James Reeves – Statement and attachments dated 1 February 2012

QUEENSLAND FLOODS
COMMISSION OF INQUIRY

STATEMENT OF JAMES EDWARD REEVES

I, **JAMES EDWARD REEVES**, of c/- 400 George Street Brisbane in the State of Queensland, Director-General, Department of Environment and Resource Management (DERM), state on oath:

Requirement from Queensland Floods Commission of Inquiry

1. I have seen a copy of a letter dated 30 January 2012 from the Commissioner, Queensland Floods Commission of Inquiry ("Commission") to me requiring a written statement under oath or affirmation, which is attachment **JER-01** and which details the topics my statement should cover.

Item 1: his understanding of which flood operations strategies, referred to in the 'Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam', were used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011 and the times at which each strategy was in use and the basis of that understanding.

2. I commenced my employment as the Director-General of the Department of Environment and Resource Management ("DERM") on 29 August 2011.

3. Prior to that date I was employed by the Queensland University of Technology as the Manager of the Institute for Sustainable Futures.

4. I took a leave of absence from the department during the period 17 September 2011 until 12 October 2011 to fulfil a longstanding family commitment.

5. At the time of commencing my role with DERM, I had no understanding of which flood operations strategies, referred to in the 'Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam', were used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011 and the times at which each strategy was in use.

6. I subsequently gained an understanding of the above from reading the relevant chapters of the *Queensland Floods Commission of Inquiry – Interim Report* ("the Interim Report") of 1 August 2011.

7. My understanding from reading the findings of the Interim Report is that the strategies changed from W1 to W3 at 8 am on Saturday, 8 January 2011 and to W4 on 8 am on Tuesday, 11 January 2011.

Item 2: whether he is aware of any accounts of the choice and timing of the dam operations strategies employed to manage the flood event that differ from his understanding of the events and if he is, a description of those different accounts and the source of the accounts.

8. I am aware of allegations reported in *The Australian* newspaper on 23 January 2012 and subsequent media reports of inconsistencies of accounts of the choice and timing of the dam operations strategies employed to manage the flood event during the dates described above.

9. Those accounts are described in the media reports from 23 January 2012 to the date of this statement.

Item 3: when he first became aware of the accounts, if any, referred to in paragraph 2 above.

10. I first became aware of the accounts referred to under Item 2 above on 23 January 2011 when those accounts were published as allegations in *The Australian* newspaper.

Item 4: all discussions, correspondence, meetings or briefings he participated in, in relation to the choice and timing of dam operations strategies used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011, and in respect of these identifying any that related to the different accounts, if any, referred to in paragraph 2.

11. As outlined in my response to Item I above, I was not employed by DERM at the time of the January 2011 flood event. Accordingly, I did not participate in any discussions, correspondence, meetings or briefings in relation to the choice and timing of dam operations strategies used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011.

12. In respect of identifying any discussions, correspondence, meetings or briefings that relate to the different accounts, referred to in Item 2 above, on 23 January 2012, I was forwarded for information, by Ms Debbie Best of DERM, three chains of emails responding to the allegations of that same day published in *The Australian* newspaper.

13. The first email forwarded to me is dated Monday, 23 January 2012 at 9:45 am and is provided as attachment **JER-02**. The email includes an attachment "Doc3.docx" being "background notes" by John Bradley, Director-General of the Department of the Premier and Cabinet ("DPC") on "the Seqwater issue".

14. The second email forwarded to me is dated Monday, 23 January 2011 at 9.57 am and is provided as attachment **JER-03**. The email includes an attachment "HIB - The Australian and Jan flood event FINAL.doc" being a draft Hot Issue Briefing titled "The Australian Newspaper article claiming Seqwater breached its operations manual during the January 2011 flood events land" (sic).

15. The third email forwarded to me is dated Monday, 23 January 2012 at 2:53 pm and is provided as attachment **JER-04**. The email includes an attachment "Seqwater Media Statement 23012011.doc" being a media statement from Seqwater in response to the article of that same day in *The Australian* newspaper titled "What the floods inquiry didn't hear: Wivenhoe 'breached the manual"

Item 5: any decision made, or action taken, by him in relation to the different accounts, if any, referred to paragraph 2 above.

16. I have not made any decisions or taken any actions in relation to the different accounts alleged in media reports.

17. As noted above, I did not become aware of the alleged different accounts until 23 January 2012. I also note that on the following day, being 24 January 2012, the Commission of Inquiry advised that it has "scheduled another round of public hearings principally to address aspects of the operation of Wivenhoe Dam during the January 2011 flood event, namely the transition to Strategy W3 and associated issues, following recent media stories and the Commission's own review of evidence". Accordingly and given the Commission is now investigating the above issues, I do not believe it is appropriate at this time to make any decision, or take any action, other than to cooperate with the Commission of Inquiry.

I make this solemn statement on oath conscientiously believing the same to be true, and by virtue of the provisions of the *Oaths Act 1867*.

Signe[redacted].
James Edward Reeves

Taken and declared before me, at Brisbane this 1st day of February 2012

[redacted]
....
Solicitor/~~Barrister/Justice of the Peace/Commissioner for Declarations~~

Our ref: Doc 1837419

30 January 2012

Mr Jim Reeves
Director-General
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001

REQUIREMENT TO PROVIDE STATEMENT TO COMMISSION OF INQUIRY

I, Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act 1950* (Qld), require Mr Jim Reeves to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry, in which the said Mr Jim Reeves gives an account of:

1. his understanding of which flood operations strategies, referred to in the 'Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam', were used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011 and the times at which each strategy was in use and the basis of that understanding

2. whether he is aware of any accounts of the choice and timing of the dam operations strategies employed to manage the flood event that differ from his understanding of the events and if he is, a description of those different accounts and the source of the accounts

3. when he first became aware of the accounts, if any, referred to in paragraph 2 above

4. all discussions, correspondence, meetings or briefings he participated in, in relation to the choice and timing of dam operations strategies used in the operation of Wivenhoe Dam between 7 January 2011 and 12 January 2011, and in respect of these identifying any that related to the different accounts, if any, referred to in paragraph 2

5. any decision made, or action taken, by him in relation to the different accounts, if any, referred to paragraph 2 above.

400 George Street Brisbane
GPO Box 1738 Brisbane
Queensland 4001 Australia
Telephone 1300 309 634
Facsimile +61 7 3405 9750
www.floodcommission.qld.gov.au
ABN 82 696 762 534

In addressing these matters, Mr Jim Reeves is to:

- provide all information in his possession and identify the source or sources of that information;
- make commentary and provide opinions he is qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion.

All documents relating to the matters set out in the Statement should be included as attachments to the statement.

The statement is to be provided to the Queensland Floods Commission of Inquiry by 4pm Wednesday, 1 February 2012.

The statement can be provided by post, email or by arranging delivery to the Commission by emailing info@floodcommission.qld.gov.au.

C. Holmes

Commissioner
Justice C E Holmes

Hartwell Deborah

From: Best Debbie
Sent: Monday, 23 January 2012 9:45 AM
To: Reeves Jim; Walsh Paul
Subject: FW: Note re Seqwater
Attachments: Doc3.docx

Debbie Best
Deputy Dir[redacted]tcomes Division
Telep[redacted]
Emai[redacted]
www.derm.qld.gov.au

Department of Environment and Resource Management
Level 13, 400 George Street, Brisbane Q 4000
GPO Box 2454, Brisbane Q 4001

From: John Bradley [redacted]
Sent: Monday, 23 Ja[redacted]
To: Best Debbie; 'rachel.nola[redacted]
Cc: Renee Mickelburgh
Subject: Note re Seqwater

Minister

As requested by Debbie Best– this is my note on the Seqwater issue. Pls treat as background, I will ask Renee in Prem's office to send you the HIB that they are using.

John b

The Commission of Inquiry has had the legal powers of a Court and has been given the documentation referred to in the Australian, including situation reports.

There is no doubt the move by Seqwater Flood Engineers to "W3" was not formally recorded and the updated strategy was not reflected in the flood event log, leading to incorrect statements in other documents.

However, apart from the Flood Event log, the Commission was able to directly examine the evidence of Engineers under cross examination, outflows from the dam and flood modelling used by engineers.

It took evidence directly on the issue of when Seqwater moved to "W3" and on page 72 of its interim report, the Queensland Flood Commission of Inquiry states that then the trigger level of the dam was exceeded at 8 am on 8 January 2011:

> *"The flood engineers moved immediately to strategy W3, which on their understanding required the flow at Moggill to be limited to 4000 m3/s."*
>
> *(page 72, Interim Report)*

The Commission noted that the flood operations centre logs for 8 January 2011 did not record the transition to W3 (or indeed when other changes in strategy were made). As a result, the Commission and made recommendations in its Interim Report for all future logs to record when decisions are made to transition from one strategy to the next (see pages 66 and 67 of the Interim Report). Seqwater has accepted this recommendation and it has been implemented in flood operations centre procedures.

The Report noted that some of the deficiencies were explicable because the log was being compiled by assistants as the flood engineers were managing the flood.

> *"In a number of instances, mistakes were later identified by the flood engineers in the recording of details in the flood event log, including, in some instances, the terms of significant conversations.298 Some telephone conversations were not recorded at all; in others the participants were incorrectly identified. The log did not record all model runs undertaken or the time at which they were undertaken,299 and no note was made of decisions to change strategy or their basis.*
>
> *Some of the deficiencies are explicable, although undesirable. The technical assistants recording telephone discussions were often not participants in them.301 They were not always informed about the flood engineers' actions as they were taken.302 There was no particular form or process for the recording of information, and the entries were not checked by the flood engineers.*
>
> (page 66, Interim Report)

BACKGROUND:

- It's important to understand that even under W3, this does not mean that Seqwater would immediately go to the maximum operating releases under that Strategy. (4000 m3/s downstream). While the primary consideration under W3 is the protection of urban areas from inundation, the flood engineers must consider lower level objectives when making decisions on water releases. These lower level objectives include minimising disruption and inconvenience to rural life (including by maintaining bridges immediately downstream of Wivenhoe trafficable).

- For these reasonsns there isn't an obvious corroboration or 'proof' that W3 had been introduced (eg. releases did not immediately increase to 4,000 m3/s and communications to Councils about bridge closures did not occur til that was considered likely the following day).

- Note also, the QFCOI has issued a further request for a statement from Seqwater yesterday concerning the time at which the W3 strategy was introduced. Seqwater has been asked to provide by COB today, so it is expected that it may be further addressed in the Final Report.

Hartwell Deborah

From: Best Debbie
Sent: Monday, 23 January 2012 9:57 AM
To: 'alex.kasacou[redacted]; Reeves Jim
Subject: FW:
Attachments: HIB - The Australian and Jan flood event FINAL.DOC

HIB from Seqwater

Debbie Best
Deputy Director-General, Water and Ecosystem Outcomes Division
Telephone [redacted]
Email [redacted]
www.derm.qld.gov.au

Department of Environment and Resource Management
Level 13, 400 George Street, Brisbane Q 4000
GPO Box 2454, Brisbane Q 4001

From: Mike Foster [redacted]
Sent: Monday, 23 January 2012 9:54 AM
To: Best Debbie
Subject:

Mike Foster
Manager - Corporate & Community Relations

seqwater
WATER FOR LIFE

Ph [redacted]
Level 3, 240 Margaret St, Brisbane City QLD 4000
PO Box 16146, City East QLD 4002
Website | www.seqwater.com.au

cid:image008.png@01CB8736.F84905B0

HOT ISSUE BRIEFING NOTE

HOT ISSUE G.X	The Australian Newspaper article claiming Seqwater breached its operations manual during the January 2011 flood events land
Question	

Issue:

- The Australian newspaper on Monday 23 January 2011 published a news article claiming Seqwater breached its manual of operating procedures during the January 2011 flood event.

- The article claims there is a discrepancy between the actual flood operation centre logs and the technical reports produced by Seqwater during the Jan 2011 flood event and the final Seqwater flood report and evidence given to the COI in relation to when Seqwater invoked W3 strategy.

- The article misunderstands that although under W3 strategy the primary consideration is the protection of urban areas from inundation, the flood engineers must consider lower level objectives when making decisions on water releases. These lower level objectives include minimising disruption and inconvenience to rural life (including by maintaining bridges immediately downstream of Wivenhoe trafficable) .limiting outflows to a maximum of 4000 cumecs at Moggill to avoid flooding in Brisbane.

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Answer:

- The issue and the detailed documents referred to by the Australian have been extensively investigated by the Queensland Floods Commission of Inquiry as part of its Interim Report in July 2011.
- Speculation by the Australian today is unfounded and inaccurate.
- The Commission in its Interim Report found that W3 was invoked at 8am on Saturday 8 January as required by the manual (see page 72 of the Interim Report)
- This was based on the flood chronology included in the Seqwater January 2011 Flood Event – Report on the Operation of Somerset Dam and Wivenhoe Dam 2 March 2011 as well as written and oral evidence given by the flood engineers.
- The Commission noted that the flood operations centre logs for 8 January 2011 did not record the transition to W3 (or indeed when other changes in strategy were made). As a result, the Commission and made recommendations in its Interim Report for all future logs to record when decisions are made to transition from one strategy to the next (see pages 66 and 67 of the Interim Report).
- Seqwater has accepted this recommendation and it has been implemented in flood operations centre procedures.
- Further, the Commission closely scrutinised the rates of release during Saturday and Sunday (the period referred to in

the Australian). The Commission identified no error in those release rates nor any failure to comply with the manual. It is important to note that under the manual of operations used during the event, W3 strategy allows from a range of priorities from continuing to minimise the impact on rural life and downstream bridges to the upper limit of the strategy which requires limiting flows to 4000 cumec at Moggill to protect Brisbane from flooding.

- On January 8 when W3 was invoked the strategy focused on minimising impact to rural life as required under the manual.

Hartwell Deborah

From: Best Debbie
Sent: Monday, 23 January 2012 2:52 PM
To: Reeves Jim
Cc: Walsh Paul; Claydon Greg
Subject: FW: Media Statement - Seqwater
Attachments: Seqwater media statement 230112.DOC

Jim
In case you haven't received this.
Debbie

Debbie Best
Deputy Director-General, Water and Ecosystem Outcomes Division
Telephone [redacted]
Email [redacted]
www.derm.qld.gov.au

Department of Environment and Resource Management
Level 13, 400 George Street, Brisbane Q 4000
GPO Box 2454, Brisbane Q 4001

From: SEQWGM Media [redacted]
Sent: Monday, 23 January 2012 2:19 PM
To: Undisclosed recipients
Subject: Media Statement - Seqwater

Please find attached a statement from Seqwater, in response to today's article in the Australian, titled:
What the floods inquiry didn't hear: Wivenhoe 'breached the manual'

Regards
SEQ Water Grid Communications Unit

For further details contact the SEQ Water Grid Communications Unit on:

Ph: [redacted]

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seqwater
WATER FOR LIFE

Media Release

23 January 2012

Seqwater media statement

Claims in *The Australian* newspaper today suggesting Seqwater breached its operational manual during the January 2011 flood are inaccurate and unfounded.

Further, the implied allegation that Seqwater (and its engineers) gave misleading evidence to the Queensland Floods Commission of Inquiry is baseless and is utterly rejected.

The issue and the documents referred to by *The Australian*, have been investigated by the Commission as part of its Interim Report in July 2011.

The Commission's Interim Report (page 72) found that Seqwater did invoke Strategy W3 at 8am on Saturday 8 January 2011 in accordance with the manual.

From this time, the primary consideration was the protection of urban areas from inundation. In making decisions about the volume of water released, Seqwater also considered the requirement to minimise the impact on rural life and downstream bridges, as the manual requires.

The Commission's Interim Report noted that the flood operations centre logs for 8 January 2011 did not record the transition to Strategy W3 and recommended that all future logs record when decisions are made to transition from one strategy to the next (pages 66 and 67 of the Interim Report). Seqwater has accepted and implemented this recommendation.

Seqwater also notes that the Commission closely scrutinised the rates of release during 8-9 January, the period referred to in *The Australian* (pages 72-75 of the Commission's Interim Report). The Interim Report does not identify any error in these release rates nor any failure to comply with the manual.

The Commission's independent expert has examined Seqwater's management of Wivenhoe and Somerset dams during the January 2011 flood event. The report investigates, amongst other things, the impact of an earlier release strategy, such as that suggested by *The Australian*. The report of the Commission's expert finds that Seqwater's engineers, using the strategies in the manual and the information available to them, achieved close to the best possible mitigation result.

ENDS

Media contact

Mike Foster, Seqwater Communications Manager
m: [redacted]

Our ref: Doc 1846438

7 February 2012

James Reeves
Director-General
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001

REQUIREMENT TO PROVIDE INFORMATION TO COMMISSION OF INQUIRY

I, Justice Catherine E Holmes, Commissioner of Inquiry, require Mr James Reeves to provide the following information, documents, records and other things to the Queensland Floods Commission of Inquiry pursuant to section 5 of the *Commissions of Inquiry Act 1950* (Qld):

1. all flood event reports submitted to the Queensland Government for flood events at Wivenhoe and/or Somerset Dams from 1995 to 2011 (excluding the January 2011 flood event report).

Material is to be provided to the Queensland Floods Commission of Inquiry by 12 pm, Wednesday 8 February 2012.

Material required can be provided by post, email or by arranging delivery to the Commission by emailing info@floodcommission.qld.gov.au.

C. Holmes

Commissioner
Justice C E Holmes

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REPORT ON FLOOD EVENTS AT WIVENHOE, SOMERSET AND NORTH PINE DAMS

MAY 2009 TO JULY 2009

July 2009

TABLE OF CONTENTS

1 INTRODUCTION

Between 14 April 2009 and 8 July 2009, four separate flood events impacted on Wivenhoe, Somerset and North Pine dams. This report contains details of those events and is prepared in accordance with the requirements of the following Flood Operations Manuals:

- Manual of Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam, Revision No 6, December 2004.
- Manual of Operational Procedures for Flood Releases from North Pine Dam, Revision No 4, September 2007.

Section 2.9 of both of these Manuals requires the preparation of a suitable report at the completion of a flood event. The *'report shall contain details of the procedures used, the reasons therefore and other pertinent information'*. This document contains a combined report covering the four separate flood events across all three dams.

2 FLOOD EVENT SUMMARY

A series of flood events occurred in South-East Queensland between 14 April 2009 and 8 July 2009. These events resulted in significant water releases (including gate operations) being required at Somerset and North Pine Dams. These water releases were necessary to prevent the dam overtopping and subsequent failure. All water releases were made in accordance with the Manuals of Flood Operations and the Water Supply Act 2008. Details of the flood events are as follows:

EVENT DATES	DAMS REQUIRING FLOOD RELEASES
April Event (14 April to 17 April 2009)	Somerset Dam
May Event (19 May to 22 May 2009)	North Pine Dam and Somerset Dam
Early June Event (4 June 2009)	North Pine Dam
Late June Event (22 June to 8 July 2009)	North Pine Dam

The April Event was not strictly a flood event as defined by the Manual of Flood Operations as the event did not require mobilisation of the Flood Operations Centre, even though Somerset Dam attained Full Supply Level. This event was treated as an operational release on the basis that the catchment rainfall was just sufficient to fill the reservoir and there was no significant corresponding inflow into Wivenhoe Dam. This event is mentioned as it contributed to the elevated lake levels for the later events.

The May Event was the most significant in terms of releases from the dams. This event resulted in the full mobilization of the Flood Operations Centre and both Somerset Dam and North Pine Dam.

The Early June Event was as a result of base-flow into North Pine Dam causing the lake level to exceed gate trigger level. The Flood Operations Centre and North Pine Dam were mobilized for this drainage activity.

The Late June Event involved the mobilization of the Flood Operations Centre and North Pine Dam. This event featured a trial drainage release involving the use of the cone valves to minimise as much as possible adverse impacts on both fish and the closure of downstream crossings. The event was relatively small in nature and slightly higher rainfalls would have necessitated operation of the radial gates to protect the structural safety of the dam.

3 MOBILISATION AND STAFFING DETAILS

3.1 April Event (14 April to 17 April 2009)

Heavy rain in the catchment on the 14 April 2009 caused Somerset Dam to attain its full supply level. The event did not require mobilization of the Flood Operations Centre or dam staff because significant rises above the Somerset Dam Full Supply Level did not eventuate. This event was treated as an operational release on the basis that the catchment rainfall was just sufficient to fill the reservoir and there was no significant corresponding inflow into Wivenhoe Dam.

3.2 May Event (19 May to 22 May 2009)

Heavy rain started falling over the catchments of the dams on the afternoon of 19 May 2009. The catchments of the dams had a low antecedent moisture store and there was a sizable storage deficit in all three dams prior to the onset of the event. As a consequence runoff did not commence until the afternoon of Wednesday 20th May 2009.

The SunWater Flood Response Team was formally mobilized on 20 May 2009 at 09:00.

Heavy rain continued throughout 20 May 2009 and into 21 May 2009. The Duty Flood Operations Engineer monitored the event by downloading data through FLOODPC from his home during the evening of the 19 May 2009. Rainfall and river heights were then monitored continuously throughout the day from around 09:00 on the 20 May 2009 in the Flood Operations Centre.

The Duty Flood Operations Engineer advised Seqwater at 21:00 on 19 May 2009 that flood operations were likely at Somerset Dam and North Pine Dam sometime late on the following day. The Dam Supervisors were then placed upon high alert, but formal mobilisation was delayed until gate operations were expected.

Once mobilized, the following staffing arrangements applied:

a) Duty Flood Operations Engineers: Two Duty Engineers were on duty until midnight on 20 May 2009 when this role reverted to the use of a single Duty Engineer. Shifts then reverted to a single Duty Engineer until the end of the event.

b) Data Collectors: A team of three Data Collectors were mobilised to the Flood Operations Centre on the morning of 20 May 2009. Subsequent Data Collectors were then mobilized in groups of three and then two for the remainder of the event.

c) Seqwater Dam Operators: Operators were formally mobilized during the early phase of the event. As noted above, Dam Supervisors were placed upon alert during the early phases of the event. Formal mobilization of the dam operators took place on 20 May 2009, when gate operations were considered likely. Two Dam Operations staff remained on duty at each dam for the duration of the event.

The event was declared over at 17:30 hours on Friday 22 May 2009. At this stage it was considered that further significant runoff into the storages was unlikely and the probability of further operation of the gates at each of the dams was low. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

3.3 Early June Event (4 June 2009)

The Flood Operations Centre was mobilized at 08:30 am on 4 June 2009. Although light rainfall had occurred over the catchment of North Pine Dam on the proceeding night, the lake levels in the reservoir exceeded gate trigger levels due to continued base flows from the May event. This event was effectively a drainage activity to return the lake level back to Full Supply Level. The Flood Operations Centre was staffed by a Duty Engineer and two Data Collectors for the duration of the event.

The event was declared over at 19:00 on 4 June 2009. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

Two Dam Operations staff remained on duty at North Pine Dam for the duration of the event.

3.4 Late June Event (22 June to 8 July 2009)

The Flood Operations Centre was mobilized at 09:00 on 22 June 2009 in response to moderate to heavy rainfall over the catchments of the Stanley River and North Pine River.

Four shifts were effectively conducted during this event which lasted until 21:30 on 23 June 2009. The Flood Operations Centre was staffed by a Duty Engineer and two Data Collectors for the duration of the event.

The event was declared over at 21:30 on 23 June 2009. Following this declaration, monitoring of the dams and the continuing weather situation reverted to the Duty Flood Operations Engineer on close call.

Two Dam Operations staff remained on duty at North Pine Dam for the duration of the event.

Further drain down of North Pine Dam was undertaken using the cone valves to minimise as much as possible adverse impacts on both fish and the closure of downstream crossings. The Flood Operations Centre was not mobilised for these releases as no rain was forecast in the catchment and dam inflows were minimal.

4 EVENT RAINFALL

A summary of the average catchment rainfall for each event is contained in the table below.

EVENT DATES	CATCHMENT	AVERAGE CATCHMENT RAINFALL (mm)
April Event	Wivenhoe Dam Somerset Dam North Pine Dam	45 88 157
May Event	Wivenhoe Dam Somerset Dam North Pine Dam	114 175 336
Early June Event	Wivenhoe Dam Somerset Dam North Pine Dam	6 10 18
Late June Event	Wivenhoe Dam Somerset Dam North Pine Dam	26 43 72

The table above shows that the May Event was significant, with the remaining events being relatively minor. Event Magnitude is further discussed in Section 4.2 below.

4.1 Rainfall Forecasts

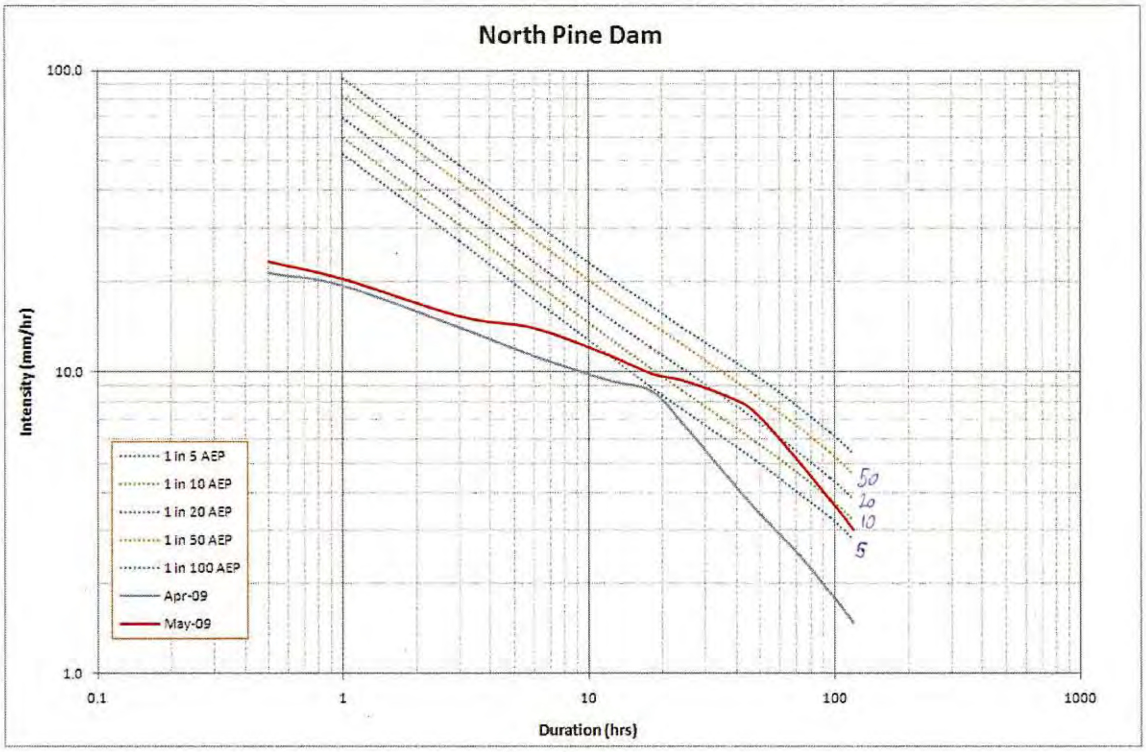
The Bureau of Meteorology provides Seqwater with Quantitative Precipitation Forecasts on a twice daily basis. This forecast provides an estimate of the likely rainfall within the next 24 hour period. These forecasts proved useful in encouraging a state of alert prior to each event. Seqwater intends to continue with this service.

The Flood Response Team also subscribes to the SILO Meteogram medium duration forecast (up to seven days) service. Four day outlooks are also available via the Water and the Land site on the Bureau of Meteorology webpage. These services were also useful in raising the state of alert prior to the event.

4.2 Event Magnitude

As shown in the table above, the rainfall in the April and May events is significantly higher in all three catchments than the Early and Late June events.

Only the April and May 2009 events were significant rainfall events in the North Pine catchment. The graph below shows that the April event was about 1 in 5 AEP for a duration of 18 to 24 hours. The May event was more significant just exceeding the 1 in 20 AEP for a 48 hour duration storm.



Similar to North Pine the May event in the Somerset catchment was statistically more significant than any of the other events. However, the rainfall in both the April and May events was below a 1 in 5 AEP for all durations.

The rainfall in the Wivenhoe catchment during all four events is not considered to be statistically significant.

5 INFLOW AND WATER RELEASE DETAILS

The tables below summarise dam inflows, dam outflows and water levels for each event.

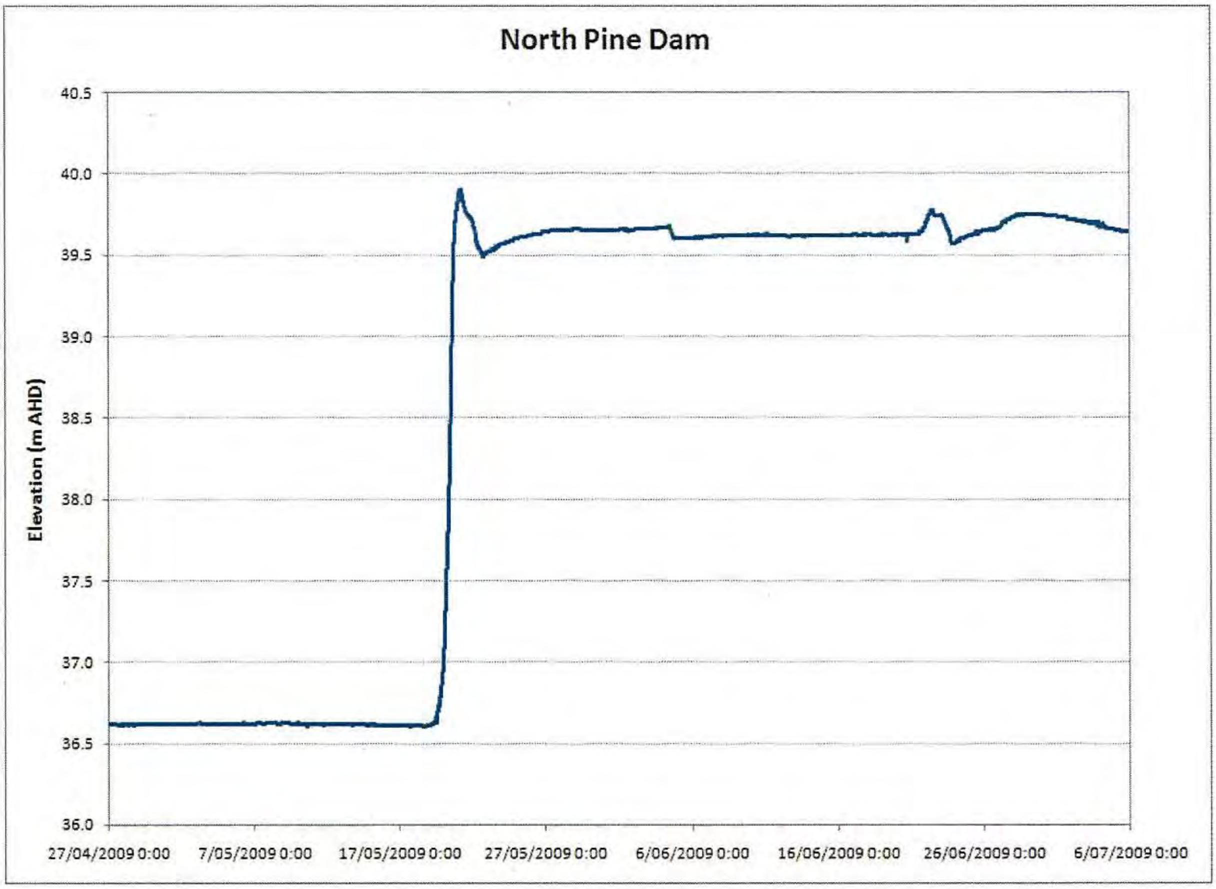
APRIL EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	74900	101200	45200
Release (ML)	78300	0	0
Peak Outflow (m^3/s)	276	0	0
Peak Water Level (mAHD)	99.06	59.04	36.61

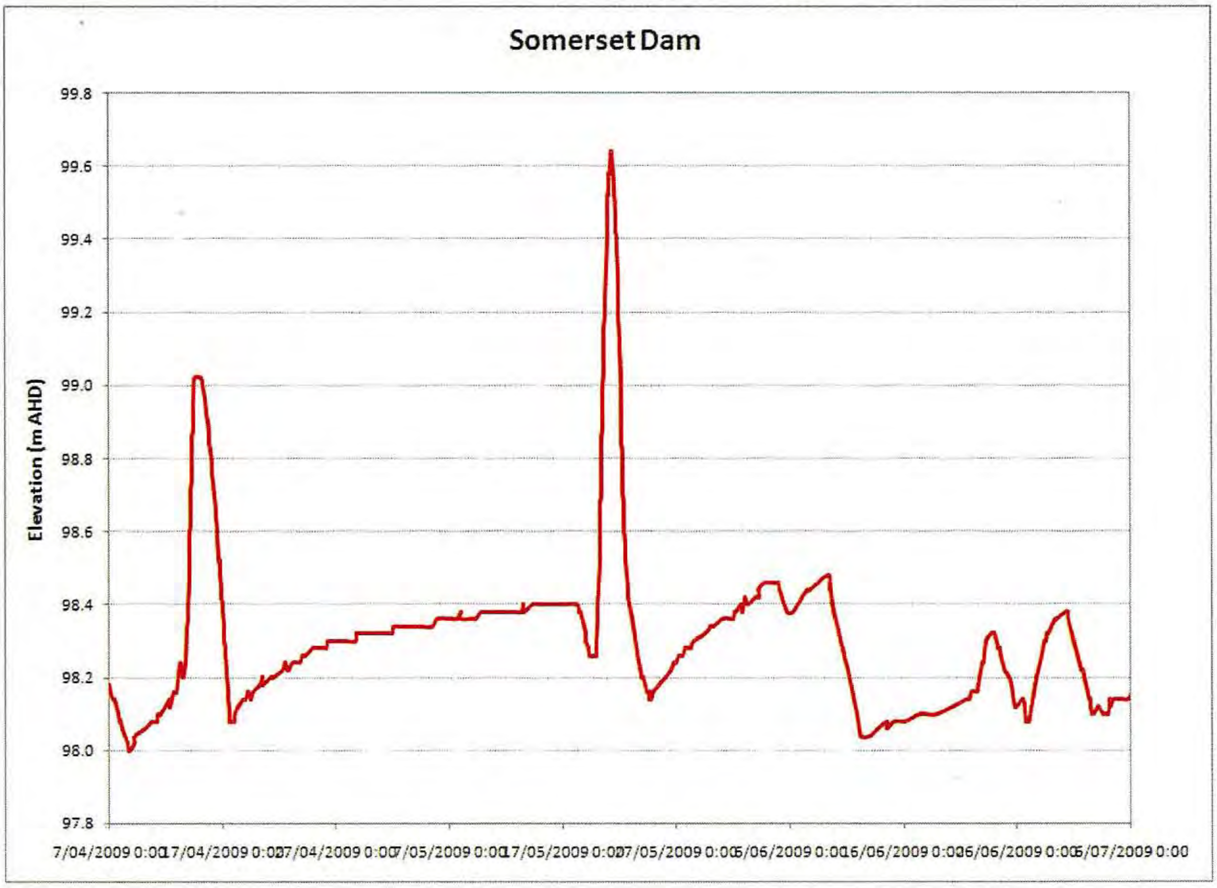
MAY EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	111200	302600	84400
Release (ML)	87400	0	26000
Peak Outflow (m^3/s)	875	0	336
Peak Water Level (mAHD)	99.68	62.54	39.90

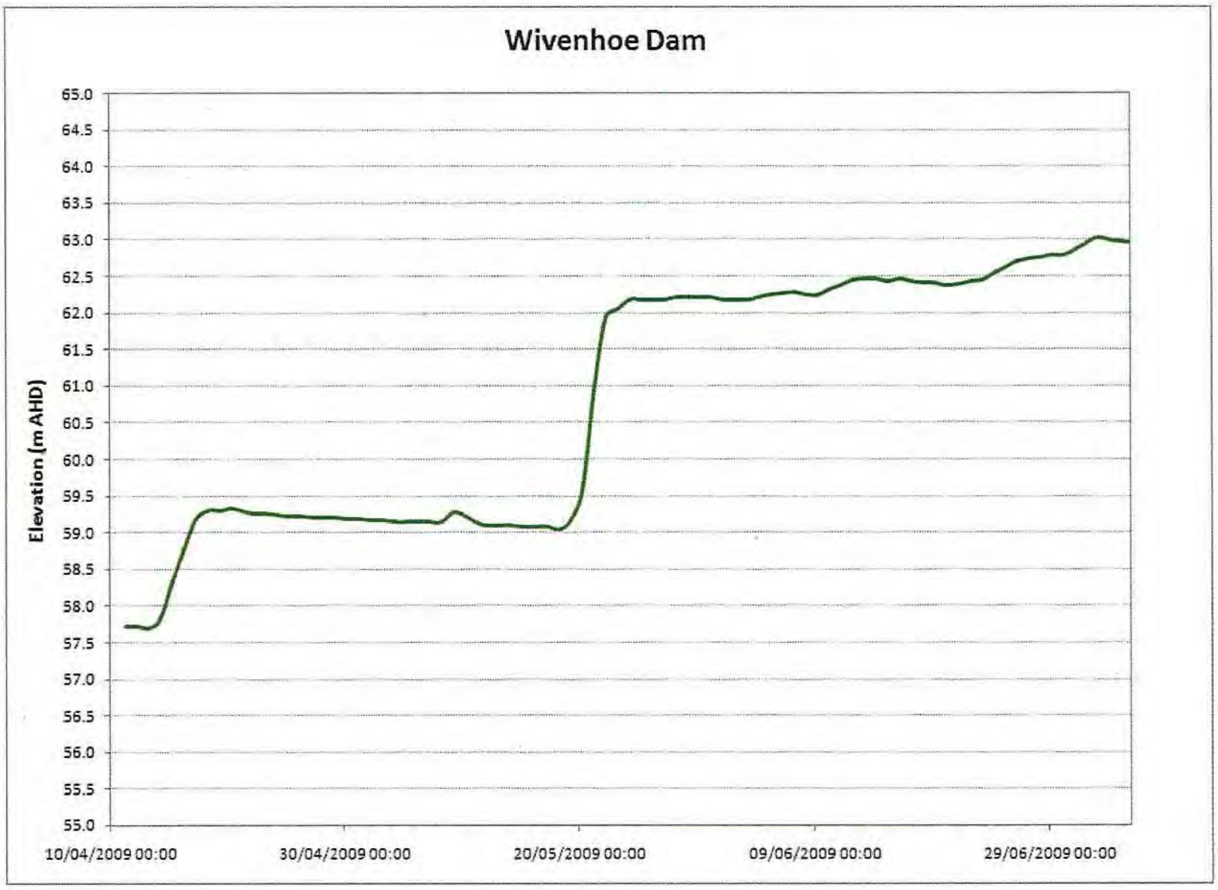
EARLY JUNE EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	Nil significant	Nil significant	Nil significant
Release (ML)	Nil significant	Nil significant	3630
Peak Outflow (m^3/s)	Nil significant	Nil significant	65
Peak Water Level (mAHD)	-	-	39.68

LATE JUNE EVENT			
	Somerset Dam	**Wivenhoe Dam**	**North Pine Dam**
Inflow Volume (ML)	Nil significant	Nil significant	11200
Release (ML)	Nil significant	Nil significant	11900
Peak Outflow (m^3/s)	67	Nil significant	105
Peak Water Level (mAHD)	98.32	-	39.78

The following graphs show the behaviour of the storages over the duration of the four events.


North Pine Dam
Elevation (m AHD)
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
27/04/2009 0:00
7/05/2009 0:00
17/05/2009 0:00
27/05/2009 0:00
6/06/2009 0:00
16/06/2009 0:00
26/06/2009 0:00
6/07/2009 0:00


Somerset Dam
Elevation (m AHD)
99.8
99.6
99.4
99.2
99.0
98.8
98.6
98.4
98.2
98.0
97.8



The events were relatively minor at Somerset and Wivenhoe Dams; however the May Event was quite significant at North Pine Dam being one of the biggest events experienced since construction was completed. In terms of classification of the flood magnitude for the May Event, the Bureau of Meteorology assessed the flood flows in the Stanley River as 'Minor' and those in the Bremer River and Warrill Creek as "Moderate". No classification is available for the Pine River as this catchment is categorized as a flash flood situation. All other streams were categorized as below minor flood levels.

Maximum gate openings were in accordance with the Manuals of Flood operations. A summary of the gate openings for the significant May Event are contained in the table below:

North Pine Gate Openings							
Calendar Time	A	B	C	D	E	North Pine Discharge	Dam Lake Levels (m AHD)
20/5/09 17:00	0	0	0	0	0	0	39.638
20/5/09 18:00	0	0	1	0	0	16	39.733
20/5/09 19:00	0	0	1	0	1	32	39.814
20/5/09 20:00	1	1	1	1	1	81	39.879
20/5/09 21:00	1	1	2	1	2	129	39.928
20/5/09 22:00	2	1	2	1	2	154	39.965
20/5/09 23:00	2	2	3	2	2	230	39.986
21/5/09 0:00	2	2	3	2	3	256	39.994
21/5/09 1:00	2	2	3	2	3	256	39.994
21/5/09 2:00	3	3	3	3	3	336	39.983
21/5/09 3:00	3	3	3	3	3	336	39.961
21/5/09 4:00	3	3	3	3	3	335	39.936
21/5/09 5:00	3	3	3	2	3	308	39.910
21/5/09 6:00	3	2	3	2	3	282	39.885
21/5/09 7:00	3	2	3	2	3	281	39.860
21/5/09 8:00	2	2	3	2	3	254	39.835
21/5/09 9:00	2	2	2	2	2	202	39.815
21/5/09 10:00	2	1	2	2	2	177	39.801
21/5/09 11:00	2	1	2	1	2	153	39.789
21/5/09 12:00	1	1	2	1	2	129	39.781
21/5/09 13:00	1	1	2	1	2	129	39.772
21/5/09 14:00	1	1	2	1	1	105	39.765
21/5/09 15:00	1	1	2	1	1	105	39.758
21/5/09 16:00	1	1	2	1	1	104	39.750
21/5/09 17:00	1	1	1	1	1	80	39.744
21/5/09 18:00	1	1	1	1	1	80	39.738
21/5/09 19:00	1	1	1	1	1	80	39.732
21/5/09 20:00	1	1	1	1	1	80	39.725
21/5/09 21:00	1	1	1	1	1	80	39.717
21/5/09 22:00	1	1	1	1	1	80	39.709
21/5/09 23:00	1	1	1	1	1	80	39.700
22/5/09 0:00	1	1	1	1	1	80	39.691
22/5/09 1:00	2	1	2	2	2	176	39.674
22/5/09 2:00	2	1	2	2	2	176	39.648
22/5/09 3:00	2	1	2	2	2	175	39.623
22/5/09 4:00	1	1	2	1	2	127	39.601
22/5/09 5:00	1	1	1	1	1	80	39.586
22/5/09 6:00	1	1	1	1	1	80	39.575
22/5/09 7:00	1	1	1	1	1	80	39.564
22/5/09 8:00	1	1	1	1	1	80	39.553
22/5/09 9:00	1	1	1	1	1	80	39.542
22/5/09 10:00	1	1	1	1	1	79	39.530
22/5/09 11:00	1	1	1	1	1	79	39.518
22/5/09 12:00	0	0	1	0	1	32	39.511
22/5/09 13:00	0	0	1	0	1	32	39.507
22/5/09 14:00	0	0	1	0	1	32	39.503
22/5/09 15:00	0	0	0	0	0	0	39.501

No issues, including equipment or infrastructure issues were encountered during the flood operations across all four events.

6 PERFORMANCE OF THE DATA COLLECTION SYSTEM

A range of data systems was used by the Flood Response Team during these events. These data systems were:

- Seqwater ALERT rainfall and river height network
- The Department of Environment and Resource Management's Hydromet Telephone Telemetry System
- Bureau of Meteorology Weather Radar Imagery
- Bureau of Meteorology Weather Forecasts and Warnings
- Bureau of Meteorology Quantitative Precipitation Forecasts
- Manually Observed Storage Levels

The Seqwater ALERT Network is the primary source of data used by the Flood Response Team. The network consists of 71 rainfall sensors and 58 river height sensors spread throughout the Pine River and Brisbane River catchments. The general performance of the network over the events is summarised in the table below.

Sensor Group	No of Sensors	Overall Sensor Availability (%)
Main Rain	60	85
Main River	45	71
Back-up Rain	11	82
Back-up River	13	69

As can be seen from the percentage available, the back-up rain and river sensor groups are lower than desirable. A percentage available of in excess of 85 percent is regarded as the target for normal operation, provided that the unavailable sites are not congregated in a specific part of the network. However, it should be noted that the majority of the main rain sensors that were out of action were located downstream of the dams and so this was not regarded as crucial.

All of the critical sites or key locations have full back-up in the network, with only one site (Lyons Bridge) not having either the main or back-up sensor operational during the events. Overall the performance of the system was judged acceptable. It should be noted however that Seqwater are committed to the improvement of the system and have recently appointed two full time Hydrographers to support this objective. Accordingly it is expected that the performance of the data collection system will show further improvement in the short term.

The Department of Environment and Resource Management's Hydromet Telephone Telemetry System was used to check data being received by the ALERT network. In particular, the stations located in the Upper Brisbane River were checked. These sites include:

- Cooyar Creek at Dam Site
- Emu Creek at Boat Mountain

- Brisbane River at Gregors Creek

The data was found to be consistent. The Flood Operations Centre also received the weather radar images from the Bureau of Meteorology for the entire duration of the event from the Bureau's web page on the internet. These images again proved to be very useful in understanding the development and movement of the weather system.

7 PERFORMANCE OF FLOOD MODELS

The Real Time Flood Models generally performed satisfactorily over the flood events. The data collection module Flood-COL performed well throughout the event and the data analysis module also provided useful outcomes. However the following issues should be noted. These issues will be further considered by the Expert Panel currently reviewing the Flood Models prior to their expect upgrade in 2010.

- In order to minimise road closures and associated impacts on the urban population downstream of the dams, some gate operations undertaken were different to those contained in the standard gate operation spreadsheets. These spreadsheets do not account for flood objectives associated with minimising impacts on urban populations downstream of the dams. Accordingly the flood operations team needed to modify the standard spreadsheets to properly model dam outflows.

- The quality of the calibration of the runoff-routing models was varied, with the South Pine River at Drapers Crossing, Lockyer Creek at Helidon and the Bremer River at Adams Bridge providing good fits with both peak flows and overall shape of the hydrograph. The other models and especially those situated above the dams provided an adequate calibration, with the volume of runoff matching well, but some differences in the shape of the hydrographs. This was probably related to the representation of rainfall within certain parts of the catchments in question.

- Due to the unreliability of the data recorded at Woodford, the derived Somerset Dam inflows contained a large amount of uncertainty. This was overcome to some extent by running a range of scenarios to provide upper and lower bound estimates.

8 COMMUNICATIONS

No issues were encountered with communications during the events and the communications systems performed satisfactorily. Notification of mobilisation was by phone, whilst flood advice issued by the Flood Operations Centre was by facsimile.

As a precaution, the two way radio was tested to ensure communication with both Somerset Dam and North Pine Dam. A satellite telephone is also available at Somerset Dam.

Communications with Emergency Response Agencies over the course of the events was undertaken in accordance with the Dam Emergency Action Plans. All communications worked well, particularly in terms of coordinating road closures. Follow-up meetings have been held with all agencies since the events to allow procedures to be reviewed and where necessary improved for future events.

9 FLOOD MANAGEMENT STRATEGIES

9.1 Wivenhoe and Somerset Dams

No gate operations were required (or at any time appeared likely) for Wivenhoe Dam during the flood events and accordingly the primary strategy was to ensure that the Somerset Dam Full Supply level was not excessively exceeded.

The situation was encountered where Somerset Dam was rising and above full supply level, with no significant inflows into Wivenhoe Dam. Although a low risk, this scenario is not fully considered in the current Manuals of Flood Operation and will be the subject of further discussion with the Dam Safety Regulator prior to the next revision of the Manuals due in September 2009.

9.2 North Pine Dam

Because of the relatively small nature of these events, the following strategies were employed in the operation of North Pine Dam during the course of the events.

- When the dam level was rising and significant rain was forecast or the dam level exceeded 39.75 metres, North Pine Dam was operated strictly in accordance with the standard table of gate operations contained in the Manual of Flood Operations.

- When the dam level was falling, consideration was given to the objective in the Manual of Flood Operations associated with minimising the impact to urban populations downstream of the dam. To support this objective, the drain down time of the dam was increased by extending the time of single increment gate openings (see Section 5). The benefits of this strategy were two fold as follows:

    - The closing of Young's Crossing Road was minimised.
    - The adverse impacts on the fish population in the dam caused by gate operations was minimised.

- When no significant rain was forecast and the dam level was below 39.75 metres, use of the cone valves in preference to the gates was maximised within a flow that would not adversely impact on public roads downstream of the dam. The reason for this was to minimise the adverse impacts on both urban populations downstream of the dam and the fish population in the dam that is caused by gate operations.

Again, the strategies and scenarios described above are not fully considered in the current Manual of Flood Operation and will be the subject of further discussion with the Dam Safety Regulator prior to the next revision of the Manuals due in September 2009.

10 IMPACT OF DAM OPERATIONS

10.1 Wivenhoe and Somerset Dams

Because no gate operations were required for Wivenhoe Dam during the flood events, no significant impacts downstream of the dams occurred as a result of flood operations. A number of dead fish were observed downstream of Somerset Dam following flood releases; however it is yet to be determined whether these were fish from the dam or fish swimming upstream from Wivenhoe Dam. This issue is the subject of a separate investigation project currently being undertaken by Seqwater.

10.2 North Pine Dam

On the North Pine River, Young's Crossing was saved from extended periods of inundation by the presence of North Pine Dam. Some closing of the road was unavoidable, however as discussed in the previous section, the release strategy adopted minimised road closure times.

A number of dead fish were discovered as a result of gate operations and this matter is currently the subject of a separate investigation and report. Seqwater minimised adverse impacts on fish by reducing as much as possible the gate operation times and also by maximising the use of the cone valves for water releases. However the structural safety of the dam must always be the primary consideration during flood events as the failure of North Pine Dam would be catastrophic both in terms of loss of life and property and infrastructure damage.

In relation to the fish impacts, Seqwater conducted extensive fish recovery operations following each event. These operations will continue into the future to support the objective of minimising fish impacts from flood releases.

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Water Resources Commission

INTERIM REPORT

ON

OPERATION OF WIVENHOE DAM DURING FLOODS (APRIL - MAY 1989)

1989

Water Resources

WATER RESOURCES COMMISSION

INTERIM REPORT

ON

OPERATION OF WIVENHOE DAM

DURING FLOODS (APRIL - MAY 1989)

1.0 INTRODUCTION

Flood inflows into Wivenhoe Dam resulted from three separate rainfall events during April and May 1989. During these events, it was necessary to operate the spillway gates at the dam to discharge excess storage. These were the first such flood discharges from the dam since its completion in 1985.

This interim report summarizes these events and reviews a number of issues arising from the dam's operation. Further action desirable as a result of this review is also outlined.

2.0 BACKGROUND

The primary objectives of Wivenhoe Dam identified in planning of the project in the early 1970's were to;

- provide an assured water supply to Brisbane and surrounding shires into the 21st century.
- protect communities along the Brisbane River from overbank flooding.
- provide a lower pool for the Wivenhoe Pumped Storage Power Station.

The Queensland Government approved in 1973 that the then Co-Ordinator Generals' Department be the constructing authority for the project. Responsibility for design and construction supervision of the dam was in turn delegated to the Water Resources Commission. In addition, the Commission has general responsibilities under the Water Act relating to the water course and water users and specific responsibilities with respect to dam safety.

During the detailed investigation and design phase of the project, close liaison was maintained through a number of committees with other authorities with an interest in the project including the Brisbane City Council and Main Roads Department.

In 1979 the Brisbane and Area Water Board was established as a funding agency for the dam and now owns, operates and maintains the dam and recreational facilities.

Recognizing the complexities of flood management arising from the presence of both Somerset and Wivenhoe Dams, the substantial part of the catchment not controlled by the dam and the extent of development on flood prone land downstream, an Advisory Committee involving officers of the Commission, Brisbane City Council and Bureau of Meteorology was formed in accordance with the provisions of the Brisbane and Area Water Board Act in 1983 to develop operating rules for both Somerset and Wivenhoe Dams during flood events. These rules were set down in the document "Manual of Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam".

In formulating these rules, the key priority areas were seen in order as;

- the restoration of the flood mitigation capacity of the dams as quickly as possible.
- the re-opening of downstream bridges which serve isolated communities as quickly as possible (e.g. Burton's Bridge).
- the re-opening of other downstream bridges.

In accordance with the Manual, control of the spillway gates at both dams for the purposes of flood management rests with the Brisbane City Council.

It was also determined by the Advisory Committee that the Manual be reviewed at five year intervals in light of actual operating experience.

3.0 THE FLOOD EVENTS

Three periods of major storms occurred over the April-May period (Figure 1).

Sustained rainfall over several days from 2nd April to 8th April, 1989 caused significant storage rise above full supply level in both Wivenhoe and Somerset Dams.

Because of the presence of both dams and their flood routing effect there is no direct record of what flood would have occurred had the dams not been in place. However, by using the recorded outflows from Wivenhoe Dam (at Savages Crossing) and taking into account the routing effect of the storage, it is possible to estimate what the flood would have been for the "no dams" case.

Figure 2A shows the recorded flood hydrograph at Savages Crossing (with dams) and the derived hydrograph for the "no dams" case. As can be seen, without Wivenhoe Dam, the flood would have peaked at nearly 3 000 cubic metres per second. The flood was of relatively long duration with a total volume of runoff approaching 600,000 megalitres.

The second April flood resulted largely from an intense storm event on the evening of 25th April. Figure 2B shows, again, the recorded flood hydrograph at Savages Crossing (with dams) and the derived "no dams" hydrograph. This second flood was of shorter duration but would have peaked at some 4 600 cubic metres per second had Wivenhoe Dam not been in place. The total volume of runoff in this second flood approached 1 million megalitres.

The third flood was smaller by comparison and the releases from Wivenhoe Dam were adjusted so as not to inundate Fernvale Bridge.

Considered separately, no flood could be described as an "extreme" event although the middle flood would have caused a degree of overbank flooding downstream. However, considering the relatively brief time interval between all events, the total volume of runoff within the months, 1.8 million megalitres was certainly a "major" event in the period of record. The volume of runoff was by some margin, the largest ever recorded at Savages Crossing for the month of April for the period of record (1909 to date) and ranks third in terms of volume of runoff for all months in the period of record. (Runoff in the January 1974 event was 2 500 000 megalitres and in February 1971, 1 756 000 megalitres.)

4.0 POSITIVE IMPACTS OF WIVENHOE DAM OPERATION

The performance of the dam itself, and in particular the spillway, during the April flood events was very satisfactory. All elements of the structure including gates, gate hoists, dissipator and discharge channel performed entirely as predicted by the dam's designers.

Indeed, the primary objectives of assuring water supply into the 21st century and of protecting communities along the river have clearly been demonstrated.

It is also now evident that the complex matter of flood management was, given the information available at the time, well addressed in that the objectives regarding protection of the dam itself and the downstream bridges were also quite reasonably met. It was always anticipated that some modification to operating procedures may be necessary in the light of operational experience and indeed, amendments were made to the spillway gate closing rules after the first of the flood events.

5.0 ASPECTS OF WIVENHOE DAM OPERATION

A number of matters received wide publicity during the flood events, namely extensive land slips along the river banks downstream of the dam and the prolonged inundation of bridges downstream of the dam.

These problems were widely perceived and portrayed in the media as having been worse than "before" and worse because of the presence of Wivenhoe Dam. Each is discussed in some detail in the following sections.

5.1 River Bank Slips

Many bank slips were reported after the first gate closing at Wivenhoe Dam. All slips reported were located, inspected and photographed. Slips were mostly in the areas indicated on the attached Figure 3.

For the most part, slips were 30 to 50 metres long and quite shallow. Although the slips are certainly unsightly 'scars' along the banks, little useable land above the high bank has been lost. Photographs of a number of typical slips are attached as Figures 4 and 5.

The extent to which the slips can be attributed either to the presence of Wivenhoe Dam or the procedure for gate operation is questionable.

There is no doubt that the presence of Wivenhoe Dam will cause (over a long period of time) changes to the natural river processes just as will many other land management practices associated with land riparian to the stream and elsewhere in the catchment. The shape of the river (called the regime) can change in response to;

- farming and other land use practices in the catchment;
- changes to the sediment flow in the river (the dam will trap a percentage of the normal sediment load).
- changes in the range and duration of flood flows.
- whatever spillway gate operating procedures are adopted.

The partial trapping of sediment by the dam means that sediment that would have normally been moved downstream primarily during flood events, is not entirely replaced as previously. The river bed will gradually change until a new stable regime is established. This will to some extent cause changes to the banks and stream bed/bank configurations.

This process will be accompanied by the development of different channelized meanders which will be a function both of sediment transport and of river flows. Where the points of these meanders are deflected by barely stable erodible banks, it is possible that undermining will cause bank collapses as part of this process.

River bank shapes (and stability) are primarily determined by the materials within the banks and the rate of river level fall experienced at different levels of the banks. There is considerable evidence along the river (and in other streams) that bank collapses have occurred prior to the recent floods and that they are part of the natural processes of river development.

Many of the people who reported bank slips after the first gate closing believed that the slips were wholly attributable to the rapid closure of the dam gates which caused water levels to fall faster than usual.

After an urgent review of the gate operating rules and of water level records along the river, it was concluded that the rate of gate closure should be slowed, although clearly, this would increase the period of inundation of the lower level bridges downstream. A slower rate of gate closure (see Figure 6) was used after the second flood. No new bank slips were reported.

Superficially, it might be concluded that the rate of gate closure in the first event was excessive and the cause of bank slips. However, it is much more likely that the rate of gate closure was only a contributory factor and certainly not the only factor or even the most important factor.

This conclusion is strongly supported by the following;

- bank slips even occurred well downstream of Savages Crossing where the rate of river level fall was slower than pre-Wivenhoe Dam events.
- bank slips along other streams in S.E. Queensland, e.g. Mary River and Logan and Albert Rivers, were reported as being much more severe than along the Brisbane River during the same period.
- bank instability has no doubt built up over a long period of low river flow in recent years and all unstable banks would have slipped during the first flood event irrespective of the rate of gate closure.

In summary, it is considered that the bank slips were a result of a combination of several factors including;

- ongoing river processes present in any river system;
- the generally unstable shape of the banks along some sections of the Brisbane River.
- the rate of change of river level during the first April flood.

Ongoing river processes, which will be modified by the presence of Wivenhoe Dam as discussed above, will also contribute to future occurrences of bank slips to some extent.

The degree to which the cause of the recent slips can be attributed to Wivenhoe Dam cannot be quantified. However it is clear that the operation of Wivenhoe Dam is only one of the contributory factors.

5.2 Effect on Downstream Bridges

Brisbane River flooding downstream of Wivenhoe Dam affects six bridges as detailed hereunder and whose locations are shown in Figure 3. For each bridge, the flood flow at which the bridge is inundated (flood immunity) is also shown.

Bridge	Owner	Flood Immunity (cumecs)	Alternative Access
Twin Bridges	Esk Shire Council	25	Lowood/Wivenhoe detour (additional distance 6.5 km)
Fernvale	M.R.D.	1020	Lowood detour (additional distance 11 km)
Savage's Crossing	Esk Shire Council	150	No practical alternative
Burtons Bridge	Moreton Shire Council	250	No practical alternative
Kholo Bridge	Moreton Shire Council	550	Mt Crosby Weir detour (additional distance 5 km)
Crosby Weir	Brisbane City Council	1600	No practical alternative

(The additional distances shown above for each detour are indicative. Actual detour distances may vary depending on origin and destination.)

Colleges Crossing which provides a direct connection between the Karana Downs area and Ipswich has an immunity of only 100 cumecs but alternative access is available via Crosby Weir as above.

It should be noted, that all crossings are affected by substantial areas of the catchment not controlled by Wivenhoe Dam, including the Lockyer Creek catchment and that the crossings were subjected to relatively frequent inundation prior to the completion of Wivenhoe Dam.

During and subsequent to the flood events, a number of complaints from various areas downstream of Wivenhoe Dam have suggested that the dam's operation has aggravated flooding of the crossings and community disruption.

Although an exhaustive examination of the frequency and duration of inundation for "no dam" and "with Wivenhoe Dam" cases for each crossing has not been completed, it is already evident that any increase in inundation attributable to Wivenhoe Dam was insignificant. In fact, in many events, the duration of inundation, particularly of the lower crossings, will be reduced as flow which would have caused inundation will be retained in the storage.

For example, Burtons Bridge which services a community of some 36 people, would have been inundated for some 25 days this year to early May, 1989 compared with 20 days actual inundation. During the first April flood, the period of inundation was reduced by some 2 days whereas it was lengthened for the later April flood by a little more than 1 day, as per Figures 1 and 2.

It is the case however, that a number of the higher level bridges were inundated for marginally longer periods. In developing the original operating rules for the dam, it was recognized that;

- it is of critical importance for the safety of the dam that any temporary flood storage be discharged before any subsequent flood event.
- damaging overbank flooding does not occur for flows less than 3 500 cubic metres per second.
- reasonable alternative access is available for Fernvale and Kholo Bridges but not for Crosby Weir.

For these reasons, discharges from Wivenhoe Dam were managed at the maximum rate which would not inundate the Crosby Weir crossing, i.e. at up to 1 600 cubic metres per second. Certainly, if discharges at up to 3 500 cubic metres per second were made, water held in temporary flood storage could be discharged more quickly and the total period of inundation of all bridges reduced but, as above, inundation of the Crosby Weir crossing would cause major disruption and it is not proposed therefore that the current approach be varied.

The total period of inundation at Fernvale and Kholo Bridges during April was some 2-3 days longer that would have been the case without Wivenhoe Dam. Clearly, this increased disruption needs to be considered in light of the probability of similar major events occurring again.

An exhaustive study of the frequency and duration of inundation for each bridge would be required to determine whether the operation of Wivenhoe Dam was in any way likely to be such as to justify in itself raising or replacement of any of the downstream bridges.

It is desirable that such a study be undertaken in conjunction with the Authorities responsible for each of the bridges to establish what further action, if any, should result.

6.0 OTHER OPERATIONAL ISSUES

A number of other issues have become apparent during the flood events. These are briefly discussed as follows:

6.1 Public Awareness

From many of the letters received and from comments made during a well attended public meeting at the Pine Mountain Hall, it is clear that many misconceptions exist concerning Wivenhoe Dam.

These have ranged from **"Wivenhoe Dam should have prevented all flooding"**, to **"Wivenhoe Dam has caused the flooding."**

It has even been suggested that **"the reservoir should be emptied in advance of cyclones."**

It is probable that public perceptions are largely shaped by what is published in the media. It is also the case that the media has in the case of the recent floods been very selective in treatment of the issues. Bank slips received far more publicity than any of the positive aspects of the dam's operation.

A public awareness campaign to inform the public of the benefits of Wivenhoe Dam could create a more informed community able to make better judgements when future flood events occur.

6.2 Warning Systems

It has been reported that the downstream bridges were flooded without prior warning. Initial flooding of the lower level bridges most probably resulted from runoff in the lower Brisbane catchment with the period of subsequent inundation being sustained by releases from Wivenhoe Dam.

It is the case that no early warning procedures are in place to warn people of possible isolation as a result of natural flood events. However, action is taken to warn authorities and the public when gate operation at Wivenhoe will create traffic and other difficulties.

6.3 Operational Manual Review

The operational manual is due for review in 1989, it being 5 years since its formulation. The recent floods have provided operational experience which will be considered in such a review. A number of issues to be considered have been identified by this report.

As part of the review of operational strategy, existing procedures to warn those likely to be affected by releases as early as possible and to provide a contact centre where reliable and up to date information can be obtained, will be examined.

7.0 CONCLUSIONS

It is concluded that;

- river bank slips downstream of Wivenhoe Dam were a result of several factors. The rate of gate closure at the dam was possibly a contributory factor but only one of the factors.
- the Water Resources Commission should continue to investigate reports of bank slumping as and when they may occur and if desirable, review further variations to the gate operating rules.
- based on a preliminary study, the effect of Wivenhoe Dam operation on flood immunity of the various downstream bridges was minimal.
- the Water Resources Commission should in conjunction with authorities responsible examine more exhaustively the effect of Wivenhoe Dam on the downstream bridges.
- a review of the flood operation manual should be undertaken as planned this year taking into account the issues identified in this report as being worthy of further consideration.

