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By Email

Dear Sir/Madam

**QUEENSLAND FLOODS COMMISSION OF INQUIRY
ADVICE ON FLOOD RISK MANAGEMENT
FOR LAND USE PLANNING WITHIN FLOODPLAINS**

1. This letter sets out my assessment of what constitutes best practice flood risk management and includes an appraisal of Brisbane City Council's flood risk management activities. It has been prepared under instructions from Clayton Utz on behalf of Brisbane City Council. At the conclusion of this letter I have also offered some suggestions to facilitate implementation of sound flood risk management in the wider areas of the State.
2. I've confined my comments to flood risk management for the purpose of land use planning. Disaster response is an important area where flood risk management is practised but I have not dealt with this issue here.

Brisbane City Council Practice

3. Up until the end of 2010 my firm had had no previous formal association with the Brisbane City Council.
4. I was largely unaware of practice within Council in regard to flood risk management. I was aware of Council's initiatives in making flood information widely available to the local community via its FloodWise property reports on the Internet as these were widely known and recognised in the flood risk management industry as some of the best available in the Country.¹
5. My assessment of flood risk management practice within Brisbane City Council has been based largely on my review of documents listed in **Appendix A** and the discussions I've had with officers from the various divisions within Council over the last two months. I've had limited time to prepare this advice and therefore attempted to provide succinct comments.
6. The documents listed in **Appendix A** also include guides to best practice flood risk management of which SCARM (2000) is the most notable.
7. Brisbane City Council is Australia's largest local government and has significant staff resources with expertise in the range of technical disciplines needed for effective

¹ Increasing the community's awareness of flood issues has long been recognised as a vital and very cost-effective method of managing flood risks. Brisbane City Council's initiatives in this regard are among the best in Australia and certainly exceed those provided by major NSW councils with significant flood problems.

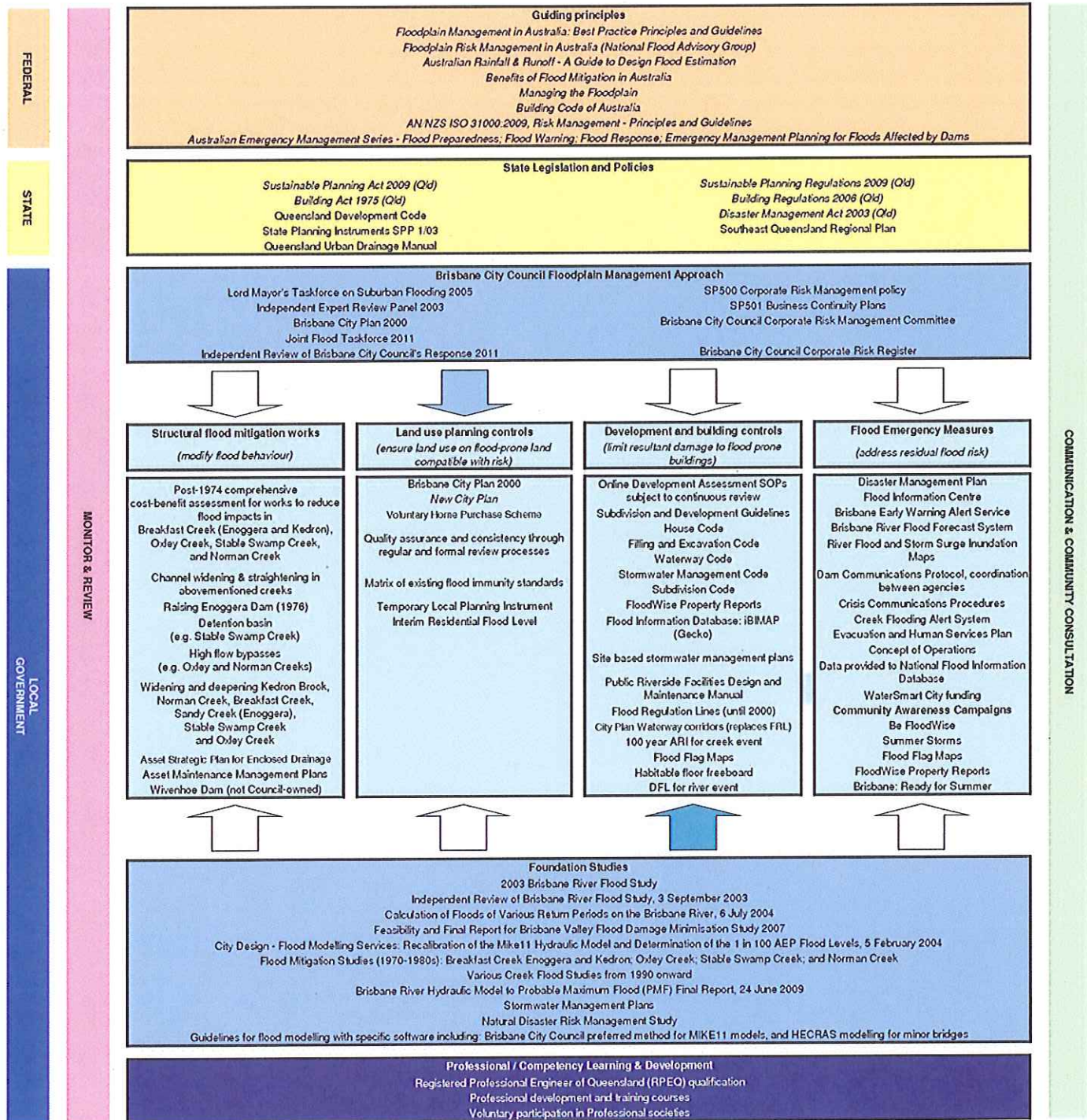
flood risk management. The Council has also employed some of the country's largest and most experienced consulting firms to assist it in this task.

