Statement of Gavin Ross Blakey

I, **Gavin Ross Blakey OAM,** Principal Engineer Stormwater Infrastructure, Asset Management Branch, Brisbane City Council, of 266 George Street, in the State of Queensland, state on oath as follows:

1. For the purposes of preparing this Statement I have, in my position as Principal Engineer Stormwater Infrastructure of the Brisbane City Council (**Council**), had access to:

   (a) the documents specified in paragraph 13 of this Statement; and

   (b) Council officers,

   to obtain information to provide this Statement. Unless otherwise stated, the matters set out in this Statement are based on my own knowledge and the information derived from the above sources.

Qualifications and Background

2. I hold the qualification of Bachelor of Engineering, am a Chartered Professional Engineer (CPEng) with Engineers Australia, and am a Registered Professional Engineer in Queensland (RPEQ).

3. I have been a qualified civil engineer for 29 years.

4. I have held my current position since 2007. My previous positions within Council have included:

   (a) 1999 - 2005: I held the position of a senior engineer in the Water Resources Branch and one of my primary roles was responsibility for flood management strategy and policy, under the direction of the senior manager responsible for water resources. Mr Barry Ball held that position over the period relevant to this statement; and

   (b) 2006 - 2007: I held the position of Principal Officer Stakeholder Engagement in the Water Resources Branch.

5. My precise title and role from time to time as a Council employee is set out in full in Attachment "**GRB-01**".

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Introductory Observations

My involvement in Council's flood study issues

6. I am aware that the Queensland Floods Commission of Inquiry (**Commission**) is investigating the circumstances surrounding the various river flood studies prepared for Council, starting from about 1996.

7. Prior to about April 1999, my role in the flood studies area within Council was filled by Mr Laurie Vosper. I was not, therefore, directly involved in:

   (a) the process leading to the 1998 report of Sinclair Knight Merz (**SKM**);

   (b) the immediate response to it (including obtaining a review from Professor Mein in December 1998); or

   (c) the initial commissioning of work reviewing the SKM 1998 work by City Design which lead to the draft June 1999 report.

8. However, on taking over management of the flood study process, I reviewed the file and those reports to obtain an understanding of the issues.

9. As part of my role as a senior engineer in the Water Resources Branch, I was directly involved in issues relating to Council's flood studies over the period 1999 to 2005. Based on the files I have reviewed (see paragraph 13 below), my direct involvement began in about April 1999. At that stage, early drafts of the June 1999 City Design draft report were being reviewed by Water Resources (then called Waterways Branch).

10. For most of the time from about April 1999 until I left my flood management role in Water Resources in 2005, I was the principal engineer responsible for managing Water Resources' processes concerning the various flood studies and related steps. I carried out this role under the supervision and direction of Mr Barry Ball, then manager of the Branch. Mr Ball occupied the equivalent position to that now occupied by Ms Julie McLellan.

11. My role over the relevant period could be best described as being that of a policy manager. I was responsible for ensuring that policy decisions about flood study issues were carried out. The policy decisions themselves, however, were not made by me. Mr Ball was closely involved in all such decisions and from time to time discussions occurred which involved members of the administration. I became more involved in this aspect in the later part of the period of my involvement. Also, within Water Resources itself there were frequent informal

discussions between the senior engineers, primarily Mr Ball, Mr Peter Barnes, and Mr [redacted] (a senior engineer in Water Resources with flood modelling expertise) and me, as to policy issues and responses to the various reports and events. Unless there was a formal meeting convened or some contemporaneous email, it is rare that there would be any record of such discussions. However, where processes were put in place or significant steps taken, they were invariably the result of consultation with, or direction from, at least Mr Ball. I also must emphasise that it is entirely possible that decisions were made and steps taken from time to time which I was not involved in. In that regard, my recollection is that Mr Ball was generally the one who dealt with the Councillors, the Lord Mayor's Office (**LMO**) and the Chief Executive Officer (**CEO**), particularly prior to September 2003.

12. I am a civil engineer. I am not a flood hydrologist and do not have special expertise in flood modelling. However, I have a good understanding of that area of engineering and had a sufficient understanding to be able to discuss such matters with specialists and to understand issues arising from flood studies.

Relationship between this statement and Ms McLellan's statement

13. I have been shown a copy of a requirement to provide a statement issued by the Commission to Ms McLellan (the **Requirement**). Attachment **"GRB-02"** is a copy of the Requirement. I have been informed by solicitors for Council that Ms McLellan's statement includes as an exhibit a 17 volume chronological bundle of documents relating to the flood study issues over the period covered by the Requirement (the **Bundle**). In the time available to me, I have reviewed, to the extent time permitted, Volumes 7 - 10 and 13 - 15 of the Bundle. These Volumes generally cover the period in which I was involved in the flood studies issues. References to documents in the Bundle in this statement are listed with page and volume numbers where possible or are otherwise attached.

14. The Requirement contains a number of questions relating to flood studies issues. I understand from Council's solicitors that Ms McLellan's statement will attempt to address these questions primarily by reference to the documentary record. I have been asked by Council's solicitors to focus in this statement on some specific matters and particular Questions in the Requirement. I have not attempted to provide details about every document or every step which I was involved in. I am happy to comment further on particular matters, to the extent I have a recollection separate from the documents, if asked.

