QUEENSLAND FLOODS
COMMISSION OF INQUIRY

SUBMISSIONS FOR STATE OF QUEENSLAND

Department of Environment and Resource Management (DERM)

Statement of John Lawrence Ruffini

[redacted]

[redacted]

Letter from Commission

1. I have seen a copy of a letter from the Executive Director, Queensland Floods Commission of Inquiry to an Assistant Crown Solicitor, Crown Law which is attachment **JLR-01** and details the topics my statement should cover.

2. In this statement when I refer to "the Seqwater Report" in singular I mean Seqwater's Report on the operation of Somerset and Wivenhoe dams during the January 2011 flood event dated 2 March 2011. When I refer to "the Seqwater Reports" in plural I mean the previous mentioned report plus Seqwater's Report on the operation of North Pine Dam during the January 2011 flood event dated 11 March 2011.

Professional Qualifications

3. I hold a Bachelor of Engineering (BEng) from the Darling Downs Institute of Advanced Education (a predecessor institution to the University of Southern Queensland). I completed this degree at the end of 1983 and was then awarded a scholarship to study a Master of Science (MSc) majoring in Agricultural Engineering from Oklahoma State University in the United States of America. I completed that degree in 1985 and the degree was conferred in early 1985.

Professional Experience

4. I have significant experience as an engineering hydrologist. A copy of my *curriculum vitae* (CV) is attachment **JLR-02** to this statement. A list of relevant articles and reports that I have authored or co-authored is included in the CV.

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QFCI

Date: 14/4/11

Exhibit Number: 42

5. In about October 1985 I commenced working for the University of Southern Queensland as a research engineer and worked there for approximately 3 years. The project on which I worked involved investigating the hydraulic properties of strip cropping and sediment movement on the Darling Downs. I also did part time lecturing in engineering hydrology at USQ in that period.

6. I then commenced employment with the former Queensland Water Resources Commission (QWRC) as an engineer in the Surface Water Hydrology area and worked on flood hydrology and yield hydrology. In around 1990 I was involved in flood forecasting including developing a real time flood warning system for the Peter Faust Dam (near Proserpine).

7. During this time I was also a part time tutor and lecturer in hydrology at the Queensland University of Technology.

8. The QWRC was then incorporated within the Department of Primary Industries (DPI) and I was employed as a senior engineer and then a senior hydrologist. I then worked in the Resource Science Centre (RSC) of the Department of Natural Resources. The RSC became known first as Natural Resource Sciences and now as Environment and Resource Sciences while the department name and functions went through several iterations (Natural Resources and Mines, Natural Resources Mines and Energy, Natural Resources Mines and Water, Natural Resources and Water) and it is now the Department of Environment and Resource Management. I progressed through the increments and promotion to more senior positions on the Professional Officer (PO) pay scale. About 4 years ago I became Director of the hydrology area on the Senior Officer (SO) pay scale as an SO2 and I was then promoted to an SO1 as Director of Water Planning Sciences with broader responsibilities for the management of the aquatic ecologists and hydrographic support unit.

9. I have been involved in many flood hydrology studies. Some of these include Nerang River Flood Plain Model, Nogoa Floodplain Model, Warwick Flood Study, Bjelke Petersen Dam Dambreak Study, Nagar Creek Flood Study, Flaggy Creek Dam Flood Study, Peter Faust Dam Break Study and Peter Faust Dam Flood Warning System. Over the past ten years I have been responsible for overseeing the delivery of surface and groundwater catchment scale water balance models for all the major aquifers and river basins in Queensland.

10. From 1990 to 1995 I was involved in a major study and revision of the Brisbane Pine River Flood Study. The study was conducted for the former South East Queensland Water Board (SEQWB) which later became the South East Queensland Water Corporation. A great detail of input was received from stakeholders e.g. local councils. The study comprises 27 volumes and is considered to be the seminal work in this area. A copy of the study is kept in the Flood Operations Centre. A copy of the volume index is attachment **JLR-03** to this statement and I understand that a copy of the study will be provided to the Commission by the State. A departmental dam safety engineer, the engineer identified as Flood Operations Engineer One in the Seqwater Report and myself were the three main people who did the work. The study was independently

expert reviewed. I believe that the Executive Summary of the study has already been supplied to the Commission.

11. Phase one of the study involved the revision of all hydrology and its application to design floods. Dam failure analysis (for factors including e.g. overtopping, breaching, sunny day failure etc) was completed. A hydraulic model was created. A hydraulic model is a numerical model where survey and other data can be input and the output will be estimates of height/discharge/velocity. Part of this focus was on dam safety and if the dams failed how long it would take for the water to reach Brisbane.

12. Phase two of the study was development of Real Time Flood Warning Model based on the ALERT data protocol developed by the United States National Weather Service. The Australian BoM had adopted this at the time as their standard system for flood warning systems. Phase one of the study had shown that the full Probable Maximum Flood (PMF) couldn't be passed through the Spillway configuration as it existed. Prior to 1996 the Brisbane Valley River Telemetry Network (BVRT) had been used as the primary data collection tool for the management of Wivenhoe and Somerset Dams. The upgrade to upgraded real-time flood warning system was in part a response to the increase in the PMF estimates and in part because of the age of limitations of the existing system.

13. As described above a real time flood model for Wivenhoe, Somerset and North Pine Dams ("the relevant dams") was developed as part of that study. After the study was finalised in 1995 there was a commissioning period and the system became fully commissioned after the 1999 floods.

14. SEQWB had contracted Brisbane City Council to operate the three dams from the completion of Wivenhoe Dam up until June 1996. In 1996 SEQWB issued a tender for a contract flood planning and operations of North Pine Dam, Wivenhoe and Somerset Dams and provide flood operations support for the three dams. The then Department of Primary Industries (DPI) competed for and won the contract. I became involved as a Senior Duty Flood engineer at this point. State Water Projects (a Division within DPI) took responsibility for dam operations for the contract. State Water Projects became SunWater when they commercialised. The contract went with SunWater. SunWater initially contracted the services of approximately ten staff of my staff including myself from DPI to support the flood operation. All staff bar me were phased out by 2006. In the recent reorganisation of water supply arrangements in South East Queensland Seqwater took over all SunWater assets in south east Queensland. As part of this process Seqwater transferred all the dam operational staff and two duty engineers from SunWater.

15. I sat on the Institute of Engineers Water Panel in Brisbane for a number of years.

16. In my professional opinion it would be beneficial for the Commission to have access to a hydrology expert to assist in the technical explanation of matters and that this expert be properly qualified and experienced in the area. Unfortunately the pool of qualified people is so small that probably none of the experts will be free of some sort of conflict of interest or perceived conflict of interest (e.g. some

have been engaged by insurance companies to prepare reports). I understand that the Commission has informally approached the government seeking such an expert. At the time I advised the relevant officers at DERM that I would be happy to advise the Commission in a technical expert role (and that in my opinion as backed up by my stated professional experience I am properly qualified and experienced in the area) however as I would probably be a witness at the Commission there might be some conflict of interest or perceived conflict of interest which would preclude me from assisting in such a role. However I am still happy to assist if required.

Current Employment

17. I am employed by the Queensland Government Department of Environment and Resource Sciences as Director Water Planning Sciences Branch, Environment and Resource Science Division, Operations and Environmental Regulator Business Group.

18. My position description duties are:
    - Ensure effective operational delivery of water scientific services across the department.
    - Manage other assigned projects to address impediments to effective science delivery to achieve business objectives sought by the Executive Management Group and the Assistant Director-General, Environment and Resource Sciences.
    - Ensure assigned staff are effectively led and managed to achieve business objectives.
    - Provide high quality scientific and policy advice and recommendations to the Executive Management Group and the Assistant Director-General, Environment and Resource Sciences as required.
    - Develop and maintain effective working relationships with internal and external stakeholders to facilitate resolution of complex scientific and operational issues.
    - Ensure delivery of business in accordance with corporate policies, standards and accountabilities.

19. I supervise approximately 83 staff. The organisational chart for Environment and Resource Sciences Division down to Group Leader level is attachment **JLR-04**. A headcount organisational chart for staff under me (including contractors i.e. not on DERM payroll) is attachment **JLR-05**.

20. As part of my position, I sit on technical panels and user reference groups, but I do not receive payment for this outside of my pay from DERM and it is not an employment relationship. When I attend it is considered that I am attending in my capacity as Director, Water Planning Sciences, DERM. Two examples are:
    - I was a member of the user reference group for the eWater River Management Development Team; and
    - I was involved in the review panel for a book titled *Review of Australian Rainfall Runoff.*

Flood Operations Engineer duties

21. I am a Flood Operations Engineer but I do not receive payment for this from SunWater or Seqwater and it is not an employment relationship. I have done this since 1 July 1996.

22. I believe DERM bills SunWater (which then presumably passes the bill on to Seqwater) for any time I spend as a Flood Operations Engineer. The finance area of Environment and Resource Sciences arranges the invoices. I do not receive any extra payment from DERM for these attendances.

23. The only formal contractual arrangement for me to work as a Flood Operations Engineer was initiated in 2000 when a Memorandum of Understanding ("the 2000 MoU") was entered into between SunWater and the then Department of Natural Resources (DNR), a copy of which is attached and marked as **JLR-06**. The MoU commenced on 1 October 2000 and was to come to an end on 30 June 2001. There was provision in the MoU for an extension for a period not less than 18 months but I am not aware if that extension was exercised. Under the 2000 MoU DNR was to provide flood operation services for Wivenhoe, Somerset and North Pine dams by providing two engineers (including myself), eight data collectors and computer support officers. This was a continuation of flood operation services that the department and the previous iterations (Queensland Water Resources Commission, etc) had provided in the past.

24. Practically, DERM and its predecessor departments have continued to operate on an understanding basis with SunWater similar to the 2000 MoU.

25. SunWater wanted to have its own staff doing the flood operations and gradually SunWater replaced all the DERM staff except myself providing flood operations services with SunWater staff (who mostly then became Seqwater staff).

26. The nature of Flood Operations Engineer duties entails infrequent (but high intensity) attendance at the Flood Operations Centre during Flood Events and a great deal of time on on-call duties. Three Flood Operations Engineers are on-call 24 hours a day 365 days a year. Flood Operations Engineers must restrict their movements while on-call (for Close or Second Close Call Duties this includes not drinking alcohol to say over 0.05BAC) and maintain themselves in the following states of readiness:-
    - Close Call
        a) Be contactable at all times and carry around, or maintain in close proximity, the lap top portable computer, mobile phone and Bureau of Meteorology weather warning pager.
        b) Monitor, as closely as necessary for the safe operation of the dams, catchment rainfall, dam levels and river levels, weather warnings and forecasts. Monitor weather situations as they develop.
        c) Monitor the performance of the data collection system to ensure the system is operational.
        d) Be ready to mobilise to the Flood Control Centre within 2 hours.
    - Second Close Call
        a) Be contactable in the event of rain.

b) Maintain a high degree of awareness of prevailing weather.
c) Be able to mobilise to the Flood Control Room to assist, as required, the Flood Operations Engineer on Close Call.
d) Communicate with the Flood Operations Engineer on Close Call as necessary to check readiness in the event of heavy rain.
e) Remain within say 4 hours of the Flood Control Room.

- Remote Call
  a) Be contactable in the event of rain.
  b) Maintain a general awareness of prevailing weather.
  c) Be able to mobilize to the Flood Control Room at the end of the first shift, and remain within, say 8 hours of the Flood Control Room.

27. Since 1 July 1996 I have generally spent one week in every four on Close Call, one week in every four on Second Close Call, one week in every four on Remote Call and one week off call if I am lucky (because if someone is away interstate or overseas then there are only three Flood Operations Engineers remaining so everyone will be on one type of call duty). The Flood Operations Engineers negotiate dates between themselves and the Senior Duty Flood Operations Engineer (currently the engineer identified in the Seqwater Report as Flood Operations Engineer 1) is responsible for ensuring there is always someone on each call type. If the engineer identified in the Seqwater Report as Flood Operations Engineer 1 is interstate or overseas then I act as the Senior Duty Flood Operations Engineer. The other two Flood Operations Engineers (identified in the Seqwater Report as Flood Operations Engineer 2 and Flood Operations Engineer 4) are not authorised to act as Senior Duty Flood Operations Engineer. Another reason I haven't liked to refuse to continue in the role is that, because there really isn't anyone else who could do it, it would also make life harder for the other three Flood Operations Engineers because then they could never travel more than eight hours from the Flood Operations Centre because at all times there must be one person on Close Call, one person on Second Close Call and one person on Remote Call.

Dates stationed at the Flood Operations Centre in 2010 and 2011

28. The Flood Operations Centre was activated on Thursday 6 January 2011 at 7:00 AM.

29. Flood Operations Centre Staffing is listed at pages 33-35 of the Seqwater Report and Engineer 3 (myself) recorded stationed hours were: -
Friday 7/1/11 from 7:00 PM to Saturday 8/1/11 7:00 AM
Sunday 9/1/11 at 3:30 PM meeting of all 4 engineers
Sunday 9/1/11 from 7:00 PM to Monday 10/1/11 7:00 AM
Monday 10/1/11 from 7:00 PM to Tuesday 11/1/11 7:00 AM
Tuesday 11/1/11 from 7:00 PM to Wednesday 12/1/11 7:00 AM
Tuesday 11/1/11 - assisted from 1:00 PM to 7:00 PM
Wednesday 12/1/11 from7:00 PM to Thursday 13/1/11 7:00 AM
Saturday 15/1/11 from 7:00 PM to Sunday 7:00 AM
Monday 17/1/11 from 7:00 AM to 7:00 PM

30. Appendix M to the Seqwater Report – Flood Event Log - entries for Engineer 3 (myself) were recorded at the following times: -
Sunday 9/1/11 at 8:30PM, 8:55 PM, 10:00 PM, 1020 PM10:30 PM10:40 PM11:20 PM, 11:25 PM, 11:30 PM11:35 PM11:38 PM &11:40 PM
Monday 10/1/11 at 12:00 AM, 12:45 AM, 12:55 AM, 1:00 AM,4:10 AM, 5:05 AM & 6:30 AM
Monday 10/1/11 at 9:00 PM.
Tuesday 11/1/11 at 6:12 AM, 3:49 PM, 5:22 PM & 7:25 PM
Wednesday 12/1/11 at 3:10 AM, 5:15 AM, 5:30 AM, 7:45 PM & 8:00 PM
Thursday 13/1/11 at 1:10 AM, 1:25 AM & 1:30 AM
Friday 14/1/11 at 12:33 PM
Sunday 15/1/11 at 6:09 AM
Monday 17/1/11 at 11:20 AM, 12:20 PM, 1:01 PM & 4:56 PM
Tuesday 18/1/11 at 12:35 AM
Wednesday 19/1/11 at11:14 AM & 11:36 AM
Flood Event Log ceases Wednesday 19/1/11 at 3:20 PM

31. The reason that some of the entries for myself are recorded at times outside my recorded station hours is that sometimes I came in a bit early and just helped out a bit until the start of my roster.