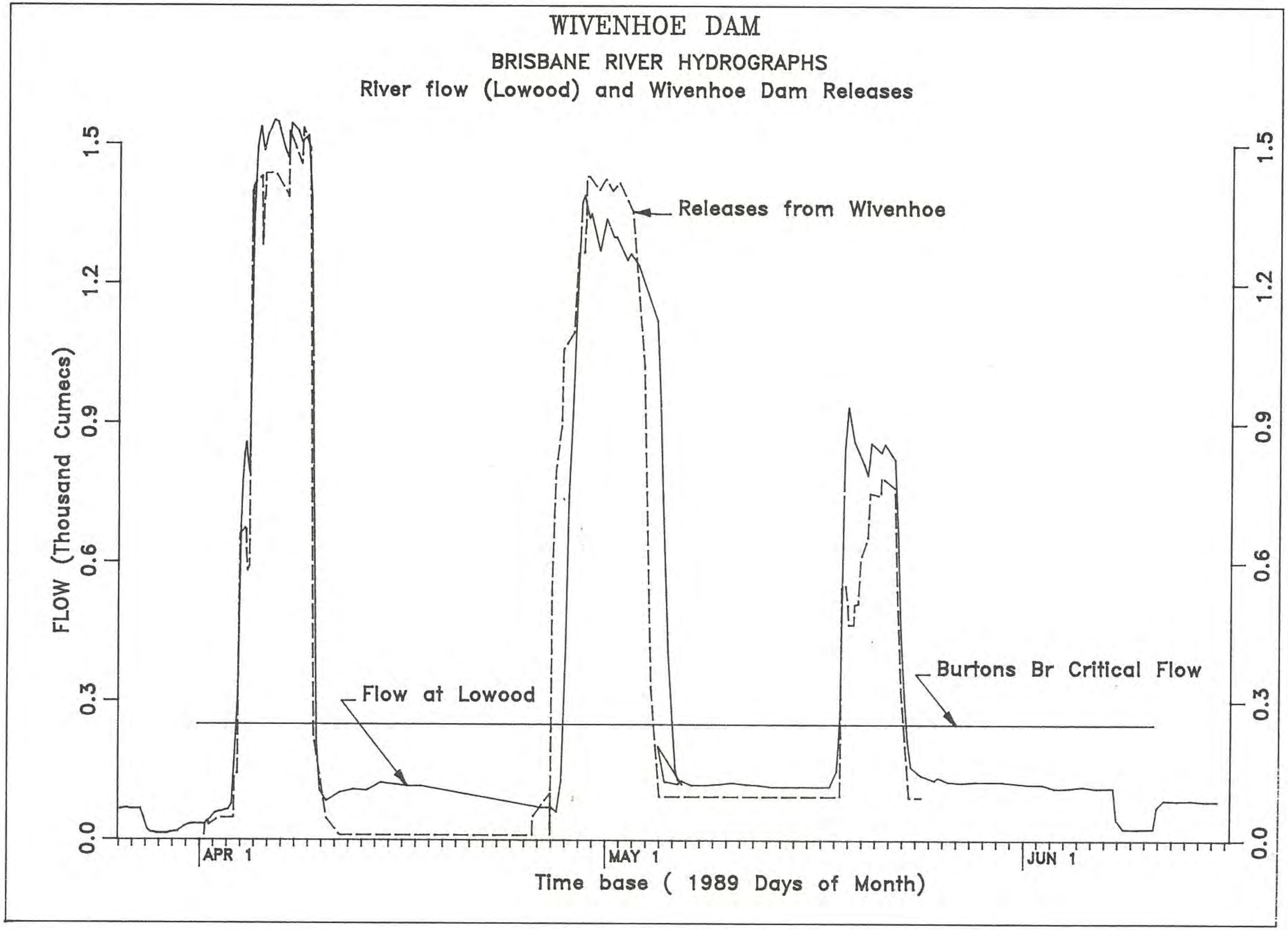

WIVENHOE DAM
BRISBANE RIVER HYDROGRAPHS
River flow (Lowood) and Wivenhoe Dam Releases
FLOW (Thousand Cumecs)
0.0
0.3
0.6
0.9
1.2
1.5
Releases from Wivenhoe
Flow at Lowood
Burtons Br Critical Flow
APR 1
MAY 1
JUN 1
Time base (1989 Days of Month)

FIG. 1

FIG. 2A

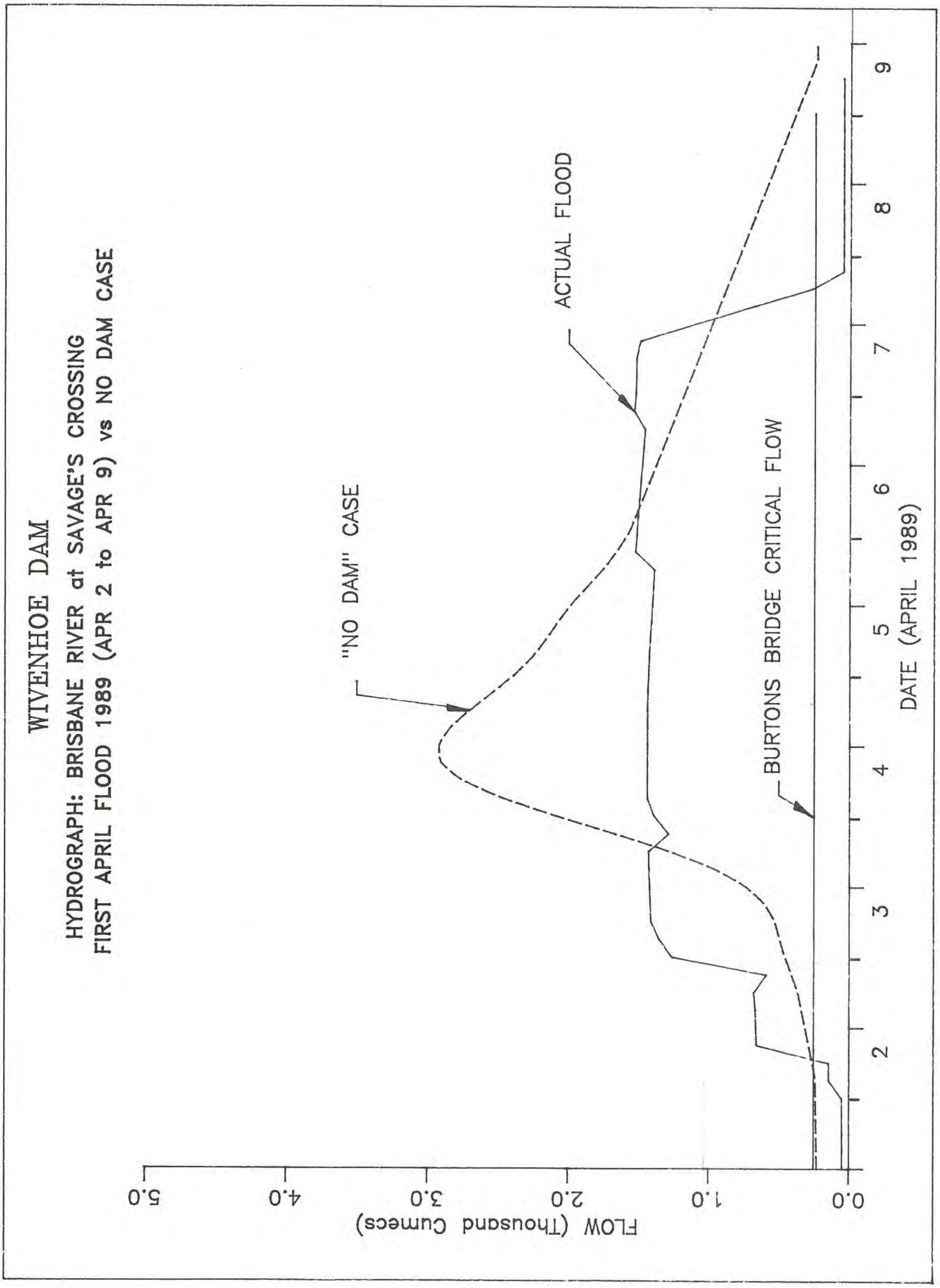
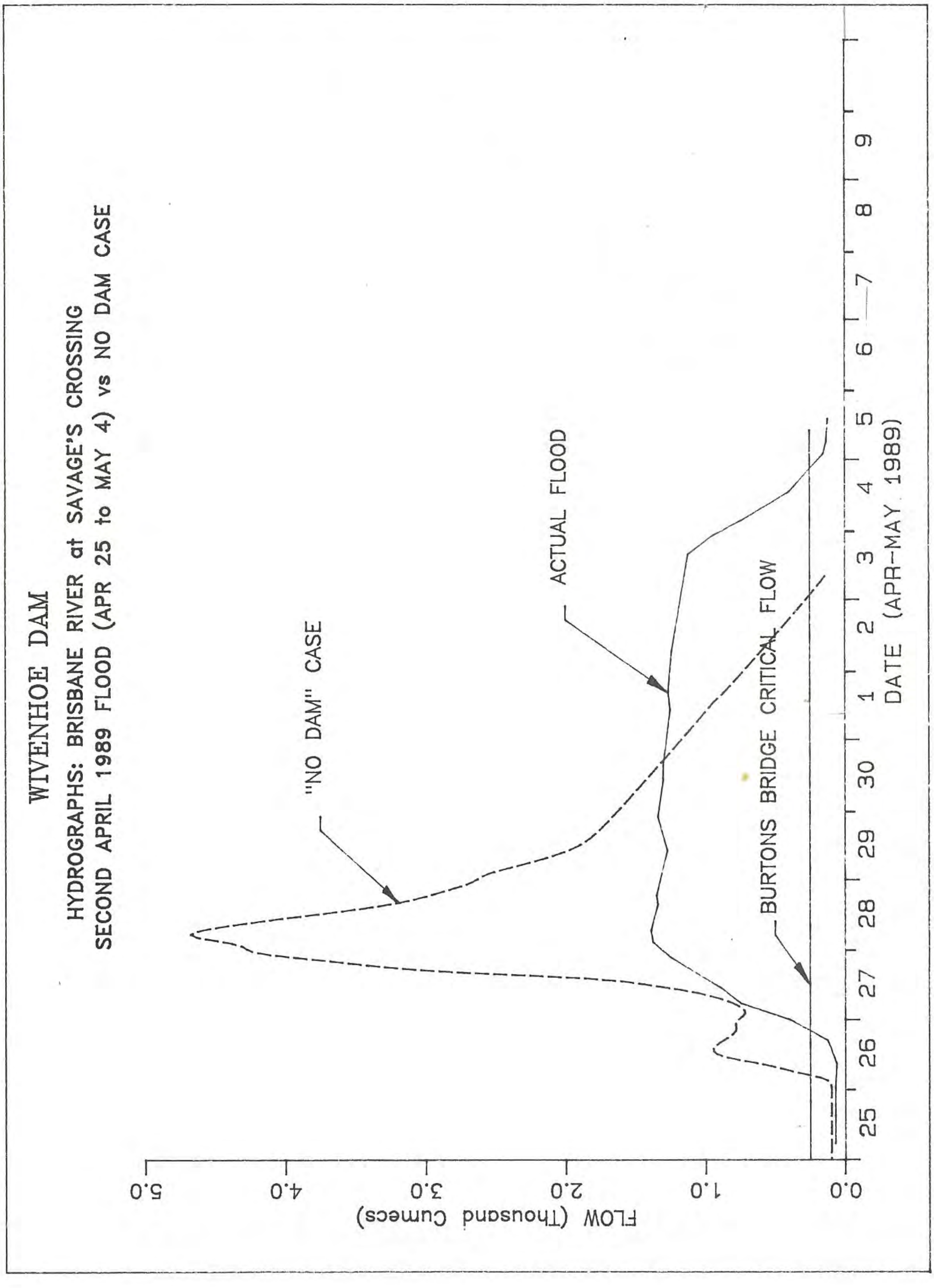

WIVENHOE DAM
HYDROGRAPH: BRISBANE RIVER at SAVAGE'S CROSSING
FIRST APRIL FLOOD 1989 (APR 2 to APR 9) vs NO DAM CASE
"NO DAM" CASE
ACTUAL FLOOD
BURTONS BRIDGE CRITICAL FLOW
FLOW (Thousand Cumecs)
0.0
1.0
2.0
3.0
4.0
5.0
DATE (APRIL 1989)
2
3
4
5
6
7
8
9

FIG. 2B


WIVENHOE DAM
HYDROGRAPHS: BRISBANE RIVER at SAVAGE'S CROSSING
SECOND APRIL 1989 FLOOD (APR 25 to MAY 4) vs NO DAM CASE
"NO DAM" CASE
ACTUAL FLOOD
BURTONS BRIDGE CRITICAL FLOW
FLOW (Thousand Cumecs)
0.0
1.0
2.0
3.0
4.0
5.0
DATE (APR-MAY 1989)
25
26
27
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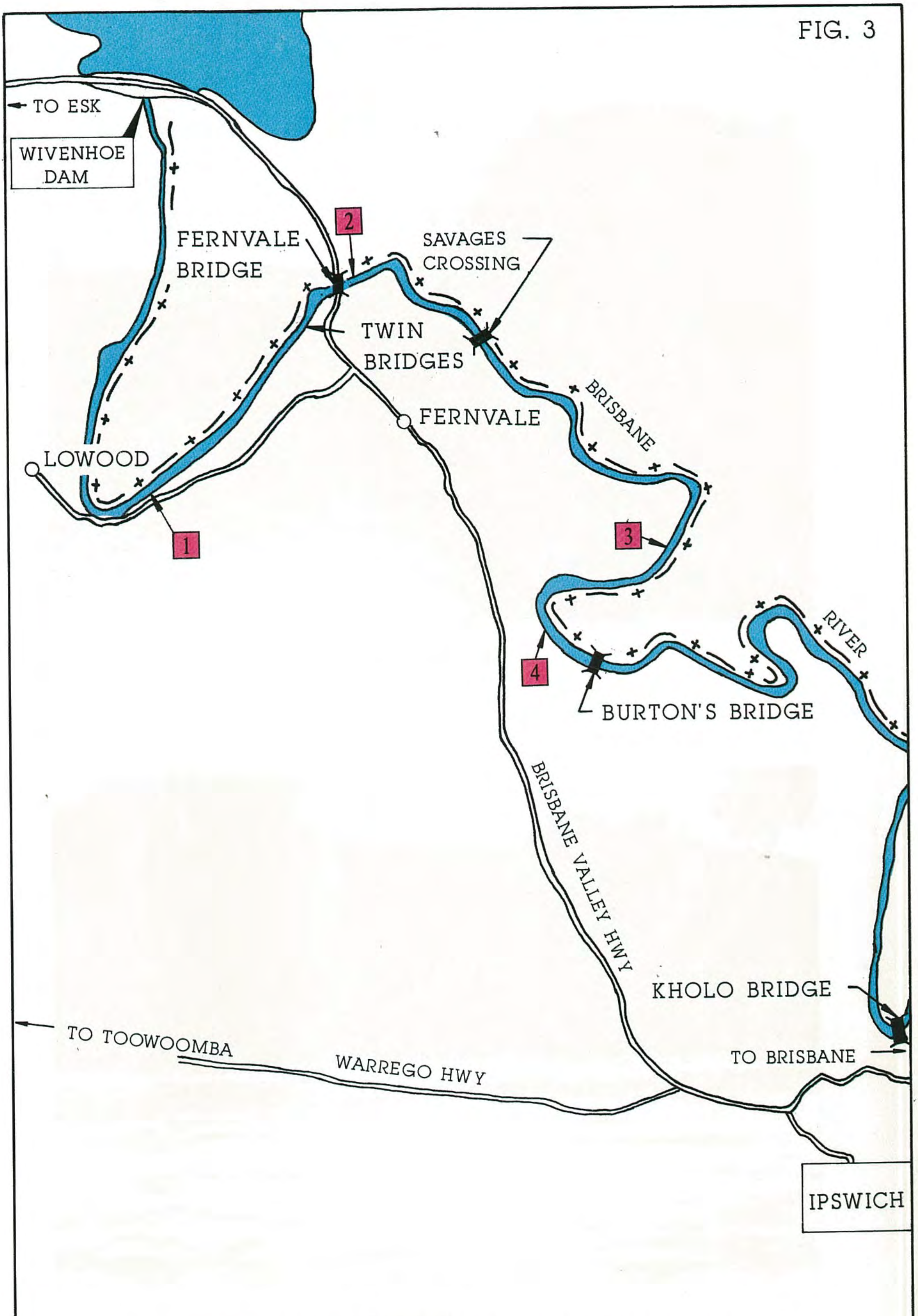


LOCATION OF BRISBANE RIVER BRIDGES & LANDSLIPS

LANDSLIP PHOTOGRAPH LOCATIONS SHOWN THUS 1

(SEE FIGURES 4 & 5)

FIG. 4

LOCATION 1

LOCATION 2

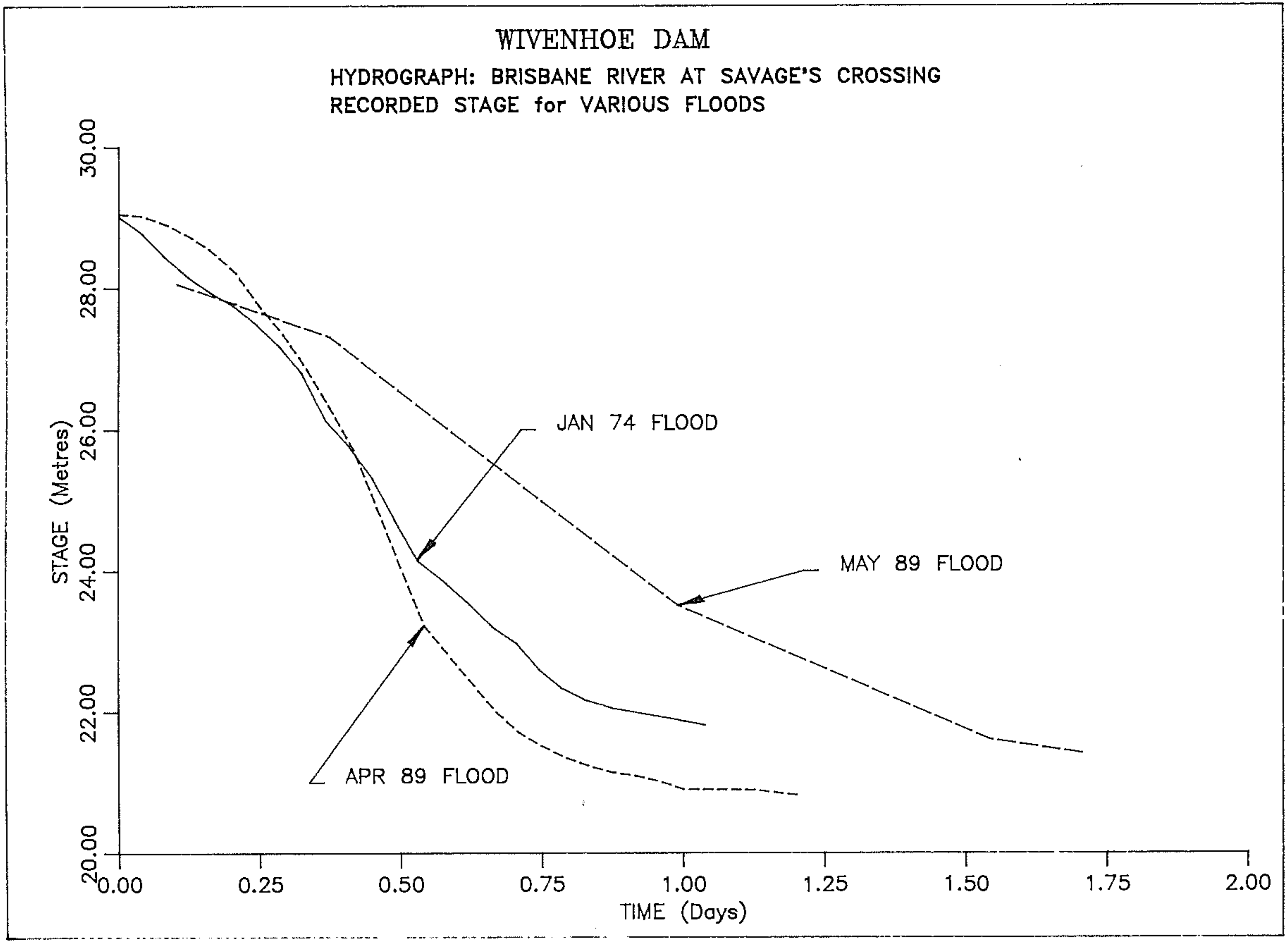
BANK SLIPS BRISBANE RIVER

LOCATION 3

LOCATION 4

BANK SLIPS BRISBANE RIVER

FIG. 6


WIVENHOE DAM
HYDROGRAPH: BRISBANE RIVER AT SAVAGE'S CROSSING
RECORDED STAGE for VARIOUS FLOODS
STAGE (Metres)
30.00
28.00
26.00
24.00
22.00
20.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
TIME (Days)
JAN 74 FLOOD
MAY 89 FLOOD
APR 89 FLOOD

September 1999

STATE WATER PROJECTS

NATURAL RESOURCES

REPORT to SOUTH EAST QUEENSLAND WATER BOARD

on

FLOOD EVENTS of FEBRUARY and MARCH 1999

at Somerset Dam, Wivenhoe Dam & North Pine Dam

Contract T5 - 95/96

Date 14 September, 1999
Reference:

TMENT OF NATURAL RESOURCES

QUEENSLAND GOVERNMENT

THE OPERATION OF WIVENHOE, SOMERSET AND NORTH PINE DAMS IN THE FEBRUARY 1999 AND MARCH 1999 FLOOD EVENTS

1. GLOSSARY OF TECHNICAL TERMS

• Real Time Flood Management Model	The suite of programs used to collect rainfall and river height data and to determine required dam operations
➢ FLOODOPS	The hydrologic and hydraulic model component of the Real Time Flood Management Model
➢ FLOODCOL	The data collection and verification package
➢ FLOODPC	The version of FLOODCOL mounted on a PC platform designed to be able to download data remotely from the Flood Control Centre
• NOAH	The name given to the primary system computer housed in the Flood Control Centre
• SWAGGY	The name given to the back-up system computer housed in Charlotte Chambers

2. LIST OF ABBREVIATIONS

AEP	Annual Exceedence Probability
ALERT	Automated Local Evaluation in Real Time (The name given to the event reporting radio telemetry system)
ARI	Average Recurrence Interval
BCC	Brisbane City Council
BoM	Bureau of Meteorology
DE	Duty Engineer
DNR	Department of Natural Resources
FCC	DNR's Flood Control Centre (Located on Floor 2 of Mineral House)
FSL	Full Supply Level
OOA	Out of Action
QPF	Quantitative Precipitation Forecast
RTFM	Real Time Flood Model
SEQWB	South East Queensland Water Board
SES	State Emergency Service
SFOE	Senior Flood Operations Engineer
SIS	Streamflow Information System
SWP	State Water Projects (the Headworks Operator)

3. EXECUTIVE SUMMARY

The South East Queensland Water Board (SEQWB) has contracted State Water Projects to operate Wivenhoe, Somerset and North Pine Dams. The dams are all gated structures requiring gate, sluice or regulator operations to release flood inflows.

All dams are operated to maximise flood mitigation benefits, with the primary objective of maintaining the structural integrity of the dams. While the North Pine Dam operates independently, Somerset Dam is upstream of Wivenhoe Dam and the two dams need to be operated in tandem to maximise flood mitigation benefits.

Two flood events occurred during February and March 1999 that required gate operations. The first flood event in February was a significant flood event, with rainfalls in parts of the catchment exceeding the 200 year ARI. The second event at the beginning of March was only a minor event, which primarily resulted from a combination of a wet catchment and full dams.

Overall summary statistics for the events are as follows:-

Item	February Event	March Event
Wivenhoe Dam		
Maximum Inflow	7274 m^3/sec	650/sec
Maximum Outflow	1800 m^3/sec	170 m^3/sec
Maximum Storage Level	EL 70.38 m AHD	EL 67.60 m AHD
Time of Maximum Level	1600 hrs 10/2/99	1600 hrs 8/3/99
Volume of Inflow	1,140,000 ML	159200 ML
Storage Deficit at start of event	287,000 ML	0 ML
Volume of Outflow	853,000 ML	159200 ML
Somerset Dam		
Maximum Inflow	4140 m^3/sec	342 m^3/sec
Maximum Outflow	857 m^3/sec	70 m^3/sec
Maximum Storage Level	EL 103.03 m AHD	EL 99.87 m AHD
Time of Maximum Level	1200 hrs 10/2/99	0300 hrs 5/3/99
Volume of Inflow	501,500 ML	62360 ML
Storage Deficit at start of event	207,800 ML	0 ML
Volume of Outflow	293,700 ML	62360 ML[1]
North Pine Dam		
Maximum Inflow	1053 m^3/sec	486 m^3/sec
Maximum Outflow	80 m^3/sec	80 m^3/sec
Maximum Storage Level	EL 39.75 m AHD	EL 39.75 m AHD
Time of Maximum Level	1400 hrs 10/2/99	1630 hrs 2/3/99
Volume of Inflow	99,470 ML	13280 ML
Storage Deficit at start of event	88,960 ML	0 ML
Volume of Outflow	10,510 ML	13280 ML

As indicated in the above Table, the February event was a significant flood event in the Brisbane River. This was especially so in the upper Brisbane River and Stanley River catchments. Rainfalls in the upper Brisbane catchments were typically greater than those associated with 2% AEP events and at Devon Hills rainfalls were greater than the

[1] Note that this volume of outflow includes the volume drained from the storage (to FSL) by the hydro station after the closure of the regulators at EL 99.22 mAHD.

0.5% AEP event. The resultant flood in the upper Brisbane was of a similar magnitude to the January 1974 event although the volume was not as big.

Below Wivenhoe Dam there were only minor rainfalls and this only generated minor flows in Lockyer Creek and the Bremer River. This avoided any repeat of the January 1974 event type flooding.

The February event was essentially handled in accordance with the Manual of Flood Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam. However, some changes need to be made to this manual to accommodate some minor difficulties encountered during the event. The March event was not well covered in the manual and it became an exercise in draining out the Somerset flood storage with a minimum of disruption to the public. This produced a long drainage time, but it was done with one eye on the weather and in full consultation with the SEQWB.

Overall, the February event was an ideal demonstration of what Wivenhoe Dam can deliver in terms of flood mitigation.

Both events at North Pine Dam were handled in complete accordance with the Manual of Operational Procedures for Flood Releases from North Pine Dam. While the magnitude of releases was similar for both events, this was only due to the drawn down state of North Pine Dam prior to the February event. The March event was relatively small and only required releases because it was completely full at the start of the event.

4. SUMMARY OF RECOMMENDATIONS

The following summary is a collation of the recommendations made in this report. The reader is referred to particular sections of this report for more detail and the reasons behind particular recommendations.

No.	Referenced Section	Recommendation
1	8.1	• SEQWB may wish to consider formal access to BoM weather briefings prior to and during major heavy rainfall weather events.
2	9.2.2	• A mechanism needs to be found to ensure the maximum availability of ALERT station #2168, David Trumpy Bridge[2] • Radio communication from Somerset Dam need to be improved as a matter of priority.
3	9.2.4	• A number of new ALERT river height stations are proposed. The list of these stations includes Linville, Kholo Bridge, Burton's Bridge, Buaraba Creek and Splityard Creek Dam
4	9.7	• A better, more accurate means of reading Wivenhoe Dam water levels needs to be provided to ensure consistency of manual readings

[2] Discussions following the event have indicated that BoM are maintaining the station and that updated calibration data can be obtained from BoM.

No.	Referenced Section	Recommendation
5	11.3	• The WIVOPS gate operations routines need to be incorporated into the FLOODOPS system. • Inclusion of a 'user-edited' gate operation sequence into FLOODOPS
6	11.5	• The rating curves for a number of stations downstream of Wivenhoe Dam need to be reviewed to ensure consistency between the stations.
7	17	• An arrangement needs to be formalised with DNR Surface Water Assessment group for the ongoing maintenance and technical support of the RTFM.
8	18.1	• Changes are made to the recommended gate opening sequences to limit the impact of the flow on the side wall of the spillway
9	18.2	• Provision should be made in the Wivenhoe and Somerset Manuals of Operations to allow for the closure of regulators and the immediate opening of a gate to replace the discharge rather than waiting for the minimum operating intervals (plus the reverse operation).
10	18.3	• Mention should be made in Somerset Dam operations of the D'Aguilar Highway bridge (Mary Smokes Bridge) at the upstream end of the storage. The SFOE can then consider the bridge in dam operations.
11	18.4	• Consideration should be given to the operation of Somerset Dam in the event of no or minimal inflows into Wivenhoe Dam.
12	18.5	• Consideration should be given to the definition of FSL in Wivenhoe Dam and to what level does this correspond to in Splityard Creek Dam.
13	18.6	• The close down sequence for North Pine Dam could be better defined.

5. REASON FOR THE REPORT

This report is prepared in accordance with the requirements of the following Flood Operations Manuals:-

- Manual of Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam, Revision No.2, 13 November 1997
- Manual of Operational Procedures for Flood Releases from North Pine Dam, Revision No.2, 13 November 1997.

Section 2.9 of both of these Manuals requires the Senior Flood Operations Engineer to submit a report to the Headworks Operator within six weeks of the completion of a flood event. The *"report shall contain details of the procedures used, the reasons therefore and other pertinent information."*

Because the one team directed the operations at all three dams using the same data collection system and operational software, a combined report has been prepared for all dams. The proximity of the events also meant that it was practical to combine both events into the one report.

6. MOBILISATION AND STAFFING OF THE FLOOD CONTROL CENTRE AND THE SEQWB DAMS

6.1 February 1999 event

The DNR flood response team was formally mobilised on the afternoon of Monday 8th February. While heavy rain started occurring in the Wivenhoe, Somerset and North Pine catchments from about 1800 hrs the night before, there was a considerable storage buffer in all three dams and only minor inflows into Somerset and North Pine Dams occurred before midnight of 7th February.

The heavy rain continued through into the next morning with the Duty Engineer (Peter Allen) periodically monitoring the event by downloading data through *FLOODPC* from home. Rainfall and river heights were continuously monitored in the Flood Control Centre (FCC) from about 0800 hrs on the Monday morning. As noted in the attached abridged FCC logs, the DNR Contract Manager was notified at 1045 hours that flood operations were likely and Dam Supervisors should be mobilised to all three dams. The Dam Supervisors progressively reported in the status of their dams and their operational readiness as follows:-

1205 hrs: North Pine fully staffed and operational
1205 hrs: Wivenhoe fully staffed and operational
≈1300 hrs: Somerset[3]

Formal mobilisation was delayed until it was evident that gate operations would be needed. SEQWB were notified of the mobilisation through a phone call to David Gill and Garry Grant (SEQWB) at 1700 hours on Monday afternoon.

Once mobilised, the following staffing arrangements applied: -

(a) Duty Engineers: Two Duty Engineers were on duty at all times at the FCC until midnight on Saturday 13th February when Wivenhoe peaked. Once the drainage phase began generally only one Duty Engineer was on duty at any one time.

(b) Data Collectors Two data collectors were on duty from the start of the event until 0800 hrs on the morning of 9th February. A third data collector was then mobilised to assist the data collection and verification operations and the notification of affected authorities. This was dropped back to two data collectors at 0800 hrs on 10th February when the gate operation strategy for Wivenhoe Dam had been developed and most of the significant rain had fallen. This was then dropped back to one data collector at 1730 hours on 12th February when the workload dropped sufficiently to be handled by one data collector.

(c) Two DNR dam operators were on duty at all times on a shift basis (2 operators per 12 hour shift; 0700 hrs to 1900 hrs and 1900 hrs to 0700 hrs) at each of the dams until gate operations were completed and no more significant inflows were expected.

The event was declared over at 1230 hrs on 19th February. This occurred once the SFOE was happy that 'dribble inflows' into Wivenhoe Dam were not going to cause any

[3] The Dam Supervisor was in Toogoolawah earlier in the day getting spare parts and was returning to Somerset when he advised the FCC of such at 12:18 hrs.

problems over the next several days. Following this declaration, the monitoring of the dams and the ongoing weather reverted to the control of the Duty Engineer on close call.

6.2 March 1999 Event

The March event was different from the February event by the fact that the catchment was still relatively wet from the February event, and all the storages had crept marginally above their set Full Supply levels. This meant that initial losses were minimal (i.e. a high percentage of what rain fell, ran off), and there was no storage capacity deficit to fill prior to operations. As a result, DNR were forced to mobilise once run-off occurred and reservoir rises were noted.

Significant rainfall had fallen in the Somerset and North Pine catchments in the several days prior to 1st March. SFOE Peter Allen discussed the emerging situation with Garry Grant (SEQWB) at 2100 hrs on the night of Sunday 28th February. SFOE Allen indicated that at that time:-

(a) An inflow of approximately 80 m^3/sec was expected into Somerset Dam, producing a rise of about 0.2 metre. A regulator may need to be opened tomorrow to pass the inflow through the Storage.

(b) DNR were likely to open a gate at North Pine Dam the next day anyway to reduce the storage level back to below EL 39.6. The storage level had crept up from its closing level of EL 39.557 on 14th February to EL 39.63.

The decision to mobilise North Pine Dam was made by Duty Engineer John Ruffini (after consultation with SFOE Peter Allen) on the morning of 1st March once heavy rain again began to fall in the North Pine catchment.

Once mobilised, the following staffing arrangements applied:-

(a) Duty Engineers: Two Duty Engineers were on duty for the first shift while the magnitude of the event was being assessed. Once this first shift was over, only one Duty Engineer was rostered to be on duty at any one time.

(b) Data Collectors Similarly to the Duty Engineers, two data collectors were used on the first shift and then this was scaled back to one for the duration of the event. Additional data collectors were available if required.

(c) The initial mobilisation was for North Pine Dam at 0630 hrs on 1st March. Two DNR dam operators were on duty at all times, on a shift basis (2 operators per twelve-hour shift; 0700 hrs to 1900 hrs and 1900 hrs to 0700 hrs) until gate operations were completed at 1145 hrs on 5th March. They were then stood down and proceeded to report lake levels at the start and finish of normal working hours.

(d) Dam operators were mobilised to Wivenhoe dam on 4th March when it was decided to operate the radial gates to release floodwaters on the Lockyer Creek recession. Up until this time, releases had been through the regulators and it was not considered necessary to permanently staff the dam. Mobilisation of the dam operators was discussed with representatives of the SEQWB (meeting 0900 3rd March) when it was agreed that Dam Supervisors would need to be on duty at all times releases through the radial gates were in progress.

(e) At no time during the event did Dam Supervisors mobilise to Somerset Dam. All releases from Somerset Dam were through the regulators and it was not considered necessary for dam staff to be present at all times for these releases.

Releases through the Somerset regulators were stopped at 1050 hrs on 10th March when a direction to do so came from the Chairman of the SEQWB who had discussed the issue with Director General of the DNR. The reservoir level at the time was 99.22 mAHD. Subsequent releases were all made through the Somerset hydro station. It is understood the hydro station discharges at a rate of approximately 13.5 m^3/sec on a 24 hour basis.

Full time monitoring of the event was finalised at 1800 hrs on 16th March when discharge control at Wivenhoe was transferred from the radial gates to the regulators. Mobilisation for the event was declared over at 1200 hrs on the 16th March once the regulator discharge was reduced to 30 m^3/sec and the SFOE was happy that dribble inflows into Wivenhoe Dam were not going to cause any problems over the next several days. Following this declaration, the monitoring of the dams and the ongoing weather again reverted to the control of the Duty Engineer on close call.

7. THE STORAGE SITUATION PRIOR TO THE FEBRUARY 1999 EVENT

In the days preceding the February flood, the catchment had been 'wetted up' by falls of 50 to 80 mm over the period 1st to 3rd February. In particular, these rains produced minor inflows into Somerset (≈ 1.0 metre rise) and North Pine (≈ 0.5 metre rise) over the period 1st to 4th February.

The following Table summarises the storage situation prior to the flood event of 7th February. It shows that there was significant storage capacity available at all dams before gate operations were required.

DAM	Level @ 1630 hrs 7/2/99 EL (mAHD)	% Full Supply Storage	Runoff required to Fill (mm)	Antecedent Precipitation Index	Expected Initial Loss (mm)	Required Rain at 5mm/hr to reach FSL (mm)	Required Rain at 10mm/hr to reach FSL (mm)	
Somerset Dam (FSL 99.0 m)	93.67	53	158	61	36	299	233	
Wivenhoe Dam	64.02	75.4	43	35	47	150	112	Inclusive of Somerset catchment
(FSL 67.0 m)			53			166	125	Exclusive of Somerset catchment
North Pine Dam (FSL 39.6 m)	34.78	58.9	272	80	27	368	330	

This information was forwarded by fax to the Bureau of Meteorology on the evening of Sunday 6th February.

8. THE WEATHER SITUATION

8.1 General

January 1999 had rainfall totals above average in the south east corner of Queensland. The beginning of the month of February, 1999 presented a situation where the Pine River and Brisbane River catchments were wet, the sea surface temperatures off the south-east coast of Australia were above average and the monsoonal trough was active in northern Australia.

The Bureau of Meteorology has access to four global circulation models that are used to provide information that allows rainfall predictions for periods of up to seven days to be made. These forecasts can be quite diverse but under some circumstances when all models are predicting heavy rainfall x days out then there can be some confidence in the fact that heavy rainfall will occur. The closer the rainfall predictions for the four models are then the more confidence the BoM has in its predictions.

The Duty Senior Meteorologist at the BoM Brisbane briefs the BoM hydrology daily at 0930 hrs. He was predicting significant rainfall in South East Queensland four days before the February event. The Duty Flood Engineers have access to this information through contact with the Duty Flood Engineer BoM and have been invited to attend briefings at the Bureau when significant rainfall is predicted. This arrangement is somewhat informal and is currently being conducted on an officer to officer basis. The SEQWB may wish to consider a more formal arrangement with the BoM. It is unclear how the BoM would respond to such a request as they may resist an arrangement that has compunction in it. We believe that access to accurate medium range forecasts provided by the global circulation models would greatly enhance the ability of the Flood Engineers to plan an ordered response to a potential flood event (eg members of the team could organise normal work commitments ahead of coming on duty). Similarly during a flood event medium range forecasts can be used to modify release strategies where appropriate to minimise the disruption to residences downstream of the dams.

The Quantitative Precipitation Forecasts are a service, which the BoM provides to the Flood Operations Engineers twice a day. These forecasts provide a 24 hour prediction for the Upper Brisbane/Stanley and Pine Rivers catchments. These forecasts have proved useful over the past two years. They did however fail to forecast the largest rainfall days in early February. The reasons for this are yet to be resolved.

8.2 February 1999 Event

The monsoonal trough lay across northern Cape York Peninsula and linked up to tropical lows in the Coral Sea that combined with an upper level cutoff low over south-east Queensland to produce heavy rainfall. Cyclone Rona subsequently formed and crossed the coast just north of Cairns on Friday the 12th, degenerated into a rain depression and proceeded down the coast threatening to create more flooding rains. On Sunday the 14th the ex-tropical cyclone moved out to sea just south of Rockhampton.

The majority of the rainfall for this event fell over a three day period from 0900 hrs on the 07/02/1999 to 0900 hrs 09/02/1999. The rainfall temporal patterns, cumulative totals, intensity /frequency/duration analyses and sub-catchment rainfall totals for the alert stations in the Brisbane River and Pine River Basins are presented in Appendices B and C.

8.3 March 1999 Event

A series of upper trough systems moved east across the south-east in an easterly direction resulting in a series of moderate to heavy rainfall events.

The majority of the rainfall for this event fell over a five day period from 0900 hrs on the 28/02/1999 to 0900 hrs 04/03/1999. The rainfall temporal patterns, cumulative totals, intensity /frequency/duration analyses and sub-catchment rainfall totals for the alert stations in the Brisbane River and Pine River Basins are presented in Appendices F and G.

9. THE DATA COLLECTION SYSTEM

9.1 General

A range of data systems was available to the Flood Operations Engineers. These data systems included:-

(a) The SEQWB ALERT rainfall and river height network
(b) The DNR Hydromet Telephone Telemetry System
(c) RAPIC weather radar imagery
(d) BoM weather forecasts and warnings
(e) BoM Quantitative Precipitation Forecasts
(f) Manually observed storage levels and river heights

Each of the following sections discusses the performance and usefulness of the above systems in more detail.

9.2 The SEQWB ALERT rainfall and river height network

9.2.1 Description of ALERT Network

The SEQWB ALERT network is the most important element of the overall data collection system available to the DNR Flood Control Room.

The network consists of 73 rainfall and 52 river height sensors spread throughout the Pine River and Brisbane River catchments. The system was supplied and installed by the SEQWB in 1996, and is now maintained by the SEQWB.

9.2.2 Performance of ALERT Stations during the February 1999 Event

Performance data has been extracted for the network and it is summarised in the following Tables.

Sensor Network	No. of Stations	Overall Station Availability
Main Rain	60	90%
Main River	41	78.5%
Back-up Rain	13	85%
Back-up River	11	100%

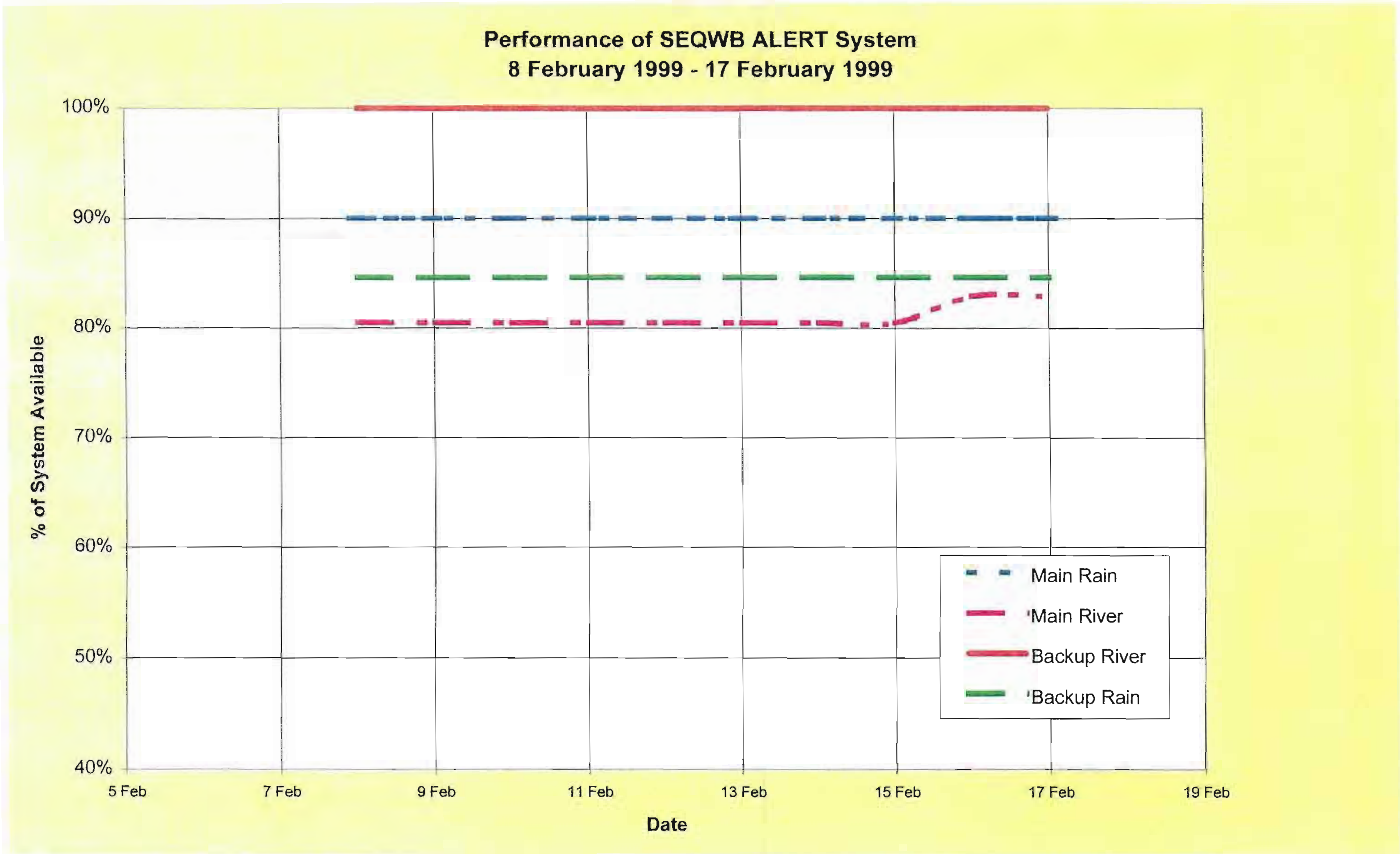

Performance of SEQWB ALERT System
8 February 1999 - 17 February 1999
100%
90%
80%
70%
60%
50%
40%
% of System Available
5 Feb
7 Feb
9 Feb
11 Feb
13 Feb
15 Feb
17 Feb
19 Feb
Date
Main Rain
Main River
Backup River
Backup Rain

FIGURE 9.1

It is noted that, of all the 'critical' main network stations that have redundant back-up stations, only the Somerset rainfall stations did not have the primary or the back-up station operational at all times. Of the above sensors, the following deserve special mention:

• #2168	David Trumpy Bridge - River	Not formally part of the SEQWB Network but out of action for extended periods. A mechanism needs to be found to ensure maximum availability for this station.[4]
• #6590 • #6593 • #6594	Somerset Dam headwater & rainfall sensors	The location has experienced radio reception problems in the past and has performed intermittently. A new aerial had been ordered prior to the event, but to date has not been installed. **It is very important this new aerial is installed as soon as possible.**
• #6706	Woodford (A) – River	DNR understand the station is full of sand and gravel. It has been out of action for an extended period.
• 6647 • 6650	Lowood (A) & Lowood (B)	The stations gave different readings during the course of both events. While some of this variation may have been due to superelevation of the flow as it passed around a bend, it needs checking.

Post event, a comparison was made of the total rainfalls occurring at a number of BoM rainfall stations in the catchment. The results of this comparison are summarised in the following Table.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[5]
Amberley	174	#6651	167	- 4.0%
Boonah PO	104	#6252 Kalbar	110	+ 5.8%
Dayboro PO	418	#6711 Baxters Ck	413	- 1.2%
Esk PO	347	#6574 Caboonbah	397	+ 14.4%
Gatton PO	82	#6577 (suspect OOA)	150	+ 83%
Harrisville PO	132	#6571	123	- 6.8%
Jimna	475	#6600 (OOA)	OOA	-
Kilcoy PO	482	#6600	396	- 17.8%
Lake Manchester	193	#6751 Mt Crosby	226	+ 17.8%
Lowood Don St	193	#6649	186	- 3.6%
Moogerah Dam	114	#6623 Tarome	105	- 7.9%
Mt Mee	648	#6690	665	+ 2.6%

[4] Following the February event, it was determined that the BoM was responsible for the operation and maintenance of the David Trumpy Bridge ALERT station. Ian Rocca (BoM) has since provided an up to date calibration for this station and it is recommended that the SEQWB foster this relationship and maintain contact with the BoM for future maintenance.

[5] It is important to note that not all of these stations are adjacent to each other and local variations in rainfall will be sufficient to cause the differences noted. Overall, the differences are considered acceptable.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[5]
Peachester Woodford Rd	890	#6775	749	-15.8%
Somerset Dam BVRT	450	#6593 (OOA) #6574 Caboonbah	413	- 8.2%
Toogoolawah	330	#6604	320	- 3.0%
Crows Nest	325	#6596	285	-12.3%
Long Pocket CSIRO	232	#6730 Jindalee	246	+ 6.0%
Wivenhoe Dam	196	#6639	205	+ 4.6%
Mary Cairncross Park	801	#6716 Bellthorpe West	613	- 23.5%
The Head	197	#6774 Wilsons Peak	217	+ 10.1%

9.2.3 Performance of ALERT Stations during March 1999 Event

Performance data has been extracted for the network and it is summarised in the following Tables.

Sensor Network	No. of Stations	Overall Station Availability
Main Rain	60	88.3%
Main River	41	84.6%
Back-up Rain	13	84.6%
Back-up River	11	92.7%

This data indicates the overall system availability was not quite as good during the March event as it was for the February event.

One heartening aspect was the SEQWB response to a DNR request to fix the Mt Crosby sensor. This station was important to the operation of the drainage phase at the time and it was up and running again in approximately one hour.

The overall station availability might have been lower but for some preventative maintenance of the ALERT station batteries. During the February 1999 event, when it was thought Cyclone Rona might head down the coast and generate a second flood, DNR requested that SEQWB check the batteries at each station. DNR understand this was carried out and it is probably reflected in the overall availabilities achieved in the second event.

BoM Station	mm	SEQWB ALERT Station	mm	Difference[6]
Amberley	66	#6651	68	+ 3%
		#6653	66	0
Boonah PO	100	#6252 Kalbar	145	+ 45%
Dayboro PO	140	#6711 Baxters Ck	103	- 26%

[6] It is important to note that not all of these stations are adjacent to each other and local variations in rainfall will be sufficient to cause the differences noted. Overall, the differences are considered acceptable.

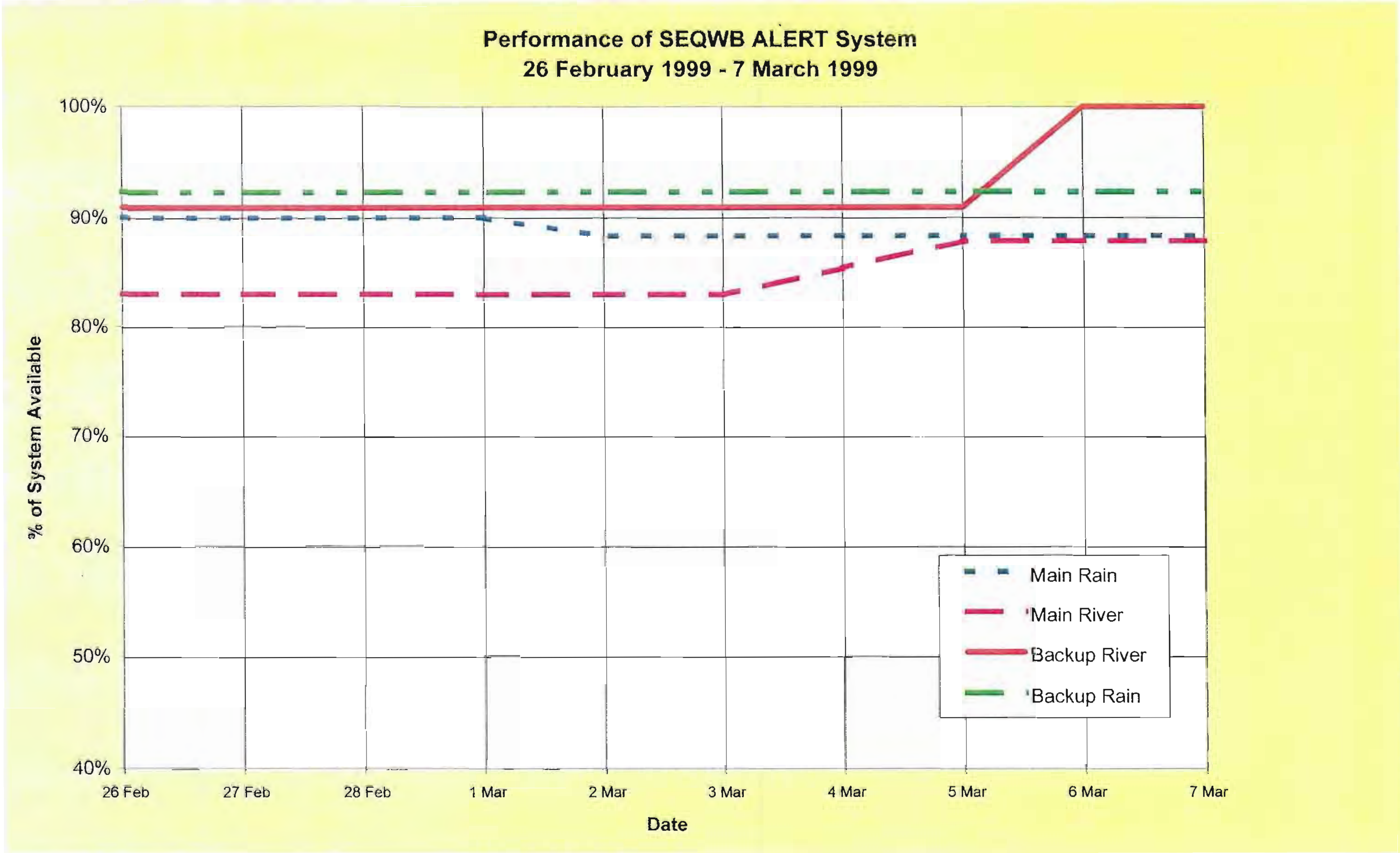

Performance of SEQWB ALERT System
26 February 1999 - 7 March 1999
100%
90%
80%
70%
60%
50%
40%
% of System Available
26 Feb
27 Feb
28 Feb
1 Mar
2 Mar
3 Mar
4 Mar
5 Mar
6 Mar
7 Mar
Date
Main Rain
Main River
Backup River
Backup Rain

FIGURE 9.2

BoM Station	mm	SEQWB ALERT Station	mm	Difference[6]
Esk PO	107	#6574 Caboonbah	96	- 10%
Gatton PO	92	#6577	90	- 2%
Harrisville PO	153	#6571	149	- 3%
Jimna	149	#6608 (OOA)	-	-
Kilcoy PO	125	#6600 (OOA once during period)	86	- 31%
Lowood Don St	91	#6646 #6649	76 68	- 16% - 25%
Moogerah Dam	116	#6623 Tarome	110	- 5%
Mt Mee	158	#6690 #6701	123 123	- 22% - 22%
Peachester Woodford Rd	275	#6775	197	- 28%
Pechey Forestry	108	#6511 Mt Pechey (A) #6513 Mt Pechey (B)	95 95	- 12%
Somerset Dam BVRT	60	#6593 (OOA) #6574 Caboonbah #6590 (OOA)	- 96 -	- + 60% -
Tarome	121	#6623	110	- 9%
Toogoolawah PO Yarraman PO	97 60	#6604 #6540	93 37	- 4% - 38%
Crows Nest	97	#6596	75	- 23%
Long Pocket CSIRO	81	#6730 Jindalee	153	+ 89%
Wivenhoe Dam	87	#6639 #6636 #6641 #6643	87 44 82 84	0 - 49% - 6% - 3%
Mary Cairncross Park	176	#6716 Bellthorpe West	155	- 12%
The Head	147	#6774 Wilsons Peak	116	- 21%

9.2.4 Proposed New Stations

As a result of DNR's experiences during the February and March 1999 events, it is recommended several new ALERT stations be installed. The recommended stations and the reasons for their recommendation are presented below:-

Location	Reason for Inclusion
Linville	To provide greater definition of the rainfall and river heights in the upper Brisbane River catchment. It is also adjacent to the Stanley catchment and would provide valuable rainfall information for the western side of the Somerset Dam catchment. The advantage of this proposed station is that it is already the site of an existing DNR river height station.

Location	Reason for Inclusion
Upstream of Kholo Bridge	To provide information on river heights affecting Kholo Bridge. The bridge is an important river crossing and is some 9 to 10 hours downstream of the dam. River level information is needed to properly manage river levels to keep the bridge open. During the February event, the Flood Operations Engineers had to dispatch a data collector to the site during the 'ramp down' of releases from 1800 m^3/sec to 550 m^3/sec to ensure that the bridge had emerged from the floodwaters as and when predicted. This feedback was necessary to enable any necessary adjustments to the dam discharge to be made as soon as possible to ensure the bridge became trafficable by the next morning.
Upstream of Burtons Bridge	Similar reasoning to Kholo with the bridge becoming trafficable when the flow drops below 250 m^3/sec. Careful management is required to ensure the bridge stays open at this target discharge.
Buaraba Creek	There is currently a 'gap' in the river height network for waters discharging from the Buaraba Creek catchment feeding into Lockyer Creek. This was felt most significantly in the March event when we were trying to keep College's Crossing open. A significant flow was apparently emerging from Buaraba Creek and affecting discharges past O'Reilly's Weir. A station on Buaraba Creek would assist in managing such minor flows and would enable more reliable management of the flows causing inundation of the minor Brisbane River crossings.
Splityard Creek	No mechanism currently exists to determine how much water is being released from the Wivenhoe pumped storage. Data obtained since the start of the February event has indicated that the power station can discharge at about 300 m^3/sec. This discharge capacity is well in excess of the releases made towards the end of most flood events and can cause unanticipated rises in Wivenhoe storage.

9.3 The DNR Hydromet Telephone Telemetry System

Prior to the flood event, DNR's SIS software had been installed on a PC resident in the FCC. At the start of the event it was realised that the reliability of the network could be improved by installing SIS on a dedicated PC. A suitable PC was located very early in the event and SIS was duly installed. The system provided backup to the ALERT network and operated successfully for the duration of the event. It especially proved useful when validating the ALERT data for Savages Crossing.

9.4 RAPIC weather radar imagery

The Flood Control Room continued to receive the RAPIC weather radar images from the Bureau of Meteorology for the entire duration of the event. In addition to this dedicated service, the FCC was also able to access radar and satellite imagery on the Internet.

These images proved very useful in understanding development and movement of the storm event.

9.5 BoM weather forecasts and warnings

The Flood Operations Engineers kept in regular contact with the Bureau of Meteorology (BoM). In particular the following contact

(a) Duty Flood Operations Engineers kept abreast of the ongoing BoM weather forecasts;

(b) Duty Engineers spoke to BoM on a regular basis (especially during the February event, the March event was not considered very significant) both to discuss the developing weather and to provide information on the adopted gate operating strategies;

(c) Duty Engineers Allen and Ruffini attended the daily weather briefing given to BoM staff on 12th February. This briefing gave details of the movements predicted for Cyclone Rona by a number of different global weather models. It allowed the Duty Engineers to more clearly understand the developing options for the cyclone and it was a consideration in assessing the required drainage time for the flood storage component of Wivenhoe Dam.

Duty Engineer attendance at such briefings is at the discretion of the BoM staff and relies on their invitation to attend. We appreciated this briefing very much and it provided valuable information for subsequent operations.

9.6 BoM Quantitative Precipitation Forecasts

DNR continued to receive BoM quantitative precipitation forecasts (QPFs) for the duration of the event. While the initial QPFs for the 7th and 8th February proved relatively low, subsequent QPFs (in combination with discussions with the BoM hydrologists) allowed the Duty Engineers to better focus the *FLOODOPS* simulations and produce more reliable results.

9.7 Manually observed storage levels and river heights

During the course of the event, the Dam Supervisors provided regular headwater and rainfall readings to the Duty Engineer. These values were recorded in the detailed FCC event logs. Many of these were not included in the summary logs attached as Appendices A and E for the sake of brevity.

In general these readings agreed well with the ALERT values. However, on several occasions, it proved necessary to recalibrate the ALERT stations on the basis that improved accuracy was required to satisfactorily operate the various outlet structures.

This was especially true at North Pine dam where radial gate movements are made at 15 mm intervals and water levels need to be known accurately for proper operation of the gates.

The manually read levels at Wivenhoe Dam were adequate while the storage levels were significantly above Full Supply Level (FSL). However, variations were noticed closer to FSL which could only be assigned to the accuracy to which the gauge boards could be read. The arrangement is shown in Figure 9.1

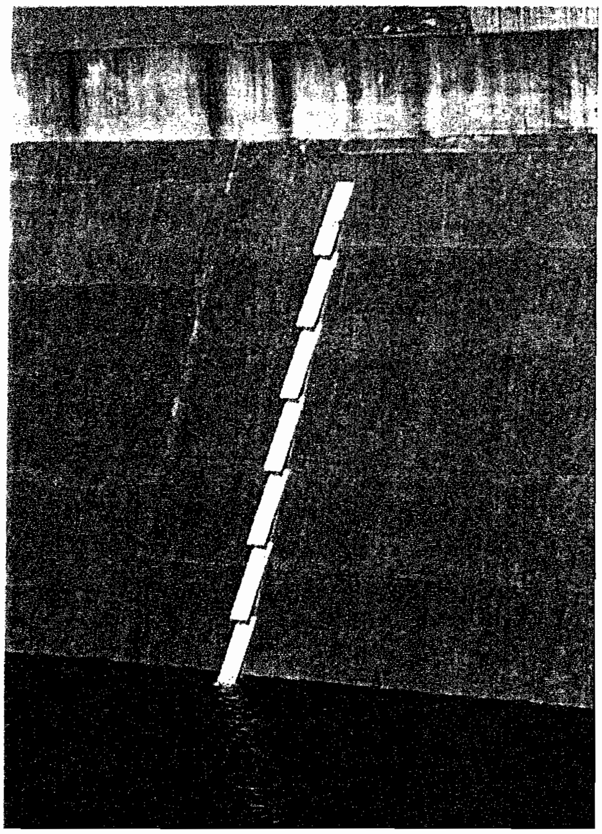


Figure 9.1 Existing Wivenhoe Dam Gauge Boards

It is recommended that a better system be devised for reading Wivenhoe Dam levels to an accuracy consistently better than ± 5mm. This may well require the installation of a float chamber at a point within easy access of the Dam Supervisors. The Duty Engineers understand that anyone reading the current gauge boards cannot get closer than about 15 metres and that the graduations on the boards require significant interpolation.

10. COMMUNICATIONS DURING THE FLOOD EVENTS

10.1 Communications with Dams

- DNR phone communications were lost with Somerset Dam at 2125 hrs on Monday 8th February. The phone lines remained to the SEQWB offices at Somerset Dam and these were used until the DNR phones were restored at 1430 hrs on 11th February.
- All other phones remained serviceable for the duration of both events
- Radio links were successfully tested with all dams at the start of the February event. The radio was only used once when the Somerset Dam operators were away from the phones and it became necessary to get a message to them.

10.2 Communications with those on Register of Contact Persons for Flood Information

Under Section 6 of the Manual of Operational procedures for Wivenhoe and Somerset Dams, the Flood Operations Engineer is required to contact those listed in the 'Register of Contact Persons for Flood Information' whenever all of the following conditions are met:-

- A flood situation is imminent and gate operations are likely and
- The flow is likely to exceed 2000 m^3/sec at Lowood

While this condition was not met in either flood event, the Duty Engineers did speak to a number of authorities on a regular basis. Further details of these communications are provided in the attached Flood Control Centre log sheets. In summary, these authorities included:-

Authority	Occasion in February Event	Occasion in March Event
Police	Advice of prospective bridge closures Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings.	Advice of prospective closure of Colleges Crossing (see also ICC) Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings.
Brisbane City Council	To advise of developing situation. Once it was determined that flows would be non-damaging, little further communication took place.	Nil – no effect
Bureau of Meteorology	Numerous occasions over event. Provision of advice on discharges from Wivenhoe; receipt of advice on probable rainfalls; exchange of information on reservoir inflows	Several occasions during event although nowhere near as frequent because of the small nature of the event and the constancy of the discharge.
Pine River Shire Council	Messages that flood releases 'were expected', 'were imminent' and 'were occurring' in accordance with PSC procedure.	Messages that flood releases 'were imminent' and 'were occurring' in accordance with PSC procedure.
Ipswich City Council	To advise of need to close bridges and crossings	To advise of potential need to close Colleges Crossing (on several occasions as the crossing was thought to be close to overtopping although this never eventuated).
Esc Shire Council	To advise of need to close bridges and crossings	To advise of need to close Twin Bridges.
Kilcoy Shire Council	Advising of probable flood levels upstream of Somerset Dam	Nil – no effect

Authority	Occasion in February Event	Occasion in March Event
SEQWB	Advice of mobilisation Advised of operational strategy on a daily basis as per FCC Log Discussions were also had with SEQWB Chairman on possible options for dam operations.	Advice of mobilisation Advised of operational strategy on a daily basis as per FCC Log

11. PERFORMANCE OF RTFM SOFTWARE

11.1 Data Collection System

Overall the data collection system performed well over both flood events. However, some major problems in the *FLOODCOL* data collection system were discovered within 36 hours of the start of the February event.

The problem was first noticed at 2015 hrs on the 9th February when it was realised that the HP workstation (Noah) had stopped receiving data from the data collector. The problem was deemed serious and Warren Shallcross (of DNR, SWA) was contacted. Warren came to the FCC and began to investigate the problem.

Warren Shallcross contacted the system developer, Bradley Alderton, by phone in Melbourne and a fix was progressively worked out which could allow the Data Collector to keep operating. The error was eventually tracked back to the corruption of a calibration curve for O'Reilly's Weir. Whenever signals were received for the station it would try to access the discharge calibration and it would hang the collector. Once the problem was isolated, a 'fix' was developed which allowed relatively trouble free subsequent operation.

11.2 Calibration of Hydrologic Models

The calibration of the various hydrologic models generally proved adequate for the purpose to which they were applied. The parameters used in calibrating the hydrological models were the 'initial loss' and 'continuing loss' parameters.

The Duty Engineer utilising the results of the hydrological models needs to be aware of the limitations of the models. These limitations include:-

(a) The hydrological modelling tended to advance the peak forward in time relative to the measured values. This effect is a typical property of the RORB type models used for the hydrological models.

This effect became especially evident during the drainage phase of the smaller March event when releases from Wivenhoe had to be timed to the recession of Lockyer Creek. This was overcome by using the ALERT data directly to determine when discharges in the Lockyer had dropped sufficiently to allow an extra opening of the Wivenhoe gates.

The effect was not so significant in the February event because the discharges from Wivenhoe were much greater than the discharges in Lockyer Creek.

(b) It is noted that the calibrations of the hydrological models were biased towards higher flows and that good calibrations were not expected at the lower flows typical of the March event. Despite this, the calibrations produced for this event were generally acceptable.

(c) The models do not model the base flows well, at the end of the recessional phase of a flood event. This can be important at the end of a flood event when the Duty Engineer is trying to close off discharges from a dam and maintain it at Full Supply Level. While the inclusion of a Sacramento soil moisture model may overcome this, the Duty Engineers are not sure whether this extra complexity is warranted.

The Duty Engineer, using the models, needs to be aware of the model limitations and modify the dam operations to suit.

11.3 Gate Operational Models

11.3.1 Operational Model for Wivenhoe and Somerset Dams

These dams are considered jointly because Somerset Dam releases are dependent on the storage levels in Wivenhoe which are in turn partially dependent on Somerset dam releases.

For some time it has been known that the existing *FLOODOPS* routines did not properly calculate the required releases from either Somerset of Wivenhoe dams. To cover this problem, a separate Fortran 77 routine, named *WIVOPS,* was developed some time ago to assess the required flood operations at each dam. This routine worked well except that it provided little flexibility for the Duty Engineer to vary the operation to suit local circumstances and practicalities (eg. It often requires rapid opening and closing of the same gate to optimally control releases to keep particular crossings open).

Use of the *WIVOPS* routine is messy as it requires the user to extract inflow hydrographs from the UNIX *FLOODOPS* system and then run *WIVOPS* under MS-DOS.

The long term 'fix' is to integrate two modules into *FLOODOPS* for the operation of these dams. The first is the integration of *WIVOPS* into *FLOODOPS.* This has been flagged for some time and it is hoped that it will be completed within the next several months. The second is a module that can run a 'user edited' version of the gate operations produced by *WIVOPS* through both storages. This option will add greatly to the flexibility of the system as it will allow running of the many 'what ifs' which are considered during the course of the event.

To overcome the inability to run a predetermined set of gate openings through each dam an EXCEL spreadsheet was developed during the first event to perform this task. This spreadsheet allowed comparison of the measured reservoir levels to the theoretical predictions and it produced accurate assessments of drainage times.

11.3.2 Operational Model for North Pine Dam

North Pine Dam is the simplest of the three dams to operate because it relies on simply setting a minimum gate opening corresponding to particular storage elevations. The *FLOODOPS* component of the RTFM performed well for this storage.

An EXCEL spreadsheet was developed during the drainage of North Pine Dam down to EL 39.55 mAHD during the March event to examine the effect of holding the radial gates open longer than would otherwise be necessary for a given level on the build up phase of the flood. This spreadsheet produced accurate estimates of the recorded drainage times.

It is expected that the integration of 'user edited' gate opening sequences (as discussed in Section 11.3.1) into *FLOODOPS* will make this spreadsheet redundant although it was extremely useful in determining the effect of 'what ifs'.

11.4 Effect of Diversions into Lake Clarendon and Atkinson's Lagoon

It was known that diversions into both Lake Clarendon and Atkinson's were occurring during both events. However, no account was taken of these activities as the diversion rates were small in comparison to the natural flows.

11.5 Review of Rating Curves

Considerable difficulty was experienced (during the drainage phase of both events) at getting flows at one station to correspond with flows at downstream stations. Because of the nature of releases from Wivenhoe, it should be possible to set a number of firm points on the discharge rating curves for the following stations.

- Wivenhoe Tailwater
- Lowood (A) and (B)
- Savages Crossing
- Mt Crosby
- Moggill
- Jindalee

The discharges of interest would be:-

- 150 m^3/sec To maintain College's Crossing open
- 250 m^3/sec To maintain Burton's Crossing open
- 550 m^3/sec To maintain Kholo Bridge open
- 1800 m^3/sec To maintain Mt Crosby Weir bridge open.

Detailed examination of the records would be required as part of such a review.

12. FLOOD MANAGEMENT STRATEGIES FOR FEBRUARY 1999 EVENT FOR WIVENHOE AND SOMERSET DAMS

12.1 Flood Development

Widespread rainfall in all catchments commenced on Sunday 7/02/1999 and late Sunday Somerset dam water level was rising at 80 mm/hr. At 1045 hrs the BoM advised that another150mm was expected in the next 24 hours. At 1645 hrs BoM advised that heavy rain would continue for another 12 hours and a decision to mobilise the Flood Control Centre was made. Soon after BoM issued a flood warning for the Stanley and upper Brisbane Rivers which was closely followed by a similar warning for Lockyer, Bremer and Warrill Creek. On Tuesday at 0745 hrs BoM advised the development of a Low in the Hervey Bay area and the prediction of a 3800 m^3/s inflow into Wivenhoe Dam. At 1624 hrs that day BoM issued a QPF of 20 mm in the next 24 hours in the catchment.

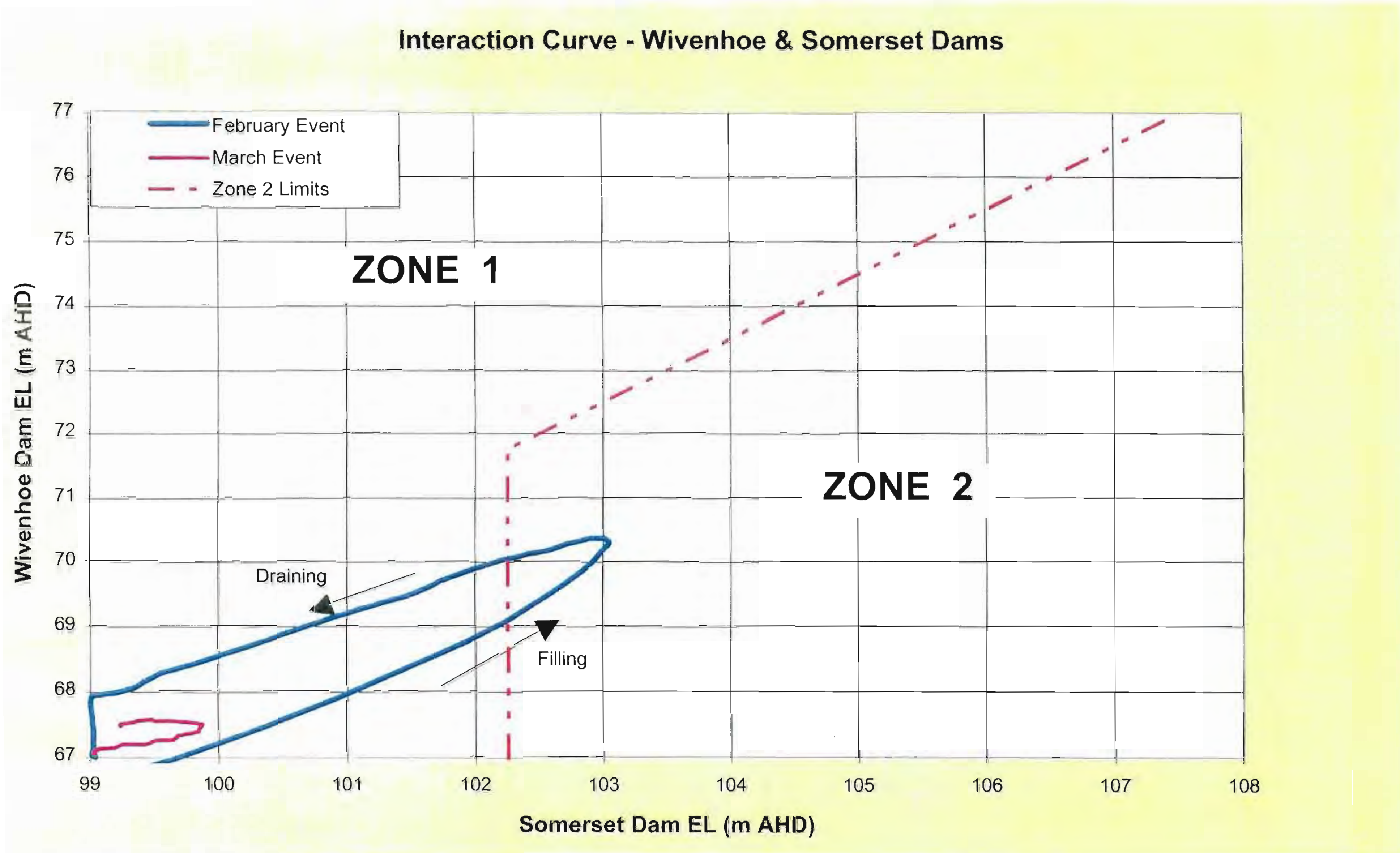
Full inflow and outflow hydrographs for the February event are presented in Appendix D.

12.2 General

- Most rain fell in the Somerset catchment and the northern part of the Wivenhoe catchment with relatively minor falls occurring in the Lockyer and Bremer catchments.
- Releases from Wivenhoe under such circumstances are not well covered by the procedures in Manual of Operations. This is because the relatively small discharges in the Bremer (peak 142 m^3/sec) and the Lockyer (peak 950 m^3/sec at O'Reilly's, 375 m^3/sec at Lyon's Bridge) restrict the Wivenhoe discharge to less than that required to discharge the flood storage component in seven days.
- Volume of the flood was assessed relatively accurately early in the event (as early at 1230 hrs on 8/2/99 a peak elevation in Wivenhoe of EL 70.05 was predicted ... (cf actual EL 70.45)
- The option to release floodwaters through Somerset regulators was not available for most of the February event because the regulators were inundated once Wivenhoe exceeded EL 69.30 mAHD. For the smaller March event, this was not a problem as Wivenhoe peaked at EL 67.59 mAHD.
- The interaction curve between Wivenhoe Dam and Somerset Dam reservoir levels is shown in Figure 12.1.

12.3 Discharge Strategy Development for Wivenhoe Dam

Date & Time		Activity
8th February	1200 hrs	Operators mobilised to site and ready for operations
		Event builds up with water levels in dams rising towards Full Supply Level
9th February	0925 hrs	Volume of the event dictates that drainage discharge had to be in excess of these peaks in order to drain in 7 days.
		Runs of FLOODOPS predicts (if no more rain) discharge of 1900 m^3/sec required at Mt Crosby for approximately 24 hrs.
	1010 hrs	Wivenhoe reaches FSL of 67.00 mAHD
	1030 hrs	Request to close Wivenhoe regulator prior to the opening of radial gates
	1037 hrs	Dam Supervisor Wivenhoe advises that a man is stuck at Twin Bridges. SES is attempting to rescue him. Decision taken by SFOE to defer gate opening.
	1140 hrs	Police and Esk Sire Council advised releases of up to 1600 m^3/sec expected over the next three days.
	1217 hrs	Run of FLOODOPS predicts discharge of 1900 m^3/sec required at Mt Crosby for approximately 72 hrs.
	1153 hrs	Wivenhoe Dam Gate 3 was opened 0.5 metres when the water level reached EL 67.25 mAHD in accordance with Procedure 1A.
		Runs of FLOODOPS confirm predictions that a discharge of 1640 m^3/sec will be required by 2050 hrs, which will gradually increase to 1840 m3/sec by 1140 hrs on 12th March as Lockyer flow decreases.



somwivinteraction.xls

Figure 12.1

Date & Time		Activity
9th February (continued)	1511 hrs	Wivenhoe reaches EL 68.25 mAHD; Dam Supervisor given direction to open Gate 3 to 4m in 10 minute intervals. (Procedure 1E); Discharge approx 400 m^3/sec.
	1535 hrs	Police advised of need to close Kholo Bridge … They agreed to check if it already been closed
	1548 hrs	Esk Shire Council confirm Burtons Bridge closed
	1600 hrs	Wivenhoe complete opening of Gate 3 to 4.0 m; Discharge 400 m^3/sec
	1630 hrs	Gates 2 & 4 opened to 0.5m and Gate 3 to 4.0 m. Wivenhoe EL 68.5m (Procedure 2 – overriding requirement to restrict discharge to peak of Lockyer/Bremer because of need to drain in excess of 1800 m^3/sec. – Aim to keep Mt Crosby open) Total discharge 507 m^3/sec.
	1700 hrs	Gate 3 was opened to 4.5m, Gates 2 & 4 to 1.0m. Wivenhoe EL 68.62m (Procedure 2). Total discharge 660 m^3/sec.
	1900 hrs	Gate 3 open to 4.5m, Gates 2 & 4 at 3.0, Gates 1 & 5 at 0.5 m Wivenhoe EL 69.0 m (Procedure 2). Total discharge 1217 m^3/sec.
	1950 hrs	Gate 3 open to 4.5m, Gates 2 & 4 at 3.5 m, Gates 1 & 5 at 1.0m;. Wivenhoe EL 69.1m, Discharge 1410 m^3/sec.
	2320 hrs	Run 'peter9' indicates releases from Somerset necessary which will necessitate releases from Wivenhoe in excess of 2000 m^3/sec and a combined Lowood flow of 2400 m^3/sec. Decision taken (after discussions with John Mulheron (SEQWB) and after consideration of advice from BoM that no significant rain was forecast) to hold releases from Somerset and Wivenhoe as is until the morning and then review decision.
	2400 hrs	Gate 3 closed to 4.0 m to avoid the peak of the Lockyer and keep Mt Crosby open; Discharge 1414 m^3/sec.
10th February	0250 hrs	Gate 2 closed to 3.0 m to reduce Lowood flow and keep Mt Crosby open; Discharge 1362 m^3/sec.
	1033 hrs	Gate 4 closed to 3.0 m to reduce Lowood flow and keep Mt Crosby open; Discharge 1327 m^3/sec.
	1615 hrs	Wivenhoe peaks on ALERT (#6638) at 70.38 mAHD; Site measurements indicate peak of 70.43 m at 1850 hrs
	1830 hrs	Gates 1 & 5 opened to 1.5 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1445 m^3/sec.
	1848 hrs to 2050 hrs	Gate 3 opened to 4.5 m and Gates 2 and 4 progressively opened to 3.5 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge at 2050 hrs 1600 m^3/sec.
11th February	0210 hrs	FLOODOPS runs predict need to hold release for Mt Crosby criterion until about 0000 hrs 14th February when it can be ramped down to 550 m^3/sec. Precise timing of 'ramp down' depends on rate of reduction of gate openings.
	0450 hrs	Gate 3 opened to 5.0 m to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1649 m^3/sec.

Date & Time		Activity
11th February (continued)	1115 hrs	After some experimentation, Gate 1 opened to 1.5 m (in preference to opening Gate 2 to 4.0m) to replace reduction in Lockyer flow and retain discharge at Mt Crosby just below 1900 m^3/sec; Discharge 1694 m^3/sec.
Period to 12th February:1935 hrs		Wivenhoe gates progressively opened to Gate 1 & 5 at 2.5 m, Gates 2 & 4 at 3.5 m and Gate 3 at 5.0 m. Discharge 1784 m^3/sec. These gate openings were then held until ramp down to 550 m^3/sec
14th February commencing at 1100 hrs until 15th February at 1100 hrs		Ramp down to 550 m^3/sec to bring Kholo bridge out of water. A one hour interval between gate closures was adopted instead of the 20 minute minimum interval set in the Manual so as to minimise bank instabilities. With only one minor problem associated with an hydraulic motor oil leak, gate closures went according to plan with final gate openings of Gates 2 at 0.5 m, Gate 4 at 1.0 m and Gate 3 at 4.0 metres. Discharge 546 m^3/sec.
15th February	1350 hrs	Ray Fitzsimon began observations of Kholo Bridge to monitor it's emergence from the flood waters. At 2040 hrs, the water level had dropped to the point where sideboards of bridge were keeping water out.
16th February	2100 hrs	Discussed options for bringing Burton's Bridge out of floodwaters with John Mulheron (SEQWB). If current release was maintained final closure would be on 18th. If discharge reduced, it would take until 23rd to drain. After some discussion convinced JM to keep status quo at least until following morning.
17th February	2330 hrs	Began closure of gates to bring Burton's Bridge out of water using 30 minute closure intervals. Completed at 0130 hrs on 18th. Designed to bring Burton's out of water by morning.
18th February	1900 hrs	Began final closure of Wivenhoe at 30 minute intervals. Closure completed by 2130 hrs
19th February	1230 hrs	Event declared over and FCC demobilised. Ongoing monitoring of lake levels by Duty Engineer remotely using FLOODPC.

