

CLAYTON UTZ

**Brisbane City Council**

BCC

**Queensland Floods Commission of Inquiry**

Inquiry

**Statement of Gavin Ross Blakey  
- 4 November 2011**

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Our reference 12371/12282/80117397.002

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Date:

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Exhibit Number:

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## 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,

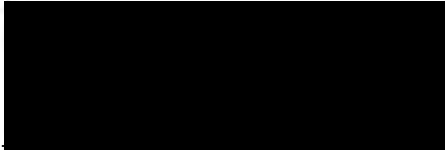
to obtain information to provide this Statement. Unless otherwise stated, the matters set out in this Statement are based on my own knowledge and the information derived from the above sources.

### 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**".



**Gavin Ross Blakey**



**Witness**

## 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

  
Gavin Ross Blakey

  
Witness

discussions between the senior engineers, primarily Mr Ball, Mr Peter Barnes, and Mr Khondker Rahman (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.

  
Gavin Ross Blakey

  
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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.

  
Gavin Ross Blaquey

  
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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 [REDACTED] for further work. While I cannot speak for [REDACTED] 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 [REDACTED] 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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Gavin Ross Blakey

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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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Gavin Ross Blakey

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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

Gavin Ross Blakey

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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 6,800m<sup>3</sup>/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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Gavin Ross Blaquey

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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 m<sup>3</sup>/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 6600m<sup>3</sup>/s. Based on this data, we would expect a figure within the range of discharge between 6000 and 7000 m<sup>3</sup>/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.

Gavin Ross Blakey

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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:

Gavin Ross Barclay

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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<sup>3</sup>/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

  
Gavin Ross Blakey

  
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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 m<sup>3</sup>/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 m<sup>3</sup>/s and for the Q100 level, 2.8 to 3.8 m AHD. It seems certain that the position of the*

Gavin Ross Blaney

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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<sup>3</sup>/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<sup>3</sup>/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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Gavin Ross Blakey

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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

  
Gavin Ross Blakey

  
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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 after the 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 [REDACTED] a Council

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 Gavin Ross Blakey

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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

Gavin Ross Blaney

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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.

Gavin Ross  

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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

  
Gavin Ross Blakey

  
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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:



Signature of person before whom the declaration is  
made



Signature of declarant

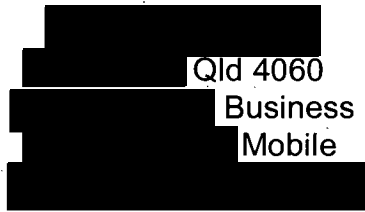
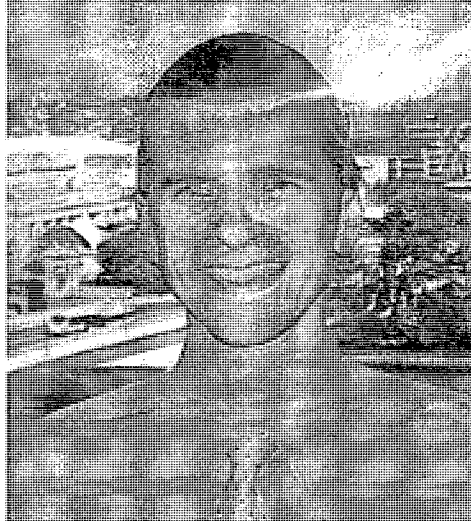


Full name and qualification of person before whom the  
declaration is made

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# CURRICULUM VITAE

## Gavin BLAKEY, OAM



### QUALIFICATIONS AND PROFESSIONAL AFFILIATIONS:

- MBA (Technology Management) (1999)
- Registered Professional Engineer of Queensland (1988)
- Chartered Professional Engineer, Engineers Australia (1987)
- Bachelor of Engineering with Honours (1982)
- Postgraduate Diploma in Management (1994)
- Certified Quality Improvement Trainer (1994)
- Order of Australia Medal (OAM) (2004)
- International President, Toastmasters International (2002-2003)
- Vice President, Toastmasters International (1999-2002)
- International Director, Toastmasters International (1994-96)

### SUMMARY OF CAREER:

- |             |  |
|-------------|--|
| 2010        | Subject Matter Expert (Asset Management)<br>Business and Systems Efficiency (BaSE) Program           |
| 2007 – 2010 | Principal Engineer Stormwater Infrastructure<br>City Assets Branch, Brisbane Infrastructure Division |

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2006 – 2007	Principal Officer Stakeholder Engagement Water Resources Branch, City Policy & Strategy Division
2005 – 2006	Principal Officer Flood Policy & Strategy Water Resources Branch, City Policy & Strategy Division
2005	Staff Exchange – working for BCC in Taiwan for 3 months
2002 – 2005	Principal Officer – Sustainable Water Resources Water Resources Branch, Urban Management Division
Various periods	Acting Manager Water Resources, City Policy & Strategy Division Acting Manager Waterways, Urban Management Division
2000 – 2002	Principal Waterways Program Officer Flood Management, Coordinator BCC Telecommunications Infrastructure Strategy
1999 – 2000	Principal Waterways Program Officer Stormwater Waterways Branch, Urban Management Division
11/99 - 2/00	Acting Business Development and Marketing Manager, Brisbane City Enterprises Pty Ltd
1998 – 1999	Principal Asset Officer Project Co-ordination Asset Support Group, Urban Management Division
Various periods	Acting Director Planning and Development Department of Works
1997 – 1998	Principal Project Manager Project Co-ordination Section, Department of Works
1995 - 1997	Supervising Engineer - Planning Planning and Development Branch, Department of Works
1996	Secondment to UK for five months Somerset County Council, United Kingdom
1994-1995	Enterprise Bargaining Agreement Coordinator (Industrial Relations) Department of Works
1989 - 1994	Geotechnical / Laboratory / Pavement Engineer Construction Branch, Department of Works
1982 - 1989	Civil and Geotechnical Engineer, McIntyre & Associates Pty Ltd

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1978 - 1981

Engineering Student, James Cook University of North Queensland

## **SUMMARY OF EXPERIENCE**

- Leadership, development and management of teams comprising professional, technical and administrative staff and volunteers.
- Identification, initiation and delivery of strategic research, policy development and projects in response to changes in the community.
- Development and implementation of initiatives to ensure local government is providing cost effective services that meet the needs of its community.
- Establishment and nurturing partnering relationships, networks and strategic alliances to influence the program arena, and actively seek opportunities to influence water policy development and integrated water-cycle management in the city.
- Development of initiatives, strategies and standards to achieve asset management and water resource outcomes.
- Strategic planning, infrastructure planning, preparation of major budget bids, program analysis and design, environmental management, managing design consultants, project management of major projects, development of management information systems.
- Participation in team and individual projects with consultants, government departments, local authorities, internal, and external clients.
- Experience in administration, coordination, monitoring and controlling costs, quality improvement, leadership, and management of projects.
- Communication and leadership training of volunteers, elite athletes and leaders in the community.
- Leadership at the highest level of an international organisation – responsible for leading and setting strategic direction of organisation with 200,000 members in 90 countries.

## **PERSONAL STRENGTHS**

- Highly developed leadership, verbal and written communication skills.
- Committed to the development of technical, leadership, and management skills of



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his staff and himself.

- Committed to continuous improvement and achieving the right outcomes.
- Enjoys working and interacting with people and participating in, and leading teams.
- Demonstrates initiative in challenging situations.
- Passionate about making a difference, e.g. in asset management.

## **QUALIFICATIONS AND OTHER EXPERIENCE**

Gavin has a Master of Business Administration (Technology Management), a Bachelor of Engineering with Honours, and a Post Graduate Diploma in Management. Subjects studied for the MBA included: Management Perspectives, Law, Accounting, Economics, Total Quality Management, Marketing, Environmental Management, Project Management, Management Information Systems, and Strategic Management, Local Government Management, and Human Resource Management.

Gavin has been a member of Toastmasters International since 1982. During this period he has completed many communication and leadership roles including:

- 2004 received the Order of Australia Medal for his contribution to communication and leadership development throughout the world
- 2002-03 International President (10,000 clubs with 200,000 members in 90 countries, with 6% membership growth during 2002-03)
- 1999-2002 Vice President Toastmasters International
- 1994-1996 International Director of Toastmasters International (represented all members outside the USA and Canada).
- Chaired meetings of over 1,000 people,
- Convened a state convention,
- Won the state evaluation contest,
- Delivered presentations to large audiences (of up to 2,000) on many occasions,
- District Governor of Toastmasters International (led 3,000 members in Queensland, northern NSW and Northern Territory and experienced 17% club growth during the year). Gavin was recognised by the International President for providing outstanding leadership during his term as District Governor.
- Conducted Distinguished Districts meetings at four international conventions,
- Responsible for ensuring high quality training was provided to 50 district executive officers and 600 club officers in one year,
- Received Toastmasters' highest award – "Distinguished Toastmaster"

Gavin has been a guest lecturer to undergraduate and postgraduate students at the

Queensland University of Technology, James Cook University, and Bond University on seminar presentation and communication skills for professionals.

Gavin has delivered communication and personal development seminars to a number of clients, including Australia's elite athletes at the *Queensland Academy of Sport* and the *Australian Institute of Sport* and to a range of other organisations.

Gavin has:

- Visited the USA 35 times, Canada five times, New Zealand three times, UK three times, Austria, Bahrain, Belgium, France, Germany, Holland, Indonesia, Ireland, Italy, Jordan, Kuwait, Malaysia, Mexico, Nepal, Oman, Qatar, Saudi Arabia, Singapore, Switzerland, Taiwan twice, The Philippines, The United Arab Emirates.
- Had more than 70 media interviews (24 Newspaper / Magazine Interviews, 20 Radio Interviews; 12 Television Interviews, 4 Press Conferences (in English, Arabic and Mandarin)), and an interview for airplay on American Airlines' in-flight entertainment.
- Delivered major presentations to technical audiences (eg international conferences on water related topics), to corporate audiences (companies and organisations), to community groups (eg at public meetings), to work colleagues, to decision makers (eg Lord Mayor and senior Councilors) and has delivered hundreds of presentations to Toastmasters audiences in 16 countries.
- Has led more than 50 visits to corporations and organisations and met with CEOs and senior managers to promote communication and leadership development.
- Has led delegations to meet with Mayors and Ministers, Sheiks and Sheikas.
- Visited many local, state, and federal organisations and companies while overseas to identify best practices, including:

**USA:**

World Bank (Washington DC), Inter-American Development Bank (Washington DC), Los Angeles City Council, Orange County Council (California), San Francisco City Council, Wilmington City Council (Delaware), Greenville City Council (South Carolina), City of Aurora (Denver), Denver Water (Colorado), City of San Marcos (San Diego), City of Coronado (San Diego), California Department of Transport, Texas State Department of Highways, Austin City Council (Texas), Washington DC City Council, Atlanta City Council, Golder Associates (USA headquarters, Georgia), Dale City Landfill (Virginia), Boston City Council, National Headquarters Federal Highways Authority (Washington DC), Asphalt Institute, Baltimore City Council.

