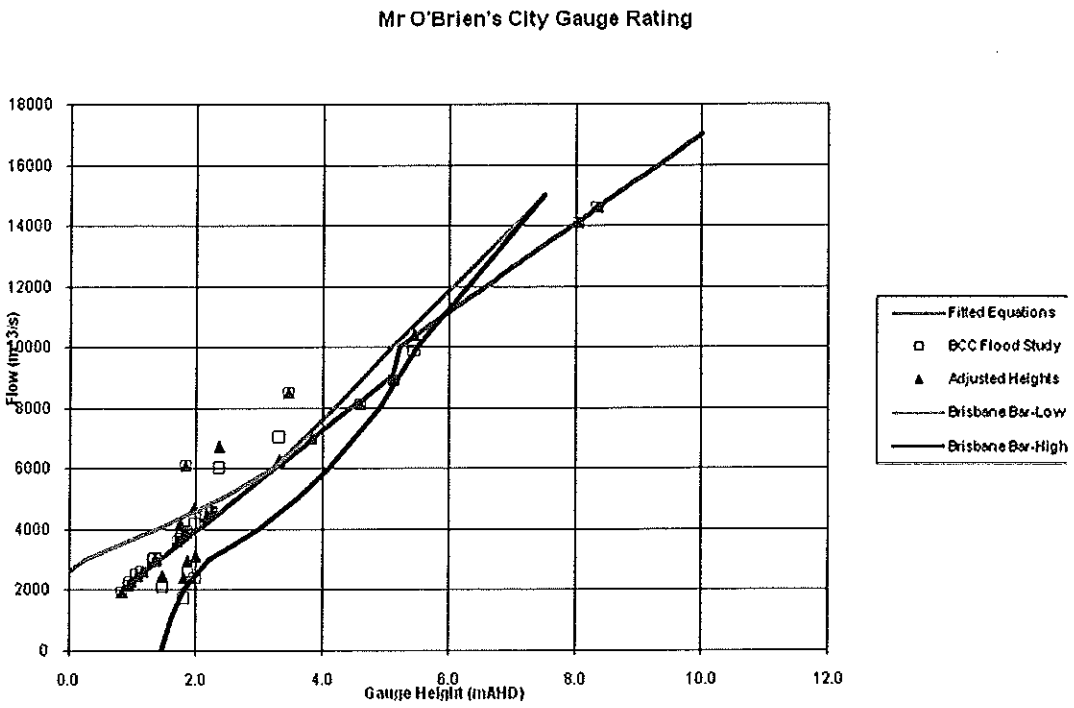


Figure 1

32 These relationships are based on numerical hydraulic models for cases of low tide and high tide at the Brisbane Bar (0.0m AHD and 2.7m AHD respectively). These relationships are just two from a family of curves that are considered appropriate for the City Gauge and which take into account downstream tidal boundary conditions.

33 It should be noted that the peak level recorded at Whyte Island, the most downstream ALERT gauge, during the January 2011 Flood Event was approximately 1.6m AHD.

34 The low and high tide rating curves that have been derived for the City Gauge, based on hydraulic modelling, suggest that for a flow of 5,000m^3/s and a tide of 1.6m AHD, the associated variation in peak level could range from 2.4m AHD up to 3.6m AHD depending on the tide level at the time. In comparison, linear interpolation suggests that for a flow of 5,000m^3/s with a tide level of 1.6m AHD, a peak level of 3.3m AHD would be expected at the City Gauge.

35 In short the O'Brien Submission relies upon an invalid rating curve and, therefore, incorrect conclusions have been drawn from it.

36 The 'outliers' shown in the figure above, with a corresponding peak height of 8.35m AHD represent the peak of the February 1893 Flood Event. Mr O'Brien has adopted this peak to derive his linear relationship. The peak from the 1893 Flood Event is considered an outlier compared with recent flood events because there have been substantial changes in the bathymetry of the Brisbane River channel since 1893. These changes are due to dredging and other river improvement works and development on the floodplains adjacent to the main channel. Therefore, reliance on this peak level leads to erroneous conclusions in respect of the derivation of a rating curve for this location.

'The volume of water released from Wivenhoe that contributed to the Major Flooding, (518,000 ML) had all been collected in Wivenhoe by 01:00 Monday 10th January at which time the total estimated cumulative releases during the flood event were only 221,000 ML.'

37 The correct figures were provided in section 9 of the Wivenhoe and Somerset Dams Flood Report 2011 entitled, 'Dam Inflow and Flood Release Details', and in particular section 9.2, at which the following table of inflow and release from Wivenhoe Dam on a daily basis can be produced:

Day & Date	Daily Inflow (ML)	Daily Release (ML)	Temporary Storage (ML)
Sunday 2/1/11*	7,169	2,520	4,649
Monday 3/1/11	8,488	4,320	8,817

[redacted]

Day & Date	Daily Inflow (ML)	Daily Release (ML)	Temporary Storage (ML)
Tuesday 4/1/11	6,009	4,320	10,506
Wednesday 5/1/11	8,106	4,320	14,292
Thursday 6/1/11	23,821	4,320	33,793
Friday 7/1/11	108,770	10,912	131,651
Saturday 8/1/11	124,081	87,520	168,212
Sunday 9/1/11	270,943	117,216	321,939
Monday 10/1/11	645,689	178,726	788,902
Tuesday 11/1/11	634,183	387,630	1,035,455
Wednesday 12/1/11	271,454	288,133	1,018,776
Thursday 13/1/11	156,272	235,231	939,817
Friday 14/1/11	126,824	301,640	765,001
Saturday 15/1/11	96,534	301,115	560,420
Sunday 16/1/11	74,545	302,000	332,965
Monday 17/1/11	38,154	264,337	106,782
Tuesday 18/1/11	42,448	151,387	-2,157
Wednesday 19/1/11*	8,806	26,694	-20,045
Total	**2,652,296**	**2,672,341**	

Note: * = part day only.

38 This table demonstrates that by the end of Sunday 9 January 2011, there had been a total inflow into Wivenhoe Dam of 557,387ML, with approximately 235,448ML released from the Dam. These figures are similar to those referenced in the O'Brien Submission.

39 However, it is important to note that the volume of temporary storage by the end of Sunday 9 January 2011 was 321,939ML, which is only 22% of the total available flood storage at Wivenhoe Dam. This equates to a lake level at Wivenhoe Dam of less than 68.6m AHD, which is only 1.6m AHD above FSL and 5.4m AHD below the threshold for strategy W4 (74.0m AHD) under the W&S Manual. Accordingly, early

morning on Monday 10 January 2011, there was a large amount of flood capacity in Wivenhoe Dam.

40 Figure 2 below shows the information in the above table displayed as a graph:

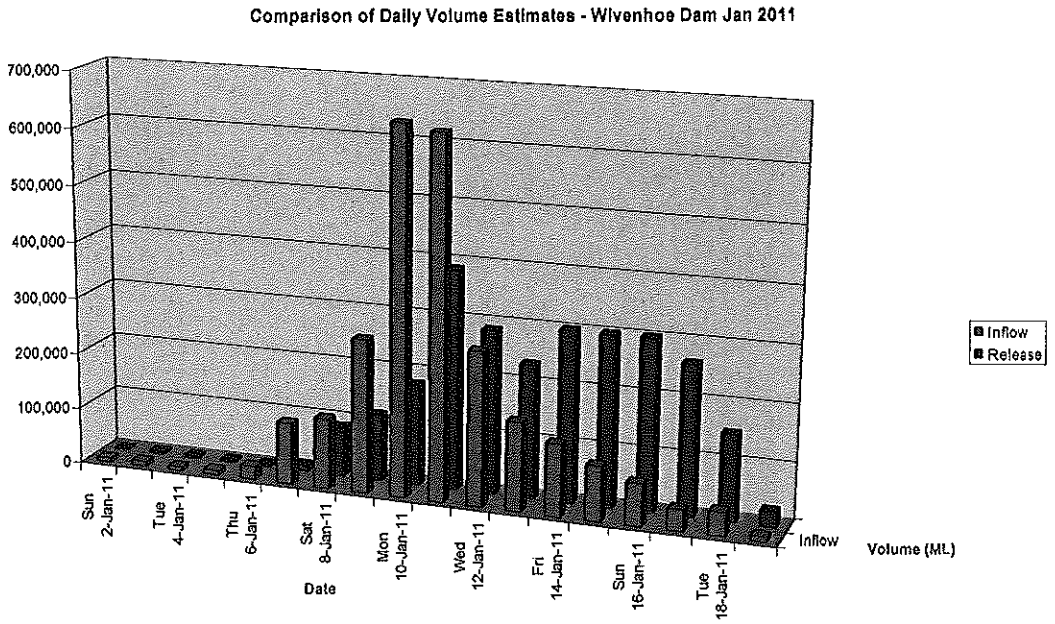


Figure 2

'SEQWater were slow to react through the whole period examined.'