12.4 Performance of Wivenhoe Radial Gates

(a) As discussed in Section 18.1, some 'experimentation' was necessary into the required gate openings for the side gates (Nos. 1 & 5) during the course of the event. It was found that the side gates had to be opened earlier than indicated in the Manual of Flood Operations to limit the impact of the spillway flow jet on the sidewall of the spillway plunge pool. This variation was done in conjunction with the Dam Supervisors who provided feedback on gate operations. This action was confirmed by a visit to the dam by the Duty Engineers on Friday 12th February.

(b) Significant vortices were noticed on the upstream side of the radial gates. A photo is shown as Figure 12.2. These vortices were evident in the original model testing and are not considered to present any problems for gate operations. Flow patterns of this type will always be present for gate arrangements such as this where the gates are relatively recessed downstream of the pier noses. These vortices should not cause significant gate vibrations. Indeed, as the gate openings become larger and the gate starts to lose control of the flow the turbulence could be expected to be more significant.

Figure 12.2 Vortex formation upstream of the Wivenhoe Radial Gates

12.5 Inundation of Brisbane River Crossings

A significant amount of time and effort was successfully input into ensuring access across the Brisbane River was maximised. The location of these crossings is shown in Figure 12.5. As indicated above, the lower level crossings were inundated early in the event and the principal control criteria soon became limiting the discharge at Mt Crosby Weir to less than 1900 m^3/sec. In the event, the flood control team was able to keep the flow lapping the underside of the weir bridge for approximately four days. The situation is show in Figures 12.3 and 12.4, which were taken at approximately 1400 hrs on Friday 12th February.

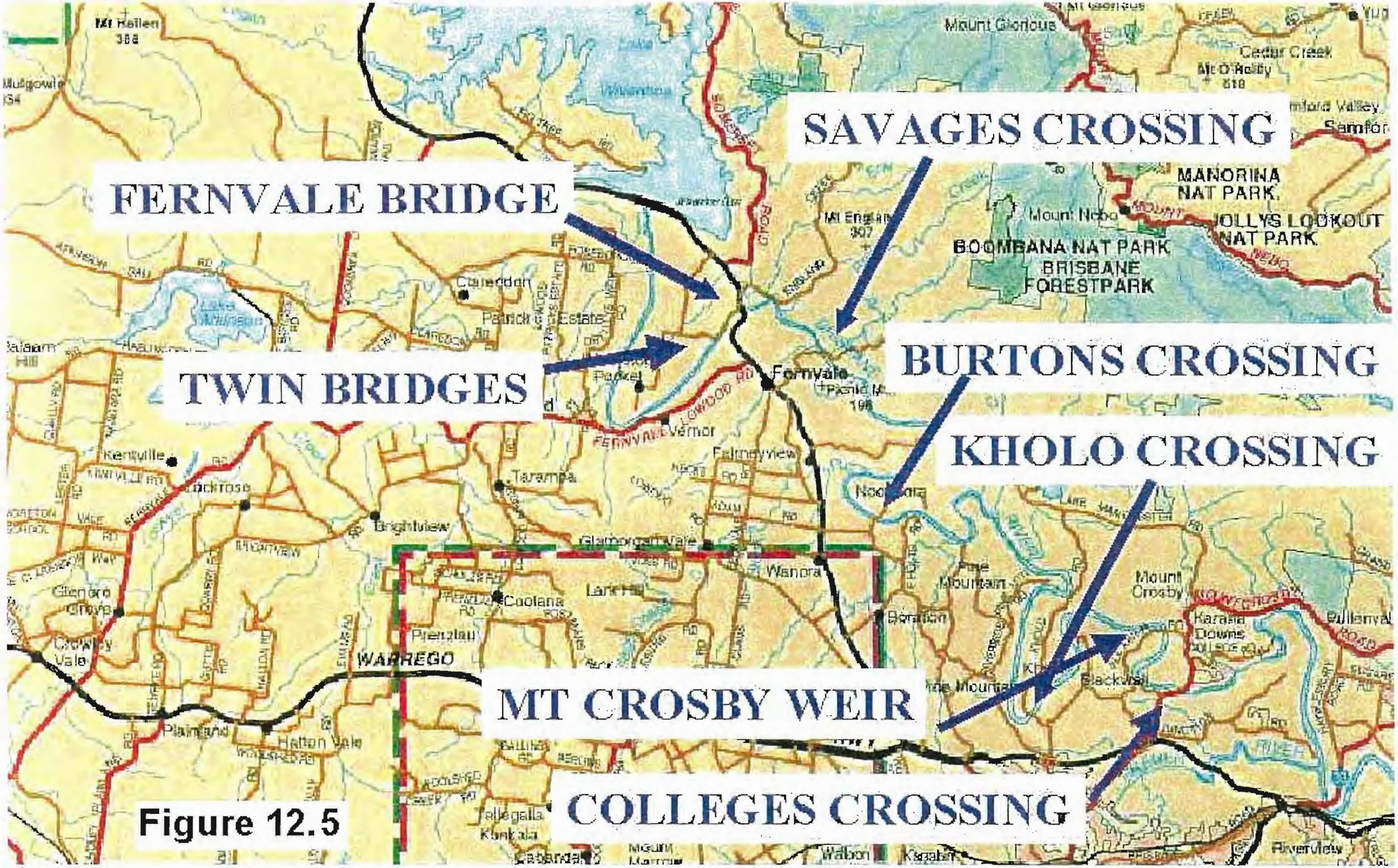

SAVAGES CROSSING
FERNVALE BRIDGE
TWIN BRIDGES
BURTONS CROSSING
KHOLO CROSSING
MT CROSBY WEIR
COLLEGES CROSSING
Mount Glorious
Cedar Creek
MANORINA NAT PARK
Mount Nebo
JOLLYS LOOKOUT NAT PARK
BOOMBANA NAT PARK
BRISBANE FORESTPARK
Fernvale
Caledon
Patrick Estate
Vernor
Fairneyview
Tarampa
Brightview
Kentville
Glamorgan Vale
Wanora
Coolana
Lark Hill
Prenzlau
WARREGO
Plainland
Hatton Vale
Mount Crosby
Karana Downs
Blackwall
Riverview
Glenore Grove
Crowley Vale
Lockrose
Figure 12.5

Figure 12.3 & 12.4 Mt Crosby Weir Bridge – 1400 hrs Friday 12th February

Fernvale Bridge, with an immunity of approximately 2000 m^3/sec remained opened at all times during the event with a small clearance between the underside of the bridge beams and the flow. This clearance was less than 200 mm at times.

Figure 12.6 Fernvale Bridge 1430 hrs Friday 12th February

As soon as it was reasonably practicable, the flow was reduced to 550 m3/sec to bring the Kholo Bridge out of water. Figure 12.7 shows Kholo Bridge on 16th February.

Figure 12.7 Kholo Bridge Tuesday 16th February

12.6 Discharge Strategy Development for Somerset Dam

Date & Time		Activity
8th February	1300 hrs	Operators mobilised to site and ready for operations
9th February	0925 hrs	Completed raising of radial gates to allow unrestricted flow over the ogee crests in accordance with the Manual of Flood Operations for Wivenhoe and Somerset Dams.
	1553 hrs	Headwater reached EL 100.45 mAHD and discharge began over the fixed crest.

Date & Time		Activity
9th February (continued)		No further action was taken until the storage reached EL 102.25 mAHD (the minimum for releases into Wivenhoe if it has not peaked). This level was achieved at approximately 2000 hrs on 9th March.
	2235 hrs	Sluice L is opened to limit the rate of rise in Somerset and to head towards (EL 107.5, EL 77) on the Wivenhoe/Somerset Dam interaction curve. This release was in accordance with DNR Procedure FLX41101.
	2340 hrs	FLOODOPS run indicates initial opening of another sluice followed by the progressive closure of the Somerset crest gate to control the rate of rise of Somerset relative to Wivenhoe. Decision taken to hold releases unchanged ... The effect will be storage neutral on Wivenhoe by mid-day (following day); it will avoid numerous gate operations and will be more acceptable to affected persons upstream in Kilcoy. ... Situation discussed and strategy agreed with John Mulheron (SEQWB)
10th February	1200 hrs	Wivenhoe peaks at EL 70.38 mAHD (ALERT)
11th February	1055 hrs	Sluice M opened to replace reductions in Upper Brisbane inflows into Wivenhoe Dam.
	1240 hrs	Discussed situation with John Mulheron (SEQWB) who advised DE that D'Aguilar Highway bridge was inundated by Somerset headwaters above EL 102.035 mAHD.
12th February	2028 hrs	Sluice K opened to increase rate of draining of Somerset Dam.
13th February	0908 hrs	Somerset regulators now above water. Tailwater EL 69.3mAHD
14th February	1320 hrs	Testing of regulators to see if they are operational following inundation by Wivenhoe floodwaters.
	1425 hrs	Sluice K closed as part of closedown sequence.
	1700 hrs	Sluice M closed and one regulator opened as part of closedown sequence.
15th February	1700 hrs	Sluice L closed when lake level dropped to EL 99.025 mAHD as part of planned closure sequence.
	2010 hrs	Somerset reaches FSL of EL 99.00 mAHD. Regulator '12' closed and shift work stopped.
18th February	0945 hrs	Closure of crest gates
		Ongoing monitoring of ALERT lake levels from FCC with twice daily reports of lake level to FCC.

13. FLOOD MANAGEMENT STRATEGIES FOR MARCH 1999 EVENT FOR WIVENHOE AND SOMERSET DAMS

13.1 General

The flood developed slowly at Somerset with a number of storms that deposited a catchment average of just over 100 mm over several days. The main components of this rainfall occurred over a 16 hour period from about 0900 hrs on the 28th February and a 6 hour period from 0300 hrs on the 1st March.

Little flow occurred at any time in the catchment above Wivenhoe Dam.

Because of the minor magnitude of the March inflows it was decided to control the Somerset Dam level using the regulators and to pass this flow almost directly through Wivenhoe. Releases from Wivenhoe were initially discharged through it's regulators until flows from the Lockyer Creek catchment inundated the Twin Bridges crossing. Once the Lockyer inundated Twin Bridges, it was decided to increase the Wivenhoe discharge to reduce the drainage time. The strategy was to keep the combined discharge from the Lockyer and Wivenhoe less than 175 m^3/sec.

Because the peak outflow from Lockyer Creek was approximately 135 m^3/sec, the discharge from Wivenhoe was initially held at 50 m^3/sec until 2030 hours on the 4th March when it was reduced to 30 m^3/sec to ensure that the peak of the Lockyer would not inundate College's Crossing. Releases were then progressively increased to 170 m^3/sec so as to drain the flood storage as quickly as reasonably possible while having the minimum effect on downstream communities.

Final closure of the Wivenhoe radial gates was achieved at 1800 hrs on 15th March with discharge control being transferred to the regulators. Final closure of the Wivenhoe regulators was ultimately achieved on 18th March.

13.2 Discharge Operations

The following tabulation summarises the principal decisions taken in operating Somerset and Wivenhoe dams during the development of the flood.

Date and Time		Item
28th February	2050	Initial runs of hydrological models indicate a maximum inflow of approximately 80 m3/sec and a reservoir rise of 0.2 metres.
1st March	0630	Initial mobilisation (primarily as a result of inflows into North Pine Dam although minor inflows had occurred in the preceding days which had increased the storage level to EL 99.10 prior to mobilisation)
	1200	Direction to Somerset Dam operators that radial gates be opened.
	1239	Confirmation received that Somerset Dam radial gates were open
	1300	DE John Ruffini discussed the emerging situation with Garry Grant (SEQWB) and advised that a regulator would be opened at Somerset and two regulators would be opened at Wivenhoe. The aim would be to drain it steadily through Wivenhoe while keeping Twin Bridges crossing open.
	1400	Direction to Somerset Dam to open two regulators 50% Total discharge 69 m^3/sec
	1418	Direction to Wivenhoe to open two regulators 50%; Total discharge 30 m^3/sec
	1422	Confirmation of opening of Somerset regulators
	2015	Dam Supervisor; Wivenhoe told to stand down for night and return to duty in the morning
	2145	Scenarios run on basis of 0 mm and 50 mm continuing rain over next 48 hours. Both cases indicated within operational range of regulators

Date and Time		Item
	2210	Dam Supervisor, Somerset told to stand down for night and to return to duty in the morning
2nd March	0600	Somerset Dam EL 99.35 mAHD; Wivenhoe Dam EL 67.17 mAHD
	1135	Review of gate operations – Twin Bridges still 43 cm below top of culvert. Decision taken to upgrade Wivenhoe discharge to 50 m^3/sec. Wivenhoe Dam Supervisor directed to open regulators to 50 m^3/sec.
2nd March (continued)	1630	Dam Supervisor, Wivenhoe told to stand down for night following a final reading at 1700 hrs.
3rd March	0900	Discussions between David Gill, Garry Grant & John Mulheron (SEQWB) and Peter Allen, John Ruffini and Don Cock (DNR) re: Somerset/Wivenhoe Dam operations. It was concluded that the slow drainage of Wivenhoe using the Twin Bridges criterion (55 m^3/sec at Lowood) was the preferred option despite the fact that it would take until 17th March to drain. (refer: Fax to SEQWB 3rd March 0730 hours).
	2145	Runoff occurring in Lockyer Creek following afternoon rainfall. Flow has inundated Twin Bridges.
	2315	Inspection of Savages Crossing bridge by Dam Supervisor, Wivenhoe – Inspection indicates bridge is unserviceable and it is not relevant to consider it in determining revised discharge criterion for Wivenhoe.
4th March	0815	Previous day's rainfall has resulted in inflow into Wivenhoe Dam – extending probable drainage time if current strategy remains in place.
	1000	David Gill (SEQWB) advised we would be releasing on the back of the Lockyer Creek flow with the aim of keeping College's Crossing open.
	1530	Esk SC, Ipswich City C, Police, BoM advised of proposed release strategy for Wivenhoe
	1710	Wivenhoe regulators closed, Gate 3 opened in preparation for larger future releases.
	2030	Wivenhoe Gate 3 discharge reduced to 30 m^3/sec to avoid Lockyer peak and keep flow at Lowood to less than 175 m^3/sec.
	2400	Somerset Dam peaks at EL 99.87 m
5th March	0108	Wivenhoe discharge increased to 50 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. … checking flows will not overtop College's crossing
	1500	Wivenhoe discharge increased to 100 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. … checking flows will not overtop College's crossing
6th March	2010	Wivenhoe discharge increased to 150 m^3/sec

Date and Time		Item
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
8th March	2000	Wivenhoe discharge increased to 170 m^3/sec
		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
9th March	0935	Wivenhoe discharge reduced to 150 m^3/sec (... due to suspected rise in discharge from Lockyer Creek.) Subsequent information proved this incorrect and the discharge was again raised to 170 m^3/sec at 2040 hours.
10th March	0915	SEQWB advised DG DNR had approved the holding of Somerset at EL 99.3 mAHD with ongoing releases using Somerset hydro operating 24 hours/day
10th March (continued)	1050	Somerset regulators closed with Somerset level 99.23 m
	1200	Installed temporary benchmark at Colleges Crossing to gauge rise and fall more effectively.
	PM	Problems experienced with O'Reilly's Weir gauge requiring several visits by Wivenhoe operators to confirm flows.
Ongoing		Continued monitoring of levels at Colleges Crossing
14th March	0930	Somerset crest gates closed, continued 24 hour releases through Somerset hydro station
15th March	1200	Closure of Wivenhoe gate to a discharge of 100 m^3/sec
	1800	Final closure of Wivenhoe gates with transfer of discharge to regulators – Regulators opened to 50 m^3/sec
16th March	1300	Reduction of regulator flow to 30 m^3/sec
18th March	0900	Final closure of Wivenhoe regulators with Wivenhoe at EL 66.94 mAHD and Somerset at EL 99.17 mAHD. (FSL deficit in Wivenhoe equivalent to FSL surplus in Somerset)

Figure 13-13.1 Colleges Crossing from Left Bank during March Event

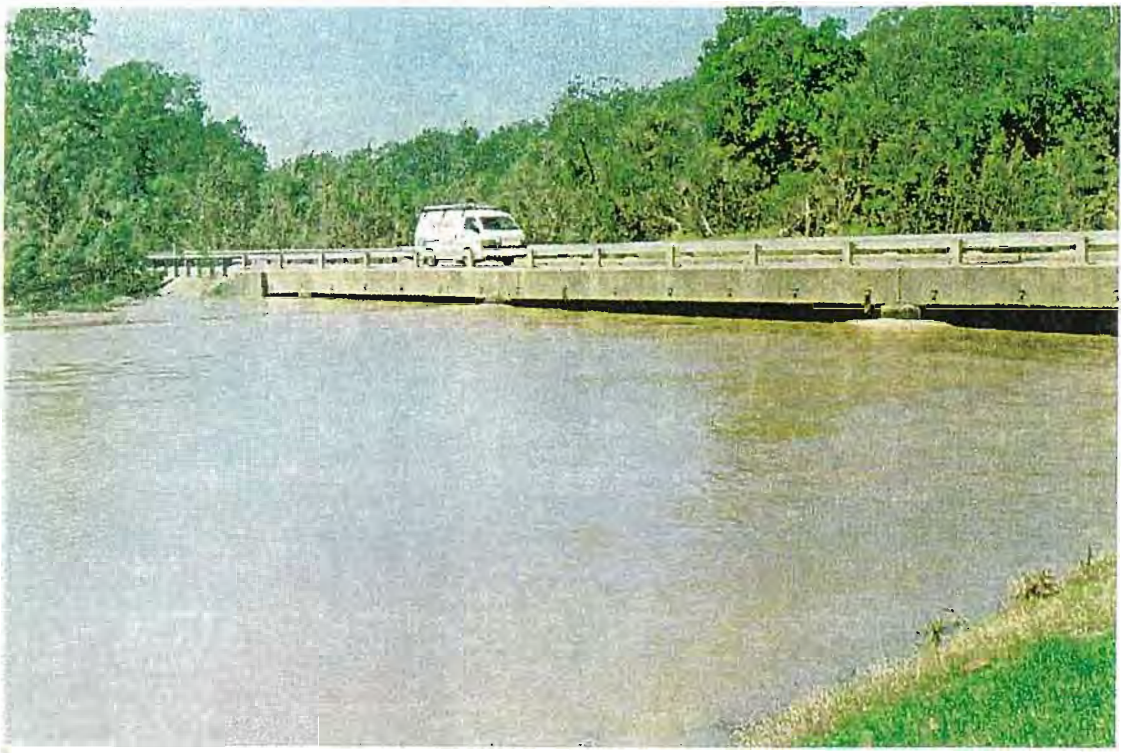


Figure 13-2 Main Span of Colleges Crossing from Upstream during March Event

14. FLOOD MANAGEMENT STRATEGIES FOR FEBRUARY 1999 EVENT FOR NORTH PINE DAM

14.1 General

The strategy adopted for North Pine Dam was in accordance with that specified in the Manual of Flood Releases for North Pine Dam.

Because North Pine was less than 60% full at the start of the event and over 300 mm of rain was required to bring it up to FSL, there was significant warning time at the start of the event prior to gate operations becoming necessary. One of the first runs of *FLOODOPS* that indicated gate operations were likely at North Pine was carried out at 2300 hrs on 8th February using the assumption of 100 mm of rainfall over the next 8 hours. This run predicted a peak level just over EL 39.60 mAHD. In the event a catchment average 76 mm of rain fell over the period with a total of 127 mm of rain falling over the next 48 hours.

A run performed at 0900 hrs on 9th February predicted it would peak at EL 39.78 mAHD at about 0400 hrs on the 10th February.

Preparations for gate openings were made by notifying the Pine Shire Council and the Police. These communications are recorded in the FCC Logs.

Gate operations began at 0530 hrs on 10th February. Initial gate movements were hampered by a sticking brakes on Gates C and E that tripped a circuit breaker. Gate A was ultimately opened and the problem rectified before the other gates needed to be operated. Maximum gate opening of all gates open to Setting No.1 was achieved at 1045 hours on 10th February. The reservoir peaked at EL 39.745 mAHD at 1130 hrs on 10th February.

14.2 Discharge Operations

Date and Time		Item
7th February		Heavy rain in catchment overnight with some minor rises recorded. Downloaded periodically to lap top through the night.
8th February	1000	Began full time monitoring in Flood Control Centre
	1045	BoM advises to expect 150 mm rain over the next 24 hours Operations Engineer advised to ensure staff report to dams
	1205	Dam Supervisor advises North Pine Dam fully operational
	1700	SEQWB formally advised of mobilisation
9th February	0645	Grant St and Young's crossings closed; Dam Supervisor contacts local police, 0715 FCC sends message to Pine Shire Council advising of proposed releases indicating a peak of ≈39.80 mAHD expected in North Pine.
	0805	Dam Supervisor advises FCC people still using Young's Crossing and contacts local police.
	0810	Pine Shire Council respond to our message
	1255	Confirmed advice that NP will operate
	1910	Advised Dam Supervisor that the first gate operation will be in early hours of morning
10th February	0100	Rang Duty Police officer to advise of imminent NP release; Rang PSC at home & at work – no answer.
	0330	Reviewed hydological models; not rising as quickly as predicted, now predict 6-7 am.
	0615	NP attempted to open Gate C; problem with electrical overload, Gate A opened instead. Problem with Gate C solved soon after and Gate A shut, Gate C opened.
	0630	PSC contacted re release.
	- 1135	All gates progressively opened to Setting 1 as water level rises to a peak of EL 39.745 mAHD.
	1726	FCC authorises Dam Supervisor to open all gates to Setting 2 according to Manual sequence if required.
		Gates progressively closed as level drops towards FSL 39.60 mAHD
12th February	0002	Second last gate (Gate E) closed
	0642	Young's Crossing being used by cars despite having water halfway across road. Grant's Crossing still impassable (flow 16 m^3/sec)
	1110	North Pine advised to revert to normal staffing with reporting requirements for levels at start of shift, regularly throughout the day and last thing at night. To revert to full 24 hour operation in the event of rain.
13th February	0145	Final gate closed. Full time monitoring of lake levels continued from FCC.

15. FLOOD MANAGEMENT STRATEGIES FOR MARCH 1999 EVENT FOR NORTH PINE DAM

15.1 General

The strategy adopted for North Pine Dam was in accordance with that specified in the Manual of Flood Releases for North Pine Dam. The event was relatively minor and, as discussed elsewhere, primarily resulted due to the saturated catchments and the full storages.

15.2 Discharge Operations

The following tabulation summarises the principal decisions taken in operating North Pine Dam during the March flood event.

Date and Time		Item
28th February	2050	Discussion with Garry Grant (SEQWB) indicated a gate was likely to be opened in the morning to drain the excess storage in North Pine. Calculations indicated one gate open to 'Setting 1' would drain the excess in 32 hours.
1st March	0630	Heavy rain in Pine River catchment causes rises in the storage. Decision to mobilise. Pine Rivers Shire Council (PSC) advised we plan to make release sometime after 0730 hrs. Requested PSC to close Young's Crossing.
	0715	BoM advise heavy rainfall over next three hours as front moves from Fraser Island south (Falls of 140 mm recorded over Sunshine coast hinterland)
	0825	Gate C opened to Setting 1
	1745	Gate E opened to Setting 1
2nd March	0415	Gate A opened to Setting 1 following heavy rain
	0720	Permission given to Dam Supervisor to exercise Cone valve regulators
	1003	Gate A shut in response to falling storage level
	1500	58 mm rain recorded at dam in previous two hours
	1625	Gate A opened to Setting 1
	1800	Gate D opened to Setting 1
	1845	Gate B opened to Setting 1; NP peaks at 39.77 mAHD
	2025	Gate B shut in response to falling storage level
	2315	Gate D shut in response to falling storage levels
3rd March	0205	Gate A shut in response to falling storage levels
	1630	Rainfall in catchment; Gate A opened to Setting 1
	2130	Decision to keep three gates open for moment as more inflow indicated by rises at Baxter's Creek
4th March	0815	Decision to keep three gates open in order to reduce the time

Date and Time		Item
		Young's Crossing is out of action.
	1735	Gate A shut as water level falls through EL 39.65 m
5th March	0522	Gate E shut as water level falls through EL 39.56 m
5th March (contd)	1025	Dam Supervisor rang to advise people using Young's Crossing despite having a flow of 19 m^3/sec.
	1145	Gate C shut with water level at EL 39.55 m
	1200	SEQWB and Police contacted and advised of cessation of operations.
		Ongoing monitoring of headwater levels

16. THE IMPACT OF WIVENHOE DAM ON THE FEBRUARY FLOOD EVENT

16.1 The Effect on the River Crossings

Figures 16.1 to 16.4 summarise the impact of Wivenhoe Dam on the crossings downstream of the dam during the February 1999 flood event. These charts show the period of inundation of Fernvale Bridge, Burton's Bridge, Kholo Bridge and Mt Crosby Weir Bridge with Wivenhoe Dam and without Wivenhoe Dam.

The results are summarised in the following Table.

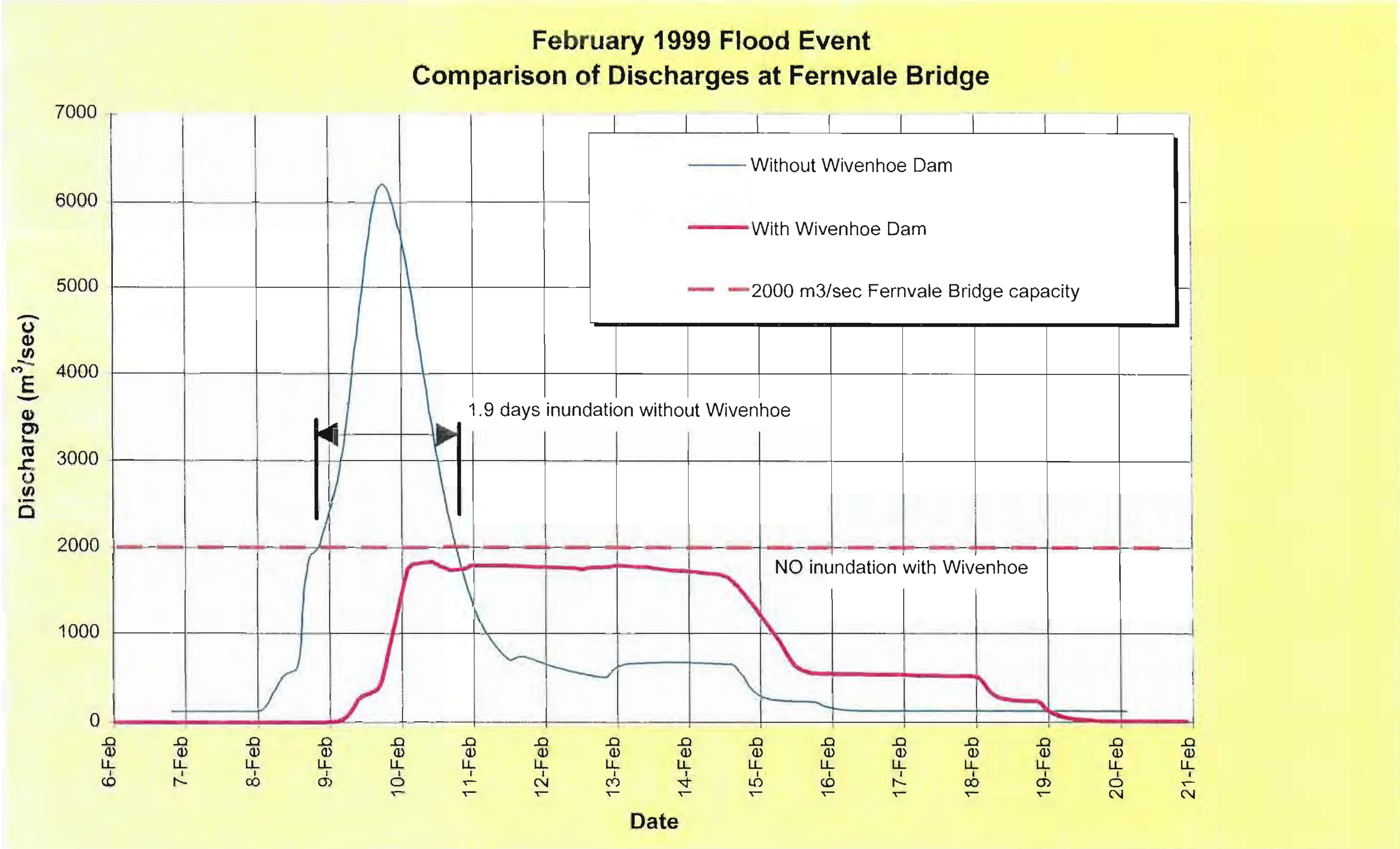
Bridge	Discharge to Render Untrafficable (m^3/sec)	Period of Inundation with Wivenhoe Dam	Period of Inundation without Wivenhoe Dam
Fernvale Bridge	2000 m^3/sec	0 days	1.9 days
Burton's Bridge	250 m^3/sec	9.2 days	7.0 days
Kholo Bridge	550 m^3/sec	5.9 days	6.3 days
Mt Crosby Weir Bridge	1900 m^3/sec	0 days	2.0 days

These results are typical of flood mitigation dams where the peak is mitigated but the duration is prolonged. The inundation periods for Burtons and Kholo bridges would have been marginally longer had it not been for the fact that both Wivenhoe and Somerset were significantly drawn down prior to the event.

16.2 The Effect on Urban Flooding

The effect of urban flooding is summarised in Figures 16.5 to 16.7. These figures provide the flood heights at Moggill, Jindalee and the Port Office gauge. Significant flood damages begin to occur in Brisbane once the discharge exceeds approximately 4000 m^3/sec and the City Gauge level exceeds about EL 2.0 metres.

The following table summarises the impact of Wivenhoe Dam on the crossings downstream of the dam during the February 1999 flood event. These charts show the period of inundation of Fernvale Bridge, Burton's Bridge, Kholo Bridge and Mt Crosby Weir Bridge with Wivenhoe Dam and without Wivenhoe Dam.



kp.a.fernvale.q.no dam.xls

FIGURE 16.1

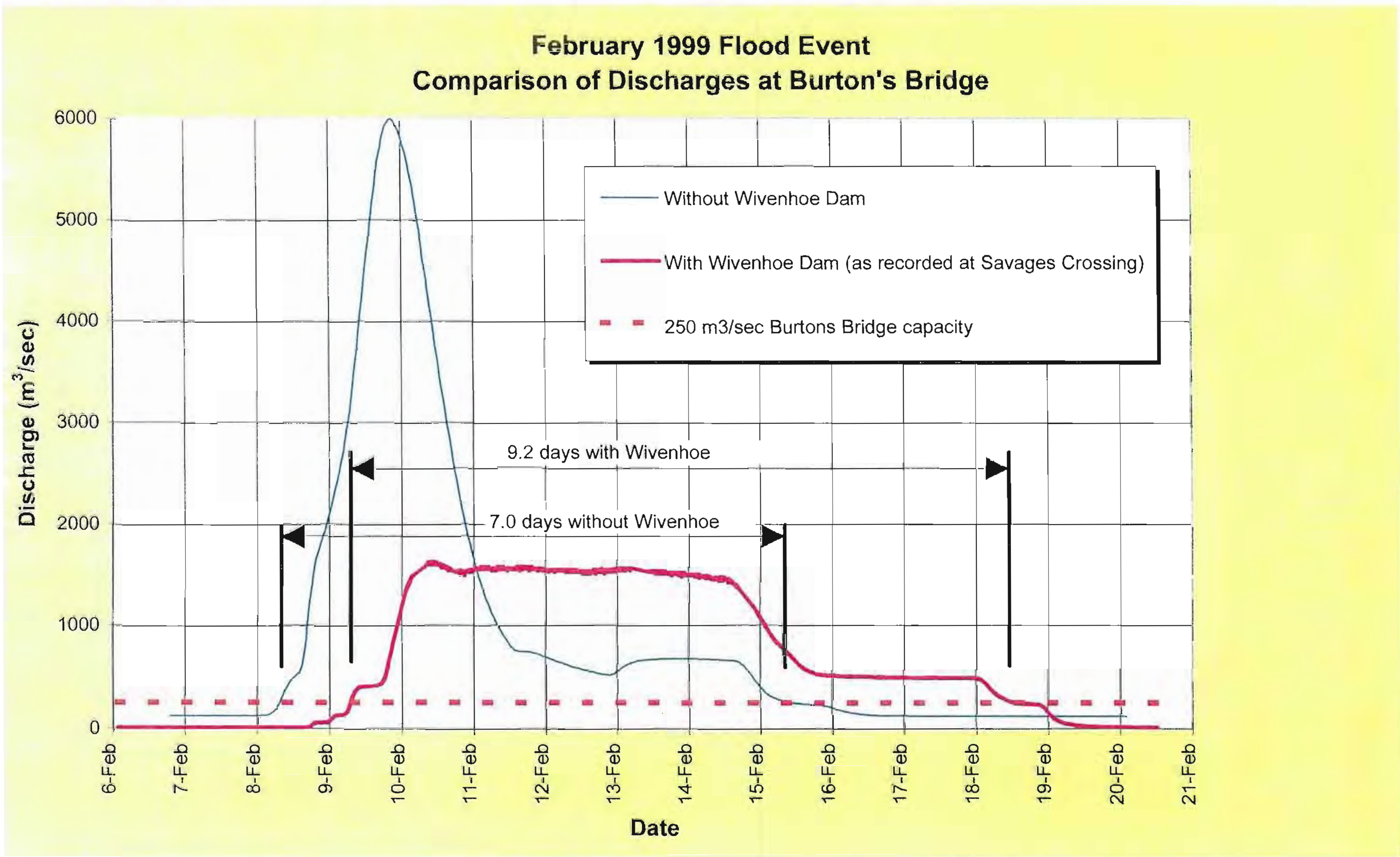


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FIGURE 16.2

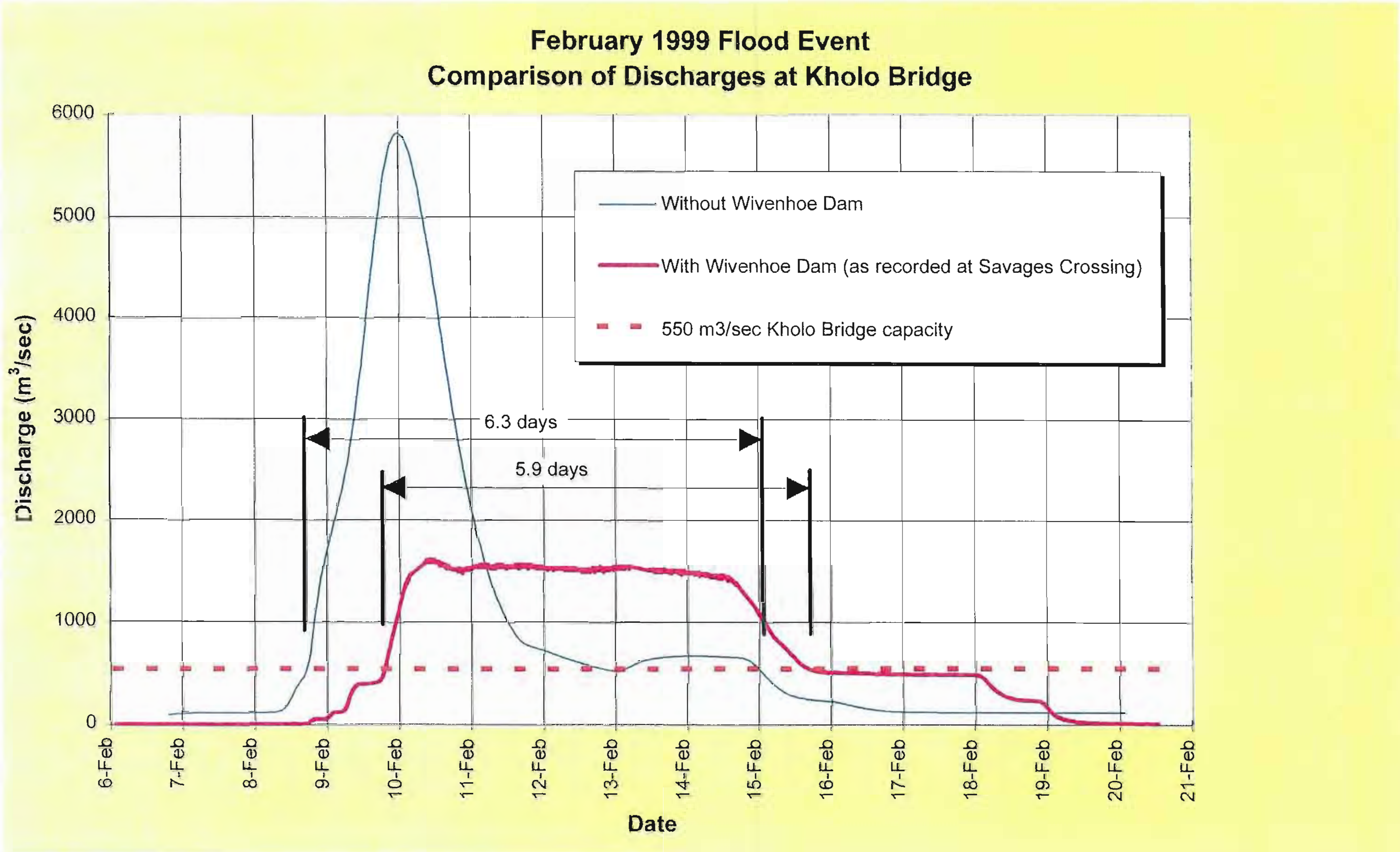

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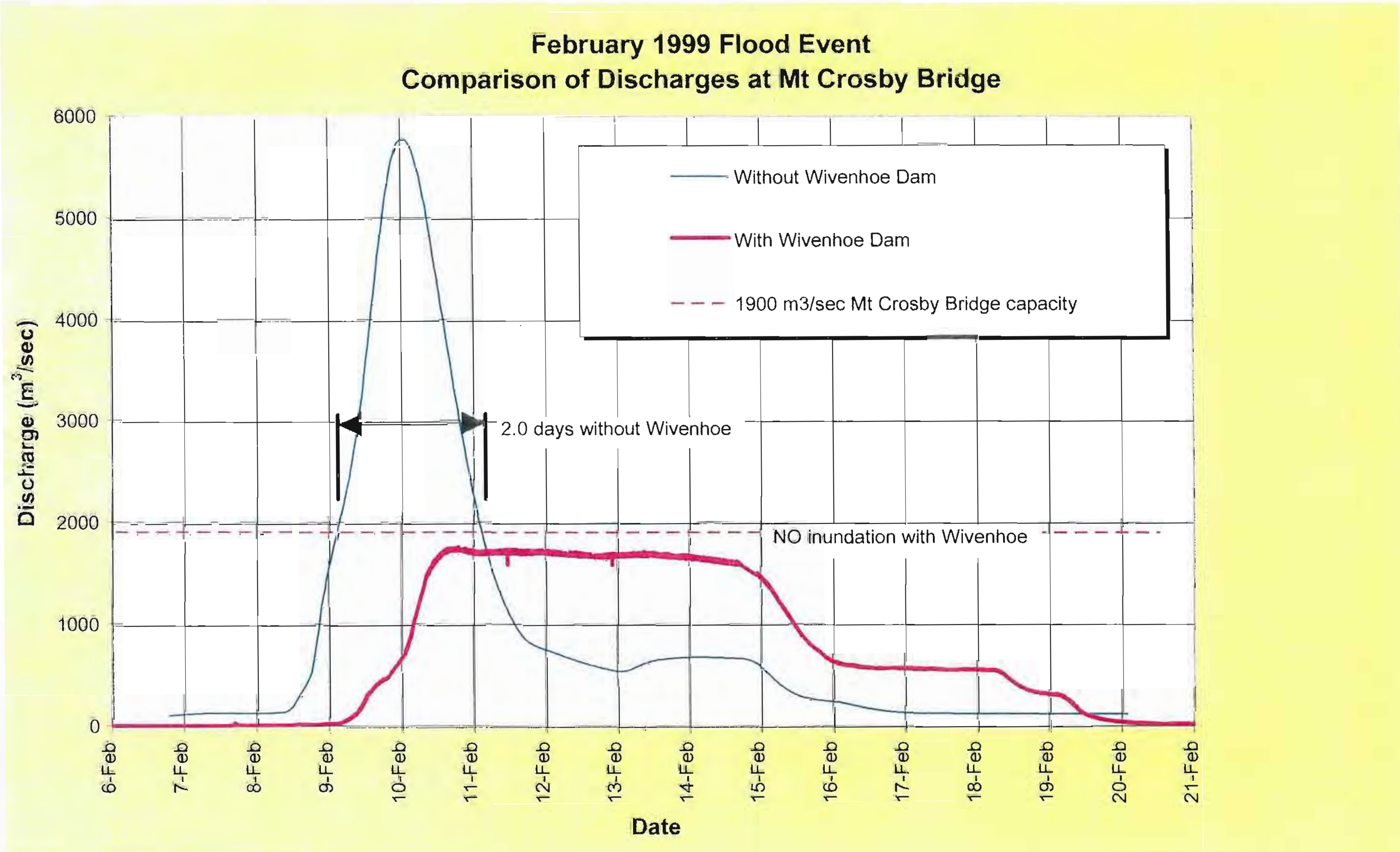
FIGURE 16.3



kp.a.crosby.q.no dam.xls

FIGURE 16.4

With Wivenhoe Dam in place the February event avoided perhaps $100 million worth of flood damages[7] and 1500 houses. As shown in the summary table, the February 1999 event was not of the same order of magnitude as the January 1974 event in the lower reaches of the Brisbane River. As stated elsewhere in this report, this was primarily due to the lack of runoff in the southern part of the catchment.

Location	Maximum Level February 1999 event with Dam	Maximum Level February 1999 event No Wivenhoe	January 1974 Level (No Wivenhoe Dam)
Moggill	1.5 mAHD	14.4 mAHD	19.9 mAHD
Jindalee	2.3 mAHD	7.95 mAHD	14.1 mAHD
Port Office Gauge	1.3 mAHD	2.5 mAHD	5.5 mAHD

Overall, the flood was just the right volume to provide maximum mitigation for downstream effects.

16.3 Effect on Bank Slumping

Every effort was made during operations for both events to minimise slope stability problems associated with rapid drawdown of water levels. This was done by not using the minimum gate operation intervals specified in the flood manuals. This was especially so for the reduction in flow from 1800 m^3/sec to 550 m^3/sec during the February event. This reduction was carried out over 24 hours using a one hour interval between successive gate operations. This interval was three times the minimum specified in the Flood Operations Manual.

Figure 16.8 provides a comparison of the water levels at Lowood during the period both 'with Wivenhoe Dam' and 'without Wivenhoe Dam'. It shows that the rates of rise and fall were similar for both conditions. It also demonstrates that, wherever reasonable, the time intervals between successive gate operations should be maximised.

17. COMMISSIONING OF THE REAL TIME FLOOD MODEL

17.1 General

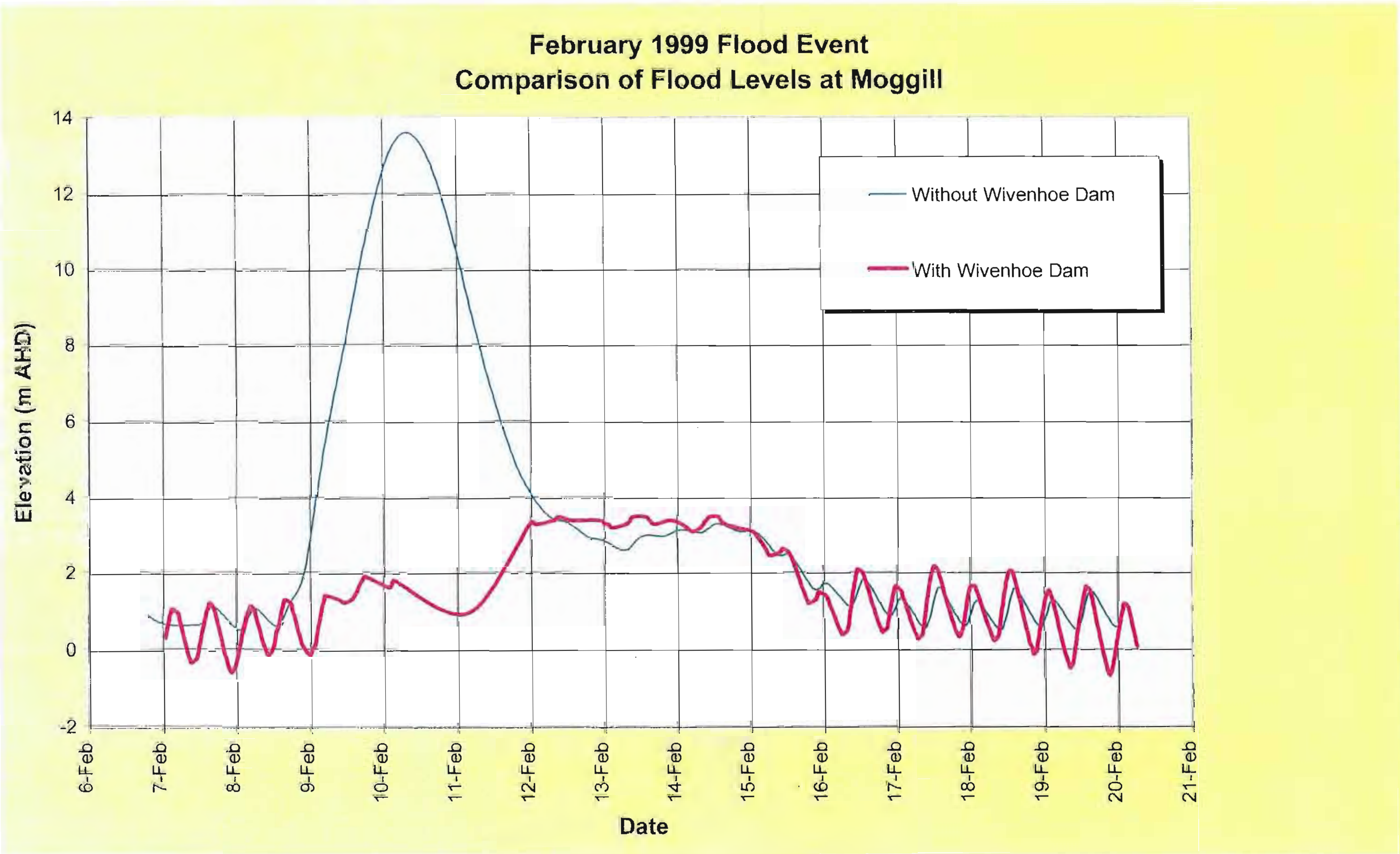
Completion of these two flood events means that consideration should now be given to the commissioning of the Real Time Flood Model. The operators of the dams now have had significant experience in the operation of the model and parts of it have performed creditably.

In particular, it would appear appropriate to commission most components of the ALERT network and the *FLOODCOL* data collection system. The following notes are, however, relevant:-

(a) While *FLOODCOL* has been shown to be relatively reliable, there are still a number of 'bugs' that need to be fixed. These include the input of 'Wivenhoe Dam gate and regulator data and the soil moisture accounting models;

(b) Arrangements need to be made for the ongoing maintenance of the Real Time Flood Model following the completion of the commissioning phase. It is suggested

[7] Flood damages were based on the Snowy Mountains Engineering Corporation report for the Cities Commission on the "Brisbane River Flood Investigations, Final Report", November 1975. The damages were inflated to 1999 prices from those figures based on Figure 15 of that report.



kp.a.moggill.q-no dam.xls

FIGURE 16.5

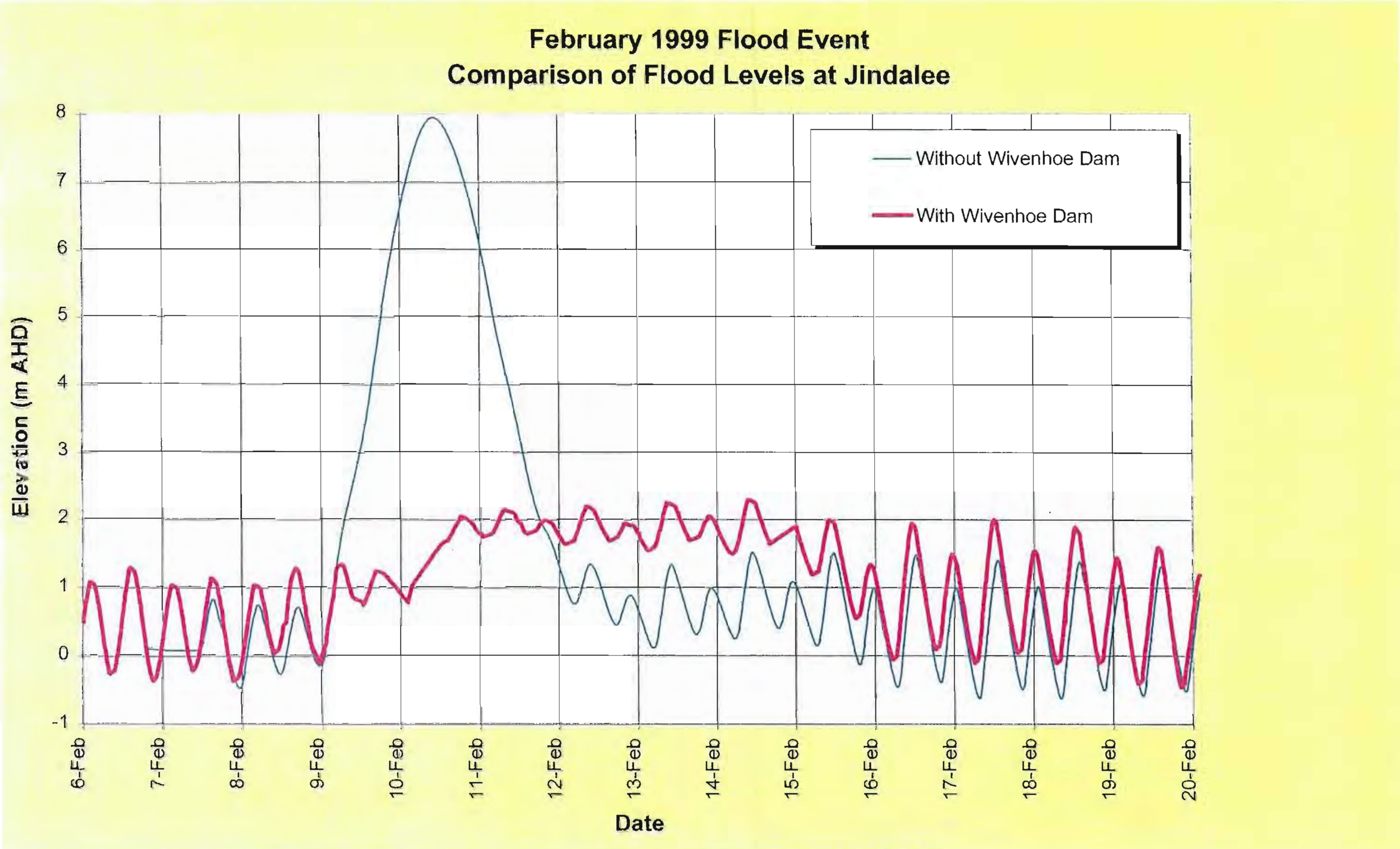


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FIGURE 16.6

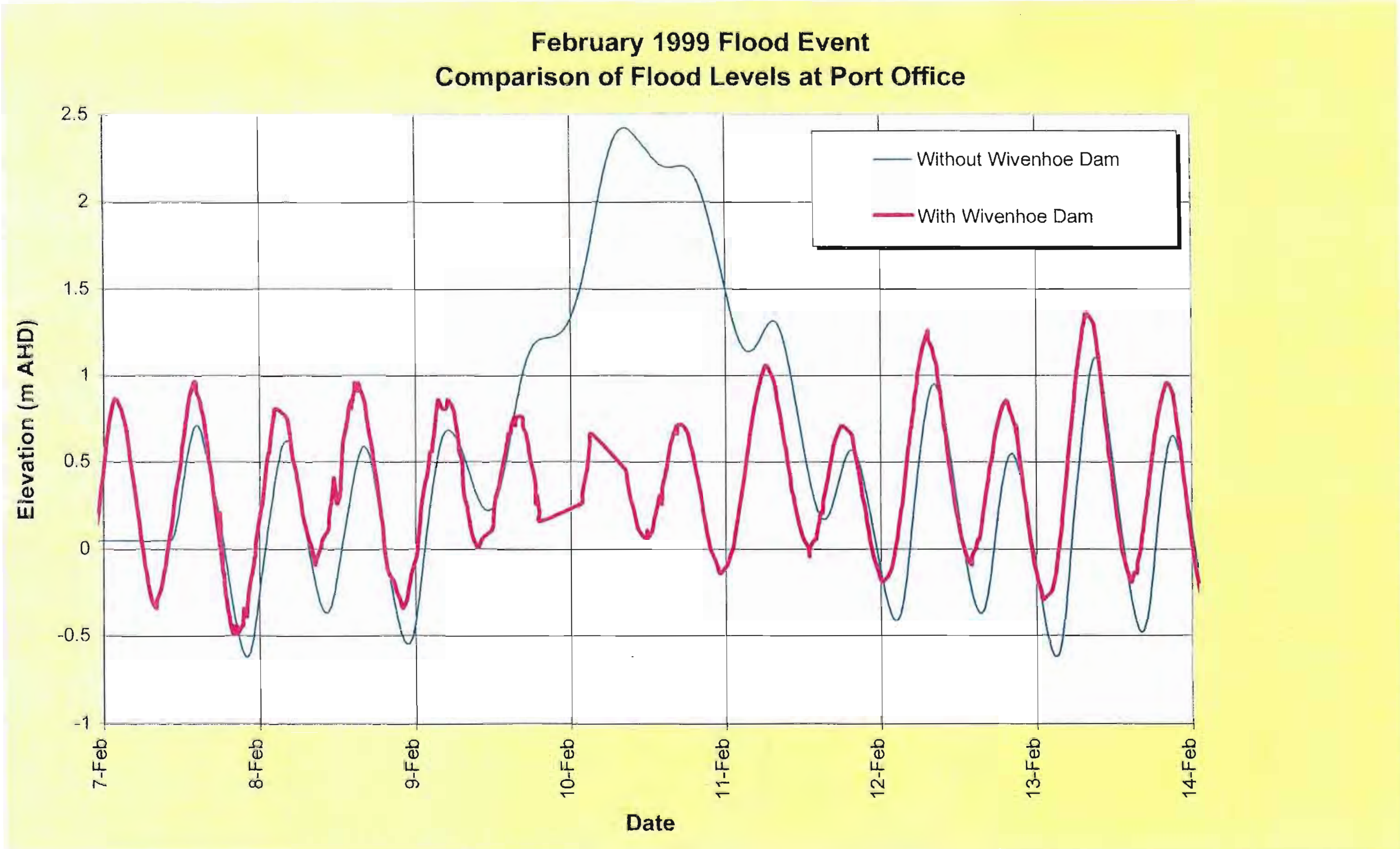

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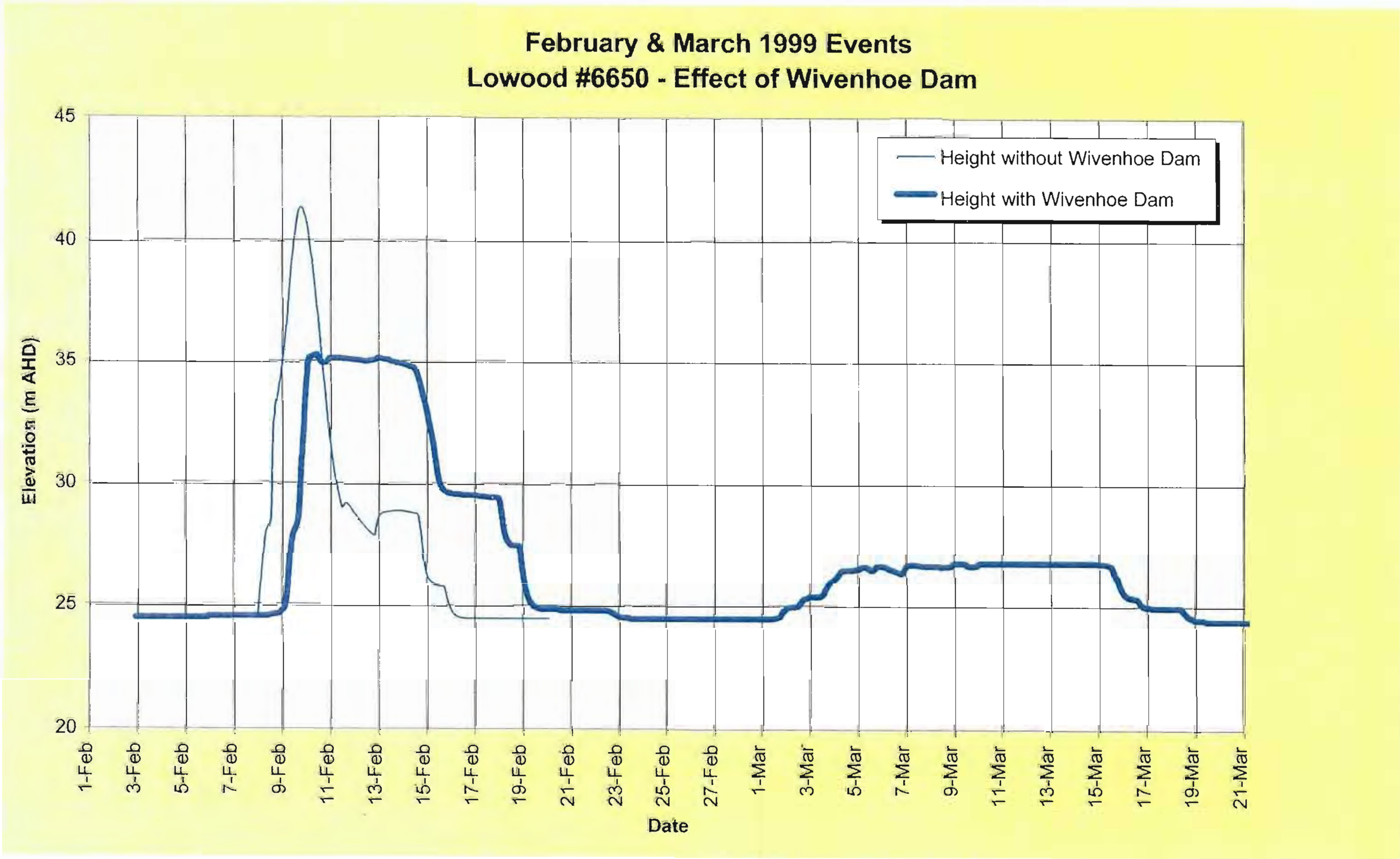
FIGURE 16.7



kp.a.lowood.h-no dam.xls

FIGURE 16.8

that DNR's Surface Water Assessment group be engaged to undertake this work. Members of this group undertook the initial development of the model and are well qualified to carry out the work or alternatively organise others to do the work.

(c) DNR State Water Projects have no arrangement with the DNR Surface Water Assessment group to maintain the back-up machine (named SWAGGY and currently housed in Charlotte Chambers) and to maintain technical support for the FCC machine. SWAGGY is currently maintained on a 'goodwill' basis by SWA.

(d) The 'alpha' version of the BoM's new PC version of *FLOODCOL* is nearly ready for distribution. It is currently envisaged that the new program will ultimately replace the UNIX based *FLOODCOL* program. However, the new program may not have some of the existing *FLOODCOL* features (such as the dam data and the soil moisture accounting models) and these will need to be added on before being installed. The SFOE understands the links are far more user friendly on the new program and it should not present significant problems.

(e) The FLOODOPS section of the RTFM still contains some 'bugs' especially in relation to storage volumes. Fixes were worked out to get around these problems during flood operations. However, when FLOODOPS is upgraded to incorporate the revised gate operations routines, these bugs should be found and fixed.

17.2 Future Direction of RTFM

The original brief for the development of the RTFM called for it to be developed on UNIX based system under OSF/Motif GUI. This decision was made at the time because UNIX was the only true multi-tasking system with a Windows interface. The HP Workstation was selected as the development platform because of the superior floating point numerical processing power and the reliability of the product.

The future direction of the RTFM software should now be considered by the SEQWB given the;

- Recent advances in computing power and operating system.
- Cost of maintaining the current UNIX workstation
- Development of Windows NT based ENVIROMON Alert data collection system

The Microsoft Windows NT/Windows98 operating systems is now a true multi-tasking system widely accepted in the market place. It has replaced many UNIX based system because of its lower operating costs. Its GUI is superior to the OSF/Motif based systems as the development of the OSF/Motif product has stagnated in the face of Windows NT's market dominance. The computational power available on "Intel" based computers is now sufficient to run hydraulic models during flood operations. The larger user base of the Windows NT system ensures that the system will advance ahead of UNIX /OFS/Motif. LINUX a shareware public domain version of UNIX for intel based system is gaining popularity amongst academics but it doesn't offer a real alternative at this point in time.

The development of ENVIROMON and the BoM commitment to maintain this system into the future through contributions from users throughout Australia

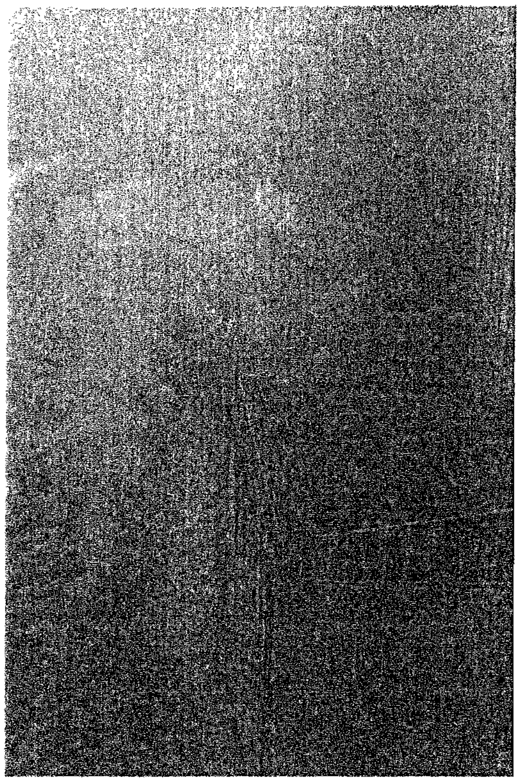
18. RECOMMENDATIONS FOR CHANGES TO THE FLOOD OPERATIONS MANUALS

18.1 Wivenhoe Dam Gate opening Sequences

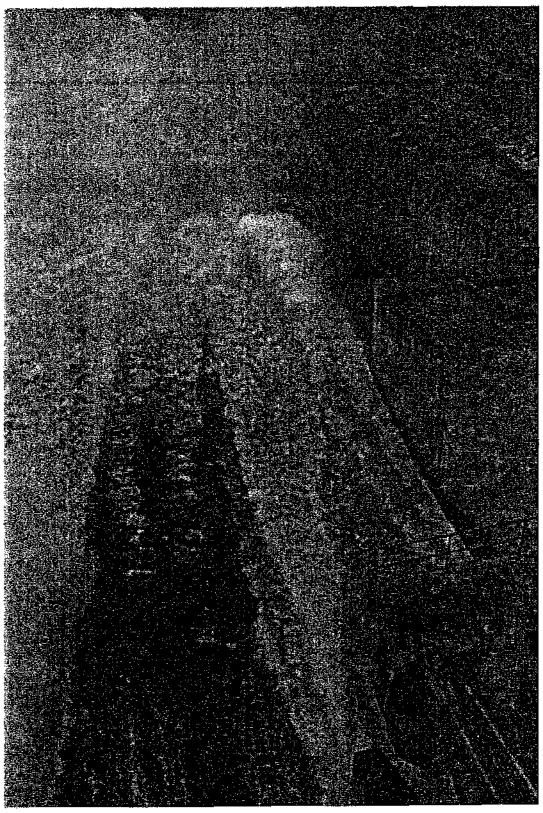
One of the principal proposed changes to the Wivenhoe Dam and Somerset Dam Manual is in the recommended gate opening sequence for Wivenhoe Dam.

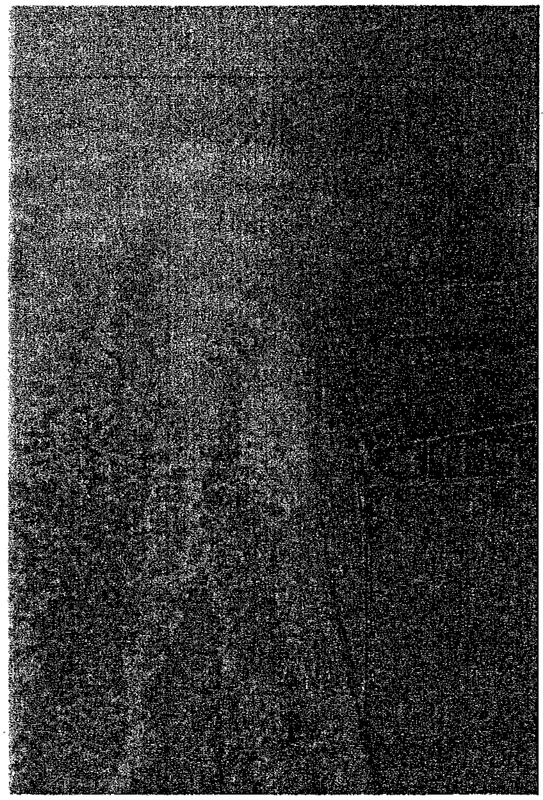
On several occasions gates 2 or 4 were opened only to find that there was a tendency for the discharge jet to impact on the sidewall of the spillway plunge pool excavation. When this occurred, it was found necessary to immediately reduce the opening of the gate 2 or 4 back to what it was and then open the adjacent side gate a further 0.5 metres instead. This limited the impact on the sidewall and allowed the opening of gate 2 or 4 to proceed as the next opening. The overall impact is that gates 1 and 5 should be opened earlier in the future to limit the impacting of the side flows on the sidewalls of the spillway plunge pool excavation. The recommended gate sequencing is shown in the following Table.

While the changes in the sequencing are relatively minor, they will also have the beneficial impact that gate openings will not need to be over-ridden when reservoir levels approach the top of closed gates at EL 73.0 mAHD.



Figures 18.1 and 18.2 Outflow from gates 4 and 5 with Gate 4 at 3.5 metres and Gate 5 at 1.0 metre open. Note impact of jet on sidewall of spillway.





Figures 18.3 and 18.4 Outflow from gates 4 and 5 with Gate 4 at 3.0 metres and Gate 5 at 1.0 metre open. Note improved clearance for jet on sidewall of spillway. The situation was further improved with Gate 5 at 1.5 metres open.

Gate Sequence	Gate to be Operated	Gate 1 Opening	Gate 2 Opening	Gate 3 Opening	Gate 4 Opening	Gate 5 Opening
1	3	-	-	0.5	-	-
2	3	-	-	1.0	-	-
3	3	-	-	1.5	-	-
4	3	-	-	2.0	-	-
5	3	-	-	2.5	-	-
6	3	-	-	3.0	-	-
7	3	-	-	3.5	-	-
8	4	-	-		0.5-	-
9	2	-	0.5		-	-
10	3	-	-	4.0	-	-
11	4	-	-		1.0-	-
12	2	-	1.0			
13	5	-	-			0.5
14	1	0.5	-			
15	4	-	-		1.5	
16	2		1.5			
17	5	-	-			1.0
18	1	1.0	-			
19	4	-	-		2.0	
20	2	-	2.0			
21	5	-	-			1.5
22	1	1.5-	-			
23	4	-	-		2.5	
24	2	-	2.5			
25	3	-	-	4.5		
26	5	-	-			2.0
27	1	2.0	-			
28	4				3.0	
29	2	-	3.0			
30	3	-	-	5.0		
31	5					2.5
32	1	2.5				
33	4				3.5	
34	2		3.5			
35	5					3.0
36	1	3.0				
37	4				4.0	
38	2		4.0			
39	5					3.5
40	1	3.5				
41	4				4.5	
42	2		4.5			
43	5					4.0
44	1	4.0				
45	4				5.0	
45	2		5.0			
47	5					4.5

Gate Sequence	Gate to be Operated	Gate 1 Opening	Gate 2 Opening	Gate 3 Opening	Gate 4 Opening	Gate 5 Opening
48	1	4.5				
49	5					5.0
50	1	5.0				
Thereafter in the order 3,4,2,5,1 with all gates within 0.5 metres of the adjacent gate.						

In general terms the above table indicates that gates 2 and 4 should be opened once gate 3 reaches an opening of 3.5 metres and gates 1 and 5 should be keep within an opening of 1.5 metres of the adjacent gates 2 and 4.

18.2 Flow Reductions from Gates/Sluices Accompanied by Opening of Regulators

The situation whereby discharge from a gate or sluice is replaced by discharge from a regulator is not covered in either of the Manuals of Flood Operations. It is believed that the intent of the Manuals is that such a replacement is reasonable. i.e. If, for instance, 50 m^3/sec is discharging from a radial gate at Wivenhoe, it is reasonable to shut the gate and immediately replace this discharge by opening up the regulators to 50 m^3/sec without having the mandatory 20 minute interval following closure of a gate before the regulator is opened.

If shutting of the gate is immediately followed by an equivalent opening of the regulators, the river flow is virtually unaffected by the change of control within a short distance downstream. Whereas, if the minimum intervals are observed, there will be a definite fall in river levels followed by a similar rise for much farther downstream.

The immediate flow replacement is to be recommended.

18.3 D'Aguilar Highway Bridge

It was not until we were well into the drainage of Somerset Dam flood storage that we were advised that the headwaters of Somerset Dam were inundating the D'Aguilar Highway bridge. We now understand that the bridge becomes untrafficable when the storage level exceeds EL 102.035 mAHD.

The inundation level of the D'Aguilar Highway bridge is not stated in the flood manuals. it should be if this level is to become a consideration in the operation of Somerset Dam it should be included in the manual.

18.4 Drainage Sequences to be used when Wivenhoe Dam has NO Inflows

The March 1999 event highlighted the case when inflows occur into Somerset Dam without any corresponding inflows occurring into Wivenhoe Dam. The operating sequences for Somerset Dam rely on holding back Somerset until EL 102.45 m is reached or Wivenhoe peaks.

Neither of these events occurred in the March event because the quantity of the Somerset inflow was too small and because there was virtually no inflow into Wivenhoe from the remainder of the catchment.

As discussed in Section 12, the situation was addressed in this instance by routing the expected inflows into Somerset through the dam and determining the rate of discharge needed to drain the storage in about seven days from the peak reservoir level. In utilising this strategy, the Duty Engineers were able to also rout the same flows through Wivenhoe in what was determined to be a reasonable time.

This approach may not be the ideal solution in every case and consideration should be given to incorporating an appropriate strategy into the Manual of Flood Operations.

18.5 Consideration of the Effect of Wivenhoe Hydro Power Station

It became apparent late in the operation of the February event that the operation of the Wivenhoe pumped storage scheme was significantly affecting the storage levels being measured in Wivenhoe Dam.

Earlier in the February event we contacted the power station and we were advised that releases had been relatively minimal and that they should not affect the operation of Wivenhoe. We were also told that Wivenhoe power station is operated remotely from Tarong Power station and that it was not possible to predict when and for how long the station would operate.

The operating range of the Splityard Creek storage is from EL 133.5 mAHD to EL 168.0 mAHD. This is an operating range of 24,750 ML and represents an operating range of 0.23 metres in Wivenhoe Dam.

The other significant fact is that the power station has the capacity to discharge water from Splityard into Wivenhoe at a rate up to about 640 m^3/sec. It is also capable of pumping water out of Wivenhoe at a rate in excess of 280 m^3/sec. These are significant discharges when you are trying to release discharges of similar magnitude or less from Wivenhoe through the spillway.

Consideration should therefore be given to the following:-

(a) Defining a Full Supply Level in Wivenhoe which takes account the storage level in Splityard ... e.g. A level of 67.00 mAHD with Splityard at FSL.

(b) This is probably most significant when returning Wivenhoe back to FSL at the end of an event. However, it also has implications at changeover levels for changes of operating procedures. It may also be critically important during extreme floods when the water level approaches embankment crest level.

(c) In the critical situation when problems are being experienced at Wivenhoe, should the SFOE be given any powers to limit the discharge into Wivenhoe?

(d) The establishment of an ALERT sensor to measure headwater elevations in Splityard Creek Dam to enable Wivenhoe headwaters to be adjusted for the volume stored in Splityard.

18.6 North Pine Dam Close Down Sequence

The 'close down' sequence for North Pine Dam is ill defined. It could be assumed that the reverse of the rising sequence shown in the Manual. However, the title of Table E1 in the North Pine Dam Flood Releases indicates that these are 'minimum gate openings' and it was decided to use extra gate openings on the falling limb of the storage levels to minimise the time the gates were open.

It should be noted that the minimum gate opening and closing intervals were observed at all times during this sequence

It would seem appropriate to use more gate openings than listed in Table E1 whenever small long duration floods occur requiring prolonged gate operations. Some thought could be given to whether this option should be formally addressed in the North Pine Dam flood manual.