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15. While parts of this statement touch on Questions 1 and 2 of the Requirement in relation to some of the later reports, I address directly in this statement, to the extent I am able, Questions 6 - 9 and 12 - 16 of the Requirement.

The division of responsibility between City Design and Water Resources (previously Waterways)

16. I consider it helpful to explain the relationship between City Design Branch and Water Resources Branch and their differing responsibilities over the relevant period in order to provide context to the events surrounding the various flood studies.

17. There was a division of technical and policy responsibility introduced as part of a reorganisation of Council's administration structure which occurred in about 1997. Prior to that reorganisation, technical and policy responsibility for, amongst other things, flood management and policy, lay with the old Department of Works.

18. As part of the reorganisation, the Waterways Branch (now Water Resources Branch) was created and made responsible, among other things, for the development and implementation of water resources policy for Council, including in respect of issues such as flooding and flood immunity levels. City Design (now City Projects Office) was created and made responsible for technical work in respect of water issues generally and flood modelling in particular. It is convenient in this statement to refer to City Design and Water Resources.

19. In the area of flood studies and similar work, the relationship between Water Resources and City Design was (and is) that Water Resources would commission particular work from City Design and consult with City Design on technical issues. However, Water Resources would be responsible for the policy implications and policy recommendations arising from that work.

20. City Design was not the only source of technical work and advice relied upon by Water Resources. Water Resources also commissioned technical work from external consultants. The judgment whether, and to what extent, to commission work from inside Council or from external consultants was decided on a case by case basis.

The June 1999 City Design draft report

21. As I understood it, the June 1999 City Design draft report (**CD June 1999**) had been commissioned by Water Resources to review the SKM study of June 1998 (**SKM 1998**) to take into account certain matters raised by Professor Mein in his 1998 review of SKM 1998 (**Mein 1998**) which indicated that SKM 1998 was likely to be an overestimate of Q100.

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22. Although I was not involved in engaging City Design for this work, it is likely that it was done consistently with the administrative arrangements described in paragraphs 16 to 20 above. I have been referred to a document which appears at page 2481 in Volume 3 of the Bundle. That document reflects informal instructions to City Design from Mr Vosper for further work. While I cannot speak for Mr Vosper, I consider there is nothing unusual about entrusting this kind of work to City Design, who in my view had and still have considerable technical expertise. This answers, at least in part, Question 6 of the Requirement.

23. I was involved in the review of CD June 1999 along with Mr Barnes and Mr Ball (and possibly others). I recall our concern was that CD June 1999 had not fully addressed issues raised by Professor Mein in Mein 1998. Though I cannot now recall the detail of all the matters which we considered had not been fully addressed, one matter which was of continual concern through the process was the areal reduction factor issue.

24. It appears that I had a meeting with Mr Ball on 13 July 1999, soon after receipt of CD June 1999. Notes of that meeting appear at page 2741 in Volume 8 of the Bundle. We also had a meeting involving Mr Barnes and Mr Rahman at which we discussed those matters. The consequence of those meetings was an action plan prepared by me and a decision to retain City Design to do more work on specific issues.

25. While that decision was ultimately Mr Ball's, the view that further work ought to be undertaken for the reasons noted in the previous paragraph was one which we probably all shared, and certainly I did. I have been referred to a Meeting Agenda and Action Plan handwritten by me which are the documents appearing at pages 2746 and 2743 - 2745 in Volume 8 of the Bundle, respectively. I have also been referred to a document appearing at page 2814 in Volume 8 of the Bundle. This document is the formal proposal from City Design dated 15 September 1999 for the further work which shows the additional matters which we considered required investigation. Although I do not specifically recall this, it seems a decision to instruct City Design to do further work was reached, probably by Mr Ball in consultation with me, Mr Barnes and Mr Rahman. This responds to Question 7 of the Requirement.

26. I do not recall whether we approached the CEO (at the time it was likely to be Mr Rob Carter), the LMO or Councillors specifically about the decision to commission further work from City Design on the SKM 98 study. However, there was a meeting with Councillor Quinn and others on 5 May 1999 which I attended. At that time, we had an earlier draft of CD June 1999. I had only just become involved in the flood study issue at the time. I do not have a detailed

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recollection of the discussions on that occasion. I have been referred to a PowerPoint document which appears at pages 2677 - 2681 in Volume 8 of the Bundle. I have, reviewed that PowerPoint presentation which has some handwritten notes. Those notes are mine. Having reviewed the notes, my recollection is that Mr Ball presented a summary along the lines set out in the PowerPoint regarding where the flood study process had reached. The substance of what he said was that, though the reports to date indicated that the Q100 flow and level were higher than presently provided, we remained concerned that the work to date had not fully addressed the issues raised by Professor Mein and that the estimates could well be overestimates.

27. I do not recall that we said that further work was to be commissioned. However, I have been referred to a document which appears at page 2682 in Volume 8 of the Bundle. This is a diary note of mine dated 5 May 1999 recording a discussion with [redacted] a senior engineer in City Design raising the issues which became the subject of the later engagement for further work, and so it is entirely possible that these matters were raised with Mr Quinn and others. I do recall that the conference was relatively short. I have noted the comment I wrote at the bottom of the PowerPoint presentation to the effect that "*Tim Quinn will talk to the Lord Mayor*". I do not know whether that happened or not. However, Mr Ball was involved in the direct dealings with the administration in respect of the flood issues at this time.