**UK:**

Somerset County Council, Manchester City Council, Ealing Borough Council, British Telecom (BT), Association of Direct Labour Organisations, Mendip District Council, Centre for Local Government Research, Local Government Management Board, Wessex Water, UK Environment Agency.

**Canada:**

Vancouver City Council (British Columbia), Kamloops City Council (British Columbia), Quebec Hydro (Montreal, Quebec)

**Indonesia:**

McIntyre and Associates (Jakarta)

**Taiwan:**

Kaohsiung City Government, Central Government (Taipei), Seven Water Utility

- Delivered technical seminars following the above visits to engineers, technicians, managers, politicians, and other interested parties.

## **CAREER**

### **BRISBANE CITY COUNCIL (1989 to Present)**

Subject Matter Expert on the Business and Systems Efficiency (BaSE) Program - responsible for providing expertise in Asset Management in the business transformation that Council is undertaking. This program includes the development of a major Enterprise Resource Planning System that will replace several key systems (Asset / Works Management, Finance, Human Resources, Procurement and Customer Relationship Management).

As Principal Engineer Stormwater Infrastructure Gavin leads the application of strategic asset management principles and practices for stormwater drainage infrastructure assets consistent with Council's Corporate Total Asset Management framework. These assets include enclosed drainage, manholes, inlets outlets, open drains, stormwater quality improvement devices and flood mitigated waterways. These assets have a replacement value of approximately \$ 3 billion.

In his current role Gavin is responsible for developing strategies and plans for the development, implementation and maintenance of asset management systems solutions. He and his team are responsible for developing levels of service for maintenance and rehabilitation in partnership with customers and stakeholders.

Gavin leads the preparation and review of Strategic Asset Management Plans and Annual Budget submissions. He provides Professional Engineering advice (consistent with the requirements of the Professional Engineers Act) to customers and stakeholders on asset management issues for stormwater drainage infrastructure.

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As Principal Officer Stakeholder Engagement Gavin and his team were responsible for liaising between Water Resources and its stakeholders to identify, scope, and deliver key integrated water cycle outcomes; developing a stakeholder management process; identifying and facilitating collaboration opportunities with stakeholders; capturing feedback on Water Resources' performance and monitoring the success of Water Resources' influence in water resources management.

Gavin and his team provided direction and assistance to Water Resources project managers on community engagement aspects of projects. They managed engagement strategy, approval process and production for the highest priority projects within the branch; provide assistance on engagement for other branch projects; produce collateral (print material & promotional items); facilitated the Branch-wide Community Engagement and Communication Team and ensured consistency of language and messaging on water issues to the public, including outgoing correspondence.

The team was a key conduit for information between Council, catchment groups and community in supporting the development of catchment /waterway strategies and action plans; liaises with and fosters the development of networks and partnerships between Council Officers, other catchment groups, local, state and regional bodies; works with Council and the community to facilitate water messages and behavioural change.

As Principal Water Resources Officer Gavin led a team responsible for the delivery of Flood Policy and Strategy. Three key components of this work were flood risk management policy and strategy, implementation of the Lord Mayor's Taskforce on Suburban Flooding, and delivery of Council's \$50M flood management budget. In this role Gavin and his team facilitated and guided the first ever Lord Mayor's Taskforce. This work included forming and coordinating the work of taskforce and supporting the completion of the Taskforce's report. Council subsequently adopted that report. Gavin and his team have implemented the key recommendations in the Taskforce's report.

Gavin led the development of the Flood Risk Management Strategy – the key document that guides flood risk management for Council. This was the first strategy developed in Water Resources. This seminal document provides the framework for flood risk management in Council. It outlines how to achieve one of the key outcomes in Council's primary water policy document "Water for Today and Tomorrow".

Brisbane City Council is a key partner on the National Urban Water Governance Program. This unique project is supported by water authorities in Queensland, Victoria and Western Australia. As Council's representative on the Steering Committee of this project, Gavin provides input and direction on behalf of Council. The project is identifying ways to improve sustainable water governance in Australia.

Gavin represented Brisbane on a staff exchange program to Taiwan for 3 months in 2005. He worked for the Kaohsiung City Government (the second largest city in

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Taiwan) in their water and city planning departments. During that exchange he identified a range of opportunities for Brisbane City Council and Brisbane businesses to collaborate with Taiwanese organisations. For example the Taiwanese Government is investing A\$6B into construction of sewage treatment plants over the next decade. This represents key opportunities for Australian organisations and companies (eg engineering consultancies and construction).

As Principal Officer Sustainable Water Resources Gavin led a team responsible for ensuring sustainable water resources outcomes for Brisbane. Professions represented in the team included engineering, natural resource management, environmental science, social science and marketing. The team was responsible for policy issues across the water cycle from rainfall to floodplain management to stormwater to water supply to sewage treatment to water conservation and reuse.

In this role Gavin and his team were responsible for the delivery of a range of projects associated with the water cycle including flood risk management, least cost planning (as applied to water use), stormwater drainage, water conservation and reuse (eg rainwater tanks, grey water), community education, marketing as it related to sustainable use of water, infrastructure charges for water infrastructure, water management plans, water related policies, and standards for the development industry.

As Principal Officer Stormwater and Flood Management Gavin and his team were responsible for the policies, standards, processes and projects associated with stormwater and flooding. Capital drainage projects accounted for \$30M (individual projects were worth up to \$6M), and recurrent drainage projects amounted to \$10M.

In this role Gavin and his team were responsible for the development of policies that could be applied across the city (eg flood regulation levels), standards to be adhered to by the development industry, and processes to identify, prioritise, design, and construct drainage projects. In seeking the best outcomes for the community asset and non-asset solutions were applied. The role required interaction with branches across the organisation, external agencies, elected representatives, consultants, and stakeholders. He delivered presentations and conducted workshops for the public and community groups on issues relevant to them (eg minimising the impact of flooding).

Gavin was selected by the Urban Management Division Manager to lead a team responsible for the development and implementation of the Brisbane's Telecommunication Infrastructure Strategy and Plan. The purpose of the project was to identify what Council could do to facilitate and encourage telecommunication infrastructure in the city. The project team comprised seventeen staff from a wide range of professions (eg town planning, asset management, economics, communication engineering, and information technology). The team prepared the telecommunications infrastructure strategy and plan in consultation with industry and government agencies. The plan is currently being implemented.

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In November 1999 Gavin was seconded to the role of Marketing and Development Manager for Brisbane City Enterprises (BCE) for three months. BCE is a private company wholly owned by Brisbane City Council and delivers consultancy services in 24 countries. In this role Gavin was responsible for preparing bids and marketing the local government services to clients around the world. He also represents BCE when traveling overseas and visits key clients such as the World Bank.

As Principal Asset Officer Project Coordinator from 1998 to 1999 Gavin led a team responsible for coordinating the delivery over 1,000 projects worth \$80M. This work comprised capital projects valued at up to \$200,000 each (such as stormwater drainage infrastructure) down to recurrent projects valued as low as \$1,000 (such as road maintenance work). His team was also responsible for the acquisition of land on behalf of Council and had up to 600 projects in progress.

Gavin's team comprised several professions including engineering, accountancy, valuation, architecture and administration. He successfully implemented project management software and processes, & delivered the program on time and to budget.

Gavin has relieved in the roles of Director Planning and Development, Manager Waterways and Manager Water Resources on several occasions while the Director / Manager was on leave or secondment. In this role he was responsible for the daily operation and strategic issues associated with corporate budgets, land development, asset management, waterways, computer networks and systems, and people management. Each branch had up to 60 staff.

From September 1997 to June 1998 Gavin fulfilled the role of Principal Project Manager for Urban Management Division. In this role he was responsible for the delivery of the Division's program of major projects. During the 1997/98 financial year the major projects program comprised \$30 M worth of major road improvements, and \$10 M worth of major stormwater drainage improvements across the city.

As Principal Project Manager Gavin led a team of professionals responsible for ensuring that all capital projects in the program were delivered on time, on budget, and to the specified standard. The team comprised coordinators with engineering project management experience, land valuers, and administrative staff.

From 1995 to 1997 Gavin Blakey fulfilled the role of Supervising Engineer Planning with Planning and Development Branch of the Department of Works and led a team of professional, technical, and administrative staff. He was responsible for coordinating the preparation of, and monitoring the Works Department's \$300 M budget; managing Budget activities amounting to \$80 M per year; addressing Department wide planning issues (such as proposed development plans and proposed major roads); and coordinating the Department's compliance with the Environmental Protection Act.



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In this role Gavin supervised the development of long term plans for the roads and stormwater networks; development and reporting on Budget activities in accordance with corporate and State requirements; providing policy advice on emerging issues (such as valuing road and stormwater assets estimated to be worth \$4 B); development and implementation of a Department wide Environmental Management System to ensure compliance with the Environmental Protection Act; management of the design and construction of road and stormwater network enhancements; and management of issues in the emerging field of waterways management.

In 1996 Gavin Blakey was selected to represent Brisbane City Council on a five-month secondment to Somerset County Council in the United Kingdom. The purpose the secondment was to gather information, which would help Brisbane City Council to become a best practice organisation and to share Brisbane City Council's expertise with other local authorities.

Gavin examined a range of issues including how local authorities and other organisations in the UK are implementing purchaser / provider; competitiveness; operation of business units; environmental management; public consultation; and emerging issues in local government. During the placement Gavin provided advice and delivered presentations on the operation of Brisbane City Council, eg Pavement Management Systems; Traffic Management; Enterprise Bargaining; and local government in Australia. He compiled a series of 15 reports on the range of issues investigated during the placement.

In 1994 Gavin Blakey was appointed to the position of Enterprise Bargaining Agreement Coordinator for the Department of Works for a period of one year. He was responsible for leading a dedicated team and setting up systems to successfully implement the Works Department's (and Council's) first EBA. In this role he was responsible for the provision of systems and advice on EBA related matters to the Department Manager, Department Consultative Committee (DCC), Branch Heads, Section Heads, and Local Consultative Committees (LCC). The position of EBA Coordinator demanded highly developed communication, negotiation, and organisational skills in order to successfully facilitate the implementation of EBA initiatives and workplace change. The job entailed negotiation with Union representatives, Council management, and employees and provided an excellent opportunity to manage industrial relations and human resource issues in the workplace.

From 1989 to 1994 Gavin Blakey was employed as a civil engineer in Construction Branch of the Works Department. In this position he fulfilled the roles of Geotechnical, Laboratory, and Pavements Engineer in Geotechnical Services Section. His responsibilities included the provision of professional, technical and training services in laboratory testing (soil, concrete, asphalt) field investigations (pavement sampling, Benkelman Beam testing, pavement classifications), pavement designs, and

geotechnical engineering.