APPENDIX A

ABRIDGED FCC EVENT LOGS FOR FEBRUARY 1999 EVENT

FEBRUARY 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
		At the start of the event there were flood warnings already out for a number of Queensland rivers including Dawson, Moonie and Condamine
Sun 07/02/99	10:06	BoM Quantitative Precipitation Forecast 9am Mon 20-30mm isolated 50mm
Sun 07/02/99	16:00	BoM Quantitative Precipitation Forecast 3pm Mon 20-30mm isolated 50mm
Sun 07/02/99	19:30	Routine Handover of Duty Engineer from Don Cock to Peter Allen (Normally it would have occurred Monday morning, however, Don Cock was heading for Goondiwindi following morning)
Sun 07/02/99	21:50	Data downloaded to PC - Somerset at EL 93.72 and rising steadily at 80 mm/hr
Mon 08/02/99	2:35	Data downloaded to PC - heavy rain locally: 18-25 mm over previous 6 hours; 40-50 mm over previous 24 hours; 1.5 metre rise in Stanley at Peachester; Somerset 93.83 m AHD, No rise in Wivenhoe
Mon 08/02/99	10:00	Began full time monitoring of rainfall & river heights in FCC
Mon 08/02/99	10:45	Advice from Terry Malone (BoM) to expect up to another 150 mm over next 24hrs
Mon 08/02/99	10:45	PA rang John Ruffini & John Tibaldi to advise of developing situation and requested that Dam Supervisors report to dams and begin preparations
Mon 08/02/99	11:30	Doug Grigg advised he would be at Wivenhoe soon
Mon 08/02/99	11:30	Somerset @ EL 94.28 m AHD; Wivenhoe @ 64.18 m AHD; North Pine @ 35.13 m AHD
Mon 08/02/99	12:05	Brett Schultz advised North Pine at EL 35.12 and all operational. Monitoring of rainfall & river heights in progress - ELs agree with ALERT
Mon 08/02/99	12:05	Doug Grigg advised Wivenhoe at EL64.11 and all operational. Monitoring of rainfall & river heights in progress - ELs agree with ALERT
Mon 08/02/99	12:18	Wayne Nevin heading back to Somerset; Wayne advised he thinks the office level sensor is not reading accurately
Mon 08/02/99	12:21	Initial BoM flood warnings for Maroochy River and adjacent coastal streams
Mon 08/02/99	12:24	Initial BoM flood warning for Mary River [Note: Further warnings followed but are not recorded in this abridged version of the Log]
Mon 08/02/99	12:39	*Floodops* runs predict (if 150 mm of rain falls over next 24hrs) then Wivenhoe will peak at EL 70.05 m AHD. [165 mm was actually recorded as a catchment average]
Mon 08/02/99	14:45	PA: Decided to wait until later in afternoon to see if forecast rain eventuated before formally declaring mobilisation
Mon 08/02/99	16:45	Terry Malone (BoM) advised heavy rain will continue for another 12 hours: He also advised that a Duty Meteorologist would be on duty until 02:00 Tuesday but that the Flood Warning Centre would re-open next morning
Mon 08/02/99	17:00	SEQWB formally advised of mobilisation to FCC
Mon 08/02/99	17:08	Initial BoM flood warning for Stanley River and Upper Brisbane River
Mon 08/02/99	17:18	Initial BoM flood warning for Lockyer, Bremer & Warrill Creek
Mon 08/02/99	18:20	Duty Engineer Don Cock rang to check situation and advised he would be back in Brisbane by 11:00 am Tuesday
Mon 08/02/99	21:25	Wayne Nevin advised DNR phones at Somerset out of action; Communications to proceed through SEQWB office phones
Mon 08/02/99		Tested radio communications with Wivenhoe and Somerset Dams
Tue 09/02/99	4:30	John Tibaldi rang providing details of proposed shift arrangements for each of three dams - Rosters to run 7am to 7pm and 7pm to 7am
Tue 09/02/99	5:30	Advised BoM, discussed situation with Peter Baddiley: Releases expected during the day with low level crossings to be closed
Tue 09/02/99	6:20	Advised Garry Grant (SEQWB)of situation and planned releases
Tue 09/02/99	6:45	Brett Schultz advises all OK, Grant St and Young's Crossings shut; Indicate he will contact local police, FCC to contact Pine Shire Council
Tue 09/02/99	7:15	Pine Shire Council answering service - Message sent advising releases are expected from North Pine with a peak of about EL 39.8 M AHD
Tue 09/02/99	7:45	Terry Malone (BoM) advises low developing in Hervey Bay, predict 3800 m3/sec inflow to Somerset
Tue 09/02/99	8:00	Shifts at dams commence
Tue 09/02/99	8:05	Brett Schultz noted people still going across crossing - has advised police
Tue 09/02/99	8:10	Pine Shire responded to our message: Advised to expect a release ~200 m^3/sec about 18:00 - 20:00 hrs today and a peak of 39.8 M AHD
Tue 09/02/99	8:33	Rob Titmarsh directed to raise the crest gates at Somerset
Tue 09/02/99	8:36	Garry Grant (SEQWB) advised of Gate openings at Somerset
Tue 09/02/99	8:45	Contacted Esk Shire to get Savages Crossing & Twin Bridges closed (& any others) Dennis Misso to call back

FEBRUARY 1999 Event

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Date	Time	Action/Comment
Tue 09/02/99	9:00	Advised Maurie Maguire (Esk SC) that we will make releases from Wivenhoe beginning about midday- early afternoon, Expected release 1600 m^3/sec.
Tue 09/02/99	9:25	Rob Titmarsh advises all gates at Somerset raised
Tue 09/02/99	9:28	Darryl Hickey advises BCC Flood Centre now operational. Want to know when we are releasing
Tue 09/02/99	10:30	Advised Doug Grigg to shut regulator in preparation for release
Tue 09/02/99	10:37	Doug Grigg advises that a man is trapped in a caravan at Twin Bridges. Doug to advise progress. PA decides to defer opening.
Tue 09/02/99	10:46	Releases to be made as soon as man rescued. All preparations complete
Tue 09/02/99		Advice received that man was rescued Out of order??
Tue 09/02/99	11:40	Advised Maurie Maguire (Esk SC) that we will release up to 1600 m^3/sec very soon
Tue 09/02/99	11:48	David Gill advised we are opening 1st gate ASAP
Tue 09/02/99	11:53	Rob Gorian advised Wivenhoe Gate 3 opened to first increment at 11:50
Tue 09/02/99	12:55	Confirmed advice with Pine Shire that we will operate North Pine
Tue 09/02/99	15:11	Fax to Wivenhoe - open Gate 3 to 4m at min interval of 10 min
Tue 09/02/99	15:35	Advised police communications of need to close Kholo Bridge
Tue 09/02/99	15:47	Advised Peter Burrows (Ipswich CC) that Kholo bridge will be closed shortly
Tue 09/02/99	15:48	Dennis Misso confirmed that Burtons Bridge is closed
Tue 09/02/99	16:00	Gate 3 open to 4 m
Tue 09/02/99	16:15	Fax to Wivenhoe - open Gate 2 & 4 to 0.5 and then Gate 3 to 4.5m at min interval of 10 min
Tue 09/02/99	16:19	BoM QPF forecast Somerset / Wivenhoe forecast 10mm to 20mm over 24hrs to 3pm wed, North Pine 10mm to 20mm over 24hrs to 3pm
Tue 09/02/99	16:30	Doug Grigg (Wivenhoe) advises that Gate 2 = 0.5 Gate 3 = 4.0 Gate 4 = 0.5 Verbal
Tue 09/02/99	17:10	Fax sent to Wivenhoe Dam advising them to open Gate B and D to 2.5m in 10mm increments
Tue 09/02/99	18:02	Fax from Don Cock to Wivenhoe Dam confirming gate openings Gate 1 and 5 = 0.5m Gate 2 and 4 then opened to 4m at 0.5m 10 minute intervals
Tue 09/02/99	18:30	Fax from Wivenhoe Dam Gates 2 and 4 at 3.0m Gates 1 and 5 at 0.5m
Tue 09/02/99	18:30	(Wivenhoe) verbal approval to open Gates 1 and 5 to 1.0m then advise FCC
Tue 09/02/99	19:00	Don Cock: Fax to Wivenhoe dam to open Gate 2 and Gate 4 to 3.5m
Tue 09/02/99	19:10	Brett Schultz (North Pine) verbal message forecasting gate operations early morning
Tue 09/02/99	20:15	19:22 collector on HP stopped receiving data from system, *Floodops* not operational, Warren Shallcross was called.
Tue 09/02/99	21:00	Collector down, 1.5 hrs ahead of predictions of Somerset, Using 'Peter 9' taking Gregor's as 'gospel'; peak > 6000 @ Gregor's, Keeping Wivenhoe ~ 1400 m^3/sec (T/W doesn't quite reflect this) peaking at midnight at Lyons Bridge.
Tue 09/02/99		BoM will update at 22:00 BoM stills predicts 2200 m3/sec at Mt Crosby. We won't change as yet. Somerset gates open; all sluices shut.
Tue 09/02/99	21:10	Somerset advise EL 102.48 and are checking to se if regulators are completely submerged (cannot operate if they are)
Tue 09/02/99	21:10	Somerset EL 102.48 (2hrs ahead of what model prediction of reaching this level at 22:45)
Tue 09/02/99	21:28	Somerset advises that regulators are 3/4 covered
Tue 09/02/99	21:40	Conversation with John Mulheron, preferable to do closure during daylight. Investigate opening a sluice in Somerset and store it Wivenhoe until morning.
Tue 09/02/99	21:58	Advised Wayne Nevin (Somerset) to prepare to open sluice
Tue 09/02/99	22:03	John Clarke (Kilcoy SC) advised that Somerset would peak ~ 103.0 M AHD + and would peak ~ midday 10/2/99
Tue 09/02/99	22:20	Fax not received by Somerset, advised by phone to proceed with opening of sluice, and report back.
Tue 09/02/99	22:24	BoM duty forecaster: comparison of estimated peak discharge was good. Advised BoM that Wivenhoe discharge will be held at 1500 m3/sec until morning if possible. Rain is clearing according to BoM.
Tue 09/02/99	22:30	John Mulheron advised of our intention of opening a sluice in Somerset and rather than letting it pass directly through Wivenhoe we will store it, (with a consequent rise of ~ 0.2m in Wivenhoe) until the morning when we will reassess situation.
Tue 09/02/99		BoM have advised that there is no significant rain in sight
Tue 09/02/99	22:35	Somerset EL 102.66 Sluice 'L' is open
Tue 09/02/99	23:20	Somerset advise no calls until 24:00 as they are inspecting the galleries
Wed 10/02/99	0:00	Fax to Wivenhoe to close Gate 3 in intervals of 0.5 m until 3.0m and advise when achieved.
Wed 10/02/99	0:00	Above fax corrected to indicate closure of Gate 3 to 4.0m in 0.5m increments
Wed 10/02/99	0:05	Advised that Gate 3 closed to 4.0m

FEBRUARY 1999 Event

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Date		Time	Action/Comment
Wed	10/02/99	0.08	Somerset reverted to 1hr reports.
Wed	10/02/99	0:03	faxed North Pine re proposed gate openings
Wed	10/02/99	1:00	Rang duty officer Police re imminent release at North Pine (minimum impact). Rang Pine SC (Colin Rocket) at home and at work with no answer
Wed	10/02/99	1:20	Data collector problem: It is thought the restoration of a rating from an original corrupted a file which caused system to lock up whenever it was attempted to write to it.
Wed	10/02/99	2:40	Instructions to Wivenhoe to close Gate 2 by 0.5 to improve potential margin against inundation at Mt Crosby weir bridge.
Wed	10/02/99	2:50	Tried to contact BoM to confirm level at Lowood, #6650 Lowood 'A' 33.59 @ 2.26am #6647 Lowood 'B' 34.02 @ 2:16 Difference in discharge would be enough to close Crosby.
Wed	10/02/99		Decided to shut one opening @ Wivenhoe in case, There will be a relative 4hr delay (6.3 Lyons to Lowood 2hrs Wivenhoe to Lowood) Travel time Lowood to Crosby ~ 10hrs Therefore will not affect until midday.
Wed	10/02/99	2:15	Wivenhoe confirmed Gate 2 closed 3.0m
Wed	10/02/99	3:15	Advised police re Mt Crosby weir bridge may go out.
Wed	10/02/99	3:30	Reviewed NP fixed case FEB08021999: Case was re-run and compared with actuals.- observed levels are marginally lower; #6762 recalibrated to observe gauge board value. May not need release until 6-7am
Wed	10/02/99	3:50	Collector dead unable to restart it from inside *Floodcol*. Switched to *FloodPC*, decided not to call JR or WS to investigate as no gate openings planned for next several hours.
Wed	10/02/99	4:10	Malcolm Lane expects NP to reach EL 39.65 [FSL] at approx 05:15. He will advise police and FCC prior to any openings
Wed	10/02/99	4:18	North Pine Dam 'rate of change' calculations faxed to FCC
Wed	10/02/99	4:30	Tried to ring BoM re which Lowood station to adopt but no answer as yet. [Lowood A and Lowood B were giving ~0.4 metre difference]
Wed	10/02/99	5:00	Brian Keech, BoM advised they will chase up an observed level at Lowood gauge.
Wed	10/02/99	5:11	North Pine advise that they will spend the next 10 min checking equipment and will open a gate when the level reaches EL 39.65 M AHD.
Wed	10/02/99	5:30	Brian Keech BoM rang, He has not been able to confirm which Lowood station is correct but he suspects that the lower value is the correct one. He will try to get a level from Lowood this morning.
Wed	10/02/99	5:40	Notes on run 'Peter10' Repeated WIVOPS run. WIVOPS begins with an open closing of a Somerset sluice. It was decided not to implement this closely spaced opening and closing - most likely a 'bug' in the program.
Wed	10/02/99		However, FCC will confirm prior to any increases in discharge
Wed	10/02/99	6:15	North Pine attempted to open Gate 'C' to the first increment but the brake coupling had rusted onto the shaft and that lead to the motor tripping out on overload. They found that Gate 'A' would open so they opened it to increment 1.
Wed	10/02/99		They then repaired the fault and opened Gate 'C' satisfactorily, Gate 'A' was then closed. They estimate that they have 45min before the next opening is required.
Wed	10/02/99	6:30	Contracted Colin Rocket Pine River SC re North Pine release
Wed	10/02/99	6:45	Faxed BoM Terry Malone up to date data on releases from Wivenhoe and Somerset
Wed	10/02/99	7:00	John Clarke Kilcoy SC- advised that Somerset would peak at ~ 18:00 hours approx 103.3m AHD
Wed	10/02/99	7:00	Fax of gate openings log from North Pine Dam
Wed	10/02/99	7:37	North Pine expect to open next Gate 'E' to setting 1.
Wed	10/02/99	8:05	Fax from SEQWB re #6569 - problem is ours it seems (O'Reilly's Weir)
Wed	10/02/99	8:27	John Read (North Pine) EL 39.713 they will open the 3rd gate when the level reaches 39.715 and will confirm opening
Wed	10/02/99	8:43	North Pine Gate 'A' opened 1 notch
Wed	10/02/99	8:57	Advised Doug Grigg that Wivenhoe will peak at 19:00 hours at EL 70.485
Wed	10/02/99	9:40	North Pine Dam Gate 'B' opened 1 increment as instructed.
Wed	10/02/99	9:45	Doug Grigg advises that Gate 4 impacting on flow from Gate 5 - will video problem
Wed	10/02/99	10:10	Vim Balachandran (ESK SC) provided the following feedback: @ 8:15am level was 0.3 below underside; @10:00am lapping underside
Wed	10/02/99	10:18	Wivenhoe Gate 4 discharge is impinging on right wall of spillway (1.0 3.0 4.0 3.5 1.0 Gate openings).
Wed	10/02/99		Decided to close Gate 4 from 3.5 to 3.0 to limit any impinging on wall. Next gate openings will need to be Gates 1 & 5 to 1.5m before raising Gates 2, 3 & 4 again.
Wed	10/02/99	10:35	Doug Grigg advised Gate 4 closed to 3m. Doesn't seem to have fixed the problem.
Wed	10/02/99	10:55	Malcolm Lane - North Pine Water Quality - turbidity problem. Would like to shut outside gates.

FEBRUARY 1999 Event

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Date	Time	Action/Comment
Wed 10/02/99	11:35	Brett Schultz rang to advise North Pine at 39.744. When reaches 39.745 propose to open radial Gate B to increment 1. There will then be 5 gates open.
Wed 10/02/99	12:00	North Pine. All gates open to Setting 1;. Gate B opened at 11:35.
Wed 10/02/99	16:45	Wivenhoe gates opened to 1.5 3.0 4.0 3.0 1.5
Wed 10/02/99	16:55	Wivenhoe flow pattern now restored
Wed 10/02/99	17:26	Fax to North Pine to authorise opening according to sequence to lake level up to Setting 2 if required for all gates. NP to ring FCC and get approval before opening.
Wed 10/02/99	18:00	Wivenhoe peaks at EL 70.42 m AHD (observed). This is 0.03 metres below level provided by ALERT #6640. Level plateaus & holds at about this level.
Wed 10/02/99	18:30	Discussions with Wivenhoe re: which gate is the most appropriate to open. Doug Grigg advised that outer gates are performing their tasks only reasonably. So a 0.5m additional opening is in order for next opening.
Wed 10/02/99	18:15	John Tibaldi confirmed Mt Crosby weir level OK. Based on this info, release strategy will continue. (Q=1724m3)
Wed 10/02/99	18:45	Doug Grigg tried to open Gate 1 by another 0.5m but problems with side wall impact eventuated. Approval given to cancel this opening and instead open Gate 3 by another 0.5m to a total opening of 4.5m.
Wed 10/02/99	19:00	Wivenhoe Gate 3 opened to 4.5m. Wivenhoe operators favour opening Gates 2 & 4 next, for flow control and containment reasons.
Wed 10/02/99	19:35	Wivenhoe Gate 3 open to 4.5m and Gate 5 closed to 1.5m.
Thu 11/02/99	2:00	North Pine Gate D closed. @ EL 39.715
Thu 11/02/99	4:50	Wivenhoe Gate 3 opened to 5.0m
Thu 11/02/99	6:15	Peter Allen advised Peter Baddiley Wivenhoe discharge 1635 at 4:50. Likely to open another gate at 11:40 to increase discharge to 1685 with aim of
Thu 11/02/99		keeping Crosby open. NP has 3 gate openings and currently holding. Cyclone Rona declared. Heading south and likely to hit coast between Mackay and Townsville.
Thu 11/02/99	6:35	Spoke to John Tibaldi re potential gate openings. Decided to open 1 and 5 next to 2 metres followed by 2 and 4 to 4 metres. J Ruffini and D Cock to visit Wivenhoe. They will observe the openings and confirm this decision.
Thu 11/02/99	7:30	Wivenhoe advised that TW recorder not working, will read manually. Level is 36.58
Thu 11/02/99	7:45	Peter Allen advised Gary Grant (SEQWB) current status of dams. Will brief him again later in the day.
Thu 11/02/99	7:50	Wivenhoe TW gauge is OOA. Dam operators were advised that we don't need to fix it in near future. No need to read TW manually. No benefit at this stage. Rob Gorian will contact Paul Martin to see who can repair it.
Thu 11/02/99	8:05	North Pine Gate A shut
Thu 11/02/99	8:55	Peter Allen briefed Doug Grigg on strategy.
Thu 11/02/99	9:40	SES contacted Tom Fenwick re family trapped in Kilcoy and Tom was advised all crest gates and one sluice were open and we were about to open another sluice.
Thu 11/02/99	9:50	Bradley Alderton re recompilation. He will contact Warren with request for a number of files to be sent to him. PA to send gate rating file to him in Melbourne at B.Alderton@BoM.gov.au
Thu 11/02/99	10:00	Tried to contact Somerset by phone no success and left message at SEQWB. Tried to contact via RADIO no success.
Thu 11/02/99	10:43	Rang David Gill (SEQWB) and suggested he get someone to check batteries on the alert stations to prepare for any closely spaced subsequent event.
Thu 11/02/99	10:46	Warren Shallcross has spoken to Bradley Alderton and has sent required files.
Thu 11/02/99	10:55	Fax to R Titmarsh Somerset to open sluice M immediately
Thu 11/02/99	11:10	Fax to D Grigg Wivenhoe to open Gate 1 or 5 from 1.5 to 2.0 metres
Thu 11/02/99	11:20	D Cock rang re Wivenhoe gate openings. Gate 1 has been opened to 2.0 metres. They are now going to close Gate 1 to 1.5 and open Gate 2 to 4.0 metres. They will report relative merits.
Thu 11/02/99	11:25	R Titmarsh rang. Sluice M began opening at 11:10 and completed at 11:20
Thu 11/02/99	11:33	D Cock from Somerset. Experiment with Gate 2 was not as good as opening Gate 1 to 2.0 metres. Decided to open Gate 1 to 2.0 metres and close Gate 2 back to 3.5 metres
Thu 11/02/99	11:48	B Alderton rang. Has received PA flow file. He is still having trouble getting source file from W Shallcross. B Alderton to keep PA informed
Thu 11/02/99	12:00	Rang D Cock re impacts at Fernvale and Crosby. Fernvale approx 300 above water and can take more. Crosby marginal Don will assess on visit this
Thu 11/02/99		afternoon. Crosby at 7:30am water lapping underside of weir bridge. This corresponds to an alert level of 11.88 to 11.95 metres
Thu 11/02/99	12:40	J Mulheron rang for status. Informed of status and that we had opened another sluice (total of 2) at Somerset to bring level in Somerset to below

FEBRUARY 1999 Event

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Date	Time	Action/Comment
Thu 11/02/99		102.035 (deck level of Daguilar highway bridge. He asked be advised of Somerset level as it came in. PA advised him he would be visiting Fernvale and Crosby this PM to look at clearances and impact on side of spillway plunge pool.
Thu 11/02/99		He requested PA to ring on his return
Thu 11/02/99	13:12	J Mulheron (SEQWB) advised of Somerset levels and O'Shea's crossing
Thu 11/02/99	14:30	R Titmarsh advises phone back on line
Thu 11/02/99	14:45	P Allen rang from Mt Crosby. Water lapping deck beams. Water to be kept below this level 11.97 at 14:46. Traffic control from 7am to 7pm by Bill Hester (BCC) 3403 9829 0419 793176
Thu 11/02/99		
Thu 11/02/99	15:00	B Alderton rang re computer program
Thu 11/02/99	15:30	J Mulheron (SEQWB) updated on releases
Thu 11/02/99	18:00	Fernvale bridge is 2.26 below kerb on bridge same as at 10:30. Savages and Crosby remaining steady
Thu 11/02/99	18:28	J Tibaldi advised that at 18:20 water was lapping Mt Crosby deck beams but at 18:00 water was marginally higher.
Thu 11/02/99	20:00	J Tibaldi advised gate opening at Wivenhoe are 2.0, 3.5, 5.0, 3.5, 1.5
Thu 11/02/99	20:42	Discussion re next gate opening. Lockyer has dropped 5 m^3/sec in last 12 hrs, therefore if we wait 12 hrs before next gate opening. Both dams are dropping slowly. Level at Crosby is stable although 2 gate openings today
Thu 11/02/99	22:30	Discussion with J Tibaldi re manning North Pine. JT suggests one man from Friday. JT to ring again Friday morning
Fri 12/02/99	0:00	Wivenhoe Gate 5 opened to 2.0 metres
Fri 12/02/99	0:02	Malcolm (North Pine) advised he will close Gate E. Fax to follow
Fri 12/02/99	6:42	Malcolm to look at crossings d/s of North Pine. Grants crossing impassable with water knee deep. Young's crossing bridge is out of water but has water half way across road. Cars using the crossing
Fri 12/02/99	7:50	D Grigg reported some erosion of sandstone on right bank berm. Approx 3 cu metres
Fri 12/02/99	8:00	Briefed D Gill (SEQWB) Gate opening since 00:00 is 2.0, 3.5, 5.0, 3.5, 2.0 Next opening proposed at 12:00. Current outflow 1726 m^3/sec. Somerset 2 sluices open. North Pine one gate open.
Fri 12/02/99	8:55	D Grigg discussed erosion at Wivenhoe with D Cock
Fri 12/02/99	8:55	Floodcol alarm monitor not working (System reported)
Fri 12/02/99	9:21	Return fax from SEQWB re stream height station 6755. There appears to be some differences between PC Floodcol and HP Floodcol. Could be because HP recycle
Fri 12/02/99	10:30	North Pine fax Gates A, B, D, E closed Gate C open
Fri 12/02/99	10:45	D Gill rang to confirm SEQWB were checking and replacing Alert station batteries. This is being done progressively by MRD
Fri 12/02/99	11:10	North Pine to revert to normal staffing. Malcolm to staff dam over weekend from 8am to 4:30pm. To report levels on waking in morning and on going to be each night. One gate open at this stage.
Fri 12/02/99	11:21	Rang B Schultz to advise of above North Pine staffing. Brett to maintain contact with Malcolm Lane and revert to 24 hour operation if heavy rain occurs.
Fri 12/02/99	11:25	Fax to D Grigg Wivenhoe re Gate 2 opening at 12:00 from 3.5 metres to 4.0 metres
Fri 12/02/99	12:10	D Grigg reported opening of Gate 2 to 4.0 metres caused flow impacting on left wall. It was decided to close Gate 2 back to 3.5 metres and open Gate 1 to 2.5 metres
Fri 12/02/99	12:15	Fax advising earlier incorrect reporting of Gate 1 open to 3.0 metres. Correct opening is 2.5 metres
Fri 12/02/99	12:25	D Grigg advises gate movements complete. Flow has stopped impacting on wing walls.
Fri 12/02/99	15:02	D Gill advised that one gate left open at North Pine. Might remain open for a week depending on inflow
Fri 12/02/99	16:00	BoM fax: Forecast nil rain at Somerset, Wivenhoe and North Pine in next 24 hours
Fri 12/02/99	16:40	Fax from North Pine showing gate movements til 14:05
Fri 12/02/99	17:00	Fernvale bridge dropped 40 mm since 6:30am
Fri 12/02/99	18:20	Fax from North Pine showing gate settings
Fri 12/02/99	19:35	A Maughan Wivenhoe, advises Gate 5 opened to 2.5 metres. Gates now 2.5, 3.5, 5.0, 3.5, 2.5
Fri 12/02/99	20:28	Fax from Somerset confirming sluice K opened
Sat 13/02/99	5:30	Fax from Wivenhoe showing gate openings
Sat 13/02/99	7:00	Fernvale bridge level dropped 40mm 17:00 12/2/99
Sat 13/02/99	8:30	G Grant (SEQWB) rang. PA advised Somerset at EL 101.01 with 3 sluices open, North Pine EL 39.61 with 1 gate open, Wivenhoe EL 69.22 with gates at 2.5, 3.5, 5.0, 3.5, 2.5. We plan to begin ramp down at 24:00 hrs dependant on inflow.

FEBRUARY 1999 Event

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Date	Time	Action/Comment
Sat 13/02/99		Probably close sluice 3 approx 15:00 14/2
Sat 13/02/99	8:50	Wivenhoe: Erosion of wing walls same as at 12/2/99
Sat 13/02/99	9:08	Somerset regulators now above water. Tailwater 69.30 M AHD
Sat 13/02/99	10:10	Unable to contact D Gill at home, work or mobile. Need to get Savages crossing alert inspected. No valid values since 04:00. DNR station still reporting
Sat 13/02/99	10:25	Steel Tallon (Courier Mail) rang. Referred to SEQWB
Sat 13/02/99	10:40	P Baddiley (BoM) rang. PA advised him of current dam status and planned start of closure at 15:00 14/2/99. Ramp down to take 24 hours at 60 min intervals.
Sat 13/02/99		Somerset to be closed early am 15/2/99. Ex cyclone Rona behaving as predicted at BoM briefing Fri 12/2/99. Now largely stationary and predict southern movement in 12 hours. Suggests we run cases of 50 to 100mm
Sat 13/02/99	11:45	Backup machine HP fully operational. Problem with collector while running backup resolved
Sat 13/02/99	12:00	Malcolm Lane (North Pine) instructed to provide levels when he gets up, when he goes to bed, and at noon. Levels to be used for recalibrating alert stations
Sat 13/02/99	15:50	Malcolm Lane - just about to stop work - NP @ 39.581- Malcolm will check @ 6pm & 10 pm tonight to check levels. He will report in then and we will determine final timing for closure about 2am in the morning
Sat 13/02/99	17:06	Quantitative Precipitation Forecast to 3pm Sunday <5mm
Sat 13/02/99	18:03	NP 39.577 - Looking to closure @ about 01:00
Sat 13/02/99	18:30	Completed review of gate opening order
Sat 13/02/99	22:00	Fax from John Tibaldi re proposed staffing arrangements for Somerset Dam
Sat 13/02/99	22:15	Malcolm Lane - He is to shut off the gate @2:00am tomorrow. He has undertaken to inform local police accordingly, & also Pine Shire. He will ask Pine Shire if they wish to be contacted when it is closed. Malcolm will advise FCC when it is shut
Sun 14/02/99	1:45	Fax from Wivenhoe - Event Log
Sun 14/02/99	1:45	Malcolm North Pine EL 39.557 Gate 'C' closed.
Sun 14/02/99	2:00	Fax from North Pine EL 39.557 and gate settings All gates now closed.
Sun 14/02/99	5:15	Fax from Wivenhoe - operating Log
Sun 14/02/99	7:00	Wayne Somerset EL 99.95 Handing over to Rob Titmarsh and Peter Myatt
Sun 14/02/99	8:15	Fax from Doug / John Tibaldi re suggested closing sequence for Wivenhoe
Sun 14/02/99	8:30	BoM Peter Baddiley advised that rain depression heading SE will probably miss the coast
Sun 14/02/99	11:00	Fax sent to D. Grigg re: closure of Gate 2 from 3.5m to 3.0m
Sun 14/02/99	11:25	Doug Grigg confirmed gate closure sequence
Sun 14/02/99	11:30	Peter???????????? faxed list of suspect stations
Sun 14/02/99	12:00	Fax to Wivenhoe Dam operators??????? to close Gate 4 from 3.5 to 3. Rob Gorian advised???? and lake level 68.41
Sun 14/02/99	12:00	Rob Gorian Wivenhoe Gate 4 closed from 3.5m to 3.0m
Sun 14/02/99	12:30	Revised Wivenhoe gate closing sequence sent. Dam operators to advise senior???? duty engineer hourly of gate closure??? and lake level
Sun 14/02/99	13:00	Spoke to Paul Martin - Rating Mt Crosby complete when water level was =EL11.7 John Ridler verified there was a error in the savages crossing rating
Sun 14/02/99	13:00	Rob Titmarsh 99.66 Somerset EL advised that Also BCC had a ?????????? in the day
Sun 14/02/99	13:00	Wivenhoe Lake level 68.40 Gate 1 closed from 2.5 to 2.0m
Sun 14/02/99	13:15	Rang Rob Titmarsh Somerset asking him to check the to ascertain if regulators work
Sun 14/02/99	13:30	Confusion whether regulators can work once they come out of water
Sun 14/02/99	14:00	Wivenhoe Dam Lake level 68.37 Gate 5 closed to 2.0m
Sun 14/02/99	14:30	Confirmation phone call from Somerset Sluice K closed at 2:30
Sun 14/02/99	17:05	Doug Grigg - Wivenhoe @ 17:00 WL 68.30 Closing Gate 4 from 3.0 to 2.5m
Sun 14/02/99	17:37	Rob Titmarsh Somerset , Sluice M closed at 5:30pm and one Regulated opened (No.12)
Sun 14/02/99	18:00	Doug Grigg- Wivenhoe WL 68.27 Closing Gate 1 from 2.0 to 1.5 m
Sun 14/02/99	18:00	Rob Titmarsh - Somerset WL 99.51 (Rob expressed opinion that flow may have been slowed too much)
Sun 14/02/99	19:00	Wivenhoe EL68.25 closing Gate 5 to 1.5m
Sun 14/02/99	19:12	Nth Pine EL 39.577 static; will read @ 10pm then dawn. (FCC sensor @ 19:18 - last reading)
Sun 14/02/99	20:30	Somerset directed to close sluice K at EL 99.17 (expected to be @ 8:30am) and regulator 2hrs later
Sun 14/02/99	21:05	Wivenhoe Dam - Andrew Maughan WL 68.18 Gate ?? lowered to 2.0m
Sun 14/02/99	23:00	Wivenhoe dam - Andrew Maughan Gate 1 closed to 1.0m; Unable to obtain lake WL - Oil leak in hydraulic ram- being investigated

FEBRUARY 1999 Event

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Date		Time	Action/Comment
Sun	14/02/99	23:06	John Tibaldi - The oil leak will not prevent back up methods of closing gates - WL will be delayed 1/2 hr
Sun	14/02/99	22:45	No raw data since 16:15; Killed system and killed collector; restarted collector with NIL result - Note attached sheet by N Ablitt
Sun	14/02/99	23:10	Wivenhoe EL 68.11; Have located leak in ram -'O' ring - will repair; Don't anticipate any interference with gate closing sequence.
Sun	14/02/99	23:25	Internet radar printout from Mackay Remnant L now over Mackay
Mon	15/02/99	0:10	Wivenhoe - Andrew rang - Lake EL 68.11 - Gate 5 is now 1.0m
Mon	15/02/99	0:13	Hydraulic Oil leak in Ram necessitates a change in closures. Gate 4 will be closed to 1.5m@1am not Gate 2 & at 2pm Gate 2 will be closed
Mon	15/02/99	0:55	Wivenhoe rang - leak fixed- will now close Gate 2 at 1am as originally planned
Mon	15/02/99	1:10	John Tibaldi Level Wivenhoe 68.09 Leak resulting from a faulty o-ring ready to do Gate 4 at 1:00am
Mon	15/02/99	2:18	Wivenhoe - Andrew rang - Lake 68.08, Gate 4 was closed to 1.5m @2:00am
Mon	15/02/99	2:20	Wayne Nevin - fax received @ Somerset although dark colours did not fax well. I undertook to remove the dark colours & re-send
Mon	15/02/99	2:30	re-sent 02:20 hrs fax to Somerset
Mon	15/02/99	2:30	John Tibaldi --> they think they have fixed the problem -->will try closing Gate 1 in accordance with sequence but if they have problems they will switch to Gate 5 instead. I gave them approval to do so.
Mon	15/02/99	3:14	Andrew Maugham Wivenhoe 68.07 Gate 1 closed to 0.5m in accordance with schedule @3:00 Still unable to fix oil leak but still using it.
Mon	15/02/99	3:48	A Maugham oil leak now under control at Wivenhoe
Mon	15/02/99	4:00	J Tibaldi rang to discuss staffing at Wivenhoe. P Allen advised him to maintain shifts until final closure late Wednesday.
Mon	15/02/99	5:08	A Maugham rang. Wivenhoe Gate 2 closed to 1 metre.
Mon	15/02/99	6:05	J Tibaldi rang. Wivenhoe Gate 4 closed to 1 metre
Mon	15/02/99	7:13	R Gorian rang. Wivenhoe Gate 1 now closed
Mon	15/02/99	8:00	P Allen briefed Garry Grant (SEQWB) on current situation and plans.
Mon	15/02/99	8:11	M Lane taken off flood alert. Will report twice a day for next few days.
Mon	15/02/99	8:15	P Allen advised Andrew Underwood (ICC) that flow discharge to 550 m^3/sec and that Kholo should emerge at ~20:00 hrs. We will hold this discharge for 48 hrs and then close off.
Mon	15/02/99	9:00	Wivenhoe gate 2 closed to 0.5 metres.
Mon	15/02/99	9:30	A Molloy (BoM) rang. J Ruffini advised we were releasing at 550 m3/sec and would hold at that level for a few days.
Mon	15/02/99	9:35	BCC rang requesting info on current releases. J Ruffini advised 550 m^3/sec and holding that level til Wed or Thursday. Peak release from dam was 1700 to 1800 m^3/sec.
Mon	15/02/99	12:10	Fax from SEQWB acknowledging sensor repair request for Station 6747 Grain
Mon	15/02/99		Terminal.
Mon	15/02/99	13:00	K Nguyen and P Jukes instructed to do pre draining calcs to Wivenhoe catchment.
Mon	15/02/99	13:50	R Fitzsimon rang from Kholo bridge. Gauge board recorded 1 metre at 13:20. Debris mark peaked at 4.3 metres on gauge board.
Mon	15/02/99	15:45	J Ruffini consults with P Allen re North Pine dam. Decided to allow level to rise above 39.65. If needed, will make release in daylight hours.
Mon	15/02/99	16:00	P Martin - check on stability at Gregor's Ck. He advises rock control unlikely to be a problem at low flows.
Mon	15/02/99	17:02	Fax from Somerset (R Titmarsh) Sluice gate started closing at 17:00. Lake level at 99.025 M AHD
Mon	15/02/99	17:30	Fax from Somerset (R Titmarsh) Sluice gate closed at 17:08. Lake level at EL 99.025 M AHD
Mon	15/02/99	19:45	R Fitzsimon at Kholo Bridge - 0.22 above road at 19:19 - dropped 30mm in 16 minutes
Mon	15/02/99	20:12	Fax to Somerset - Close regulator once EL 99.00 has been reached. Continue to report daily at 6:00 and 22:00 while FCC is operational.
Mon	15/02/99	20:55	R Fitzsimon at Kholo Bridge - At 20:14 Gauge read 0.130 - At 20:40 no water going over bridge. White side boards keeping water out.
Mon	15/02/99	21:20	Fax from Somerset confirming closure of Regulator 12 at 20:25 - EL 99.00 ...... FINAL CLOSURE OF SOMERSET DAM
Mon	15/02/99	21:15	J. Tibaldi reported that Kholo Bridge gauge board for EL 67 - 68 is missing.
Mon	15/02/99	22:00	Wivenhoe EL = 67.91
Mon	15/02/99	23:00	Wivenhoe EL = 67.89
Mon	15/02/99	0:00	Wivenhoe EL = 67.87

FEBRUARY 1999 Event

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Date		Time	Action/Comment
Mon	15/02/99	1:00	Wivenhoe EL = 67.86
Mon	15/02/99	2:00	Wivenhoe EL = 67.85
Mon	15/02/99	3:00	Wivenhoe EL = 67.83
Mon	15/02/99	3:15	Fax from Wivenhoe - Flood Operating Log
Mon	15/02/99	4:00	Wivenhoe EL = 67.81
Mon	15/02/99	5:00	Wivenhoe EL = 67.79
Mon	15/02/99	6:00	Wivenhoe EL = 67.77 , Somerset EL = 99.00. Don Cock talked to John Tibaldi about ???
Mon	15/02/99	6:06	Fax from Wivenhoe - Flood Operating Log
Mon	15/02/99	7:00	Wivenhoe EL = 67.77
Mon	15/02/99	8:00	Wivenhoe EL = 67.75
Mon	15/02/99	8:10	Phone call from Garry Grant (SEQWB) to Don Cock about Burtons Bridge opening - SEQWB agreed to inform the enquirer
Mon	15/02/99	9:10	Doug Grigg reported Wivenhoe EL = 67.74 and confirmed current gate opening settings as: Closed, 0.5, 4.0, 1.0, Closed
Tue	16/02/99	9:15	Advised Peter Burrow at Ipswich City Council that WL Kholo Bridge is below deck but will not drop further until Thursday.
Tue	16/02/99	9:30	R.Fitzsimon - Kholo Bridge WL is 0.5m below wearing surface on U/S side and 0.5-0.7 below on D/S side.
Tue	16/02/99	10:00	David Gill (SEQWB) rang re opening of Bridges. 2pm - 8pm Thursday + 3 hours travel so Friday morning looks good.
Tue	16/02/99	12:35	JR spoke to Terry Malone (BoM) - suggested a debriefing post event. TM indicated more regular communication would have been more helpful.
Tue	16/02/99	12:50	John Mulheron (SEQWB) rang to discuss whether Burton's Bridge could be opened. There is about 200 m^3/sec unaccounted for inflows which were delaying the fall in Wivenhoe. Until we locate this we cannot reduce the discharge from the dam. PA to investigate further. JM will ring back approx 16:30 to discuss the issue further.
Tue	16/02/99	16:50	Rang John Mulheron (SEQWB) - Explained the "losses" of about 150m^3/sec not yet found. PA indicated he would discuss with J Ruffini overnight. JM to ring back at 20:30 to discuss the situation.
Tue	16/02/99	17:20	John Mulheron & Garry Grant (SEQWB) - John is applying pressure to open Burton's Bridge. PA has undertaken to review the situation to discuss it further at 21:00.
Tue	16/02/99	19:50	PA rang Brian Shannon (SWP, Support panel) to discuss the issue of gate closures to bring Burton's bridge out of water. PA has run a number of cases to test sensitivity.
Tue	16/02/99	21:00	PA rang John Mulheron (SEQWB) to discuss options of reducing discharge and bringing Burton's bridge out of water - presented JM with results of sensitivity studies. (a) If it is left as it is ... it will drain to EL 67 by about 18/2 @ 17:00 (b) If we reduce to 250 m^3/sec (to clear Burton's) straight away, it will take 7 days (ie 23/2 @ 22:00) to drain (c) If we reduce to 250m^3/sec @ 8:00 tomorrow, it will take 6 days to drain (ie 23/2 @15:00) Savage's Crossing will be out for the duration. JM accepted the argument to keep the status quo and to review the situation at 08:00 tomorrow.
Tue	16/02/99	21:45	Rob Titmarsh rang from Somerset. Lake Level 99.02, a rise of 0.02, due to hydro being off line from 13:00 to 20:00
		22:00	Wivenhoe EL 67.59
		22:30	PA fax to North Pine Dam G/B 39.60 EL BCC 39.602 Digital 39.605
Wed	17/02/99	0:00	Wivenhoe EL 67.55
		1:00	Wivenhoe EL 67.53
		2:40	Wivenhoe EL 67.50
		3:00	Wivenhoe EL 67.49
		3:30	Fax from Wivenhoe - Flood Operating Log
		4:00	Wivenhoe EL 67.47
		4:15	Fax from Wivenhoe - Event Log
		5:00	Wivenhoe EL 67.45
		6:00	Somerset EL 99.015
		6:00	Wivenhoe EL 67.41
		6:45	Rob Titmarsh (Somerset) indicated Hydro not working yesterday for a period of time causing water level to rise
		7:00	Wivenhoe EL 67.40
		7:30	Fax from North Pine Dam G/B 39.60, BCC 39.606, Digital 39.609
		8:00	Wivenhoe EL 67.38

FEBRUARY 1999 Event

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Date	Time	Action/Comment
	8:20	Received fax from Somerset - Flood Log Sheets (13 pages)
	8:30	Spoke to John Mulheron and Gary Grant (SEQWB). Advised that we would be commencing shut down when we reach approx EL 67.1 which would be some time tonight depending on the downstream rate
	9:00	Wivenhoe EL 67.37
	9:50	Doug Grigg will be off this afternoon so that he can do the night shift as Andrew's wife has gone into hospital to have a baby
	10:00	Somerset Dam EL 99.01 (Rob Titmarsh)
	10:00	Wivenhoe EL 67.35
	10:30	North Pine EL 39.606
	11:00	Wivenhoe EL 67.34
	12:00	Wivenhoe EL 67.33
	12:00	Fax from North Pine Dam G/B 39.6, BCC 39.605, Digital 39.605
	13:00	Somerset Dam EL 99.01 , Wivenhoe EL 67.32
	13:00	Fax sent to Wivenhoe with draft strategy from Wivenhoe OPT Sheet
	13:30	???
Wed 17/02/99	14:00	Wivenhoe EL 67.31
	15:00	Wivenhoe EL 67.31
	16:00	Somerset EL 99.01 , Wivenhoe EL 67.30
	16:00	North Pine EL 39.604 at 15:00 hr
	16:30	Ian Bilkie of Ipswich CC contacted Don Cock re: rumour that College Xing would not be open tomorrow. Don rang back to confirm & told him Fri am. He will ring back on Thursday to confirm (ph 38107911)
	17:00	Wivenhoe EL 67.29
	18:00	Wivenhoe EL 67.28
	18:10	Garry Grant (SEQWB) spoke to Don Cock re: Wivenhoe close down - SEQWB normally provides a base flow to keep Mt Crosby Weir full for BCC water supply purposes. Average demand @ Weir is 500ML/day or 6 cumecs. Flow is made available through a regulator.
	19:00	Wivenhoe EL 67.27
	19:00	Peter Allen discussed closing down to clear Burton Bridge with John Mulheron (SEQWB). JM was keen to clear bridge by Thursday am. PA explained that he would investigate options and ring JM back.
	19:30	PA rang JM (SEQWB) re: Opening of Burton's Bridge: Option of gate closure of 30mins interval instead of 60mins will achieve objective, but will extend lower Bridges submergence by 8 to 12 hrs.
	20:00	Wivenhoe EL 67.26
	21:00	Wivenhoe EL 67.25
	21:23	Somerset EL 99.01
	21:30	Fax from North Pine for Lake EL 39.60
	21:50	Khanh Nguyen provided info. (AMTD and Deck Levels) on Lower Bridges @ Xings to Garry Grant for preparation of Flood OPT Presentation to SEQWB on Thursday morning
	22:00	Wivenhoe EL 67.23
	23:00	Wivenhoe EL 67.21
	23:04	Faxed to Wivenhoe confirming closure sequences from 23:30 to 1:30 as per earlier advices 17/02/99
	23:08	Received Wivenhoe Dam Event Log
	23:30	Wivenhoe confirmed Gate 4 closed from 1.0 to 0.5; The Gates Setting - Closed, 0.5, 4, 0.5, Closed.
Thu 18/02/99	0:00	Wivenhoe EL 67.20
	23:30	Wivenhoe confirmed Gate 3 closed from 4.0 to 3.5; The Gates Setting - Closed, 0.5, 3.5, 0.5 Closed.
	0:30	Wivenhoe confirmed Gate 2 closed from 0.5 to 0.0(closed); The Gates Setting - Closed, Closed, 3.5, 0.5 Closed.
	1:09	Wivenhoe , Doug Grigg rang, Lake EL 67.20 @1:00 Gate 4 closed , settings now closed, closed, 3.5,closed,closed
	1:33	Wivenhoe , Doug rang, Gate 3 closed from 3.5m to 3m, settings now closed, closed, 3.0,closed,closed
	2:05	Doug Grigg, Wivenhoe 67.19; Gate 3 closed to 2.5m @ hold point for Burtons Bridge
	1:11	recd fax from Wivenhoe - Flood event Log
	3:01	Wivenhoe, Doug rang; Lake EL 67.17 @ 3:00
	4:00	Wivenhoe, Doug rang; Lake EL 67.15 @ 4:00
	5:01	Wivenhoe, Doug rang; Lake EL 67.13 @ 5:00

FEBRUARY 1999 Event

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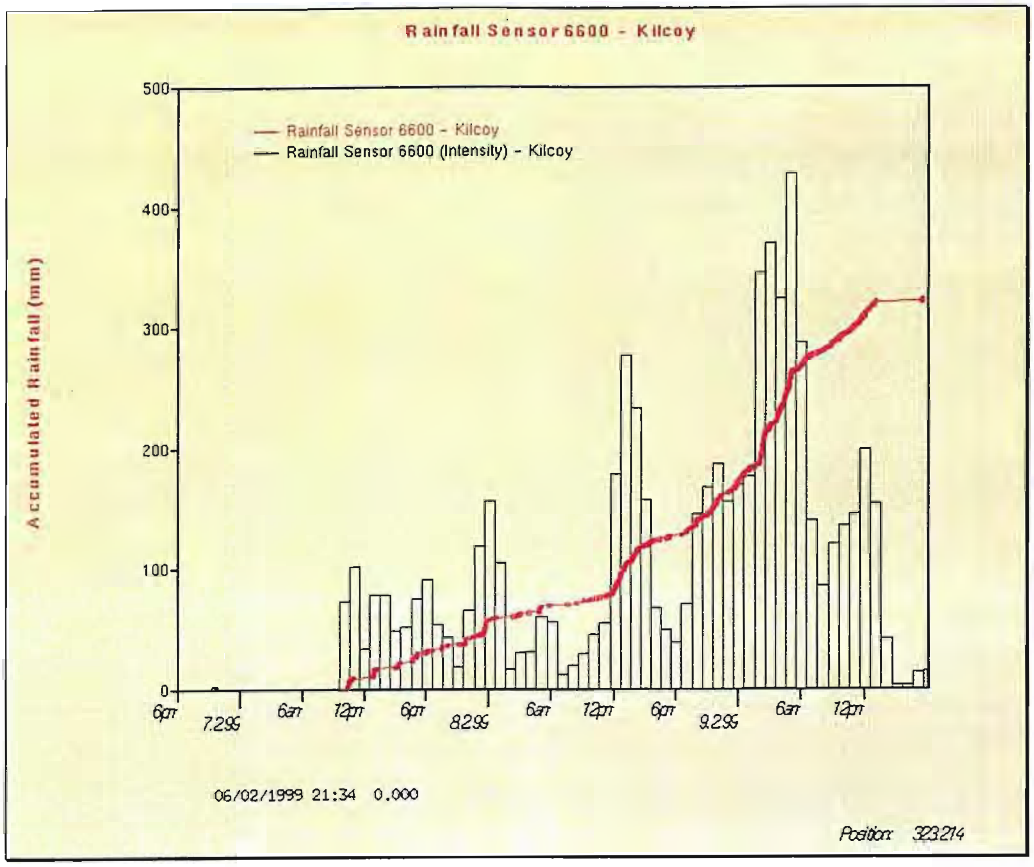
Date	Time	Action/Comment
	6:01	Wivenhoe, Doug rang; Lake EL 67.12 @ 6:00
	6:28	Somerset, Rob Titmarsh rang ; Lake EL 99.01 @ 6:30
	7:00	Wivenhoe WL 67.10; Doug Grigg reports there is still 0.6m over Burton's Bridge. Request to Doug to check bridge at 9:00 AM
	7:10	Rob Titmarsh @ Somerset; Hydro station will be closed for repairs over next weekend, therefore expect small rises in level. Advice regarding planned maintenance on the sluices next week (& ongoing for the next few months)
	7:15	North Pine Lake Level = 39.607m (refer fax)
	8:05	John Tibaldi rang from Wivenhoe; Lake EL 67.10; John estimates a difference in gauge board readings of up to 1cm.
	8:20	John Tibaldi rang from Burton's Bridge. The water is lapping the timber at the upstream side. There is about 150mm of water over the bridge decking.
	8:23	Rob Titmarsh rang requesting instructions for the crest gates
	8:52	David Gill (SEQWB) rang requesting approval to flush regulators. Advised to wait until flow at Burton's Bridge had settled down. Also any flushing should be carried out one at a time.
	8:55	Advised Rob Titmarsh to lower crest gates at Somerset
	9:00	John Tibaldi rang en route to Burton's Bridge; Lake EL 67.09
	9:20	John Tibaldi - Burton's Bridge has approx 100-150mm of water over it.
	9:30	Peter Birkles from Splityard - Max Q with 2 units approx = 320 x 2 cumecs - Monitor MW output - may be only discharge approx = 60 cumecs
	10:00	Wivenhoe 67.09
	10:15	John Tibaldi advised that there is no longer water over Burton's Bridge
	11:00	J. Tibaldi - Wivenhoe EL 67.09
	12:00	J. Tibaldi - Wivenhoe EL 67.09
	12:15	J.Tibaldi - Burton's Bridge has dropped about another foot
	13:00	Wivenhoe EL 67.09 (R.Gorian)
	14:00	Wivenhoe EL 67.10
	14:00	Peter Birkles - Splityard releasing? at 330 cumecs
	15:00	Wivenhoe EL 67.10 (R.Gorian) - opened Regulator No 1 at 15:13 for purpose of Wivenhoe Township - will keep open for approx 1 hour
	16:00	Wivenhoe EL 67.11 (R.Gorian)
	16:30	R.Gorian @ Burton's Bridge WL 500mm below deck
	16:30	Garry Grant (SEQWB) confirmed that we should take FSL as 67 plus a full Splityard. Commence closure at 19:00 based on the information at 14:00.
	17:00	Wivenhoe EL 67.11
	18:00	Wivenhoe EL 67.10
	19:00	Fax to Wivenhoe advising to commence closure at 19:30

APPENDIX B

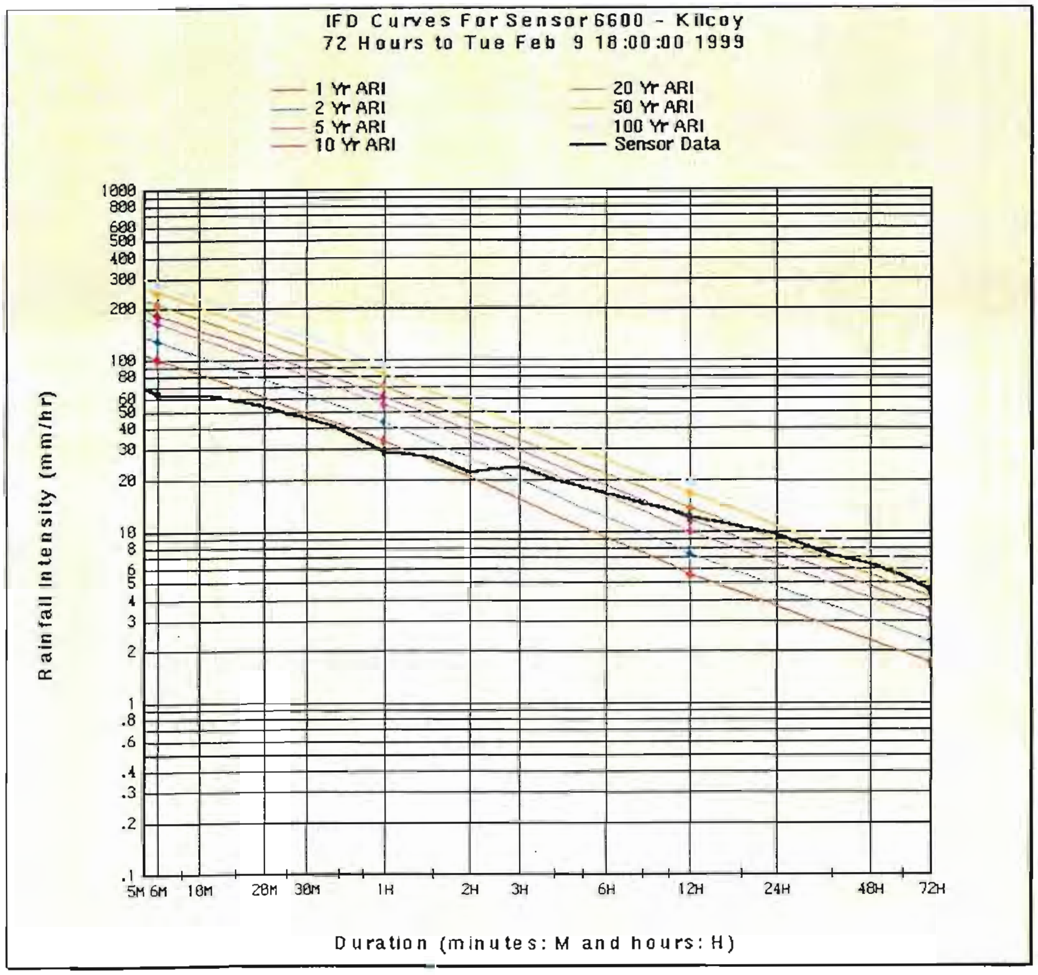
REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR FEBRUARY 1999 EVENT

APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event



Somerset Catchment - Rainfall Sensor 6600 - Kilcoy



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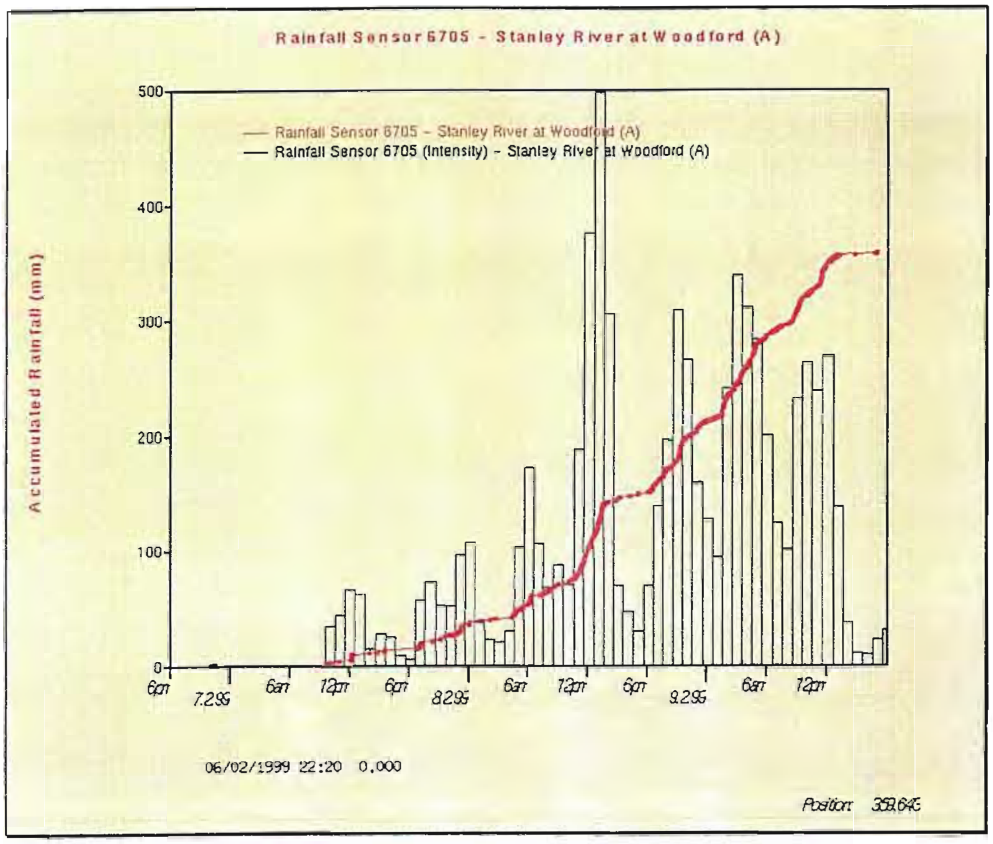
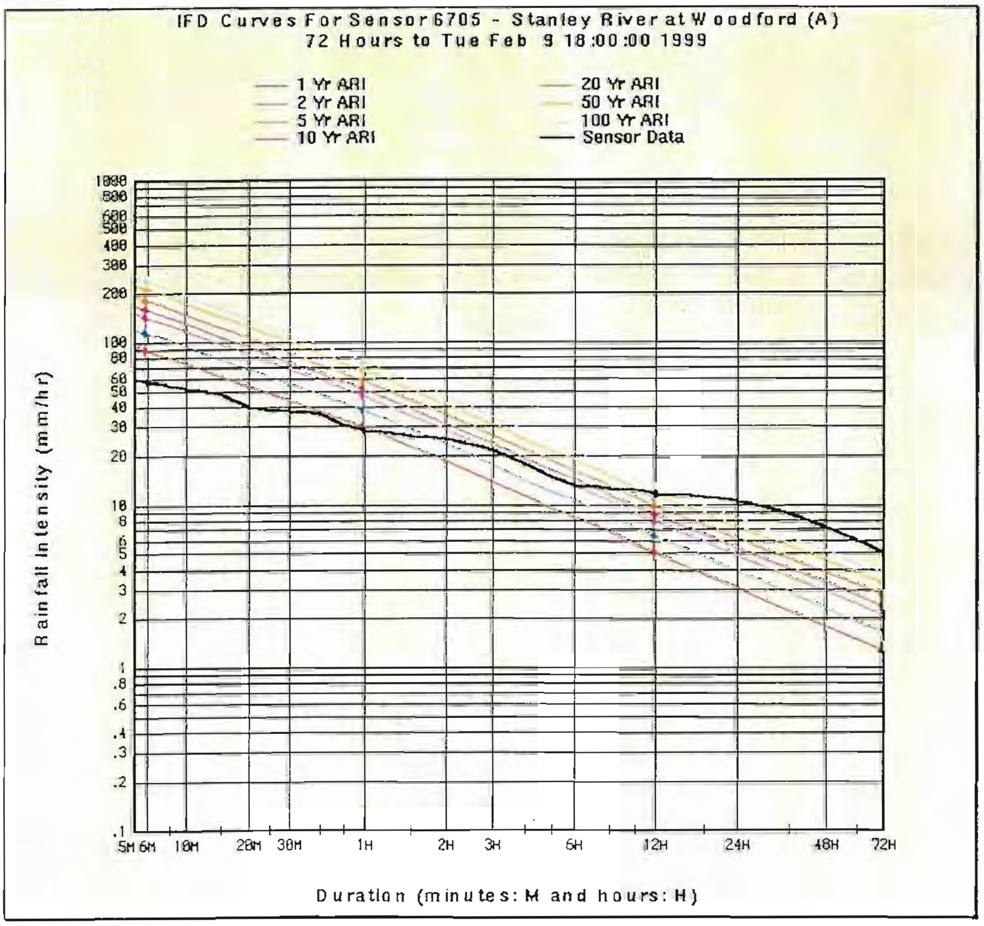


Somerset Catchment - Rainfall Sensor 6705 - Stanley River at Woodford (A)



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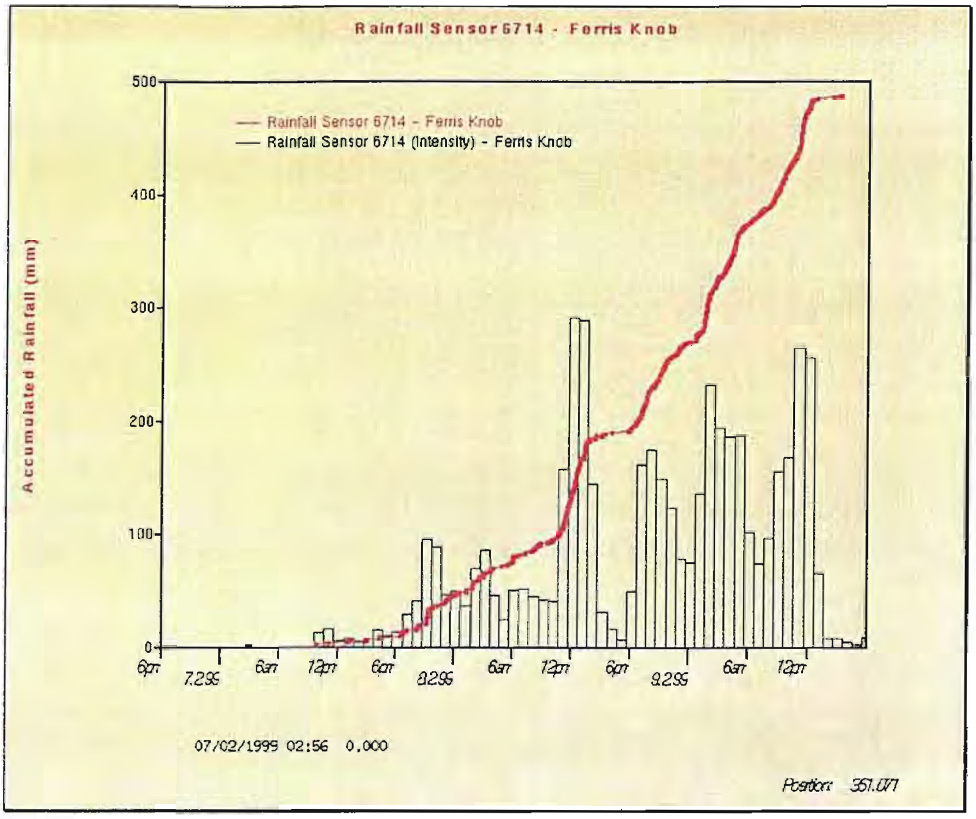
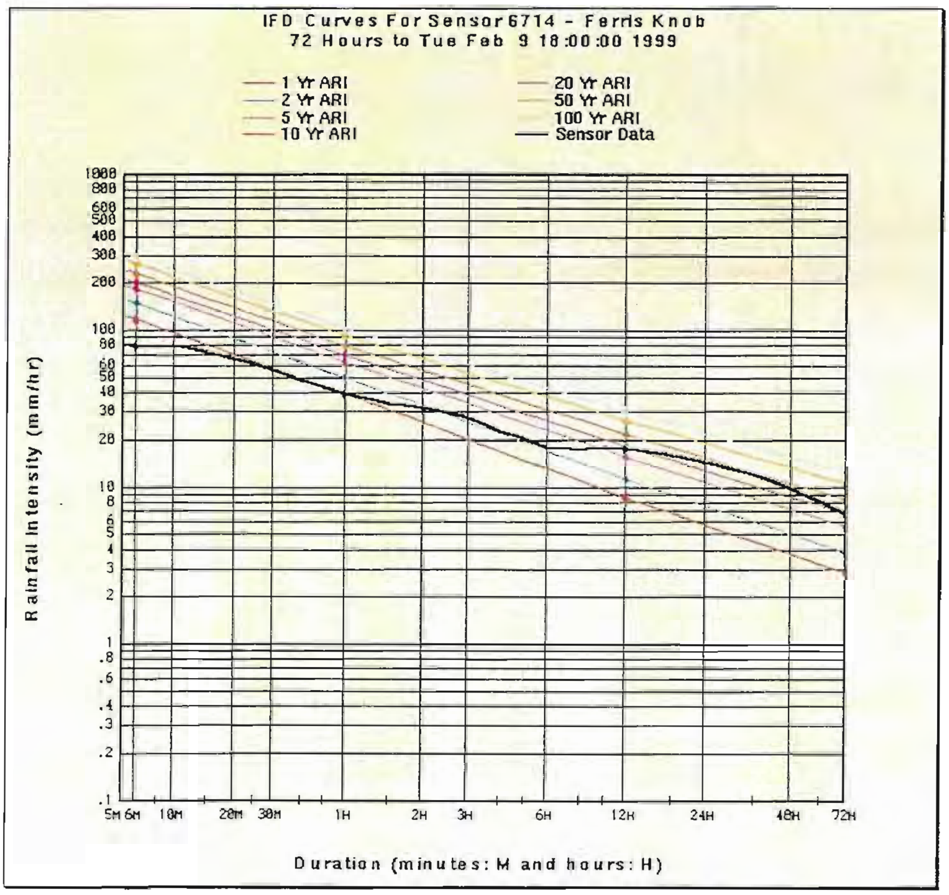


Somerset Catchment - Rainfall Sensor 6714 - Ferris Knob



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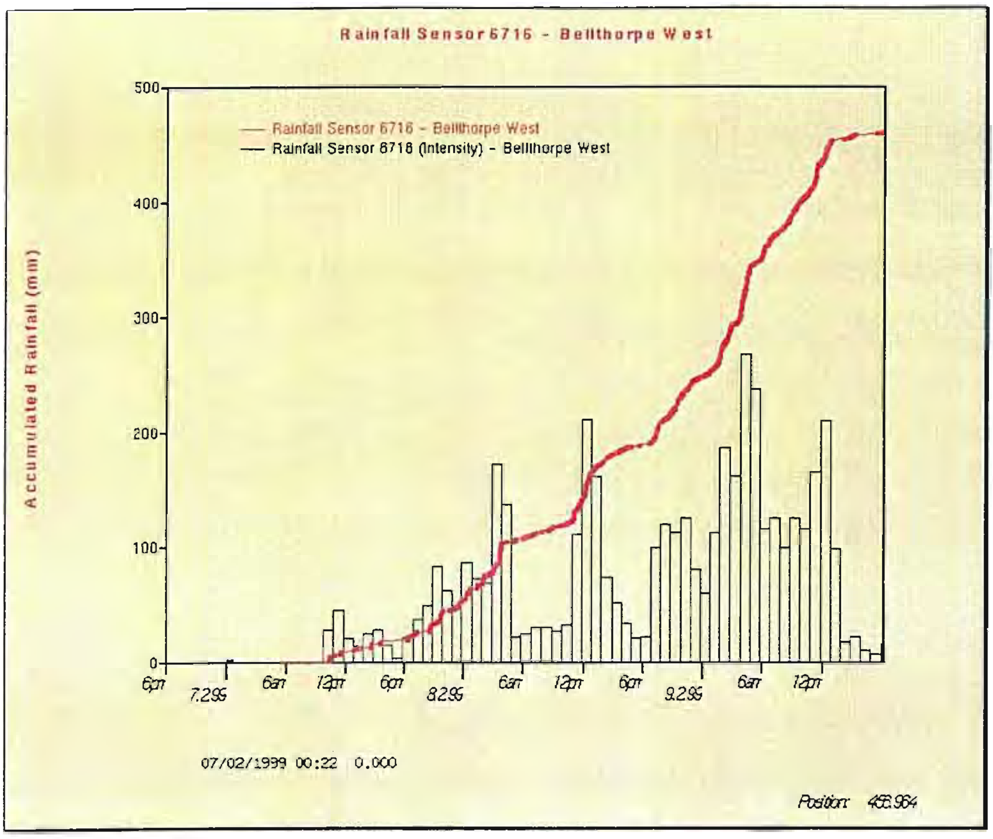
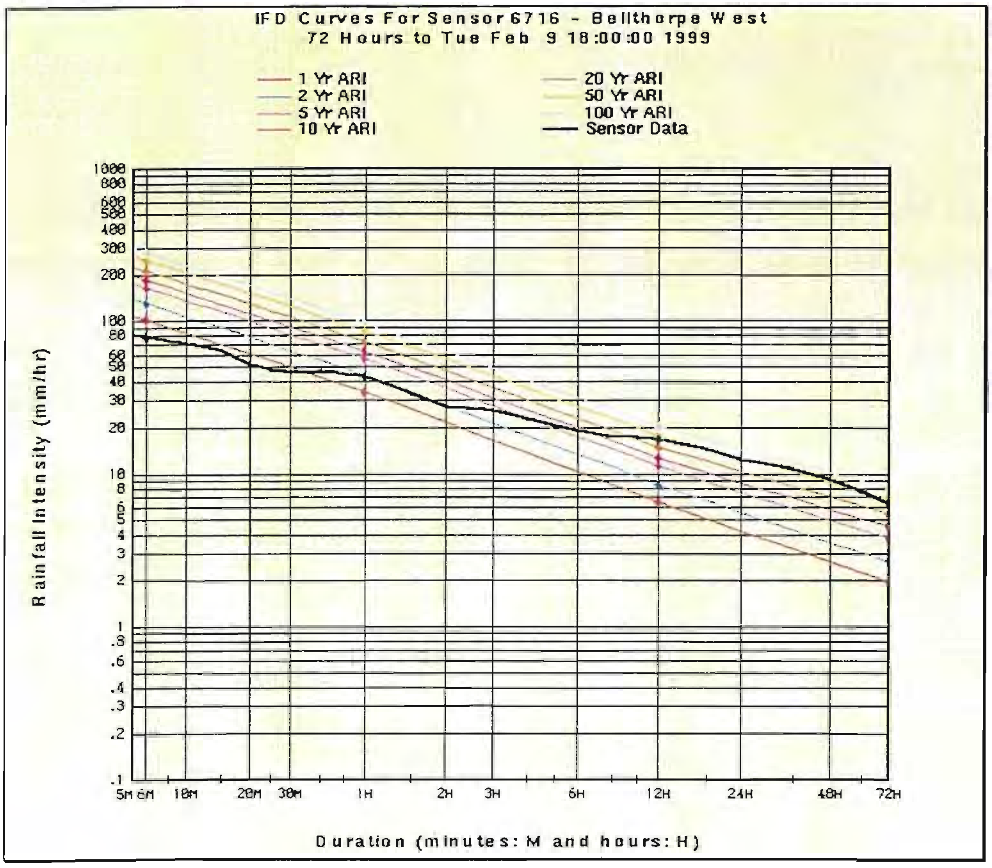
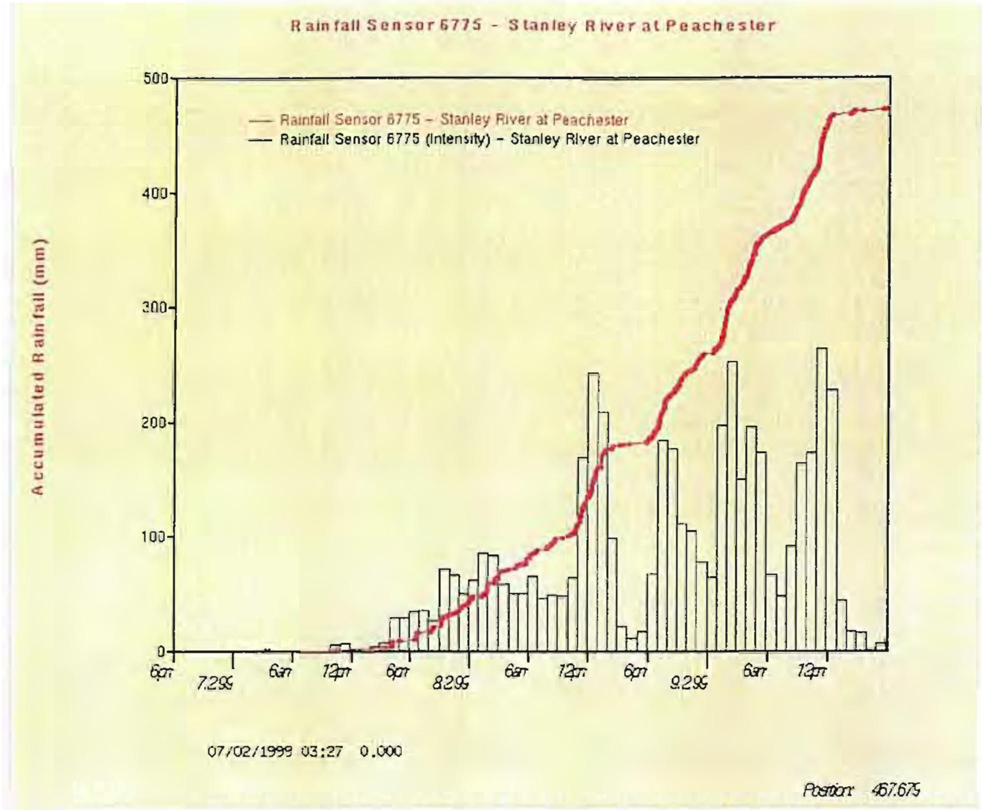