Questions 8 and 9 of the Requirement

28. I have been asked to comment directly on these Questions. I do so as follows.

29. As to Question 8, I have set out a summary of how Water Resources responded to CD June 1999. Further, following receipt of the additional work, the City Design advice and its conclusions were further considered by Water Resources leading to a workshop held on 6 October 2000. It emerged at the workshop that DNR was undertaking work which was of significance to the flood study issues. I explain below that I personally followed up this DNR study frequently over the following years. While the report foreshadowed at that meeting was never provided, we did receive the data needed on rainfall and dam operations on 27 June 2003. Once received, SKM was retained, along with the Independent Review Panel (**IRP**), to provide an authoritative view on Q100.

30. While all those steps were not specifically in response to the statement referred to in Question 8, it was always my view that the issues raised by the City Design work and SKM 1998 were very important matters which needed to be pursued to a final conclusion.

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31. Further, I refer above to the division of responsibility between City Design and Water Resources. The subject of Question 8 is a statement of policy. While I had (and have) great respect for the technical ability and opinions of my colleagues in City Design, it was ultimately a matter for Water Resources to make the judgment as to whether, and when, to recommend to Council that the Q100 be altered.

32. As to Question 9, no further flood studies were initiated because we were awaiting the data and outcome of the DNR work raised at the 6 October 2000 workshop. We had no idea that it would take so long for that data to be provided and I note that the report mentioned does not appear, to my knowledge, to have been finalised. There was no point in pursuing further studies until that data was able to be worked into the final analysis.

The December 1999 City Design draft report

33. On receipt of the December 1999 City Design draft report (**CD December 1999**), I noted that the SKM 1998 estimate of Q100 had been further reduced. CD December 1999 revised the Q100 flow down to 8000 cumecs from the 8600 cumecs estimated in CD June 1999. This tended to confirm to us that SKM 1998 had overestimated Q100.

34. Once we had considered CD December 1999, it remained our view that it had not fully addressed some of Professor Mein's recommendations. The matter which particularly comes to mind is the issue of areal reduction factors. While CD December 1999 had addressed the areal reduction factor issue to some degree, I recall that we did not consider that the approach adopted had sufficiently addressed the issue. This is not to say that we did not recognise that the document did address some factors sufficiently. For example, we noted the analysis of the various starting supply levels for the Dam, and ultimately took the view that it was appropriate to assume FSL for the flood study for the reasons that City Design gave (notwithstanding that it was thought to be a slightly conservative approach at the time).

35. Unlike past occasions, however, we did not engage City Design to do further flood modelling. In effect, our view was that we needed to consult with other key agencies involved in flood modelling and flood estimates to try to determine the best way in which to address the outstanding issues and to reach a robust conclusion, consistent with best engineering practice, on this important issue for the City.

36. Accordingly, we decided to convene a technical workshop involving officers from the key agencies. I do not recall the meeting or discussion in which that decision was made, but I refer to my note to file of 12 April 2000 (appearing at page 3022 of Volume 9 of the Bundle) which

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is the first document in the Bundle which refers to a workshop. We undertook a substantial amount of preparatory work for that workshop, including engaging directly with agencies like BoM, Ipswich City Council and so on to identify the status of any work which they were engaged in. I recall that there were many activities underway with the various agencies around this time. We also undertook inquiries with South East Queensland Water Corporation (**SEQWC**) seeking further detail on dam operation procedures. Further, it was necessary to find a time when all the experts were available to attend. Ultimately, the workshop went ahead on 6 October 2000.

The 6 October 2000 workshop and its consequences

37. The workshop identified key issues to enable the finalisation of the Brisbane River flood study. As I recall it, of particular significance was that Mr John Ruffini of DNR informed us that DNR was carrying out its own study using, amongst other things, revised rainfall data and modelling for Wivenhoe Dam's gate operations. I also recall that he said words to the effect that DNR's study was suggesting Q100 flows were more likely to be closer to the Q100 calculated in the 1984 Report (which estimated Q100 at about 6800 cumecs) rather than the Q100 contained in the 1992 DNR Report (which estimated Q100 at about 9500 cumecs). I also recall that Mr Ruffini said that the DNR study was likely to be available in December 2000. I was under the strong impression that the DNR study was going to give a Q100 flow close to the existing Q100 of 6800 cumecs.

38. Given this information, we formed the view that the best course was to await the completion of the DNR study. We formed that view because:

(a) it appeared to us that the further data which would be available as part of the DNR study was data which would allow a better and more robust estimate of Q100 to be developed;

(b) it appeared to us that the DNR work would address Professor Mein's recommendations, especially in respect of areal reduction factors; and

(c) there would be a relatively short wait until the study was available.

39. Thereafter, I followed up on the DNR study on numerous occasions over the ensuing two and a half years. I have been referred to the list of approaches made by Council to DNR and SEQWC in that regard, which shows over 20 occasions over the period up to June 2003. My clear recollection is that DNR indicated that the study was close to completion on a number of

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occasions, only to have that date pass. The matter was finally resolved in June 2003. As I discuss below in paragraph 45, we were able to obtain the data we required at that time.