8. A diagrammatic summary of the manner in which Council has approached management of its floodplains is depicted in **Figure 1**. These floodplains include not only riverine floodplains but also creeks, stormwater overland flow paths and coastal areas subject to storm surge. This figure provides a summary of Council's floodplain management activities in relation to structural flood mitigation works, land use planning controls, development and building controls and flood emergency response measures.
9. Consistent with good practice, Council has also engaged independent experts to carry out reviews of which the following are most noteworthy:
 - (a) September 2003 review of the Brisbane River Flood Study carried out by an independent review panel comprising Messrs Mein, Apelt, Macintosh and Weinmann. This panel included some of Australia's most eminent hydrologists and academics with experience in flood hydrology;
 - (b) 2009 review carried out by John Gaskell planning consultants and a team of other experts. This review looked at Council's approach to natural disaster risk management in the City Plan having regard to SPP 1/03;
 - (c) independent review of Council's emergency management response to the January 2011 flood.
10. A significant portion of Council's flood risk lies beyond the Brisbane River within the floodplains of the creeks and stormwater overland flow paths which are scattered across the local government area. As can be seen from **Figure 1** and my overview of the numerous studies I have referred to in paragraph A38, Council has devoted considerable resources over the last decade into investigating and managing these flood risks. In my opinion Council has achieved an appropriate balance of its resources between addressing its riverine and non-riverine flood risks.
11. The Lord Mayor's Task Force which was established in February 2005 had very significant implications for flood risk management across the City. In my opinion, the Task Force's report is the most significant flood risk management study that has been undertaken for the City. The study and its recommendations are well founded in my opinion.
12. For a brief time I was a member of the Lord Mayor's Panel which commenced a review of the Task Force's findings in late 2010 before the function of this Panel was suspended by the January 2011 flood. I note that by 2011 Council had achieved significant progress on implementation of the majority of the Task Force's recommendations.

Flood Risk Management is a Multi-Disciplinary Activity

13. I am a risk management consultant and hydrologist based in Sydney. My firm has completed over 20 major flood risk management studies for local government over the last 15-20 years. An integral part of these studies has been the preparation of land use planning controls to manage flood risks in floodplains.