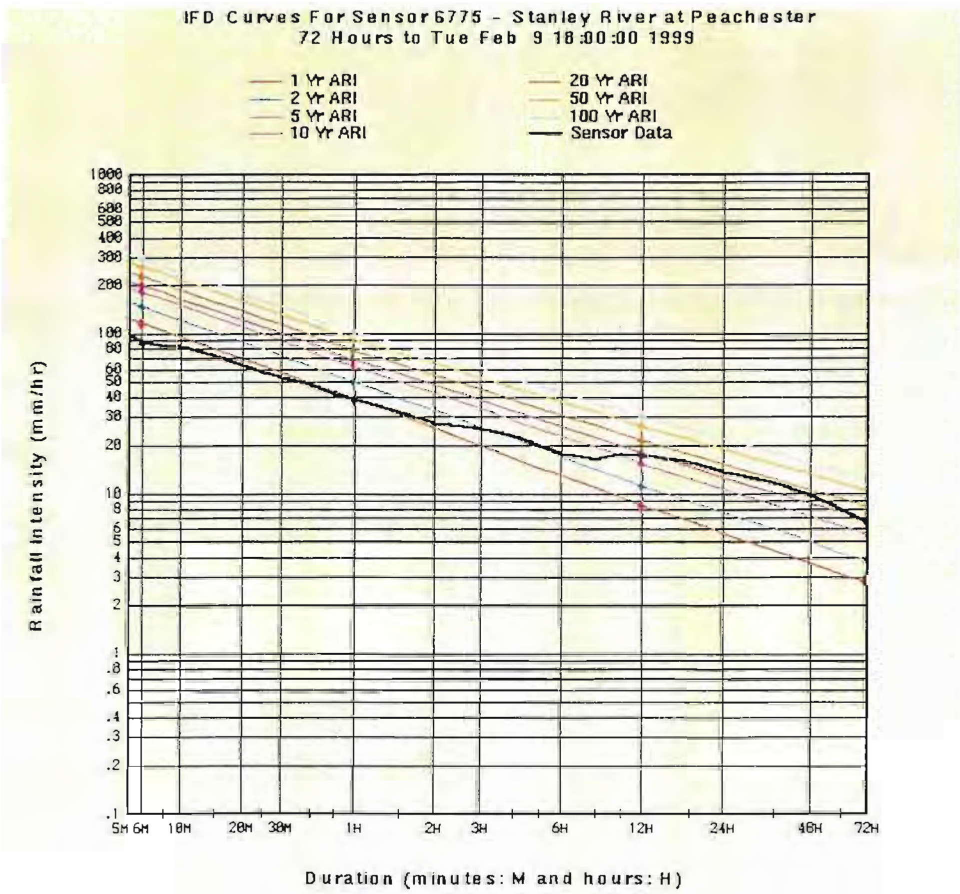
Somerset Catchment - Rainfall Sensor 6716 - Bellthorpe West



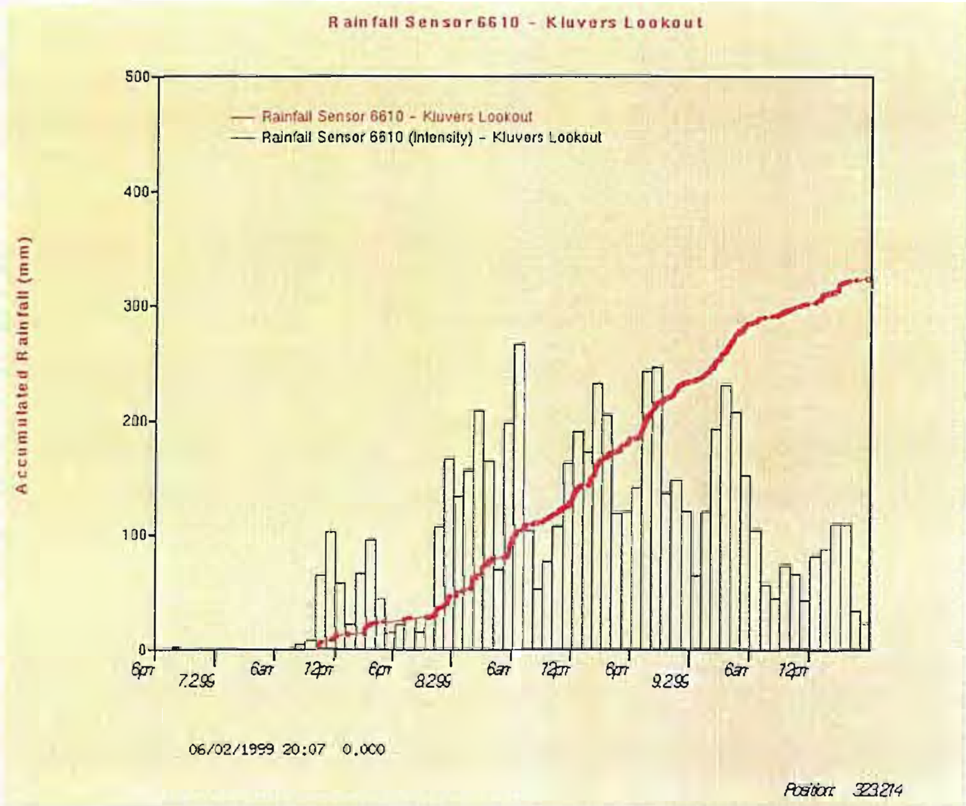
Cumulative Rainfalls & IFD Curves for February 1999 Event



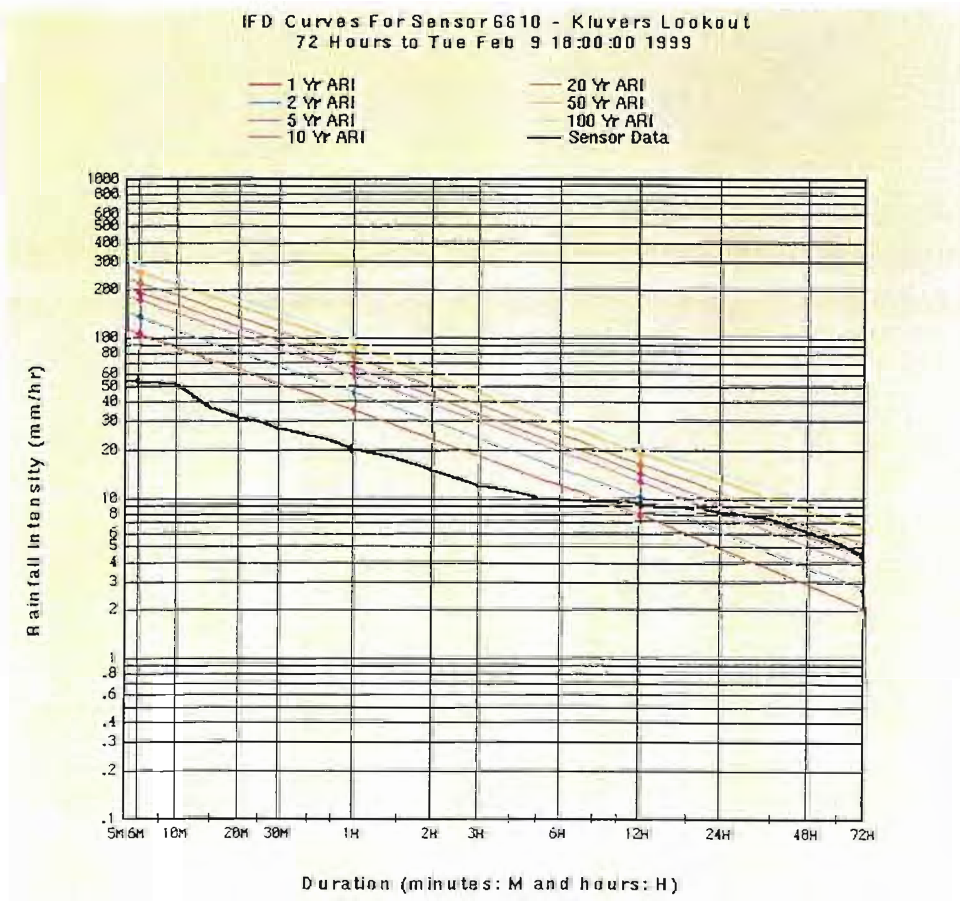
Somerset Catchment - Rainfall Sensor 6775- Stanley River at Peachester



APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event

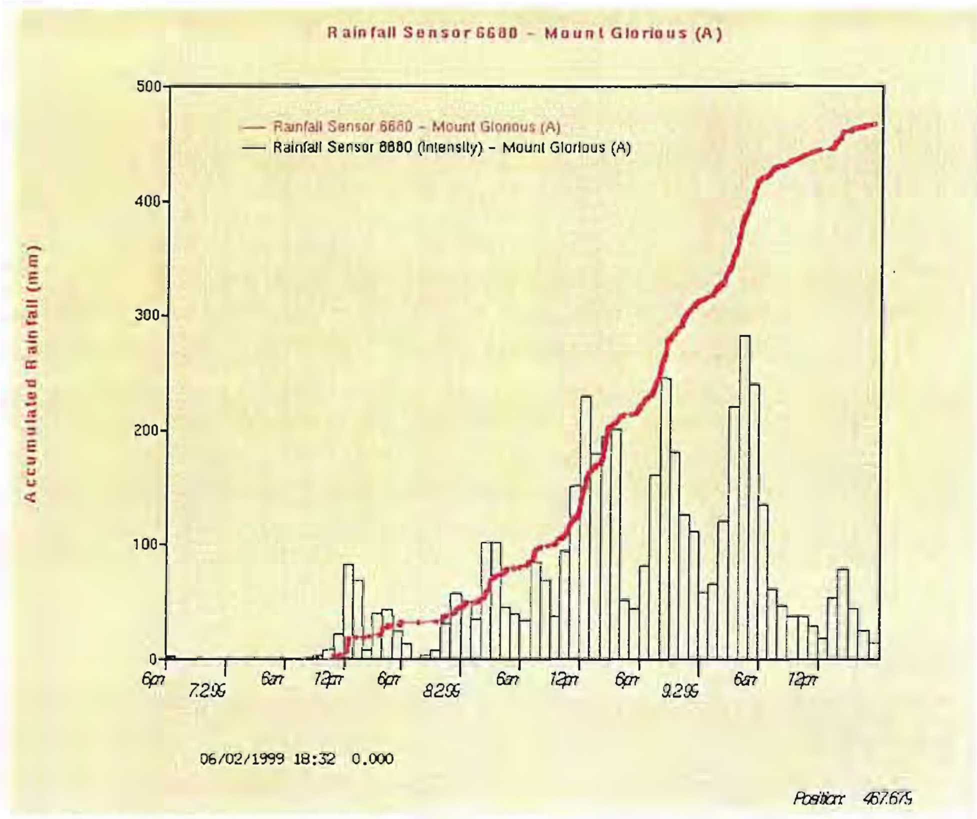


Pine Catchment - Rainfall Sensor 6610 - Kluvers Lookout

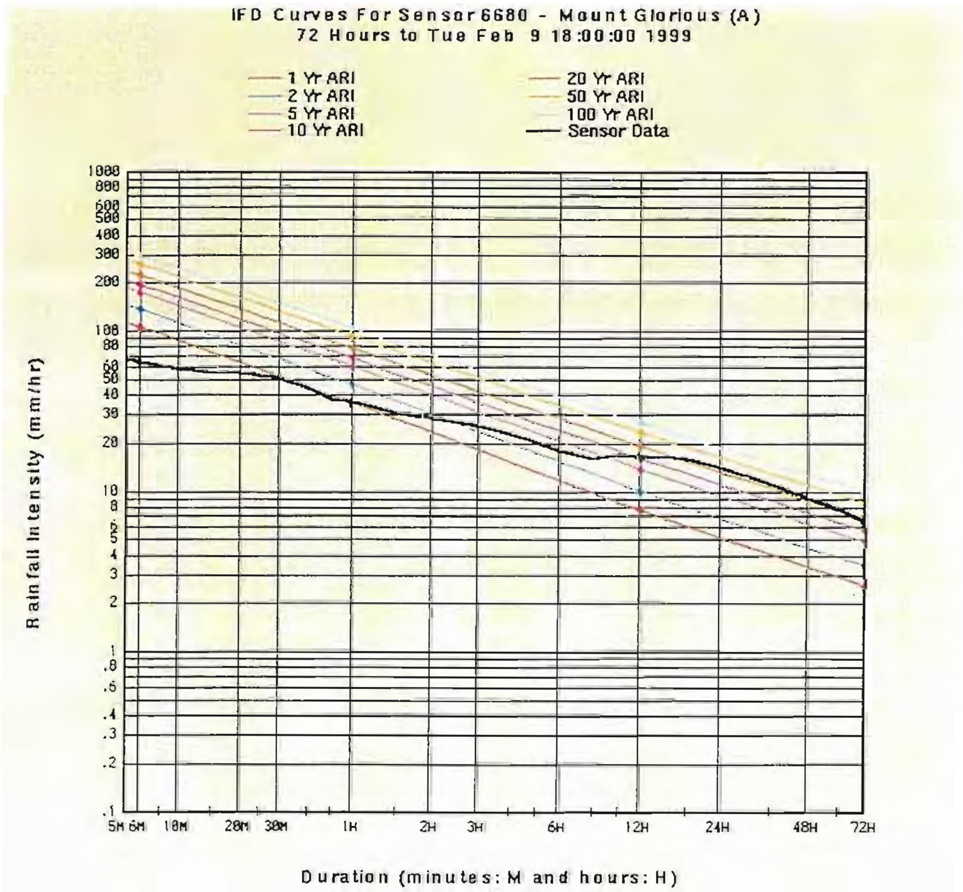


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

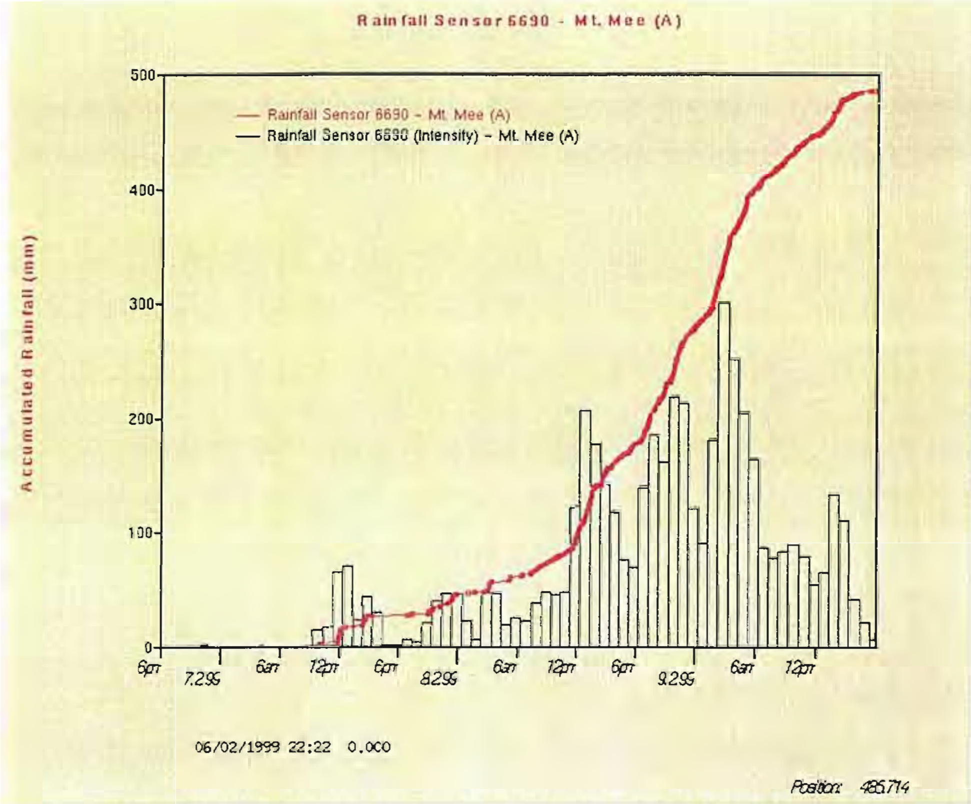


Pine Catchment - Rainfall Sensor 6680 - Mount Glorious

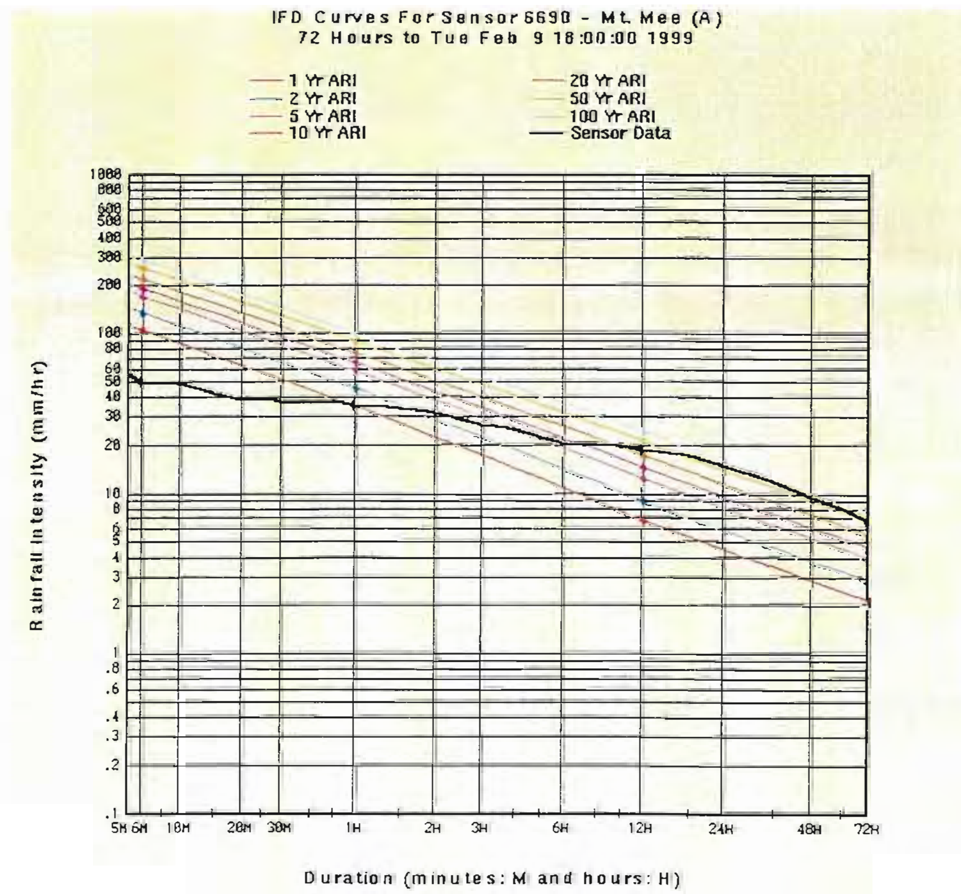


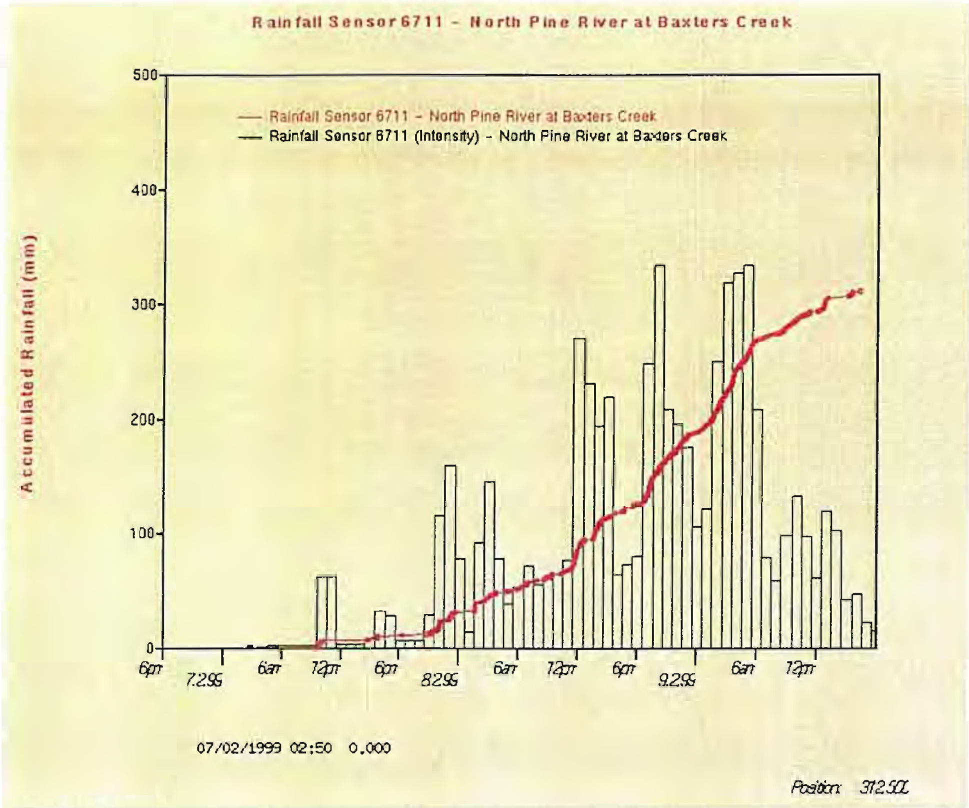
APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

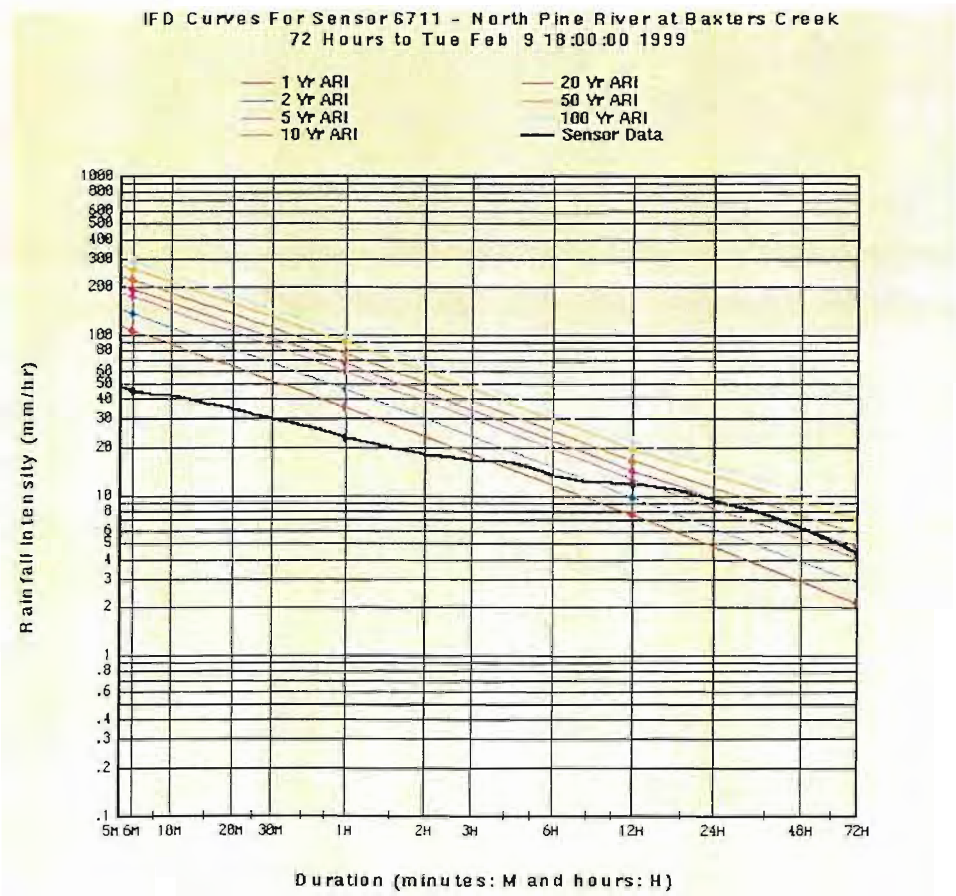


Pine Catchment - Rainfall Sensor 6690 - Mount Mee

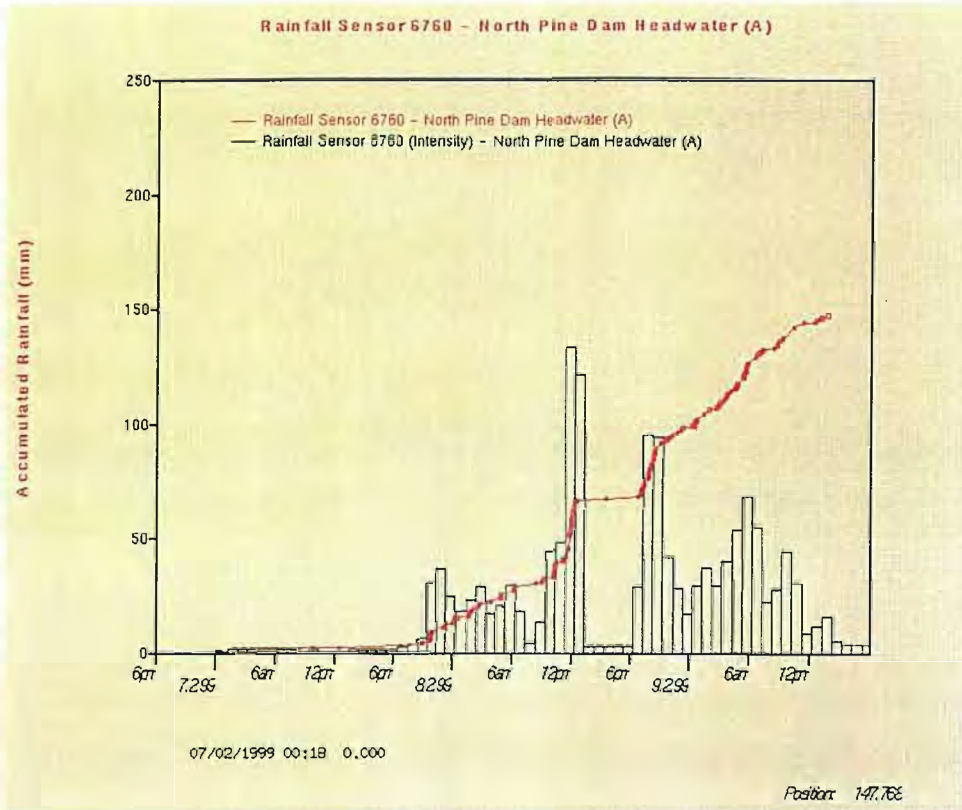




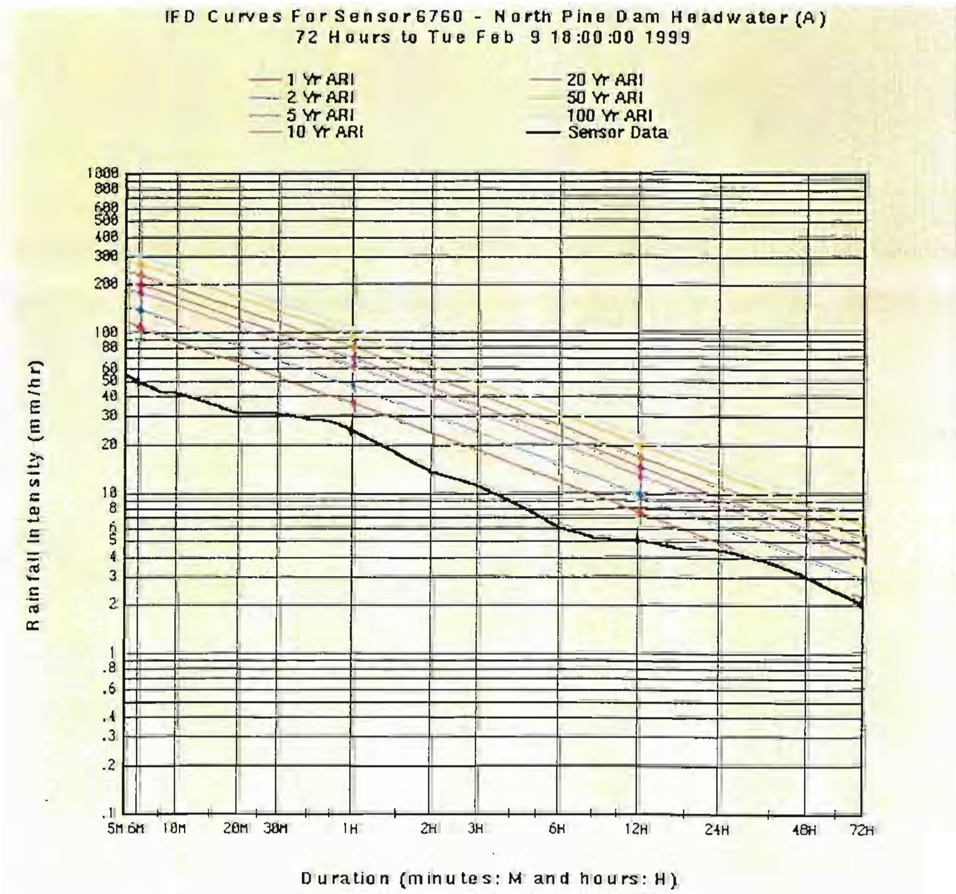
Pine Catchment - Rainfall Sensor 6711 - North Pine River at Baxters Creek



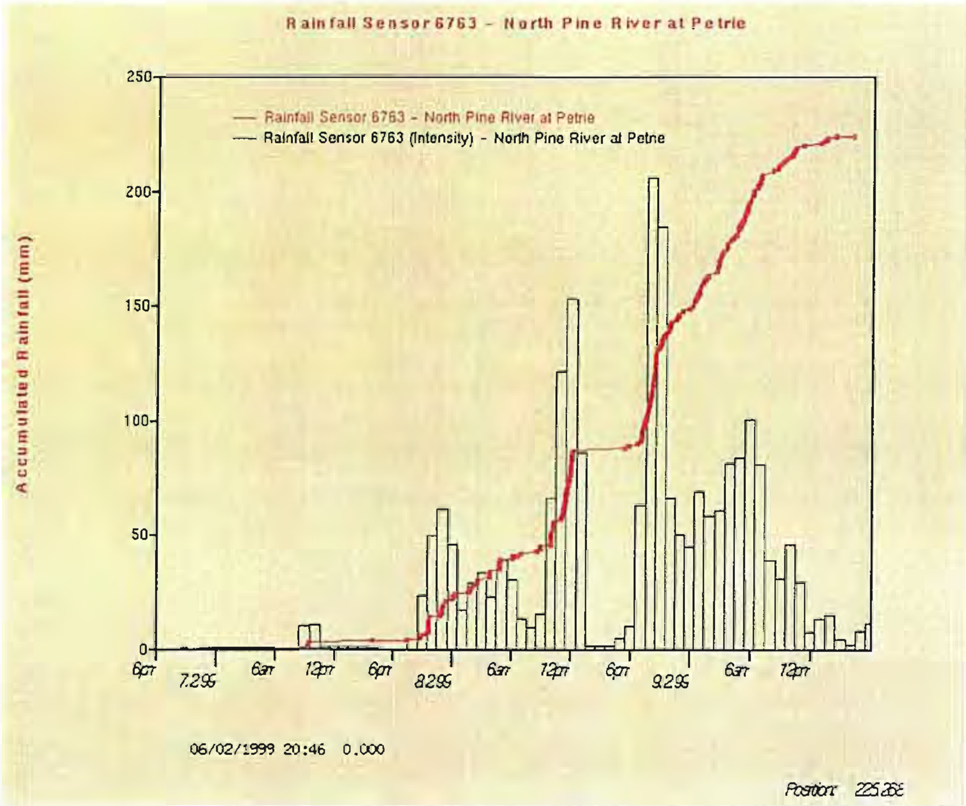
APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



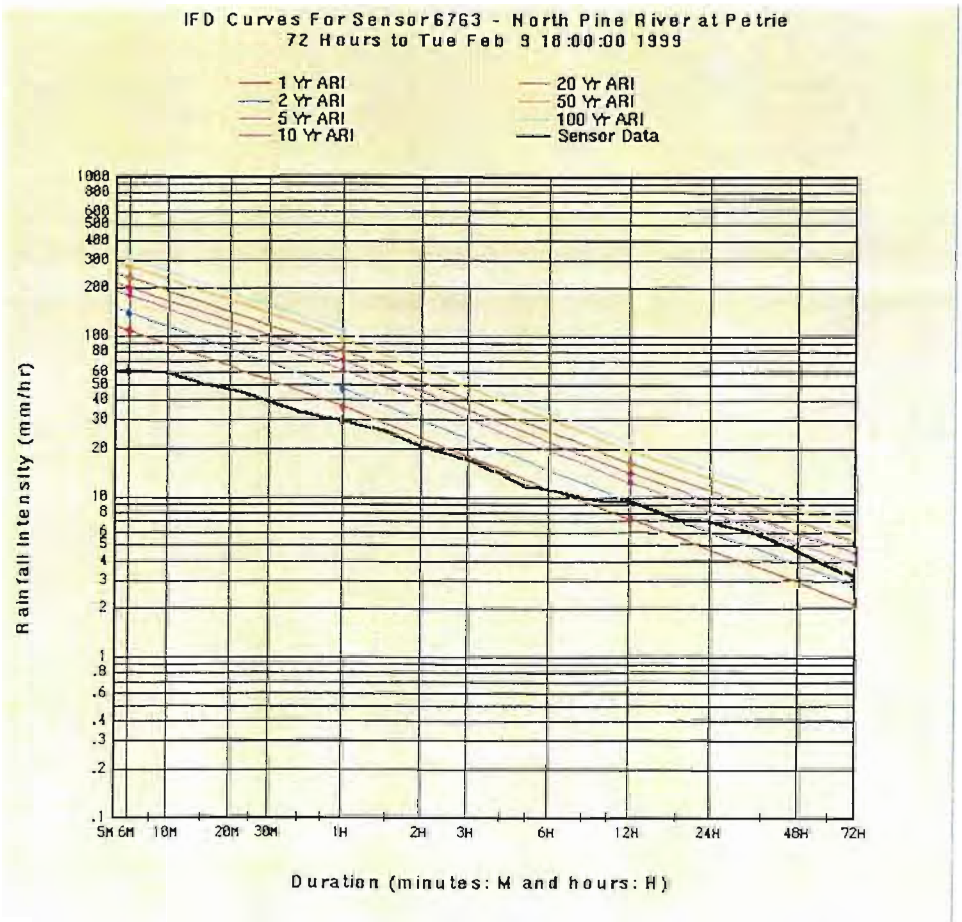
Pine Catchment - Rainfall Sensor 6760 - North Pine Dam Headwater



<u>APPENDIX B</u>
Cumulative Rainfalls & IFD Curves for February 1999 Event

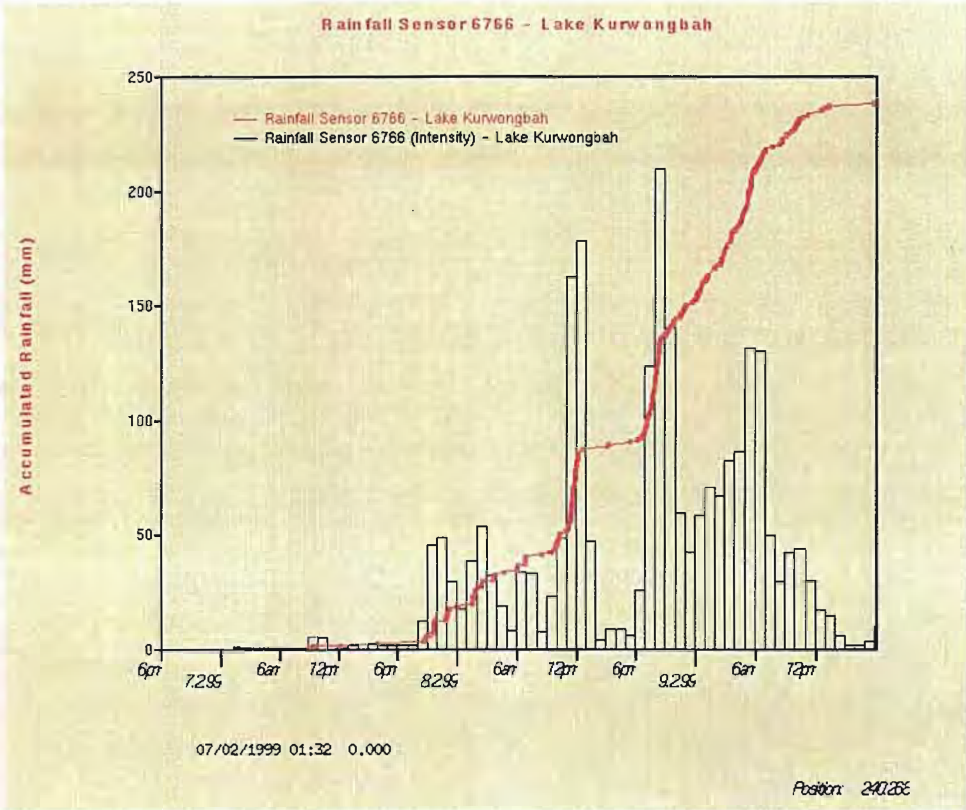


Pine Catchment - Rainfall Sensor 6763 - North Pine River at Petrie

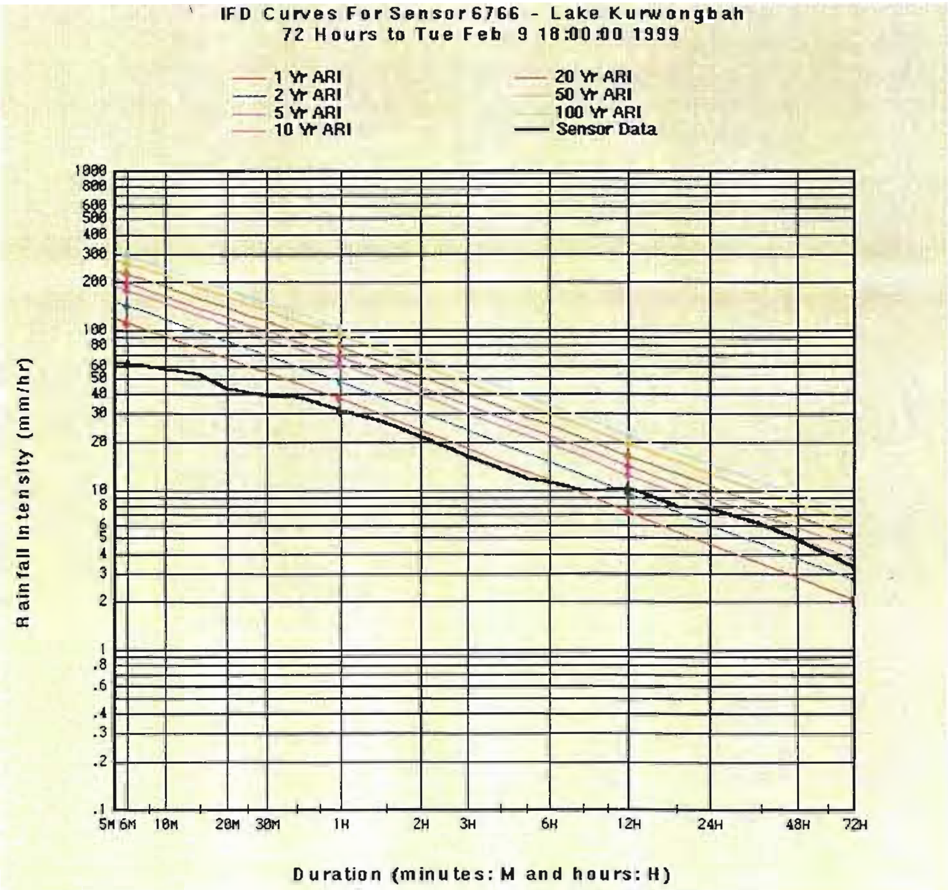


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

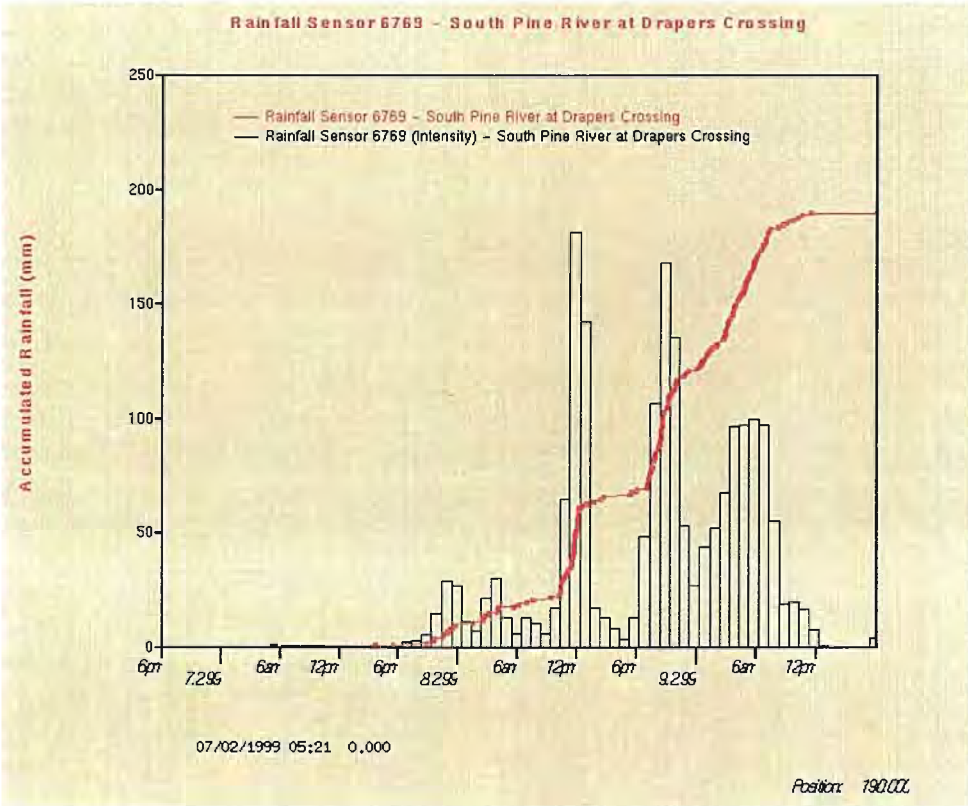


Pine Catchment - Rainfall Sensor 6766 - Lake Kurwongbah

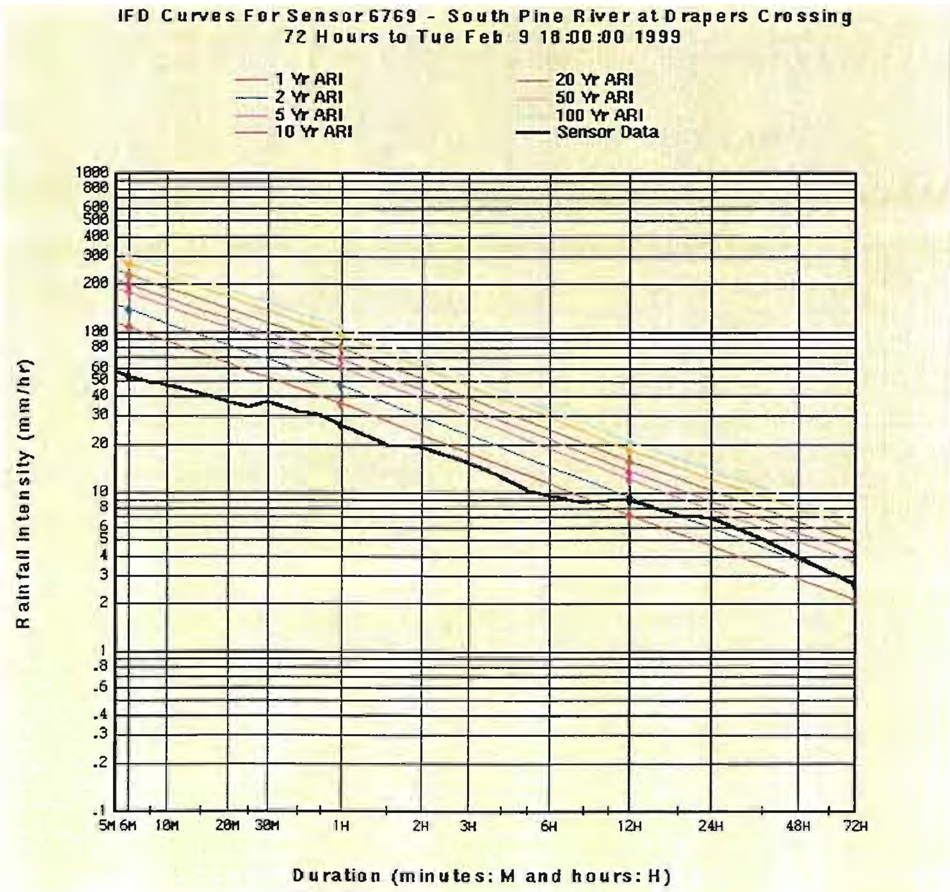


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

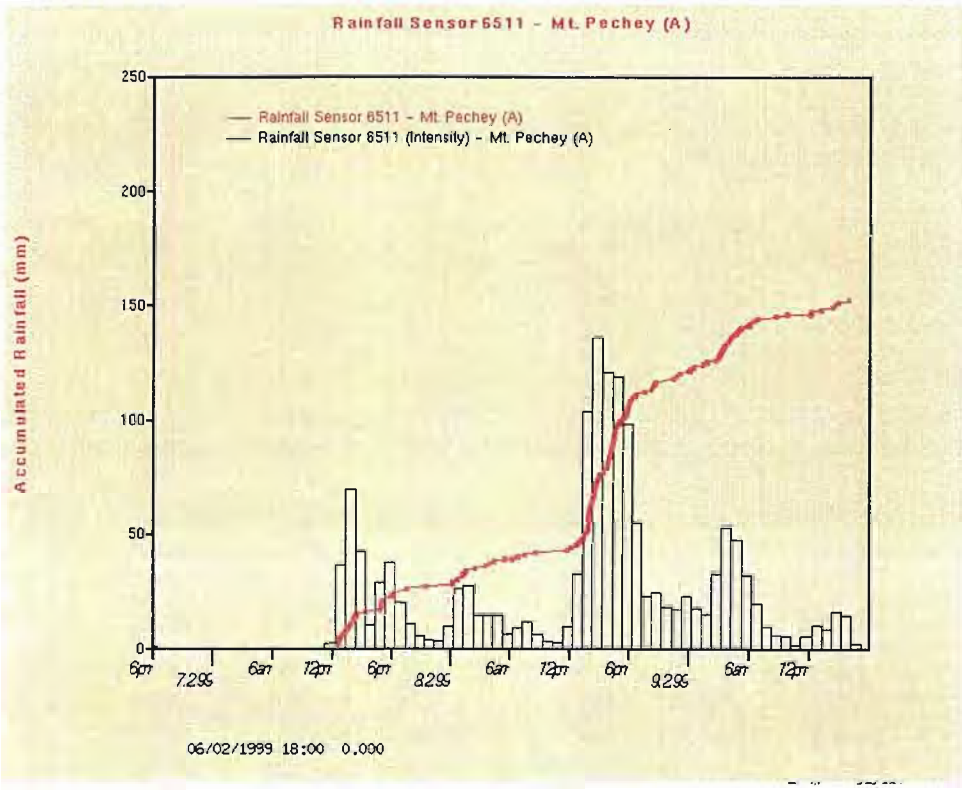


Pine Catchment - Rainfall Sensor 6769 - South Pine River at Drapers Crossing

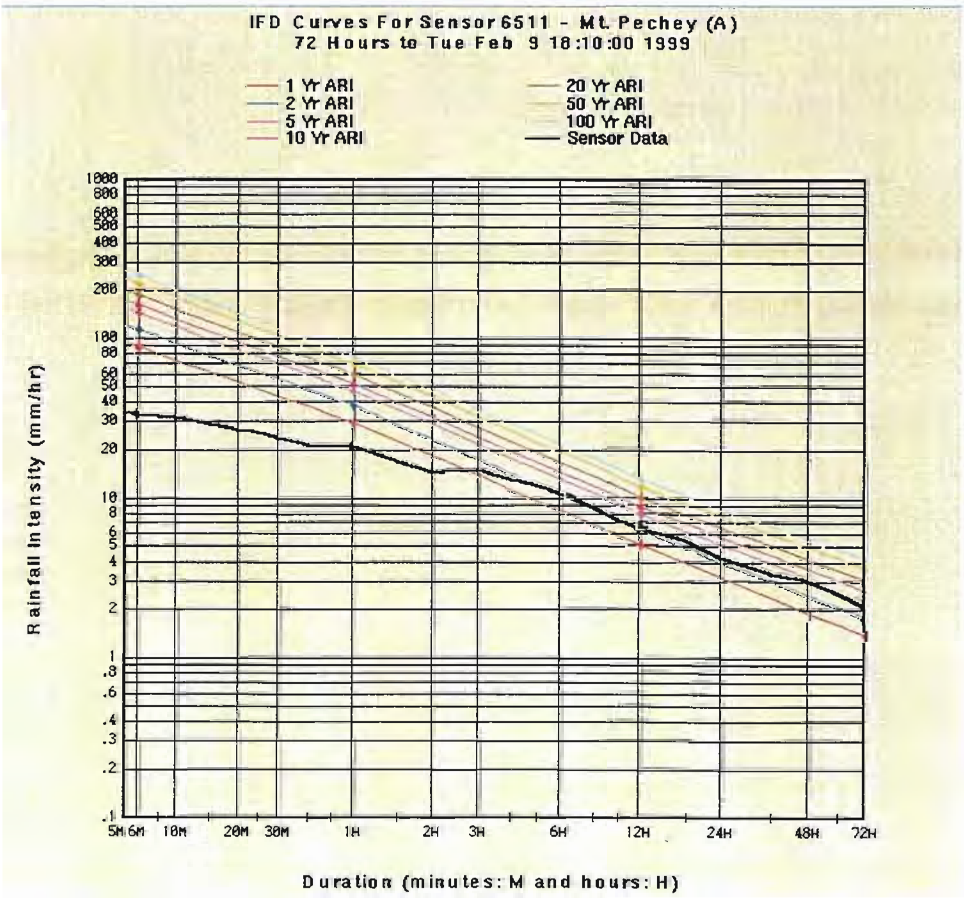


APPENDIX B

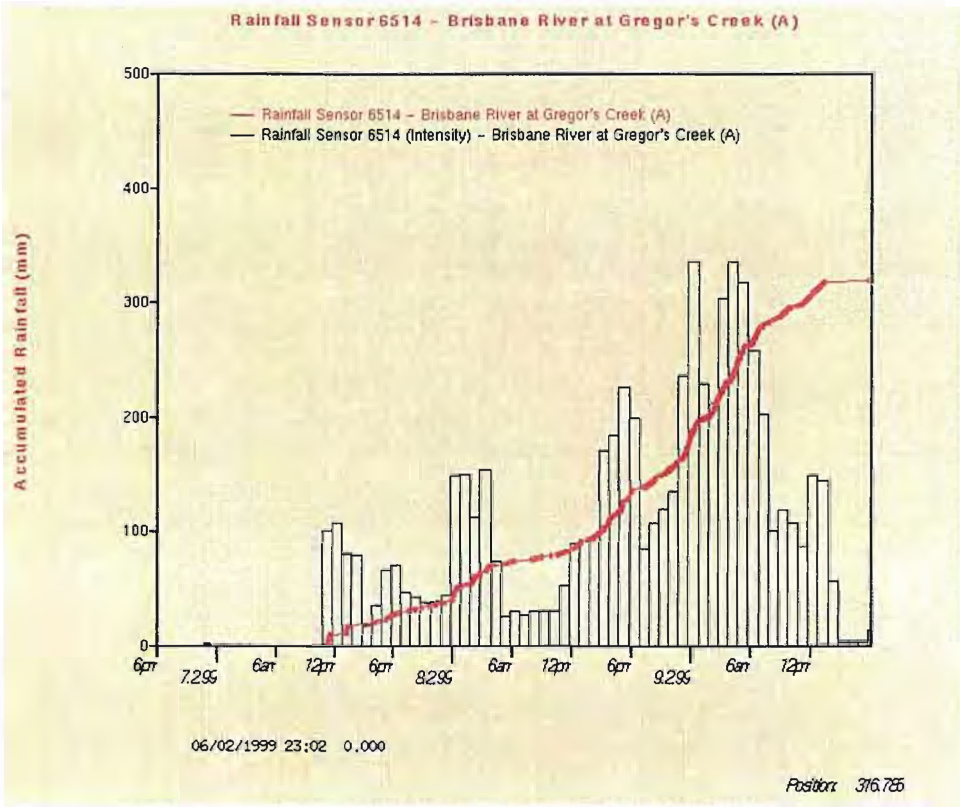
Cumulative Rainfalls & IFD Curves for February 1999 Event



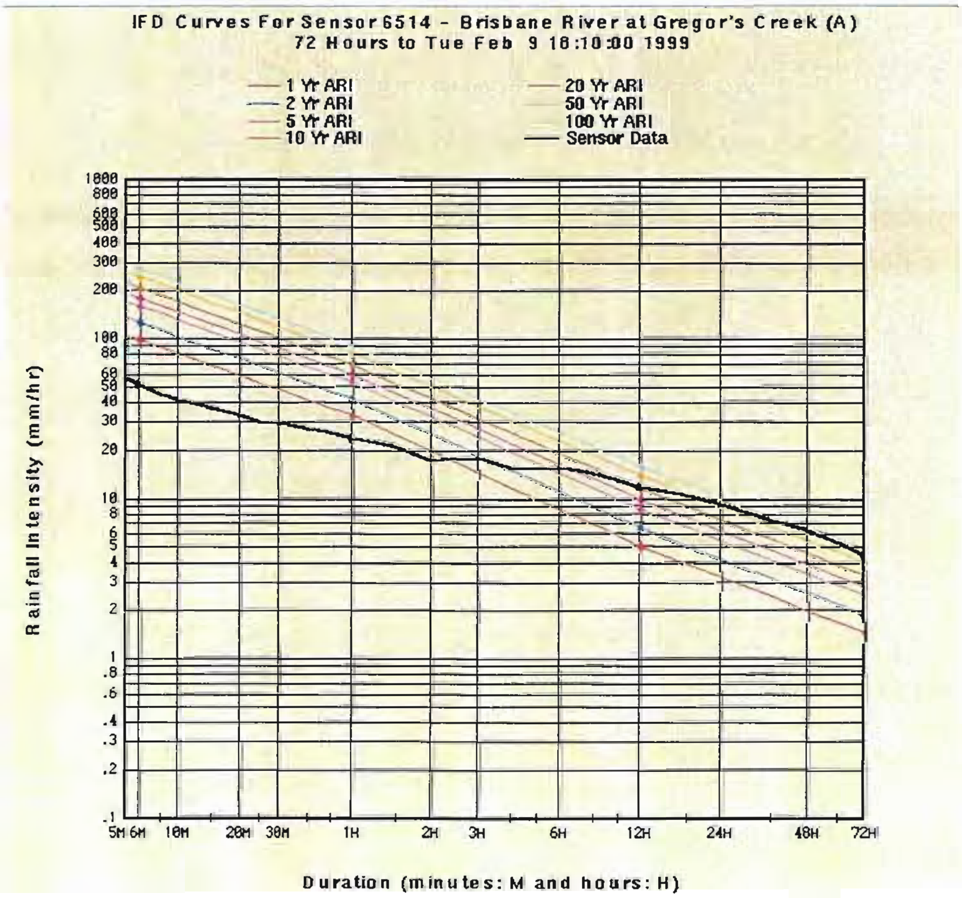
Upper Brisbane Catchment - Rainfall Sensor 6511 - Mount Pechey

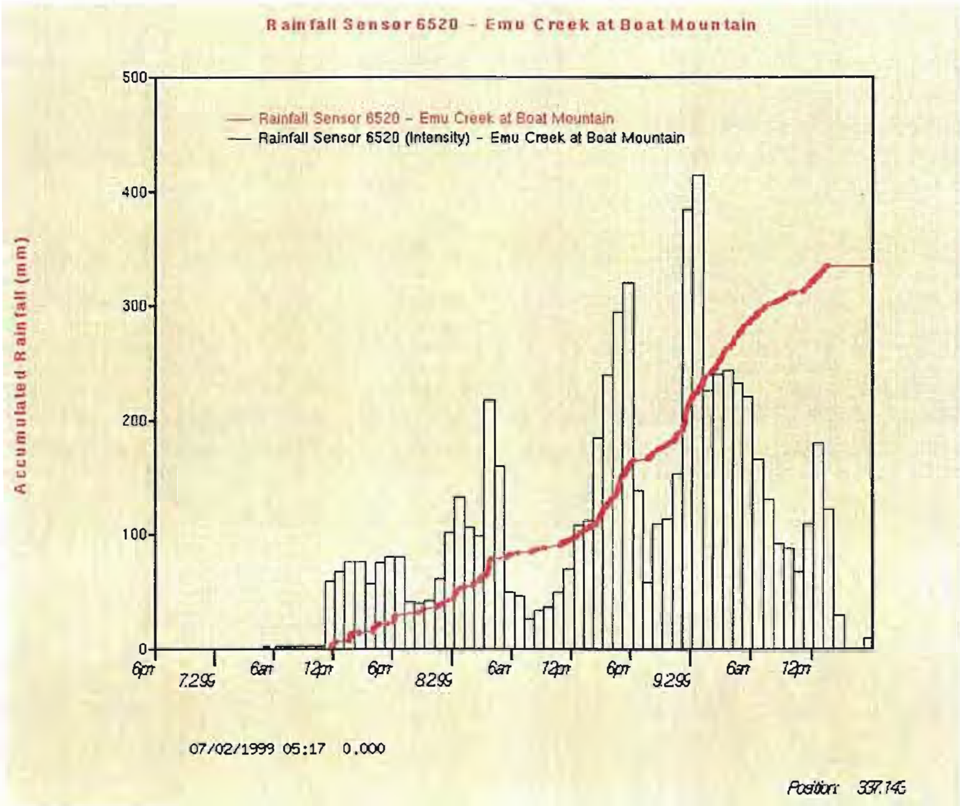


Cumulative Rainfalls & IFD Curves for February 1999 Event

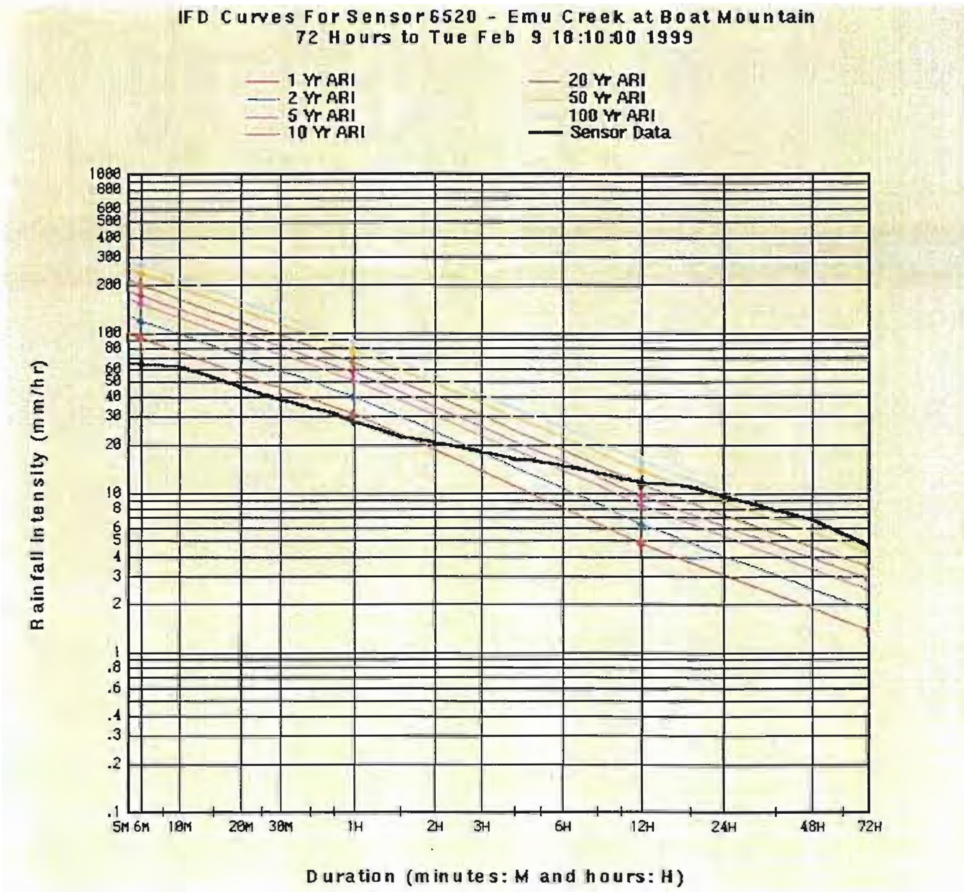


Upper Brisbane Catchment - Rainfall Sensor 6514 - Brisbane River at Gregor's Creek