Independent Review Panel Report (IRP Report)

40. The IRP Report was of particular significance to Council. Not only did it deal with the important question of the Q100 flow and level, but I recall that at that time there was acute public interest in those matters by reason of the *Courier Mail* reports which preceded the IRP Report.

41. In this part of my statement I will set out my recollection of the process followed in preparing the Terms of Reference for, and responding to, the IRP Report and the policy decisions made in that regard. These matters are generally relevant to Questions 12, 13 and 14 of the Requirement, which I specifically address where indicated below. Before continuing, however, I wish to refer to my draft Report dated March 2004 (**March 2004 Report**). I prepared the March 2004 Report because, given that the events were contentious, I thought it a useful exercise to record the information relevant to the flood studies and related events as I understood it at the time. So far as I am aware, my March 2004 Report is an accurate summary of events up to that time, as I understood them to be. Attachment "**GRB-03**" is a copy of that report.

Preparation of the Terms of Reference to the IRP

42. I refer to the Terms of Reference (**TOR**) set out at pages 25 to 27 of the IRP Report. I recall that I was primarily responsible for drafting the TOR, but would have done so based on discussions with Barry Ball, Peter Barnes and Doug Yuille of the Lord Mayor's Office. Mr Yuille was the Lord Mayor's policy adviser upon, amongst other things, flood management.

43. An important part of the TOR is the chronology of events covered in the Background section and the "Brisbane River Flood Study Chronology of Events". I drafted those sections. For the events prior to 1999, I had regard to Council files and discussions with Council officers who had been involved with those projects.

44. I have been asked about the comment in the last sentence of the "Background" section of the TOR to the following effect:

Even if the Q100 changes from 6,800m³/s, it is likely that the Development Control Level will remain the same as is currently used in the Brisbane City Plan.

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45. This comment was included by me because in June 2003 we had received advice from DNR that led us to expect that the likely Q100 flow in the Brisbane River was between 6,000 and 7,000 cumecs. At the time, I considered that that estimate was likely to reflect the outcome of the further work being carried out by SKM and the IRP. I also recall that at the 6 October 2000 conference, Mr Ruffini had said something similar as discussed above. The current Q100 of 6800 cumecs was within that range and I wished to clarify to the IRP that even if the Q100 flow determined by them was *less than* the existing Q100 flow, it was likely that the Development Control Level would *not* be *reduced*. This provided, in our view, an appropriately conservative approach.

46. This matter tends to be confirmed by the last paragraph contained in the Chronology in the TOR. It provides:

On Friday 27 June 2003, BCC received preliminary advice from DNRM that the Q100 flood flows at Brisbane Port Office would be between 6,000 and 7,000 m³/s. This affirmed that the preliminary estimate from early reports was likely to be an over-estimate. This is consistent with their advice from the October 2000 workshop and from contact with DNRM since then.

47. This is a reference to the provision of the data which I discuss in paragraphs 37 and 38 above. This paragraph of the TOR is confirmed by a file note (appearing at Page 3632 of Volume 11 of the Bundle) which was either prepared by me or one of my staff and dated 27 June 2003, which states as follows:

Results of NRM Modelling for the Brisbane River

Natural Resources and Mines have completed some modelling of Q100 flood discharge for the Brisbane River Catchment. The current best estimate of the Q100 flood discharge at Moggill from this exercise is 6600m³/s. Based on this data, we would expect a figure within the range of discharge between 6000 and 7000 m³/s at the Port Office Gauge.

48. Immediately following that file note in the Bundle is some material printed out from a CD ROM which I recall was provided by John Ruffini of DNRM. It bears a handwritten annotation identifying the date as 27 June 2003 which is in my writing and is consistent with the diary note. The printout material appears at Pages 3633 - 3639 of Volume 11 of the Bundle. That material includes a printout of a list of outputs from the DNRM model showing flows for various runs at specific locations along the River. It shows, relevantly, a peak flow at Moggill of 6580 cumecs, a point highlighted by an arrow which I marked on the document. The printout relates to the Q100 event.

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49. Having seen those documents, my recollection is that I went to see Mr Ruffini on 27 June 2003 and he gave me the CD ROM and told me what I had recorded in my file note.

50. These documents confirm my clear recollection that at the time we were preparing the TOR it was not in our contemplation that the further work being undertaken was going to lead to an estimate of Q100 flow which differed significantly from the then current 6800 cumecs. Indeed at the time we were of the understanding that it was in the range of 6000 to 7000 cumecs as provided to us by DNRM. If, contrary to our expectations, the IRP recommended an estimate of Q100 flow which exceeded the then current flow to some material degree, I have no doubt that Water Resources would have recommended to Council that the development control level be reviewed upwards to a level consistent with that revised Q100 flow. I am confident of this because the purpose of obtaining the IRP Report was to provide authoritative guidance on the best estimate of Q100.

Council's Response to the IRP Report

Summary of recommendations made by Water Resources

51. As noted earlier, the IRP Report was an important one, so there were a number of informal discussions within Water Resources, particularly between Mr Ball, Mr Peter Barnes and me, on the question of how to respond to it. I also recall that there were some discussions with Panel members. The file shows that I had discussions at least with Professor Mein, the Chair of the Panel. Few of those discussions were recorded in diary notes, especially discussions internally. Many would have occurred in an informal manner. I note from the Bundle, however, that there are notes made by me of some discussions with Professor Mein.