Any training exercises and the like undertaken in connection with duties as a Flood Operations Engineer

32. In general since the development of the system in the 1990's training packages were prepared in conjunction with the operation of the system. I was involved in the preparation of the original training material. This material has since been modified by Seqwater. One on one training in the operation of the Real Time Flood Model is provided to Flood Officers (also known as Data Collectors) and Duty Flood Operations Engineers prior to them being placed into the rotation. This training is given by other Flood Operations Engineers and experienced Flood Officers.

33. Annually before the commencement of the wet season training is provided to the Dam Operators and to the Flood Officers by Seqwater. Occasionally I attend these trainings, not as a participant to be trained, but to "show my face", meet any new personnel and see what training is given to participants. I attended one such session in 2010 at one of the dams.

34. During a drought the Dam Operators exercise the dam gates as part of maintenance to ensure they are in proper working order if there is a flood event. None of the dam gates failed to operate during the January 2011 Flood Event.

35. A full simulated Flood Event training exercise was conducted in February 2006. I participated in this exercise. This involves the Flood Operations Centre. In every year that there is not a flood event a simulated training exercise is run (generally sometime between September and November) and I attend as a participant. The simulated training exercise involves:
    - One full day.

- As many Flood Operations Engineers and Flood Officers as possible attend at the Flood Operations Centre.
- Where possible, local councils are involved in the exercise.
- Dummy data is fed in and decision making based on that data is simulated by the Flood Operations Engineers.
- The telephone numbers in relevant lists are tested by the Flood Officers.

36. As there were two flood events in 2010 (February 2010 and October 2010) there was not a simulated training exercise that year. I have attended every simulated training exercise since 1996. Seqwater will have a full list of those simulated training exercises and my attendance. The last simulated training exercise was in 2006.

Any previous experience working in a Flood Operations Centre during Flood Events

37. I have worked in the Flood Operations Centre for Wivenhoe, Somerset and North Pine Dams for every Flood Event since 1 July 1996.

38. I am currently designated as one of the Senior Flood Operations Engineers.

39. Attachment **JLR-07** is a list of all the major Flood Events for which I worked in the Flood Operations Centre. A flood event is as defined in the Manuals of Operational Procedures for Flood Mitigation at Wivenhoe, Somerset and North Pine Dams.

40. I also developed, maintained and operated the flood warning system for the Peter Faust Dam (near Proserpine) during its construction phase.

Involvement, if any, in relation to revision(s) of the Manuals of Operational Procedures for Flood Mitigation at Wivenhoe, Somerset and North Pine Dams.

41. The flood manuals allow qualified personnel to make decisions based on risk in accordance with the policy settings of the government.

42. Geoff Cousins a senior duty flood engineer responsible for operating Somerset Dam during the 1974 flood describes some of the challenges that face duty flood operations engineers in his paper entitled "Ghosts of 1893". A copy can be provided upon request.

43. The manuals have been revised a number of times. I have had technical input into revisions since the flood studies in the 1990's. My input has included:
    - wording
    - hydrology
    - methodology
    - flood sizing
    - CRC-FORGE methodology
    - risk profiles
    - dam security

- fuse plug phases - construction and operation in 2005.

44. I provide comments and revision to the manuals but Seqwater, as the author, has the final decision on content subject to the approval of the regulator.

45. I was involved in Revision 7 of the Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam. The revised manual was completed in November 2009, approved by the chief executive in December 2009 and gazetted in January 2010.

46. The process of my involvement with the above revision is that a draft document was sent out by Seqwater for comment. Then a meeting of all the Flood Operations Engineers, and representatives from the relevant Councils was held. I attended the meeting as a Flood Operations Engineer.

Involvement, if any, in relation to the review of any other policy or procedure relevant to the operations of the dams.

47. There are two large methodologies applicable to the operations of the dams in which I was involved. I was involved in these in my capacity as Director, Water Planning Sciences, DERM rather than in my capacity as a Flood Operations Engineer.

48. The Co-operative Research Centre (CRC) for Catchment Hydrology modified the Focussed Rainfall Growth Estimation (FORGE) concept originating from the UK Institute of Hydrology into the CRC-FORGE Methodology for Rainfall Derivation project, which had a number of investors. Councils who contributed money to the study were given a CD of results.

49. Two essential components of the CRC-FORGE methodology were:
    - Aerial reduction factors output (how to translate design rainfall into catchment rainfall); and
    - Estimated rainfall durations across time between 24 and 120 hours was used to extrapolate the AEP 1 in 2000 and then used as pivot points for Probable Maximum Floods.

50. The General Tropical Storm Methodology Revision (GTSMR) was a collaboration between the State of Queensland through DERM, BoM, the NSW government and the WA government. I was a member of the Technical reference panel for this study. The methodology developed provided a way to estimate the Probable Maximum Precipitation (PMP). The PMP is an estimate of the largest possible rainfall event that could fall over a given area in a given time. The GTSMR Manual contains the methodology and applies to all dams in Queensland.

51. Once the GTSMR project was finished hydrological assessments were conducted by various dam owners to assess the spillway adequacy. Many dams were found to be in need of spillway upgrades. Significant investment in spillway upgrades to dams has since occurred across Queensland, New South Wales and Western

Australia. The need to upgrade the spillway capacity for Wivenhoe came out of this process and resulted in the construction of the fuse plugs.

52. A semi-technical description of each methodology prepared by a DERM Water Planning Sciences scientist is attachments **JLR-8** and **JLR-9**.

53. I had no involvement in the recent modelling for the reduction in storage capacity of Wivenhoe Dam to 75% of Full Storage Level (FSL). My group (the Water Planning Sciences Branch within the Environment and Resource Sciences Division of DERM) was asked to comment on the technical aspects of the work conducted by QWC hydrologists and two scientists within my team provided comments. Attachment **JLR-10** shows the names of the two DERM scientists (CJ and JV) who commented.

54. The Assistant Director-General, Environment and Resource Sciences was preparing a brief and she asked me in my role of Director Water Planning Sciences for my comments about the duration of the drain (Wivenhoe Dam was planned to be reduced to 75% of FSL over a nine day period). I advised that care was needed to ensure during the ramp up/down of flow should minimise potential bank slumping. I said 400 cumecs is contained in bank but it is a big release and might be a hazard to people if they tried to recreate in this flow.

55. I spoke to the Director of Dam Safety at DERM and to the appropriate officer at Seqwater seeking clarification of what was happening under this release and what if any role the Duty Flood Engineers would have.

56. RD confirmed that this was an operation release under the ROL. This was not a flood release and the Flood Duty Engineers would not be involved in anyway other than their normal on call monitoring role. Clarification was sought as to what the process was if a flood eventuated during the release. The response was that the normal rules would apply that is gate trigger would be 67.25 mAHD. If gate operations were open and were to continue once the lake level had reached 67.0 mAHD then a request would have to be put to the regulator.

57. The Water Planning Sciences Group that I manage within DERM provides hydrological analysis for the development of Water Resource Plans and Resource Operation Plans for all the dams in Queensland currently covered by Water Resource Plans. The Resource Operation Plans cover certain aspects of Dam operations complementary to the flood Manuals.

Whether designated Flood Operations Engineer 1, 2, 3 or 4 for the January 2011 Flood Events.

58. I was designated Flood Operations Engineer 3 for the January 2011 Flood Events.

When rostered off or on breaks during the period stationed at the Flood Operations Centre for the January 2011 Flood Events

59. Details of my stationing at the Flood Operations Centre are listed in Item 4 of my statement.

60. I drove to the Flood Operations Centre for rostered duties and parked in the car park under the building and when not on duty at the Flood Operations Centre I returned to my home.

61. A Flood Operations Engineer is rostered on for a 12 hour shift. There are no rostered breaks in this time. When I was the only Flood Operations Engineer if things were not busy occasionally I would have a break for a few minutes to go to the toilet or go out to buy food (I paid for all my own meals and drinks while at the Flood Operations Centre). Things were extremely busy from 9 January 2011 to 13 January 2011 and during those times there were two Flood Operations Engineers rostered on duties. We did not have any rostered breaks during the 12 hour shifts. Occasionally one of us would have a break for a few minutes to go to the toilet or go out to buy food and be covered by the other Flood Operations Engineer.

62. My work as a Flood Operations Engineer at this time took precedence over all my other work duties. I was scheduled to be on leave over Christmas but I ended up working very long days all Christmas and New Year and half of January.

What happened at the Flood Operations Centre with reference to the January 2011 Flood Event Report on the operations of Somerset Dam and Wivenhoe Dam and the January 2011 Flood Event Report on the operation of North Pine Dam.

63. The Dams were operated in accordance with the approved flood operations manuals.

64. Wivenhoe Dam and Somerset Dam provided clear and significant flood mitigation benefits during the 2011 Flood Event.

65. The January 2011 Flood Event, which impacted Wivenhoe, Somerset and North Pine Dam catchments between Thursday 6 January 2011 and Wednesday 19 January 2011, can be categorised as a large (Annual Exceedance Probability of 1:100) to rare (Annual Exceedance Probability of 1:2000).

66. Studies associated with the design and operation of Somerset and Wivenhoe Dam dating back to1971 indicate a flood of this magnitude would be expected to result in urban damage below Moggill.

67. BoM rainfall forecasts did not support the additional release of flood water early in the event. A fuller discussion demonstrating this statement is contained in the Seqwater flood event report.

68. There were major flood flows from Lockyer Creek, Bremer River and all the downstream tributaries. These flows alone would have caused damaging floods

in urban areas below Moggill during the critical period of the event from 11 January 2011 to 14 January 2011.

69. The data collection and flood modelling systems used to support decisions made during the Event performed well and assisted informed decision-making, in accordance with the manual.

70. To mitigate a flood you need to store water in the flood storage compartment of the dam and release it at lower rate then the inflow up to the peak. All releases from Wivenhoe Dam up to the peak were lower than the inflows. The flood was mitigated.

71. The Communications Protocol was adhered to during the event.

72. I understand that Seqwater has had its Report for the flood operations of the Wivenhoe and Somerset Dam 2011 reviewed by a panel of six external experts who are recognised nationally for their expertise. These reviews have been provided to the Commission of Inquiry.

73. The Flood Operations Centre is located in an office building at Level 9, 197 Turbot Street, Brisbane. It is just office rooms with computers, desks and telephones. There is a small kitchen area and a couple of mattresses for staff to sleep on if necessary (for example if they can't return to their homes if cut off by floods). There is a backup generator for power however one of the other Flood Operations Engineers was able to convince Energex not to shut down power to the building. The Flood Operations Centre remained operational and functional for the duration of the event.

74. Flood Operations Engineers and the Flood Officers were stationed at the Flood Operations Centre when it was activated as shown in the Seqwater Report. The Dam Operators were stationed at the dams (there is a building at each dam with faxes, telephones and computers). The Dam Operators physically move all the levers, open and close the gates and take pressure reading measurements in accordance with instructions from the Flood Operations Centre.

75. Details of what happened at the Flood Operations Centre as set out on pages 41 to 44 of the Seqwater Report.

76. The Flood Operations Centre was extremely busy during the Flood Event.

A detailed account, verbatim where possible, of conversations involved in noted in the Flood Event Log.

77. My comments are attachment **JLR-11**.

Opinion as to whether any changes should be made to the Flood Operations centre and if so, what changes.

78. Chapters 12 to 15 of the Seqwater Flood Event report describe some learnings from this event. Seqwater are currently working on updating the Real Time Flood

Model. This new system will use a more modern IT suite of software and approaches and it will also be able to leverage off advances in technology that were not available at the time the original system was constructed. The Flood Operation Centre will need to be configured to support this revised platform, which may involve moving the Flood Operations Centre to a new location.

79. As regards staffing, it has been historically difficult to obtain suitably qualified and experienced staff for the Flood Operations Centre. Factors causing this difficulty included:
    - pay
    - conditions
    - not a full time job
    - public scrutiny
    - uncertainty of floods to get experience.

Opinion as to whether as to whether the Manuals of Operational Procedures for Flood Mitigation for Wivenhoe, Somerset and North Pine Dams (Flood Mitigation Manuals or FMM's) should be revised and if so, how.

80. The January 2011 Flood Event was a large and significant event. Under clause 7.4 of the FMM's there is to be a report of the operational procedures in the FMM by Seqwater. The Seqwater Reports have been prepared and submitted to DERM. The Seqwater Reports have now been placed on the DERM internet site and provided to the Commission of Inquiry. The Seqwater Reports recommend a review of the FMM's that will be conducted by Seqwater in conjunction with the regulator. There is a need to review the technical hydrology information incorporating the information from the January 2011 Flood Event. A number of detailed studies will need to be undertaken as part of the overall manual review. The review will need to take into account the government's policy settings on water supply and flood. The balance of water security / dam safety / flood mitigation in the relevant dams is a matter for government policy and not an area I can really give an opinion on except in a technical sense.

81. After the DERM review and the expert review it will be up to Seqwater to revise the FMM's if necessary. In my opinion they will need to have people experienced in flood operations and flood hydrology involved and it may take several years. In my opinion the major study and revision done from 1990 to 1995 would be a good template for the revision process and provides some guidance as to the size and scope of work.