Figure 1: Flood Risk Management within Brisbane City Council



14. Flood risk management is a multi-disciplinary exercise. The various disciplines that contribute include hydrology, town planning, flood simulation, risk management, civil engineering, GIS mapping, community consultation, social planning, emergency management, economics and environmental assessment. In the flood risk management studies that my firm has undertaken, I've normally been the project coordinator overseeing a team of individuals with the above skills whilst also undertaking many of the risk management tasks myself.
15. At its core, flood risk management involves a balancing of flood risk considerations against the economic and orderly development of floodplains in a manner which is socially and environmentally responsible and sustainable. A key outcome of this process is the selection of levels of risk for a variety of floodplain land uses that are acceptable to the community.
16. Flood risk management is best carried out at the local government level where the above disciplines can be integrated and competing tensions resolved. The level of guidance provided by state governments in this process varies between states. Nevertheless there is sufficient commonality of approach for national guidelines (e.g. SCARM, 2000) to be valuable.

Expert Reports Submitted Recently to the Commission

17. I've also been given copies of the following reports on flood mapping and town planning issues that have recently been provided to the Commission by three town planners:
 - (a) Town Planning Report. Planning Aspects of Alternative Approaches to Mapping the Effect of Flood. Prepared by Greg Van, Buckley Vann Town Planning Consultants. 3 November 2011;
 - (b) Flood Mapping in Queensland Planning Schemes. Recommendations to the Queensland Floods Commission of Inquiry. Prepared by Steve Reynolds, Humphrey Reynolds Perkins, Planning Consultants. 28 October 2011;
 - (c) Flood Mapping in Queensland Planning Schemes – Addendum. Prepared by Steve Reynolds, Humphrey Reynolds Perkins, Planning Consultants. 3 November 2011; and
 - (d) Report to Queensland Floods Commission of Inquiry Addressing Town Planning Issues. Statement of Paul Grech, Grech Planners. October 2011
18. I have provided some brief comments on these reports where relevant to the practice of flood risk management for land use planning purposes.
19. I note however that Mr Grech appears to be the only town planner with demonstrated flood risk management experience and his experience is considerable². I concur largely with his explanation of flood risk management and his suggested approach to its application for land use planning within floodplains.

² I have previously worked with Mr Grech in completing a large number of flood risk management studies for councils outside Queensland. He and I have also co-authored a number of technical papers relating to flood risk mapping and land use planning practice within floodplains.

The Term 'Risk'

20. The practice of flood risk management is hindered by confusion and misunderstanding about what the term 'risk' means. In common usage 'risk' is usually taken to mean 'chance' or 'probability'. This however is not how the term is used in the risk management industry.
21. In the industry, 'risk' means a combination of probability and consequence. The most significant flood risks that the community faces and that need to be addressed through a flood risk management process, are typically not those which occur most frequently (as these usually have the least consequences), nor those which have the most severe consequences (as these usually occur very rarely). Rather it is the mid-range events with a combination of both probability and consequence that produce the most significant risk.

Mapping Flood Risk

22. Within the industry there is no commonly accepted standard for mapping of flood risk. Flood behaviour and its consequences are numerous and varied and it comes as no surprise that a multitude of different types of mapping are produced to describe both the probability and consequences of flooding. These can include maps of flood extents, flood depths, flood velocities, flood hazards, evacuation risks, building damage, etc.
23. It is my opinion based on my experience in carrying out flood risk management studies for about two dozen communities that the most effective method of communicating flood risks (for land use planning purposes) is through production of simple mapping products that display for example, 'low', 'medium' and 'high' flood risks³. This approach is widely used across the country for mapping many natural hazards.