41 I have responded to this assertion at paragraphs 42 to 44 and 114 to 125 of this statement.

'The delay in responding, especially in the days leading up to Monday 10th January, eventually left SEQWater with few alternatives.'

42 Release rates from the Dams during the January 2011 Flood Event were made in accordance with the strategies outlined in the W&S Manual.

43 The FOC ensured that needless closure of bridges or damage of property was avoided by adopting the release strategy recommended by the W&S Manual. It also ensured that no bridges or properties were inundated prematurely.

44 Decisions that impact public safety, such as the closing of bridges, the isolating of communities or the evacuating of residents, are not made lightly. Every effort is made by the FOC, and other relevant agencies, to ensure that bridges are closed

prior to inundation and that the local authorities have sufficient time to implement proper response plans.

45 I also refer to my response at paragraphs 114 to 125 of this statement.

'Even after SEQWater were aware at 0:55 on Monday 10th that increases in release rates were required to avoid triggering the fuse plug, the required release rates were not implemented until after 09:00 Tuesday 11th.'

46 Modelling results produced on Sunday 9 January 2011 and Monday 10 January 2011 did not indicate that fuse plugs were likely to be triggered.

47 Model runs 21, 23 and 26 (contained in Appendix A of the Wivenhoe and Somerset Dams Flood Report 2011 and also in Schedule 1 to my first statement) predicted a lake level well below the fuse plug trigger level and show that even with the inclusion of forecast rainfall, peak lake levels in Wivenhoe Dam were predicted to be one metre below fuse plug trigger level of 75.7m AHD.

'Given the delay in responding leading up to Monday 10th, if SEQWater had increased the release rates at 0:55 on Monday 10th the duration and extent of the Major Flooding in Brisbane would have been substantially reduced and potentially eliminated.'

48 The FOC commenced increasing release rates from Wivenhoe Dam at 2am on Monday 10 January 2011, in accordance with the models that had been undertaken at that time, after it was clear that Mt Crosby Weir Bridge and Fernvale Bridge had been closed and there was no danger to public safety. There was no 'delay in responding' as alleged by Mr O'Brien.

49 In any event, even if release rates had been increased at 12:55am as asserted by Mr O'Brien, as opposed to 2am, it would have had no material effect on the flows and the flood level 42.5 hours later at the peak of the January 2011 Flood Event.

'In only 14 out of the 180 hours in the lead up to the very high releases at 19:00 on Tuesday 11th did the releases from Wivenhoe exceed the inflows. In this period SEQWater were collecting water in Wivenhoe that was subsequently released into the peak of the flood in Brisbane.'

50 I refer to paragraphs 108 to 110 of my first statement where I discuss flood mitigation.

51 As said in my first statement, in the lead up to the peak of a flood event, outflows will generally be less than inflows so as to mitigate a flood event. A flood mitigation dam cannot completely prevent a flood where the total volume of water inflow during the flood event is greater than the dam's flood storage capacity.

'It is likely the delay in acting and the resulting very high rates of release that became necessary also increased flooding in the Lockyer and Bremer and caused damage to the banks in the Brisbane River Valley.'

52 It is correct to say that high flow rates in the Brisbane River will result in backwater effects in Lockyer Creek and the Bremer River (and any other tributary for that matter). However, the extent of the backwater effect depends upon the relative magnitude of the flow in each stream at any given time. It is not possible to conclude that releases from Wivenhoe Dam increased flooding in Lockyer Creek and Bremer River without further hydraulic analysis.

53 I note that the peak flow in Lockyer Creek during the January 2011 Flood Event is considered to be the highest peak flow ever observed in Lockyer Creek. The peak flow in the Bremer River was a Major Flood as defined by the BoM classification system. Therefore, the flood levels recorded in these streams were substantially caused by the flows that came from the headwaters of the catchments and not from backwater as asserted in the O'Brien Submission.

54 Releases from Wivenhoe Dam are made with consideration of the magnitude of the flows in downstream tributaries, as well as the timing of such flows. Annexure 1 to my supplementary statement illustrates the approximate timing of flows downstream from Wivenhoe Dam. The approximate travel time for releases from Wivenhoe Dam to reach the junction of Lockyer Creek is about one hour, whereas it takes approximately 16 hours for the release of floodwaters from Wivenhoe Dam to reach the junction of the Bremer River.

55 Releases that were made from Wivenhoe Dam peaked at about 7:30pm on Tuesday 11 January 2011 at a rate of 7,464m^3/s. The estimated peak flow emanating from Lockyer Creek was approximately 3,500m^3/s at about 6pm on Tuesday 11 January 2011. Therefore, the peak releases at Wivenhoe Dam will have flowed through the junction of Lockyer Creek just after the peak of the Lockyer Creek flowed through. The estimated peak flow from the Bremer River was 2,793m^3/s at about 9pm on Tuesday 11 January 2011, which was before the peak

releases from Wivenhoe Dam would have reached the junction of the Bremer River (taking into account the 16 hour travel time).

56 The peak releases from Wivenhoe Dam were reduced as quickly as possible, from 9:30pm on Tuesday 11 January 2011, so as to avoid the concurrent arrival of the release peak from Wivenhoe Dam and the peak flows in both Lockyer Creek and Bremer River.

57 The combined flow out of Wivenhoe Dam and Lockyer Creek was recorded (at Savages Crossing) at about 3am on Wednesday 12 January 2011.

58 The combined peak flow was observed at Mt Crosby Weir at about 10am Wednesday 2011, which is 14.5 hours after the peak release from Wivenhoe Dam and 13 hours after the peak of the Bremer River. Accordingly, the Wivenhoe Dam releases were timed so as to avoid the peak in the Lockyer Creek and Bremer River and hence any possible backwater effects were limited.

'In the Flood Event Report (3) SEQWater has relied on an undocumented rainfall event, twice the size of any of the actual rainfall evens to support the dam level readings that were used as a basis for the maximum releases late Tuesday 10th.'

59 The date referred to in this point in the O'Brien Submission is 'Tuesday 10th', which is incorrect. I have assumed, for the purpose of responding to this issue, that Mr O'Brien meant to refer to Tuesday 11 January 2011.

60 The post-event modelling was not performed to support the dam level readings that were used as the basis for decision making during the January 2011 Flood Event. Rather, that modelling was performed after the event in order to quantify and understand the magnitude of the rainfall required to match the actual rate of rise of the dam levels during the event. Prior to Tuesday 11 January 2011, the hydrological models did match the rate of rise of the dam levels. On Tuesday, the models were not matching the rate of rise. Therefore, reverse-route modelling of was required to estimate the release rate required.

61 Operational decisions were based on manual readings of the headwater dam levels during the January 2011 Flood Event from 11am to 6pm on Tuesday 11 January 2011. Manual observations were relayed from the dam operators on a half hourly basis during this period. Rate of rise calculations and reverse-routing were the techniques used to implement strategy W4 at this time.

'For reasons that are not apparent, SEQWater did not use the available capacity of the flood storage system. This could be because the declared capacity is truly unavailable: -

- *due to operational concerns,*
- *changes to the assets, or*
- *SEQWater deliberately or unconsciously choose not to use the available capacity.'*

62 The conclusions made by in the O'Brien Submission in relation to this issue are incorrect and I respond as follows.

63 *Changes to the assets:* The available capacity of the flood storage for Wivenhoe and Somerset Dams are referenced in paragraphs 84 and 88 of my first statement respectively.