82. Also there is presently a review being conducted of the *Australian Rainfall and Run-off* *(ARR). In my opinion it would be beneficial if the review of the FMM's could dovetail with the revision of the ARR. In my opinion there also needs to be a coordinated approach with other stakeholders especially the councils in regard to flood levels.

*The ARR is one of the most influential and highly used documents published by the Institution of Engineers, Australia. The current edition, initially published in 1987 and published in a modified form in 1997, has received widespread Australian and international acclaim. The

handbook is the key source of technical information in Australia for designing infrastructure to withstand the impact of extreme rainfall, flooding and storm surge. I was on the review panel for the 1997 publication. I am not on the review panel for current review as I am too busy.

83. Naturally after any large event best practice is to go back and do the technical work to review the hydrology.

84. In my opinion the FMM performed well and did the job it was supposed to do i.e. mitigating large floods whilst protecting the integrity of the dam structure in accordance with government policy settings for water supply and dam safety.

Opinion as to the adequacy and accuracy of information received from the Bureau of Meteorology during the January 2011 Flood Events.

85. Seasonal outlooks provide an assessment of above median rainfall for the next three months. They give you a probabilistic assessment based on current state of the El Nino – Southern Oscillation (ENSO) and, in case of the current BoM system Indian Ocean sea surface temperatures are also incorporated. These outlooks assess the probability of exceeding the long-term median seasonal rainfall for the next three months ahead. They do not forecast event rainfalls or the likelihood of extreme events. In August 2010 the Bureau of Meteorology (BoM) advised that there was a 50-55% chance of above median rainfall. By 17th December 2010 this was revised to 65-70% of above median rainfall. On 20 January 2011 this was revised to 50-55% of above median rainfall. On 24 February 2011 it was updated to 55-60% of above median rainfall. The seasonal outlooks do not provide a defensible basis for event based flood operational decisions.

86. The Seqwater Report contains a commentary (Section 6.2) on the forecast rainfall for 1, 3 and 5 days available during the event and the accuracy of this information. These forecasts provided a general picture of weather pattern and for this event provided useful indication that rainfall system was moving. Seqwater receives a 24 hour Quantitative Precipitation Forecasts (QPF) from BoM for the dam catchments. This is considered to be the most robust of the current forecast products. The information provided is consistent with best practice but there are limitations in using this information in an operational sense as shown by the difference between the predictive and actual rainfall during the Flood Event as highlighted in Section 6.2 Table 6.2.1 of the Seqwater Report. This assessment is consistent with the advice provided to Seqwater by BoM in 2006. Attachment **JLR-12** is an email trail and attachment from BoM first sent 24 July 2006 and then forwarded with comments on 1 December 2010.

87. Three and Five day forecasts show an indication of future rainfall but cannot be used as a basis for flood operations decision making. The difference between the predictive and actual rainfall during the Flood Event is highlighted in Section 6.2 Table 6.2.1 of the Seqwater Report. In my opinion the BoM forecasts are as good as the current state of knowledge for weather forecasting (which is not that accurate).

88. The duty Flood Operations Engineers were aware of the limitations of the forecasts being provided and took this into consideration in their decision making process.

Opinion as to the adequacy and accuracy of rainfall and stream-flow data provided by the Department of Environment and Resource Management during the January 2011 Flood Events.

89. Seqwater has its own rainfall gauges and stream-flow systems which are independent systems that do not rely on data being fed from the DERM loggers or telemetry. For a number of stream gauging stations they do rely on access to the DERM river end. There are a number of DERM gauging stations where other organisations (e.g. Seqwater, BoM) also locate their logging and telemetry equipment in or near DERM huts. This equipment operates independently and transmits information directly to Seqwater. Calibration of the equipment is independently maintained by Seqwater. Real-time data published by DERM was used during the Flood Event to check information coming into Seqwater's ALERT system at various times. Where a Seqwater gauging station ceases to operate and data is not available then the DERM data may be referenced. At Section 5 of the Seqwater Report Seqwater discusses in detail data availability at the start and during the Flood Event - what sites were lost, the implications for flood operations and how this was catered for during the Flood Event.

90. In my opinion, given the severity of the event, the rainfall and stream-flow data from the DERM network was adequate and accurate.

Opinion of how the Agency Communications protocol used during the January 2011 Flood Event could be improved.

91. In my professional opinion it is better to ask the stakeholders about the adequacy of the information they received and what enhancements they would like to see in future. In what ever future form the protocol takes care must be taken to ensure the Flood Operations Engineers on duty stay focused on the primary task of managing the flood.

92. In my professional opinion I would like to see a more standardised approach to the formatting and wording of situation reports (see Appendices E and F of the Seqwater Report) sent from the Flood Operations Centre to BoM and others on its distribution list. In the future I would prefer the use of pro formas where possible. There would benefits in providing training and materials to the people who are to receive this information to enable a consistent interpretation of the pro forma material. This could be incorporated into the wet season preparations.

Signed by John Lawrence Ruffini this 24th day of March 2011 at Brisbane before

[redacted]

John Lawrence Ruffini

[redacted]

Solicitor/~~Barrister/JP/C.Dec~~

CURRICULUM VITAE

NAME: John Lawrence Ruffini
DATE OF BIRTH: [redacted]

EDUCATION:

Bachelor of Engineering, (Agricultural).
University of Southern Queensland
Australia, 1983.

Master of Science (Ag. Eng.), Oklahoma State University, USA, 1985.

EMPLOYMENT RECORD:

May 2008 to Date	Director Water Planning Sciences Department of Environment and Resource Management Department of Natural Resources and Mines
July 2007 to April 08	Director Water Assessment Department of Natural Resources and Mines
2001 to June 2007	Principal Hydrologist Water Assessment Department of Natural Resources and Mines
1995 to 2001	Principal Engineer Surface Water Assessment Department of Natural Resources and Mines
1991 to 1995	Senior Hydrologist/Engineer, QDPI Water Resources
1988 to 1991	Hydrologist/Engineer, QDPI Water Resources and Queensland Water Resources Commission
1985 to 1988	Research Engineer, University of Southern Queensland, NSCP Flood Plain Management Project
1983 to 1985	Research Engineer, Oklahoma State University
1996 - date	Senior Duty Flood Operations Engineer South East Queensland Water Board/Corporation
1990 - 1998	Part-time Lecturer/Tutor in Hydrology, QUT, Dep of Civil Engineering.

May 2008 to Date

Director — Department of Environment and Resource Management
Water Planning Sciences

Duties

- Ensure effective operational delivery of water scientific services across the department.
- Manage other assigned projects to address impediments to effective science delivery to achieve business objectives sought by the Executive Director, Natural Resource Sciences and the Service Delivery Executive team.
- Ensure assigned staff are effectively led and managed to achieve business objectives.
- Provide high quality scientific and policy advice and recommendations to Executive Management including the Executive Director, Natural Resource Sciences and Service Delivery Executive team and Water and Catchment Executive team as required.
- Develop and maintain effective working relationships with internal and external stakeholders to facilitate resolution of complex scientific and operational issues.
- Ensure delivery of business in accordance with corporate policies, standards and accountabilities.

July 2007 to April 2008

Director
Water Assessment — Department of Natural Resources and Water
Water Services

Duties

- To develop and guide the strategic direction of the Water Assessment Directorate and associated technology and research to inform water resource policy and planning decisions.
- To provide professional, scientific leadership and direct and develop collaborative programs which deliver expert hydrology services and advice on groundwater and surface water availability for water resource plans, regional water supply strategies, infrastructure planning and other government business.
- Lead and develop the provision of expert knowledge and experience in hydrology, hydrologic and hydraulic modelling
- Direct the development of strategic, business and operation plans (including program and project management) and initiate, develop, manage and lead multidisciplinary teams and projects.
- Guide the development and implementation of best practice standards, techniques and methodologies for the science used in planning and management policies and procedures and for monitoring compliance. Maintain quality procedures and systems to support water resource plans and compliance
- Direct the development of strategic, business and operation plans (including program and project management) and initiate, develop, manage and lead multidisciplinary teams and projects.
- Direct and manage multi-disciplinary projects, departmental and inter-governmental teams and consultants involved in developing and supporting the scientific basis for implementing the COAG Water Reform agenda, regional water supply planning and implementation of water infrastructure commitments in Qld.
    - Represent the interests of the Department at the State and Federal level and in community and industry forums.

- Develop networks, partnerships and collaborative partnerships and consult with peers, departmental staff, clients, consultants, community groups and other agencies to develop and implement integrated State water assessment programs and procedures to underpin departmental priorities
- Provide high-level strategic technical and scientific advice and recommendations to executive management of the Department and the Queensland Water Commission relevant to the development and management of the State's water resources and infrastructure

September 2001 to October 2007

Principal Hydrologist — Department of Natural Resources and Mines
Water Assessment — Water Services

Duties

- Lead, develop and promote the Water Assessment program as a centre of excellence for better management of Queensland's natural resources.
- Lead the strategic and operational planning for Water Assessment by providing statewide co-ordination and developing statewide priorities of water resource assessments
- Provide strategic leadership and management to achieve government outcomes, meet client demand and develop and maintain a highly skilled innovative and motivated professional workforce.
- Provide high-level strategic scientific advice and recommendations to the Minister, Director-General, Deputy Director-General, General Managers and senior management on water resource assessment issues.
- Represent the interests of the Department at the State and Federal level and in community and industry forums.
- Maintain systems to support water resource plans and compliances. Identify and develop business opportunities for joint strategies within NR&M and with other State and Commonwealth agencies, the private sector and international agencies to enhance the quality of services and products delivered to NR&M clients.
- Guide the development and implementation of best practice standards for the science used in planning and management policies and procedures and for monitoring compliance
- Develop networks and consult with peers, departmental staff, clients, consultants, community groups and other agencies to promote and develop integrated State programs and procedures to underpin departmental policies
- Ensure effective and efficient utilisation Water Assessment Groups finances assets and human resources

September 1995 to September 2001

Principal Engineer — Department of Natural Resources
Surface Water Assessment — Resource Condition and Trend

Duties

To provide professional leadership and to manage and direct the delivery of activities associated with Surface Water Assessment in Water Assessment and Planning through:

- providing professional leadership within the section
- ensuring effective and efficient delivery of service
- managing the work plans for the section in accordance with the agreed standards and objectives
- ensuring coordination and effective use of resources
- providing timely and high quality technical and scientific information on management issues related to surface water hydrology

The position supports the Principal Hydrologist, Water Assessment and Planning, in providing technical and scientific advice on and support to the activities of the Department in natural resource management.

December 1988 - September 1995:

Senior Hydrologist/Engineer/ - Hydrologist/Engineer
Department of Primary Industries, Water Resources
Water Resources Division,
Surface Water Assessment.

Duties
Responsibility to perform hydrologic and river hydraulic studies for Departmental clients and external clients in tropical and sub-tropical Queensland as part for investigations of new and existing water resource systems and flood management proposals, provide expert advice on hydrology and river hydraulics and carry out research and development of hydrologic and river hydraulics techniques.

October 1985 - November 1988:

Research Engineer -
University of Southern Queensland,
Toowoomba, Queensland, Australia.

Duties
Responsible for the development of guide-lines for the effective implementation of flood strip cropping in tropical and sub-tropical Queensland. This required the development of hydraulic models to model the flow of water and the deposition of sediment in floodplains. The development of an experimental program was developed using the outside flume and the field sites in New South Wales and Queensland.

September 1983 - September 1985:

Research Engineer -
Agricultural Engineering Department (Half Time) and USDA
Oklahoma State University,
Stillwater, OK, 74075, USA.

Duties
I was responsible for the conduct of an investigation to verify the applicability of hydrodynamically derived Muskingum' flood routing coefficients for the purposes of improving the flood routing component of SEDIMONT II (a commercial mine hydrology program).

February 1983 - July 1983

Works Supervisor - Toowoomba Transportable Homes
Industrial Avenue
Toowoomba, QLD.

Duties
Responsibility to supervise construction and installation of 400 domestic water tanks for the Army Aviation Base at Oakey.

PUBLICATIONS

SELECTION OF CONFERENCE PAPERS AND REFEREED JOURNAL ARTICLES

Ruffini, JL and Wilson BN (1985) Evaluation
of Muskingum's Parameters for Ungaged Watersheds.
ASAE paper No. 85 2018, ASAE, St. Joesph, MI 498085.

Ruffini, JL (1985) The Applicability of Hydrodynamically
Derived Muskingum Flood Routing Coefficients. M.Sc. Thesis, Oklahoma State University, Stillwater, OK, 120pp.

Wilson, BN and Ruffini, JL (1988) Comparison of Physically based Muskingum Methods. TRANSACTIONS of the ASAE. 31(1):91-97.

Connolly, RB, Ruffini, JL and Smith, RJ (1988)
Design of Structural Soil Conservation Measures using Kinematic Wave Theory. Conference on Agricultural Engineering. The Institution of Engineers, Australia, National Conference Publication No 88/.

Smith, RJ, Hancock, NH and Ruffini, JL (1990) Flood flow through tall vegetation. Agricultural Water Management, 18(1990)317-332.

Smith, RJ, Hancock, NH and Ruffini, JL (1991) Strip cropping - development of guidelines for selection of strip Cropping. Agricultural Water Management 20(1991)1-16.

Ruffini, JL, Ayre, RA, Shallcross, W, and Alderton BA (1994) A Real Time Flood Operations Model For Somerset Dam, Wivenhoe Dam and North Pine Dam. (1994). 1994 International Conference on Hydraulics in Civil Engineering. The Institution of Engineers, Australia, National Confernce Publication 94/.

Loy, A, Ayre, RA and Ruffini, JL (1996) Regional loss model relationships for catchments in South East Queensland. 23rd Hydrology and Water Resources Symposium. The Institution of Engineers, Australia, National Conference Publication 96-05.

Shallcross W, Alderton, BA, Ruffini JL and Ayre RA (1996) Enhancing real time flood management systems with Winsock Applications. 23rd Hydrology and Water Resources Symposium. The Institution of Engineers, Australia. National Conference Publication 96-05.

Loy, A, McGrath, T, Ruffini, JL and Harding P (1997) Changes in the modelling of river systems in Queensland, Australia. 24th Hydrology and Water Resources Symposium. The Institution of engineers, Australia. National Conference Publication 97-12.