52. The priority on receipt of the IRP Report was to develop a policy response on three matters:

(a) What change to make, if any, to Council's existing Q100 flow and Q100 level at the Port Office gauge as a result of the IRP Report;

(b) What change to make, if any, to Council's development control levels over the length of the River as a result of the IRP Report; and

(c) What further work ought to be undertaken prior to making those decisions given the recommendations by the IRP Report for further work.

53. The recommendations made to the Establishment & Coordination Committee of Council (**E&C**), and adopted by it and by Full Council, were:

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(a) to adopt the IRP's best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 cumecs (m^3/sec);

(b) that the current adopted flood immunity level of 3.7m AHD at the Brisbane Port Office gauge is still the most appropriate level, and that this level become known as the defined flood level; and

(c) there is no need to change current development levels for properties adjacent to the Brisbane River

Presentations to E&C Strategy and to E&C

54. In developing its recommendations about the IRP Report, Water Resources consulted from time to time with E&C Strategy. At that time, E&C Strategy was an informal convening of the E&C Committee which could be approached by Council officers to make presentations on policy issues and obtain guidance as to the appropriateness of the course contemplated by Council officers on a particular issue.

55. There were a number of presentations to E&C Strategy made in the course of development of the recommendations set out in paragraph 53. No formal minutes were kept of such presentations at the time, though I often prepared PowerPoints and sometimes hand written notes. There were at least two such presentations:

(a) The first presentation was on 8 September 2003. This was five days after the IRP Report was produced. The documentation prepared to brief E&C Strategy and an informal minute of the meeting which I have been able to locate appears at Pages 4513 - 4517 of Volume 13 of the Bundle. I note the strategy presentation refers to a visual presentation. Attachment **"GRB-04"** is a copy of that presentation. The informal minute notes the acceptance of the IRP Report and the need for further consideration of its implications for planning purposes. Pages 4508 - 4510 of Volume 13 of the Bundle is a handwritten note I made of the presentation which notes, relevantly, that Professors Mein and Apelt attended (I recall they attended the 7 September 2003 meeting with the Press on the previous day as set out in paragraph 81 - 83 below and stayed on for the E&C Strategy meeting).

(b) The second presentation was on 27 October 2003. The presentation focused on setting the planning policy response to the IRP report. Pages 4703, 4715-4735 and 4736 of Volume 14 of the Bundle are documents relevant to this meeting. Of

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particular note is the PowerPoint presentation headed "Brisbane River Flood Study - E&C Strategy Presentation" which, among other things, recommended adoption of the best estimate of Q100 provided by the IRP Report and maintaining the existing development control levels (i.e. to be based on the 6800 cumecs) as the appropriate development control level.

56. I recall that E&C Strategy endorsed and supported the recommendations developed by Water Resources.

57. On 24 November 2003 there was a submission to E&C which sought approval of the recommendations in paragraph 53. Pages 4812 - 4822 of Volume 14 of the Bundle is a copy of the approved submission to E&C. The E&C's recommendation was approved by Full Council on 2 December 2003 (see pages 4832 - 4835 of Volume 14 of the Bundle).

Reasons for recommendations

58. The reasons for the above recommendations were broadly as follows.

Confirmation of the existing flood immunity level at the Port Office gauge

59. *First*, the IRP Report advised that there was a sufficient basis for Council to determine that the existing flood levels were broadly acceptable. The context of the Panel's advice is important. The IRP Report at page (i) provided as follows:

" *The Panel:*

(i) *have reviewed the methodology used by SKM to determine the Q100 river flow and level;*

(ii) *believe that the appropriate technical processes have been followed in this study;*

(iii) *based on the evidence available, is of the view that, for the Brisbane Port Office, the best current estimates for*

- *the Q100 flow is 6000 m³/s*
- *the Q100 level is 3.3 m AHD*

There is an inevitable degree of uncertainty in any estimates of this kind; in this case, heightened by the variable influence of the Somerset and Wivenhoe Dams on different storm events on the Brisbane River Catchment. A quite plausible range for the Q100 flow is 5000 to 7000 m³/s and for the Q100 level, 2.8 to 3.8 m AHD. It seems certain that the position of the

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best estimates in the respective ranges can be more precisely determined, and the width of these ranges could be significantly reduced, with further investigation as outlined in Section 5.2 of this report.

The Panel notes that the current 'best estimates' of Q100 and the corresponding flood level at the Port Office provide a sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable. However, for general flood risk assessments and risk-based flood management decisions, more refined flood frequency estimates will ultimately be required."

60. Further in Section 5.1 and 5.2, the IRP Report states:

"With respect to its Terms of Reference, the Panel:

(i) have reviewed the methodology used by SKM to determine the Q100 river flow and level;

(ii) believe that the appropriate technical processes have been followed in this study;

(iii) based on the evidence available, is of the view that, for the Brisbane Port Office, the best current estimates for

- *the Q100 flow is 6000 m^3/s*
- *the Q100 level is 3.3 m AHD*

There is an inevitable degree of uncertainty in any estimates of this kind. The Panel believes the possible range for the flow to be 5000 to 7000 m^3/s; for level to be 2.8 to 3.8 m AHD.

The Panel notes that the current 'best estimates' of Q100 and of the corresponding flood level at the Port Office, provide a sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable. However, for general flood risk assessments and risk-based flood management decisions, more refined flood frequency estimates will ultimately be required."