64 From the February 1996 survey of the storage capacity curve, Wivenhoe Dam has an available flood storage capacity of 1,420,000ML above FSL to 77.0m AHD (the original evaluation design flood level) and 1,966,000ML to 80.0m AHD, which is the top of the wave wall post-auxiliary spillway upgrade.

65 The auxiliary spillway at Wivenhoe Dam consists of a three bay fuse plug and was constructed in 2005. The auxiliary spillway works also included the post-tensioning of the spillway monoliths and the addition of baffle plates under the service bridge to enable floodwaters to be stored up to the top of the wave wall. The wave wall was also made continuous across the entire dam crest and raised so that floodwater could be stored to the full height of 80.0m AHD. References to the original design of Wivenhoe Dam, which notes that the top of the wave wall is at 79.9m AHD, have been superseded by the auxiliary spillway works.

66 The amount of wind set-up and wave run-up that is estimated for a 1 in 100 AEP wind event at Wivenhoe Dam is calculated to be approximately 2.8m. Therefore, the design flood level adopted for an extreme flood and wind event (post-auxiliary spillway works) is around 77.2m AHD. This figure allows for a storage capacity of 1,436,000ML above FSL. This figure is similar to the previous evaluation of the design flood level of 77.0m AHD. Consequently, the addition of the fuse plugs to Wivenhoe Dam has not significantly altered the flood storage capacity of the Dam

and as a result no revision of the flood storage capacity was deemed necessary during the 2009 review of the W&S Manual.

67 In relation to the fuse plugs, the first fuse plug is triggered at 75.7m AHD, which corresponds to a storage capacity of 1,180,000ML above FSL. The second fuse plug initiates at 76.2m AHD, which corresponds to a storage capacity of 1,264,000ML above FSL. The third fuse plug initiates at 76.7m AHD, which corresponds to a storage capacity of 1,349,000ML above FSL.

68 The temporary air space above the fuse plug initiation levels is still available for use as flood mitigation storage. The fuse plugs simply provide another means of releasing floodwater during extreme flood events. These changes have increased the overall structural safety of the Dams. They have not reduced the flood mitigation capacity.

69 There has been no loss of flood storage capacity since the auxiliary spillway works. Therefore, a 'change to the assets' has not altered the flood storage capacity at Wivenhoe Dam.

70 Somerset Dam has a flood storage capacity of 520,900ML above FSL to a level of 107.46m AHD (the non-overflow level of the monoliths). The figure of 520,900ML is derived from the latest storage capacity curve, which was surveying in February 1996.

71 Somerset Dam can store floodwater to a level of 109.70m AHD (721,000ML above FSL), which is the imminent failure of the Dam and the duty point nominated in the Operating Target Line (refer to Figure 3 below).

72 *Operational concerns, or a deliberate or unconscious decision not to use available flood storage capacity:* The amount of flood storage used in either Wivenhoe Dam or Somerset Dam is determined by consideration of the Operating Target Line (refer to paragraphs 93 and 282 to 290 of my first statement). The January 2011 Flood Event followed the strategies outlined in the W&S Manual. The resultant Operating Target Line from the January 2011 Flood Event is shown in Figure 3:

[redacted]

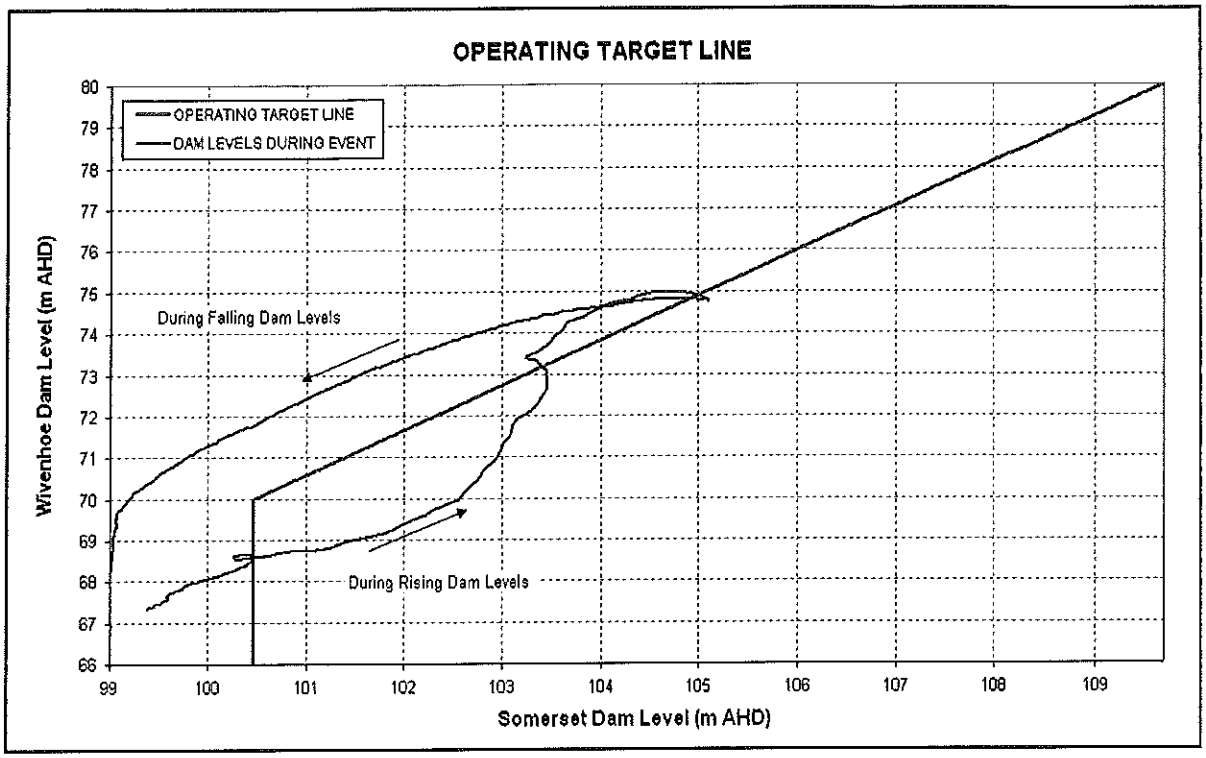


Figure 3

73 The ability to use flood storage capacity in either of the Dams is largely dependent on where the rainfall actually falls. For example, if rain only falls within the Upper Brisbane catchment (that is, downstream from Somerset Dam) then it will only be possible to store the floodwater when it flows into Wivenhoe Dam.

74 The objectives in the W&S Manual highlight that it is imperative to ensure the structural safety of the Dams. Therefore, it is not desirable to try to attempt to store floodwaters to the limit of the duty point (that is, 80.0m AHD at Wivenhoe Dam and 109.7m AHD at Somerset Dam) as a failure of either Dam would have catastrophic impacts.

75 Therefore, the assertion by the O'Brien Submission that Seqwater deliberately avoided using flood storage capacity is incorrect.

2.2 Operational Manual

'While compliance with the Operational Manual is not a focus of this submission, it would appear that at times SEQWater did not comply with the requirements of the Manual, while at other times, appear not to have used the flexibility that the Manual provided and consequently would fail to meet the objectives of the Manual.'

76 As stated at paragraphs 379 to 385 of my first statement, the strategies, procedures and gate operations adopted during the January 2011 Flood Event were in compliance with the requirements dictated by the W&S and NP Manuals.

77 Therefore, I reject the assertion in the O'Brien Submission that Wivenhoe and Somerset Dams were not operated in accordance with the W&S Manual during the January 2011 Flood Event.

'There appears to be no provision in the Operational Manual (2) which prevented the Operator from reducing the level in the dam below FSL.'

78 This assertion in the O'Brien Submission is not correct. I have responded to this assertion at paragraphs 165 to 173 of this statement.

'The Operational Manual does not appear to substantially constrain the Operator's ability to undertake the appropriate course of action.'

79 To implement the 'appropriate course of action' the Duty Flood Operations Engineer has to follow and implement the strategies contained in the W&S Manual.