Arthington A, S Brizga, Mkennard, S Mckay, RmcCosker, S.Choy and J. Ruffini. Development of a Flow Restoration Methodology (FLOWRESM) for determining environmental flow requirements in regulated rivers using the Brisbane as a case study.(1999) 25th Hydrology and Water Resources Symposium. & 2nd International Conference on Water Resources and Environmental Research The Institution of engineers, Australia. National Conference Publication.

Young Robert A, John Rufffini, Frank Van Schagen, Jozef Syktus, Lawrence Lau
Potential use for seasonal climate forecasts to improve the management of Queenslands' water resources. (2000) 3rd International Hydrology and Water Resources Sysmposium The Institution of engineers, Australia. National Conference Publication.

SELECTION OF REPORTS

This is a list of a series of reports relevant to Wivenhoe Dam, Somerset Dam and North Pine Dam prepared for the South East Queensland Water Board from 1990 to 1995. These reports comprise 27 volumes for the *SEQWB (South East Queensland Water Board) 1993 Study (Commercial in Confidence)*. I was one of the primary authors of many of these reports and reviewer/editor of all reports.

Report Number	Title	Date
1	Real Time Flood Operations Model Report	Nov-90
2	Brisbane River And Pine River Hydraulic Model Report	Nov-90
3	Real Time Flood Operations Model Report	May-91
4	Pine River Flood Hydrology Report Volumes I, II, III & IV	Aug-91
5	Pine River Flood Hydrology Report	Dec-91
6	Brisbane River And Pine River Flood Hydrology Report	Apr-92
7	Brisbane River Flood Hydrology Report Volumes I, II, III & IV	Sep-92
8	Brisbane River Flood Hydrology Report Volumes I, II, III & IV	Mar-93
9	Pine River System Hydraulic Model Report Volumes I, II, III & IV	Apr-93
10	Pine River Flood Hydrology Report	Apr-93
11	Pine River System Hydraulic Model Report Volumes I, II, III & IV	Jun-93
12	Brisbane River And Pine River Hydraulic Model Report	Jun-93
13	Brisbane River Flood Hydrology Report	Aug-93
14	Pine River System Hydraulic Model Report Volumes I, II, III & IV	Oct-93
15	Pine River Soil Moisture Accounting Model Report	Nov-93
16	Brisbane River Soil Moisture Accounting Model Report Volumes I, II & III	Nov-93
17	Brisbane River System Hydraulic Model Report Volumes I, II, III & IV	May-94
18	Brisbane River And Pine River Flood Hydrology Report	Jun-94
19	Brisbane River System Hydraulic Model Report - Report On Historical Flood Data.	Jun-94
20	Brisbane River System Hydraulic Model Report - Report On Somerset Dam - Dam Failure Modes.	Jun-94
21	Brisbane River System Hydraulic Model Report Volumes I, II, III & IV	Jul-94
22	Brisbane River System Hydraulic Model Report - Report On Wivenhoe Dam - Dam Failure Modes.	Jul-94

23	Brisbane River System Hydraulic Model Report - I, II, III & IV	Oct-94
24	Brisbane River System Hydraulic Model Report I, II, III, IV & V	Oct-94
25	Brisbane River And Pine River Hydraulic Model Report	Dec-94
26	Brisbane River And Pine River Flood Study Report	Dec-94
27	Real Time Flood Operations Model Report	May-95

SEQWB (South East Queensland Water Board) 1993 Study (Commercial in Confidence) Volume Index

SEQWB (South East Queensland Water Board) 1993 Study (Commercial in Confidence)

REPOR	Title	Date
1	**REAL TIME FLOOD OPERATIONS MODEL REPORT** Report on the Feasibility of a Real Time Flood Warning Model.	Nov-90
2	**BRISBANE RIVER AND PINE RIVER HYDRAULIC MODEL REPORT** Report on Review and Evaluation of Hydraulic Models.	Nov-90
3	**REAL TIME FLOOD OPERATIONS MODEL REPORT** Report on the Evaluation of Available Hardware Platforms.	May-91
4a	**PINE RIVER FLOOD HYDROLOGY REPORT** VOLUME I Report on Runoff-Routing Model Calibration.	Aug-91
4b	**PINE RIVER FLOOD HYDROLOGY REPORT VOLUME II** Report on Design Flood Estimation.	Aug-91

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4c	**PINE RIVER FLOOD HYDROLOGY REPORT VOLUME III** Appendix A Runoff-Routing Model Data files Appendix B Bureau of Meteorology PMP Report	Aug-91
5	**PINE RIVER FLOOD HYDROLOGY REPORT** Report on North Pine Dam -Post Dam Flood Frequency Analysis.	December 1991
6	**BRISBANE RIVER AND PINE RIVER FLOOD HYDROLOGY REPORT** Report on Warragamba Dam EIS Flood Study.	Apr-92
7a	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME I Report on Runoff-Routing Model Calibration.	Sep-92
7b	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME II Appendix A Comparative Plots.	Sep-92
7c	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME III Appendix B Runoff-Routing Model Layouts.	Sep-92
7d	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME IV Appendix C Runoff-Routing Model Data Files.	Sep-92
8a	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME I Report on Design Flood Estimation.	Mar-93

8b	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME II Appendix A Probable Maximum Precipitation Estimates.	Mar-93
8c	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME III Appendix B Flood Frequency Analysis Results.	Mar-93
8d	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** VOLUME IV Appendix C Runoff-Routing Model Layouts.	Mar-93
9a	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I Report on Model Calibration.	Apr-93
9b	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II Appendix I Pine River Cross-Sectional Data	Apr-93
9c	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME III Appendix II Lateral Inflows Appendix III Time Series Plots	Apr-93
9d	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME IV Appendix IV Hydraulic Model Data Files.	Apr-93
10	**PINE RIVER FLOOD HYDROLOGY REPORT** Report on North Pine Dam Rating of Spillway Gates.	Apr-93

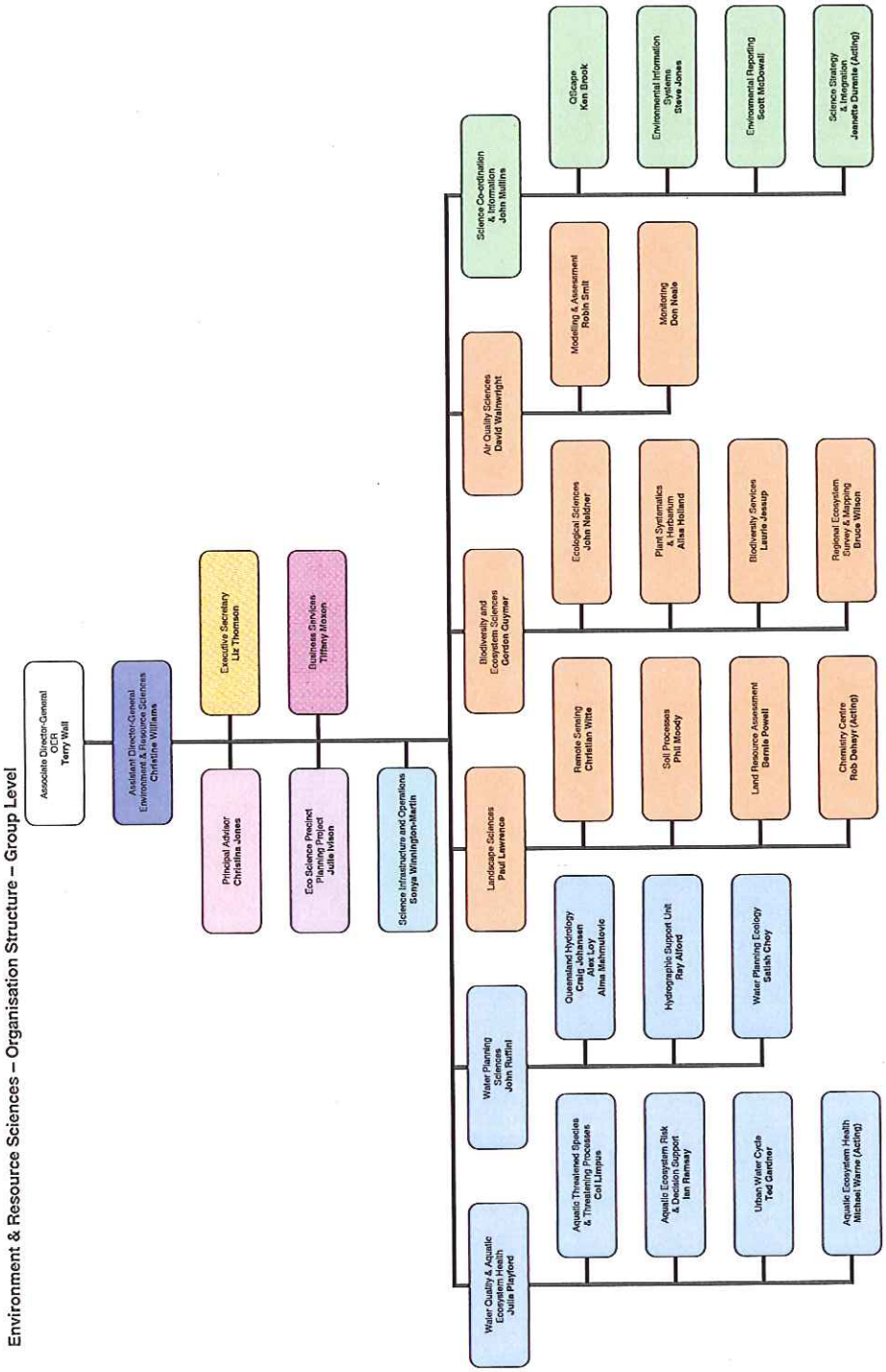
11a	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I Report on North Pine Dam Dambreak Analysis.	Jun-93
11b	**PINE RIVER SYSTEM HYDRAULIC MODEL** VOLUME II Appendix I Flood Height Profiles and Flood Inundation Maps.	Jun-93
11c	**PINE RIVER SYSTEM HYDRAULIC MODEL** VOLUME III Appendix II Wave Set Up and Wave Run Up Estimation. Appendix III Time Series Plots for Selected Locations. Appendix IV Cross-Sectional Data	Jun-93
11d	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME IV Appendix V Hydraulic Model Data Files.	Jun-93
12	**BRISBANE RIVER AND PINE RIVER HYDRAULIC MODEL REPORT** Report on Validation of RUBICON Hydrodynamic Modelling System.	Jun-93
13	**BRISBANE RIVER FLOOD HYDROLOGY REPORT** Report on Downstream Flooding.	Aug-93
14a	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I Report on Sideling Creek Dam Dambreak Analysis.	Oct-93
14b	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II	Oct-93

	Appendix I Flood Height Profiles and Flood Inundation Maps.	
14c	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME III Appendix II Wave Set Up and Wave Run Up Estimation. Appendix III Time Series Plots for Selected Locations. Appendix IV Cross-Sectional Data	Oct-93
14d	**PINE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME IV Appendix V Hydraulic Model Data Files.	Oct-93
15	**PINE RIVER SOIL MOISTURE ACCOUNTING MODEL REPORT** Report on Model Calibration.	Nov-93
16a	**BRISBANE RIVER SOIL MOISTURE ACCOUNTING MODEL REPORT** VOLUME I Report on Model Calibration.	Nov-93
16b	**BRISBANE RIVER SOIL MOISTURE ACCOUNTING MODEL REPORT** VOLUME II Appendix I Daily Streamflow Plots.	Nov-93
16c	**BRISBANE RIVER SOIL MOISTURE ACCOUNTING MODEL REPORT** VOLUME III Appendix II Daily and Monthly Flow Duration Curves and Monthly Scatter Diagrams.	Nov-93
17a	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I	May-94

	Report on Somerset Dam to Wivenhoe Dam Hydraulic Model Calibration.	
17b	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II Appendix I Cross-Sectional Data.	May-94
17c	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME III Appendix II Calibration Event - Time Series Plots.	May-94
17d	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME IV Appendix III Somerset Dam to Wivenhoe Dam Hydraulic Model Rubicon Data Files.	May-94
18	**BRISBANE RIVER AND PINE RIVER FLOOD HYDROLOGY REPORT** Report on Regional Loss Model Relationships.	Jun-94
19	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** Report on Historical Flood Data.	Jun-94
20	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** Report on Somerset Dam - Dam Failure Modes.	Jun-94
21a	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I Report on Somerset Dam - Dam Failure Analysis.	July 1994

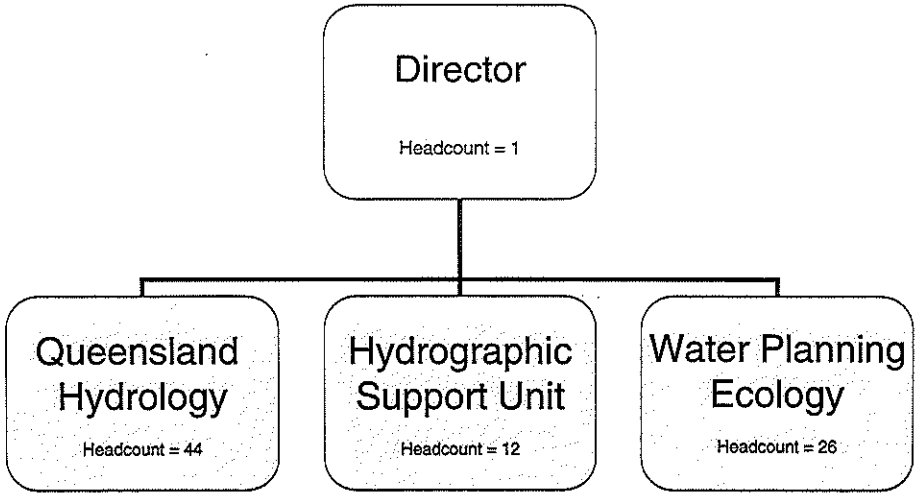
21b	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II Appendix A Flood Height Profiles and Inundation Maps.	July 1994
21c	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME III Appendix B Time Series Plots.	July 1994
21d	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME IV Appendix C Somerset Dam to Wivenhoe Dam Hydraulic Model Rubicon Data Files.	July 1994
22	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** Report on Wivenhoe Dam - Dam Failure Modes.	July 1994
23a	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** Report on Wivenhoe Dam Hydraulic Model Calibration. October 1994	VOLUME I
23b	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II Appendix A Volume of A3 Figures	October 1994
23c	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT - Volume III** Appendix B Derivation of Wivenhoe Dam Discharges	October 1994
23d	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT Volume IV** Appendix C Cross-sectional Data	October 1994