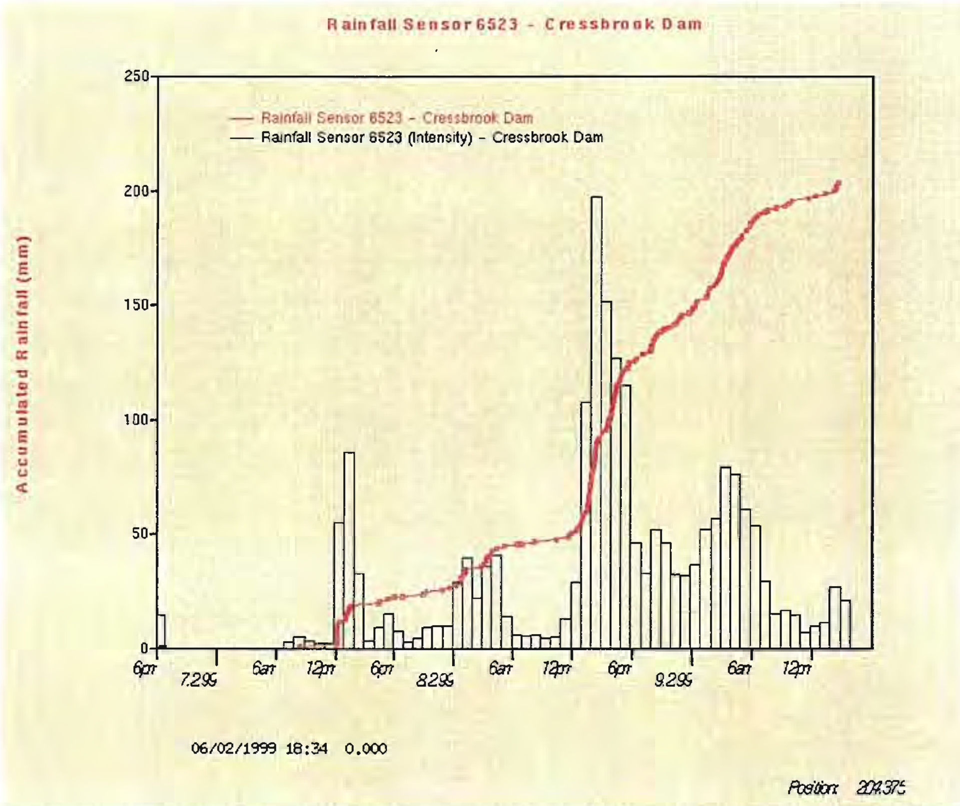


Upper Brisbane Catchment - Rainfall Sensor 6520 - Emu Creek at Boat Mountain

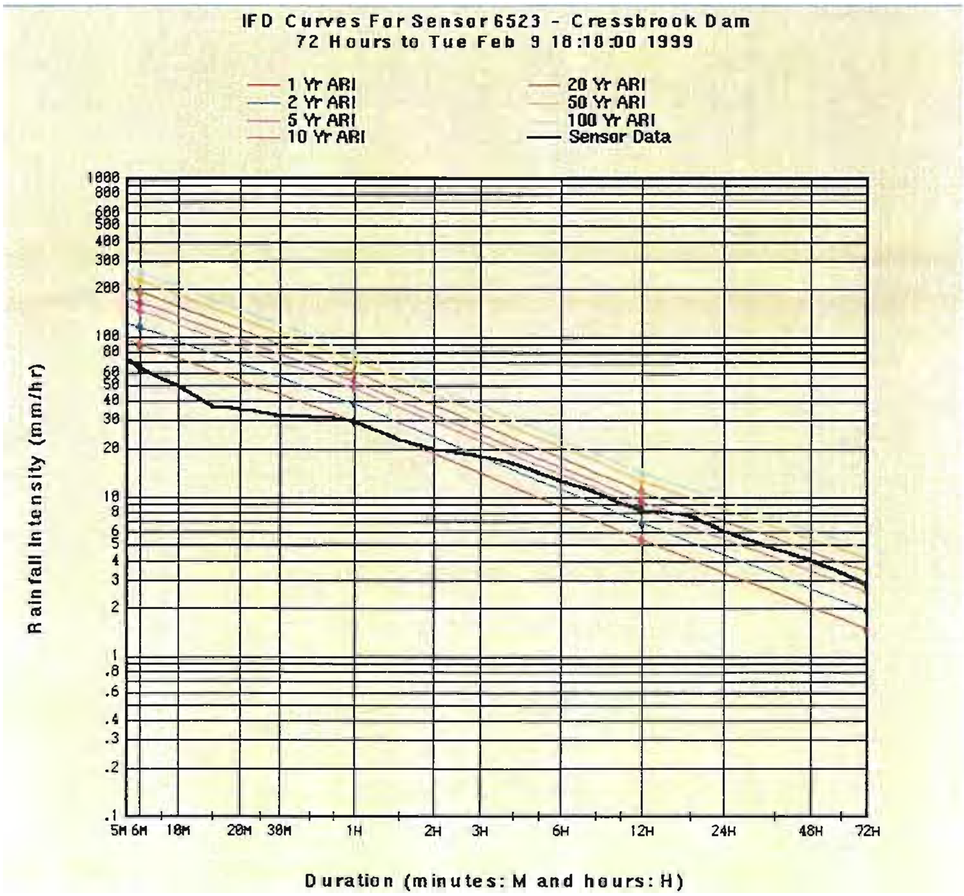


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

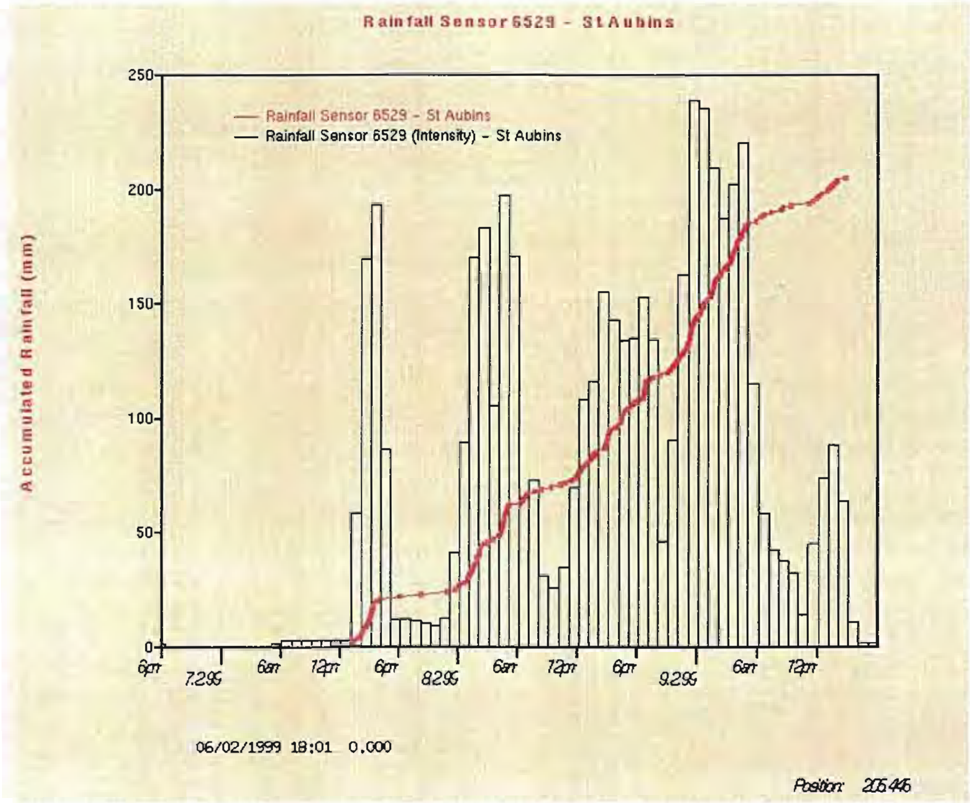


Upper Brisbane Catchment - Rainfall Sensor 6523 - Cressbrook Dam

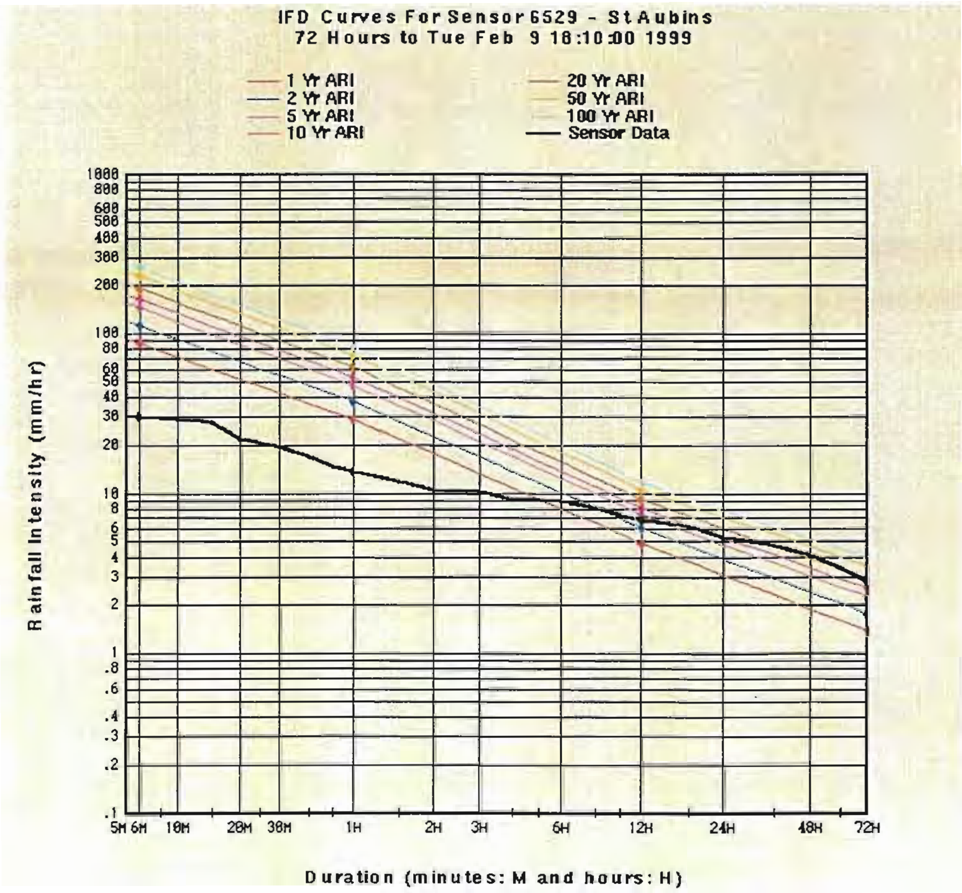


<u>APPENDIX B</u>

Cumulative Rainfalls & IFD Curves for February 1999 Event

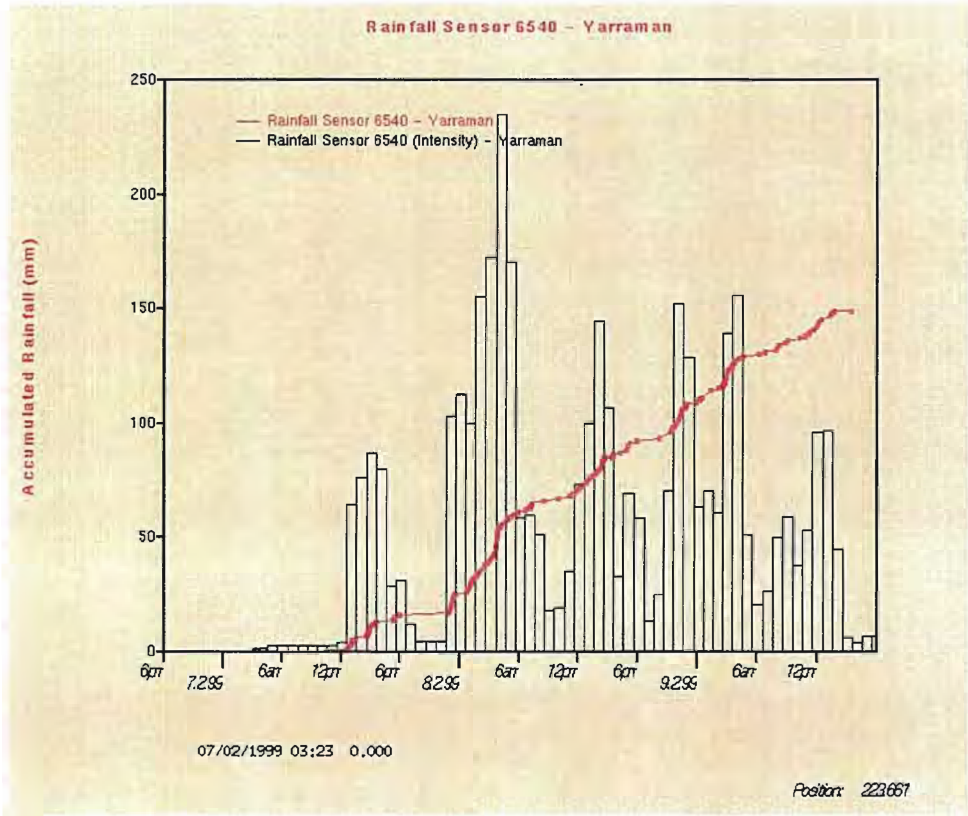


Upper Brisbane Catchment - Rainfall Sensor 6529 - St Aubins

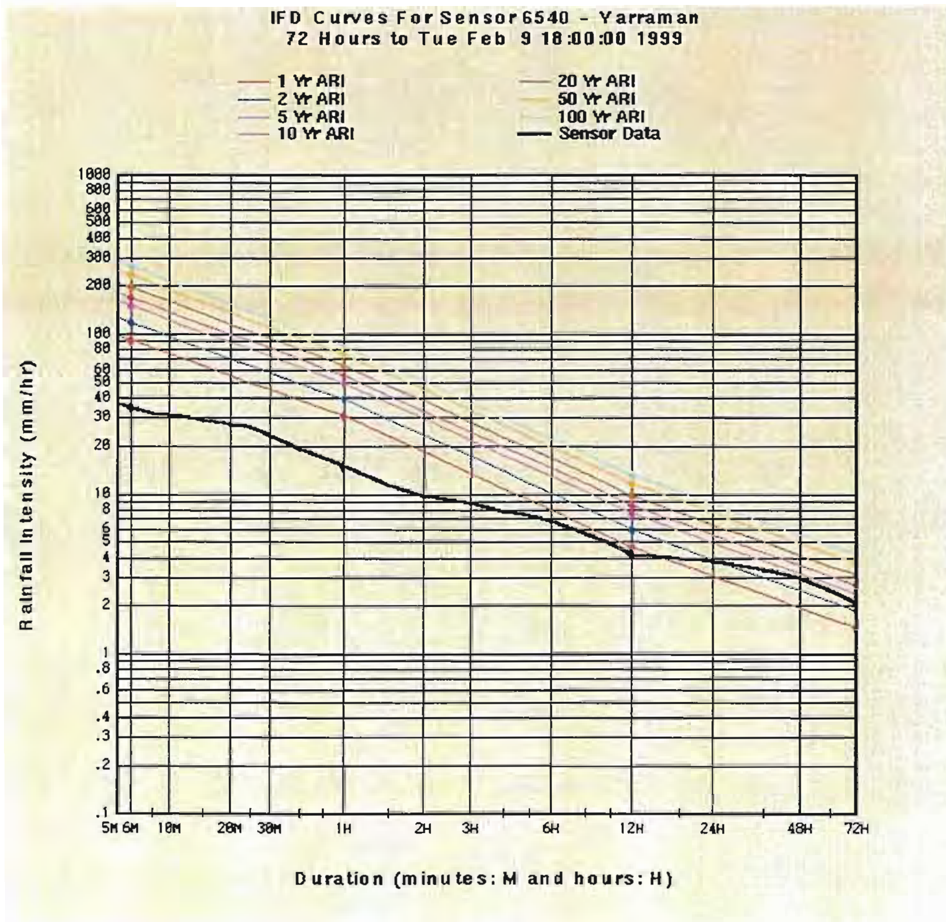


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

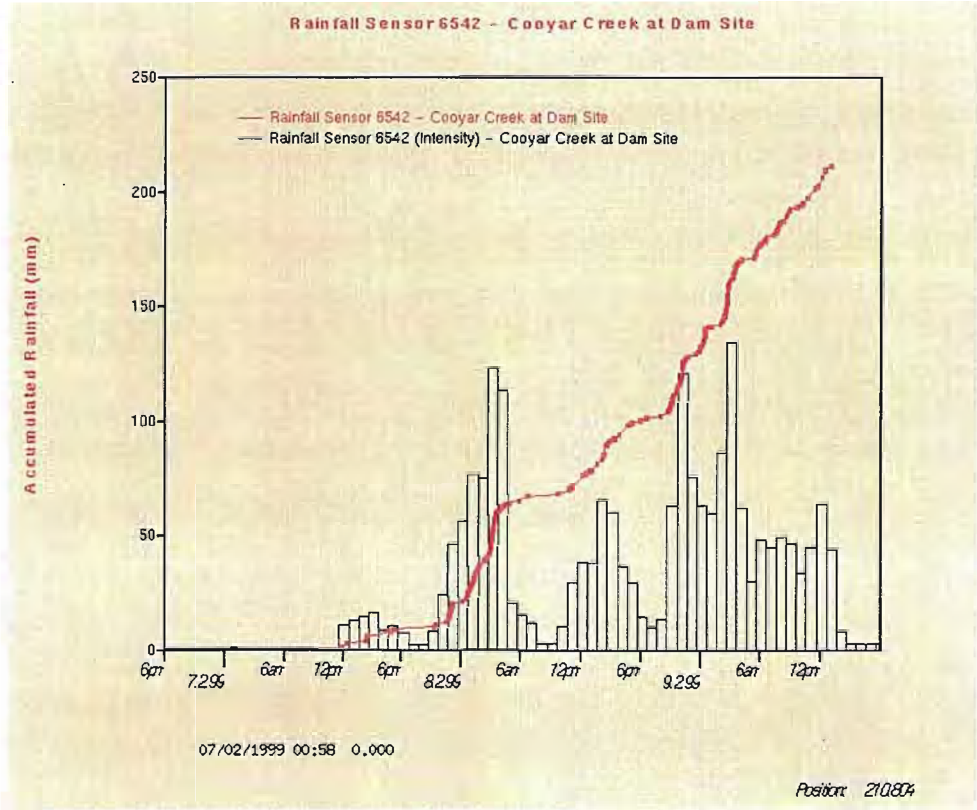


Upper Brisbane Catchment - Rainfall Sensor 6540 - Yarraman

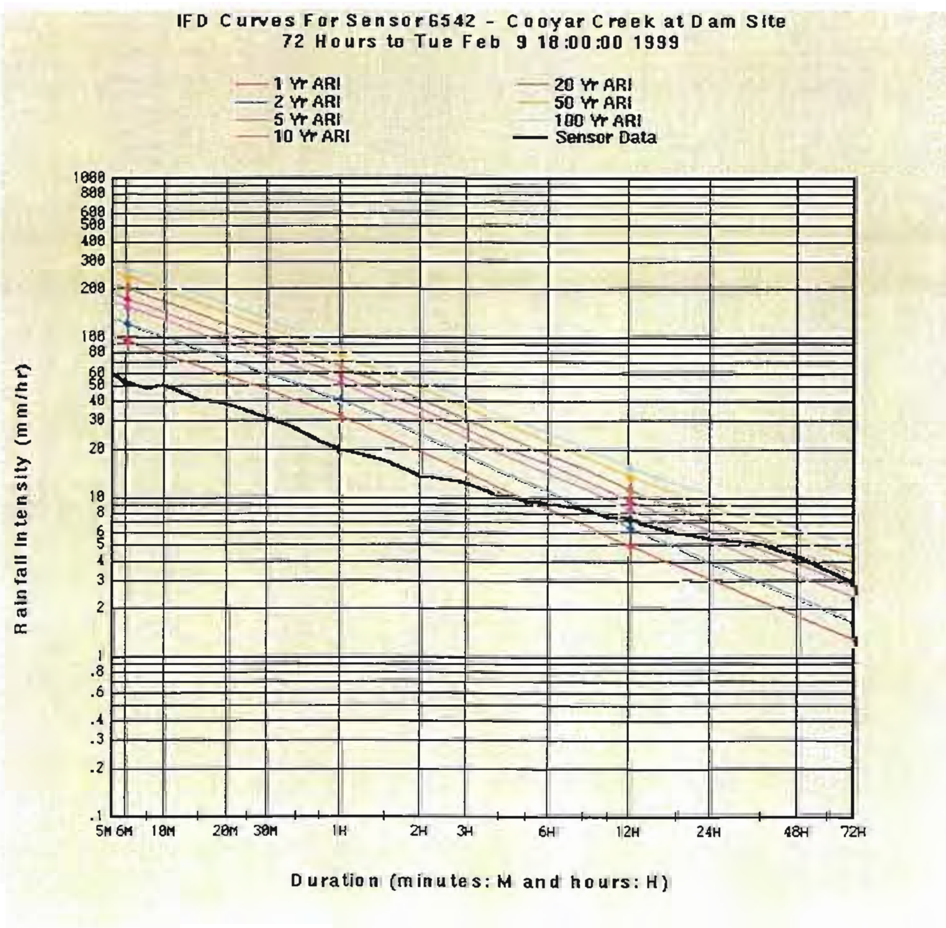


APPENDIX B

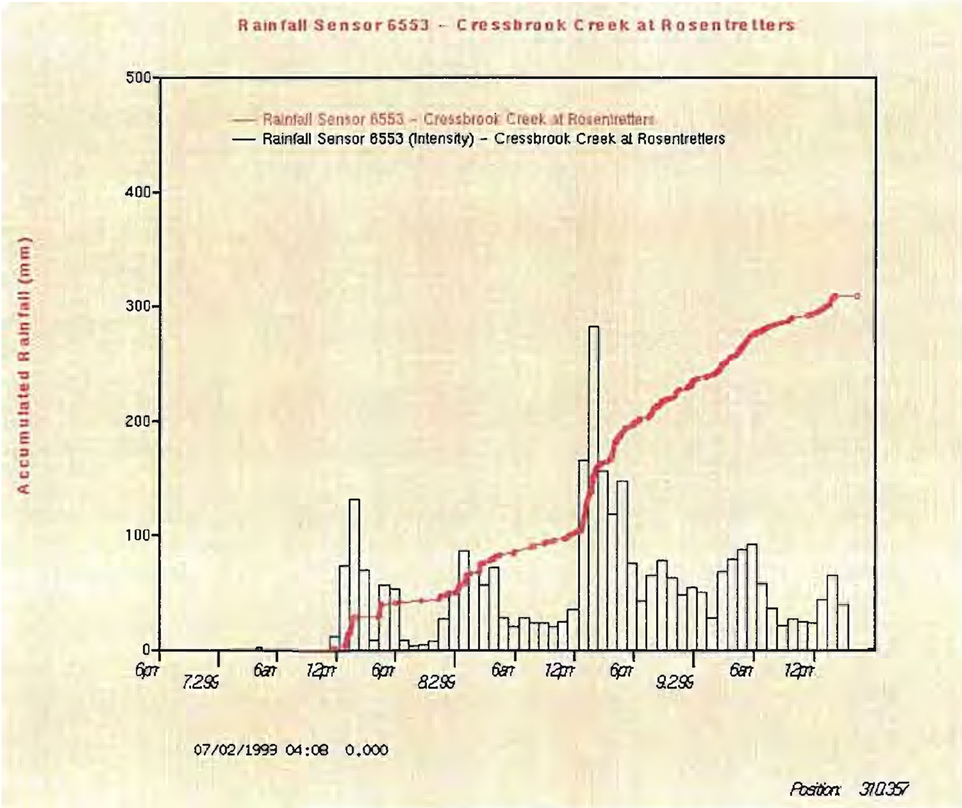
Cumulative Rainfalls & IFD Curves for February 1999 Event



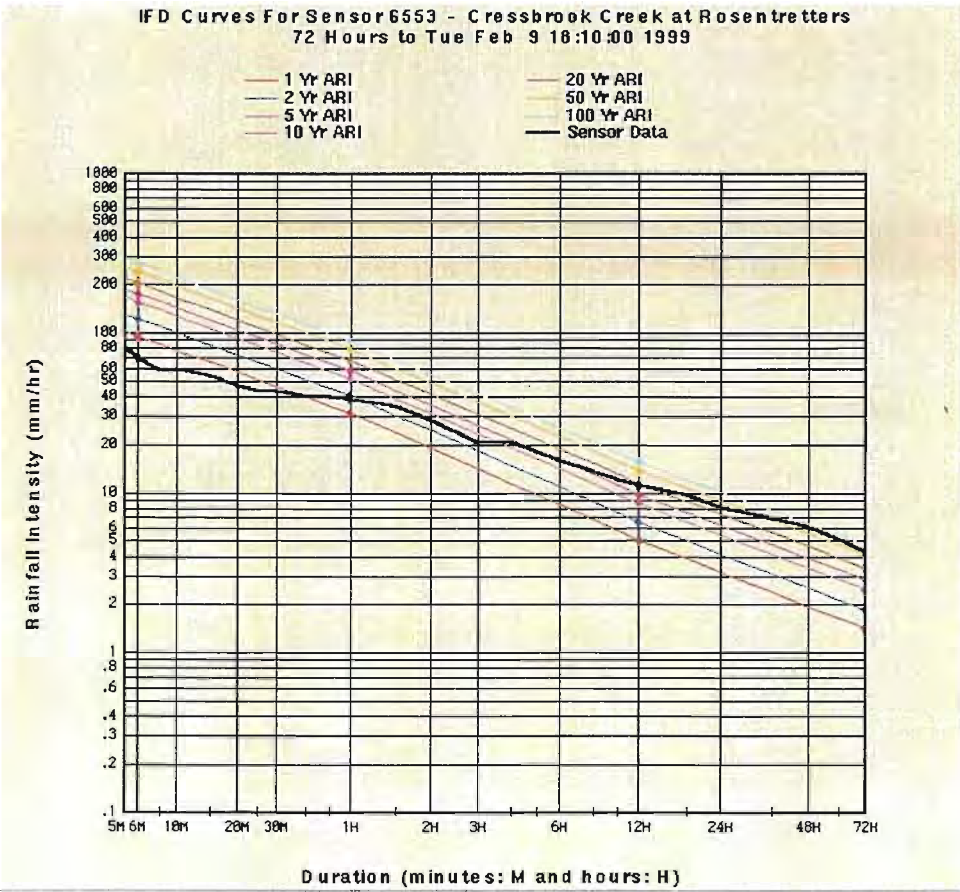
Upper Brisbane Catchment - Rainfall Sensor 6542 - Cooyar Creek at Dam Site



Cumulative Rainfalls & IFD Curves for February 1999 Event

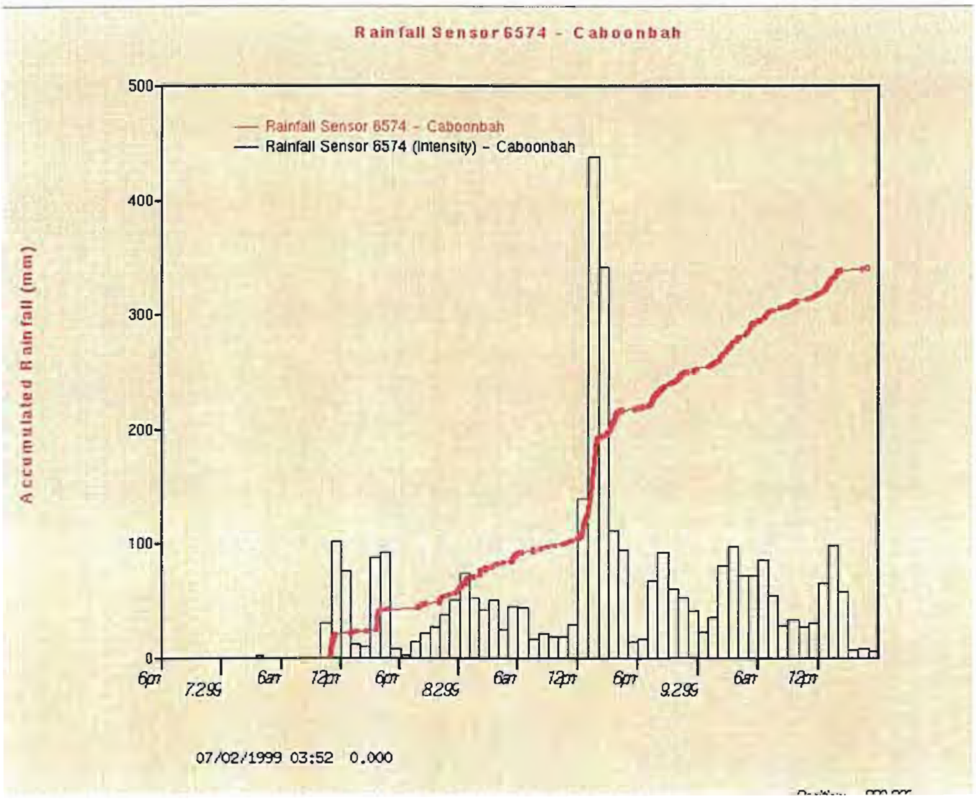


Upper Brisbane Catchment - Rainfall Sensor 6553 - Cressbrook Creek at Rosentretters

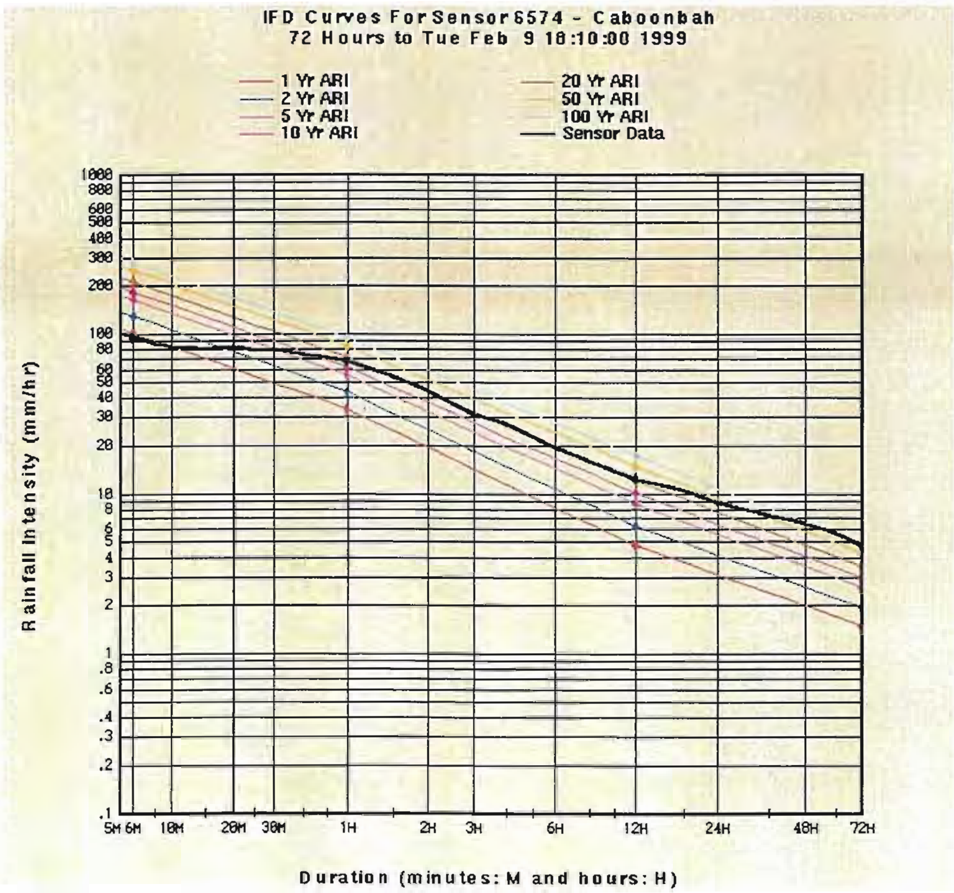


APPENDIX B

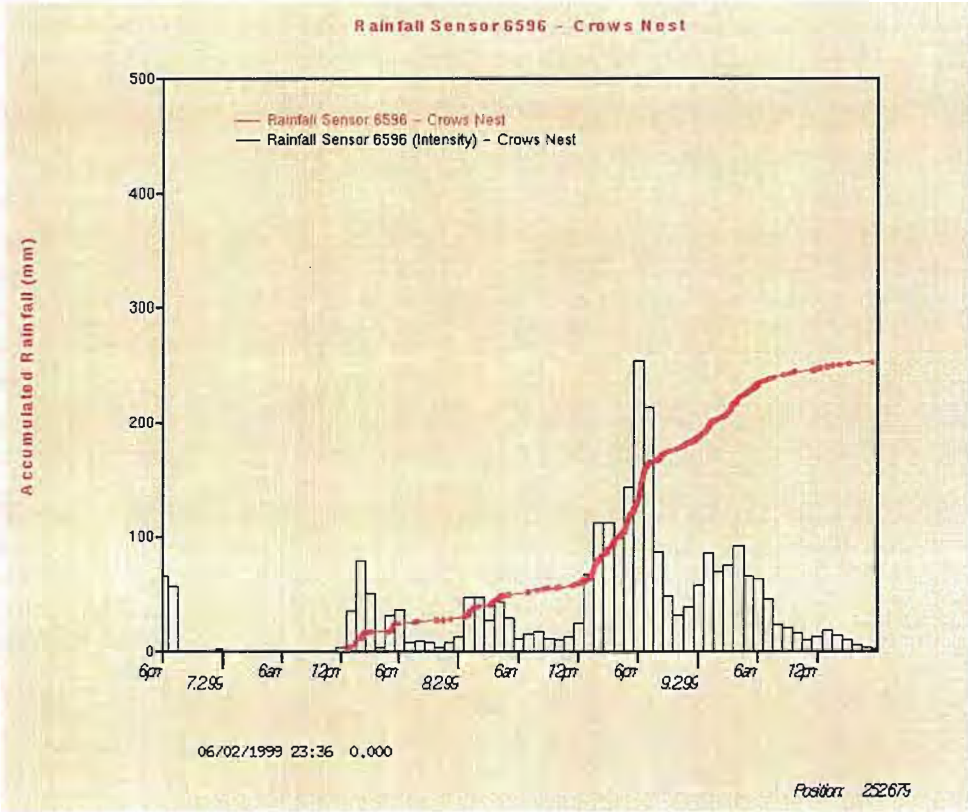
Cumulative Rainfalls & IFD Curves for February 1999 Event



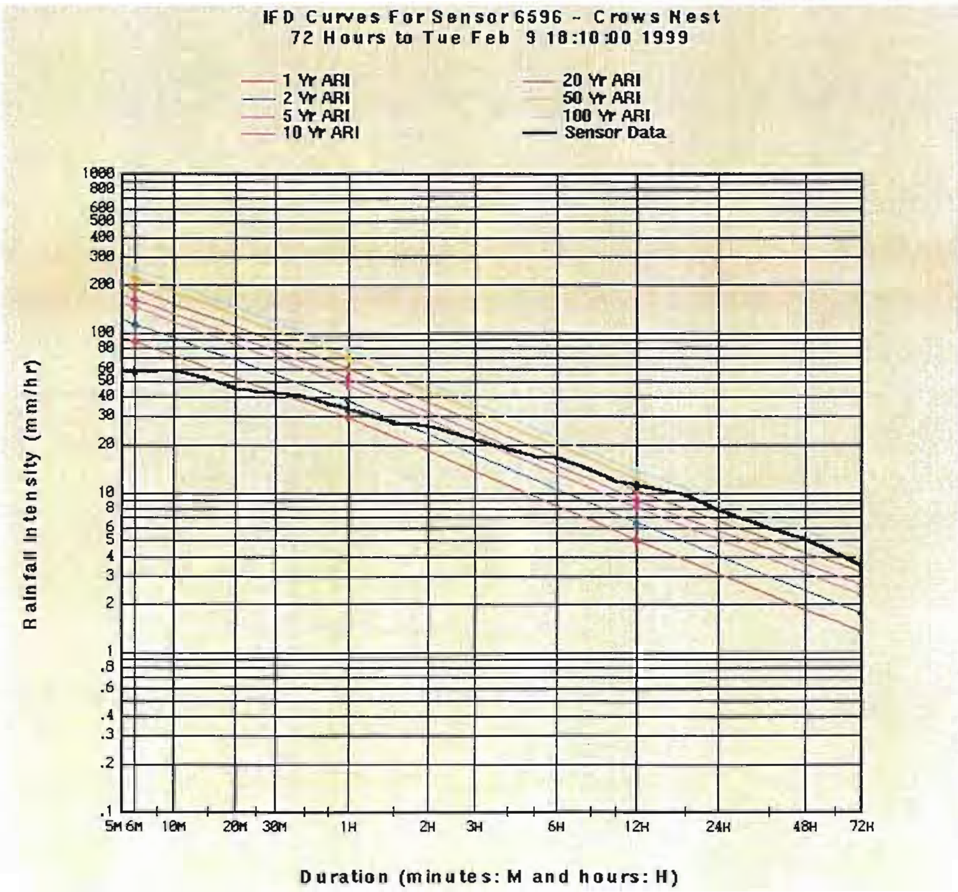
Upper Brisbane Catchment - Rainfall Sensor 6574 - Caboonabah



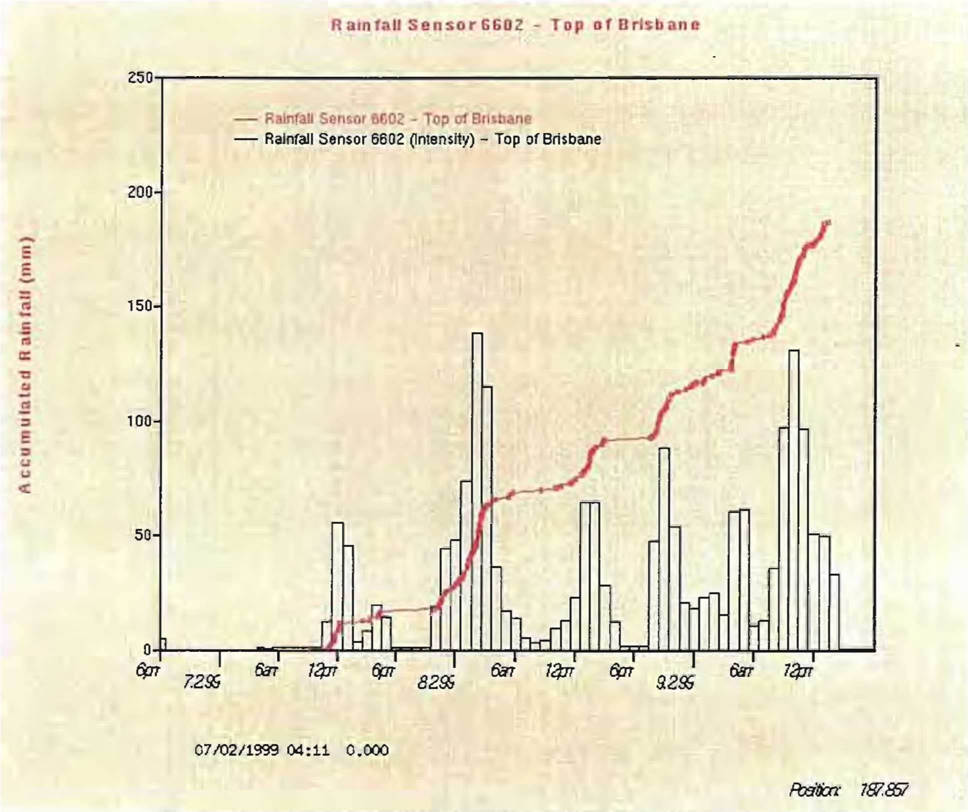
Cumulative Rainfalls & IFD Curves for February 1999 Event



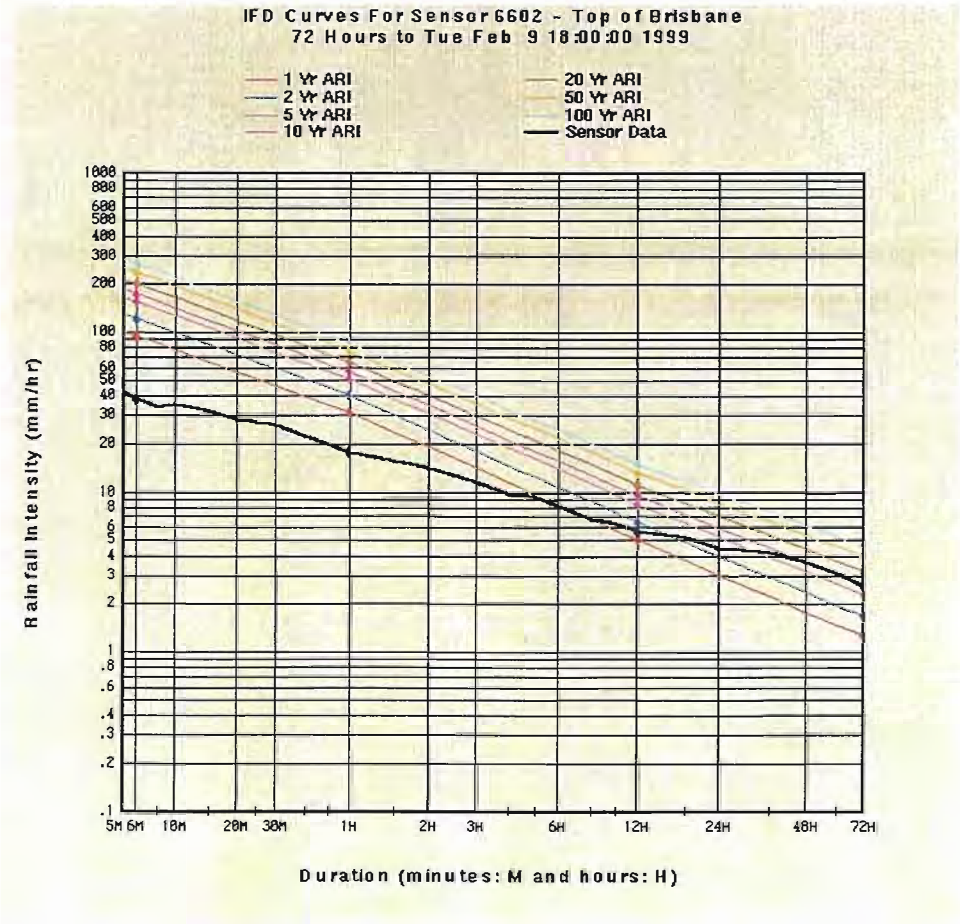
Upper Brisbane Catchment - Rainfall Sensor 6596 - Crows Nest



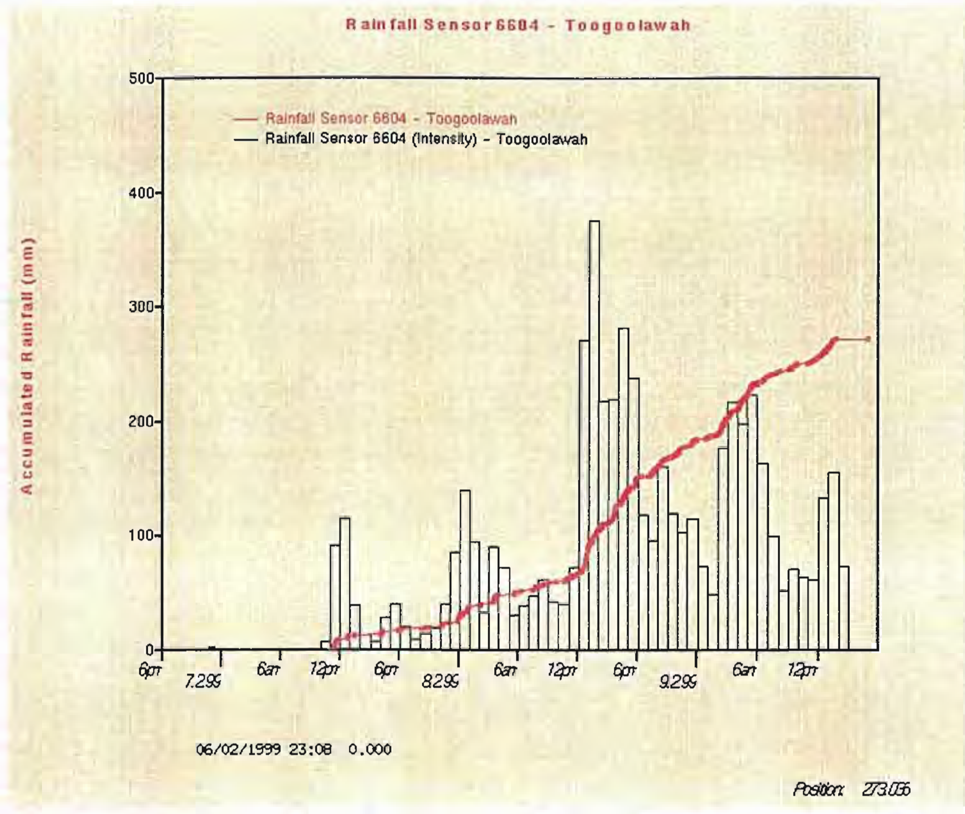
APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



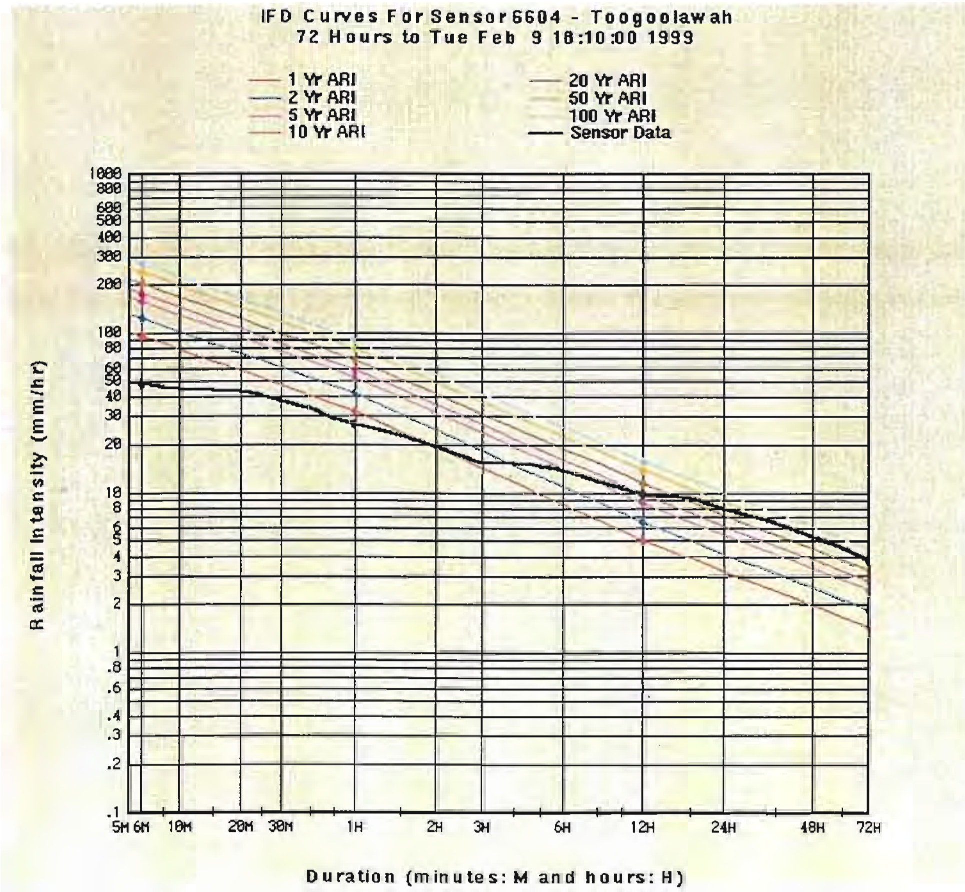
Upper Brisbane Catchment - Rainfall Sensor 6602 - Top of Brisbane



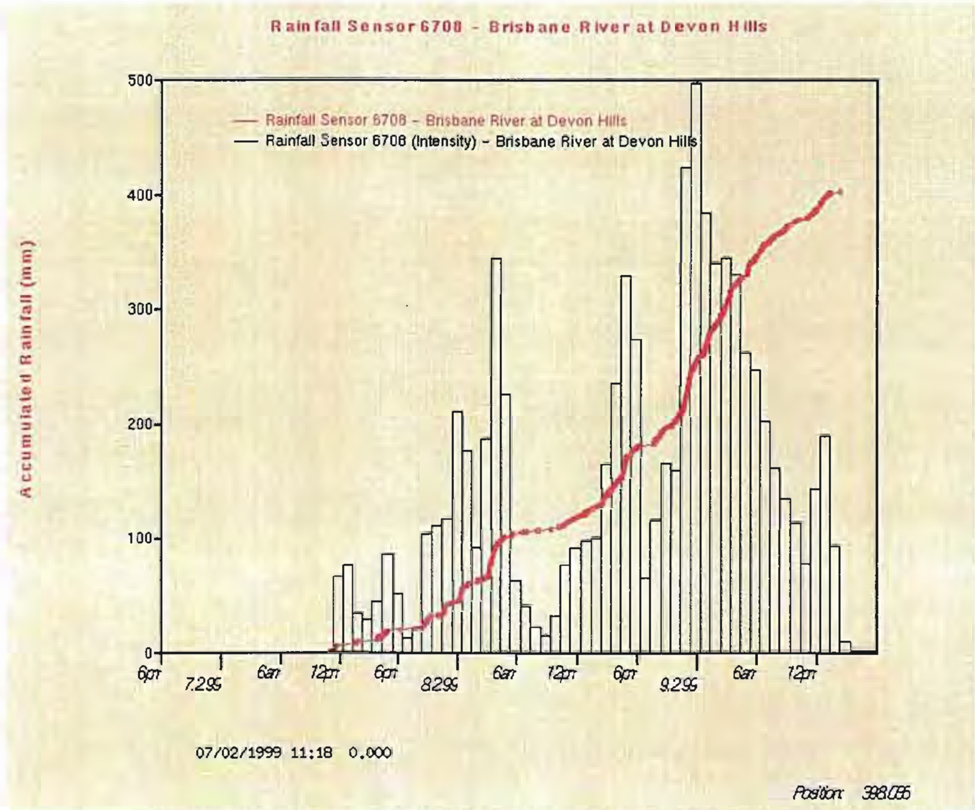
APPENDIX B
Cumulative Rainfalls & IFD Curves for February 1999 Event



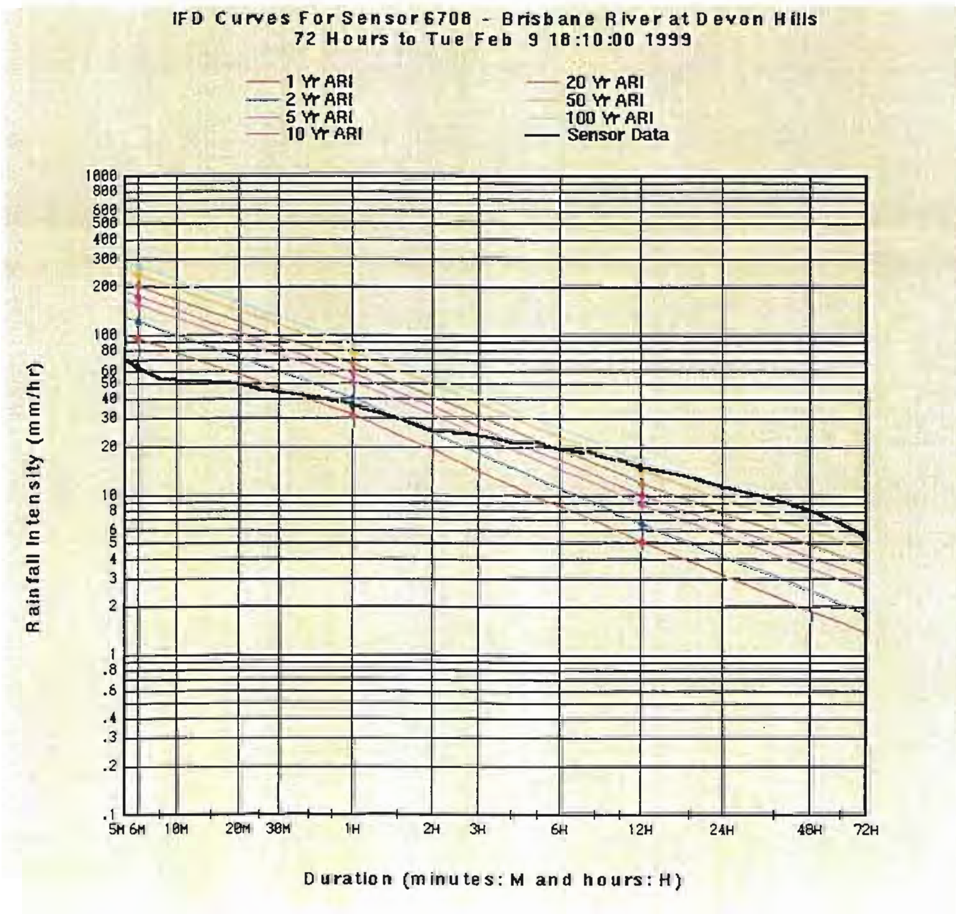
Upper Brisbane Catchment - Rainfall Sensor 6604 - Toogoolawah



Cumulative Rainfalls & IFD Curves for February 1999 Event



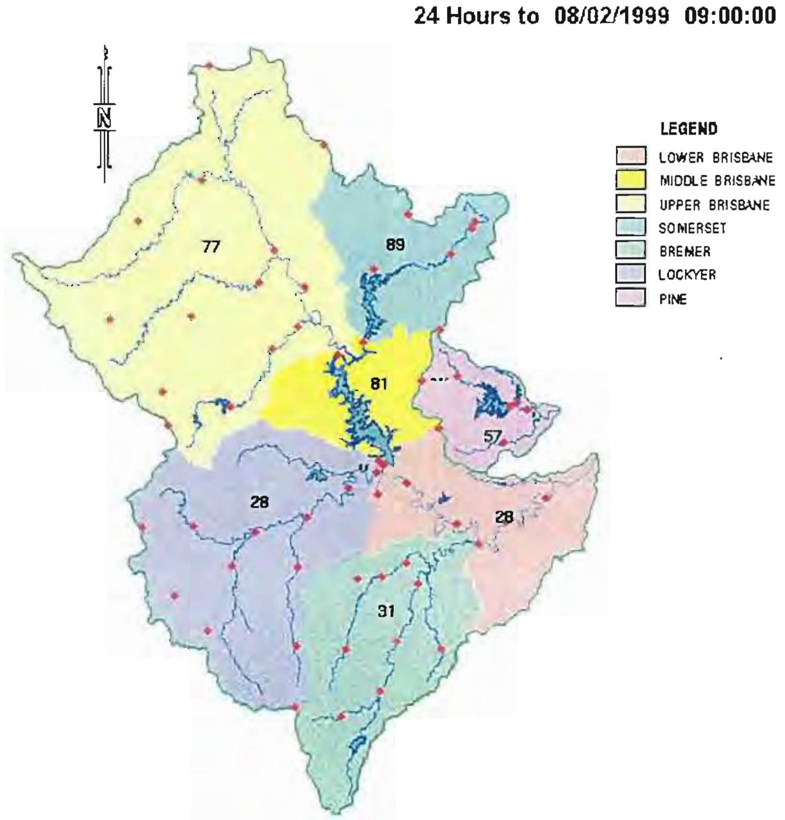
Upper Brisbane Catchment - Rainfall Sensor 6708 - Brisbane River at Devon Hills



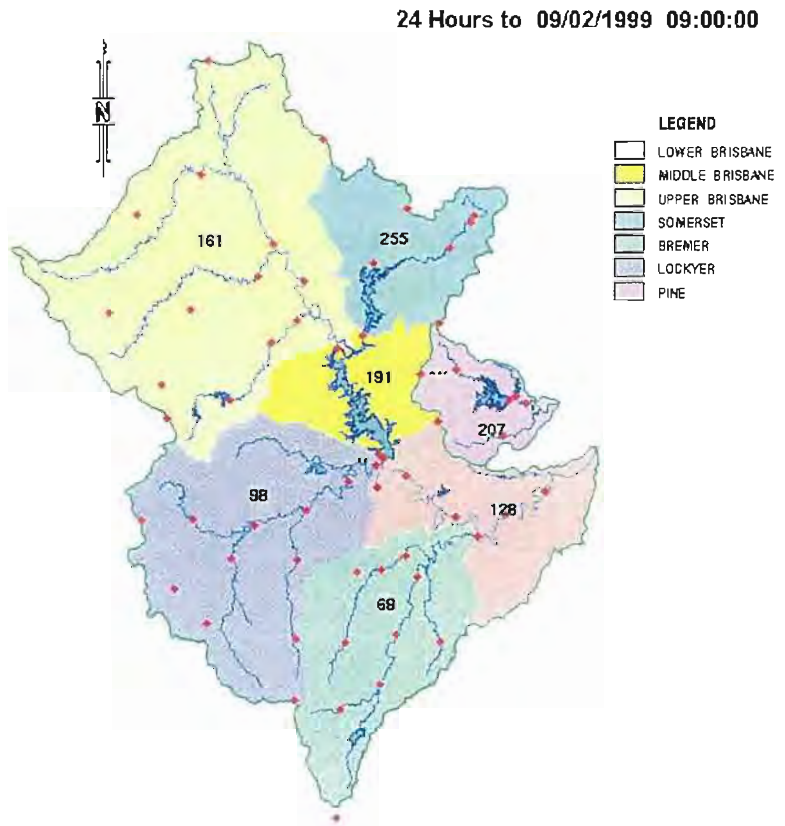
APPENDIX C

CATCHMENT RAINFALLS FOR FEBRUARY 1999 EVENT

APPENDIX C
Sub-Catchment 24 hour Total Rainfall for February 1999 Event

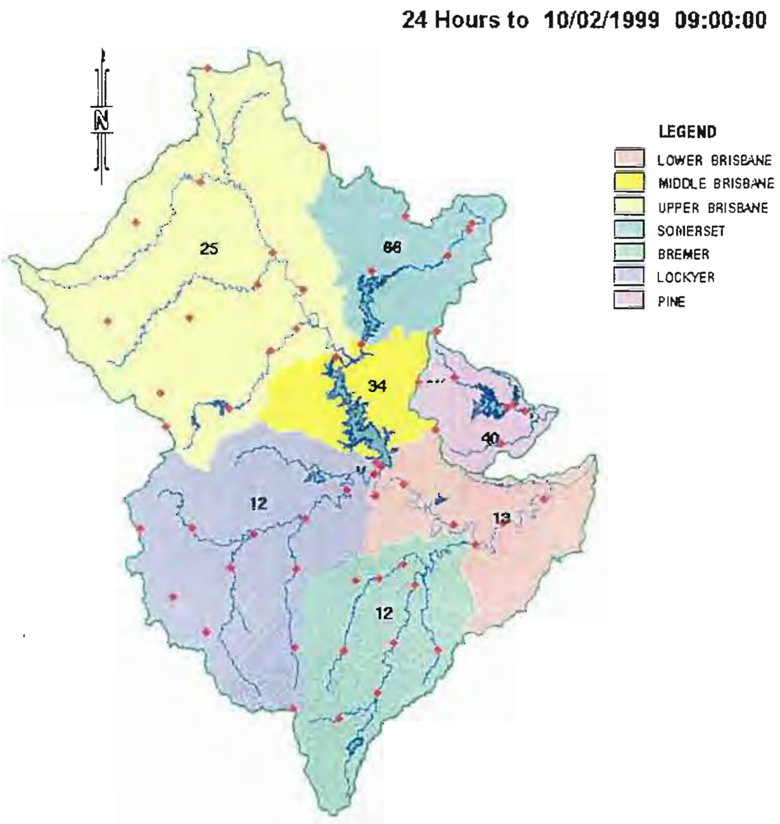


Sub-Catchment 24hr Total Rainfall to 9:00am 8/2/99

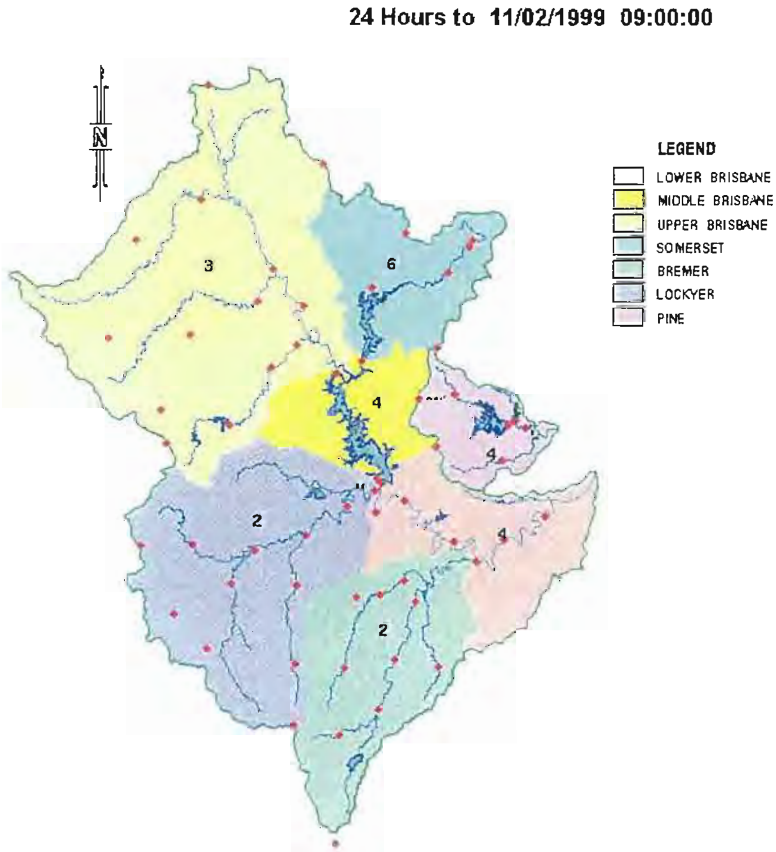


Sub-Catchment 24hr Total Rainfall to 9:00am 9/2/99

APPENDIX C
Sub-Catchment 24 hour Total Rainfall for February 1999 Event



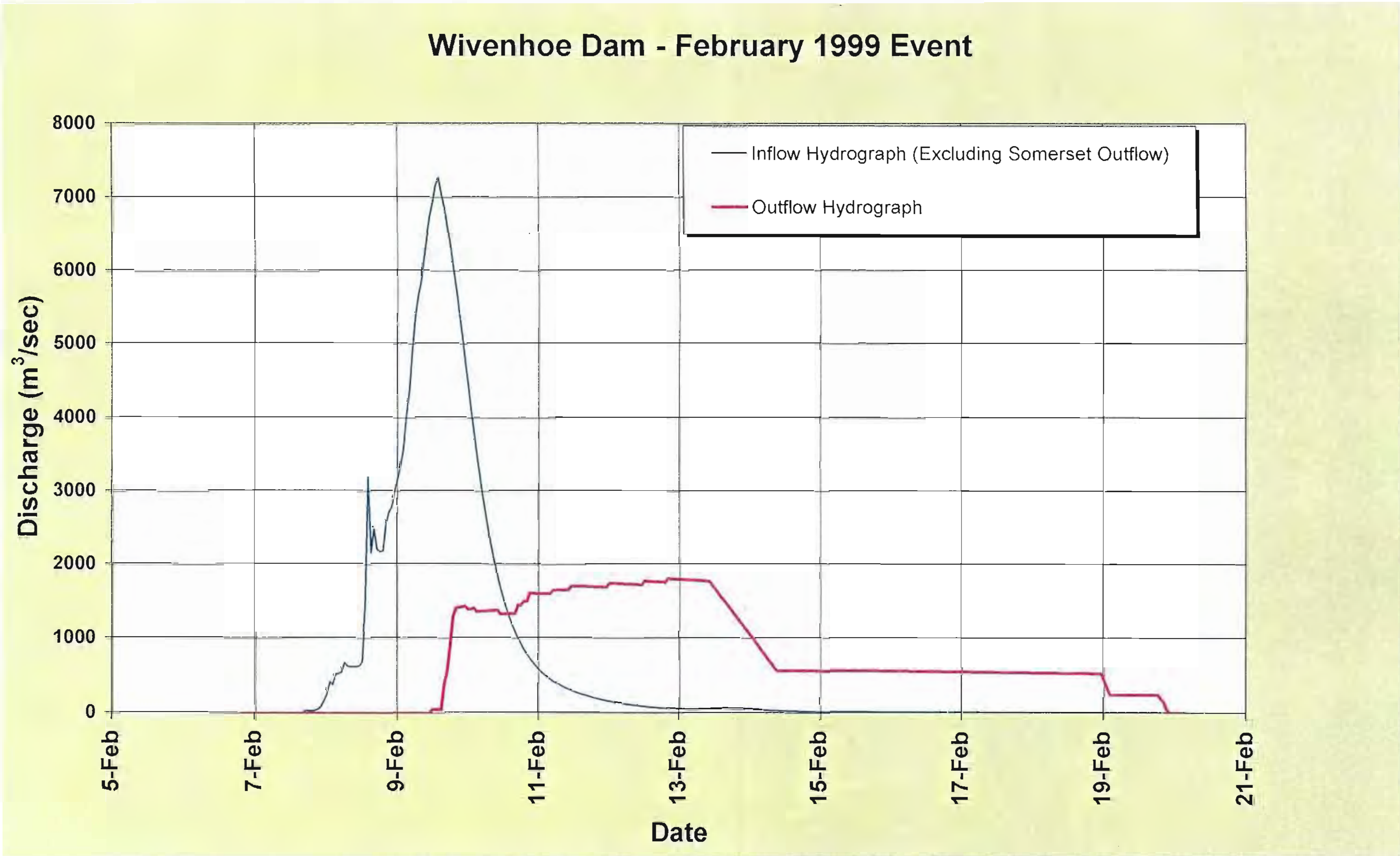
Sub-Catchment 24hr Total Rainfall to 9:00am 10/2/99



Sub-Catchment 24hr Total Rainfall to 9:00am 11/2/99

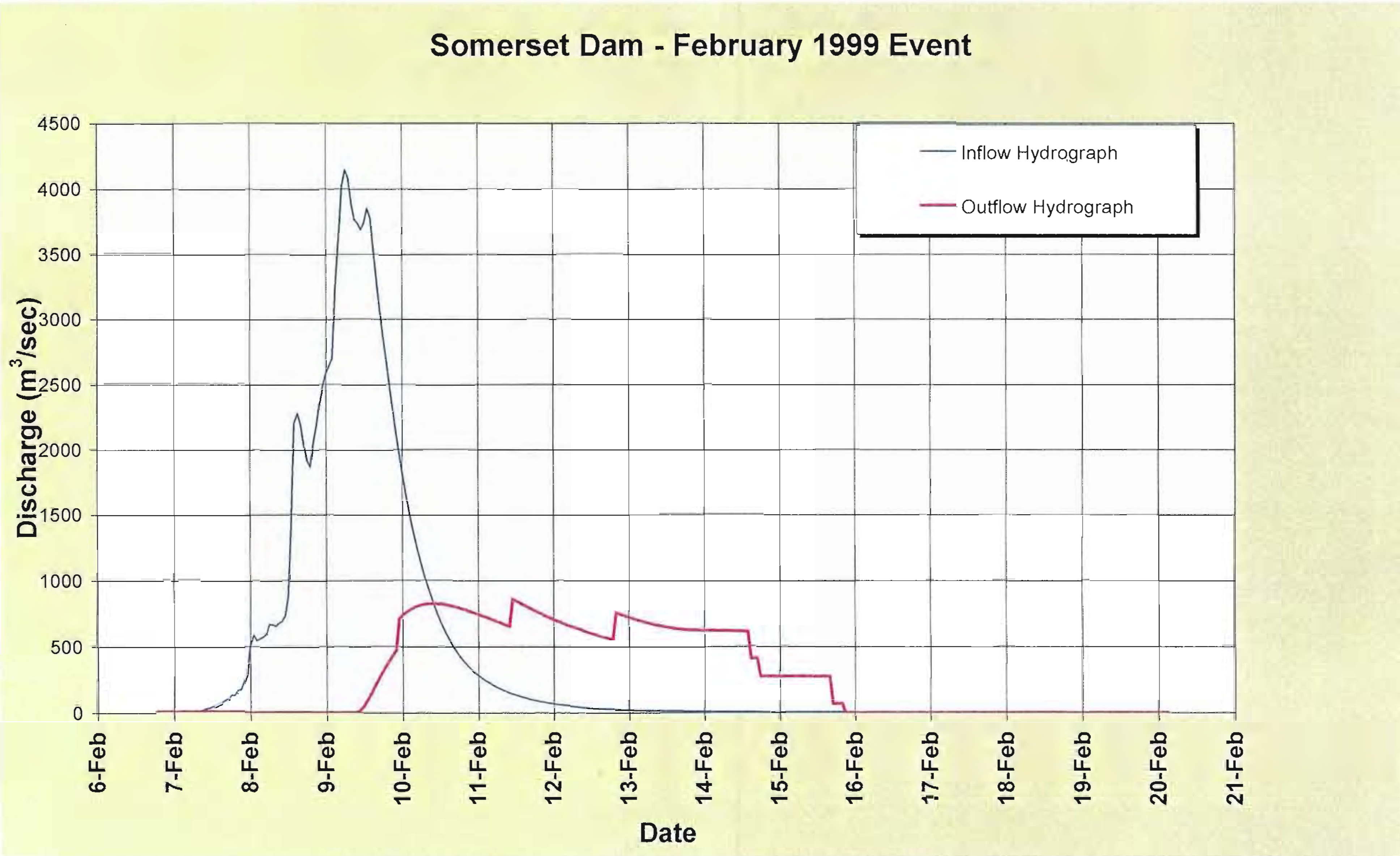
APPENDIX D

INFLOW and OUTFLOW HYDROGRAPHS FOR FEBRUARY 1999 EVENT



SOMFLOW11b.xls

FIGURE D1



SOMFLOW11b.xls

FIGURE D2

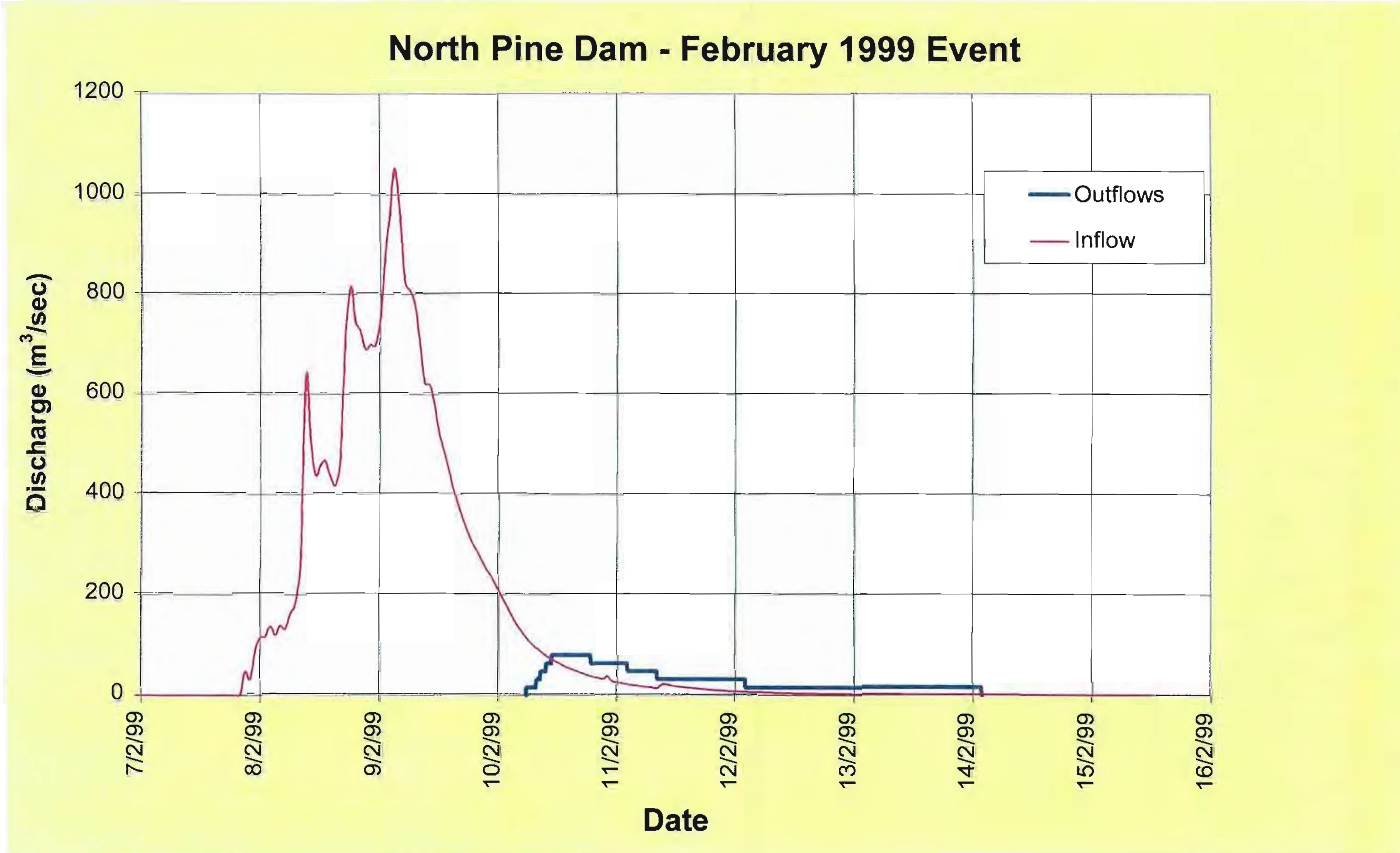

North Pine Dam - February 1999 Event
Discharge (m3/sec)
1200
1000
800
600
400
200
0
Outflows
Inflow
7/2/99
8/2/99
9/2/99
10/2/99
11/2/99
12/2/99
13/2/99
14/2/99
15/2/99
16/2/99
Date

FIGURE D3

APPENDIX E

ABRIDGED FCC EVENT LOGS FOR MARCH 1999 EVENT

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
01-Mar-99	6:30	Mobilise skeleton Crew for Flood Control Centre
	6:30	J Ruffini takes over as Duty Flood Engineer (relieving Peter Allen)
	6:30	Contact made with Malcolm Lane @ North Pine advising of proposal to release for approx. 30 hrs.
	6:30	Malcolm Lane advised to contact Pine Shire regarding closing Young's Crossing and Grant Street as releases will commence sometime after 7:30
	7:15	BOM predict local rainfall over next 3 hrs as influence moves from Fraser Island south. Falls of 140mm recorded in Sunshine Coast Hinterland
	7:30	Malcolm Lane at North Pine Dam contacted. Young's Crossing not yet closed.
	7:30	Gary Grant rung at home. Informed him that North Pine to open with the potential to open Somerset later.
	7:45	Dave Gill from SEQWB rang requesting situation report. Informed briefly on what was happening. Advised we would contact him after North Pine Dam had opened.
	7:50	Doug Grigg @ Wivenhoe Dam checked in. Lake level EL 67.08 and Splityard @ EL 165.7
	8:00	Rob Titmarsh @ Somerset checked in. Confirmed roster contact. Condition of Sluice 'L' discussed.
	8:13	North Pine Fax: GB 39.67; BCC 39.67; Digital 39.673. Gate 'C' opened.
	8:25	Malcolm Lane @ North Pine Dam confirmed by 'phone that he had opened Gate 'C' to opening 1.
	8:30	E-mail sent to all Flood Duty Engineers & Data Collectors to confirm availability.
	8:45	Jeff Watson (SEQWB) requests opportunity to visit FCC.
	9:00	North Pine Fax: GB 39.67; BCC 39.677; Digital 39.684. Rain in last hour = 18mm.
	10:00	North Pine Fax: GB 39.67; BCC 39.679; Digital 39.684. Rain in last hour = 0.6mm.
	11:00	North Pine Fax: GB 39.67; BCC 39.679; Digital 39.684. Rain in last hour = 0.1mm.
01-Mar-99	12:00	Somerset Dam operators instructed to raise crest gates and report when completed.
	12:00	North Pine Fax: GB 39.67; BCC 39.682; Digital 39.684.
	12:39	Fax from Somerset confirming opening of crest gates.
	13:00	J Ruffini supplied Gary Grant with a status report. Advised we would open one regulator at Somerset and two regulators at Wivenhoe.
	13:00	Rob Titmarsh @ Somerset checked in. Lake level EL 99.17. Will now report every hour.
		North Pine (Rob Gorian) Fax: @ 13:00:- GB 39.68; BCC 39.683; Digital 39.684.
	13:08	Rain in last hour = 0.1mm.
	13:30	Fax sent to Doug Grigg, operator @ Wivenhoe: Open two (2) regulators to 50%
	13:45	Fax sent to Rob Titmarsh, operator @ Somerset: Open Regulators 3 & 12 to 50% capacity
	14:00	Fax to Somerset: Open 2 regulators to 50%
	14:18	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.14m. Regulator 1 to 50% @ 13:30 & Regulator 2 to 50% @ 14:00.
	14:22	Rob Titmarsh @ Somerset: 2 regulators 50% opened O/C
	14:55	Doug Grigg @ Wivenhoe Dam checked in. Splityard @ EL 159.8 Campers in 4 vans @ Twin Bridges warned
	15:00	North Pine @ EL 39.696 Dark cloud approaching.
	15:02	Somerset @ EL 99.20 Heavy rains to the north.
	15:30	John tibaldi rang: Discussed O/time claims of Data Collectors
	15:45	John Ruffini discussed situation with Peter Allen regarding current flood. Decided on 12 hr. shifts for Data Collectors.
	15:50	Malcolm Lane @ North Pine Dam rang. Reported Lake Level having reached 39.65 - 39.70 (Rob Gorian)
	16:00	Rob Titmarsh @ Somerset: Lake level EL 99.21
	16:15	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. Tailwater checked. Twin Bridges checked again. No problems.
	17:00	Rob Gorian @ North Pine Dam rang. Lake Level 39.704
	17:00	North Pine Fax: GB 39.7; BCC 39.701; Digital 39.701.
	17:00	Rob Titmarsh @ Somerset Dam: Lake level EL 99.24
	17:30	Fax from North Pine Dam: Open Gate 'E'
	17:45	Fax sent to North Pine Dam operator: Open Gate 'E' to setting 1. Spoke to Malcolm on the 'phone.
	18:00	QPF of 4:18 10 - 20 mm to 3pm Tuesday
	18:00	Fax from North Pine: GB 39.71; BCC 39.702; Digital 39.7.
	18:30	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. @ 18 00 hrs.
		At Twin Bridges: 800mm from bottom of bridge to water. Water has risen 45mm in last 2 hrs.
	18:35	John Ruffini spoke to Peter Allen. Informed him that Somerset would need to release for approx. 7 days.
		North Pine until 6pm Tuesday. Wivenhoe: 10 days plus.
	19:10	Rob Titmarsh ....
	20:00	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.27
	20:15	
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. @ 20 00 hrs.
		River @ Twin Bridges has risen 9cm. i.e. water is 71cm below bottom of bridge deck.
		Duty Eng. advised Doug to stand down tonight, & to check Twin Bridges & Savages first thing in the morning.
	20:15	(Will increase Wivenhoe releases to 50 cumecs in the morning)
	21:00	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.28

MARCH 1999 Event

NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
	21:45	Somerset: Two scenarios run. One 50mm extra over 48 hrs and 0mm over the next 48 hrs. Both are within operational bands of regulators. If continue on this path send Rob T. 11:30 at (?????) of an track.
	22:10	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.29 Rain: 1.6mm in last hour. Don Cock advised Rob to go home and call in when he (Rob) goes on duty in the morning.
	22:00	Fax from North Pine: GB 39.70; BCC 39.699; Digital 39.70. Rain: 0.5 hr = 19mm
	22:30	Fax from North Pine: GB 39.705; BCC 39.704; Digital 39.706. Rain: 0.5 hr = 13mm
	23:00	Fax from North Pine: GB 39.710; BCC 39.707; Digital 39.709. Rain: 0.5 hr = 5mm
02-Mar-99	0:00	Rang North Pine to discuss next Gate opening.
	0:05	Brett Schultz from North Pine Dam 'phoned: Young's Crossing is closed with barricades etc.
	0:15	Fax to North Pine: Open Gate 'A' to setting 1 when level reaches 39.715
	1:10	Fax from North Pine: GB 39.71; BCC 39.711; Digital 39.711.
	2:00	Fax from North Pine: GB 39.710; BCC 39.713; Digital 39.714.
	3:10	Fax from North Pine: GB 39.710; BCC 39.713; Digital 39.714.
	4:20	Fax from North Pine: GB 39.710; BCC 39.714; Digital 39.715. Gate 'A' opened at 4:10am. Lake EL 39.716
	5:12	Fax from North Pine: GB 39.710; BCC 39.715; Digital 39.714.
	6:10	Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.35 @ 06 00. 1.0mm of rain since 22:00 last night.
	6:22	Fax from North Pine: Gate setting & Lake Level log. Readings @ 06 00:- GB 39.710; BCC 39.713; Digital 39.712
	6:32	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.16m. @ 06 00 hrs. Little/no rain. Brisbane River @ Twin Bridges is 45cm below bridge deck. Savage's Crossing is 92cm below the deck level (Most of the decking @ Savages was washed away during February event).
	6:32	Splityard still pumping out of Wivenhoe Dam with about 2m to go. Water level in Splityard = 164.2
	7:12	J.Tibaldi requested advice on mobilising dams to 24hr rosters
	7:14	Fax from North Pine: GB 39.710; BCC 39.711; Digital 39.710 @ 7:00
	7:19	M.Lane Nth Pine - requested permission to exercise to exercise cone valve regulators - OK given - just open & close
	7:37	David Gill - SEQWB - update on storages & releases - unknown projections for Wed weather
	8:00	R.Titmarsh @ Somerset - WL 99.37 & no rain for last 2 hrs
	8:27	Fax from North Pine: GB 39.70; BCC 39.703; Digital 39.704. - 0.2mm hourly rain @ 8:00
	9:07	R.Titmarsh @ Somerset - WL 99.38 - mist only
	9:15	Fax from North Pine: GB 39.70; BCC 39.699; Digital 39.702. - 0.2mm hourly rain
	9:57	Malcolm Lane - North Pine: WL 39.968 - request to shut Gate 'A'
	10:00	Somerset EL 99.39 - No rain
	10:00	Fax from North Pine: GB 39.69; BCC 39.695; Digital 39.698. - 0.2mm hourly rain @ 8:00 - Closed Gate 'A'
	10:03	Fax to North Pine - Instruction to shut Gate 'A'
	10:05	Doug Grigg - Wivenhoe EL 67.17 - Twin Bridges 43cm below culvert
	11:00	Fax from North Pine: GB 39.68; BCC 39.691; Digital 39.692. - nil rain
	11:00	Doug Grigg - Wivenhoe EL 67.175 - Twin Bridges 43cm below top of culvert
	11:04	R.Titmarsh @ Somerset - WL 99.40 - nil rain past hour
	11:15	Fax to Wivenhoe - open regulators to release 50 cumecs
	11:35	Doug Grigg - Wivenhoe Dam regulators were opened at 11:30am to 50 cumecs. (#1 fully + #2 = 20 cumecs)
	12:00	R.Titmarsh @ Somerset - WL 99.42
	12:00	Fax from North Pine: GB 39.68; BCC 39.69; Digital 39.688. - nil rain
	12:25	Doug Grigg - Wivenhoe at 12:00 EL 67.20 - Tailwater 28.12 - requires peak check
	13:00	R.Titmarsh @ Somerset - WL 99.43
	13:00	Fax from North Pine: GB 39.68; BCC 39.687; Digital 39.685. - 1 hour rainfall 1.4mm
	13:15	Doug Grigg - Wivenhoe EL 67.20 - Twin Bridges 41.5cm below top of culvert
	14:00	R.Titmarsh @ Somerset - WL 99.44 - no rain
	14:00	Fax from North Pine: GB 39.70; BCC 39.712; Digital 39.712. - 1 hour rainfall 41mm
	14:30	Doug Grigg - Wivenhoe EL 67.201 @ 14:00 - no problems with regulators - no cavitation
	15:00	R.Titmarsh @ Somerset - WL 99.46 - 1 hour rainfall 4.2mm
	15:00	Fax from North Pine: GB 39.74; BCC 39.732; Digital 39.732. - 1 hour rainfall 17mm
	15:00	Doug Grigg - Wivenhoe EL 67.22 - Twin Bridges 34cm below top of culvert
	16:00	R.Titmarsh @ Somerset - WL 99.47 - no rain
	16:00	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.739. - 1 hour rainfall 0.1mm
	16:00	Doug Grigg - Wivenhoe EL 67.24