Investigating Floods across the 'Full Probability Domain'

24. A few weeks ago I participated in the expert panel of hydrologists who provided evidence to the Commission on Brisbane River flood frequency issues. It was the recommendation of that panel that the proposed flood study for the Brisbane River provide information across the 'full probability domain'.
25. Floods come in all shapes and sizes. Small floods occur more frequently and large floods occur less frequently. The advice of the hydrologists was that the future comprehensive flood study should provide information about the characteristics of all potential floods.
26. Once this flood behaviour information is available, the consequences of these events need to be considered as part of a comprehensive flood risk management approach.
27. I note concerns raised by Mr Reynolds in his addendum that the recommended use of 'Monte Carlo' techniques for the Brisbane River may be required elsewhere across the State with significant time implications. Might I respond by saying that the expert panel made no recommendation for Monte Carlo techniques to be used elsewhere in the State. The panel's focus was entirely on Brisbane River.

³ This is consistent with the risk mapping advice provided by Mr Grech in pages 19 to 23 of his statement. Note that the production of these flood risk maps should not replace production of flood behaviour maps.

28. From my knowledge of Queensland catchments, it would be most unusual for Monte Carlo techniques to be required (beyond the Brisbane River) in order to prepare the flood behaviour studies which are a necessary precursor to flood risk management studies.

Selection of a Singular Flood Planning Level

29. Traditionally, planning schemes across the country have been based on a singular flood planning level. Over the last decade, the application of risk management approaches to land use planning has resulted in the development of a range of flood planning levels depending on the susceptibility of individual land uses to the flood hazard.
30. Nevertheless in most cases it's been my experience that the 100 year flood level has often been adopted as the basis for setting floor levels for the most common forms of residential development. Whilst there is no imperative to do this however the prevalence of this past standard makes change difficult in the absence of compelling reasons.
31. I note that contrary to the practice of other councils, Brisbane City Council has for many years not adopted the Q100 as its floor level standard (in its riverine floodplains). My review of both the 2003 and 2011 expert panel reports indicate that the panels gave rigorous consideration to the benefits and dis-benefits of alternative flood planning levels before making their recommendations to Council.

Consideration of Larger Floods

32. Once a designated flood level has been established it is important to realise that floods bigger than the designated flood will occur at some time. In the industry this is often expressed by saying that it is not a matter of 'if' these events will happen but 'when'. The events of last summer are a poignant reminder of this truth.
33. I have expressed some criticism to the Council that the 'message' conveyed to the public by their existing mapping products, particularly those on the Internet, do not always indicate that larger floods than those shown could possibly occur. I have recommended to Council that modifications (generally minor) to the existing mapping products should be introduced to better convey this message to the public.
34. From my review of the documentation in **Appendix A** and my discussion with Council officers however it is clear that Council has directed significant efforts into investigating and appreciating the consequences of floods larger than the designated flood. In particular I note that over the last decade Council has produced mapping including inundation extents, evacuation zones, isolated property areas property accounts and lists of at-risk critical infrastructure for a range of floods larger than the Q100.⁴ Nevertheless this mapping is not as accessible as some of Council's other mapping products.
35. Whilst care must be taken to ensure information presented to the public is not overly alarmist, it is my opinion that mapping of the probable maximum flood (PMF) should be made available to the public (with appropriate explanation). Such maps identify

⁴ These include floods with discharges of 7000m³/s, 9000m³/s, 10000m³/s, 12000m³/s, 15000m³/s, 21000m³/s and 38000m³/s. I also understand further work is currently underway to add more floods to this list.

the full extent of the floodplain and the most severe (and most unlikely) flood hazards that the community might face.

36. I note also that in November 2011 Council had plans in place to publish more mapping of larger flood events through the Catchment Flood Risk Management Plan Pilot (refer paragraph A37). Further I understand that the Flood Flag mapping project is to be extended to publish mapping of larger events and these should be available to the public by June 2012. I support these initiatives.

A Risk Management Approach to Land Use Planning

37. In **Table 1** I have provided a very condensed summary of key steps involved in the application of a risk management approach to the development of land use planning controls for floodplains.
38. I've also included in the table my understanding of how Brisbane City Council has gone about implementing this approach.