24a	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME I Report on Wivenhoe Dam - Dam Failure Analysis.	October 1994
24b	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME II Appendix A Volume of A3 Figures	Oct-94
24c	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME III Appendix B Wivenhoe Dam Wind Set Up and Wave Run Up Appendix C Time Series Plots	
24d	BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT VOLUME II Appendix D Hydraulic Model Data Files	Oct-94
24e	**BRISBANE RIVER SYSTEM HYDRAULIC MODEL REPORT** VOLUME V Appendix IV Wivenhoe Dam to Moreton Bay Hydraulic Model - Rubicon data Files	Oct-94
25	**BRISBANE RIVER AND PINE RIVER HYDRAULIC MODEL REPORT** Report on Brisbane River and Pine River Geographic Information System	
26	**BRISBANE RIVER AND PINE RIVER FLOOD STUDY REPORT** Executive Summary Report.	Dec-94
27	**REAL TIME FLOOD OPERATIONS MODEL REPORT** **'FLOOD' USERS MANUAL** User Manual and System Manual.	May-95


Environment & Resource Sciences – Organisation Structure – Group Level
Associate Director-General CCR Terry Wall
Assistant Director-General Environment & Resource Sciences Christine Williams
Executive Secretary Liz Thomson
Business Services Tiffany Mckeon
Principal Advisor Christina Jones
Eco Science Precinct Planning Project Julie Ivison
Science Infrastructure and Operations Sonya Winnington-Martin
Landscape Sciences Paul Lawrence
Biodiversity and Ecosystem Sciences Gordon Guymer
Air Quality Sciences David Wainwright
Science Co-ordination & Information John Mullins
Remote Sensing Christian Witte
Soil Processes Phil Moody
Land Resource Assessment Bernie Powell
Chemistry Centre Rob Dehayr (Acting)
Ecological Sciences John Neldner
Plant Systematics & Herbarium Ailsa Holland
Biodiversity Services Laurie Jessup
Regional Ecosystem Survey & Mapping Bruce Wilson
Modelling & Assessment Robin Smit
Monitoring Don Neale
Officape Ken Brook
Environmental Information Systems Steve Jones
Environmental Reporting Scott McDowell
Science Strategy & Integration Jeanette Dumitrie (Acting)
Water Planning Sciences John Ruffini
Queensland Hydrology Craig Johansen Alex Loy Alma Mahmulovic
Hydrographic Support Unit Ray Alford
Water Planning Ecology Satish Choy
Water Quality & Aquatic Ecosystem Health Julia Playford
Aquatic Threatened Species & Threatening Processes Col Limpus
Aquatic Ecosystem Risk & Decision Support Ian Ramsay
Urban Water Cycle Ted Gardiner
Aquatic Ecosystem Health Michael Warne (Acting)

Water Planning Sciences Directorate (John Ruffini) – As of 23 March 2011

Total headcount for the Water Planning Sciences Directorate = 83



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SUNWATER FCC

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Qld 4002

Water Supply Services | Operations & Maintenance | Engineering Services | Corporate

FACSIMILE

TO:	Mr Alex Loy	**FAX NO:**
FROM:	Rob Ayre	**TEL NO**
DATE:	12 September 2003	**PAGES (incl cover): 7**
SUBJECT:	**MOU SEQWATER FLOOD OPERATIONS**	

MESSAGE:

Alex

As discussed please find attached a copy of the MOU for the SEQWater flood operations that was put in place prior to the new contract. As mentioned, SunWater are reviewing the draft agreement and will endeavour to present it to the Department by the end of September.

If you have any questions, please do not hesitate to contact me.

Regards

[redacted]

Rob Ayre
Senior Flood Operations Engineer

MEMORANDUM OF UNDERSTANDING DEPARTMENT OF NATURAL RESOURCES (DNR) SERVICES FOR SOUTH EAST QUEENSLAND WATER CORPORATION (SEQWC) FLOOD OPERATIONS

INTRODUCTION

This document has been prepared to outline the services to be provided to SunWater by DNR and for the provision of key DNR personnel to undertake the duties required for the management of flood operations as required under SunWater's contract with the SEQWC. It is intended that these arrangements apply until SunWater and DNR enter into a formal agreement for the provision of services in accordance with the arrangements outlined in the document. It is intended that this agreement be in place before 28 February 2001.

PURPOSE

The purpose of this understanding is to provide for the continuation of services provided by DNR key personnel while a formal agreement is prepared for execution.

SCOPE

The scope of these support services is limited to the provision of qualified and trained personnel during the course of the current Agreement between SunWater and SEQWC. Should SunWater be successful with a new contract with SEQWC commencing July 2001 provision will be made for the extension of services.

BACKGROUND

SunWater has an agreement with SEQWC for the operation and maintenance (including flood operations) of Wivenhoe, Somerset and North Pine Dams. This contract remains current until 30 June 2001. The Flood Operations services provided under this contract is supported by a number of DNR personnel who have been fully training, many of which have been involved with the services since the start of the contract in 1996.

Procedures for the flood operations of SEQWC dams have been prepared and implemented. Provided these procedures are followed the State indemnifies personnel who are involved in flood operations.

SunWater is currently tendering for a new eight year contract with SEQWC. It is acknowledged that key DNR personnel will be required to continue to provide support for at least 12-18 months into this contract.

SERVICES TO BE PROVIDED:

DNR are to provide key personnel to perform the State's obligations in accordance with the duty statements and terms and conditions of the Agreement between SunWater and SEQWC.

Key personnel have been grouped into two categories:

- Flood Operations Engineers
- Data Collectors

Duty statements for these categories are shown in Schedule 1.

SUNWATER FCC

PERSONNEL PROVIDED:

DNR are to provide the key personnel named in Schedule 2 and make them available for duty as defined in the Duty Statements (Schedule 1).

Subject to agreement between SunWater and DNR those names shown in Schedule 2 may be amended provided that at least two (2) month's notice is given to allow sufficient time to train new personnel. The addition of new personnel to Schedule 2 will also be subject to the approval of SEQWC.

The personnel identified in Schedule 2 will be made available at the hourly rate as shown in Schedule 2.

SENIOR DUTY FLOOD ENGINEERS:

Currently John Ruffini is undertaking the role of Senior Duty Flood Engineer for the contract. This is an interim arrangement agreed with the SEQWC and is to remain in place until Robert Ayre of SunWater is able to accept the responsibility of this role. It is expected that subject to the agreement of SEQWC that Robert Ayre will be able to accept responsibility on or before 31st December 2000. Until that time it is agreed that John Ruffini will undertake the role as defined in the Flood Manual.

INDEMNITIES:

Provided personnel operate within the Flood Procedures identified in the Flood Manual they will be afforded the same indemnities as SEQWC.

INVOICING AND PAYMENTS:

DNR will invoice SunWater monthly for work undertaken by personnel in Schedule 2 in accordance with the duty requirements shown in Schedule 1.

The invoice shall show the time duty of each person, together with the allowances which are due.

SunWater shall pay the invoices within thirty (30) days.
On 30 June each year the chargeout rates will be reviewed in accordance with wages movements

CONFIDENTIALITY:

All information, including the terms of this Agreement and costs/prices are to be kept confidential and not disclosed to any other party without the written authorization of SunWater.

SERVICE REPRESENTATIONS:

The service representatives for this Agreement are:

- John Ruffini (DNR)
- Robert Ayre (SunWater)

If any disputes arise during the performance of the Agreement that are not able to be resolved by the Service Representatives within fourteen (14) days of notification of the existence of a dispute, then the issue shall be referred to the General Manager (Operations and Maintenance) and Executive Director (RSK).

SUNWATER FCC

PERIOD OF AGREEMENT:

This Agreement commences on 1st October 2000 and will continue until 30th June 2001.

Should SunWater be successful with a new 8 year contract the Agreement may be extended. The period of extension will be as agreed by DNR and SunWater but will be no less than 18 months.

[redacted]

GENERAL MANAGER
(Operations & Maintenance)
SunWater
02/02/2001

[redacted]

EXECUTIVE DIRECTOR
Natural Resources Sciences
Department Natural Resources
07/02/01

Schedule 1

Requirements for Duty Flood Operation Engineers

1. Flood Operations Engineers are to direct flood operations at Somerset Dam, Wivenhoe Dam and North Pine Dam in accordance with the following documents, on behalf of SunWater:-
   - Contract documents for SEQWB contract T5 - 95/96
   - Manual of Operational Procedures for Flood Mitigation for Wivenhoe and Somerset Dam, Revision No:2, 13 Nov 1997
   - Manual of Operational Procedures for Flood Releases from North Pine Dam, Revision No: 2, 13 Nov 1997
2. Flood Operations Engineers will negotiate with the Senior Flood Operations Engineer (SFOE) regarding recreation leave where the taking of leave is likely to inhibit their involvement in flood operations at the dams. The SFOE will not unduly restrict the taking of such leave. Any resultant restriction on the taking of leave will be grounds for deferment of leave.
3. If the Senior Flood Operations Engineer determines it to be necessary to recall a Flood Operations Engineer from leave because of the potential for flood operations, SunWater agree to pay all reasonable expenses associated with such a recall to duty.
4. Where Flood Operations Engineers are called away from the Brisbane area on work related activities so that they will be unable to fulfill their rostered duties in the event of flood operations becoming necessary, they are to notify the SFOE and organize a replacement to undertake their rostered duties.
5. Flood Operations Engineers are to restrict their movements while on-call and maintain themselves in the following states of readiness for flood operations:-
   - Close Call
     a) Be contactable at all times and carry around, or maintain in close proximity, the lap top portable computer, mobile phone and Bureau of Meteorology weather warning pager.
     b) Monitor, as closely as necessary for the safe operation of the dams, catchment rainfall, dam levels and river levels, weather warnings and forecasts. Monitor weather situations as they develop.
     c) Monitor the performance of the data collection system to ensure the system is operational
     d) Be ready to mobilize to the Flood Control Centre within 2 hours
   - Close Call (2nd)
     a) Be contactable in the event of rain
     b) Maintain a high degree of awareness of prevailing weather
     c) Be able to mobilize to the Flood Control Room to assist, as required, the Flood Operations Engineer on Close Call.
     d) Communicate with the Flood Operations Engineer on Close Call as necessary to check readiness in the event of heavy rain
     e) Remain within say 4 hours of the Flood Control Room.

   a) Remote Call
     b) Be contactable in the event of rain
     c) Maintain a general awareness of prevailing weather
     d) Be able to mobilize to the Flood Control Room at the end of the first shift, and remain within, say, 8 hours of the Flood Control Room.
7. For maintaining the level of call specified in Section 6, the Flood Operations Engineers will receive the following 'On-call' allowances:-
   a) Close Call — Standard Public Service On-Call Allowances
   b) Close Call (2nd) — Standard Public Service On-Call Allowances
   c) Remote Call — No On-Call Allowance will be payable
8. The Flood Operations Engineer on Close Call (also referred to as the Duty Flood Operations Engineer) will accept the responsibility of making the decision to mobilize to the Flood Control Centre flood response teams in the event of flood operations at any of the dams becoming likely. The Flood Operations Engineer on Close Call (2nd) shall support the Duty Flood Operations Engineer in making this decision as necessary. For accepting these responsibilities, both the Duty Flood operations Engineer and the Duty Engineer on 'Close Call (2nd)' will receive a 'Responsibility Allowance' of $100 per week.

9. The Flood Operations Engineers are to receive the 'Performance Payments' set out in the DPI Tender Document for Contract TS – 95/96. Such payments are currently $900/year for the Flood Operations Engineers with payments becoming payable for the previous 12 months as soon after 30th June each year as is reasonably practicable. Where there are changes in personnel over the period, payments are to be prorated.

10. Once an event is declared and the Flood Response teams are mobilized, the Flood Operations Engineers are to man the Flood Operations Centre on a 24 hour basis in shifts as required for flood operations at the dams. While undertaking this work, the Duty Engineers shall receive the shift allowances and overtime payments specified in the ??

11. When on close call, the Duty Flood Operations Engineer is to have the use of the SEQWC Flood Operator's vehicle for private purposes. Such use is to enable the transport of computer equipment and documentation and to enable 24-hour response to problems, emergencies or flood events as and when they arise.

12. To assist in round the clock communications, the Flood Operations Engineers are to have use of mobile phones supplied by the project

13. SunWater to pay rental for phone line into private residence.

14. Flood Operations Engineers to provide at least two months notice of their intention to resign from the project.

15. SunWater agree to keep the Flood Operations Engineers informed of any work being planned or going on at any of the three dams which may restrict flood operations. Such information to include, but not be limited to:-

    - Duty Rosters
    - Maintenance on the various gates/sluices/valves.
    - Installation of bulkhead gates
    - Failure of opening/closing systems
    - Failure of gates/sluices/valves to open/close

Where planned maintenance activities impact on flood operations the requirements for flood operations take precedence.