80 Section 2.8 of the W&S Manual does allow the Senior Flood Operations Engineer to depart from the procedures set out in the W&S Manual if it is necessary to meet the flood mitigation objectives set out in section 3 of the W&S Manual. However, this discretion is subject to the following:

- *'Before exercising discretion under this Section of the Manual with respect to flood mitigation operations, the Senior Flood Operations Engineer must make a reasonable attempt to consult with both the Chairperson and Chief Executive.*
- *The Chief Executive would normally authorise any departures from the Manual. However if the Chief Executive cannot be contacted within a reasonable time, departures from the Manual can be authorised by the Chairperson.*
- *If both the Chairperson and the Chief Executive cannot be contacted within a reasonable time, the Senior Flood Operations Engineer may proceed with the procedures considered necessary and report such action at the earlier opportunity to the Chairperson and Chief Executive.'*

81 The only occasion on which the discretion under section 2.8 of the W&S Manual was considered during the January 2011 Flood Event was on Monday 10 January 2011 (refer to paragraphs 118 to 124 and 133 of my supplementary statement).

82 At no other time during the January 2011 Flood Event did I (as the Senior Flood Operations Engineer) consider that it was necessary to contemplate exercising the discretion under section 2.8 of the W&S Manual.

'It is of concern that based on the Flood Event Log entry for 00:45 Monday 10th January, the non-damaging flow within Brisbane is not well understood by all parties, especially as achieving the maximum rate of release from Wivenhoe up to this flow is essential for maintaining the maximum capability for flood mitigation.'

83 The telephone call at 12:45am on Monday 10 January 2011 is referred to at paragraphs 88 and 89 of my supplementary statement.

84 The W&S Manual specifies the 'upper limit of non-damaging floods' at Moggill at 4,000m^3/s and this is a figure that is well understood by the Duty Flood Operations Engineers. The purpose of strategy W3 is to specify a flow rate limit. I operated during the January 2011 Flood Event in accordance with this value specified in the W&S Manual and implemented strategies accordingly.

85 This is demonstrated by the situation reports sent from the FOC at about 1:14am and 6:30am on Monday 10 January 2011 (attached at Appendix E to the Wivenhoe and Somerset Dam Flood Report 2011), which both state that '*...the combined flows in the lower Brisbane will be limited to 4,000m3/s if possible.*'

86 As set out in my supplementary statement at paragraph 88, the conversation at 12:45am on Monday 10 January 2011 between John Ruffini and Ken Morris of BCC related to the description of that flow rate in situation reports.

87 The wording in Strategy W3 states that 4,000m^3/s is the "upper limit of non-damaging floods". This phrase is not meant to convey that there is no damage below that level. We know from the 2006 BCC's Brisbane Valley Flood Damage Minimisation Study that there is damage below that level, but the damage curve increases significantly above 4,000m^3/s For this reason, the phrase "upper limit of non-damaging floods" in the W&S Manual might be amended, however, the target flow rate of 4,000m^3/s at Moggill should not, in my view, be changed without a comprehensive study.

88 As set out in paragraph 257 of my first statement, when the W&S Manual was reviewed in 2009, the panel discussed the "*Brisbane Valley Flood Damage Minimisation Study: Brisbane City Flood Damage Assessment.*", but no change was made to the reference to 4,000m^3/s in Strategy W3.

89 I refer to the table on page 8, Table 4.1, and the graph on page 8, Figure 8.1 (see below). This table and figure shows that damage starts to increase significantly once a flow rate of 4,000m^3/s at Moggill is reached.

Table 4.1 Residential and Non-Residential Flood Damage Summary Results, Brisbane City

Flood Discharge (m^3/s)	Residential			Non-Residential			Total Damage ($million)
	Total Damage ($million)	No. of Flood Damaged Properties	Average Damage Per Property ($1000)	Total Damage ($million)	No. of Flood Damaged Buildings	Average Damage Per Building ($1000)	
1000	0	0	0	0.002	1	2.06	0.002
2000	0	0	0	0.24	1	241.48	0.24
3000	0.40	29	13.78	0.71	4	177.81	1.11
4000	4.22	138	30.56	1.75	26	67.12	5.97
5000	29.10	831	35.02	13.30	125	106.41	42.40
6000	98.27	2052	47.89	59.07	383	154.23	157.34
7000	225.76	4073	55.43	169.27	803	210.80	395.03
8000	382.63	6280	60.93	288.54	1356	212.78	671.17
10000	718.21	10296	69.76	589.12	2259	260.79	1307.33

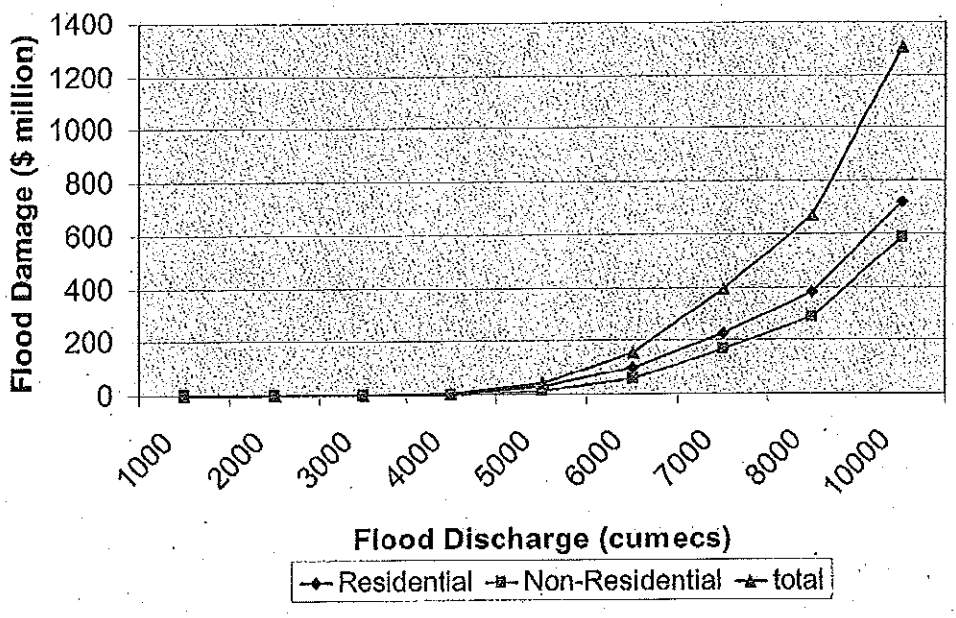


Figure 4.1 Residential, Non-Residential and Total Flood Damage Estimates, Brisbane City

90 During the January 2011 Flood Event, I applied the flow rate of 4,000m^3/s as the upper limit of strategy W3 as required by the Manual.

91 In summary I have a good understanding that the target maximum flow rate at Moggill under strategy W3 is 4,000m^3/s.

2.3 Events Outside Current Flood

'Changes in the assets and to operational procedures appear to have substantially reduced the capacity of the dams to provide flood mitigation for Brisbane.'

92 As discussed in paragraphs 63 to 71 above, the inclusion of the auxiliary spillway does not reduce the flood storage capacity of the Dams as suggested by Mr O'Brien in the O'Brien Submission.

93 In terms of operational procedures, the major change that has occurred since the auxiliary spillway works is the release rates associated with implementing strategy W4. The requirement that all radial gates be fully opened before the lake level reaches 75.5m AHD does require more water to be released that was required in previous versions of the W&S Manual. However, the benefit is that now the risk of dam failure has been reduced from 1 in 15,000 AEP to 1 in 100,000 AEP.

94 Strategy W4 is still invoked at the same threshold level of 74.0m AHD as was the case with the previous version of the W&S Manual. The auxiliary spillway has not, therefore, impacted on the implementation of any of the lower level objectives in strategies W1, W2 and W3, including the optimisation of the protection of urban areas.

95 These changes have increased the overall structural safety of the Dams and have not reduced the flood mitigation capability of the Dams.

96 The construction of the auxiliary spillway at Wivenhoe Dam has resulted in the Dam now being able to meet current dam safety standards in respect to spillway adequacy. In accordance with the *Water Supply (Safety and Reliability) Act 2008* (Qld), Wivenhoe Dam meets the Acceptable Flood Capacity requirements implemented by DERM. Further augmentation of the spillway capacity will need to be completed by Seqwater by 2035 to ensure that Wivenhoe Dam continues to meet the spillway adequacy requirements specified by the legislation and by DERM.