He was responsible for the delivery of services to customers throughout Council, the financial management of the Geotechnical Services Laboratory, and the supervision and development of twenty-two of its technical staff. He represented Geotechnical Services Section on the Construction Branch Training Advisory Body (BTAB), and was the elected general representative on their LCC.

### **CONSULTING ENGINEERS - McINTYRE AND ASSOCIATES (1982-1989)**

For the eight years prior to joining Brisbane City Council Gavin was employed as a civil engineer with consulting engineers McIntyre and Associates and was based in their Townsville office. He gained experience in geotechnical engineering, laboratory management, civil design and construction (eg water, land and road assets).

Our ref: Doc 1752823

20 October 2011

Ms Julie McLellan  
Manager, Water Resources Branch  
Brisbane City Council  
GPO Box 1434  
BRISBANE QLD 4001

**REQUIREMENT TO PROVIDE STATEMENT TO COMMISSION OF INQUIRY**

I, Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act 1950* (Qld), require Ms Julie McLellan to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry, covering the following:

1. for the following reports:

- a) *Brisbane River Flood Study for Brisbane City Council*, Sinclair Knight Merz, June 1998
- b) *Brisbane River Flood Study: Review of Hydrological Aspects (for BCC)*, Monash University, (Professor Russell Mein), 9 December 1998
- c) *Brisbane River Flood Study (Draft)*, City Design, June 1999
- d) *Further Investigations for the Brisbane River Flood Study*, Brisbane City Council, City Design, December 1999
- e) *Review of Brisbane River Flood Study Report to Brisbane City Council*, Independent Expert Review Panel, 3 September 2003
- f) *Brisbane River Flood Study: Further Investigation of Flood Frequency Analysis Incorporating Dam Operations and CRC-Forge rainfall estimates – Brisbane River (Final)*, Sinclair Knight Merz, 18 December 2003
- g) *Flood Modelling Services, Recalibration of the Mike11 Hydraulic Model and Determination of the 1 in 100 AEP Flood levels*, Final Report, Sinclair Knight Merz, 5 February 2004

the following information:

- h) how the study was conducted, including how the Brisbane City Council ('Council'):
  - i) chose the external consultants or the section within Council that would do the work
  - ii) provided the consultants or section within Council with previous studies and other material
  - iii) provided the consultants or section within Council with data
  - iv) determined the scope of work
  - v) provided the consultants or section within Council with instructions
  - vi) determined the timeframe for the project
  - vii) determined the data to be used by the consultants or section within Council
  - viii) determined the assumptions to be made
  - ix) was otherwise involved in the study
- i) who within Council made those decisions or undertook those activities
- j) whether the chief executive officer of the Council or any Councillor or civic cabinet or the Lord Mayor (identifying which) was briefed regarding the results of the report, and if not, why not
- k) by whom the decision to give or not give briefings regarding the results was made; when and on what basis was that decision made
- l) what decision was made as to whether the results of the report would have an effect on the Q100 or planning control lines; when, by whom and on what basis was that decision made
- m) what decision was made as to whether or not to obtain a review of the report, by whom; when and on what basis was that decision made
- n) whether a decision was made that further investigations were required or not required following the report, and if so, (identifying each such report), who made that decision, what was decided; when, and on what basis

2. the Council's current approach, (ie as of 2011), to obtaining and assessing flood studies relevant to planning control lines, including:
  - a) how it is decided whether work will be done within Council or by external consultants
  - b) the Council's current approach to the decisions and actions described in 1(h) above
  - c) the identity of the person who decides:
    - i) what is done with the study when it is completed
    - ii) who is informed about the results of the study
    - iii) when a study must be considered by any or all of the chief executive officer of Council, any Councillor, civic cabinet, Council or the Lord Mayor
    - iv) what further studies should be undertaken
    - v) whether any studies or work recommended by the flood study should be progressed
    - vi) whether the results of a flood study should be reflected in changes to the Q100 or any other planning control line
    - vii) whether the results of a flood study should be reflected in changes to any emergency management procedures
  - d) how, and the basis on which, decisions falling within items 2(c) above are taken
3. whether the Council approved or determined the following technical assumptions and decisions taken by Sinclair Knight Merz ('SKM') in its carrying out the Brisbane River Flood Study between 1996 and 1998:
  - a) use of an areal reduction factor
  - b) initial dam storage
  - c) losses from rainfall

and if the Council did so approve or determine them, by whom were they approved or determined; when and on what basis

4. whether the decision to obtain an expert review of the 1998 SKM Brisbane River Flood Study was made before the results (or draft results) of that study were available to the Council
5. who made the decision that, following Professor Mein's 1998 Review Report, the flood study investigations would continue internally within the Council; when, and on what basis was that decision made
6. why City Design was chosen to continue flood study investigations following Professor Mein's 1998 Review Report
7. who decided to continue the investigations internally within the Council following the June 1999 City Design draft report; when, and on what basis
8. what, if anything, was done in response to the statement on page 10 of the June 1999 City Design draft report that '...saying that the current development control level represents the 1 in 100 flood level is not valid'; when, by whom and on what basis was that decision made
9. why no further flood studies were initiated by the Council between the December 1999 City Design draft report and the 2003 Independent Expert Review Panel process
10. whether the following are decisions made by Council, and if so when, by whom and on what basis were the following decisions made:
  - a) that the flood study investigations initiated in 2003 should be conducted through an Independent Expert Review Panel process
  - b) that the flood study investigations initiated in 2003 would involve SKM
  - c) the timeline for the 2003 flood study investigations undertaken by SKM
  - d) that SKM should submit draft reports (as opposed to final reports) to the Independent Expert Review Panel
11. whether there were any discussions held with the South East Queensland Water Corporation about potential changes to dam operations during the course of the flood study investigations in 2003 and if so:
  - a) what were the purpose of those discussions
  - b) who was involved in them
  - c) what was the outcome of them

12. whether Council considered using a Monte Carlo approach in a flood study; if not, why not and if so; when, by whom and on what basis was any decision about using a Monte Carlo process made
13. in respect of the recommendations for further work contained in section 5.2 of the Independent Expert Review Panel report (3 September 2003):
  - a) what decisions were made about what action the Council would take in response to each recommendation, and by whom
  - b) why each recommendation was or was not implemented
14. in respect of the recommendations for further work on page 48 of the SKM December 2003 report:
  - a) what decisions were made about what action the Council would take in response to each recommendation, and by whom
  - b) why each recommendation was or was not implemented
15. for SKM's February 2004 report, why did the Council instruct SKM to use the Independent Expert Review Panel report (3 September 2003) estimate of Q100 flow instead of the estimate determined by the SKM December 2003 report, who gave that instruction and when
16. if, as Council's Submission Two (8 April 2011) indicates at paragraph 2.4, the Council relies on the Independent Expert Review Panel report (3 September 2003) estimates of Q100 flow and height for its planning control lines, an explanation of why it has adopted that estimate instead of the estimates determined by the SKM December 2003 report or SKM February 2004 report

'Q100' is used in this requirement to denote the flow and/or height of a 1% AEP (annual exceedance probability) flood.

In addressing these matters, Ms McLellan is to:

- in respect of those topics which seek the identity of the person or persons who made a decision or undertook an activity – provide the name, position and qualifications of that person or persons
- provide all information in her possession and identify the source or sources of that information;
- make commentary and provide opinions she is qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion;



Ms McLellan may also address other topics relevant to the Terms of Reference of the Commission in the statement, if she wishes.

The statement is to be provided to the Queensland Floods Commission of Inquiry by 4 pm, Tuesday 1 November 2011.

The statement can be provided by post, email or by arranging delivery to the Commission by emailing [info@floodcommission.qld.gov.au](mailto:info@floodcommission.qld.gov.au).

A handwritten signature in cursive script, appearing to read 'P. Holmes', is written above a horizontal line.

Commissioner  
Justice C E Holmes

# Brisbane River Flood Studies Report

Key findings of studies undertaken to  
analyse flooding in the Brisbane River



Toowong Railway Station during 1893 flood

March 2004

26/3/04

DRAFT

**BRISBANE RIVER FLOOD STUDY REPORT – March 2004**

**BRISBANE RIVER FLOOD STUDY REPORT – MARCH 2004..... 1**

1. INTRODUCTION BY THE LORD MAYOR ..... 2

2. PURPOSE OF THIS REPORT ..... 3

3. BACKGROUND..... 3

3.1. THE BRISBANE RIVER CATCHMENT..... 3

3.2. RESPONSIBILITIES OF AGENCIES..... 3

3.3. BRISBANE RIVER STUDIES ..... 4

1984 ..... 4

1993 ..... 4

1996 ..... 5

1998 ..... 5

1999 ..... 6

2000 ..... 6

2003 ..... 7

4. KEY OUTCOMES OF THE BRISBANE RIVER FLOOD STUDY ..... 10

5. OTHER WORK BEING UNDERTAKEN ..... 10

6. FUTURE WORK ..... 11

7. ATTACHMENTS ..... 13

**Attachment A – Decision of the Brisbane City Council – Setting of Flood Development Levels and Adoption of New Flood Measurement Standards..... 14**

**Attachment B: Proposed Defined Flood Level along the Brisbane River ..... 22**

**Attachment C: Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas 23**

**Attachment D: Amendment to Brisbane City Plan 2000 ..... 24**

**Attachment E: Amendments to the Subdivision and Development Guidelines Chapter 2 ..... 25**

## 1. INTRODUCTION BY THE LORD MAYOR

One of the defining features of Brisbane's landscape is the Brisbane River. It meanders through Brisbane for over 100 km from our boundary with Ipswich City Council to the mouth of the river in Moreton Bay. The Brisbane River is an icon of our city. Indeed we are known as the River City.

The river has been an integral part of the economic development of the city. For example the city reaches of the river served as a bustling port in the early days of our city. Today we use the river for many purposes, including as a transport corridor for the city's famous City Cats.

The city was first established on the river over 150 years ago. Since that time development has occurred along the banks of the river and its floodplain. During major rainfall events floodwaters from the river and adjoining creeks have affected those living, working, or moving within the floodplain. The earliest recorded flood events since the establishment of the city occurred in 1842 with other major flood events occurring at irregular intervals, including 1844, 1893 and 1974.

By building on the floodplain there has been and will continue to be impacts on people and property during major flood events. To manage these impacts we need to understand the characteristics of the river and its floodplain. This understanding also allows us to better predict the extent and depth of flooding likely to occur during major flood events.

Brisbane City Council uses the Bureau of Meteorology's estimations to forecast the level and extent of river flooding throughout the City. That way residents and businesses can take actions to minimise the impact of flooding on their properties.