SCHEDULE 2

PROJECT TEAM MEMBERS – POSITIONS AND LOCATIONS

Name	Designation	Position	Work Group	Location	Charge-Out Rates $/hr (inc GST)
Duty Engineers					
Don Cock	PO4/4	Project Engineer	RID – West Moreton District	Landcentre Level 3	92.97
John Ruffini	PO5/5	Principal Engineer Surface Water Assessment	RSK – Water Assessment	Charlotte Chambers Level 3	104.15
Data Collectors					
Rob Drury	PO6/1	A/Manager Infrastructure Management	Infrastructure Management South East Region	Mineral House Level 12	107.72
Ray Fitzsimon	TO3/4	Technical Officer	West Moreton District	Landcentre Level 3	70.65
Alex Loy	PO4/4	Senior Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	92.97
Toby McGrath	PO4/4	Senior Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	92.97
Paul Martin	TO4/3	Supervising Hydrographer	West Moreton District	Landcentre Level 3	79.01
Bill Mead	PO3/4	Technical Officer – Hydrography	West Moreton District	Landcentre Level 3	81.06
Khanh Nguyen	PO4/1	A/Senior Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	86.29
Darren Thompson	TO3/4	Technical Officer	West Moreton District	Landcentre Level 3	70.65
Computer Support					
Warren Shallcross	PO4/4	Senior Hydrologist	RSK – Water Assessment	Charlotte Chambers Level 3	92.97
M Goods	PO2/6	Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	70.65
C Johansen	PO3/2	Hydrologist	RSK – Water Assessment	Charlotte Chambers Level 3	76.40
C Musgrove	PO3/2	Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	76.40
K Pandeye	PO3/4	Hydrologist	RSK – Water Assessment	Charlotte Chambers Level 3	81.06
S Schreiber	PO3/4	Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	81.06
R Wierkhorst	PO3/4	Engineer	RSK – Water Assessment	Charlotte Chambers Level 3	81.06

JLR-07

Seqwater Flood Events

Dam	Start Date	End Date
2010/2011 Wet Season		
North Pine Dam	10 October 2010	14 October 2010
North Pine Dam	16 October 2010	16 October 2010
Somerset Dam	9 October 2010	18 October 2010
Wivenhoe Dam	9 October 2010	18 October 2010
Somerset Dam	2 December 2010	17 December 2010
North Pine Dam	4 December 2010	5 December 2010
North Pine Dam	6 December 2010	7 December 2010
North Pine Dam	9 December 2010	10 December 2010
Wivenhoe Dam	13 December 2010	16 December 2010
North Pine Dam	14 December 2010	15 December 2010
North Pine Dam	16 December 2010	17 December 2010
Wivenhoe Dam	17 December 2010	24 December 2010
Somerset Dam	18 December 2010	23 December 2010
North Pine Dam	18 December 2010	19 December 2010
North Pine Dam	23 December 2010	24 December 2010
North Pine Dam	25 December 2010	26 December 2010
Somerset Dam	26 December 2010	31 December 2010
Wivenhoe Dam	26 December 2010	2 January 2011
North Pine Dam	1 January 2011	2 January 2011
North Pine Dam	6 January 2011	14 January 2011
Wivenhoe Dam	7 January 2011	19 January 2011
Somerset Dam	8 January 2011	17 January 2011
North Pine Dam	18 January 2011	19 January 2011
North Pine Dam	20 January 2011	20 January 2011
North Pine Dam	21 February 2011	22 February 2011
North Pine Dam	4 March 2011	5 March 2011
2009/2010 Wet Season		
North Pine Dam	16 February 2010	18 February 2010
Somerset Dam	24 February 2010	18 March 2010
North Pine Dam	26 February 2010	4 March 2010
North Pine Dam	4 March 2010	6 March 2010
North Pine Dam	10 March 2010	11 March 2010
2008/2009 Wet Season		
Somerset Dam	14 April 2009	17 April 2009
North Pine Dam	19 May 2009	22 May 2009
Somerset Dam	19 May 2009	22 May 2009
North Pine Dam	4 June 2009	4 June 2009
Somerset Dam	22 June 2009	8 July 2009
North Pine Dam	22 June 2009	8 July 2009
2000/2001 Wet Season		
Wivenhoe Dam	5 February 2001	10 February 2001
Somerset Dam	6 February 2001	10 February 2001
North Pine Dam	6 February 2001	8 February 2001
1998/1999 Wet Season		

Wivenhoe Dam	9 February 1999	20 February 1999
Somerset Dam	9 February 1999	15 February 1999
North Pine Dam	10 February 1999	14 February 1999
Wivenhoe Dam	1 March 1999	18 March 1999
Somerset Dam	1 March 1999	20 March 1999
North Pine Dam	1 March 1999	5 March 1999

JLR-08

CRC FORGE Method

The CRC FORGE method is an analytical method for estimating rainfall totals for storm durations from 12 to 72 hours with annual exceedence probabilities (AEPs) from 1 in 50 to 1 in 2000.

The method is a development of the Focussed Rainfall Growth Estimation (FORGE) concept originating from the UK Institute of Hydrology, which was further modified by the CRC for Catchment Hydrology. A description of the methodology can be found in
http://www.catchment.crc.org.au/pdfs/technical199704.pdf

Using the method, estimates can be made for any site within a region. When data is available for a particular site, information from other compatible sites are used to increase the accuracy of the estimates. If there is no gauge at the site, the method uses regional relationships between frequency distribution parameters and site characteristics to make an estimate of the rainfall.

The method was originally developed using daily rainfall data from more than 1400 medium to long record rainfall stations in Victoria. The method was then applied to the Tropical and Sub-Tropical regions of Queensland and border areas using a large data set of over 2,000 daily rainfall stations provided by the Bureau of Meteorology.

A description of this work can be found in
Hargraves, Gary W; Ruffini, John L and McConnell, Russ J. Applicability of the CRCFORGE Method of Extreme Rainfall Estimation to Tropical and Sub-tropical Regions [online]. In: Hydrology and Water Resources Symposium (25th : 1999 : Brisbane, Qld.). Water 99: Joint Congress; 25th Hydrology & Water Resources Symposium, 2nd International Conference on Water Resources & Environment Research; Handbook and Proceedings. Barton, ACT: Institution of Engineers, Australia, 1999: 697-702

REVISION OF THE GENERALISED TROPICAL STORM METHOD FOR ESTIMATING PMP

The Generalised Tropical Storm Method (GTSM) is used to estimate the Probable Maximum Precipitation (PMP) in the zone of Australia that is affected by Tropical Storms.

The PMP is defined as the '*greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends*'.

The PMP is a key design rainfall input to the calculation of the Probable Maximum Flood (PMF) and the Probable Maximum Precipitation Design Flood (PMPDF). These quantities are used as design standards for the spillways of large dams.

The PMP concept is based around the hypothesis that the rainfall results from the simultaneous occurrence of a storm of optimal efficiency together with maximum moisture availability. Determining maximum storm efficiency is difficult with Australia having only about 100 years of data to estimate the biggest storms.

The GTSM was revised in 2003 to include the better techniques and more data. The revision included the creation of a data base of the largest storms. A final set of 122 storms was chosen with a range of daily durations from 24 hours to 168 hours and different spatial extents up to 150,000 km^2.

The storms were adjusted for the effects of topographic enhancement and local moisture availability so that they could be transposed within the zone. An adjustment was also made for the geographic variation in the decay of the storm mechanism, such as the effect of sea-surface temperatures on tropical cyclones.

The standardised storms were then used to derive an envelope of depth-duration-area curves, and design temporal distributions. Procedures were then developed to use this information to determine the characteristics of a PMP rainfall event.

A description of the GTSM revision can be found in:
http://www.bom.gov.au/hydro/has/hrs8.shtml

JLR – 10

From: Vitkovsky John [redacted]

Sent: Tuesday, 22 March 2011 10:02 AM

To: Johansen Craig

Subject: Review of QWC changes documents

Attachments: 2011-02-03__WathNet Model Modification Review__v3.doc; 2011-03-02__QWC Modelling Review__v2.doc

Hi Craig,

There were two review documents of the modifications to the Grid Model by QWC. This was because after the initial modification I worked out a better way to achieve a reduction in the full storage level of Wivenhoe Dam.

Cheers,

JV

John Vitkovsky
Hydrologist, Queensland Hydrology,
Water Planning Sciences, Environment and Resource Sciences,
Department of Environment and Resource Management, Queensland Government.

Mail: GPO Box 2454, Brisbane Qld 4001.
Location: Block A, Ground Floor, 41 Boggo Rd, Dutton Park Qld 4102, Australia.
Email: [redacted]
Web: www.derm.qld.gov.au

Review of WathNet Model Modifications

Introduction

The Queensland Water Commission (QWC) has undertaken modifications to the WathNet Grid Model to investigate the affect on the LOS statistics of reducing the full storage volume of some of the major storages in SEQ. This document outlines a brief review of those modifications.

Modifications Required

Table 1 lists changes in the model spreadsheet that are required for the assessment of LOS statistics resulting from modification of the full volume of Wivenhoe Dam (or any other storage). Note that the changes assume that the only difference will be the full volume of the storage, other operational rules, e.g. trigger levels that are based on percentages of the full volume of the storage, are maintained as per the original storage volume.

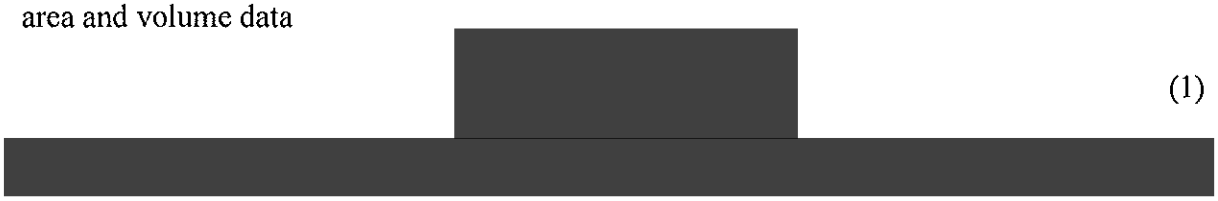
Table 1. Modifications Required to Spreadsheet

No.	Modification Details	Worksheet
1	Modify "Full Volume" for storage	Storage_Data
2	Calculate new "Storage-Area-Volume Data" and update in sheet. (Fa, Fb, Fc require updating)	Storage_Data
3	Ensure that "Emergency Volume" of storage is not modified (sometimes based on a percentage of full volume)	Storage_Data
4	Ensure that "Drought Volume" of storage is not modified (sometimes based on a percentage of full volume)	Storage_Data
5	Ensure that "Initial Volume" of storage is not modified (sometimes based on a percentage of full volume)	Storage_Data
6*	Modify "SEQ Trigger Volume %" in "Additional Inflow Sources" such that the trigger level (in ML) is not modified. (4 modifications)	Simulation_Data
7*	Modify "T1/T2/T3/T4 On/Off Trigger Level Volume" in "Regional Restriction Parameters" such that the trigger level (in ML) is not modified. (8 modifications)	Simulation_Data
8*	Modify "WCRWS Irrigator Cutoff Level" in "Regional Restriction Parameters" such that the trigger level (in ML) is not modified.	Simulation_Data
9*	Modify "WCRWS Wivenhoe Supply Start Level" in "Regional Restriction Parameters" such that the trigger level (in ML) is not modified.	Simulation_Data
10**	Modify "SPI Southerly Flow Rule #1 – Percentage Trigger" in "Southern Pipeline Interconnector (SPI) Rules" that the trigger level (in ML) is not modified.	Link_Data
11‡	Modify "SPI Southerly Flow Rule #2 – Minimum Percentage Difference" in "Southern Pipeline Interconnector (SPI) Rules".	Link_Data
12**	Modify "SPI Northerly Flow Rule #1 – Percentage Trigger" in "Southern Pipeline Interconnector (SPI) Rules" that the trigger level (in ML) is not modified.	Link_Data
13‡	Modify "SPI Northerly Flow Rule #2 – Minimum Percentage Difference" in "Southern Pipeline Interconnector (SPI) Rules".	Link_Data
14†	Modify "NPI Southerly Flow Rule #1 – Percentage Trigger" in "Northern Pipeline Interconnector (SPI) Rules" that the trigger level (in ML) is not modified.	Link_Data
15‡	Modify "NPI Southerly Flow Rule #2 – Minimum Percentage Difference" in	Link_Data

No.	Modification Details	Worksheet
	"Northern Pipeline Interconnector (SPI) Rules".	
16†	Modify "NPI Northerly Flow Rule #1 – Percentage Trigger" in "Northern Pipeline Interconnector (NPI) Rules" that the trigger level (in ML) is not modified.	Link_Data
17‡	Modify "NPI Northerly Flow Rule #2 – Minimum Percentage Difference" in "Northern Pipeline Interconnector (NPI) Rules".	Link_Data

* Only if the SEQ Regional Volume contains the modified storage.
** Only if the Southern Regional Volume contains the modified storage.
† Only if the Northern Regional Volume contains the modified storage.
‡ Only if either the two Regional Volumes contains the modified storage.

Modification of the Storage-Area-Volume Data parameters should be performed by recalibration of the following equation, using the modified full volume, to the actual storage area and volume data



(1)

Modification of percentage trigger levels should be performed as

(2)

Modification of the difference in percentage levels (used in the SPI and NPI Rule #2s) is more problematic and cannot be simply modified from the spreadsheet. This change requires modification of the internal rules in the network model. In particular, the summation links embedded in the system network representation. This modification must be done by someone who intimately knows the model setup and requires changes to file "Network_SEQ.p2p.tpl".

Both the Long-Term and Forecast models have certain percentages "hard-coded" in their output statistics calculation. Although all output statistics for the Regional Volumes will be correct (by changing the spreadsheet as per the preceding text), the individual statistics of single storages that are based on percentages, e.g., probability of reaching the 10% volume in the Brisbane System, will not be correct for both the Long-Term and Forecast modes. Modifications required are either volumes in files "LT_Extract_2.in.tpl", "FC_Extract_2.in.tpl" or percentages in files "LT_Process_1.in.tpl", "FC_Process_1.in.tpl".

Some behaviour cannot be maintained, such as the proportional volume operation rule, which is encoded in the WathNet program itself, and will only ever use the modified volumes (not the original volumes). This can only be modified by the WathNet programmers.

Review of Modifications in QWC Scenarios

Forecast scenarios op_11_001, op_11_002, op_11_003, and op_11_004 are sensitivity analyses for different initial volumes for Wivenhoe, Baroon Pocket and Hinze Dams. Table 2 outlines the details of the review of the forecast runs. The model setups for all runs seem correct.