5.2 Recommendations for Further Work

a) The SKM 2003 study has demonstrated the very significant effect of assumed storm variability on the estimated post-dams flows at the Port Office. The Panel believes that this variability could be reduced if a similar study was conducted, but using Monte Carlo methodology to simulate the possible combinations of storm temporal and spatial patterns (instead of seven observed storms). Such a study could also

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properly estimate and account for the correlations between event occurrence, losses and reservoir drawdown (instead of using fixed average values). The Panel strongly recommends that such a study be done as Council moves towards a risk-based approach to flood management.

b) *More confidence would be engendered in the results if there was a better match between the flood frequency analysis of observed data and the estimates obtained from the rainfall-based RAFTS model. The current variance of around 20% is not desirable. Given the importance of runoff volume in a situation involving large dams, the Panel recommend that:*

(i) *Calibration of the RAFTS model be re-visited with the view to reducing the variance with FFA outcomes to within acceptable bounds.*

(ii) *Frequency analysis of event volumes be carried out, and compared with run off volumes predicted by the RAFTS model from design rainfalls of corresponding frequency.*

c) *The MIKE11 model of the Brisbane River should be calibrated throughout the length of the river within Brisbane City to provide good estimates of flood levels throughout.*

d) *Consideration should be given to including the effect of tidal variation of flood levels in the estuarine zone. This would involve a Monte Carlo type analysis to examine the joint probabilities of flow-rates and tide height.*

e) *The DNRM model for simulating the expected operation and effect of Wivenhoe and Somerset Dams on flood flows, and associated data, should be independently reviewed when the DNRM final report is made available.*

61. The existing Q100 flow and level at the Port Office gauge as at the date of the IRP Report was 6800 cumecs and 3.7m AHD, respectively. As can be seen from the above references, the IRP Report advised that the further investigations recommended in Section 5.2 would facilitate the narrowing of the plausible ranges for the Q100 flow and level and the best estimate of those figures within the range. However, as Council's existing Q100 flow and level were, in effect, at the very top of the plausible ranges for both flow and level, we considered that it was not necessary to undertake that further work before deciding to retain the existing Q100 flow and level. It was for that reason that we thought it appropriate to recommend that Council maintain

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the existing flow and level without it being necessary to undertake the further work recommended.

62. My reference to "we" above is intended to be a reference primarily to Mr Ball and I. However, as I have said, there were probably informal discussions with other senior engineers in Water Resources about this issue. I do not recall discussing this matter with City Design, although City Design was consulted about the appropriateness of a Monte Carlo analysis around this time as I set out in paragraph 85 below.

63. I do not have an independent recollection of discussions with members of the Panel to the effect that it was appropriate to confirm the existing levels without first carrying out the further work, but I have identified in Council's records a diary note written by me dated 5 September 2003 of a discussion involving Mr Ball, Professor Mein and me (see Pages 4495 and 4496 of Volume 13 of the Bundle). I know Professor Mein was there because of the references to "*Russell*". Russell is Professor Mein's first name and the notes appearing next to that name record the substance of statements by Professor Mein.

64. I refer in particular to my note as follows on the second page:

"*Russell believes that we shouldn't change DCL. Peak flows will go up dramatically. 6800 is in range 5000 - 7000 – need to look at frequency curve.*

Current DCL about right, would need to do Monte Carlo. Not enough evidence to shift DCL."

65. This note records Professor Mein affirming that the existing Q100 level (referred to in that note as the "*DCL*": Development Control Level) was about right. I am not sure now what the reference to "*peak flows will go up dramatically*" means, but it cannot have meant that the Q100 would be increasing as that would have been inconsistent with both the statements in the note and in the IRP Report. Given the timing of this conversation (immediately afterthe IRP Report was finalised), it is highly likely that this discussion occurred as part of our decision process in respect of recommendations as to the response to the IRP Report.

Confirmation of existing river profile

66. *Second*, a Q100 level for the Port Office does not provide all the information needed for planning purposes along the length of the River. It is necessary to convert that level into a river profile from which development control levels can be derived at points upstream and downstream of the Port Office gauge. At the time the IRP Report was provided, the river profile used by Council was, as I understand it, that prepared by Mr Hegerty, a Council

engineer, in about 1988. It was necessary to decide whether to alter this profile using the Mike 11 hydraulic model developed by SKM or to maintain the existing profile (based on a Q100 flow at the Port Office gauge of 6,800 cumecs). Our recommendation was to persist with the existing profile.

67. Our reasons for making that recommendation were:

(a) As explained in paragraph 61 above, the existing river profile was derived from a level at the Port Office which was at the upper end of the plausible range for the Q100 level determined by the IRP. Accordingly, it was reasonable to expect that the existing river profile would provide levels which were also at the upper end of the plausible range for Q100 levels; and

(b) While it was possible that there would have been some change in the river profile if the Mike 11 profile was adopted, it was unlikely to be significantly different. It did not seem to us that the possible minor changes in the development control levels justified the expense and inconvenience to Council and the ratepayers which would have accompanied a minor alteration to long-standing levels.

68. A comparison of the DFL profile and the Mike 11 profile based on a Q100 flow of 6000 cumecs was undertaken at the time recommendations were being developed for consideration by Council to check if the expectations described in paragraph 67 were correct. I refer in that regard to the submission to E&C approved on 24 November 2003.