We have undertaken several studies into the flood characteristics of the Brisbane River, so the people of Brisbane can be confident they are receiving the best available information that will help them protect themselves and their property.

This report summarises the extensive work that Council has undertaken to date and provides a good insight into your Council's commitment to provide high quality information to the people of Brisbane that is based on the best available studies.

Tim Quinn  
Lord Mayor

*Draft only - did not go to  
Lord Mayor - election  
occurred about the time  
that this report was drafted.*

## **2. PURPOSE OF THIS REPORT**

The purpose of this report is to briefly outline the significant amount of work that has been undertaken by Brisbane City Council in examining flooding characteristics of the Brisbane River. This work enabled the development of computer models to forecast flood levels during flood events, and provided information that can be used to inform Council in setting development levels adjacent the Brisbane River. This report summarises the key findings of the work undertaken to date and outlines possible future work.

## **3. BACKGROUND**

### **3.1. The Brisbane River Catchment**

The Brisbane River is a significant feature of the Brisbane landscape. It has been the focus of city life, trade and commerce since the settlement of Brisbane. Thousands of residential, commercial and industrial properties are situated on the banks of the river and within its floodplain.

The Brisbane River catchment covers 13,570 km<sup>2</sup> and extends from near Nanango in the north to Cunningham's Gap in the south, west to the Toowoomba range and East to Woodford. It has two major dams – Somerset commissioned in 1943 and Wivenhoe, commissioned in 1985. Wivenhoe Dam is by far the largest dam in the Brisbane River catchment. It was constructed as a water supply dam and flood mitigation dam and commands approximately half the Brisbane River catchment. Lockyer Creek and the Bremer River are two of the major sub-catchments in the Brisbane River catchment, and both enter the Brisbane River downstream of Wivenhoe Dam.

### **3.2. Responsibilities of agencies**

A number of government agencies have responsibilities associated with the river, for example, the Bureau of Meteorology forecasts water levels in the river during minor, moderate and major flood events. The South East Queensland Water Corporation is the owner of Wivenhoe and Somerset Dams. The Department of Natural Resources and Mines operates the dams for the South East Queensland Water Corporation. The dams have dual roles of water supply and flood mitigation. Water is stored and released during flood events using procedures enshrined in State legislation.

Brisbane City Council works closely with these agencies in its role of forecasting the level and extent of flooding throughout Brisbane during major river flood events. The Brisbane River Flood Study has been undertaken to enable Brisbane City Council to fulfil its role of providing detailed flood information to residents. For example:



- Council has developed computer models that assist in setting Defined Flood Levels for construction of infrastructure (eg houses, commercial buildings) on the banks of the river and its floodplains. The Defined Flood Levels enable residents and businesses to construct buildings to a level that provides a low level of risk (the risk of flooding can only be managed, not eliminated). Members of the public can contact Council to find out the Defined Flood Level for their property. It is proposed that in the future a system will be developed so that the DFL will be available via Council's website.
- During major river flooding Council sets up a Flood Information Centre. The role of this group is to provide detailed interpretation of forecasted flood levels to determine, areas of the city that are likely to be affected and actions people need to take to minimise the impact of the flooding

### 3.3. Brisbane River Studies

Over the years several studies have been undertaken to investigate aspects of flooding in the river, however none have comprehensively investigated flooding in the Brisbane City Council reach of the river like the current study. The studies undertaken to date are:

- **1984**

**Report for Brisbane City Council and Water Resources Commission.**

This report was prepared during construction of the Wivenhoe Dam. The river flood flow with an average recurrence interval (ARI) of 100 years (also known as Q100 which is the peak discharge that can be expected to be equalled or exceeded once every 100 years on average) was set at 6,800 m<sup>3</sup>/s (cubic metres per second). This flood flow and its corresponding level at the Brisbane Port Office gauge (located near the intersection of Edward and Alice Streets in the city) were used as the basis for setting development control levels in areas adjacent to the river, and in its floodplain.

- **1993-94**

**DNR study undertaken for the South East Queensland Water Board to examine operating rules for the dam.**

The study estimated that the Q100 flow was 9,380 m<sup>3</sup>/s. This is considered to be a conservative estimate (ie an overestimation) as it was not specifically calculated for the Q100 event in Brisbane and did not include Areal Reduction Factors (ARF). For large areas like the Brisbane River catchment it is not realistic to assume that the same intensity can be maintained over the entire area. The DNR report determined that further work be required to calculate areal reduction factors for the Brisbane River, and that ARF's would need to be applied to more accurately estimate flood flows in the river. Subsequently



Council decided to specifically examine flood levels in the Brisbane City Council reaches of the river and commissioned Sinclair Knight Merz (SKM) to undertake the Brisbane River flood study. This work commenced in November 1996.

- **1996**

**Council commissioned Sinclair Knight Merz (SKM) to undertake a comprehensive flood study to:**

- **Investigate and understand flood behaviour associated with the Brisbane River.**

This study comprehensively assessed the flood carrying capacity of the river and its floodplain, the impact of flooding along the river, and assessed the effect of development, revegetation, and cross-river structures on flood levels.

- **Determine flood levels that apply to development.**

At the time this study commenced development levels were based on findings from the 1984 study (eg Q100 flood flow). A considerable amount of information and has been gathered since that time, and flood modelling techniques have been refined. This latest study was required to update the minimum flood immunity levels that apply to development that may be affected by Brisbane River flooding.

- **Develop and provide improved flood emergency information.**

The study updated flood level data so Council can provide high quality flood advice to the public during a major flood event. Being able to predict flood levels and the extent of flooding during a flood event is crucial so that the impact of flooding on people and property is minimised. This study developed a flood forecasting model and ancillary information so that Council can provide specific advice to residents, and can advise emergency personnel about inundated and likely isolated areas.

- **1998**

**Flood model developed and draft SKM report prepared for Council.**

This is the report from the study that commenced in 1996. The report proposed a Q100 flow of 9,560 m<sup>3</sup>/s. The report and results were reviewed by Council officers who determined that this flow was based on assumptions that equated to a lower probability of flooding than the Q100 (ie 9,560 m<sup>3</sup>/s was an over-estimate of the Q100). Council commissioned Professor Russell

Mein, eminent hydrologist, to undertake an independent review of the work to date.

### **Professor Mein's review of the draft SKM report**

Professor Mein's review stated that the overall approach for the hydrologic component of the study was appropriate, however conservative assumptions in key input variables pointed to the likelihood that the magnitude of the Q100 flow obtained in this draft study is an over-estimate. Professor Mein made six recommendations for work needed to address the issues of concern. These recommendations were progressively implemented as more information and data came to hand.

- **1999**

#### **Council incorporated recommendations from Professor Mein's review.**

The 1999 study revised downwards the Q100 flow to 8,600 m<sup>3</sup>/s, then to 8,000 m<sup>3</sup>/s as the analysis was refined. There were still a number of conservative assumptions in the study so the work to date was still over-estimating the Q100 flow.

- **2000**

**Council officers reviewed all work to date**, and discussed findings with external stakeholders, including the South East Queensland Water Corporation, the Department of Natural Resources, the Ipswich City Council, and the Bureau of Meteorology.

In October 2000 a **Brisbane River Flood Study Technical Workshop** was held with key stakeholders to ensure that the definitive flood study report would be technically rigorous and adopt an approach / methodology that would be consistent with the current practices using the latest available information. At that meeting DNRM indicated that it was undertaking a study of flood flows associated with Wivenhoe Dam and that outputs of their CRC FORGE study would be beneficial to the flood study being undertaken by the Brisbane City Council (eg through the estimation of areal reduction factors).

Preliminary work by DNRM was indicating that the Q100 flow would be closer to the 1984 flow of 6,800 m<sup>3</sup>/s than the 1993 DNR flow of over 9,000 m<sup>3</sup>/s. This reinforced Council's view that the latest Council estimate of 8,000 m<sup>3</sup>/s was an over-estimate of the Q100 flood flow at the Brisbane Port Office gauge (especially since not all of Professor Mein's recommendations had been implemented at that time and Council was committed to ensuring that this occurred).



Based on discussions by stakeholders at the October 2000 meeting it was expected that **findings from DNRM's CRC FORGE study** would be available by the end of 2000. Participants at the workshop concluded that the work being undertaken by DNRM would need to be taken into account in the Brisbane River Flood Study, as it was consistent with recommendations from Professor Mein's review. It was estimated at the time that the inclusion of Areal Reduction Factors (which Professor Mein had already recommended) would produce a 20% reduction in rainfall and a commensurate reduction in flood flow at the Brisbane Port Office gauge.

- **2003**

On 27 June 2003 **BCC received preliminary advice from DNRM** that using their newly developed rainfall predictions that the estimated Q100 flood flows at the Brisbane Port Office may be between 6,000 and 7,000 m<sup>3</sup>/s. This supported the assessment that the preliminary estimate from earlier reports was likely to be an over-estimate of the Q100 flood flow. DNRM's preliminary advice was consistent with their comments at the October 2000 workshop and with discussions with DNRM officers since that time.

In June 2003, **SKM was engaged** to undertake further work on the Brisbane River Flood Study using the new information (eg rainfall estimations and areal reduction factors) from the DNRM study. DNRM also supplied the latest version of their dam operations procedures and computer model so Council's flood model could more accurately reflect the operations of the dam during major flood events.

In July 2003 an **Independent Review Panel** was appointed to obtain independent and expert advice as to whether the latest estimates of the Q100 flow and level at the Brisbane Port Office were reasonable. The independent panel comprised Australian experts on hydrology and hydraulics.

Membership of Panel:

- Professor **Russell Mein** (Chair) – Experience: Former Chief Executive Officer of Cooperative Research Centre (CRC) for Catchment Hydrology and former Chairman of Australian Rainfall and Runoff Advisory Panel
- Professor **Colin Apelt** – Experience: Former Head of the Department of Civil Engineering, University of Queensland
- Dr [REDACTED] – Experience: Chairman Engineers Australia National Committee on Water Engineering, and Director / Principal Water Engineer with consultants Water Solutions Pty Ltd
- **Erwin Weinmann** – Experience: Deputy Director CRC for Catchment Hydrology (Monash Node), Senior Lecturer in water subjects at Monash University and Co-author of Book VI (Estimation of Large and Extreme Floods)

## Panel's Objectives:

1. Review the methodology used to estimate Q100 river flow (1998 – 2003)
2. Ensure that the appropriate technical process were followed for the 2003 Q100 river flow / level at the Brisbane Port Office.
3. If required, provide specific recommendations on further work be undertaken.
4. Assess the suitability of the 2003 Q100 river flow and level for design purposes.

## Outcome sought from Panel:

The panel was asked to produce a report providing opinions, recommendations and advice on the technical process followed and the estimated Q100 river flow / level at the Brisbane Port Office. The Panel's report was received in September 2003 and was loaded on Council's website so that the review was available for all interested parties to access.