'Even with this apparent reduction in the capacity of the dams for flood mitigation, the flooding in Brisbane could still have been avoided or substantially mitigated.'

97 This assertion is not correct.

98 The peak flow in the Brisbane River was substantially mitigated as demonstrated by Figure 4 below (refer also to paragraphs 357 and 358 of my first statement):

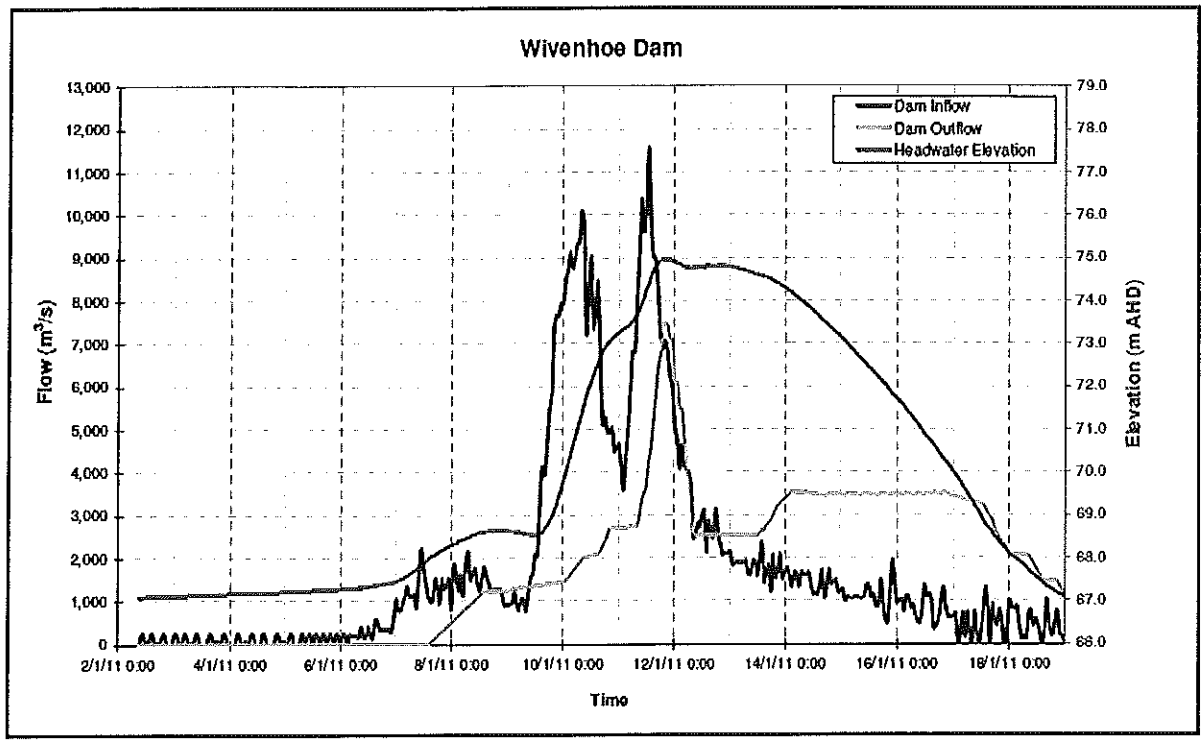


Figure 4

99 As discussed in my first statement, the peak release from Wivenhoe Dam was approximately 40% lower than the peak of the inflow. In other words, Wivenhoe Dam reduced the rate of flows downstream of the Dam by approximately 40% compared with the flows going into the Dam.

100 As stated at paragraph 108 of my first statement, flood mitigation is the process of reducing the impact of flooding downstream of a dam and does not necessarily prevent downstream flooding. The larger an inflow event, the less capacity a dam has to mitigate the effects of flooding. A flood mitigation dam cannot completely prevent a flood where the total volume of water inflow during a flood event is greater than a dam's flood storage capacity (which is what occurred during the January 2011 Flood Event).

101 Accordingly, the January 2011 Flood Event was substantially mitigated and, as discussed at paragraphs 15 to 22 above, the flooding in Brisbane could not have been avoided during the January 2011 Flood Event.

[redacted]

THE O'BRIEN SUBMISSION SECTION 3 - SUMMARY

3.1 A Simple Plan

102 In this section of the O'Brien Submission sets out what Mr O'Brien says are the 'simple operating philosophies'.

103 In fact, the operating strategies for Wivenhoe and Somerset Dams are contained in the W&S Manual.

104 The primary objectives of the procedures contained in the W&S Manual are (in order of importance):

- *'Ensure the structural safety of the dams;*
- *Provide optimum protection of urbanised areas from inundation;*
- *Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;*
- *Retain the storage at Full Supply Level at the conclusion of the Flood Event.*
- *Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.'*

105 The 'simple operating philosophies' proposed by Mr O'Brien fail to acknowledge the lower level objectives required in the W&S Manual, in particular minimising disruption to rural life in the valleys of the Brisbane and Stanley Rivers.

106 The flood storage capacity of Wivenhoe Dam between FSL and 74.0m AHD (the trigger level for strategy W4) is intended to be used for providing flood mitigation for the lower level objectives (that is, minimising disruption to rural life and providing optimum protection of urbanised areas).

107 The dam safety objective is triggered when the lake level exceeds 74.0m AHD. This objective requires the releases of floodwaters to limit the rise in storage level. On the other hand, the lower level objectives require the retention of floodwaters to limit the magnitude of downstream releases.

108 If the 'simple operating philosophies' asserted in the O'Brien Submission were followed it would be in breach of the objectives in the W&S Manual.

109 The objectives in the W&S Manual were followed when implementing strategies during the January 2011 Flood Event.

3.2 An Avoidable Flood

110 Mr O'Brien asserts, in this section of the O'Brien Submission, that higher releases from Wivenhoe Dam should have been made earlier during the January 2011 Flood Event (for example, over the weekend of the 8 and 9 January), or that more water should have been retained in the flood compartments of the Dam until after the peak flows from downstream events had passed.

111 Of course, decisions as to releases from the Dams must be made in accordance with the W&S Manual and based upon the information available at the time the decision was made, not based on information known in hindsight.

112 A response to the assertion that releases should have been made earlier during the January 2011 Flood Event are discussed at paragraphs 363 to 371 of my supplementary statement. In summary:

(a) Over the course of Saturday 8 January 2011, the lake level at Wivenhoe Dam rose from 68.32m AHD to 68.65m AHD and the lake level was predicted (as at 2pm on Saturday 8 January 2011) to peak at 68.7m AHD at about 1am on Tuesday 11 January 2011. There was still a significant amount of flood storage available in the Dam if rainfall increased significantly;

(b) Higher releases earlier in the event would have resulted in the premature inundation of downstream bridges;

(c) On the morning of Sunday 9 January 2011, heavy rainfall occurred in the Stanley River catchment and further rainfall was forecast and as a result of that rainfall the Duty Flood Operations Engineers met to discuss the current strategy;

(d) The Duty Flood Operations Engineers made the decision to maintain the current release rate from Wivenhoe Dam to allow the peak of the Lockyer Creek to pass through Brisbane River, without the need to close Mt Crosby Weir Bridge and Fernvale Bridge (in accordance with the objectives in the W&S Manual);

(e) Following the meeting further heavy rainfall fell and the strategy was revised to release further water from the Dam, which would inundate Mt Crosby Weir Bridge and Fernvale Bridge. However, it is important the bridges are closed to the public before they are inundated and the higher releases from Wivenhoe Dam were immediately put in place once it was safe to do so.

113 If higher releases were made earlier during the January 2011 Flood Event those releases would have been in breach of the objectives in the W&S Manual, in particular the objectives to maximise protection to urban areas and to minimise the impact of rural life downstream. Further, higher releases were made from the Dam when it was required following heavy rainfall, but only after it had been confirmed that it was safe to do so in light of the fact that downstream bridges would be inundated.