69. I refer in particular to attachment B to that submission which shows a comparison of the (then) DFL profile and the Q100 profile based on the 6000 cumecs advised by the IRP Report. It can be seen that the DFL is above the Q100 profile, usually well above it.

70. I refer to the SKM Reports referred to in paragraph 75 below. I note that the IRP Report recommended calibration of the Mike 11 model and that this was undertaken by SKM by, at the latest, 23 December 2003 when they provided the calibration report and the flood levels based on 6000 cumecs based on the recalibrated model (see Appendix E to the report). I am not certain whether the profile for 6000 cumecs was based on the Mike 11 model after the calibration work referred to was carried out or not. The fact that the formal report postdates 23 November 2003 does not mean that the work was not available from SKM at an earlier time. However, I note that the comparison profiles used in the 24 November 2003 E&C presentation were the same as used on 27 October 2003. I have been referred to the document appearing at Pages 4677 - 4680 in Volume 14 of the Bundle. This document is a spread sheet

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which appears to be the source of those profiles. It seems likely it was prepared based on the Mike 11 model prior to calibration.

71. I do not know if the comparison of the profiles was revisited after the recalibration of SKM's Mike 11 model as set out in their recalibration report of 5 February 2004 referred to below. However, I refer to the first statement of Jeffrey Secker sworn 13 October 2011 and in particular to "JDS-2" which plots amongst other things the river profile for the DFL and for "the Existing Q100". I have been informed by Mr James Charalambous, one of Council's flood engineers who was involved in preparing JDS-02 that the profile plotted on that graph as the existing Q100 is the profile derived from the recalibrated Mike11 model run for a flow of 6000 cumecs. It can be seen from JDS-02 that the profile for 6000 cumecs based on the recalibrated Mike11 model is also clearly below the DFL over the whole of the relevant river profile.

The Recommendations for Further Work

72. I refer to section 5.2 of the IRP Report which is set out in paragraph 60 above. I also refer to paragraph 61 above, where I observe that it was our view that the Panel were recommending the steps in section 5.2 as a way of narrowing the plausible range and refining the best estimate, rather than as a necessary step before making policy decisions. That consideration provides the background to our approach to those recommendations.

73. However, there are some more specific comments that I can make about the response to those recommendations as follows.

74. It is convenient to deal firstly with the recommendations in paragraphs (c) and (e).

Paragraph (c): Calibration of the Mike 11 model

75. The Mike 11 model was recalibrated as recommended. A copy of SKM's report dated 5 February 2004 titled *Recalibration of the MIKE11 Hydraulic Model and Determination of the 1 in 100 AEP Flood Levels* appears at Pages 5125 - 5219 of Volume 15 of the Bundle. Council also obtained from SKM calculations of floods for Q10, Q20, Q50 and Q2000. A copy of SKM's report dated 6 July 2004 entitled *Calculation of Floods of Various Return Periods on the Brisbane River* appears at Pages 5347 - 5371 of Volume 15 of the Bundle.

Paragraph (e): Review of the DNRM model when final report available

76. Council had been waiting for DNRM to prepare the final report on the operation and effects of the dams on flood flows since October 2000. I had personally followed this up on numerous

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occasions, both before and after 2003. The Final DNRM report was not provided prior to the completion of the IRP Report. It was not provided over the period up to my move within Council to another area in 2005. I do not know if a finalised report has ever been produced.

Paragraphs (a), (b) and (d): Matters relevant to Monte Carlo analysis

77. I have already explained above that our view was that:

(a) the IRP Report indicated that the existing flood levels were broadly acceptable for planning purposes in the light of the estimates of Q100 in that Report; and

(b) the further work recommended, including the Monte Carlo analysis, was directed at refining the plausible range and the best estimate within that range.

78. Nevertheless, we did turn our minds more specifically to whether the Monte Carlo analysis should in any event be carried out.

79. The primary reason why a Monte Carlo analysis was not carried out was that it was considered by me and Mr Ball and Mr Barnes (both senior engineers in Water Resources), that the Monte Carlo analysis was at that time a methodology which was not sufficiently well developed, and certainly had not been developed to the stage where it was suited to reliably modelling a catchment as complex as the Brisbane River Catchment. While we thought that it would be an appropriate step to take in future, it was not one which was at the time likely to provide substantially improved information to Council, especially given the recommendation to retain the existing flood levels which were at the upper end of the plausible range for Q100.

80. My view in that regard was reinforced by the fact that, at the time, the Monte Carlo analysis went beyond the techniques for flood estimate outlined in the then current version of the *Australian Rainfall and Runoff*. In my view, the techniques adopted by SKM and referred to in *Australian Rainfall and Runoff* were accepted as the most appropriate engineering practice at the time.

81. I also recall that there was some discussion with Panel members about this issue to similar effect: i.e. that the Monte Carlo analysis was still in its early stages of application and that current best practice did not include such an analysis. I had a discussion with Professor Mein, who was the chairman of the Independent Panel, about this issue. My recollection of discussion to this effect is confirmed by notes which I have found of a press conference with the *Courier Mail* and others on 7 September 2003. **Pages 4508 - 4510 of Volume 13 of the Bundle**is a copy of my notes.