## Key findings by the Independent Review Panel:

The estimation of Q100 for a catchment of this size (nearly 14,000 sq. km) is a challenging task. The extreme variability of rainfall, the change in catchment response due to the construction of dams, and the variable conditions in the tidal section of the river, are some of the factors which complicate the application of 'standard' flood methodologies. The advent of new techniques for flood frequency analysis and for extreme rainfall estimates, together with much improved hydraulic routing methods for estuaries, has added much to the technologies now available for flood estimation.

## The Panel:

- (i) 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 the study,
- (iii) Based on the evidence available, the Panel was of the view that, for the Brisbane Port Office, the best current estimates for:
  - Q100 flow is 6,000 m<sup>3</sup>/s
  - Q100 level is 3.3 m AHD (Australian Height Datum)

The panel determined that:

- 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 5,000 to 7,000 m<sup>3</sup>/s and for the Q100 level, 2.8 to 3.8 m AHD.
- It seems certain that the position of the best estimates in the respective ranges can be more precisely determined, and the width of these ranges could be significantly reduced, with further investigation.

**The Panel noted 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.

December 2003 the **SKM final report on the Brisbane River Flood Study** (*Further investigation of frequency analysis incorporating dam operations and CRC FORGE rainfall estimates*) was completed. The report was prepared for interpretation by the independent panel and other experts familiar with flood frequency analysis techniques such as regional analysis and Bayesian techniques, and with hydrological terminology and abbreviations.

At its meeting on 2 December 2003 **Council adopted the resolution titled: "Setting of Flood Development levels and adoption of new flood measurement standards"**. By adopting this resolution, Council:

1. Adopted the expert panel's best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 m<sup>3</sup>/s;
2. Determined that the current adopted flood immunity level of 3.7m AHD at the Brisbane Port Office gauge is still the most appropriate level;
3. Determined that as a consequence of 1 and 2 above that there is no need to change current development levels for properties adjacent to the Brisbane River;
4. Determined that in future, the flood level used to set development levels for properties adjacent to the Brisbane River be determined by the "Defined Flood Levels" as set by Council;
5. Determined that the current Defined Flood Level be set at 3.7m AHD at the Brisbane Port Office gauge;
6. Determined that Administrative Policy AP 065, Erection of Dwellings in flood Prone Areas, be rescinded and replaced with the Draft Policy AP 065 (copy attached as Attachment C);
7. Determined that the Subdivision and Development Guidelines be amended as set out in Attachment E;

8. Resolved that pursuant to the requirements of Section 1(1) of Schedule 1 of the Integrated Planning Act 1997 (IPA) Council proposes to prepare amendments to Brisbane City Plan 2000 to amend house flood immunity levels in the House Code;
9. Resolved that pursuant to Section 9(2) of Schedule 1 of IPA, Council proposes amendments to the Planning Scheme to change the House Code as set out in Attachment D;
10. Directed that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA, and that the Minister be given a copy of the proposed amendments for consideration of State interests.

#### **4. KEY OUTCOMES OF THE BRISBANE RIVER FLOOD STUDY**

In summary, key outcomes of the Brisbane River Flood Study include:

- The Q100 level being used by Council to set development levels along the river could be
- Council was able to set Defined Flood Levels (DFL) for properties affected by river flooding based on the existing Q100 level
- The Q100 flow was reduced to 6,000 m<sup>3</sup>/sec, so the DFL will give slightly better than 100 year Average Recurrence Interval (ARI) immunity to infrastructure constructed above the DFL
- A better understanding of flooding characteristics of the Brisbane River
- More sophisticated models that allow more accurate forecasting of level and extent of inundation during flood events

All of the above outcomes enable Council to provide better advice to the public for development and redevelopment purposes, and better information during major river flood events.

#### **5. OTHER WORK BEING UNDERTAKEN**

Council has been taking other actions as well, for example:

- Updating Council's flood information system which predicts flood levels in the river during major flood events,
- Automating the system to improve the accuracy and consistency information provided to residents on Defined Flood Levels on their properties,
- Raising community awareness of flooding issues, for example by providing fact sheets on flooding outlining what residents can do to minimise the impact of flooding on their properties, and producing articles in publications such as *Livable Brisbane* (which is posted to all rate payers), and including information on flooding on Council's website.

## 6. FUTURE WORK

The Independent Review Panel made five recommendations for further work. An update on the current status of each of these recommendations is included below:

- 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 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.

**Council is committed to continuous improvement of its flood management system and processes. Work will be undertaken over time to enhance the system as new information and techniques become available.**

**The Monte Carlo analysis is a sophisticated technique used to model complex flooding scenarios that have many inter-dependent variables. The technique goes beyond the standard techniques outlined in the current publication *Australian Rainfall & Runoff*. The Monte Carlo technique can be used to model thousands of storms with varying temporal (rainfall variation with time) and spatial (rainfall variation across the catchment) patterns to determine the most appropriate rainfall event that produces a Q100 flow. Other flows could also be determined using this technique, eg Q50 and Q2000. It is anticipated that the technique will be outlined in future editions of the Australian Rainfall & Rainfall publications. When this will occur is unknown.**

**The expert analysis undertaken by the Independent Panel was based on work undertaken by SKM and DNRM provides sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable. Council relied on this expert advice and retained the existing development level adjacent to the river (now called the Defined Flood Level). This level is within the plausible range for the Q100 flow of 5,000 to 7,000 m<sup>3</sup>/s, and above the best current estimate of 6,000 m<sup>3</sup>/s determined by the Independent Panel.**

- b) More confidence would be engendered in the results if there were 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 revisited 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 runoff volumes predicted by the RAFTS model from design rainfalls of corresponding frequency.

**The current variance of around 20% between the Flood Frequency Analysis (FFA) of observed data and the estimates of flood flows obtained from the rainfall based RAFTS model could be reduced with further work. However the Defined Flood Level is within the plausible range for Q100, and higher than the best estimate for Q100, so rather than undertaking more analysis to better correlate the FFA and RAFTS methods, it is more likely that this work would be undertaken as part of a Monte Carlo Analysis.**

- 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.

**As recommended by the Independent Panel the Mike 11 computer model of the Brisbane River has been recalibrated to give a more accurate estimate of flood levels in the river. The recalibration was based on work undertaken by SKM on the Brisbane City Council and Ipswich City Council reaches of the river.**

- d) Consideration should be given to including the effect of tidal variation on 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.

**Considerable work would be required to properly carry out the Monte Carlo analysis. This technique could be used to refine flood frequency estimates and more accurately predict the effects of tidal variation on flood levels in the estuarine zone when Council undertakes a general flood risk assessment and enhances its risk based flood management decision processes and procedures.**

- 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.

**The Department of Natural Resources and Mines is presently finalising its report on the operation and effects of Wivenhoe and Somerset Dams on flood flows. Outputs of that report may be useful in refining predictions of flood flows in the Brisbane City Council reach of the Brisbane River.**

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## **7. ATTACHMENTS**

**Attachment A** – Decision of the Brisbane City Council – Setting of Flood Development Levels and Adoption of New Flood Measurement Standards

**Attachment B** – Graph – Comparison of DFL and Q100 = 6,000 m<sup>3</sup>/s

**Attachment C** – Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas

**Attachment D** – Amendment to Brisbane City Plan 2000

**Attachment E** – Amendments to the Subdivision & Development Guidelines Chapter 2

## **Attachment A – Decision of the Brisbane City Council – Setting of Flood Development Levels and Adoption of New Flood Measurement Standards**

### **DECISION OF THE BRISBANE CITY COUNCIL**

#### **Establishment and Co-ordination Committee's Recommendation of 24 November 2003**

**Presented to Council: 2 December 2003; and ADOPTED**

**J SETTING OF FLOOD DEVELOPMENT LEVELS AND ADOPTION OF  
NEW FLOOD MEASUREMENT STANDARDS  
295/10/10**

82. The Divisional Manager, Urban Management Division, provides the following background information in relation to this matter.
83. Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a one in one hundred chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river, the flow is related to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge, which is near the corner of Edward and Alice Streets.
84. Administrative Policy No. AP065 – *Erection of Dwellings in Flood Prone Areas* was adopted by the Establishment and Co-ordination Committee on 30 October 1978, and still applies. This policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m Australian Height Datum (AHD) flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process, eg. pontoons.
85. In 1984, a Brisbane City Council (BCC) study determined that  $Q100 = 6,800$  cumecs ( $m^3/sec$ ), which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and State Government signed off on this flow in November 1984.
86. A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988, and has been used ever since to set development levels along the river. It is proposed that the levels interpreted from this graph continue to be used for development purposes.



87. Work undertaken by the State Government in the 1990s, indicated that the Q100 flow in the river might have been higher than the 6,800 cumecs estimated in the 1980s.
88. In November 1996, BCC commissioned Sinclair Knight Merz (SKM) to undertake a study of flood flows in the Brisbane River. One of the outputs of that report was an estimation of the Q100 flow. Following is a chronology of the work undertaken since then:
- 1998 February – Draft SKM Report
  - 1998 December - Peer review by Professor Mein
  - 1999 June and December - City Design's Draft Reports
  - 2000 October – Review of issues and progress by stakeholders. The Department of Natural Resources (DNR) committed to provide information on Areal Reduction Factors (ARF) within a few months
  - 2003 June – the Department of Natural Resources and Mines (DNRM) produces draft results with Areal Reduction Factors and estimated a Q100 flow of 6,000-7,000 cumecs at the Brisbane Port Office
  - 2003 July and August – SKM and City Design undertake rainfall and flow analysis using the latest DNRM information
  - 2003 September – Independent expert panel completes its review into the Q100 flow and level at the Brisbane Port Office gauge
89. The expert panel determined that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8 m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.
90. The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100 and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.
91. Currently, flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is equivalent to 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods, it is appropriate to maintain the existing flood immunity levels for development purposes.

92. The following is a history of habitable floor levels in residential developments adjacent to the river:

Year	Standard for Habitable Floor
1992	Q100
1997 approximately	Q100 + 525 mm
2000 City Plan House Code and Subdivision and Development Guidelines	Q100 + 500 mm

93. The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg. development level for habitable floors = 100year ARI+0.5m {= Q100 + 500mm}).
94. The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and can correspond to the Q100 level, or some other flow level set by the agency. In some jurisdictions development levels are set based on an historic flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie. 3.7m AHD at the Brisbane Port Office, which corresponds to a flow of 6,800 cumecs at that location.
95. The following Attachments are submitted:
- "B" - a graph showing the proposed Defined Flood Level along the Brisbane River and how it relates to the new Q100;
  - "C" - the draft wording of proposed revised Policy AP065;
  - "D" - the proposed change to table 1 of the Brisbane City Plan House Code; and
  - "E" - the proposed amendments to the relevant tables B2.2.1 and B2.2.2 from the Subdivision and Development Guidelines.
96. If approved, the proposed changes to Brisbane City Plan 2000 will be sent to the Minister for a first state interest check and for authority to publicly consult on the proposed amendments.