Table 2. Review of Forecast Scenario Model Setup

Run	Initial Storage Volumes Wivenhoe, Baroon, Hinze	Notes
op_11_001	50%, 100%, 100%	Ok.
op_11_002	87.10%, 100%, 100%	Ok.
op_11_003	50%, 50%, 50%	Ok.
op_11_004	70%, 100%, 100%	Ok.

The setup parameters for the Long-Term scenario LOS_11_001 seem reasonable. See Table 3 for checking details. There could be marginal differences (other than the change to Wivenhoe's full volume) to the amount of emergency and drought storages compared to the base case. A very minor difference could result from slight differences in the initial volume of Wivenhoe.

Table 3. Review of Long-Term Scenario Model Setup

Run	Wivenhoe Full Volume	Notes
LOS_11_001	90%	- Wivenhoe Full Volume ok. - Wivenhoe Area-Volume parameters ok. - Emergency and Drought Volumes for Wivenhoe are 30% and 40% of the new Wivenhoe Full Volume. The amount of contingency volume in Wivenhoe will change from the Original Wivenhoe Full Volume case. This may affect results marginally, but may affect output statistics relating to the Emergency and Drought volumes a little more. - Initial Volume for Wivenhoe is 95% or the new volume. This may affect result very marginally. - "SEQ Trigger Volume %" ok. - ""T1/T2/T3/T4 On/Off Trigger Level Volume"" ok. - "WCRWS Irrigator Cutoff Level" ok. - "WCRWS Wivenhoe Supply Start Level" ok. - Other changes (in Table 1 don't apply).
LOS_11_002	75%	Same as above.

Review of Output Statistics

Table 4 lists inconsistencies with output data in the summary tab in the spreadsheet "January 2011 Scenarios ~ modelling register, data, assumptions, results.XLS" and model output.

Table 4. Forecast Run Output Statistic Inconsistencies

Run	Initial Storage Volumes Wivenhoe, Baroon, Hinze	Notes
op_11_001	50%, 100%, 100%	- 5-year T1 statistic should be 0.31% (compare with 0.48%) NOTE: This was a typo and has been subsequently fixed.
op_11_003	50%, 50%, 50%	- Spreadsheet says initial Hinze is 50%, but output results suggest that initial Hinze was 100%? - Spreadsheet says initial Baroon is 50%, but output results suggest that initial Baroon was 100%? NOTE: After checking the original data files it was found that incorrect output data were supplied with this scenario. This has been subsequently fixed.

Table 5 shows a comparison of the forecast analysis results. These results seem entirely reasonable and satisfy the SOP Criteria.

Table 5. Comparison of Forecast Run Output Statistics

Statistic (Probability of Reaching)	Wivenhoe/Baroon/Hinze Initial Storage Volumes (%)				SOP Criteria
	50/100/100 op_11_001	87/100/100 op_11_002	50/50/50 op_11_003	70/100/100 op_11_004	
40% SEQ in 1 Year	na	na	na	na	na
40% SEQ in 3 Years	<0.01%	<0.01%	<0.01%	<0.01%	<0.2%
40% SEQ in 5 Years	0.31%	0.09%	0.49%	0.20%	<5.0%
30% SEQ in 1 Year	na	na	na	na	na
30% SEQ in 3 Years	<0.01%	<0.01%	0.01%	<0.01%	<0.5%
30% SEQ in 5 Years	0.02%	<0.01%	0.03%	0.01%	<1.0%

Table 6 shows a comparison of the long-term analysis results. These results seem entirely reasonable and satisfy the LOS Criteria.

Table 6. Comparison of Long-Term Run Output Statistics

Statistic	Wivenhoe Dam Full Storage Volume			LOS Criteria
	100% Base Model	90% LOS_11_001	75% LOS_11_002	
LOS System Yield (ML/a)	485,000	485,000	455,000	
Grid Twelve 40% (ARI)	35	27	26	>25
Grid Twelve 30% (ARI)	132	106	130	>100
Grid Twelve 10% (ARI)	9,750	11,700	na	>1,000
Grid Twelve 10% (ARI)	na	na	na	na
Brisbane Dead Volume (ARI)	na	na	na	na
Baroon Pocket Dam Dead Volume (ARI)	na	na	na	na
Gold Coast Dead Volume (ARI)	na	na	na	na

Summary

Modifications were made to the WathNet SEQ Grid model for the purposes of a sensitivity analysis of the SEQ LOS statistics from lowering the full storage volume of key large storages. There a number of changes to the model that can only be done by someone with intimate knowledge of the lower-level files in the model—and cannot be made using the spreadsheet. However, as long as it is only the SEQ volume LOS statistics that are being reported on and given the modifications made to the spreadsheet the results should be reasonable.

Initial inconsistencies with data supplied to DERM have been resolved and the output statistics for both the long-term and forecast model runs seem reasonable (without re-running those scenarios) and are compliant with the LOS and SOP criteria.

Review of WathNet Model Modifications

Introduction

This document outlines a review of modifications to the SEQ Stochastic Grid Model with respect to reducing the full operating level in Wivenhoe Dam. LOS yield analysis was then applied to the modified models.

Modifications Required

The reduction of the full operating level in Wivenhoe Dam is achieved in the grid model by a reduction in the dam's corresponding "working volume." Modifications have been made from the base model in "Model_D4d_2010 0b (April-2010).xls". Table 1 shows the required reduction in the Wivenhoe Dam's working volume (given the full, dead, emergency and drought volumes in the base model).

Table 1. Percentage reduction required in Wivenhoe Dam working volume

Run Name	Reduction in Wivenhoe Dam Full Storage Level	Reduced Level in Wivenhoe Dam Working Volume
LOS_11_018	25%	58%
LOS_11_019	20%	67%
LOS_11_020	15%	75%
LOS_11_021	10%	81%

The reduction in the full operating volume in Wivenhoe Dam is made in the WathNet program using the "Reservoir End-of-Season Target" option. In terms of the grid model Table 2 outlines the modifications that are required to the runfile-template file.

Table 2. Modifications required to reduce Wivenhoe Dam's full operating level (15% reduction used in example)

File "Network_SEQ.run.tpl", Line 1331:												
Original	0					0						
Modified	1					0						
File "Network_SEQ.run.tpl", Line 2263:												
Original	100	100	100	100	100	100	100	100	100	100	100	100
Modified	75	75	75	75	75	75	75	75	75	75	75	75

These modifications were correctly implemented in model runs LOS_11_018 to LOS_11_021.

Review of Output Statistics

Table 3 shows the output statistics from LOS yield runs. These results seem reasonable (without re-running each model).

The LOS yield for the 10% reduction in Wivenhoe Dam's FSV shows an increase compared to the base model. This is due to the failure of criterion 4 (5% of the SEQ volume level) and stems from the sensitivity of one event in the 116,000 years of simulation to the change in operation brought about by the reduction in Wivenhoe Dam's full operating level. Note that for the same demand, criteria 1 and 2 are worse for the reduced operating level case.

Table 3. Review of Model Output Statistics

Value/Statistic	Model Name					
	Base	***Base Failed***	**LOS_11_018 (25% FSV)**	**LOS_11_019 (20% FSV)**	**LOS_11_020 (15% FSV)**	**LOS_11_021 (10% FSV)**
Grid Demand	485,000	*490,000*	455,000	470,000	475,000	490,000
Criteria #1	35	*32*	27	25	27	29
Criteria #2	132	*122*	122	107	110	116
Criteria #3	9,750	*7,799*	19,500	13,000	11,700	11,700
Criteria #4	na	*116,959*	na	na	na	na
Criteria #5	na	*na*	na	na	na	na
Criteria #6	na	*na*	na	na	na	na
Criteria #7	na	*na*	na	na	na	na

Summary

The required modifications were correctly applied to the grid model files. The correct percentage reductions of Wivenhoe Dam's working volume were performed. The output statistics seem reasonable.

JOHN RUFFINI– FLOOD EVENT LOG COMMENTS

Note: The names of individuals have been removed from this version of the Flood Event log. Gate Operation Directives have also been removed for clarity and a full listing of all Gate Operations Directives can be found in Appendix L.

JOHN RUFFINI – FLOOD EVENT LOG COMMENTS (continued)

Date	Time	Action	Comment by Engineer 3	Title
Thursday 6 January 2011	7:00 AM	Engineer 2 Duty Engineer. Rainfall and water had been remote monitored to this point in time. Engineer 2 advises Senior Duty Engineer that Flood Operations are required at Somerset, Wivenhoe and North Pine Dams. Engineer 2 arrived at FOC to assess strategies and mobilised FOC, Wivenhoe, Somerset and North Pine Dam. North Pine Dam At 07:00hrs Thursday, North Pine Dam was 39.60m, 0.05m below gate trigger level and having risen 0.18m since 2/1/2011 due to a combination of base flow and runoff from rain in the last 24 hours. Given the forecast rain, gate operations will commence tonight. MBRC will be advised this morning. Somerset Dam At 07:00hrs Thursday, Somerset Dam was 99.34m, 0.34m above FSL, and rising slowly. The rain in the Stanley River catchment has produced a small amount of runoff in the upper Stanley but there have been significant rises in Kilcoy Ck. Further regulator operations will be required later Thursday. Wivenhoe Dam The regulator and hydro were discharging at 50 cumecs to manage baseflow recession from previous flow event. At 07:00hrs Thursday, Wivenhoe Dam was 67.31m and rising slowly. This is 0.31m above FSL and above the gate trigger level of 67.25m. There have been rises recorded at rivers and stream upstream of Wivenhoe Dam. Gates will be opened in the next 24 hours to manage the inflows from the upper Brisbane River and the outflow from Somerset.	All duty engineers received this advise by Email that we had mobilised.	Flood Officer 7
Sunday 9 January 2011	3:30 PM	Duty Engineer Conference. Attended by all Duty Engineers (Engineer 4 by Telephone). At this stage operating at top end of W1 and bottom of W2. Storing Approximately 300,000 ML at present (above Wivenhoe Dam) with an additional 500,000 ML expected to flow into the dams from rainfall on the ground. The rainfall producing system is currently in the N-E part of the catchment and expected to travel south over next 24-36 hours according to BoM forecasts. This has the potential to significantly increase flows in Lockyer Creek and the Bremer River which will potentially close Fernvale Bridge and Mt Crosby Weir Bridge and increase the risk of flooding in the Lower Brisbane. Releases will be maintained at current level of 1,400 cumecs. If required, releases from Wivenhoe Dam will be reduced to contain flow in the Mid- Brisbane to 1,600 cumecs. And 3,000 cumecs	I can't recall the exact words spoken at this meeting. The description provided is consistent with my recollection of the meeting.	Engineer 1

JOHN RUFFINI – FLOOD EVENT LOG COMMENTS (continued)

		in the Lower Brisbane. At this stage it is anticipated that levels below 102.5 m in Somerset and 72.5 in Wivenhoe Dam can be attained.		
	8:30 PM	ICC returned call and spoke to Engineer 3. He was informed of current situation and the likelihood of high releases tomorrow causing flood damage.	This is consistent with my recollection of this call.	Flood Officer 6
	8:55 PM	BCC called back and spoke with Engineer 3. Confirmed BCC mobilisation triggers need to be in place. Status report is in preparation and will be emailed out shortly.		Flood Officer 6
	10:00 PM	Engineer 3 called Wivenhoe operator (Dam Operator 7) and confirmed current flooding expectations based on rainfall predictions and expected impacts.	Nothing to add.	Flood Officer 6
	10:30 PM	Engineer 3 called Wivenhoe Dam operator (Dam Operator 7) requesting for a visual inspection of Fernvale Bridge.	Nothing to add	Flood Officer 6
	10:40 PM	Dam Operator 7 (Wivenhoe Dam) called discussed Fernvale Bridge situation with Engineer 3. Water was lapping the bridge girders.	Nothing to add	Flood Officer 6
	11:20 PM	Engineer 3 called ICC and left message regarding rates of rise at Mt Crosby. Bridge will be inundated within the next couple of hours.	Nothing to add	Flood Officer 6
	11:25 PM	Engineer 3 called ICC regarding rates of rise at Mt Crosby (approx 200 mm from going over) - will be inundated within the next couple of hours. Confirmed more rain is on the way and releases will need to be increased.	Nothing to add	Flood Officer 6
	11:30 PM	Engineer 3 called SRC and left message advising of situation.	Nothing to add	Flood Officer 6
	11:35 PM	Engineer 3 called SRC and left message for call to be returned re Fernvale Bridge situation.	Nothing to add	Flood Officer 6
	11:38 PM	Engineer 3 called SRC CEO and left message regarding Fernvale Bridge situation and requested call be returned ASAP.	Nothing to add	Flood Officer 6
	11:40 PM	SRC called back and spoke with Engineer 3. Engineer 3 confirmed the high flow levels and anticipated further level rises will impacts road crossings. Fernvale Bridge was about to go out. Informed of the levels and inflows to Wivenhoe and Somerset and the expectation for more rain.	Nothing to add	Flood Officer 6
Monday 10 January 2011	12:00 AM	SRC called again and spoke with Engineer 3. Engineer 3 confirmed Police were on site at Fernvale Bridge and were contemplating road closure signs at Fernvale. Confirmed message has been left with DTMR but call not yet returned.	Nothing to add	Flood Officer 6
	12:45 AM	BCC called and spoke with Engineer 3. Indicated that 3500 cumecs is	The 4000 cumecs refers to the combined flow at Moggill in	Flood Officer 6