3.3 Too Little Too Late

114 In section 3.3 of the O'Brien Submission, Mr O'Brien incorrectly states that '*SEQWater was obliged to declare a flood event prior to 06:30 Tuesday 4th January.*' While the lake levels of Wivenhoe and Somerset Dams were above FSL at this time (as a result of base flows from the previous Boxing Day flood event), there was only minor rainfall forecast and operational releases (as opposed to flood mitigation releases) were being made from both Dams at the time.

115 Therefore, there was no requirement for the FOC to be mobilised or for a flood event to be declared at this time.

116 Further, in section 3.3 of the O'Brien Submission, it states:

'*Once this flood event had been declared SEQWater was then required to select various operating strategies for both Wivenhoe and Somerset based on the predicted levels in each of these dams. While we don't have access to these predictions, we do have access to the actual dam levels and any reasonable predictive model will converge with the actual value at any given time.*'

117 There were no model predictions undertaken at this time. This is because the QPF for Tuesday 4 January 2011 was for 10 to 20mm in the morning and 5 to 15mm in the afternoon (refer to Appendix C of the Wivenhoe and Somerset Dams Flood

Report 2011) and, as a result, the Duty Flood Engineer did not consider model predictions necessary. I agree with this judgment.

118 I note that the predicted model results produced after the FOC was mobilised on Thursday 6 January 2011 are contained in Appendix A to the Wivenhoe and Somerset Dams Flood Report 2011.

119 Also in section 3.3 of the O'Brien Submission, Mr O'Brien provides a summary of what he says are '*the latest dates and times that the trigger levels for the various strategies would have been exceeded.*' It is not clear what those dates and times are based upon. I have assumed that he has used the data from the automatic level recorder 540177 from the BoM website (as indicated in section 9.1 of the O'Brien Submission).

120 The table below compares the implementation of strategies as per Mr O'Brien's analysis and the actual times strategies were implemented by the FOC during the January 2011 Flood Event 2011:

Strategy	Mr O'Brien	FOC
W1A	00:46 6/1/2011	07:00 6/1/2011
W1B	00:37 7/1/2011	02:00 7/1/2011
W1C	08:29 7/1/2011	09:00 7/1/2011
W1D	14:34 7/1/2011	15:00 7/1/2011
W1E	21:16 7/1/2011	22:00 7/1/2011
W2	07:11 8/1/2011	Not Implemented
W3	07:11 8/1/2011	08:00 8/1/2011
W4	Not indicated	08:00 11/1/2011

121 Mr O'Brien further suggests in section 3.3 of the O'Brien Submission that based on an entry in the Event Log:

'*...SEQWater were indeed aware as early as 19:10 Sunday 9th January that substantially increased discharge rates of 3000 cubic metres per sec were required.*

Despite this knowledge, the rapid escalation through the Strategies for Wivenhoe, the forecasts and real time data available, SEQWater did not increase the release rate to 3000 cubic metres per sec until after 09:00 Tuesday 11th January.'

122 This assertion is not correct. As referred to at paragraph 76 of my supplementary statement, on Sunday 9 January 2011, the strategy that was applied at this time is set out in the situation report issued at 9:04pm on Sunday 9 January 2011. The report stated:

'*The current release rate from Wivenhoe Dam is 1,400m3/s (120,000ML/day). Gate operating will start to be increased from noon Monday and the release is expected to increase to at least 2,600m3/s during Tuesday morning.*'

123 This scheduling of the increase in release rates from Wivenhoe Dam was necessary to ensure that Mt Crosby Weir Bridge and Fernvale Bridge were closed prior to increasing releases.

124 Further, the model run (on a 'no further rainfall' basis) on Sunday 9 January 2011 at 7pm predicted that a release of 2,880m^3/s would be required from Wivenhoe Dam but not until 8am on Tuesday 11 January 2011.

125 It should also be noted that a release rate from Wivenhoe Dam of 2,750m^3/s was actually reached by 7:30pm on Monday 10 January 2011 (earlier that previously scheduled) as a result of further rainfall.

3.4 Fundamental Issues

126 Mr O'Brien asserts that the there were four 'basic fundamental contributions to this event', which are:

- '*Not releasing sufficient water from the flood storage volume prior to 10:00 Monday 10th January when it could have been released with no downstream flooding.*
- *Instead retaining this water in the flood storage volume thereby reducing flexibility to cater for design flood events.*
- *Undertaking peak discharges of this stored water at a time which had maximum impact on downstream flooding.*
- *Not using the full capacity of the flood storage system at the peak of the flood.*'

127 Further, Mr O'Brien asserts that '*in essence water was banked in the flood storage system to be released at the worst possible time.*'

128 These assertions are not correct.

129 In respect to the first bullet point, I have dealt with the assertion in respect to the release of flood storage prior to 10am Monday 10 January 2011 in paragraphs 37 to 40. It is simply not correct that releases of water from Wivenhoe Dam cause no downstream flooding. Releases of water from Wivenhoe Dam can cause considerable disruption to rural communities and the lower level strategies contained in the W&S Manual seek to limit that disruption.

130 In respect to the second bullet point, as I said in paragraph 107 above, the lower level objectives require the retention of floodwaters to limit the magnitude of downstream releases, but this does not 'reduce flexibility to cater for design flood events'. The higher level strategies contained in the W&S Manual are designed to deal with the rare to extreme flood range.

131 In respect to bullet point 3, as set out in paragraphs 37 to 40 and 52 to 58 above, peak discharges from Wivenhoe Dam were only made when large rainfall meant that strategy W4 had to be implemented and dam safety became the primary concern.

132 In respect to bullet point 4, once strategy W4 is invoked the W&S Manual requires that releases be increased until such time that the lake level is stabilised. The amount of flood storage used during a flood event depends on the magnitude of the inflow.

THE O'BRIEN SUBMISSION SECTION 7 - THE FLOOD

7.2 Contribution from Wivenhoe

133 In this section, Mr O'Brien has taken a relatively simplistic and approximate approach to equating Wivenhoe Dam releases with flood volumes at the Brisbane City Gauge. To undertake this assessment properly would require a calibrated numerical hydraulic model to account for the conveyance of the floodwaters through the 150km of river channel that exists between Wivenhoe Dam and the mouth of the Brisbane River.

134 This hydraulic assessment has not been undertaken due to the time permitted, however, a preliminary assessment has been conducted using a hydrologic model, which is discussed at section 8.10 of the Wivenhoe and Somerset Dams Flood Report 2011 (refer to paragraphs 16 to 22 above and paragraphs 371 to 373 of my first statement).

135 As discussed in my first statement, the hydrologic models were run under five case scenarios:

(a) Case 1 (dark blue)– the actual downstream estimated flow during the January 2011 Flood Event;

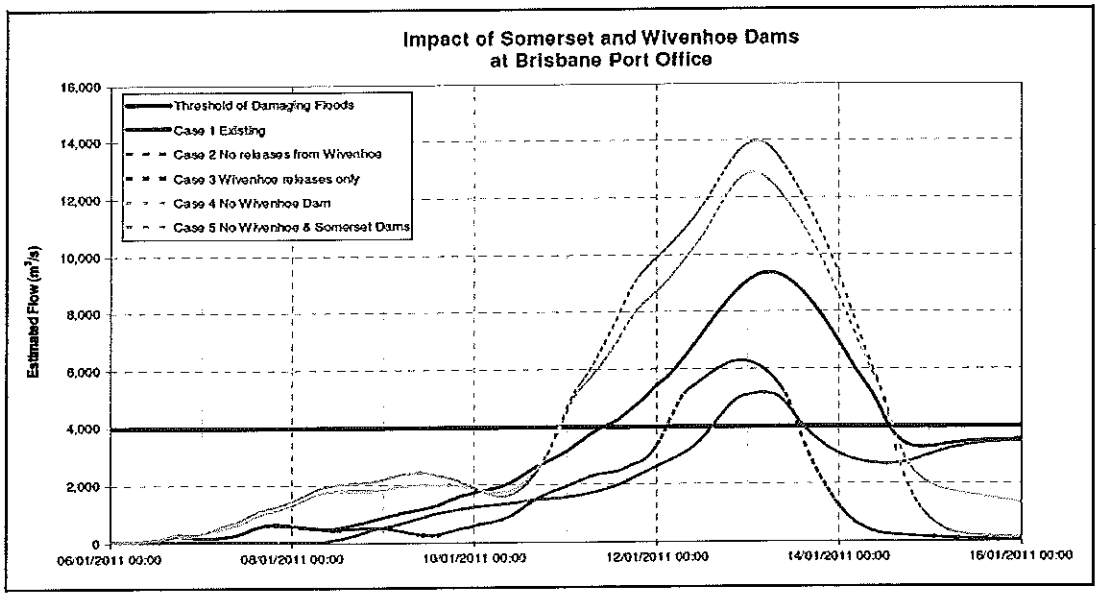
(b) Case 2 (purple)– if (theoretically) Wivenhoe Dam could have retained all of the water, which flowed into the Wivenhoe Lake, bearing in mind that Brisbane would still be affected by flooding from Lockyer Creek, Bremer River and rainfall in the Brisbane catchment;

(c) Case 3 (red)– releases from Wivenhoe Dam only, excluding flows from Lockyer Creek, Bremer River and rainfall in the Brisbane catchment;

(d) Case 4 (light blue)- the downstream flooding had Wivenhoe Dam not existed; and

(e) Case 5 (yellow) – the downstream flooding had Wivenhoe and Somerset Dams not existed.