Concluding Comments – Wider Implementation of the Risk Management Approach

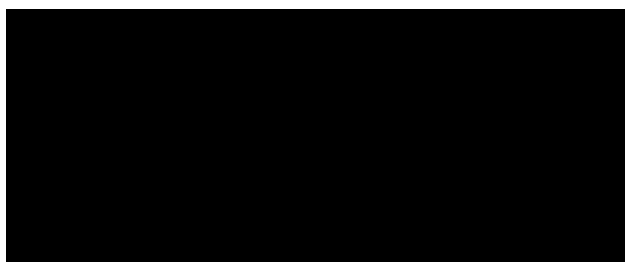
39. In considering what might best be done to facilitate wider implementation of a risk management approach to floodplain management within Queensland, may I suggest that consideration be given to the following⁵:
- (a) **Merit Assessment:** Implementation of a risk management approach to the selection of flood planning levels based on a merit assessment. This merit assessment should take into account social, economic and ecological factors, as well as flooding considerations. (The adoption of residential flood planning levels set higher than the Q100 plus freeboard would be the normal outcome of this process in a catchment within the State where the flood risks are unusually severe).
 - (b) **Best Practice Guidelines:** Development of best practice guides to facilitate wider understanding and implementation of the risk management approach within the State. This would be assisted by Queensland being a more active contributor to the current nationwide review of SCARM (2000) with a view to the new document becoming the recognised guide to best practice for floodplain management in Queensland. (This document is scheduled for release in June 2012). Brisbane City Council would likely be a lead agency in this process given their existing flood risk management experience.
 - (c) **Increase Skill Levels:** Steps are taken to raise the skills base of floodplain management practitioners in Queensland in both the private and public sector, and targeting particularly the engineering and town planning professions. This could be achieved in a variety of ways if funding was made available (e.g. to prepare guidelines, run workshops, promote formal education of flood risk management at Queensland tertiary institutions). Further a key means of raising and maintaining awareness would be for both state and local agencies to participate in the formation of the National Association of Floodplain Managers. The existing body which is largely NSW and Victorian based has a

⁵ I will leave the issue of the necessary revisions to SPP 1/03 (and other legislation) to better implement a risk management approach to floodplain management, to other experts including Mr Grech.

membership of over 90 councils as well as state agencies and representatives from the private sector, but with very little participation from Queensland. The national body will promote the development and understanding of floodplain management practice in Australia.⁶

- (d) **Government Facilitation:** Government facilitation of responsible floodplain management across the State at the local level through a variety of means including consideration of:
 - (i) changes to indemnity provisions for councils in relation to their floodplain management activities and land use planning instruments; and
 - (ii) Government funding eligibility for floodplain works and measures.
- (e) **Flood Risk Mapping:** Formalisation of a common approach to mapping flood risks (such as that suggested in paragraph 23 above) which ensures as a minimum that:
 - (i) the most dangerous parts of the floodplain are mapped having regard to both the risks to life and the risks to property;
 - (ii) the extent of flooding that will likely control the most common type of residential development are shown; and
 - (iii) the full extent of possible risks is indicated (e.g. including mapping of the probable maximum flood).

Yours sincerely



Drew Bewsher
Director

⁶ Details of the existing body can be found at www.floods.org.au. Note that a similar body to the proposed national body has been in existence in the USA for many decades – see www.floods.org.

Table 1: Steps in the Application of the Flood Risk Management Approach to Land Use Planning and the Preparation of Development Controls for Floodplains