MARCH 1999 Event

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Date	Time	Action/Comment
	16:25	Fax to North Pine - Instruction to open Gate 'A'
	16:30	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.738. confirmation of Gate 'A' opening
	17:00	R.Titmarsh @ Somerset - WL 99.49 - no rain - no further readings reqd
	17:00	Fax from North Pine: GB 39.74; BCC 39.74; Digital 39.737 - no rain
	17:25	Sensor Invest. Request form faxed to Seqwb - 6591 - Somerset Dam Headwater (B) no longer agrees with 5m Druck or manual readings
	17:30	Doug Grigg - Wivenhoe EL 67.25 - Twin Bridges 23cm below top of culvert
	18:00	Fax to North Pine - Instruction to open Gate 'D' one setting
	18:00	Fax from North Pine: GB 39.74; BCC 39.739; Digital 39.738 - no rain confirmation of Gate 'D' opening
	18:45	Fax to North Pine - Instruction to open Gate 'B' one setting as a precaution
	18:53	Fax from North Pine: confirmation of Gate 'B' opening
	20:00	Fax from North Pine: GB 39.73; BCC 39.730; Digital 39.728 - 1/2 hr rain 0.6mm
	20:20	Fax to North Pine - Instruction to close Gate 'B'
	20:25	Brett Schultz from North Pine Dam phoned: Gate 'B' closed
	21:00	Fax from North Pine: GB 39.725; BCC 39.726; Digital 39.723 - no rain
	22:00	Fax from North Pine: GB 39.720; BCC 39.722; Digital 39.718 - no rain
	23:10	Fax from North Pine: GB 39.715; BCC 39.716; Digital 39.712 - no rain
	23:15	Gate 'D' shut - confirmed by Brett Schultz
03-Mar-99	0:00	Fax from North Pine: GB 39.710; BCC 39.710; Digital 39.708
	1:00	Fax from North Pine: GB 39.700; BCC 39.707; Digital 39.703
	2:00	Fax from North Pine: GB 39.700; BCC 39.705; Digital 39.700
	2:00	P.Allen gave verbal approval to shut Gate 'A'
	2:05	Fax from North Pine - Log confirming Gate 'A' closed
	3:00	Fax from North Pine: GB 39.700; BCC 39.701; Digital 39.697
	4:00	Fax from North Pine: GB 39.700; BCC 39.700; Digital 39.695
	5:00	Fax from North Pine: GB 39.700; BCC 39.696; Digital 39.693
	6:00	Somerset EL 99.63 - 0.6mm rain since 2/3/99 15:00
	6:00	Fax from North Pine: GB 39.695; BCC 39.695; Digital 39.692
	7:00	Fax from North Pine: GB 39.690; BCC 39.693; Digital 39.690
	7:00	Wivenhoe 67.24, Splityard 164.00, Twin Bridges 8cm clear
	7:52	PA discussed draining options for Wivenhoe with J.Tibaldi. JT is keen not to have the dams staffed if we open a gate 1-1.5m. PA will discuss with G.Grant before decision.
	8:00	Fax from North Pine: GB 39.680; BCC 39.691; Digital 39.686
	8:04	Somerset EL 99.64 - 0.6mm rain since 2/3/99 15:00
	8:40	Splityard 164.00 @ 7:00, 162.4 @ 8:00 (generating) Storage 164.00=26200ML 162.40=24712ML - implies Q = 410 cumecs
	9:00	Somerset EL 99.65
	9:00	Wivenhoe 67.27
		Doug Grigg reported that Splityard Creek Levels for last 3 days were 1/3/99 8:00 165.7 2/3/99 8:00 164.7 3/3/99 8:00 162.4
	9:00	Fax from North Pine: GB 39.680; BCC 39.686; Digital 39.684
	9:00	Discussions between: David Gill, Garry Grant, John Mulheron, PA, JR & DC about proposed operations for Somerset/Wivenhoe. Agreed to keep as is rather than reduce Wivenhoe Drainage time and put Twin Bridges out
	11:00	Fax from North Pine: GB 39.670; BCC 39.68; Digital 39.677
	12:00	Somerset EL 99.67
	12:00	Wivenhoe EL 67.30
	15:00	Somerset Dam EL 99.69 @ 15:00, 99.69 @ 14:00, 99.67 @ 13:00
	15:20	Wivenhoe 67.33 @ 15:00
	16:10	Splityard 156.7m, Somerset Dam HW 99.71
	16:30	Instructed North Pine to open Gate 'A' one setting
	16:45	North Pine 39.686, Gate 'A' opened to setting 1
	17:00	Somerset 99.72, O'Shea's Bridge 67.38
	17:00	North Pine 39.672
	18:00	North Pine EL 39.677. The reading 30min prior was 39.682, 30 min prior 39.673, 30 min prior 39.684 - possible swell in storage
	18:05	Somerset Dam 99.72
	18:05	Fax from North Pine: GB 39.67; BCC 39.677; Digital 39.677
	18:30	Wivenhoe 67.40 - 33mm rain since 9:00
	18:37	Twin Bridges - water is 70mm deep on the Fernvale side - Doug Grigg to advise Esk Shire

MARCH 1999 Event

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Date	Time	Action/Comment
	19:00	Somerset 99.73
	19:15	Fax from North Pine: GB 39.67; BCC 39.678; Digital 39.682
	20:00	Fax from North Pine: GB 39.675; Digital 39.679
	20:30	Somerset @ 8:30 EL 99.75
	21:00	Somerset EL 99.76
	21:30	Advised North Pine to keep 3 gates open as more flow in system
	21:45	Flows in Lockyer Creek have taken out twin bridges
	22:00	Somerset 99.77
	22:00	North Pine 39.674
	22:30	Wivenhoe 67.41, Splityard 158.00, Doug instructed to check Savage's - 28cm over road at Twin Bridges
	23:00	39.673 North Pine
	23:15	Doug Grigg - Water lapping at deck of Savage's Xing - Bridge closed
04-Mar-99	0:00	Somerset 99.77
	0:00	North Pine 39.672
	1:00	North Pine 39.60
	2:00	North Pine 39.667
	3:00	North Pine 39.665
	4:00	North Pine 39.663
	5:00	North Pine 39.655
	6:00	Wivenhoe 67.37, Splityard 164
	6:00	North Pine 39.655
	7:00	Somerset 99.84
	7:00	North Pine 39.652
	8:00	Wivenhoe 67.38, Splityard 165
	8:00	North Pine 39.650
	8:15	SEQWB rang. JR advised David Gill
		1. North Pine to continue with 3 gates open to reduce time that Young's Crossing OOA
		2. Yesterday's rainfall caused additional inflow into Wivenhoe Dam. This has extended the drainage of Somerset to 12/3/99 15:00 if current strategy remains in place. Total inflow into Somerset no expected to be 66000ML
		3. Lockyer Creek will peak at approx 120 cumecs. Twin Bridges closed
		4. Savage's Xing is closed
		5. We are examining a strategy which would require Wivenhoe releasing at 150 cumecs.
	9:00	North Pine 39.646
	10:00	North Pine 39.642
	11:00	North Pine - digital 39.636
	13:00	North Pine: GB 39.620; BCC 39.626; Digital 39.624
	14:00	North Pine: GB 39.620; BCC 39.620; Digital 39.620
	15:30	Advised Esk SC of Wivenhoe release
	15:40	Advised Ipswich SC of Wivenhoe release
	15:45	Advised Police Communications of Wivenhoe release
	15:50	Advised BOM of Wivenhoe release
	16:15	Somerset 99.87
	16:30	Faxed Wivenhoe instructions to close reg @ 17:00 and open Gate 1 to 0.5m
	17:10	Doug Grigg advised regulator at Wivenhoe closed, Gate 3 open 0.5m
	17:30	North Pine 39.601
	17:32	Advised Malcolm Lane @ North Pine to close Gate 1 (A).
	17:47	Fax from North Pine confirming Gate 1 closed
	18:00	Wivenhoe 67.46, Splityard 158.00
	20:10	Directed Doug Grigg to close Wivenhoe Gate 3 to 0.3m to keep Lowood to 175 cumecs
	20:30	J.Tibaldi confirmed Wivenhoe Gate 3 closed to 0.3m
	21:00	Wivenhoe 67.50, Splityard 158.0 @ 18:00
	21:00	North Pine: GB 39.590; BCC 39.590; Digital 39.592
	22:15	North Pine: GB 39.580; BCC 39.587; Digital 39.589
	23:00	North Pine: GB 39.580; BCC 39.584; Digital 39.585
05-Mar-99	0:00	Wivenhoe 67.52, Splityard 156.3
	0:00	North Pine: GB 39.580; BCC 39.58; Digital 39.581
	1:08	Instructed Wivenhoe to open Gate 3 to 0.5m
	1:15	Wivenhoe confirmed open Gate 3 to 0.5m
	1:24	North Pine: GB 39.570; BCC 39.575; Digital 39.576
	2:00	North Pine: GB 39.570; BCC 39.571; Digital 39.570
	2:30	Wivenhoe 67.51
	3:00	Advised Police of expectation that Colleges will submerge between 10am and 12 noon today.
	3:10	North Pine Digital 39.568

MARCH 1999 Event

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Date	Time	Action/Comment
	4:00	North Pine: GB 39.560; BCC 39.561; Digital 39.565
	5:00	Wivenhoe 67.475
	5:22	North Pine Gate E shut at 5:15, Lake EL 39.561
	6:00	North Pine: GB 39.550; BCC 39.557; Digital 39.561
	7:00	Wivenhoe 67.460
	7:00	Somerset 99.89, 2 regs at 50%
	7:00	North Pine: GB 39.550; BCC 39.557; Digital 39.560
	8:00	North Pine: GB 39.550; BCC 39.557; Digital 39.557
	9:00	Wivenhoe 67.47
	9:00	North Pine: GB 39.550; BCC 39.55; Digital 39.556
	10:00	North Pine: GB 39.550; BCC 39.553; Digital 39.554
	11:00	North Pine: GB 39.550; BCC 39.552; Digital 39.552
	11:48	Instructed North Pine to close gate
	12:00	Malcolm Lane - North Pine: closed Gate 'C' at 11:45
	12:00	North Pine: GB 39.550; BCC 39.550; Digital 39.551
	14:00	North Pine 39.55
	14:45	Faxed Wivenhoe instructions to open Gate 3 from 0.5m to 1.0m
	15:00	Wivenhoe confirmed open Gate 3 to1.0m
	15:00	Wivenhoe 67.50
	15:00	North Pine 39.55
	15:45	Requested SEQWB to bring Crosby 6752 River Sensor back on line ASAP
	16:00	North Pine 39.551 - confirmed operation ceased 16:00
	16:00	Somerset 99.88
	17:00	Wivenhoe 67.51
	17:17	Fax from SEQWB - Mt Crosby back in action
	18:45	J.Tibaldi reported water 400mm below Colleges
	19:00	Wivenhoe 67.51
	20:00	Splityard 165.8
	21:00	Wivenhoe 67.53
	23:00	Wivenhoe 67.53
06-Mar-99	1:00	Wivenhoe 67.54
	1:30	Splityard 165.80
	5:15	Wivenhoe 67.54
	7:00	Wivenhoe 67.53
	8:00	Somerset 99.78, Regulator at 50%
	9:00	Wivenhoe 67.54
	11:00	Wivenhoe 67.55, Splityard 165.7
	13:00	Wivenhoe 67.55, Splityard 165.1, TW 28.45
	15:00	Wivenhoe 67.54, Splityard 165.7, TW 28.45
	16:00	Somerset 99.74
	17:00	Wivenhoe 67.54
	19:00	Wivenhoe 67.56
	20:00	Wivenhoe 67.56
	20:00	Faxed Wivenhoe to open Gate 3 to 1.5m
	20:10	Wivenhoe confirmed open Gate 3 to 1.5m
	23:00	Wivenhoe 67.57
07-Mar-99	0:00	Wivenhoe 67.57
	6:00	Wivenhoe 67.57
	8:00	Wivenhoe 67.56
	8:30	Somerset 99.65
	10:10	Wivenhoe 67.55, Splityard 165.00 Fernvale Bridge 300mm Higher than that recorded 12:30 6/3 300mm of water over O'Reilly's Weir
	11:05	Downloaded Savages Crossing - Flattened out @ 3.36m
	12:15	Wivenhoe 67.56, Splityard 165.0
	14:10	Wivenhoe 67.55, Splityard 165.00
	15:20	J Ruffini @ College's Crossing - Approx 5cm clearance to lower part of R/B Bridge sections Flow @ Crosby of 168cumecs - Approx 0.6m over @ Twin Bridges
	15:30	Somerset 99.61
	16:00	Wivenhoe 67.55
	18:00	Wivenhoe 67.54
	20:05	J. Tibaldi @ Wivenhoe. He read gauge board @ 67.57 - does not see how day shift have recorded 67.5
	20:07	J Tibaldi advised Wivenhoe level has been @ 67.53 - 67.54 for the last 24 hrs.
	21:00	300mm of water over O'Reilly's Weir, Splityard 165.0
	22:00	Wivenhoe 67.57

MARCH 1999 Event

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Date	Time	Action/Comment
08-Mar-99	0:00	Wivenhoe 67.57
	2:00	Wivenhoe 67.57
	4:00	Wivenhoe 67.57
	6:00	Wivenhoe 67.54
	6:30	Splityard 165.60
	7:00	Somerset 99.52 - No Rain
	8:00	Wivenhoe 67.54
	10:20	Wivenhoe 67.54, Splityard 164.6
	12:15	Wivenhoe 67.54, Mt Crosby Weir 7.77m AHD Colleges Crossing 300mm from road surface in middle
	12:45	Discharge @ O'Reillys 31.5m=>13.6cumecs
	14:00	Wivenhoe 67.54, Splityard 162.2
	15:00	Somerset 99.47 (wind affected)
	15:45	No signal @ Mt Crosby Weir gauge - requested SEQWB fix immediately
	16:00	Wivenhoe 67.57, Splityard 161.0 (15mm rain)
	18:00	Wivenhoe 67.59, Splityard 159.5
	19:50	Wivenhoe directed to open Gate 3 to 1.7m
	20:00	Wivenhoe 67.59, Confirmed gate opened to 1.7m
	20:45	Splityard 158.4
	22:00	Wivenhoe 67.59
09-Mar-99	0:00	Wivenhoe 67.59, Splityard 158.4
	3:00	Wivenhoe 67.56
	6:00	Wivenhoe 67.51
	6:30	Splityard 165.6 & pumping
	7:00	Somerset 99.38 - Hydro releasing 1170Ml per day (13.54 cumecs)
	8:00	Wivenhoe 67.51
	8:20	Splityard 165.00 - Hydro operating
	9:30	Wivenhoe requested to close Gate 3 to 1.5m
	9:35	Confirmation from Wivenhoe - Gate 3 closed to 1.5m
	11:00	Wivenhoe 67.53, Splityard 163.0
TM	12:00	Somerset 99.35, 9mm Rain overnight
	14:00	Wivenhoe 67.53, Splityard 162.0
	15:00	Somerset 99.33
	16:00	Somerset 99.32
	17:00	Wivenhoe 67.52, Splityard 161.6
	20:00	Wivenhoe 67.52
	20:23	Faxed Wivenhoe directing Gate 3 be opened to 1.7m
	20:40	Wivenhoe advised Gate 3 opened to 1.7m @ 20:35
10-Mar-99	0:00	Wivenhoe 67.52, Splityard 161.2
DR	6:00	Wivenhoe 67.48, Splityard 165.60 Effective Lake Level 67.455, Simulated Drawdown 67.458
	7:00	Somerset 99.24
	9:15	Wivenhoe 67.47
	9:40	Mr T Fenwick approved holding Somerset at current level & allowing Hydro to draw it down - confirmation fax to follow
	9:47	Received fax from SEQWB (G Grant) re closure of Somerset
	9:55	Fax sent to Somerset re direction to close regulators
	10:50	Somerset confirmed regulators closed - Fax to follow
	10:50	QPF from BOM to 9:00 Thu (11/01/1999) = 2mm
	11:17	Confirmation fax received from Somerset
AL	12:00	at 12:00 Wivenhoe Lake level 67.47; Splityard level 165.4
PA	12:50	College's Crossing - Peter Myatt. They have installed a temporary benchmark @ Colleges 0.61m =m underside of bridge deck; currently at 0.48m maximum overnight was 0.56m (0.05m below bridge deck)
PA	15:10	Andrew Maughan - Wivenhoe 67.47 (cf Alert:67.44)
AL	16:30	QPF for 24h to 3pm Thu is less than 2mm rainfall for Somerset/Wivenhoe and less than 2mm rainfall for North Pine catchments
AL	18:00	Wivenhoe W.L. 67.45 @ 18:00 (A. Maughan) (cf Alert 67.40 (#6640) @ 18:00), Splityard W.L. 165.5 at 17:30. Andrew took measurement at O'Reilly's Weir @ 17:00 of 0.265m on temporary gauge board, a drop of 40mm since last reading 0.305m @ 16:30 on 9/3/99. Advised that we may want Doug Grigg to take another reading at about 2-3am on 11/3/99 if we see another dip in flow similar to dips on 9/3/99 & 10/3/99. Andrew estimated that W.L. was about 0.08m above weir crest @ 17:00. Alert #6569 at 17:00 approx 24.60 CTF on current rating curve would be 24.60-(24.0+0.08) = 0.52m reduction to levels in rating curve. Need more data before such change to rating curve is made

MARCH 1999 Event

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Date	Time	Action/Comment
AL	21:00	Wivenhoe Dam W.L. 67.44 (Doug Grigg). Asked Doug to take another measurement of height at O'Reilly's Weir. He will try to do it at 23:00
DC	23:09	Doug Grigg rang re O'Reilly's Weir - gauge board now reads 0.260m (prev 0.265m at 17:00). Also flow over O'Reilly's Weir crest 0.12m over the crest - this measurement made by a staff on the weir crest - more accurate than Andrew's measurement) -
		FCC to contact Doug when mesurement required. Note: Sensor in FCC dropped 0.1m - supports theory of power surge.
11-Mar-99	0:00	Doug Grigg Wivenhoe EL 67.42m, Spiltyard 165.2m
KN	6:00	Wivenhoe 67.40 (Don asked Doug Grigg to visit O'Reilly Weir)
	7:00	Doug Grigg reported O'Reilly's Weir gauge board reading of 0.25m, flow depth over weir measured at 0.10m
	7:45	Rob Titmarsh report Somerset lake level reading at 6:00am = 99.20
	8:30	David Gill SEQWB rang. Wanted confirmation that Wivenhoe will be closed off on Sunday & that Somerset was closed too
KN	9:00	Wivenhoe lake level 67.39
JR	9:00	Discussed with Senior Flood Duty Engineer that we will draw Wivenhoe down below Full Supply Level to accommodate trickle from Somerset hydro
DC	9:50	Splityard 164.7m - phone call
KN	10:30	QPF to 9am Friday approx 5mm
JR	11:00	SEQWB. Spoke to David Gill requesting problems with O'Reilly's Weir gauge oscillations be examined. Also asked for a confirmation level at Mt Crosby
JR	11:15	Mt Crosby gauge BCC 7.81 and constant. BCC currently using between 400-450 ML/day
JR	11:30	7 day forecasts checked. Possible +60mm on Sunday. Radar confirms weather in the North.
DT	12:00	Wivenhoe EL 67.39 (Peter Myatt)
DT	15:50	Peter Myatt rang. Wivenhoe EL 67.40, Splityard EL 160.90, O'Reilly's Weir 95mm over crest at approx 14:40
DT	15:50	Faxom Wivenhoe Dam showing event log
DT	18:00	Wivenhoe EL 67.41
DT	19:00	Peter Myatt phoned. Level at College's Crossing 0.56m on gauge board, 0.61m below bridge, 130mm top of road to water level in middle.
DT	21:00	Wivenhoe EL 67.41, Splityard EL 157.6 (Doug Grigg) (deficit = 7442ML, corrected 67.342m AHD)
12-Mar-99	0:00	Wivenhoe EL 67.39, Splityard EL 157.6 (no change) (corrected 67.322)
AN	6:00	Wivenhoe EL 67.30, Splityard EL 165.7
AN	9:00	Peter Myatt phoned. Wivenhoe EL 67.28
PA	9:05	Peter Myatt - Wivenhoe - requested levels at Splityard about 3 times per day am, midday and pm. They will also check out O'Reilly's today. I have not asked for a College's Crossing level at this stage, but indicated we might ask for one if we get rain.
AN	11:30	Phoned Somerset. Lake Level 99.20
AN	12:00	Peter Myatt phoned. Wivenhoe EL 67.29, Splityard EL 163.2
DC	12:27	David Gill SEQWB rang requesting info on close down on Sunday
NA	15:00	Andrew Maughan - Wivenhoe EL 67.28, will read Wivenhoe and Splityard again at 18:00
NA	15:20	Colin Rockett, Pine Shire rang back - the preferable time for a release for them is Sunday & please provide a minimum of three hours prior notice
NA	16:50	John Tibaldi rang from Ipswich (home). Queried whether current downpour was affecting North Pine Dam (No)
DC	16:53	Rang M. Lane, North Pine. Digital reading 39.602. Gauge board just over 39.60.
DC	18:00	Andrew Maughan rang. Wivenhoe EL 67.27, Splityard Ck 163.3m - Colleges Crossing 0.49m on temp gauge board. 90mm going over Mt Crosby Weir.
NA	18:30	Wivenhoe event log fax received
JR	21:00	Wivenhoe Dam EL 67.26, Splityard Ck Dam 163.10
13-Mar-99	0:10	Doug Grigg phoned. Wivenhoe Dam EL 67.25, Splityard Ck Dam EL 163.10
RD	6:00	Doug Grigg phoned. Wivenhoe Dam EL 67.22, Splityard Ck Dam EL 163.10
PA	9:00	Andrew Maughan. Wivenhoe Dam EL 67.20
PA	12:30	Andrew Maughan. Wivenhoe Dam EL 67.191 @ 12:00, Splityard EL 163.10, Adjusted level 67.
TM	15:20	Andrew Maughan. Wivenhoe Dam EL 67.18 @ 15:00, Splityard 163.10 @ 15:00
PA	18:00	Andrew Maughan. Wivenhoe Dam EL 67.17 @ 18:00, Splityard 163.10, Mt Crosby @ 7.81m (cf Alert @ 7.80) & Colleges Crossing at 0.47m on temporary gauge board (down from 0.49 yesterday & 14cm under deck)
PA	21:00	Doug Grigg Wivenhoe 67.16, Splityard 162.6, Somerset report @ 6.00am - 90.19m
14-Mar-99	0:00	Doug Grigg. Wivenhoe 67.15, Splityard 162.6. He will report again at 6am
KN	6:00	Doug Grigg. Wivenhoe 67.12, Splityard 162.6
KN	6:50	Received fax of Wivenhoe Dam Event Log
KN, DC	8:00	Don Cock has sent a fax to Rob Titmarsh @ Somerset Dam requesting closure of all crest gates. Rob Titmarsh had rung - water level 99.19 steady. Power station generating 24 hours per day. Rob will ring again about 3-4pm.

MARCH 1999 Event

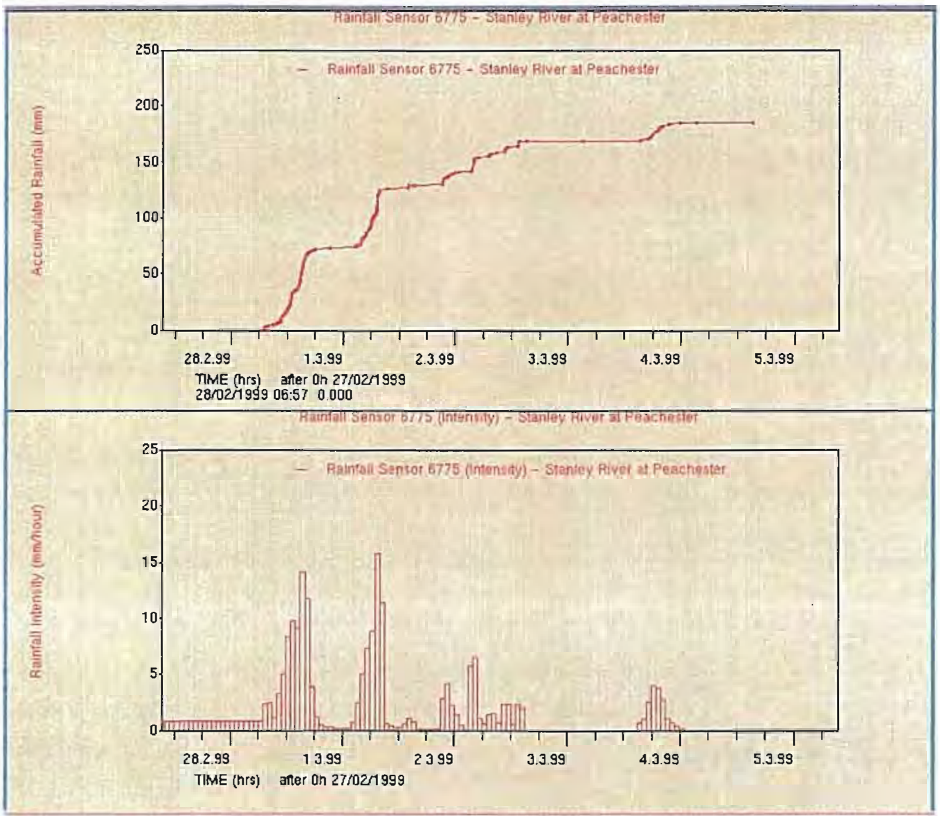
NOTE: Only the major instructions and formal advice are listed in this log - See the paper log for the full set of logged comments

Date	Time	Action/Comment
DC	9:00	Wivenhoe EL 67.10, Splityard 162.6
KN	9:30	Confirm fax from Rob Titmarsh regarding closure of all crest gates on Somerset Dam
KN	10:00	Malcolm Lane phoned from North Pine Dam. Gauge Board 39.60, BCC 39.603, Digital 39.605
KN	10:30	QPF for North Pine, Somerset and Wivenhoe 0mm to 3pm Monday
JR	10:45	Discussed with Peter Allen the need to provide baseflow after final closedown
JR	12:00	Wivenhoe Dam EL 67.09, Splityard 162.6
JR	12:30	Rang Power Station at Somerset. Still releasing continuously (about 13.5 cumecs) and will be until Somerset reaches EL 99.00
AL	14:00	John Tibaldi rang. Wivenhoe Dam EL 67.085, Splityard Ck Dam EL 162.6

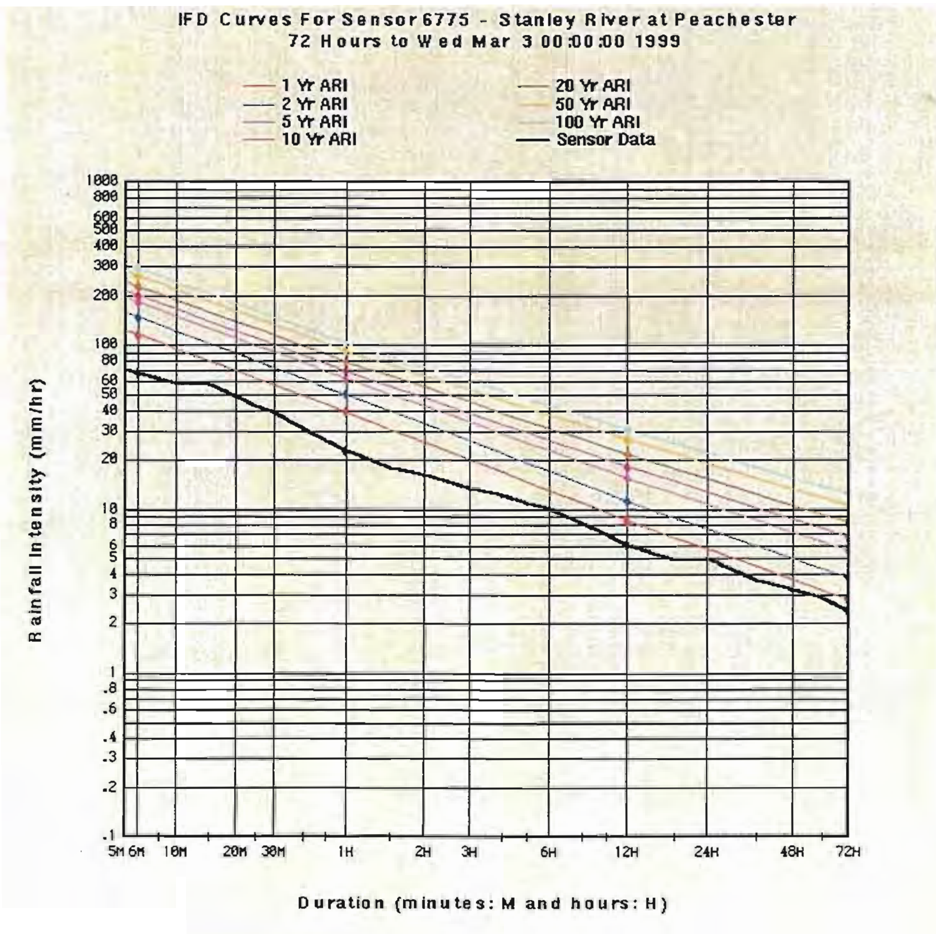
APPENDIX F

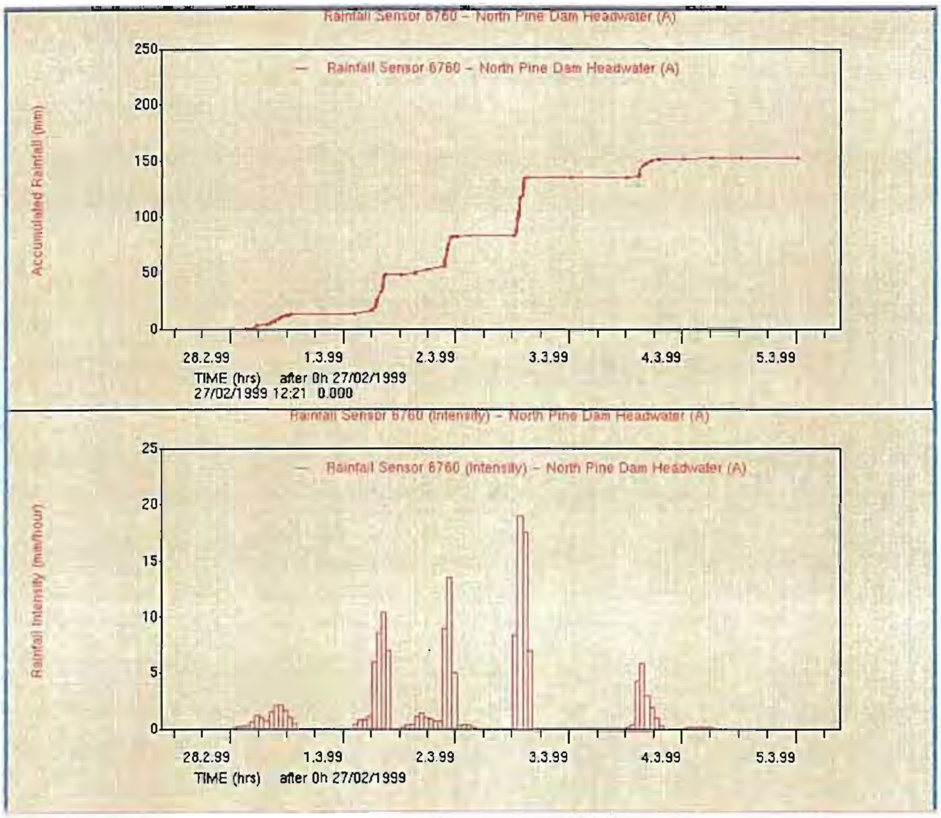
REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR MARCH 1999 EVENT

APPENDIX F- Cumulative Rainfalls & IFD Curves for March 1999 Event

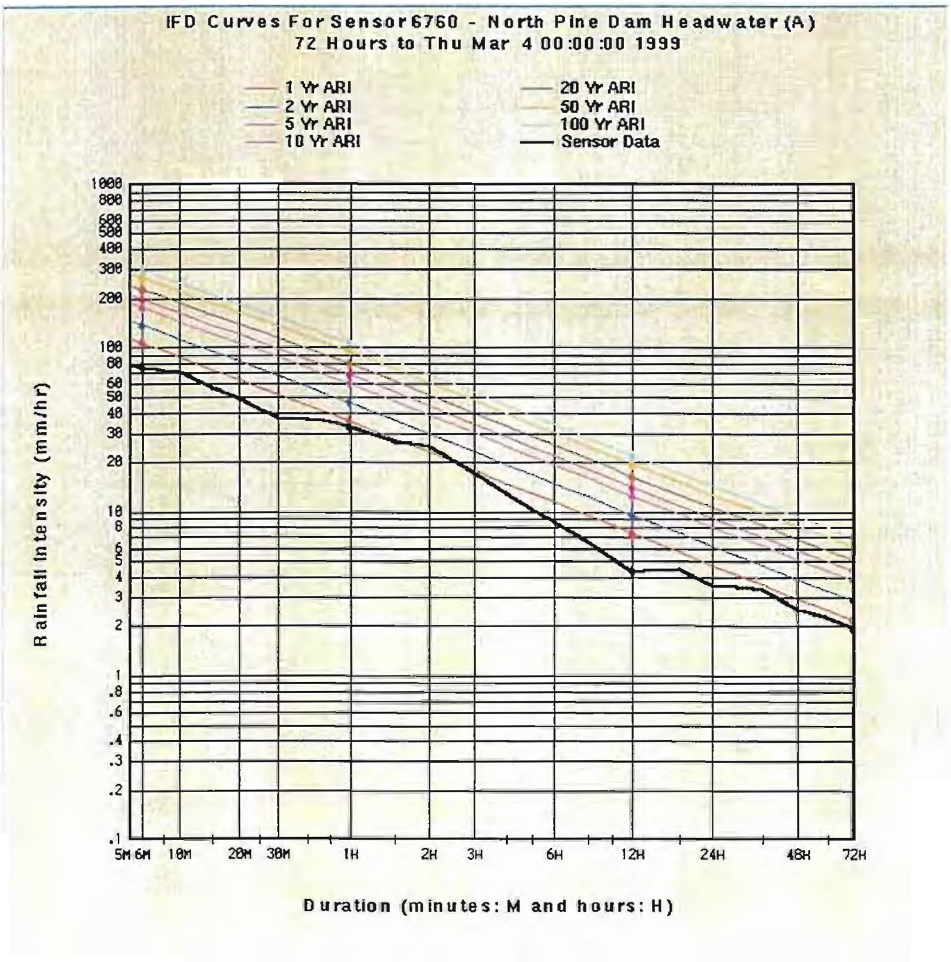


Somerset Catchment Rainfall Sensor 6775 - Stanley River at Peachester





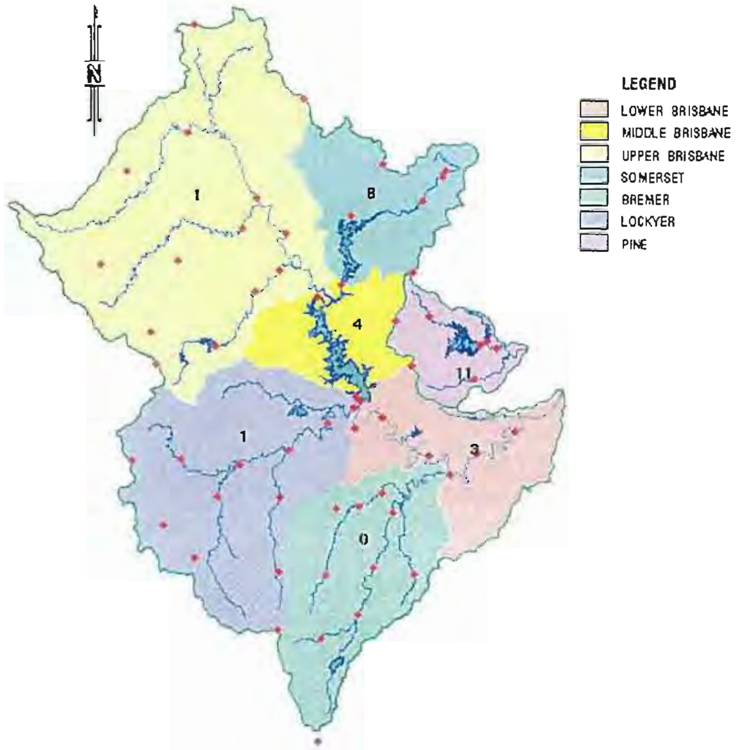
Pine Catchment Rainfall Sensor 6760 - North Pine Dam Headwater



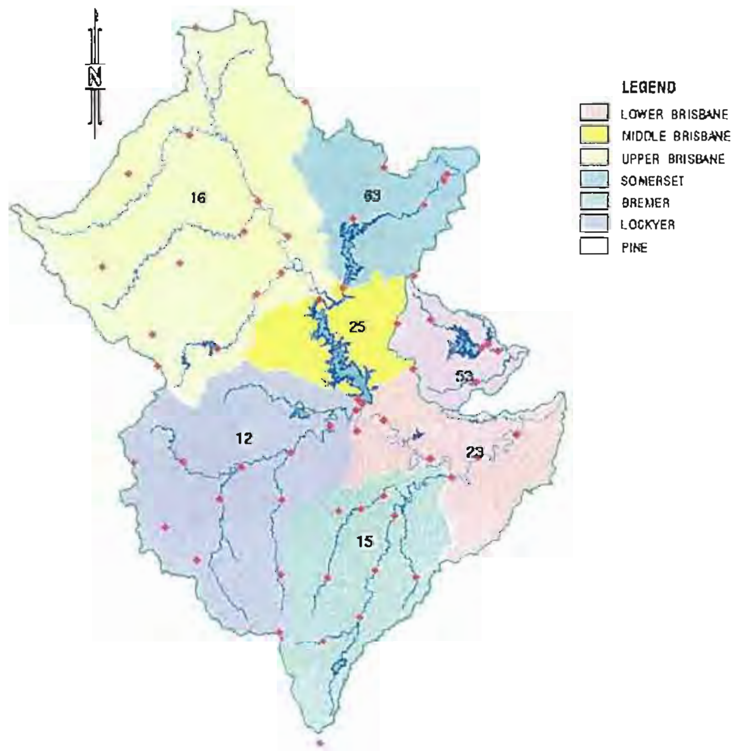
APPENDIX G

CATCHMENT RAINFALLS FOR MARCH 1999 EVENT

APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event



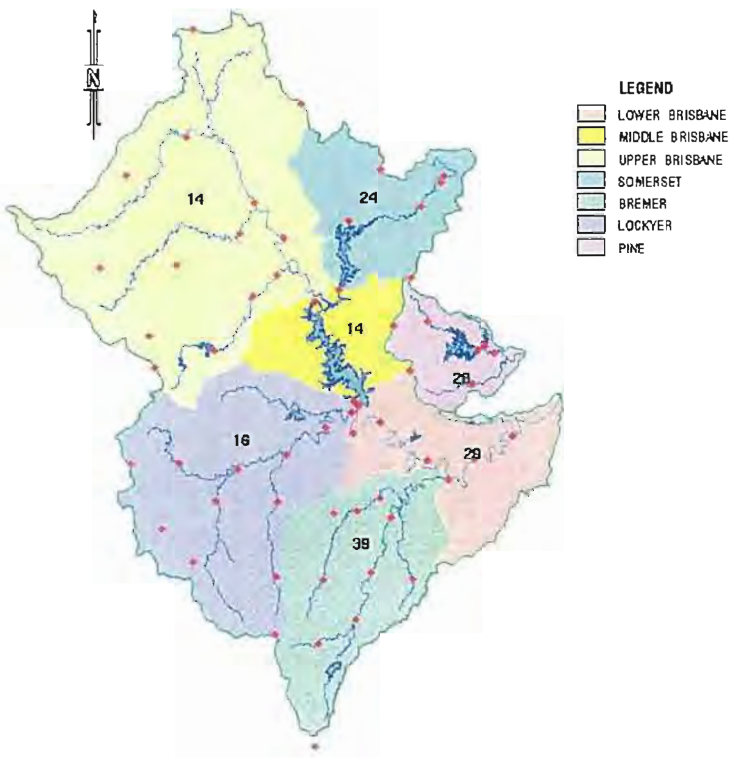
Sub-Catchment 24hr Total Rainfall to 9:00am 28/2/99



Sub-Catchment 24hr Total Rainfall to 9:00am 1/3/99

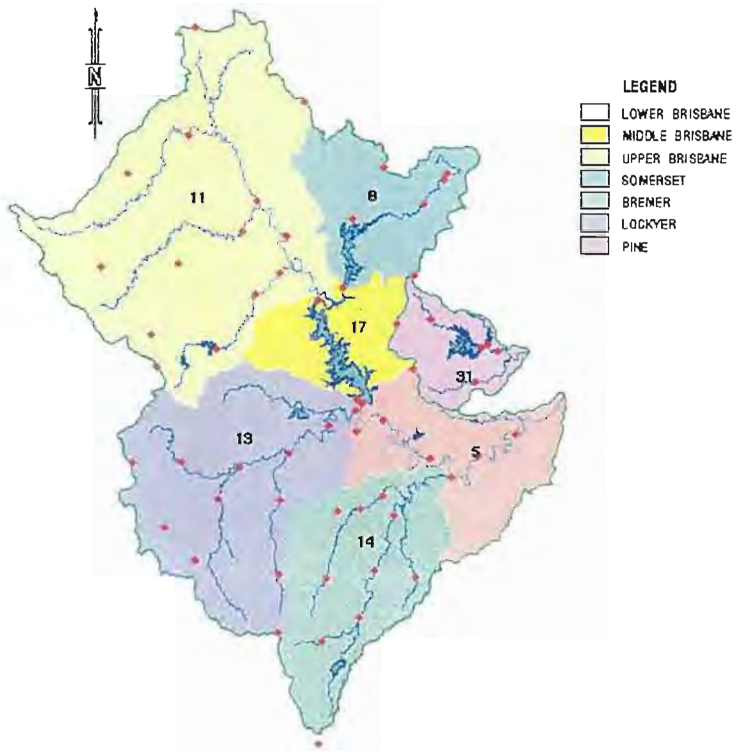
APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event

Sub-Catchment 24hr Total Rainfall to 9:00am 2/3/99

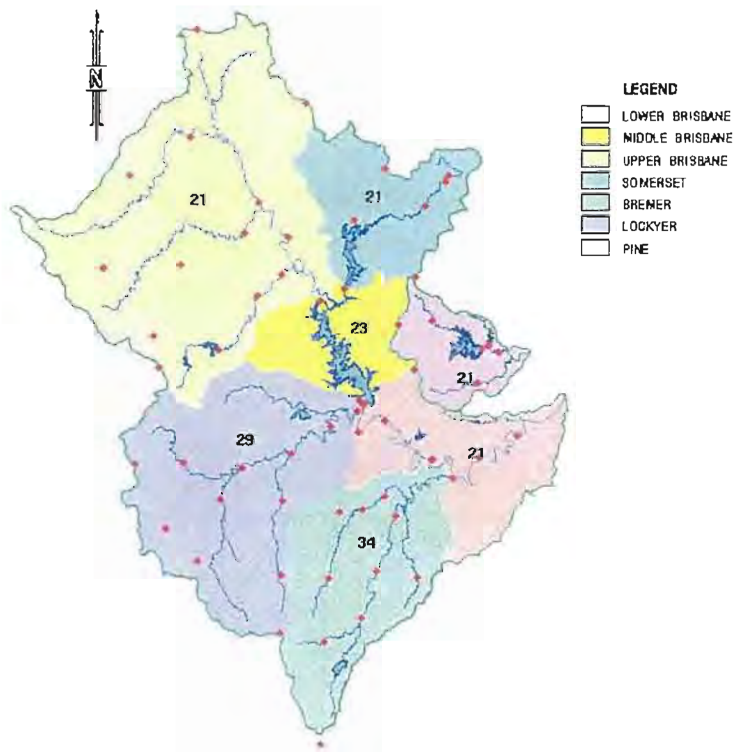


Sub-Catchment 24hr Total Rainfall to 9:00am 3/3/99

APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event



Sub-Catchment 24hr Total Rainfall to 9:00am 4/3/99



APPENDIX H

INFLOW and OUTFLOW HYDROGRAPHS MARCH 1999 EVENT

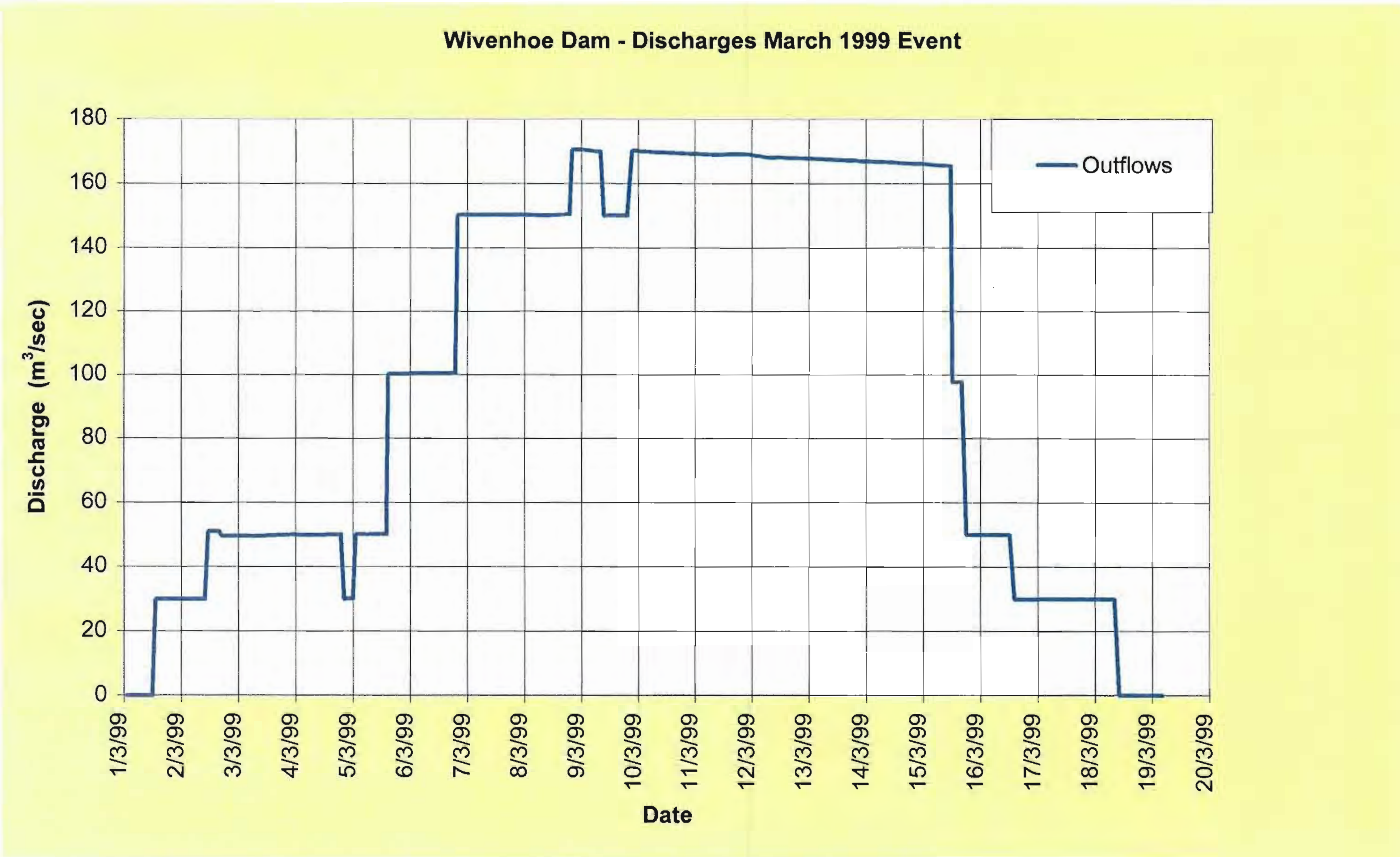
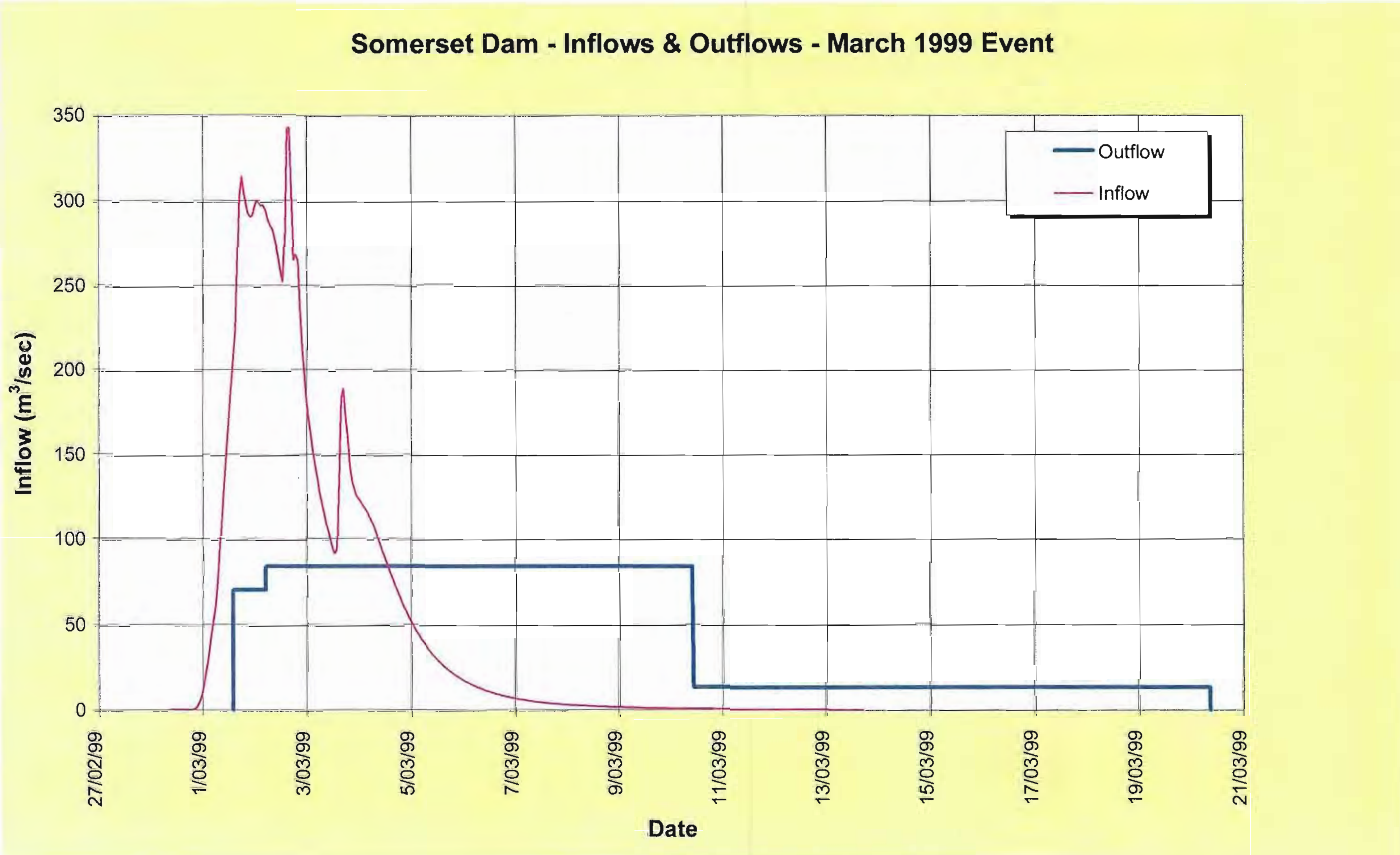

Wivenhoe Dam - Discharges March 1999 Event
Discharge (m3/sec)
180
160
140
120
100
80
60
40
20
0
Outflows
1/3/99
2/3/99
3/3/99
4/3/99
5/3/99
6/3/99
7/3/99
8/3/99
9/3/99
10/3/99
11/3/99
12/3/99
13/3/99
14/3/99
15/3/99
16/3/99
17/3/99
18/3/99
19/3/99
20/3/99
Date

FIGURE H1



Somerset Dam - Inflows & Outflows - March 1999 Event
Outflow
Inflow
Inflow (m³/sec)
350
300
250
200
150
100
50
0
27/02/99
1/03/99
3/03/99
5/03/99
7/03/99
9/03/99
11/03/99
13/03/99
15/03/99
17/03/99
19/03/99
21/03/99
Date

FIGURE H2

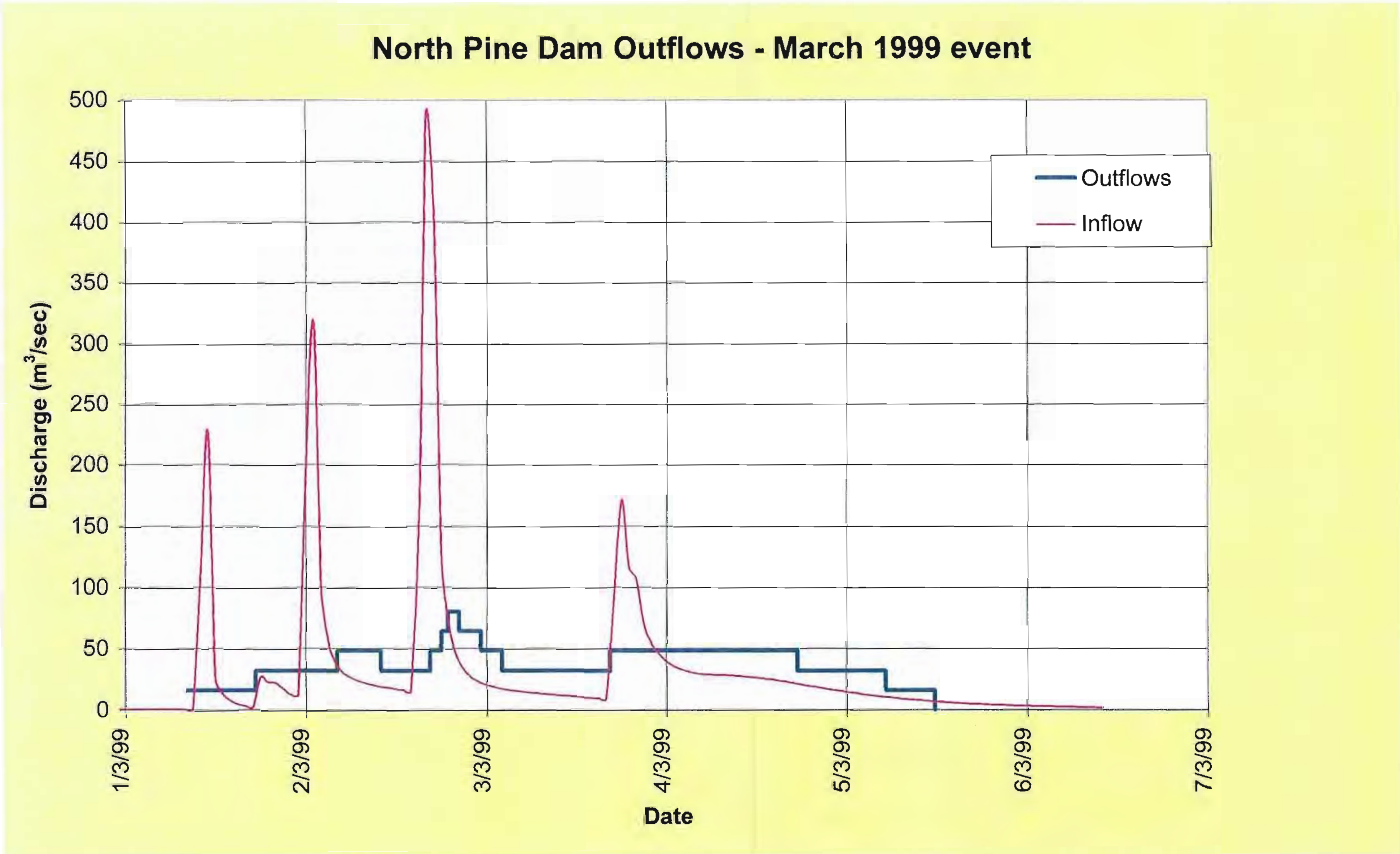
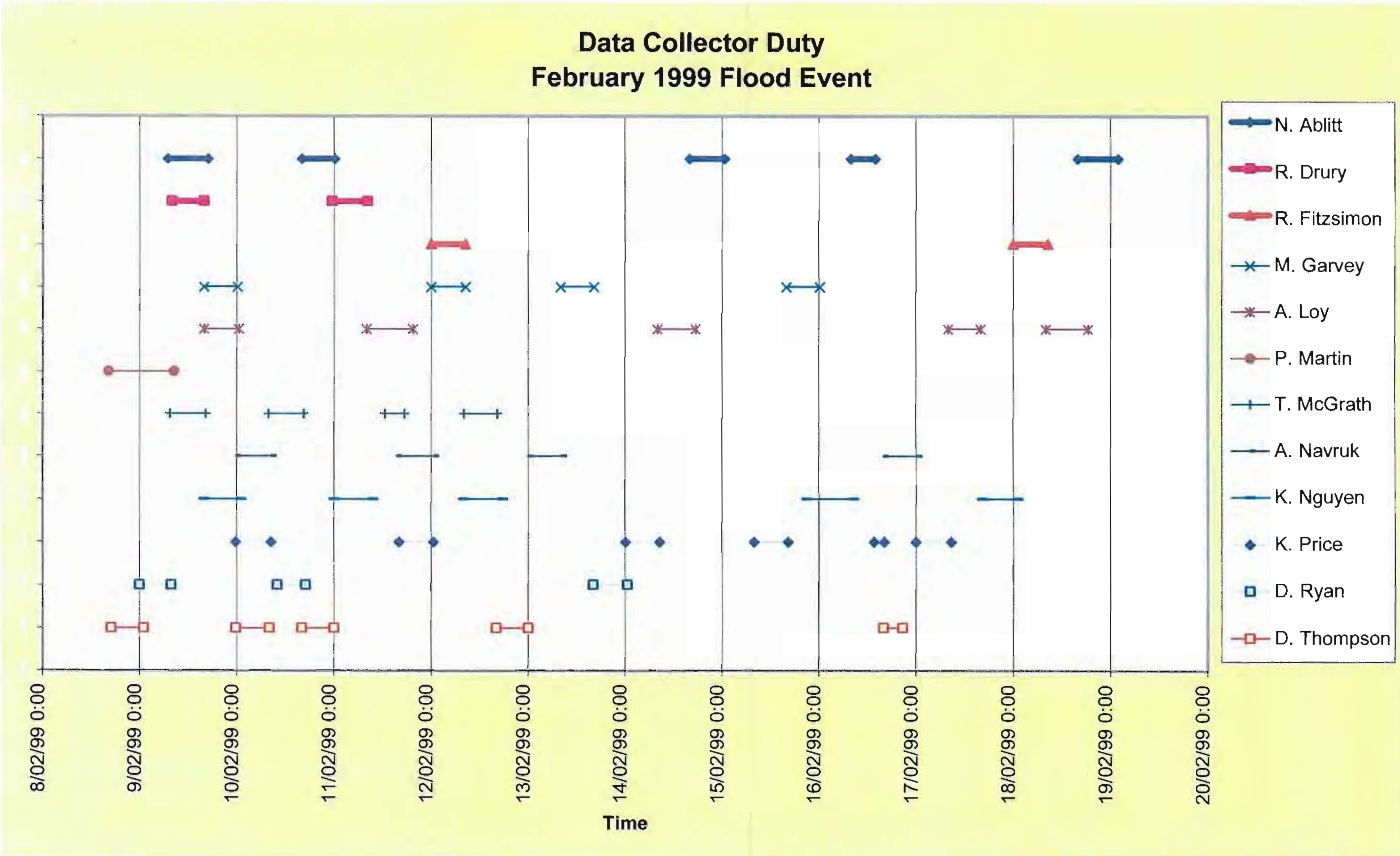

North Pine Dam Outflows - March 1999 event
500
450
400
350
300
250
200
150
100
50
0
Discharge (m3/sec)
1/3/99
2/3/99
3/3/99
4/3/99
5/3/99
6/3/99
7/3/99
Date
Outflows
Inflow

FIGURE H3

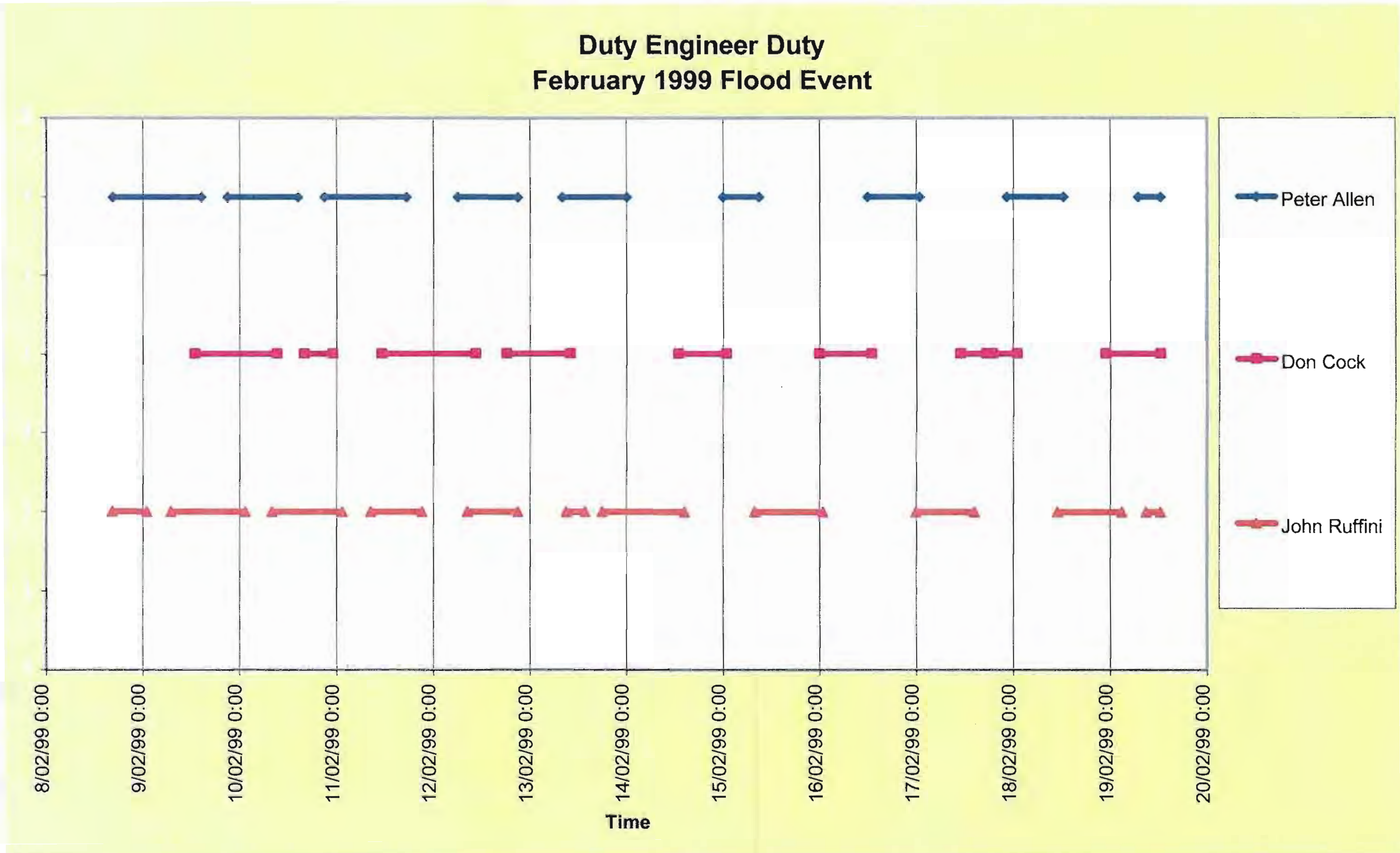
APPENDIX I

RECORD OF DUTY ENGINEERS and DATA COLLECTORS FOR FEBRUARY and MARCH 1999 EVENT

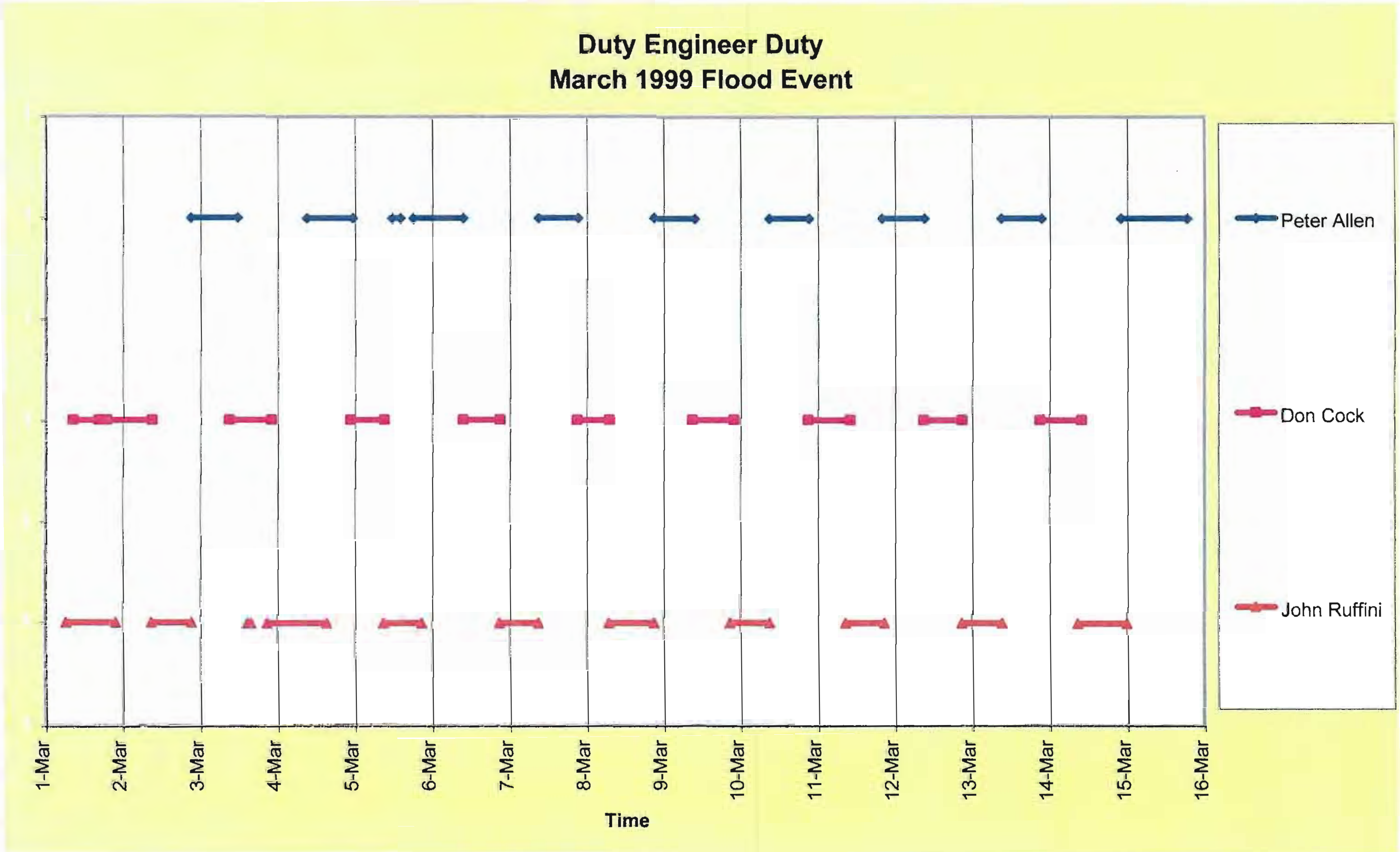
APPENDIX I



Duty_Feb99.xls

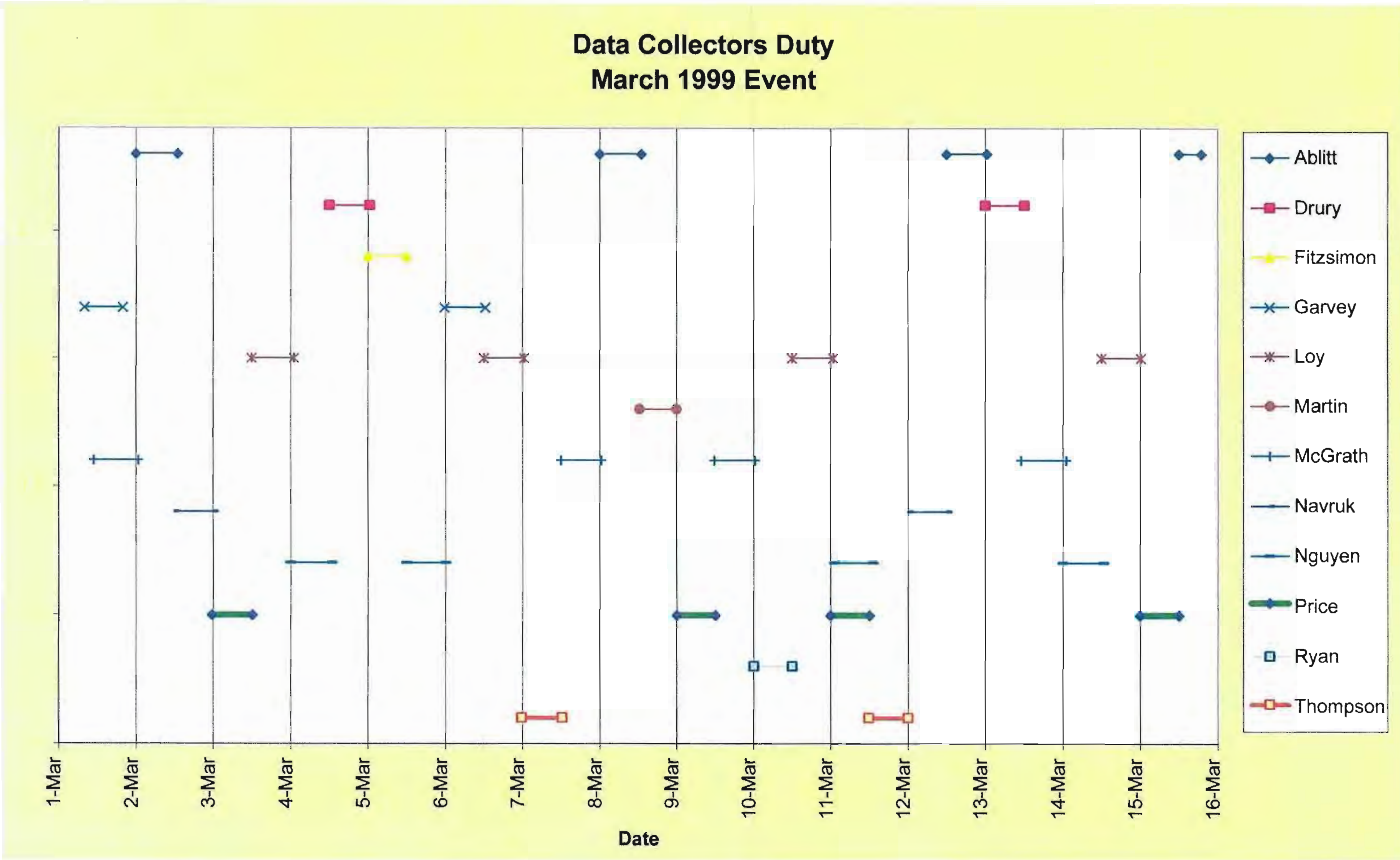

Duty Engineer Duty
February 1999 Flood Event
Peter Allen
Don Cock
John Ruffini
8/02/99 0:00
9/02/99 0:00
10/02/99 0:00
11/02/99 0:00
12/02/99 0:00
13/02/99 0:00
14/02/99 0:00
15/02/99 0:00
16/02/99 0:00
17/02/99 0:00
18/02/99 0:00
19/02/99 0:00
20/02/99 0:00
Time

APPENDIX I



Duty_Mar99.xls

APPENDIX I



Duty_Mar99.xls

OCTOBER - DECEMBER 2010
FLOOD EVENTS

REPORT ON THE OPERATION OF
SOMERSET DAM AND WIVENHOE DAM

MAY 2011

EXECUTIVE SUMMARY

Somerset Dam and Wivenhoe Dam are located in the Brisbane River Basin. The Dams are dual-purpose storages that provide urban water supplies (including drinking water) to South East Queensland, as well as flood mitigation benefits to areas potentially impacted by flood flows along the Brisbane River below Wivenhoe Dam.