#### Implications of Proposal

97. Implications include:

Current development levels adjacent to the Brisbane River remain unchanged – consistent approach in maintaining development levels based on estimated flood levels;

The terminology in Policy AP065, the Minimum Immunity Levels tables from the Subdivision and Development Guidelines and the City Plan will need to be changed to include Defined Flood Level (DFL). For example, the flood immunity level for a habitable floor constructed adjacent to the Brisbane Port Office:

Current House Code: 100 year ARI + 500 mm (= 3.7+0.5m AHD)

Proposed amendment to House Code: DFL + 500 mm (= 3.7+0.5m AHD);

Administrative Policy AP065 “Erection of Dwellings in Flood Prone Areas” will need to be updated to indicate the same basic intent but clarify terminology; and

The estimated Q100 has decreased from 6,800 cumecs to 6,000 cumecs, so the likelihood of flooding at properties adjacent to the river has decreased as a result of the recent study (ie. those properties will now be slightly less likely to flood than previously estimated).

#### Customer Impact

98. By adopting the recommendations in this submission, there will not be any changes to design flood levels on the river for development impacted by City Plan. The level that customers receive corresponding to the 100 year ARI prior to this submission will be the same as the DFL that they will receive if this submission is approved. The changes will only be to the terminology. Changes will be made to the City Plan and associated documents using the standard amendment process, which takes up to two years. In the interim, the terminology used in the existing documents will be used.
99. The Divisional Manager therefore submits the following draft resolution, with which the Committee concurs.
100. **RECOMMENDATION:**

#### **THAT IT BE RESOLVED THAT –**

- (i) As:
- (a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;

- (b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;
- (c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6,000 cumecs;
- (d) this range indicates that the current adopted flood immunity level of 3.7m AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;
- (e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

**THEN COUNCIL:**

- (1) **ADOPTS THE EXPERT PANEL'S BEST ESTIMATE OF THE NEW Q100 FLOW AT THE BRISBANE PORT OFFICE GAUGE TO BE 6,000 CUMECS;**
- (2) **DETERMINES THAT THE CURRENT ADOPTED FLOOD IMMUNITY LEVEL OF 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE IS STILL THE MOST APPROPRIATE LEVEL;**
- (3) **DETERMINES as a consequence of (1) and (2) THAT THERE IS NO NEED TO CHANGE CURRENT DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER;**
- (4) **DETERMINES THAT IN FUTURE, THE FLOOD LEVEL USED TO SET DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER BE DETERMINED BY THE "DEFINED FLOOD LEVEL" AS SET BY COUNCIL;**
- (5) **DETERMINES THAT THE CURRENT DEFINED FLOOD LEVEL BE SET AT 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE;**
- (6) **DETERMINES THAT ADMINISTRATIVE POLICY AP 065, ERECTION OF DWELLINGS IN FLOOD PRONE AREAS, BE RESCINDED AND REPLACED WITH THE DRAFT POLICY AP065 submitted at Attachment "C";**

- (7) **DETERMINES THAT THE SUBDIVISION AND DEVELOPMENT GUIDELINES BE AMENDED** as set out in Attachment "E" submitted;
- (8) **RESOLVES THAT** pursuant to the requirements of Section 1(1) of Schedule 1 of the *Integrated Planning Act 1997* (IPA), **COUNCIL PROPOSES TO PREPARE AMENDMENTS TO BRISBANE CITY PLAN 2000 TO AMEND HOUSE FLOOD IMMUNITY LEVELS IN THE HOUSE CODE;**
- (9) **RESOLVES THAT** pursuant to Section 9(2) of Schedule 1 of IPA, **COUNCIL PROPOSES AMENDMENTS TO THE PLANNING SCHEME TO CHANGE THE HOUSE CODE** as set out in Attachment "D" submitted;
- (10) directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA, and that the Minister be given a copy of the proposed amendments for consideration of State interests.

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**Attachment "A"**

**DRAFT RESOLUTION TO SET FLOOD DEVELOPMENT LEVELS AND TO  
ADOPT NEW FLOOD MEASUREMENT STANDARDS.**

**[Recommendation:** that Council resolve that:-

|

**[Resolution:** that:-

|

1. As:-

- (a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;
- (b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;
- (c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6000 cumecs;
- (d) this range indicates that the current adopted flood immunity level of 3.7AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;
- (e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

then:-

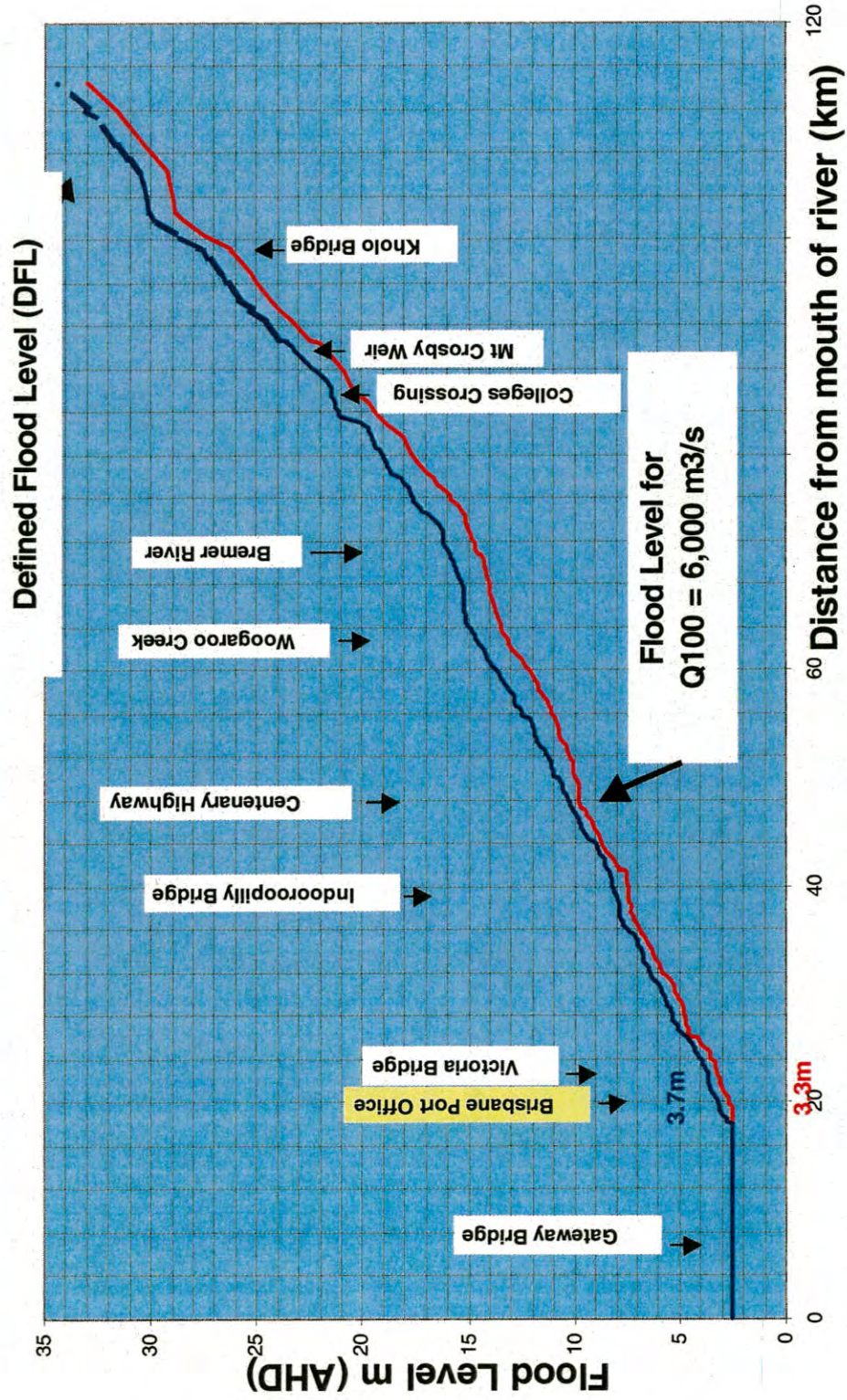
- (i) adopts the expert panels best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 cumecs;
- (ii) determines that that the current adopted flood immunity level of 3.7AHD at the Brisbane Port Office Gauge is still the most appropriate level;
- (iii) determines as a consequence of (i) and (ii) that there is no need to change current development levels for properties adjacent to the Brisbane River;
- (iv) determines that in future the flood level used set development levels for properties adjacent to the Brisbane River be determined by the "Defined Flood Level" as set by Council;

- (v) that the current Defined Flood Level be set at 3.7AHD at the Brisbane Port Office Gauge;
- (vi) that Administrative Policy AP 065 Erection of Dwellings in Flood Prone Areas be rescinded and replaced with the draft Policy AP065 at Attachment "C";
- (vii) that the Subdivision and Development Guidelines be amended as set out in Attachment "E";
- (viii) that pursuant to the requirements of Section 1(1) of Schedule 1 of the Integrated Planning Act 1997 ("IPA"), Council proposes to prepare amendments to Brisbane City Plan 2000 to amend House Flood Immunity Levels in the House Code;
- (ix) that pursuant to Section 9(2) of Schedule 1 of IPA, Council proposes amendments to the Planning Scheme to change the House Code as set out in Attachment "D";
- (x) Council directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA. And give the Minister a copy of the proposed amendments for consideration of state interests.



**Attachment B: Proposed Defined Flood Level along the Brisbane River**

**Comparison DFL and Q100 = 6,000 m<sup>3</sup>/s**





***Attachment C: Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas***

**Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas**

**AP065 Erection of Dwellings in Areas Prone to Brisbane River Flooding**

Overview

Flooding levels relevant to determining habitable floor levels in areas liable to Brisbane River flooding and standards of flood immunity.

Policy

In determining habitable floor levels the 3.7m AHD level at the Brisbane City Gauge is to be used from the river flood profiles derived in 1988.

That level constitute the "Defined Flood Level".

The 100 year Average Recurrence Interval (Q100) flow for the Brisbane Rive at the Brisbane Port Office Gauge is 6,000 cumecs.

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Authority

E&C 24/11/2003

Further Assistance

Principal Waterways Program Officer Flood Management Stormwater, Water Resources, Urban Management Division.