136 Figure 5 shows the results produced by the hydrologic assessment:



137 In summary, this hydrologic assessment demonstrates that Wivenhoe and Somerset Dams did substantially mitigate the flood impacts downstream of the Dams.

138 Further, it appears that Mr O'Brien relies on his derived rating curve to determine flood volumes at the City Gauge. As set out in paragraphs 26 to 36 above I have responded to this issue and commented upon the fact that it is not appropriate to use this derived rating curve.

7.3 SEQWater Assessment

139 Mr O'Brien makes assertions in respect to '*the importance of ensuring that releases from Wivenhoe are undertaken either before or after peaks from streams entering downstream. Not as apparently occurred in this event where the peak release from Wivenhoe occurred during peak downstream flows.*'

140 As I have stated in paragraphs 52 to 58 above, this assertion is not correct.

THE O'BRIEN SUBMISSION SECTION 8 - OPERATION OF THE WIVENHOE SOMERSET SYSTEM

8.1 General

141 Mr O'Brien states that in the 2009 revision of the W&S Manual there was a '*fundamental change in the philosophy of selection of the operating Strategy between Rev 6 and Rev 7 of the Operations Manual and this was a change from selecting the operating Strategy from the actual level in the dam to the predicted level in the dam.*'

142 This assertion is not correct.

143 As stated at paragraph 254 of my first statement, the word 'predicted', which was added to revision 7 of the W&S Manual was to make clear that runoff from the rainfall that had already occurred in the catchment area should be taken into account in determining the implementation of strategies. The addition of the word 'predicted' did not change the operational strategies between revision 6 and 7.

144 The change in the wording in revision 7 did not, as the O'Brien Submission asserts, change the operational strategies during the January 2011 Flood Event.

145 Mr O'Brien has referred to an entry in the Event Log at 12:55am on Monday 10 January 2011. I have discussed this entry at paragraph 89 of my supplementary statement.

146 It is not correct to say (as is asserted in the O'Brien Submission) that 'under Rev 7 of the Operational Manual SEQWater would be obliged to implement Strategy W4 from 00:55 Monday, 35 hours earlier than under Rev 6'. As at 1am on Monday 10 January 2011, strategy W3 applied and the predicted lake levels (on a 'no further rainfall' basis) was 72.9m AHD, which was 1.1m AHD below the trigger level for strategy W4 (74.0m AHD).

8.2 Critical Lead Up Period

147 In this section, Mr O'Brien again asserts that strategy W4 was required to be implemented from early on Monday 10 January 2011.

148 As set out in response to section 8.1 'General' above, that assertion is not correct.

THE O'BRIEN SUBMISSION SECTION 9 - TUEDSAY 11TH JANUARY

9.1 Dam Levels

149 The graph discussed in the O'Brien Submission is based on the data obtained from the Wivenhoe headwater gauge (station 540177), which is data that is obtained from the BoM website. The O'Brien Submission does not note that the BoM website contains the following caution in relation to this information:

'*1. The river height data is the latest available operational data provided for flood warning purposes and has not been quality controlled.*' (emphasis added)

150 The information obtained from the automatic headwater gauge is not validated operational data. In fact, as set out below, the data from that station was erroneous.

151 The graph in the O'Brien Submission, which is plotted using the data from station 540177, shows that there is considerable oscillation within the data, especially after 12pm Tuesday 11 January 2011. This station generally reports approximately 10mm variations, however, the oscillations shown of Mr O'Brien's graph show oscillations up to 200 and 300mm. Generally, such large variations in data (such as 200 to 300mm) indicate that there is problem with the gauge.

152 As set out in paragraphs 175(e) and 390 of my first statement, during the January 2011 Flood Event, the Duty Flood Operations Engineers identified there was a problem with readings from the automatic headwater gauge. Accordingly, manual lake level readings were used for operational purposes. Subsequent analysis showed that the automatic headwater gauge suffered from drawdown effect or blockage during the January 2011 Flood Event.

153 Accordingly, it is not appropriate to use readings from the automatic headwater gauge as is done in the O'Brien Submission.

9.2 Discussion

154 I have responded to assertions in relation to operational decisions chosen during the January 2011 Flood Event refer to my response to section 2 of the O'Brien Submission at paragraphs 15 to 101 above.

155 I have responded to assertions in relation to the readings from the automatic headwater gauge (station 540177) in paragraphs 149 to 153 above.

156 The remainder of the assertions in this section of the O'Brien Submission are largely based upon the readings from the faulty automatic headwater gauge.

157 The operational strategies adopted during the January 2011 Flood Event are set out in detail in my first statement and supplementary statement.

9.3 Discrepancy in Dam Level

158 This section of the O'Brien Submission again deals with the differences in readings between the automatic headwater gauge and the manual gauge board readings. As set out in response to section 9.2 'Discussion' above, the readings from the automatic headwater gauge were faulty as a result of drawdown effect or blockage.

159 Accordingly there is no 'discrepancy in dam level' as is asserted.

160 In respect to the last bullet point in section 9.3 of the O'Brien Submission, the automatic headwater gauge is known to be effected by drawdown during very large flood events (as the January 2011 Flood Event was). Those matters do not, as is suggested, reflect 'very poorly on the standard of instrumentation available'.

THE O'BRIEN SUBMISSION SECTION 10 - MANUAL OF OPERATIONAL PROCEDURES

10.1 General

161 I refer to paragraphs 141 to 146 above in response to the issue of the 2009 revision of the W&S Manual.

162 In this section of the O'Brien Submission, Mr O'Brien asks, '*Was there a change in the approach using the flood mitigation capabilities of Somerset in the period between 2004 and 2009?*'

163 There was a change in approach in relation to the revision of the design flood estimates for Somerset Dam in the 2009 W&S Manual. Those changes are based on the adoption of design rainfalls using the Generalised Tropical Storm Method Revised (2003) of Probable Maximum Precipitation. Those changes are found in the description of strategies S2 and S3 and the Operating Target Line. In particular, strategies S2 and S3 allow the sluices at Somerset Dam to be opened even if the Wivenhoe Dam level is not falling, whereas in previous revisions of the W&S Manual, the Somerset Dam sluices were not able to be opened until such time that the Wivenhoe Dam level was falling or the lake level in Somerset Dam had exceeded 102.25m AHD. The 2009 revision of the W&S Manual recognises the increased vulnerability of Somerset Dam as a consequence of the revised design flood estimates and, therefore, allows for an earlier release of water from Somerset Dam than permitted under previous revisions.

164 Further, strategy S1 (minimising impact of rural life upstream) was introduced in the 2009 revision of the W&S Manual in order to overcome an issue that had arisen in 2008 during the drought when localised rain would increase the Somerset Dam lake level, but not the Wivenhoe Dam lake level. In previous revisions of the W&S Manual, there was no ability to release water from Somerset Dam to Wivenhoe Dam in those circumstances, except as an operational release of water under the Moreton ROP, which was very slow. It also meant that there was an upstream impact from Somerset Dam (if water could not be released), for example, the unnecessary inundation of Mary Smokes Creek Bridge on the D'Aguilar Highway. Strategy S1, introduced under the 2009 revision of the W&S Manual, now allows flood mitigation release of water so as to be able to drain Somerset Dam into Wivenhoe Dam in circumstances where Wivenhoe Dam is not expected reach FSL (67.0m AHD).