JOHN RUFFINI – FLOOD EVENT LOG COMMENTS (continued)

		the damaging flow level for Brisbane urban areas. The manual documents 4000 cumecs as the damaging level. Engineer 3 undertook to take this into consideration when preparing the current situation report, and would not refer to damage levels.	the manual is the point at which there is a change in the shape of the damage curves. BCC participated in the latest revision of the manual and was aware of this level. The issue that they were bringing to our attention was the fact that at discharges above 3500 cumecs some damage starts to occur in some Brisbane reaches. They were worried about the Situation Reports stating that 4000 cumecs was the limit of non damaging floods.	
	12:55 AM	Engineer 3 called Dam Operations Manager to discuss BCC's view on damaging flow. Engineer 3 confirmed that if flows were kept below 3500 the fuse plug would be triggered. Agreed that situation reports will not allude to damage levels - the councils can make decisions on what to report in this regard.	It was agreed that Council was responsible for providing the advice on what, when and were damage would occur in Brisbane based on the BOM forecast levels at the Port Office gauge. Any reference to damaging levels in Situation reports was therefore removed to allow BCC to provide more appropriate advice based on their mapping systems and the BOM forecast heights at the port office gauge.	Flood Officer 6
	1:00 AM	Situation Report – 01:00 Monday 10 January 2011.	Nothing to add	Engineer 3
	4:10 AM	Engineer 3 discussed Wivenhoe status and release strategy with Dam Operator 7.	Nothing to add	Flood Officer 6
	5:05 AM	Dam Operations Manager called and received situation update from Engineer 3.	Nothing to add	Flood Officer 6
	6:30 AM	Situation Report – 06:00 Monday 10 January 2011.	Nothing to add	Engineer 3
	9:00 PM	Engineer 1 and Engineer 3 spoke to Director Dam Safety regarding strategies for reducing Wivenhoe release to mitigate latest event in Lockyer. He endorsed variation to manual to operate at minimum gate settings to create gap to allow peak of flash flood to pass. Also endorsed concept allowing Wivenhoe HW to rise above 74.0 mAHD briefly (less than 12 hours) providing levels did not rise too high (i.e. less than 74.2 mAHD).	The size and magnitude of the flash flood in the Lockyer Valley was being assessed at this time. This was a discussion about obtaining in principle approval for the use of discretionary powers if the following circumstances eventuated. The Director of Dam Safety agreed in principle. This was not an approval to proceed with this action or a variation under clause 2.8 of the Manual.	Flood Officer 9
Tuesday 11 January 2011	6:12 AM	Situation Report – 06:00 Tuesday 11 January 2011.	Nothing to add	Engineer 3
	3:49 PM	BoM had a conference with Engineer 1, 2, 3 and 4 about current release strategy and possible maximum release scenario of 10000m3/s. This would be of a similar magnitude to the 1893 event (~8.36m in Brisbane Port Office)	Discussed scenarios and possible direction of event.	Flood Officer 4
	5:22 PM	BoM, Engineer 2 and Engineer 3 discussed current Wivenhoe inflows and anticipated outflows. Engineer 2 confirmed that 7500cumecs is still likely early tonight.	Discussion with BOM on current model predictions.	Flood Officer 4

JOHN RUFFINI – FLOOD EVENT LOG COMMENTS (continued)

	6:07 PM	Recap of current release strategy amongst Duty Engineers. Current Wivenhoe scenario: 74.9 m - all gates at 12m. Won't go to 13m settings until level reaches 75.0 m AHD.	All four duty Engineers assess and discuss current state of operations prior to shift handover.	Flood Officer 4
	8:35 PM	Seqwater CEO called FOC to speak with all duty engineers on the operating strategies for Wivenhoe releases.	Nothing to add	Flood Officer 3
	7:25 PM	Engineer 3 called North Pine Dam Operator to advise that a directive will be sent to move all gates down to 11m.	Nothing to add	Flood Officer 3
Wednesday 12 January 2011	3:10 AM	Engineer 3 rang NPD Operator and advised no changes to gate settings planned for the next hour or so.	Nothing to add	Flood Officer 3
	5:15 AM	Dam Operations Manager rang enquiring current storage levels and releases. Engineer 3 advised.	Nothing to add	Flood Officer 3
	5:30 AM	Engineer 3 called Wivenhoe Dam for the current level. Dropped 2 cm in 30 minutes.	Nothing to add	Flood Officer 3
	4:20 PM	BCC called FOC and had phone conference with Duty Engineers. He was seeking update for briefing with Lord Mayor.	Nothing to add	Flood Officer 1
	7:45 PM	Engineer 1 & Engineer 3 advised BoM that FOC will be sending updated projected releases from Wivenhoe Dam. This has been prepared with the aim of limiting flows at Moggill to 3,500 cumecs.	Nothing to add	Flood Officer 7
	8:00 PM	Engineer 1 & Engineer 3 advised BCC Flood Information Centre that FOC will be sending updated projected releases from Wivenhoe Dam. This has been prepared with the aim of limiting flows at Moggill to 3,500 cumecs.	Nothing to add	Flood Officer 7
Thursday 13 January 2011	1:00 AM	BCC called FOC to enquire if Wivenhoe Dam has been compromised. Engineer 3 assured him that that is not the case.	Nothing to add	Flood Officer 7
	1:10 AM	BCC called the FOC regarding a viral text rumour that Wivenhoe Dam has failed. Engineer 3 assured him that that is not true and will speak with Dam Operations Manager about this matter.	Nothing to add	Flood Officer 7
	1:25 AM	Engineer 3 called Dam Operator 7 (Wivenhoe Dam) to confirm Wivenhoe Dam has not been compromised.	Nothing to add	Flood Officer 7
	1:30 AM	Engineer 3 called Dam Operations Manager advising him about the rumours that Wivenhoe Dam has been compromised. Engineer 3 will send him the BCC contact details.	Nothing to add	Flood Officer 7
Friday 14 January 2011	12:33 PM	Flood Officer 7 phoned Engineer 2. Request from Seqwater Corp Comms about hourly updates. Particular concern about NPD which ceased flood operations at 5:00am this morning!! Engineer 3 advised that updates from the dams would continue to be channeled solely	Nothing to add	Flood Officer 1

		through the FOC.		

JOHN RUFFINI – FLOOD EVENT LOG COMMENTS (continued)

Sunday 16 January 2011	6:09 AM	Situation Report – 06:00 Sunday 16 January 2011.	**Nothing to add**	Engineer 3
Monday 17 January 2011	11:20 AM	Dam Operations Manager called - Council wants to know draw down rates, so they can determine the effects on Coronation Dr. Engineer 3 informed Dam Operations Manager that BCC did not raise this when they spoke 10 mins before.	Nothing to add	Flood Officer 8
	12:20 PM	Engineer 3 contacted BCC to get an update on Coronation Dr situation. Engineer 3 spoke to BCC. BCC advised he had spoken to BCC Geotechnical Officers and they had advised that at this stage as Coronation Dr was back within the banks that they could not see an immediate problem. Some bank slumping have been identified further up the river. Council would like the recession of flow to be as flat as practicable but also that releases be as small as possible at the Port Office gauge by the time of the high tide on Friday. This is consistent with our current strategy of closing releases by Wednesday 20 Jan 2010.	Nothing to add	Flood Officer 8
	1:01 PM	Dam Operations Manager called, saying MBRC wanted to know if there will be any more releases from NPD. Engineer 3 said none planned unless we get more rain.	Nothing to add	Flood Officer 8
	4:56 PM	Situation Report -17:00 Monday 17 January 2011.	Nothing to add	Engineer 3
Tuesday 18 January 2011	12:35 AM	FOC contacted Esk WTP Team Leader in regards to pumping issues at Lowood. Engineer 3 decided to halt all further gate closure operations until further notice in order to ensure security of water supply to Lowood.	Nothing to add	Flood Officer 9
Wednesday 19 January 2011	11:14 AM	Engineer 3 phoned Engineer 2 - Still operational until tonight.	Nothing to add	Flood Officer 2
	11:36 AM	Engineer 2 phoned Engineer 4 confirming that Engineer 3 and Flood Officer 8 will be on tonight.	Nothing to add	Flood Officer 2

From: Peter Baddiley
Sent: Wednesday, 1 December 2010 9:44 AM
To: 'Rob Drury'
Subject: FW: Forecasting rainfall in Wivenhoe Dam catchment [SEC=UNCLASSIFIED]

Rob
A small miracle - I found the Bureau's 2006 response/advice regarding forecasting rainfall for the Wivenhoe catchment.

As briefly discussed today, whilst weather prediction models are steadily improving, the forecast of rainfall amounts over catchment time/space scales is recognised as one of the most challenging/difficult tasks. Detailed rainfall forecasting is not deterministic - the uncertainties involved are often expressed in probablistic forecasts, an example of which is at our website at: http://www.bom.gov.au/jsp/watl/rainfall/pme.jsp . Click on the "chance of rainfall' radio button.

regards, peter

Peter Baddiley
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GPO Box 413, BRISBANE, QLD, AUSTRALIA 4001

WWW : www.bom.gov.au

From: Peter Baddiley
Sent: Monday, 24 July 2006 4:59 PM
To: [redacted]
Cc: Mike Bergin
Subject: Forecasting rainfall in Wivenhoe Dam catchment

Chris
As discussed with Mike on Friday, please find the attached. Apologies for the delay since our meeting of 6 July.

Please contact us if you require further information or clarification.

Regards, Peter

Peter Baddiley
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Rainfall Forecasting for the Wivenhoe Dam Catchment

Background

1. On 6 July, Chris Russell, of Connell Wagner, met with Mike Bergin and Peter Baddiley seeking advice regarding the predictability of significant rain events over the Wivenhoe Dam catchment. Connell Wagner has been engaged by SEQWCo to provide advice on the feasibility of maintaining the water level in the Wivenhoe storage at one metre above Full Supply Level. As a part of the dam operations under that scenario, it would be required that the additional storage above FSL be released ahead of a major inflow into Wivenhoe Dam. This would require some 24 to 48 hour advance prediction of catchment average rainfalls in the order of 300mm in 24 hours; 375mm in 36 hours and/or 430mm in 48 hours.

2. Wivenhoe Dam catchment is located to the north-west of Brisbane and has an area of about 7,000 square kilometres. For meteorological forecasting, the catchment is broadly about 100 km in the north-south direction, and 70 kilometres wide (east-west); bounded in the west by the Dividing Range with its eastern boundary varying from about 40 to 80 kilometres inland from the coast. The distribution of rainfall over the catchment is significantly influenced by the topography in major events.

Discussion

3. As discussed at the meeting, the experience of Meteorologists and Hydrologists in the Brisbane office of the Bureau is that the short to medium term (0 to 48 hour) prediction of rainfall for the purpose of objective use in flood forecasting models is a difficult task. Quantitative Precipitation Forecasts (QPF) are available from the Australian and international Numerical Weather Prediction (NWP) models and have been used subjectively in the Brisbane office for many years. Whilst the NWP models have shown improvement in the accuracy of QPF over the past decade or so, there is still at times considerable error or uncertainty, in the prediction of the location, amount and timing of rainfall events at the catchment scale.

4. The improved skill of NWP models in recent years has particularly been in forecasting the development and movement of broad-scale synoptic features that would be likely to produce the threshold rainfall amounts in question. These large-scale features include decaying tropical cyclones, east coast low pressure systems and significant upper level troughs. However while these systems maybe well forecast on a time scale of 2 to 3 days the very heavy rainfall concentrations are dependent on finer scale (mesoscale) and convective features. Whilst there is often the ability to forecast the potential for a significant rain event to occur in the southeast Qld-northern NSW region, it is difficult (if not impossible) to predict the actual location of the heaviest rain, even with only a few hours notice.

5. Examples of high rainfall events that have occurred in the past 10 to 15 years in this region, some of which had little to no advance prediction of the "precise" location and/or magnitude of resulting rainfall, include Feb 1991, Dec 1991, Feb 1992, May 1996, Feb 1999, Mar 2001 and June 2005. Several of these events were not produced by large-scale features but by slow moving convergence zones which the current

modelling capability cannot adequately predict. The two most recent events in 2001 and 2005 were relatively short-lived events and occurred at different times of the day – 2001 in the afternoon and 2005 overnight. While one could reasonably expect that most really significant rainfall events are most likely through the warmer months, winter extreme events are by no means rare.

6. Considerable effort is being applied to derive improved deterministic and probabilistic QPFs from NWP models. In the near future, the Bureau will be providing a publicly available rainfall forecasting service via a website. The rainfall predictions will be generated automatically by combining the outlooks from a suite of Australian and international. Forecast rainfall amounts for 24 hour periods will be given for 4 days ahead, together with the chance of exceeding various amounts from 1mm to 50mm. The latter is a "pseudo" measure of probability based on the consistency in the forecast rain amounts given by up to eight NWP models used in deriving the rainfall forecast. Whilst it is not considered that this will provide a sufficiently accurate method for objective decision making for pre-releases from Wivenhoe Dam, the probabilistic rain forecasts may provide a basis for a risk management approach. There may need to be further studies on risk quantification for prediction of high to extreme rainfall events to support this approach. Given that there are large levels of uncertainty in rainfall forecasts, the forecasting of hydrological response may require an ensemble of future rain scenarios to be considered for the Wivenhoe Dam application.

7. As for a potential service provided by the Bureau an alert type product would seem to be the best alternative where the potential for an extreme rainfall event in the following 2 to 3 days across southeast Queensland was given a rating on say a 3 level scale. If that rating was high then a second phase could be activated which could provide more detailed forecast of expected rainfall amounts and location. However I emphasise that this type of service can be expected to not provide the required 2 days advice of an event on some occasions and may fail to provide anything more than a few hours notice, such is the nature of the predictability of the mesoscale components of these events.

8. Currently the Bureau provides a QPF service for the dams in Southeast Queensland. This twice-daily service predicts the average rainfall across the catchments in the following 24-hour period. We have not undertaken any verification of the service. However it is likely that verification would show reasonable skill in identifying rainfall events but quite poor skill in predicting extreme events. This service is to be reviewed in the next few months and we may commence charging for the product as it is essentially not a basic service and should not be publicly funded. We have yet to commence discussions with the client so these comments should be kept confidential. This issue is raised because any future customized product provided in support of dam operations will certainly be on a fee for service basis. There is also the issue of whether the Bureau would have the capacity to provide such a service at all and that would have to be part of any future discussions.

Summary

9. In light of the demand for water in southeast Queensland and the highly variable nature of rainfall in the area the project has many obvious attractions. However the capability of the science to provide sufficiently reliable 24 to 48 hour advance predictions of high catchment average rainfalls is limited. The Bureau would be willing to participate in future discussions on the subject and maybe able to assist with some service that would assist.

Mike Bergin
Manager Weather Services,
Bureau of Meteorology, Queensland.

Peter Baddiley
Supervising Engineer Hydrology
Bureau of Meteorology, Queensland

24 July 2006