Related Information

File 223/1/18

Local Government Act (as amended) Part X1, Section 37(10)

See policies -

AP074 Flood Management for Flood Plain Management

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**Attachment D: Amendment to Brisbane City Plan 2000**

**Amendment to Brisbane City Plan 2000**

That Table 1 of Brisbane City Plan 2000 House Code Table 1 be replaced with the following:-

**Brisbane City Plan 2000 House Code Table 1: House Immunity Levels**

Type of Flooding	Minimum Ground Level for House Pad after filling (where permitted)	Habitable Floor level	Non-habitable Areas (i.e. Utility areas, garage, laundry and storage room)
Brisbane River	Defined Flood Level + 300mm	Defined Flood Level + 500mm	50 year ARI + 300mm
Creek or waterway	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm
Localised Overland flow path or designed open channel	50 year ARI + 300mm	50 year ARI + 500mm	50 year ARI + 300mm
Storm surge	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm

'ARI' means Average Recurrence Interval and is defined in the definitions.

'Defined Flood Level' means the flood level associated with the flood event selected for the management of flood hazard.

Note:

Where subject to more than one type of flooding the highest immunity level as determined for each case applies.

**Attachment E: Amendments to the Subdivision and Development Guidelines  
Chapter 2**

**Amendments to the Subdivision and Development Guidelines Chapter 2**

Replace tables B2.2.1 and B2.2.2 with the following:

**TABLE B2.2.1  
MINIMUM FLOOD IMMUNITY LEVELS FOR  
RESIDENTIAL DEVELOPMENTS**

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor	Non- Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level + 0.3m	Defined Flood Level + 0.5m	Defined Flood Level + 0.3m	20y ARI
Creek or Waterway	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI
Localised Overland Flow Path	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Designed Open Channel	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Storm Surge (Note 4)	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI

**TABLE B2.2.2  
MINIMUM FLOOD IMMUNITY LEVELS FOR  
INDUSTRIAL/COMMERCIAL DEVELOPMENTS**

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor (if applicable)	Non- Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level	Defined Flood Level + 0.5m	Defined Flood Level	20y ARI
Creek or Waterway	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI
Localised Overland Flow Path	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Storm Surge (Note 4)	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI

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1.0 FILE NUMBER 295/10/10

295/10/10 3

X.REF.....

INFORMATION MANAGEMENT  
A03/135282

**SUBMISSION TO THE ESTABLISHMENT AND CO-ORDINATION COMMITTEE**

2.0 TITLE

Setting of Flood Development levels and adoption of new Flood Measurement Standards.

3.0 ISSUE / PURPOSE

To recommend to Council that:-

- (a) existing flood development levels be retained;
- (b) it adopt a new 100 year ARI (Q100) flow at the Brisbane Port Office;
- (c) to set the Defined Flood Level (DFL) for development adjacent to the Brisbane River;
- (d) to authorise appropriate amendments to City Plan and other relevant policies and guidelines.

4.0 PROPONENT

*Michael Kerry, Divisional Manager, Urban Management Division*  
~~Barry Ball, Manager Water Resources Branch, Urban Management Division~~

5.0 SUBMISSION PREPARED BY

(PWPOM)

Gavin Blakey, Principal Officer Water Resources Branch, Urban Management Division

6.0 DATE

24 November 2003

**APPROVED**

24 NOV 2003

7.0 FOR E&C APPROVAL OR RECOMMENDATION TO COUNCIL ?

For recommendation to Council

Lord Mayor

8.0 IF FOR RECOMMENDATION TO COUNCIL, IS A COUNCIL RESOLUTION REQUIRED UNDER AN ACT OR ORDINANCE ?

Yes. Schedule 1 of the Integrated Planning Act 1997.

9.0 RECOMMENDATION

That Council resolve as per draft resolution Attachment "A".

**RECEIVED**

24 NOV 2003

**COMMITTEE SECTION**

10.0 DIVISIONAL MANAGER

[Redacted Signature]  
Michael Kerry  
Divisional Manager  
URBAN MANAGEMENT

I Recommend Accordingly  
[Redacted Signature]  
CHIEF EXECUTIVE OFFICER

## 11.0 BACKGROUND

Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a 1 in 100 chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river we relate the flow to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge which is near the near corner of Edward and Alice Streets.

Administrative Policy No. AP065 – *Erection of Dwellings in Flood Prone Areas* was adopted by E&C on 30/10/78 and still applies. This policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m AHD flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process eg pontoons.

In 1984 a BCC study determined that  $Q100 = 6,800$  cumecs ( $m^3/sec$ ) which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and State Government signed off on this flow in November 1984.

A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988 and has been used ever since to set development levels along the river. It is proposed that the levels interpreted from this graph continue to be used for development purposes.

Work undertaken by State Government in the 1990's indicated that the Q100 flow in the river might have been higher than the 6,800 cumecs estimated in the 1980's.

In November 1996 BCC commissioned Sinclair Knight Merz to undertake a study of flood flows in the Brisbane River. One of the outputs of that report was an estimation of the Q100 flow. Following is a chronology of the work undertaken since then:

- 1998 February –Draft SKM Report
- 1998 December - Peer review by Professor Mein
- 1999 June and December - City Design's Draft Reports
- 2000 October – Review of issues and progress by stakeholders. DNR committed to provide information on Areal Reduction Factors (ARF) within a few months
- 2003 June – DNRM produces draft results with Areal Reduction Factors and estimated a Q100 flow of 6,000-7,000 cumecs at the Brisbane Port Office
- 2003 July and August –SKM and City Design undertake rainfall and flow analysis using the latest DNRM information
- 2003 September – Independent expert panel completes its review into the Q100 flow and level at the Brisbane Port Office gauge

The expert panel determined that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8 m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.

The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100 and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.

Currently flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is equivalent to 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods it is appropriate to maintain the existing flood immunity levels for development purposes.

The following is a history of habitable floor levels in residential developments adjacent to the river:

Year	Standard for Habitable Floor
1992	Q100
1997 approximately	Q100 + 525 mm
2000 City Plan House Code and Subdivision and Development Guidelines	Q100 + 500 mm

The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg development level for habitable floors = 100year ARI+0.5m (= Q100 + 500mm))

The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and can correspond to the Q100 level, or some other flow level set by the agency. In some jurisdictions development levels are set based on an historic flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie 3.7m AHD at the Brisbane Port Office, which corresponds to a flow of 6,800 cumecs at that location.

Attached are:

- "B" a graph showing the proposed Defined Flood Level along the Brisbane River and how it relates to the new Q100.
- "C" the draft wording of proposed revised Policy AP065
- "D" the proposed change to table 1 of the Brisbane City Plan House Code
- "E" the proposed amendments to the relevant tables B2.2.1 and B2.2.2 from the Subdivision and Development Guidelines

If approved the proposed changes to City Plan 2000 will be sent to the Minister for a first state interest check and for authority to publicly consult on the proposed amendments.

## 12.0 CONSULTATION

The following have been consulted in the preparation of this submission:

- [REDACTED] Manager Brisbane City Legal Practice
- [REDACTED] Strategic Planning/Project Manager City Planning
- Don Carroll: Group Manager Water and Environment City Design
- [REDACTED] Team Leader Team 6 Development Assessment

### **13.0 IMPLICATIONS OF PROPOSAL**

Implications include:

- Current development levels adjacent to the Brisbane River remain unchanged – consistent approach in maintaining development levels based on estimated flood levels.
- The terminology in Policy AP065, the Minimum Immunity Levels tables from the Subdivision and Development Guidelines and the City Plan will need to be changed to include Defined Flood Level (DFL). For example the flood immunity level for a habitable floor constructed adjacent to the Brisbane Port Office:
  - Current House Code: 100 year ARI + 500 mm (= 3.7+0.5m AHD)
  - Proposed amendment to House Code: DFL + 500 mm (= 3.7+0.5m AHD)
- Administrative Policy AP065 “Erection of Dwellings in Flood Prone Areas” will need to be updated to indicate the same basic intent but clarify terminology
- The estimated Q100 has decreased from 6,800 cumecs to 6,000 cumecs, so the likelihood of flooding at properties adjacent to the river has decreased as a result of the recent study (ie those properties will now be slightly less likely to flood than previously estimated).

### **14.0 CORPORATE PLAN IMPACT**

Nil

### **15.0 CUSTOMER IMPACT**

By adopting the recommendations in this submission there won't be any changes to design flood levels on the river for development impacted by City Plan. The level that customers receive corresponding to the 100 year ARI prior to this E&C Submission will be the same as the DFL that they will receive if this submission is approved. The changes will only be to the terminology. Changes will be made to the City Plan and associated documents using the standard amendment process – which takes up to two years. In the interim, the terminology used in the existing documents will be used.

### **16.0 ENVIRONMENTAL IMPACT**

Nil

### **17.0 POLICY IMPACT**

It will be necessary to amend Policy No. AP065, Table 1 of the House Code of City Plan and Tables B2.2.1 and B2.2.2 of the Subdivision and Development Guidelines to reflect this E&C decision.

### **18.0 FINANCIAL IMPACT**

Nil.

### **19.0 HUMAN RESOURCE IMPACT**

Nil



## **20.0 URGENCY**

Within normal course of business.

## **21.0 PUBLICITY / MARKETING STRATEGY**

There has already been publicity for the river flooding issues and meetings held with key groups. Further presentations will be programmed after acceptance of this policy.

## **22.0 OPTIONS**

1. Adopt a Defined Flood Level for the Brisbane River based on the flood profile corresponding to 3.7m AHD at the Brisbane Port Office gauge (located adjacent to the corner of Alice and Edward Streets) and amend terminology in the Subdivision and Development Guidelines accordingly. Accept the expert panel's best estimate that Q100 = 6,000 cumecs at the Brisbane Port Office gauge.
2. Base the Defined Flood Levels on Q100 = 6,000 cumecs (3.3m AHD at the Brisbane Port Office gauge). This does not make provision for climate variation.
3. Don't adopt Q100 = 6,000 cumecs and maintain the existing flows and levels, ie Q100 = 6,800 cumecs (3.7m AHD at Brisbane Port Office gauge) together with City Plan and Policy 065. This is inconsistent with the expert panel's recommendation.

Option 1 is the recommended option.