[redacted]

10.2 Full Supply Level (FSL)

165 In the O'Brien Submission it is asserted that, *'Under the current version of the Operational Procedures (2) there is no limitation on the Operator's ability to reduce the level in Wivenhoe below FSL once a flood event has been declared.'*

166 I do not agree with Mr O'Brien's interpretation of the W&S Manual.

167 The W&S Manual does not contemplate the lake level being reduced below FSL in either a pre-emptive manner or during the course of an event, except when returning the lake to FSL at the conclusion of a flood event.

168 It is not possible to invoke any strategy in a way that would enable the lake to be drawn down below FSL during the flood without violating the requirements of the W&S Manual.

169 Mr O'Brien has referred to section 8.5 of the W&S Manual and that it provides that, '*This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.*' However, this reference is taken out of context in the O'Brien Submission.

170 Section 8.5 of the W&S Manual relates to gate closing strategies where the '*aim should always be to empty stored floodwaters stored above EL 67.0m within seven days after the flood peak has passed through the dams.*'

171 The reference used by Mr O'Brien is taken from the following paragraph of section 8.5:

'*There may be a need to take into account base flow when determining final gate closure. This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.*'

172 In my view, that paragraph allows the Duty Flood Operations Engineers to reduce the level of Wivenhoe Dam below FSL during the gate closing strategies due to the fact that there is known inflow, which when it reaches the lake, will recover the level back to FSL. This strategy takes into account that there is a delay between rainfall hitting the ground and flowing into the lake (commonly described as base flow).

173 Section 8.5 of the W&S Manual does not give the Duty Flood Operations Engineers the ability to release water pre-emptively or allow the lake level to be reduced below

FSL during the course of a flood event (other than through the closure strategy described above).

THE O'BRIEN SUBMISSION SECTION 11 - WHERE DID THE FLOOD STORAGE CAPACITY GO?

174 In this section the O'Brien Submission questions the flood storage capacity in Wivenhoe Dam. I have responded to these assertions in paragraphs 62 to 75 above.

THE O'BRIEN SUBMISSION SECTION 12 - FUSE PLUGS

175 In this section of the O'Brien Submission, Mr O'Brien makes assertions about the fuse plugs. I have responded to these assertions at paragraphs 63 to 71 above.

12.4 Alliance Delivery

176 In section 12.4 of the O'Brien Submission, Mr O'Brien refers to a section of the Design Flood Estimate Report from the Alliance Delivery programme in about 2005. This report sets out the characteristics and assumptions used to design the fuse plugs.

177 Mr O'Brien tries to match the January 2011 Flood Event to the design storm characteristics contained within this report. However, the design storm characteristics contained are for a two day event with certain assumptions regarding downstream concurrent flooding. The January 2011 Flood Event, however, was effectively a seven day event and had significantly different downstream concurrent flooding conditions.

178 Accordingly, it is not appropriate to compare the design storm characteristics with the January 2011 Flood Event and try to draw conclusions from that comparison.

THE O'BRIEN SUBMISSION SECTION 13 - LOCKYER CREEK AND BREMER RIVER

13.1 Lockyer Creek

179 In this section of the O'Brien Submission, Mr O'Brien suggests that releases from Wivenhoe Dam resulted in backwater effects on Lockyer Creek. As set out in paragraphs 52 to 58 above, high flow rates in the Brisbane River will result in backwater effects in Lockyer Creek. This effect is mostly evident at the stream

gauge at O'Reilly's Weir, which is the lowest gauge on the Lockyer Creek before Brisbane River.

180 My preliminary assessment based on my knowledge of the January 1974 flood and an examination of the stream flow records at Lyons Bridge and Rifle Range Road from the January 2011 Flood Event, is that the backwater effect did not propagate upstream to the gauging station at Rifle Range Road as is implied in the O'Brien Submission. The Rifle Range Road gauge is 26km from the junction, which is a considerable distance for a backwater effect. Detailed hydraulic analysis would be required to make any conclusions as to the backwater effect in Lockyer Creek during the January 2011 Flood Event.

13.2 Downstream River Banks

181 In section 13.2 of the O'Brien Submission, Mr O'Brien asserts that there was bank slumping due to rapid drawdown from the very high release rates from Wivenhoe Dam on Tuesday 11 January 2011.

182 Bank slumping is a well known phenomenon during floods. It can occur naturally (as was the case in the Coronation Drive bank slumping following the 1974 flood), but is also known to occur in the drainage phase in flood mitigation dams, such as Wivenhoe Dam. The best example of this, was the significant bank slumping that occurred after the April 1989 where there was a rapid gate closing sequence, which cause bank slumping. Bank slumping occurs when the water does not have time to naturally drain from the banks and the weight of the banks with the extra water causes the bank to slip.

183 Following the April 1989 flood experience, subsequent revisions of the W&S Manual identified gate closure strategies that would reduce bank slumping by mirroring the natural flood recession.

184 During the January 2011 Flood Event, that drawdown sequence was observed. I refer to paragraph 357 of my first statement and to the graph showing dam inflows and outflows. One can note that from approximately 9:30pm Tuesday 11 January 2011, the outflows were reduced at a similar rate to the reduction in the inflows so as to reflect the natural recession of the water.

THE O'BRIEN SUBMISSION SECTION 14 - INCONSISTENCIES

14.1 Maximum Level in Wivenhoe

185 In section 14.1 of the O'Brien Submission, Mr O'Brien again refers to the automatic headwater gauge (station number 540177). I have dealt with that issue in paragraphs 149 to 153 above.

14.2 Non Damaging Flood Heights

186 In section 14.2 of the O'Brien Submission, Mr O'Brien again refers to the issue of the 'non-damaging flood level' for Brisbane and asserts that there is a discrepancy between the W&S Manual reference to 4,000m^3/s and the BCC's Brisbane River Flood Study from 2006.

187 I have dealt with this assertion in paragraphs 83 to 91 above.

14.3 Fuse Plug Flow Rates

188 In section 14.3 of the O'Brien Submission, Mr O'Brien compares the release rates set out in table 10.2 in the W&S Manual with the release rates in Appendix J.

189 The release rates in Appendix J only apply in the case of a flood event where the fuse plugs have previously been initiated (but not yet replaced). Appendix J does not apply, for example, where the fuse plugs are initiated during an event (i.e. you do not move from reference to table 10.2 to Appendix J if the fuse plugs are initiated).

190 Mr O'Brien suggests that the figures in Appendix J are incorrect because the "discharge" rates in Appendix J are less than the addition of the figure in table 10.2 (gate releases) and the figure in Appendix C (auxiliary spillway releases) for the same lake level.

191 The example Mr O'Brien uses is releases at 76.0m AHD. He calculates that the rate of release for EL76 in table 10.2 (10,340m^3/s) plus the auxiliary spillway release at 76.0m AHD in Appendix C (9,033m^3/s) totals 19,374m^3/s. He then asserts that "discharge" for 76.0m AHD in Appendix J is 11,530m^3/s, and notes that this is greatly less than 19,374m^3/s.

192 However, that figure is not correct because Appendix J provides that the discharge rate of 11,530m^3/s is for lake levels greater than 76.8m AHD, not at 76.0m AHD.

193 However, the comparison is also wrong due to the fact that the reference to "discharge" in Appendix J is the discharge from the gates only, not the discharge from the gates combined with the auxiliary spillway. The purpose of Appendix J is to guide the Duty Flood Operations Engineers in respect to what the gate release settings should be when the fuse plugs have been initiated. It does not set out the full rate of release from Wivenhoe Dam (that is, gate release plus the auxiliary spillway release).

194 Accordingly, the O'Brien Submission misinterprets the W&S Manual references in Appendix J.

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 11th day of April 2011 in the)

presence of:)

[redacted] .....

Signature of the declarant

[redacted] .....

~~Justice of the Peace~~/ Solicitor/

~~Commissioner for Declarations~~