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82. I recall that press conference well. It was organised to allow Council to respond directly to the issues raised by the *Courier Mail* about Council's dealings with the Q100 over the preceding years. I note that in addition to Professor Mein, Professor Apelt was present from the Panel. Mr Ball and the Lord Mayor were also present.

83. At that meeting, Professor Mein observed (according to my notes referred to in paragraph 81 above) that the Monte Carlo approach was "*emerging; beyond best practice*" and "*unproven in practice*". These observations are consistent with my views expressed above and it is possible those views were informed, at least in part, by Professor Mein's opinion on the issue.

84. I have addressed the approach of Water Resources to the recommendations for Monte Carlo analysis. That analysis is specifically raised by recommendation 5.2(a) and (d) in the IRP Report. Further, it was our view at the time that the need for further detailed work on the hydrological model (see recommendation (5.2(b)) was not necessary or appropriate to undertake separately from a Monte Carlo analysis when it was ultimately undertaken.

85. I am aware that Mr Ball gave further consideration to undertaking a Monte Carlo analysis in around early 2004. I do not recall discussion about that myself, but I am informed by Mr Ken Morris of City Design and believe that shortly after the time of Council's resolution in December 2003 to retain the current development control level, he had a discussion with Mr Ball about whether to undertake a Monte Carlo analysis. Mr Morris has confirmed to me that he (Mr Morris) expressed the view to Mr Ball that it was his view that the Monte Carlo analysis was not worth doing at the time for the following reasons:

(a) in his opinion, the analysis tends to underestimate the best estimate of Q100 by approximately 20% due to technical limitations for a catchment like the Brisbane River such as the whether the correlation of variables could be sufficiently taken into account;

(b) in his opinion, the fact that the lack of information regarding rainfall prior to 1917 would limit the effectiveness of a Monte Carlo analysis.

86. During the period 2003 up to 2005 (when I left my role in flood policy) there was no review of the acceptable methodology in *Australian Rainfall and Runoff*. In fact the review of this seminal document is still underway and is likely to take up to two more years. As the adopted level corresponding to 6,800 cumecs is in the upper part of the plausible range of 5,000 to 7,000 cumecs, it was considered a conservative level. From my perspective, Council's focus

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in the following years was on flood risk management as a key mechanism to reduce the impact of flooding on people and properties.

Questions 12 and 13 of the Requirement

87. The matters in paragraphs 58 to 86 comprise the response to Questions 12 and 13 of the Requirement to the extent I am able to provide it.

Question 14 of the Requirement: Recommendations at page 48 of the SKM December 2003 Report

88. I now deal with Question 14 of the requirement to Ms McLellan. At page 48 of the SKM December 2003 Report (**SKM 2003**) (Pages 4918 - 5012 of Volume 14 of the Bundle) there are two recommendations made for further work in the following terms:

The following actions could be undertaken to further improve this analysis:

- *Undertake rainfall-runoff modelling in a Monte Carlo framework to explicitly consider the natural variations in spatial and temporal patterns of rainfall and variations in initial dam storage levels (other variables such as variable rainfall losses and gate failure likelihood can also be incorporated). This will provide the most robust estimate of Q100 that accurately reflects the combined influences of these stochastic factors.*

  It is noted that while undertaking rainfall-runoff modelling in a Monte Carlo framework is an accepted method, it is not a standard method for flood studies.

- *Re-calibrated the Ipswich City Council's MIKE11 hydraulic model within the Brisbane City Council Boundary.*

89. I do not specifically recall reading this report or its various preceding drafts, though I would have done so at some point. I do not recall turning my mind to the recommendations made in this report separately from the consideration given by my colleagues and me to the recommendations made in the IRP Report. However, it is plain to me that:

(a) the first dot point set out above is, in substance, the same recommendation to that made at 5.2(a) of the IRP Report; and

(b) the second dot point set out above is, in substance, the same recommendation as that made at 5.2(c) of the IRP Report.

90. Accordingly, while I do not specifically recall the recommendations, I would not have taken any particular action in relation to them separate from, or different to, the response to the recommendations in the IRP Report. Given those matters, it is not surprising that I have no particular recollection of separately considering these recommendations.

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Question 15 of the Requirement

91. I do not recall who gave the instruction to SKM to use the IRP Report best estimate of Q100 (of 6000 cumecs) for the work done in SKM's February 2004 report. However, so far as I am concerned, the reason that SKM was instructed to use that Q100 was likely to have been because that was the best estimate given by the IRP for the Q100 flow and it was the IRP, not SKM, to whom the Council was looking for authoritative guidance as to the figure to adopt for the Q100 flow. SKM's role in the process undertaken in mid-2003 was to provide technical input and analysis in consultation with and under the direction of the IRP. However, as I have said, it was the view of the IRP which Council intended to rely upon and did rely upon.

Question 16 of the Requirement

92. I refer to my answer given in the previous paragraph.

I make this statement conscientiously believing the same to be true, and by virtue of the provisions of the Oaths Act 1987 (Qld).

Dated 4 November 2011

Signed and declared by Gavin Ross Blakey at
Brisbane in the State of Queensland
this 4th day of November 2011
Before me:

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Signature of person before whom the declaration is made

[redacted]

Signature of declarant

MARK STEPHEN SAMMUT (SOLICITOR)

Full name and qualification of person before whom the declaration is made