---o0o---

**Attachment "A"**

**DRAFT RESOLUTION TO SET FLOOD DEVELOPMENT LEVELS AND TO ADOPT  
NEW FLOOD MEASUREMENT STANDARDS.**

**[Recommendation:** that Council resolve that:-

**[Resolution:** that:-

]  
]

1. As:-

- (a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;
- (b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;
- (c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6000 cumecs;
- (d) this range indicates that the current adopted flood immunity level of 3.7AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;
- (e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

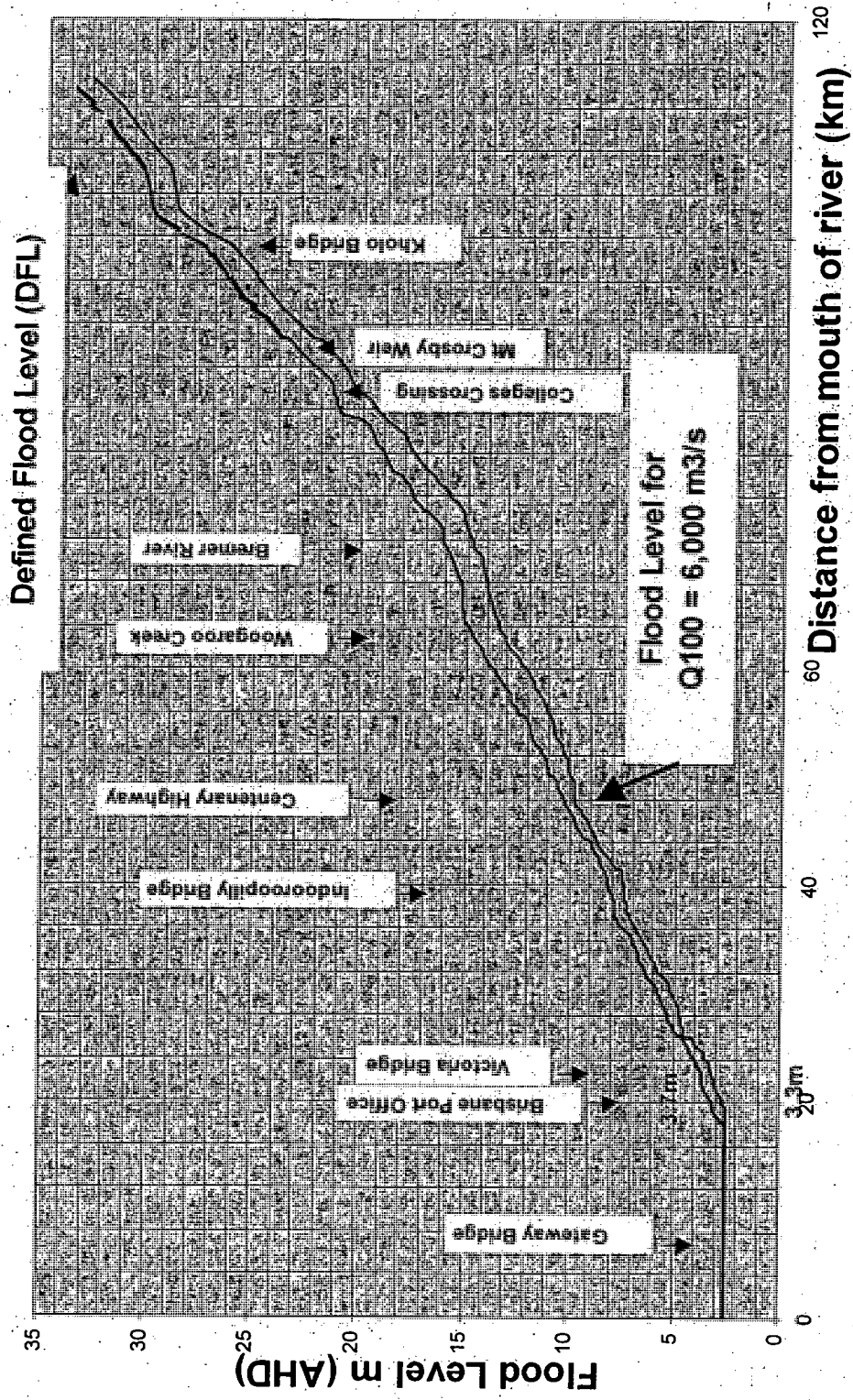
then:-

- (i) adopts the expert panels best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 cumecs;
- (ii) determines that that the current adopted flood immunity level of 3.7AHD at the Brisbane Port Office Gauge is still the most appropriate level;
- (iii) determines as a consequence of (i) and (ii) that there is no need to change current development levels for properties adjacent to the Brisbane River;
- (iv) determines that in future the flood level used set development levels for properties adjacent to the Brisbane River be determined by the "Defined Flood Level" as set by Council;
- (v) that the current Defined Flood Level be set at 3.7AHD at the Brisbane Port Office Gauge;
- (vi) that Administrative Policy AP 065 Erection of Dwellings in Flood Prone Areas be rescinded and replaced with the draft Policy AP065 at Attachment "C";
- (vii) that the Subdivision and Development Guidelines be amended as set out in Attachment "E";

- (viii) that pursuant to the requirements of Section 1(1) of Schedule 1 of the Integrated Planning Act 1997 ("IPA"), Council proposes to prepare amendments to Brisbane City Plan 2000 to amend House Flood Immunity Levels in the House Code;
- (ix) that pursuant to Section 9(2) of Schedule 1 of IPA, Council proposes amendments to the Planning Scheme to change the House Code as set out in Attachment "D";
- (x) Council directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA. And give the Minister a copy of the proposed amendments for consideration of state interests.

Attachment B: Proposed Defined Flood Level along the Brisbane River

# Comparison DFL and Q100 = 6,000 m<sup>3</sup>/s



## Attachment C.

### Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas

#### **AP065 Erection of Dwellings in Areas Prone to Brisbane River Flooding**

##### *Overview*

Flooding levels relevant to determining habitable floor levels in areas liable to Brisbane River flooding and standards of flood immunity.

##### *Policy*

In determining habitable floor levels the 3.7m AHD level at the Brisbane City Gauge is to be used from the river flood profiles derived in 1988.

That level constitute the "Defined Flood Level".

The 100 year Average Recurrence Interval (Q100) flow for the Brisbane Rive at the Brisbane Port Office Gauge is 6,000 cumecs.

---

##### Authority

E&C 24/11/2003

##### Further Assistance

Principal Waterways Program Officer Flood Management Stormwater, Water Resources, Urban Management Division.

##### Related Information

File 223/1/18

Local Government Act (as amended) Part X1, Section 37(10)

See policies -

AP074 Flood Management for Flood Plain Management

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**Attachment D**  
**Amendment to Brisbane City Plan 2000**

That Table 1 of Brisbane City Plan 2000 House Code Table 1 be replaced with the following:-

**Brisbane City Plan 2000 House Code Table 1: House Immunity Levels**

Type of Flooding	Minimum Ground Level for House Pad after filling (where permitted)	Habitable Floor level	Non-habitable Areas (ie. Utility areas, garage, laundry and storage room)
Brisbane River	Defined Flood Level + 300mm	Defined Flood Level + 500mm	50 year ARI + 300mm
Creek or waterway	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm
Localised Overland flowpath or designed open channel	50 year ARI + 300mm	50 year ARI + 500mm	50 year ARI + 300mm
Storm surge	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm

'ARI' means Average Recurrence Interval and is defined in the definitions.

'Defined Flood Level' means The flood level associated with the flood event selected for the management of flood hazard.

Note:

Where subject to more than one type of flooding the highest immunity level as determined for each case applies.

## Attachment E

### Amendments to the Subdivision and Development Guidelines Chapter 2

Replace tables B2.2.1 and B2.2.2 with the following:

**TABLE B2.2.1  
MINIMUM FLOOD IMMUNITY LEVELS FOR  
RESIDENTIAL DEVELOPMENTS**

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor	Non- Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level + 0.3m	Defined Flood Level + 0.5m	Defined Flood Level + 0.3m	20y ARI
Creek or Waterway	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI
Localised Overland Flow Path	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Designed Open Channel	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Storm Surge (Note 4)	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI

**TABLE B2.2.2  
MINIMUM FLOOD IMMUNITY LEVELS FOR  
INDUSTRIAL/COMMERCIAL DEVELOPMENTS**

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor (if applicable)	Non- Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level	Defined Flood Level + 0.5m	Defined Flood Level	20y ARI
Creek or Waterway	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI
Localised Overland Flow Path	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Storm Surge (Note 4)	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI



# Brisbane River Flood Study

E&C Strategy Presentation

8 September 2003



"GRB-04"



# Purpose of presentation on Brisbane River Flood Study

- To provide an update on outcomes of the review of the Brisbane River Flood Study
- To obtain guidance from E&C Strategy on the development control level for river flooding



# History of Flood Studies (1984-2003)

- 1984 Council report Q100 = 6,800 cumecs
- 1992 DNR report for Q100 = 9,400 cumecs
- 1998 Draft SKM's report Q100 = 9,600 cumecs
- 1998 Professor Mein reviewed SKM report and recommended more work
- June 1999 Draft City Design reported Q100 = 8,600 cumecs
- December 1999 Draft City Design reported Q100 = 8,000 cumecs



# History of Flood Studies (1984-2003)

- October 2000 review workshop determined that these estimates too high
- October 2000 DNR said that they expected to have data ready by December
- Awaiting BoM and DNRM to provide data
- Draft DNR data available in June 2003
- Expert Panel appointed to independently review work to date and determine Q100
- August 2003 Expert Panel reported that Q100 = 6,000 cumecs



# Membership of Panel

- Professor Russell Mein
- Professor Colin Apelt
- Dr John Macintosh
- Erwin Weinmann
- All are eminent experts in hydrology or hydraulics.  
They are well qualified to undertake this task.





# Role of Independent Panel

- Review the methodology used to date calculate Q100 river flow
- Ensure that the correct technical processes are followed to calculate Q100
- Determine Q100 river flow and level
- If required, recommend further work



# Independent Panel's Findings

- Reviewed work undertaken by SKM & CD
- Believe that the appropriate technical processes have been followed in study
- For the Brisbane Port Office the best current estimates are:
  - Q100 flow is 6,000 cumecs (plausible range 5,000 to 7,000 cumecs)
  - Q100 level is 3.3m AHD



# Estimating Q100 Flood Flow

- Use historic river level readings (1840's to date) and convert these to estimated flows
- Use design rainfall to estimate flow in river
- Determine flood level for a given flow and location (eg Brisbane Port Office Gauge)
- Dam operations have significant influence on flows ie. reduce flow by 50%



# Why Reduction in Flow

- 9,600 cumecs to 6,000 cumecs
- More accurate estimates of rainfall in catchment (approx. 20%)
- Application of Wivenhoe Dam operating procedures



# Development Control Level

- 1992 Habitable Floor = Q100 level
- Current Habitable Floor = Q100 level + 500 mm
- Residential fill level = Q100 level + 300 mm
- Commercial and industrial development fill level = Q100 level + 0 mm



# Options

## Habitable Floor Level

- Maintain current development control levels, ie. Q100 (6,800 cumecs and 3.7m) + 500 mm
- Adopt new Q100 (6,000 cumecs and 3.3m) + 500 mm (will be 400 mm lower at Brisbane Port Office)
- Adopt Q100 level corresponding to 6,000 cumecs + 900 mm so that development control level remains same at 3.7m



# Brisbane River Flood Study

E&C Strategy Presentation

8 September 2003