	Steps	Evaluation of Brisbane City Council's Activities
1	<p>Understand the Flood Behaviour</p> <ul style="list-style-type: none"> • review the full spectrum of floods from frequent events (e.g. two year) through 100 year to the less frequent and improbable events such as the PMF; • examine aerial extent, velocities, depths, etc; • examine inundation risks from all sources riverine, creeks, stormwater, etc. 	<ul style="list-style-type: none"> • BCC has undertaken a very large number of flood studies; • many of these studies have examined a range of flood probabilities not just the Q100; • Council has identified inundation risks from the River, from creeks, from stormwater overland flow paths and storm surge, and separately investigated these risks.
2	<p>Understand the Consequences</p> <ul style="list-style-type: none"> • examine the risk to life and risk to property; • assess evacuation capability; • assess critical evacuation risks (e.g. formation of low flood islands); • determine extent of private and public flood damages; • consider direct, indirect and intangible damages. 	<ul style="list-style-type: none"> • the City's current exposure to flood damage from River flooding has been assessed in the Brisbane Valley Flood Damage Minimisation Study; • local stormwater management plans consider damage potential. The proposed catchment flood risk management studies will look further at this issue; • the Brisbane River flood forecasting system provides indications of depth and extents of inundation for properties during flood events; • the emergency management implications have been examined by Council's Disaster Response Unit.
3	<p>Classify and Map Flood Risks</p> <ul style="list-style-type: none"> • considering all the probabilities and consequences of flooding, classify areas of the floodplain subject to similar severities of flood risk flood risk. 	<ul style="list-style-type: none"> • hazard mapping has not generally been produced for use in planning and development assessments to date. However hazard maps are being prepared for use in the 'New City Plan'; • a very large range of flood mapping products are available on Council's GIS; • much information about hazard is available and utilised in Council's investigations although formal hazard maps have not been prepared; • Council has recently had consultants prepare a draft 'Flood Hazard Overlay Code Methodology' for consideration by Council.
4	<p>Determine What Types of Development are Appropriate given the Risk. Prepare and Implement Controls</p> <ul style="list-style-type: none"> • classify land use types into different susceptibility to flood risks; • determine standards appropriate to each land use type, for each type of inundation; • review broader social, environmental and economic considerations in order to determine an appropriate balance; • consider range of controls including floor levels, building materials, access, flood effects on others, etc. 	<ul style="list-style-type: none"> • significant consideration was given to these issues by the 2005 Task Force (and the 2011 Task Force); • the City's Subdivision and Development Guidelines which were gazetted in 2008 provide for a number of different flood immunity standards for private and public infrastructure subjected to riverine, waterway, local stormwater and storm surge flooding.

Appendix A

Documents Reviewed in Order to Establish the Flood Risk Management Practice of Brisbane City Council

Documents have been sorted into chronological order:

- A1. Floodplain Management Australia – Best Practice Principles and Guidelines. Standing Committee on Agriculture and Resource Management (SCARM), Agriculture and Resource Council of Australia and New Zealand, 2000;
- A2. The City Plan. Brisbane City Council. 2000.
- A3. State Planning Policy 1/03. Mitigating the Adverse Impacts of Flood, Bushfire and Landslide. Queensland Government. May 2003.
- A4. Review of Brisbane River Flood Study. Report to Brisbane City Council. Independent Review Panel. September 2003.
- A5. AS/NZS 4360:2004 Risk Management. Australian and New Zealand Standard. 2004.
- A6. A Framework for Flood Risk Management by Brisbane City Council (Draft). Prepared by Water Matters Pty Ltd for Urban Management, BCC. 2004
- A7. Risk Based Approach to Flood Management - Benchmarking Component. Prepared by Water and Environment Group, City Design, BCC for Urban Management, BCC. 2004
- A8. Floodplain Development Manual, NSW Government, 2005;
- A9. Report on Brisbane City Natural Disaster Risk Management Study. River Flood Phase. 2005.
- A10. Lord Mayor's Task Force on Suburban Flooding. Prepared for Brisbane City Council. August 2005.
- A11. Report on Brisbane City Natural Disaster Risk Management Study. Report on Other Water-Based Hazards Phase (Severe Storm, East Coast Low and Storm Tide). Prepared by Queensland Risk Management Consultants Pty Ltd in association with Kellogg Brown & Root Pty Ltd. 2005.
- A12. Brisbane City Natural Disaster Risk Management Study. Finalisation Package. Prepared in association with the Queensland Government Counter Disaster and Rescue Services, Queensland Department of Emergency Services and Commonwealth Department of Transport and Regional Services. 2005.
- A13. Subdivision and Development Guidelines. Part A Hazard Management. Chapter 1 - Flood Affected Land. Prepared by City Policy and Strategy Division. Brisbane City Council. Gazetted 8 February 2008.
- A14. Threat Specific Sub-Plans: River Flood and Storm Surge. Report for Brisbane City Council. Submitted by Apis Pty Ltd. May 2008.

- A15. Threat Specific Sub-Plan. Storm Surge V0.1. Brisbane City Council. 2008.
- A16. Threat Specific Sub-Plan. Brisbane River Flood. V0.1. Brisbane City Council. 2008.
- A17. Brisbane River Hydraulic Model to Probable Maximum Flood (PMF). Final Report. Prepared by Flood Management, City Design, Brisbane City Council, for Families And Community Services Division, Brisbane City Council. 24 June 2009.
- A18. Natural Disaster Risk Management and the City Plan - Consideration of SPP 1/03. Brisbane City Council. Prepared by John Gaskell Planning Consultants, Environmental & Community Risk International, Ken Granger, and WRM Water and Environment. 2009.
- A19. Review of the Brisbane City Council Response to Brisbane Storm Events 16-22 November 2008. RFM Consulting Services. Draft. March 2009.
- A20. Concept of Operations. Disaster Management. Brisbane City Council. Revised November 2009.
- A21. Australian Emergency Manual's series, AGD (Attorney General's Department), Commonwealth of Australia. 2009;
- A22. Maintain and Enhance Flood Models Project – Level of Service. Water Resources Branch. Brisbane City Council. November 2010.
- A23. Brisbane Flood January 2011 – Independent Review of Brisbane City Council's Response, 9-22 January 2011. The review board consisted of Major General Peter Arnison AC, CVO (Retd), Mr Robert Gotterson QC and Emeritus Professor Colin Apelt.
- A24. Queensland Floods Commission of Inquiry. Initial Submission. Brisbane City Council. 11 March 2011.
- A25. Queensland Floods Commission of Inquiry. Submission Two. Brisbane City Council. 8 April 2011.
- A26. Temporary Local Planning Instrument - 01/11. Brisbane Interim Flood Response. Brisbane City Council. 2011.
- A27. Joined Flood Task Force Report. March 2011.
- A28. Inundation Plan. Brisbane City Council Disaster Management Plan. Brisbane City Council. 2011.
- A29. Temporary State Planning Policy 2/11. Planning for Stronger, More Resilient Floodplains. Queensland Reconstruction Authority. September 2011.
- A30. Planning For Stronger More Resilient Floodplains. Part 1 - Interim Measures to Support Floodplain Management in Existing Planning Schemes. Queensland Reconstruction Authority. 2011.
- A31. Cabbage Tree Creek-Pilot Catchment. Flood Risk Management Plan. BMT WBM. Prepared for Brisbane City Council. June 2011.

- A32. Statement of Martin John Reason. Queensland Floods Commission of Inquiry. 1 September 2011.
- A33. Draft Flood Hazard Overlay Code Methodology. Discussion Paper. Prepared by BMT WBM for Brisbane City Council. October 2011.
- A34. FloodWise Property Reports. Brisbane City Council. www.brisbane.qld.gov.au. Downloaded November 2011.
- A35. Temporary Local Planning Instrument - 01/11. Brisbane Interim Flood Response. Frequently Asked Questions. Brisbane City Council. . www.brisbane.qld.gov.au. Downloaded November 2011.
- A36. Residents Guide to Flooding. Understanding Your Flood Risk. Brisbane City Council. . www.brisbane.qld.gov.au. Downloaded November 2011.
- A37. Flood Flag Map. Brisbane City Council. . www.brisbane.qld.gov.au. Downloaded November 2011.
- A38. Numerous studies carried out by Brisbane City Council's Waterway Division. These include 11 Catchment Management Plans, 13 Waterway Management Plans, 21 Stormwater Management Plans, 24 Local Stormwater Management Plans and 25 Creek Flood Studies.