October 2010 Flood Event

The October 2010 Flood Event impacted the Dams between Saturday 9 October 2010 and Tuesday 19 October 2010. The Event had an Annual Exceedance Probability (AEP) of less than 1 in 50 and can be categorised as a frequent flood event according to the Institution of Engineers Australia (Engineers Australia) national guidelines for the estimation of design flood characteristics (AR&R).

The flood was managed primarily to minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers. There were no known adverse impacts to urban areas downstream of Moggill as a result of the Flood Event.

Clear flood mitigation benefits provided by Wivenhoe Dam during the Event included preventing the inundation of Mt Crosby Weir Bridge and reducing the peak flow in the Brisbane River at Moggill from a potential flow of 3,000m^3/s to an actual flow of around 1,500m^3/s. Damage tables supplied by the Brisbane City Council indicate a flow of 3,000m^3/s at Moggill could cause damage in the Brisbane area exceeding $5 million.

December 2010 Flood Events

Three flood events impacted Somerset and Wivenhoe Dams between Monday 13 December 2010 and Sunday 2 January 2011. The December Flood Events had an Annual Exceedance Probability (AEP) of less than 1 in 10 and can also be categorised as frequent flood events according to the Institution of Engineers Australia (Engineers Australia) national guidelines for the estimation of design flood characteristics (AR&R).

The floods were managed primarily to minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers. There were no known adverse impacts to urban areas downstream of Moggill resulting from the Events.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Meaning of terms

In this report, the following terms are defined as below:

"Act" means the Water Supply (Safety and Reliability) Act 2008;

"AEP" means Annual Exceedance Probability, the probability of a specified event being reached or exceeded in any one year. This may be expressed as a ratio (e.g. 1 in Y) or a percentage;

"Agency" includes a person, a local government and a department of State government within the meaning of the *Acts Interpretation Act 1954*;

"AHD" means Australian Height Datum;

"ALERT" means Automated Local Evaluation in Real Time System, a system of monitoring and displaying rainfall and water level data. It is a combination of field stations, communications networks and data collection software;

"AMTD" means the Adopted Middle Thread Distance, which is the distance along the centre line of the mainstream from a junction, usually in kilometres;

"ANSI" means the American National Standards Institute;

"AR&R" means *Australian Rainfall and Run-off (Book 6),* The Institution of Engineers Australia (Engineers Australia) national guidelines for the estimation of design flood characteristics;

"BoM" means the Bureau of Meteorology;

"Chairperson" means the Chairperson of Seqwater;

"Chief Executive" means the Director-General of the Department of Environment and Resource Management or nominated delegate;

"Controlled Document" means a document subject to managerial control over its contents, distribution and storage. It may have legal and contractual implications;

"Dams" means Somerset Dam and Wivenhoe Dam;

"Dam Crest Flood" means the flood event which, when routed through the storage with the storage initially at Full Supply Level, results in the still water level in the storage reaching the lowest point in the dam embankment, excluding wind and wave effects;

“Dam Supervisor” means the senior on-site officer at Somerset or Wivenhoe Dam as the case may be;

“DERM” means the Queensland Government department, the Department of Environment and Resource Management;

“Duty Flood Operations Engineer” means the Senior Flood Operations Engineer or Flood Operations Engineer rostered on duty to be in charge of Flood Operations at the Dams;

“EL” means elevation in metres Australian Height Datum;

“Enviromon” is the Bureau of Meteorology data collection software used to collect and display rainfall and water level data;

“ERRTS” means Event Reporting Radio Telemetry System;

“Flood Event” is a situation where the Duty Flood Operations Engineer expects the water level in either of the Dams to exceed the Full Supply Level;

“FLOOD-Col” is the data collection software used in the Flood Operations Centre to collect and display rainfall and water level data;

“FLOOD-Ops” is the modelling software used in the Flood Operations Centre to model the runoff from the catchments;

“Flood Operations Centre” means the office location used by Flood Operations Engineers during a flood event to manage the event;

“Flood Operations Engineer” means a person designated to direct flood operations at the Dams in accordance with Section 2.4 of the Manual;

“Flood Operations Engineers” means the collective group of persons who individually have designation as either a **Flood Operations Engineer** or a **Senior Flood Operations Engineer**;

“**Flood Operations Manager**” means the Senior Flood Operations Engineer or Flood Operations Engineer designated responsibility for the overall management of the Flood Operations Centre leading up to or during a flood event;

“FSL” or “Full Supply Level” means the level of the water surface when the reservoir is at maximum operating level, excluding periods of flood discharge;

“Gauge” when referred to in (m) means river level referenced to AHD or a local datum, and when referred to in (m^3/s) means flow rate in cubic metres per second;

“IFD” means Intensity Frequency Duration and refers to the statistical analysis of rainfall intensities;

“Manual” or **“Manual of Operational Procedures for Flood Events at Wivenhoe Dam and Somerset Dam”** means the current version (Revision 7) of the Manual;

“m^3/s” means a rate of water flow being one cubic metre of water per second or 1,000 litres of water per second;

“OOA” means ‘out of action’ in relation to the operation of a rainfall or river height gauge that provides catchment data;

“Operating Target Line” means the Wivenhoe/Somerset Operating Target Line from Strategy S2 of the Manual;

“Power Station” means the Wivenhoe pumped storage hydro-electric power station associated with Wivenhoe Dam and Splityard Creek Dam;

“Protocol” means draft Communication Protocol prepared by DERM to ensure information is effectively communicated to the public during flood events impacting Somerset Dam and Wivenhoe Dam;

“QPF” means Quantitative Precipitation Forecast provided by the Bureau of Meteorology and is an estimate of the predicted rainfall in millimetres, usually in the next 24 hours;

“RTFM” means Real Time Flood Model and is a combination of Flood-Col, Flood-Ops and other ancillary software;

“SD” means State Datum, which is a level height datum that is different from AHD;

“Senior Flood Operations Engineer” means a person designated in accordance with Section 2.3 of the Manual under whose general direction the procedures in the Manual must be carried out;

“Seqwater” means the Queensland Bulk Water Supply Authority, trading as Seqwater;

“URBS” means Unified River Basin Simulator.

Note: Dam levels in this document represented as metres (m) are metres Australian Height Datum or (m AHD).

1.2 Background

Given the potential significant impact on downstream populations and property, it is imperative Somerset and Wivenhoe Dams are operated during flood events in accordance with clearly defined and pre-determined procedures. The current procedures are contained in Revision 7 of *The Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam* ("the Manual") that was gazetted in January 2010. The Manual is an approved flood mitigation manual under the *Queensland Water Supply (Safety and Reliability) Act 2008*. An understanding of the Manual is important when reading this Report.

The Manual requires the owner of Somerset and Wivenhoe Dams (currently Seqwater) to prepare a report after each flood event impacting the Dams. A flood event is defined as a situation where either Somerset and or Wivenhoe Dams exceed their Full Supply Level (FSL) and flood water releases are made. The report must contain details of the procedures followed during the flood event, the reasons why those procedures were used and other pertinent information. Seqwater must forward the report to the Director-General of the Department of Environment and Resource Management (DERM). These reports are normally required within six weeks of the end of the Event. However, given the large number flood events experienced during the 2010/11 wet season and the requirements of the Flood Commission of Inquiry, DERM extended the deadline for this report until 31 May 2011.

This document comprises the required report relating to the four flood events that impacted Somerset and Wivenhoe Dams between October 2010 and December 2010.

2. EVENT MOBILISATION AND STAFFING

2.1 Event Mobilisation

The Flood Operations Centre was mobilised well before gate opening trigger levels were reached at the Dams during each flood event. This allowed the Flood Operations Centre to be well prepared for the events and provided time for the Dam Operators to prepare the dam sites for the releases and undertake all operational checks. The table below details the date and time of each mobilisation time in relation to the commencement of flood releases.

Flood Event	Mobilisation Time	Flood Release Commencement
October 2010	06:30 - 09 October 2010	19:00 - 09 October 2010
Early December 2010	07:00 - 11 December 2010	12:30 - 13 December 2010
Mid December 2010	10:00 - 17 December 2010	18:00 - 17 December 2010
Late December 2010	05:30 - 25 December 2010	09:00 - 26 December 2010

The following actions were undertaken as soon as mobilisation occurred:

- 24/7 staffing commenced at the Flood Operations Centre, generally with at least one Duty Flood Operations Engineer and one trained Flood Officer present (normally two persons);
- 24/7 staffing commenced at the Dams, generally with two trained Dam Operators present;
- Flood Operations Engineers were called back early from annual leave to assist with the management of the events.

The Flood Operations Centre and Dams continued to be staffed on this basis until event de-mobilisation.

2.2 Flood Operations Centre Staffing

The tables below detail Flood Operations Centre staffing during each flood event. Each table has been compiled in accordance with the confirmed Event Roster.

OCTOBER EVENT			
Shift start time	**Shift finish time**	**Flood Operations Engineer**	**Flood Officer**
Sat 09/10/10 07:00	Sat 09/10/10 19:00	Engineer 1	Flood Officer 5 Flood Officer 2
Sat 09/10/10 19:00	Sun 10/10/10 07:00	Engineer 4	Flood Officer 3

OCTOBER EVENT			
Shift start time	**Shift finish time**	**Flood Operations Engineer**	**Flood Officer**
Sun 10/10/10 07:00	Sun 10/10/10 19:00	Engineer 2	Flood Officer 6
Sun 10/10/10 19:00	Mon 11/10/10 07:00	Engineer 3	Flood Officer 4
Mon 11/10/10 07:00	Mon 11/10/10 19:00	Engineer 1, Engineer 2	Flood Officer 10
Mon 11/10/10 19:00	Tue 12/10/10 07:00	Engineer 4	Flood Officer 11
Tue 12/10/10 07:00	Tue 12/10/10 19:00	Engineer 2	Flood Officer 5
Tue 12/10/10 19:00	Wed 13/10/10 07:00	Engineer 1	Flood Officer 7
Wed 13/10/10 07:00	Wed 13/10/10 19:00	Engineer 3	Flood Officer 3
Wed 13/10/10 19:00	Thu 14/10/10 07:00	Engineer 2	Flood Officer 9
Thu 14/10/10 07:00	Thu 14/10/10 19:00	Engineer 4	Flood Officer 4
Thu 14/10/10 19:00	Fri 15/10/10 07:00	Engineer 3	Flood Officer 1
Fri 15/10/10 07:00	Fri 15/10/10 19:00	Engineer 1	Flood Officer 11
Fri 15/10/10 19:00	Sat 16/10/10 07:00	Engineer 4	Flood Officer 10
Sat 16/10/10 07:00	Sat 16/10/10 19:00	Engineer 2	Flood Officer 8
Sat 16/10/10 19:00	Sun 17/10/10 07:00	Engineer 1	Flood Officer 12
Sun 17/10/10 07:00	Sun 17/10/10 19:00	Engineer 3	Flood Officer 2
Sun 17/10/10 19:00	Mon 18/10/10 07:00	Engineer 2	Flood Officer 6
Mon 18/10/10 07:00	Mon 18/10/10 19:00	Engineer 4	Flood Officer 9
Mon 18/10/10 19:00	Tue 19/10/10 07:00	Engineer 3	Flood Officer 5
Tue 19/10/10 07:00	Tue 19/10/10 09:15	Engineer 2	Flood Officer 7

OCTOBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Sat 09/10/10 07:00	Sat 09/10/10 19:00	Dam Operator 10 Dam Operator 9	Dam Operator 2 Dam Operator 13
Sat 09/10/10 19:00	Sun 10/10/10 07:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Sun 10/10/10 07:00	Sun 10/10/10 19:00	Dam Operator 10 Dam Operator 6	Dam Operator 2 Dam Operator 13
Sun 10/10/10 19:00	Mon 11/10/10 07:00	Dam Operator 7 Dam Operator 9	Dam Operator 4 Dam Operator 1
Mon 11/10/10 07:00	Mon 11/10/10 19:00	Dam Operator 10 Dam Operator 11	Dam Operator 2 Dam Operator 13
Mon 11/10/10 19:00	Tue 12/10/10 07:00	Dam Operator 7 Dam Operator 21	Dam Operator 4 Dam Operator 1

OCTOBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Tue 12/10/10 07:00	Tue 12/10/10 19:00	Dam Operator 10 Dam Operator 6	Dam Operator 2 Dam Operator 13
Tue 12/10/10 19:00	Wed 13/10/10 07:00	Dam Operator 7 Dam Operator 9	Dam Operator 4 Dam Operator 1
Wed 13/10/10 07:00	Wed 13/10/10 19:00	Dam Operator 10 Dam Operator 12	Dam Operator 2 Dam Operator 13
Wed 13/10/10 19:00	Thu 14/10/10 07:00	Dam Operator 7 Dam Operator 9	Dam Operator 4 Dam Operator 22
Thu 14/10/10 07:00	Thu 14/10/10 19:00	Dam Operator 10 Dam Operator 11	Dam Operator 2 Dam Operator 1
Thu 14/10/10 19:00	Fri 15/10/10 07:00	Dam Operator 7 Dam Operator 21	Dam Operator 4 Dam Operator 13
Fri 15/10/10 07:00	Fri 15/10/10 19:00	Dam Operator 10 Dam Operator 6	Dam Operator 2 Dam Operator 1
Fri 15/10/10 19:00	Sat 16/10/10 07:00	Dam Operator 7 Dam Operator 21	Dam Operator 2
Sat 16/10/10 07:00	Sat 16/10/10 19:00	Dam Operator 10 Dam Operator 12	Dam Operator 4 Dam Operator 1
Sat 16/10/10 19:00	Sun 17/10/10 07:00	Dam Operator 7 Dam Operator 9	Dam Operator 2 Dam Operator 13
Sun 17/10/10 07:00	Sun 17/10/10 19:00	Dam Operator 10 Dam Operator 11	Dam Operator 4 Dam Operator 1
Sun 17/10/10 19:00	Mon 18/10/10 07:00	Dam Operator 7 Dam Operator 6	Dam Operator 2 Dam Operator 13
Mon 18/10/10 07:00	Mon 18/10/10 19:00	Dam Operator 10 Dam Operator 12	Dam Operator 4 Dam Operator 1
Mon 18/10/10 19:00	Tue 19/10/10 07:00	Dam Operator 7 Dam Operator 9	Dam Operator 2 Dam Operator 13
Tue 19/10/10 07:00	Tue 19/10/10 19:00	Dam Operator 10	Dam Operator 4

EARLY DECEMBER EVENT			
Shift start times	**Shift finish times**	**Flood Operations Engineer**	**Flood Officer**
Mon 13/12/10 07:00	Mon 13/12/10 19:00	Engineer 2	
Mon 14/12/10 19:00	Tue 14/12/10 07:00	Engineer 4	

EARLY DECEMBER EVENT			
Shift start times	**Shift finish times**	**Flood Operations Engineer**	**Flood Officer**
Tue 14/12/10 07:00	Tue 14/12/10 19:00	Engineer 2	Flood Officer 6
Tue 14/12/10 19:00	Wed 15/12/10 07:00	Engineer 4	
Wed 15/12/10 07:00	Wed 15/12/10 19:00	Engineer 3	Flood Officer 4
Wed 15/12/10 19:00	Thu 16/12/10 07:00	Engineer 4	
Thu 16/12/10 07:00	Thu 16/12/10 10:30	Engineer 2	Flood Officer 9

EARLY DECEMBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Mon 13/12/10 11:00	Mon 13/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 4 Dam Operator 9
Mon 13/12/210 19:00	Tue 14/12/10 07:00	Dam Operator 10 Dam Operator 21	Dam Operator 2 Dam Operator 22
Tue 14/12/10 07:00	Tue 14/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 4 Dam Operator 9
Tue 14/12/10 19:00	Wed 15/12/10 07:00	Dam Operator 10 Dam Operator 21	Dam Operator 2 Dam Operator 22
Wed 15/12/10 07:00	Wed 15/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 9
Wed 15/12/10 19:00	Thu 16/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 2 Dam Operator 13
Thu 16/12/10 07:00	Thu 16/12/10 10:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1

MID DECEMBER EVENT			
Shift start times	**Shift finish times**	**Flood Operations Engineer**	**Flood Officer**
Fri 17/12/10 16:00	Sat 18/12/10 07:00	Engineer 3	Flood Officer 1
Sat 18/12/10 07:00	Sat 18/12/10 19:00	Engineer 4	Flood Officer 6
Sat 18/12/10 19:00	Sun 19/12/10 07:00	Engineer 2	Flood Officer 2
Sun 19/12/10 07:00	Sun 19/12/10 19:00	Engineer 1	Flood Officer 3
Sun 19/12/10 19:00	Mon 20/12/10 07:00	Engineer 4	Flood Officer 7
Mon 20/12/10 07:00	Mon 20/12/10 19:00	Engineer 3	Flood Officer 9
Mon 20/12/10 19:00	Tue 21/12/10 07:00	Engineer 1	Flood Officer 8

MID DECEMBER EVENT			
Shift start times	**Shift finish times**	**Flood Operations Engineer**	**Flood Officer**
Tue 21/12/10 07:00	Tue 21/12/10 19:00	Engineer 2	Flood Officer 4
Tue 21/12/10 19:00	Wed 22/12/10 07:00	Engineer 3	Flood Officer 6
Wed 22/12/10 07:00	Wed 22/12/10 19:00	Engineer 2	Flood Officer 2
Wed 22/12/10 19:00	Thu 23/12/10 07:00	Engineer 4	Flood Officer 3
Thu 23/12/10 07:00	Thu 23/12/10 19:00	Engineer 1	Flood Officer 1
Thu 23/12/10 19:00	Fri 24/12/10 07:00	Engineer 4	Flood Officer 7
Fri 24/12/10 07:00	Fri 24/12/10 15:00	Engineer 3	Flood Officer 9

MID DECEMBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Fri 17/12/10 07:00	Fri 17/12/10 19:00	Dam Operator 7	Dam Operator 2 on-call
Fri 17/12/10 19:00	Sat 18/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 2 on-call
Sat 18/12/10 07:00	Sat 18/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 2 on-call
Sat 18/12/10 19:00	Sun 19/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 4 on-call
Sun 19/12/10 07:00	Sun 19/12/10 19:00	Dam Operator 7 Dam Operator 5	Dam Operator 4 on-call
Sun 19/12/10 19:00	Mon 20/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 4 on-call
Mon 20/12/10 07:00	Mon 20/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 4 Dam Operator 1
Mon 20/12/10 19:00	Tue 21/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 2 Dam Operator 3
Tue 21/12/10 07:00	Tue 21/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Tue 21/12/10 19:00	Wed 22/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 3
Wed 22/12/10 07:00	Wed 22/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Wed 22/12/10 19:00	Thu 23/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 3

MID DECEMBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Thu 23/12/10 07:00	Thu 23/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Thu 23/12/10 19:00	Fri 24/12/10 07:00	Dam Operator 10 Dam Operator 9	Dam Operator 2 Dam Operator 13
Fri 24/12/10 07:00	Fri 24/12/10 19:00	Dam Operator 7 Dam Operator 5	Dam Operator 4 Dam Operator 1

LATE DECEMBER EVENT			
Shift start times	**Shift finish times**	**Flood Operations Engineer**	**Flood Officer**
Sun 26/12/10 07:00	Sun 26/12/10 19:00	Engineer 1	Flood Officer 3
Sun 26/12/10 19:00	Mon 27/12/10 07:00	Engineer 4	Flood Officer 2
Mon 27/12/10 07:00	Mon 27/12/10 19:00	Engineer 2	Flood Officer 4
Mon 27/12/10 19:00	Tue 28/12/10 07:00	Engineer 4	Flood Officer 1
Tue 28/12/10 07:00	Tue 28/12/10 19:00	Engineer 2	Flood Officer 8
Tue 28/12/10 19:00	Wed 29/12/10 07:00	Engineer 3	Flood Officer 9
Wed 29/12/10 07:00	Wed 29/12/10 19:00	Engineer 2	Flood Officer 7
Wed 29/12/10 19:00	Thu 30/12/10 07:00	Engineer 1	Flood Officer 3
Thu 30/12/10 07:00	Thu 30/12/10 19:00	Engineer 2	Flood Officer 2
Thu 30/12/10 19:00	Fri 31/12/10 07:00	Engineer 3	Flood Officer 4
Fri 31/12/10 07:00	Fri 31/12/10 19:00	Engineer 2	Flood Officer 1
Fri 31/12/10 19:00	Sat 01/01/11 07:00	Engineer 3	Flood Officer 8
Sat 01/01/11 07:00	Sat 01/01/11 19:00	Engineer 2	Flood Officer 9
Sat 01/01/11 19:00	Sun 02/01/11 07:00	Engineer 1	Flood Officer 7
Sun 02/01/11 07:00	Sun 02/01/11 09:45	Engineer 2	Flood Officer 3

LATE DECEMBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Sun 26/12/10 07:00	Sun 26/12/10 19:00	Dam Operator 7 Dam Operator 9	Dam Operator 4 Dam Operator 1
Sun 26/12/10 19:00	Mon 27/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 13

LATE DECEMBER EVENT			
Shift start times	**Shift finish times**	**Wivenhoe Dam Operators**	**Somerset Dam Operators**
Mon 27/12/10 07:00	Mon 27/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Mon 27/12/10 19:00	Tue 28/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 13
Tue 28/12/10 07:00	Tue 28/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Tue 28/12/10 19:00	Wed 29/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 13
Wed 29/12/10 07:00	Wed 29/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 4 Dam Operator 1
Wed 29/12/10 19:00	Thu 30/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 13
Thu 30/12/10 07:00	Thu 30/12/10 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 4 Dam Operator 1
Thu 30/12/10 19:00	Fri 31/12/10 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 2 Dam Operator 13
Fri 31/12/10 07:00	Fri 31/12/10 19:00	Dam Operator 7 Dam Operator 6	Dam Operator 23 (Dam Operator 4 on-call)
Fri 31/12/10 19:00	Sat 01/01/11 07:00	Dam Operator 10 Dam Operator 5	Dam Operator 13 (Dam Operator 4 on-call)
Sat 01/01/11 07:00	Sat 01/01/11 19:00	Dam Operator 7 Dam Operator 12	Dam Operator 23 (Dam Operator 4 on-call)
Sat 01/01/11 19:00	Sun 02/01/11 07:00	Dam Operator 10 Dam Operator 6	Dam Operator 13 (Dam Operator 4 on-call)
Sun 02/01/11 07:00	Sun 02/01/11 19:00	Dam Operator 7 Dam Operator 5	Dam Operator 23 (Dam Operator 4 on-call)

3. EVENT CONDITIONS

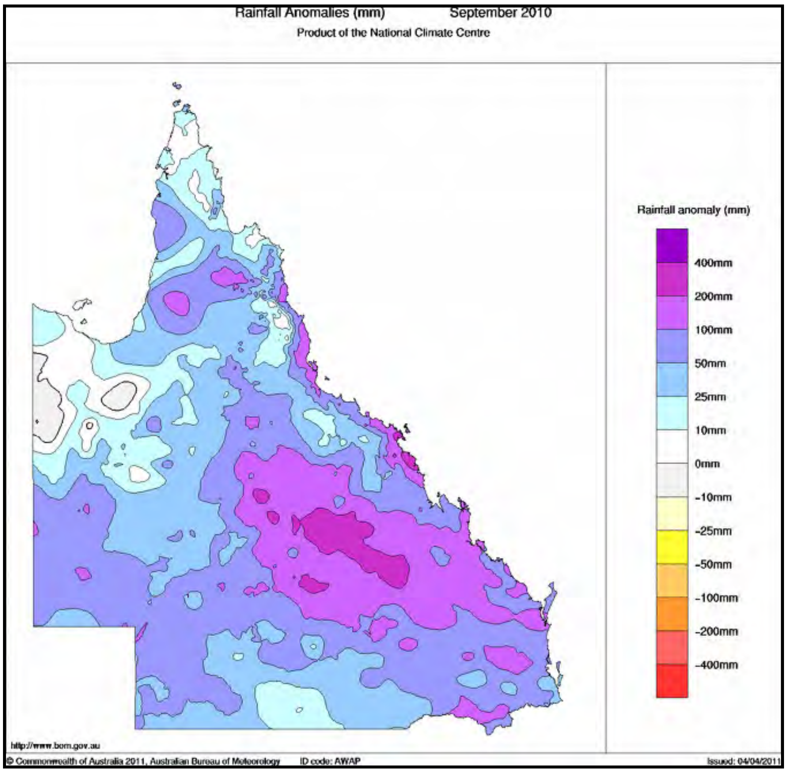
3.1 Introduction

For the purposes of this section of the report, the designated start date of each event has been taken as the commencement of modelling which may be earlier than the time the Flood Operations Centre was mobilised. This is to account for antecedent conditions and any rainfall which occurred prior to mobilisation of the Flood Operations Centre. These start dates are shown in the following table:

Event	Designated Start Date
October 2010	06/10/2010 09:00
Early December 2010	01/12/2010 09:00
Mid December 2010	16/12/2010 09:00
Late December 2010	24/12/2010 09:00

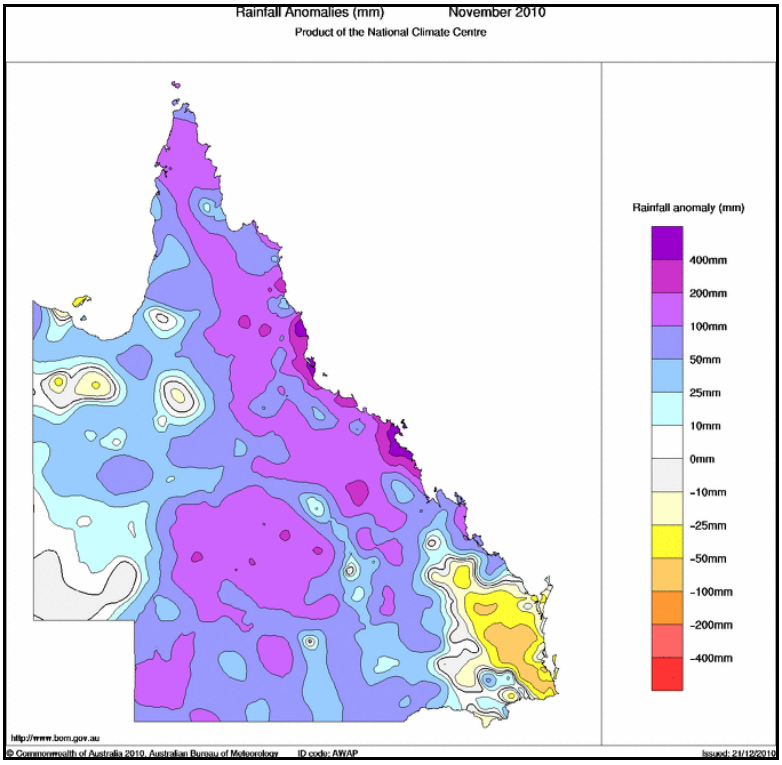
3.2 Pre Event Conditions – October Event

In the four weeks prior to the start of the October Event on Wednesday 6 October 2010, rainfall in South East Queensland had been above the September average by between approximately 50mm to100mm as demonstrated in the following diagram. As a result, the Dam catchments were relatively wet.



3.3 Pre Event Conditions – December Events

In the four weeks prior to the start of the Early December Event on Wednesday 1 December 2010, rainfall in South East Queensland had been just below the November average by between approximately 25mm to 50mm as indicated in the diagram below. This led to a slight drying out of the catchments.

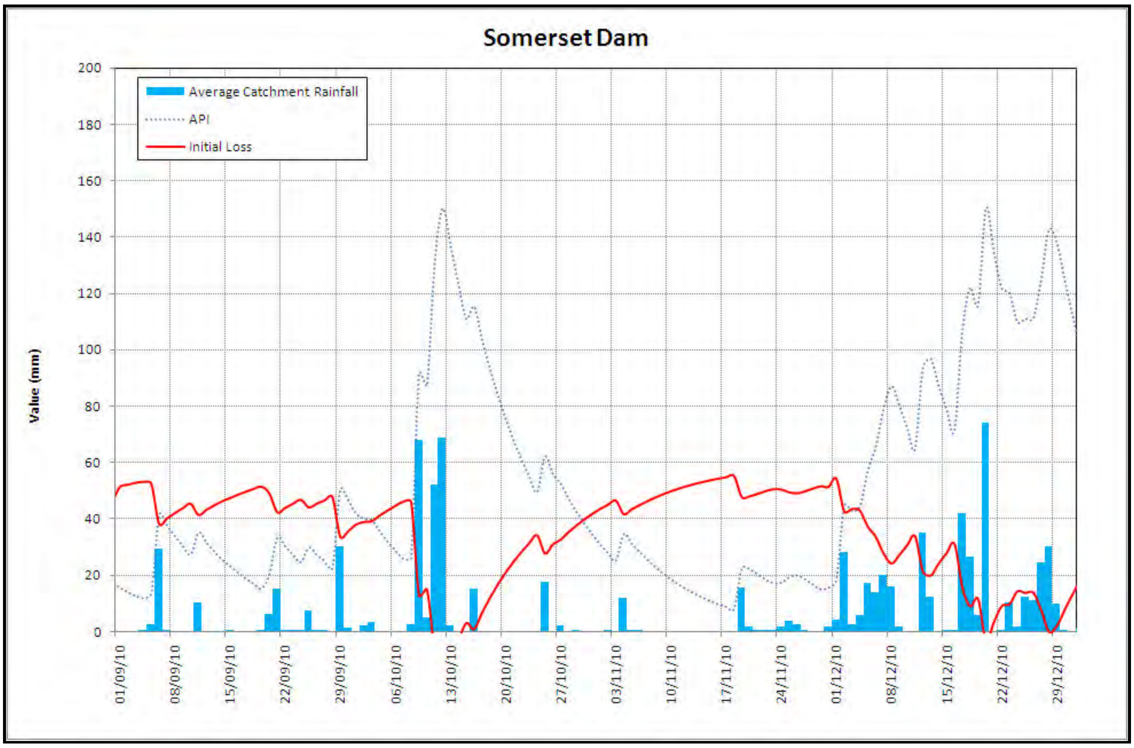


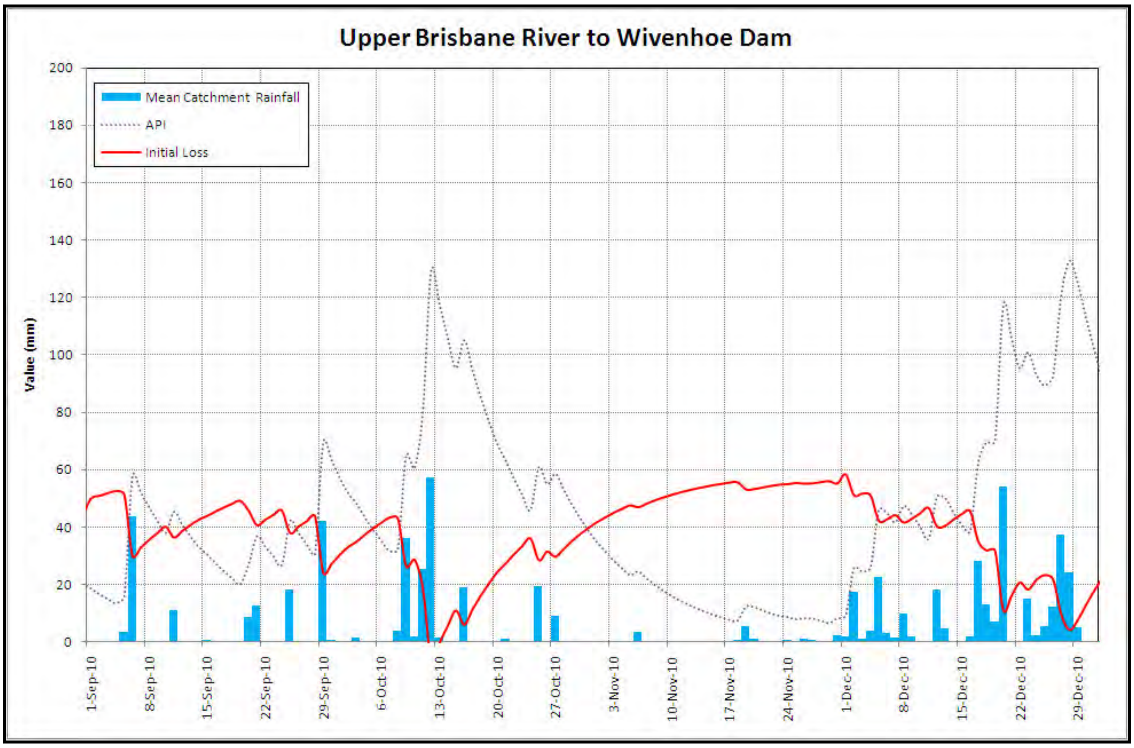
3.4 Antecedent Conditions

In the lead up to the October event, the Antecedent Precipitation Index (API) for the Stanley River to Somerset Dam was oscillating between 20mm and 40mm indicating that the catchment was reasonably wet. Initial loss was estimated to be about 45mm at the start of the October event. Historically, the Upper Brisbane to Wivenhoe catchment is much drier than the Stanley River catchment; however, at the start of the October event it was in a slightly drier state than the Stanley catchment, with a higher API and an estimated initial loss of 40mm to 50mm.

By the end of November 2010, the Somerset and Wivenhoe Dam catchments had dried out. APIs were approximately 10mm to 20mm and initial losses recovered to be as high as 50mm to 60mm by the start of December 2010. The APIs and initial loss estimates at the commencement of each of the flood events between October and December is shown below.

The following diagrams and tables highlight the change in initial loss and API over this four month period.


Somerset Dam
Average Catchment Rainfall
API
Initial Loss
Value (mm)
200
180
160
140
120
100
80
60
40
20
0
01/09/10
08/09/10
15/09/10
22/09/10
29/09/10
06/10/10
13/10/10
20/10/10
27/10/10
03/11/10
10/11/10
17/11/10
24/11/10
01/12/10
08/12/10
15/12/10
22/12/10
29/12/10


Upper Brisbane River to Wivenhoe Dam
Mean Catchment Rainfall
API
Initial Loss
Value (mm)
200
180
160
140
120
100
80
60
40
20
0
1-Sep-10
8-Sep-10
15-Sep-10
22-Sep-10
29-Sep-10
6-Oct-10
13-Oct-10
20-Oct-10
27-Oct-10
3-Nov-10
10-Nov-10
17-Nov-10
24-Nov-10
1-Dec-10
8-Dec-10
15-Dec-10
22-Dec-10
29-Dec-10

Event Start Date	Somerset Dam		Wivenhoe Dam	
	Estimated Initial Loss	Starting Level (FSL 99.0)	Estimated Initial Loss	Starting Level (FSL 67.0)
	mm	m AHD	mm	m AHD
06/10/2010	45	99.02	42	67.06
01/12/2010	54	99.06	58	67.01
16/12/2010	31	99.07	46	67.10
24/12/2010	14	99.10	22	67.12

4. DATA COLLECTION SYSTEM PERFORMANCE AND EVENT DATA

4.1 Introduction

A real time flood monitoring and forecasting system has been established to monitor rainfall and water levels in the Dam catchments and to provide adequate, accurate and timely information for informed decision-making. Field stations consisting of rainfall and water level gauges use the Event Reporting Radio Telemetry System (ERRTS) to communicate data to the Flood Operations Centre.

More than one gauge may be located at an individual field station. Water level gauges are often located at the Department of Environment and Resource Management (DERM) gauging stations. DERM is responsible for the maintenance of the water level gauges and Seqwater for the ERRTS equipment.

Rainfall gauges consist of a standard tipping bucket. Water level gauges vary in type and model but include shaft encoders, wet pressure transducers and dry pressure transducers. At a rainfall gauge, an event is defined as the tip of the bucket. At a water level rainfall gauge, an event is defined as an incremental increase or decrease in water level.

When an event is triggered at a gauge, data is transmitted via VHF radio through a series of redundant radio repeaters to the Flood Operations Centre and other data collection centres. Each signal has a unique identification number which is relayed to computer hardware platform serial port via a decoder when it arrives at the Flood Operations Centre base station. It is then time stamped, read, decoded, accepted or rejected, filtered, validated before being stored in a gauge database in the Centre's FLOOD-Col and Enviromon databases. Redundant base stations at Mineral House and the Land Centre in Brisbane's CBD are synchronised with the Flood Operations Centre database.

The FLOOD-Col and Enviromon databases contain gauge details including:
- Gauge name;
- ALERT number;
- Type of gauge;
- Calibration information;
- Alarm thresholds;
- Rating curve information, if applicable.

Both FLOOD-Col and Enviromon allow filtered gauge data to be viewed in either a text or graphical format. Information that can be viewed or edited includes height, discharge, rainfall pluviographs, rainfall hyetographs, lake levels and Dam volumes. Applications are also available for viewing groups of gauges.

The combination of ERRTS field stations, rainfall gauges and water level gauges, radio network and data collection software is referred to as an ALERT system. ALERT, or Automated Local Evaluation in Real Time System, has become a standard for flood warning systems in Australia and the United States of America, and is widely used by the Bureau of Meteorology (BoM) and other flood warning agencies throughout the world.

The modelling software used to analyse and produce forecast runoff is called FLOOD-Ops. This software extracts data from the FLOOD-Col database, calculates areal rainfalls and generates runoff hydrographs. Model parameters can be adjusted and forecast rainfall included as an *option* while results can be displayed and imported into gate operation models.

The ALERT system, FLOOD-Ops and ancillary software make up the Real Time Flood Model (RTFM).

4.2 Field station descriptions

Seqwater operates 75 rain gauges and 71 river gauge field stations within and around the Brisbane River Basin. Of these 146 sites, 129 operate under the ALERT system and the remaining 17 operate as telephone telemeter gauging stations, but are not directly available in the operational suite.

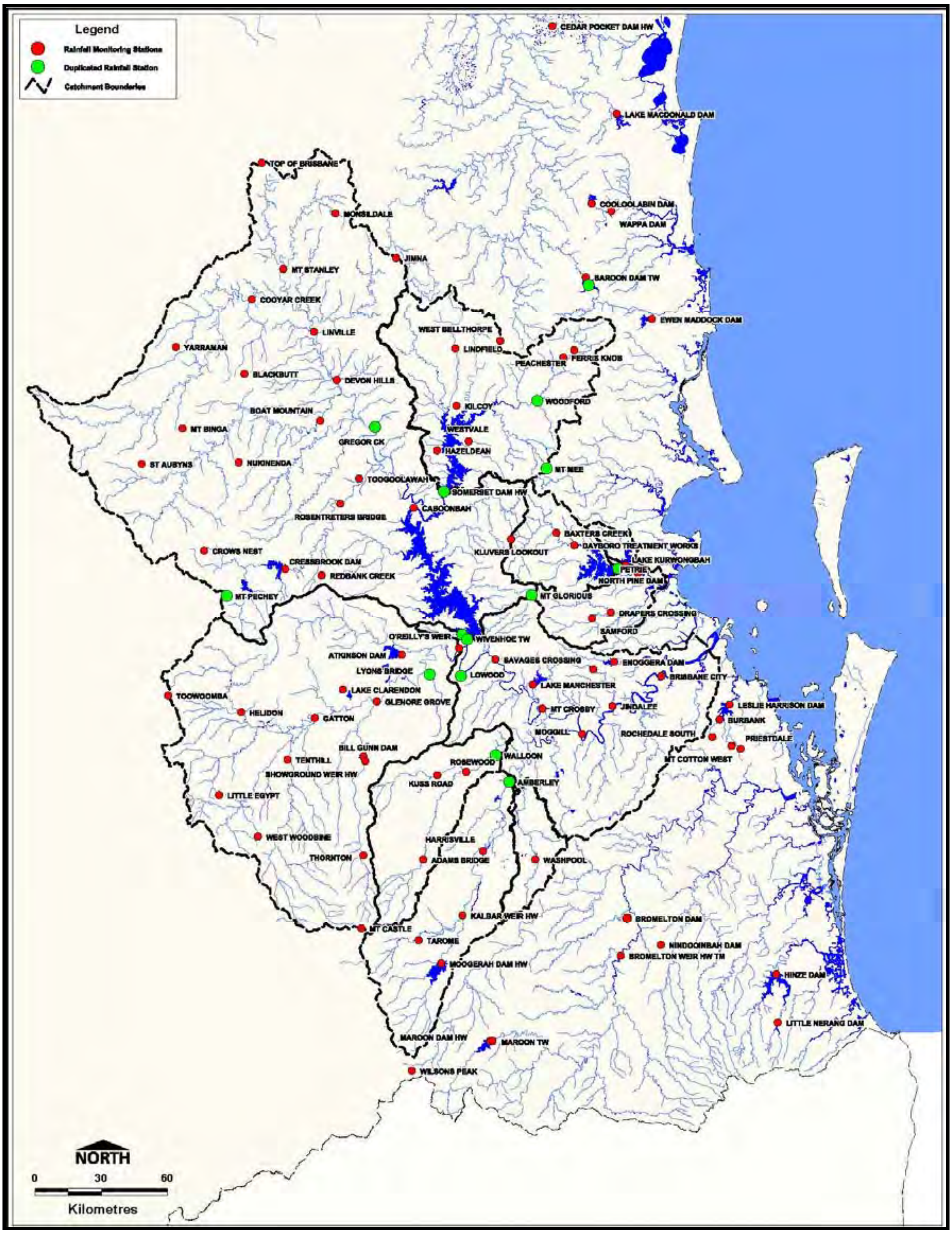
Manual gauge board readings are taken at Somerset and Wivenhoe Dams to confirm the ALERT data received from these sites. These manual observations form the basis of gate operations.

In addition to the Seqwater owned and operated network, the Flood Operations Centre also has access to the Enviromon system, which collects data from an additional 225 rain gauges and nearly 200 water level gauges throughout South East Queensland. This extensive network of rain and water level gauges ensures the Flood Operations Centre always has access to the most up-to-date information during flood events.

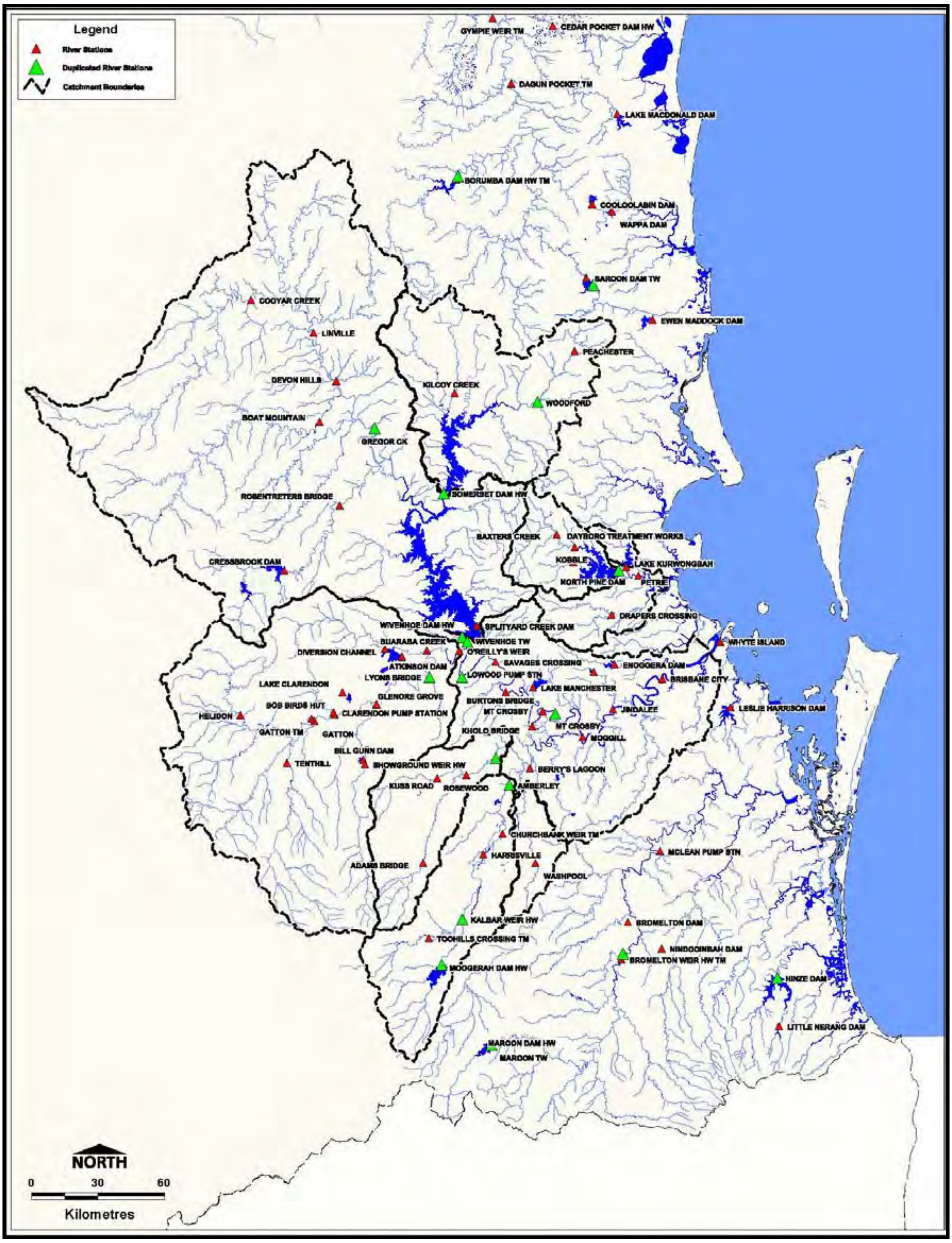
Most of the water level data contained in this report was collected via the Seqwater ALERT network. Manual observations of gauge boards at Somerset and Wivenhoe Dams were collected via email and telephone during the event. These gauge board observations provided the basis for all decisions relating to gate operations at the Dams.

It should be noted that data from the ALERT network is operational data and has not been validated.

Rainfall stations and water level network locations are shown in the Figures below.



Legend
Rainfall Monitoring Stations
Duplicated Rainfall Station
Catchment Boundaries
CEDAR POCKET DAM HW
LAKE MACDONALD DAM
TOP OF BRISBANE
MONSILDALE
COOLOOLABIN DAM
WAPPA DAM
JIMNA
MT STANLEY
BAROON DAM TW
COOYAR CREEK
EWEN MADDOCK DAM
WEST BELLTHORPE
LINVILLE
LINDFIELD
YARRAMAN
PEACHESTER
FERRIS KNOB
BLACKBUTT
DEVON HILLS
WOODFORD
KILCOY
BOAT MOUNTAIN
MT BINGA
GREGOR CK
WESTVALE
HAZELDEAN
ST AUBYNS
NUKINENDA
MT MEE
TOOGOOLAWAH
SOMERSET DAM HW
CABOONBAH
ROSENTRETERS BRIDGE
BAXTERS CREEK
DAYBORO TREATMENT WORKS
KLUVERS LOOKOUT
CROWS NEST
CRESSBROOK DAM
LAKE KURWONGBAH
PETRIE
REDBANK CREEK
NORTH PINE DAM
MT PECHEY
MT GLORIOUS
DRAPERS CROSSING
SAMFORD
O'REILLY'S WEIR
WIVENHOE TW
ATKINSON DAM
SAVAGES CROSSING
ENOGGERA DAM
LYONS BRIDGE
LOWOOD
BRISBANE CITY
LAKE CLARENDON
LAKE MANCHESTER
TOOWOOMBA
GLENORE GROVE
HELIDON
MT CROSBY
JINDALEE
LESLIE HARRISON DAM
GATTON
BURBANK
MOGGILL
ROCHEDALE SOUTH
PRIESTDALE
BILL GUNN DAM
TENTHILL
WALLOON
MT COTTON WEST
ROSEWOOD
SHOWGROUND WEIR HW
KUSS ROAD
AMBERLEY
LITTLE EGYPT
HARRISVILLE
WEST WOODBINE
THORNTON
ADAMS BRIDGE
WASHPOOL
KALBAR WEIR HW
BROMELTON DAM
MT CASTLE
TAROME
NINDOOINBAH DAM
BROMELTON WEIR HW TM
MOOGERAH DAM HW
HINZE DAM
LITTLE NERANG DAM
MAROON DAM HW
MAROON TW
WILSONS PEAK
NORTH
0
30
60
Kilometres


Legend
River Stations
Duplicated River Stations
Catchment Boundaries
GYMPIE WEIR TM
CEDAR POCKET DAM HW
DAGUN POCKET TM
LAKE MACDONALD DAM
BORUMBA DAM HW TM
COOLOOLABIN DAM
WAPPA DAM
BAROON DAM TW
COOYAR CREEK
EWEN MADDOCK DAM
LINVILLE
PEACHESTER
DEVON HILLS
KILCOY CREEK
WOODFORD
GOAT MOUNTAIN
GREGOR CK
SOMERSET DAM HW
BAXTERS CREEK
DAYBORO TREATMENT WORKS
KOBBLE
LAKE KURWONGBAH
CRESSBROOK DAM
NORTH PINE DAM
PETRIE
DRAPERS CROSSING
WIVENHOE DAM HW
SPLITYARD CREEK DAM
BUARABA CREEK
WIVENHOE TW
WHYTE ISLAND
DIVERSION CHANNEL
O'REILLY'S WEIR
SAVAGES CROSSING
ATKINSON DAM
ENOGGERA DAM
LYONS BRIDGE
LOWOOD PUMP STN
BRISBANE CITY
LAKE CLARENDON
LAKE MANCHESTER
GLENORE GROVE
BURTONS BRIDGE
BOB BIRDS HUT
MT CROSBY
JINDALEE
LESLIE HARRISON DAM
HELIDON
CLARENDON PUMP STATION
GATTON TM
GATTON
KHOLO BRIDGE
MOGGILL
BILL GUNN DAM
TENTHILL
SHOWGROUND WEIR HW
BERRY'S LAGOON
KUSS ROAD
ROSEWOOD
AMBERLEY
CHURCHBANK WEIR TM
MCLEAN PUMP STN
HARRISVILLE
ADAMS BRIDGE
WASHPOOL
KALBAR WEIR HW
BROMELTON DAM
TOOHILLS CROSSING TM
NINDOOINBAH DAM
BROMELTON WEIR HW TM
MOOGERAH DAM HW
HINZE DAM
LITTLE NERANG DAM
MAROON DAM HW
MAROON TW
NORTH
0
30
60
Kilometres

4.3 October Event – Overview

The October Flood Event has a designated start date of 09:00, Wednesday 6 October 2010.. Dam releases during this event commenced on Saturday 9 October 2010 and concluded on Tuesday 19 October 2010.

The October 2010 Flood Event was a relatively significant event. The peak outflow from Wivenhoe Dam during the event was in the order of 1,500m^3/s. Accordingly, comprehensive rainfall and water level data has been reported to allow a detailed assessment of the event to be undertaken.

4.4 October Event – Base Rainfall Data

The following rainfall tables and maps show the daily rainfall recorded in the Brisbane River Basin during the October Event. On the maps, "None" signifies that no rainfall reports were received from the station during the period and figures in red also indicate errors in the data.

Rainfall in 24 hours to 09:00										
ALERT ID	Station	7 Oct	8 Oct	9 Oct	10 Oct	11Oc t	12 Oct	13 Oct	Total	Comment
6775	Peachester									OOA
6714	Ferris Knob	0	8	91	16	103	103	2	323	
6705	Woodford-P	0	2	87	8	78	73	4	252	
6702	Woodford-B	0	2	87	8	76	69	4	246	
6600	Kilcoy	0	2	74	3	41	81	1	202	
6593	Somerset Dam HW-P	0	8	76	7	68	211	4	374	Double counting
6590	Somerset Dam HW-B	0	5	49	4	41	129	2	230	
6602	Top of Brisbane	0	2	15	0	8	21	0	46	
6540	Yarraman	0	2	39	0	4	15	1	61	
6542	Cooyar Ck	0	2	29	0	6	30	0	67	
6717	Linville	0	3	52	3	28	67	0	153	
6708	Devon Hills	0	2	58	2	17	63	0	142	
6529	St Aubyns	0	2	47	0	3	10	2	64	
6621	Nukinenda	0	23	38	0	9	31	2	103	
6520	Boat Mountain	0	3	54	1	7	53	0	118	
6514	Gregor Ck-P	0	5	44	1	21	72	1	144	
6517	Gregor Ck-B	0	5	48	2	21	80	0	156	
6596	Crows Nest	0	12	38	1	2	25	3	81	
6780	Perseverance	0	0	27	0	5	24	1	57	
6782	Ravensbourne	0	4	55	4	32	83	9	187	
6523	Cressbrook Dam	0	14	36	0	8	30	0	88	
6553	Rosentretters Br	0	3	32	1	11	55	0	102	
6604	Toogoolawah	0	1	42	1	9	66	4	123	
6574	Caboonbah	0	17	38	3	28	112	1	199	

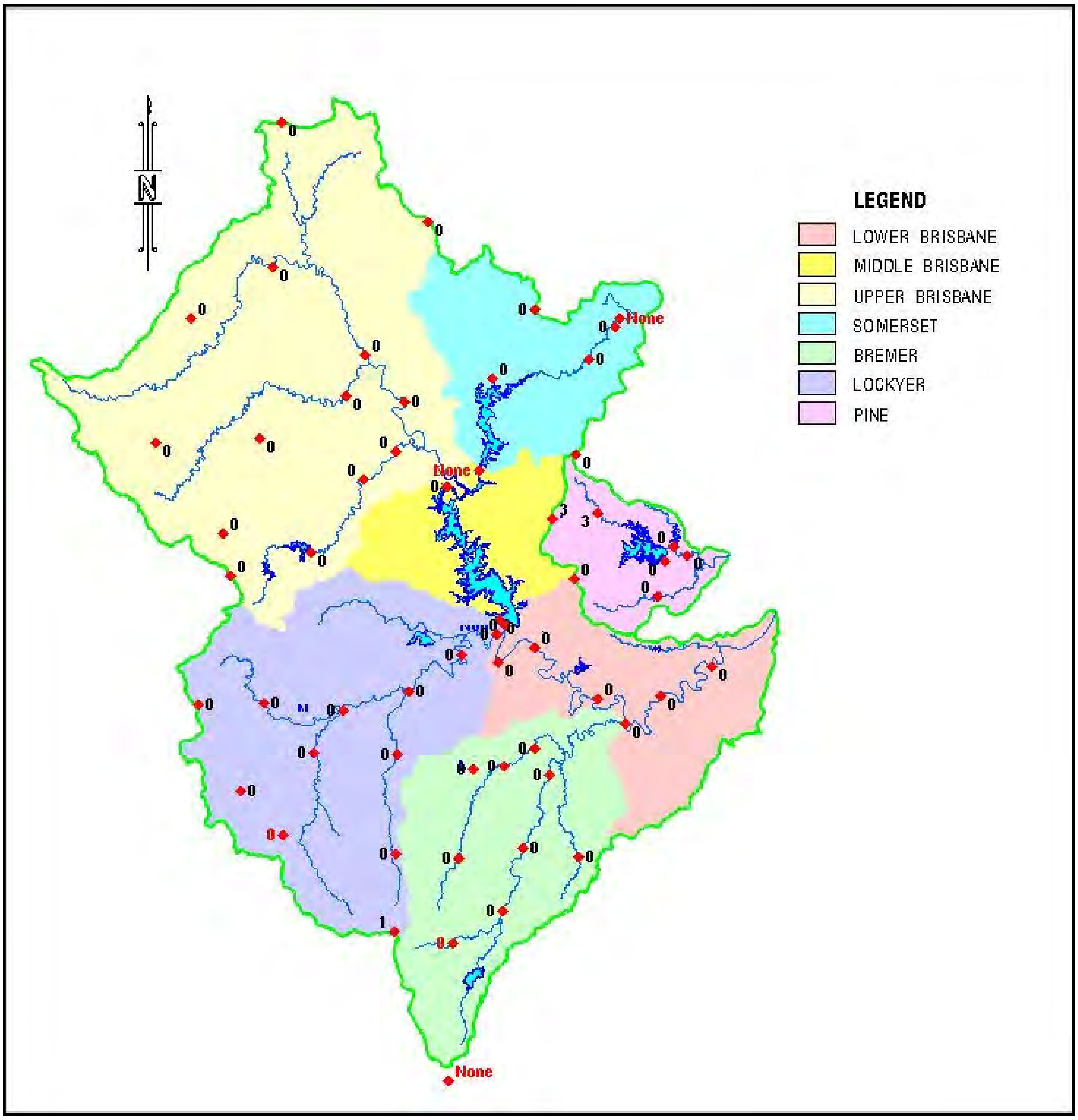
Rainfall in 24 hours to 09:00										
ALERT ID	Station	7 Oct	8 Oct	9 Oct	10 Oct	11Oct	12 Oct	13 Oct	Total	Comment
6636	Wivenhoe Dam HW-B	0	0	23	1	64	58	0	146	
6643	Wivenhoe Dam TW-P	0	0	24	1	70	62	0	157	
6641	Wivenhoe Dam TW-B	0	0	26	1	67	63	0	157	
6598	Toowoomba	0	3	18	2	8	27	0	58	
6526	Helidon	0	2	16	2	14	36	0	70	
6617	Little Egypt	0	8	13	2	12	22	2	59	
6606	West Woodbine									Did not work
6565	Tenthill	0	7	15	1	20	22	3	68	
6577	Gatton	0	6	21	1	27	36	2	93	
6619	Mt Castle	1	1	36	6	68	47	9	168	
6615	Thornton	0	1	12	2	50	29	12	106	
6583	Showground Weir	0	5	15	1	39	24	1	85	
6556	Glenore Grove	0	1	15	2	30	24	1	73	
6633	Lyons Br-P	0	1	21	2	39	29	0	92	
6630	Lyons Br-B	0	1	23	1	42	31	0	98	
6568	O'Reillys Weir	0	0	23	1	58	48	0	130	
6646	Lowood-B	0	0	23	0	56	33	0	112	
6649	Lowood-P	0	1	21	1	79	36	1	139	
6559	Savages Crossing	0	0	25	1	100	49	0	175	
1730	Lake Manchester	0	0	21	5	125	28	2	181	
6751	Mt Crosby	0	0	13	4	101	21	3	142	
2059	Colleges Crossing	0	1	14	6	68	12	5	106	
6580	Adams Br	0	2	18	2	44	23	4	93	
2192	Franklyn Vale									OOA
2065	Grandchester	0	3	20	3	31	24	10	91	
6736	Kuss Rd	0	0	22	3	49	22	6	102	
2068	Tallegalla	0	1	10	3	43	17	4	78	
6733	Rosewood	0	0	16	2	51	26	2	97	
6550	Five Mile Bridge	0	1	22	3	59	24	1	110	
6623	Tarome-P	0	0	17	4	28	9	0	58	
6562	Kalbar Weir	0	0	18	3	27	5	0	53	
6571	Harrisville	0	0	24	4	38	9	2	77	
6651	Greens Road	0	1	22	3	52	15	1	94	
6739	Washpool	0	3	18	2	51	11	1	86	
2062	Peak Crossing	0	0	21	3	46	8	3	81	
2055	Loamside	0	0	4	3	12	9	9	37	
2160	One Mile Br	0	1	15	4	37	16	4	77	
2040	Churchill	0	7	4	2	44	0	0	57	
2035	Brassall (Hancock Br)	0	2	5	1	18	0	0	26	
2106	Lyons	0	0.4	0	0.2	0.9	1.4	0.7	3.6	Under reading

Rainfall in 24 hours to 09:00										
ALERT ID	Station	7 Oct	8 Oct	9 Oct	10 Oct	11Oct	12 Oct	13 Oct	Total	Comment
2145	Ripley	0	2	9	2	1	1	2	17	Under reading
2050	Bundamba (Barclay St)	0	0	11	2	61	16	1	91	
2045	Bundamba (Hanlon St)	0	0	8	4	64	10	1	87	
6754	Moggill-P	0	2	10	6	59	18	3	98	
2150	Opossum	0	7	9	5	58	19	2	100	
2116	Carole Park	0	11	11	6	72	19	5	124	
1518	Wacol	0	8	13	6	67	19	6	119	
2102	Jingle Downs	0	3	12	5	64	14	2	100	
2104	Greenbank (Thompson Rd)	0	11	12	7	90	16	3	139	
2108	Forestdale (Johnson Rd)	9	38	12	11	35	7	7	119	
2114	Calamvale	18	84	14	8	82	23	5	234	
1736	Inala	1	22	12	5	74	20	4	138	
2020	Corinda High	0	22	13	6	84	20	7	152	
2138	Mt Gravatt	3	33	5	9	34	0	0	84	
1548	Holland Pk West	0	51	22	5	91	16	5	190	
1554	East Brisbane	0	60	22	7	88	23	3	203	
1836	Eight Mile Plains	0	54	16	7	90	23	6	196	
1803	Wishart	0	44	19	7	92	17	9	188	
1706	Carindale	0	56	24	7	76	16	4	183	
1596	Camp Hill	0	72	26	8	87	23	2	218	
1830	Mansfield	1	19	23	8	85	13	4	153	
1739	Lytton	0	34	47	16	99	30	5	231	
1527	Hemmant	0	37	35	10	80	19	3	184	
2141	Ransome	0	31	28	12	67	12	3	153	
1755	Manly	0	14	45	15	67	9	2	152	
1742	Pullenvale	0	19	19	6	116	30	8	198	
1515	Kenmore Hills	0	13	19	7	132	26	4	201	
6730	Jindalee	0	17	15	6	84	24	7	153	
1749	Toowong	0	11	23	5	110	21	5	175	
6748	Brisbane City	0	42	23	6	90	22	6	189	
1507	Three Ways	0	3	30	8	192	64	6	303	
1718	Gold Ck Res	0	11	27	7	144	44	7	240	
1533	Enoggera Dam	0	8	33	7	133	37	6	224	
1512	Mt Coot-tha	0	5	26	6	118	29	5	189	
1578	Alderley	0	42	35	7	135	31	5	255	
1524	Bowen Hills	0	59	31	7	115	29	6	247	
2285	Steiglitz Wharf	0	7	14	20	71	2	2	116	
2086	Marburg	0	0	12	5	48	3	3	71	
2074	Stokes Crossing	0	2	18	3	53	27	5	108	
2080	Spressers Bridge	2	2	22	3	34	27	7	97	

Rainfall in 24 hours to 09:00										
ALERT ID	Station	7 Oct	8 Oct	9 Oct	10 Oct	11Oc t	12 Oct	13 Oct	Total	Comment
2083	Rosewood WWTP									OOA
2071	Churchbank Weir	0	2	19	3	25	13	2	64	
2077	Greys Plains Rd	0	1	17	2	51	25	7	103	
1837	Wynnum Bowls	0	25	46	14	64	11	3	163	
1838	Luggage Point	0	36	45	11	93	27	7	219	
1840	Chandler	0	25	19	8	63	9	6	130	
1841	Bulimba	0	85	28	9	93	25	5	245	
6585	Sandy Creek Road	0	1	21	2	11	43	1	79	
6588	Upper Sandy Creek	0	2	51	4	41	73	2	173	
2089	Harrisville-B	0	1	20	3	39	9	3	75	
2092	Rosewood-B	0	0	9	4	19	0	0	32	
2095	Bellbird Park	0	7	13	5	69	19	5	118	
2011	Buaraba	0	3	34	4	35	82	2	160	
2006	Hays Landing	0	0	27	2	76	70	0	175	
2004	Pohlman Range	0	8	81	5	32	107	1	233	
5356	Mt Alford	0	0	0	0	0	0.2	0		Did not work
6656	Bill Gunn Dam	0	1	17	2	49	26	2	97	
6658	Lake Clarendon Dam	0	3	25	3	35	41	1	108	
6555	Atkinson Dam	0	1	36	2	44	57	0	140	
6624	Moogerah Dam	0	0	19	3	29	10	0	61	
6609	Monsildale	0	1	33	1	13	44	1	93	
6612	Mt Stanley	0	1	44	3	14	50	1	113	
6607	Lindfield	0	0	85	16	77	123	1	302	
6603	Blackbutt	0	22	50	0	13	51	2	138	
6601	Mt Binga	0	2	70	1	7	22	4	106	
6613	Hazeldean	0	1	56	3	36	105	1	202	
6614	Westvale	0	2	66	4	43	108	1	224	
6605	Eskdale									Not yet installed
6611	Redbank Creek	0	14	50	3	19	57	1	144	
6100	Mt Mowbullan	0	4	66	1	5	9	4	89	
6427	Maleny	0	29	150	40	163	120	5	507	
5425	Hume Lane	0	25	101	7	107	89	0	329	
6400	Bald Knob	0	27	129	25	106	79	1	367	
6716	West Bellthorpe	0	1	79	27	98	119	3	327	
6701	Mt Mee-B	0	3	90	13	94	173	12	385	
6690	Mt Mee-P	0	3	90	13	94	173	12	385	
6680	Mt Glorious-P	0	5	67	10	179	182	12	455	
5423	Landsborough	0	31	107	28	117	68	2	353	
6608	Jimna	0	9	38	4	38	65	1	155	
2194	Wilsons Peak	0	1	30	10	26	21	4	92	

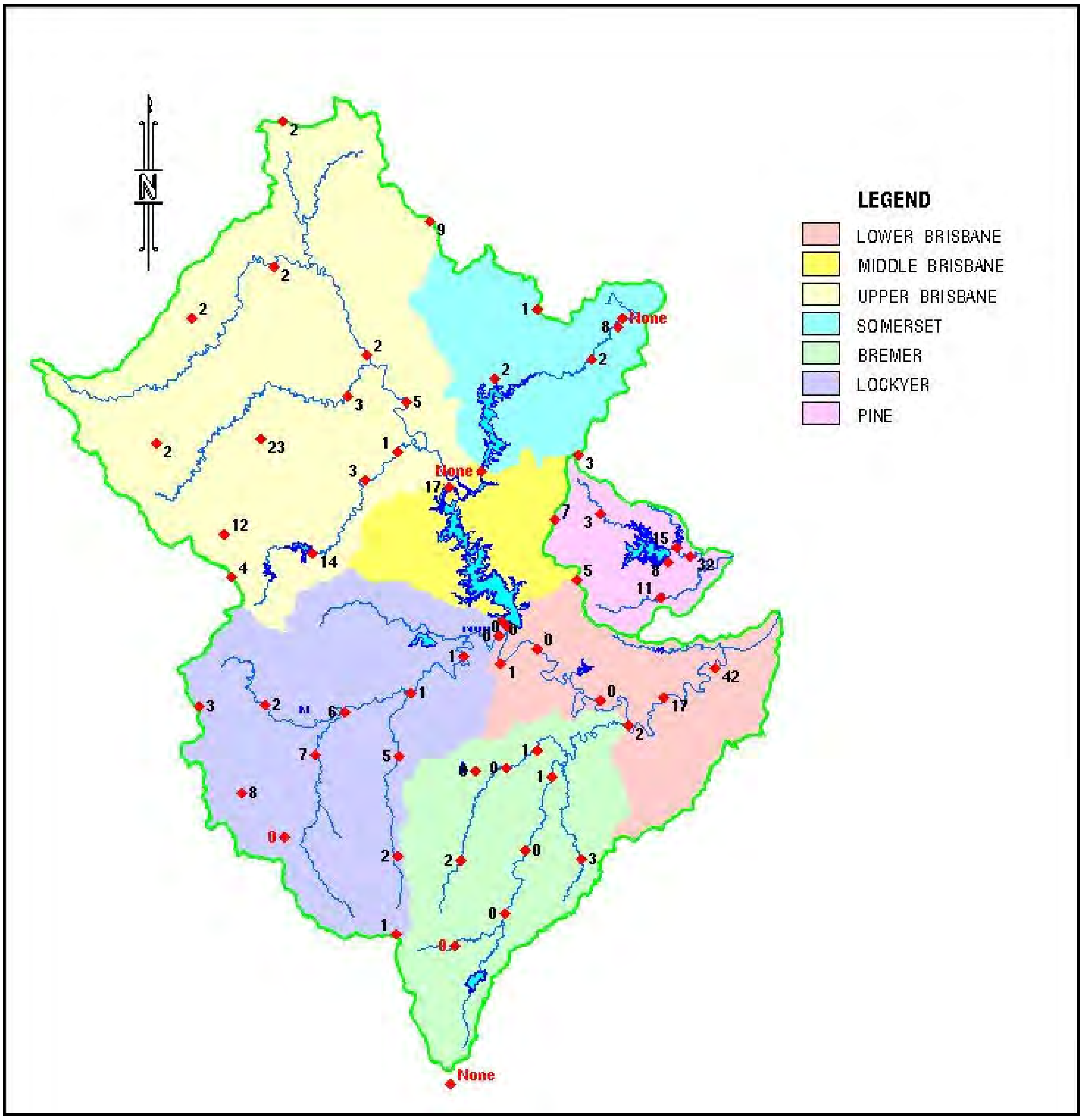
Rainfall in 24 hours to 09:00										
ALERT ID	Station	7 Oct	8 Oct	9 Oct	10 Oct	11Oc t	12 Oct	13 Oct	Total	Comment
6774	Wilsons Peak-P									OOA

Rainfall in 24 hours to 09:00 07/10/2010



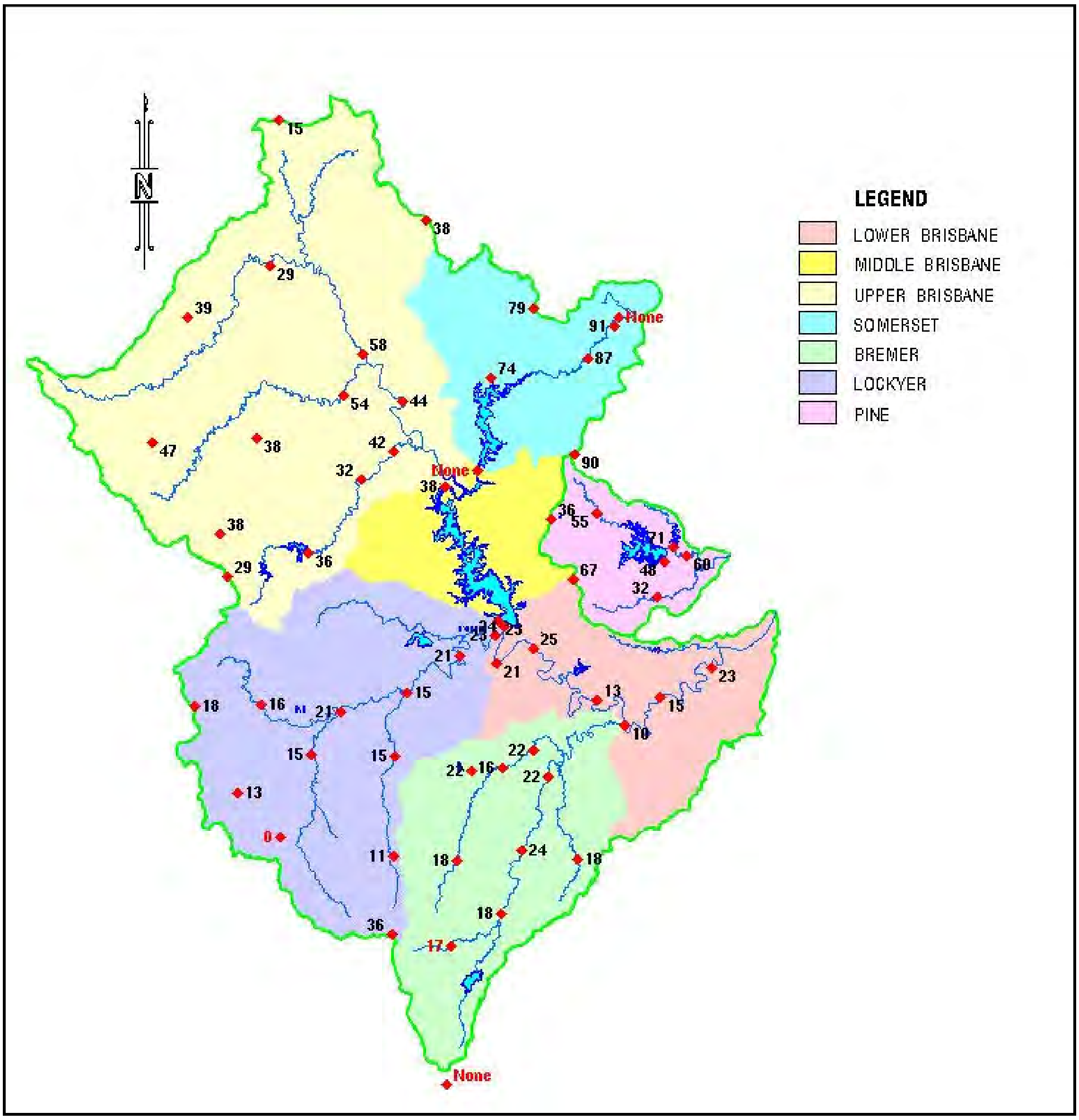
In the 24 hours to 09:00 on Thursday 7 October 2010, only small rainfall totals, generally less than 3mm, were recorded throughout the region.

Rainfall in 24 hours to 09:00 08/10/2010



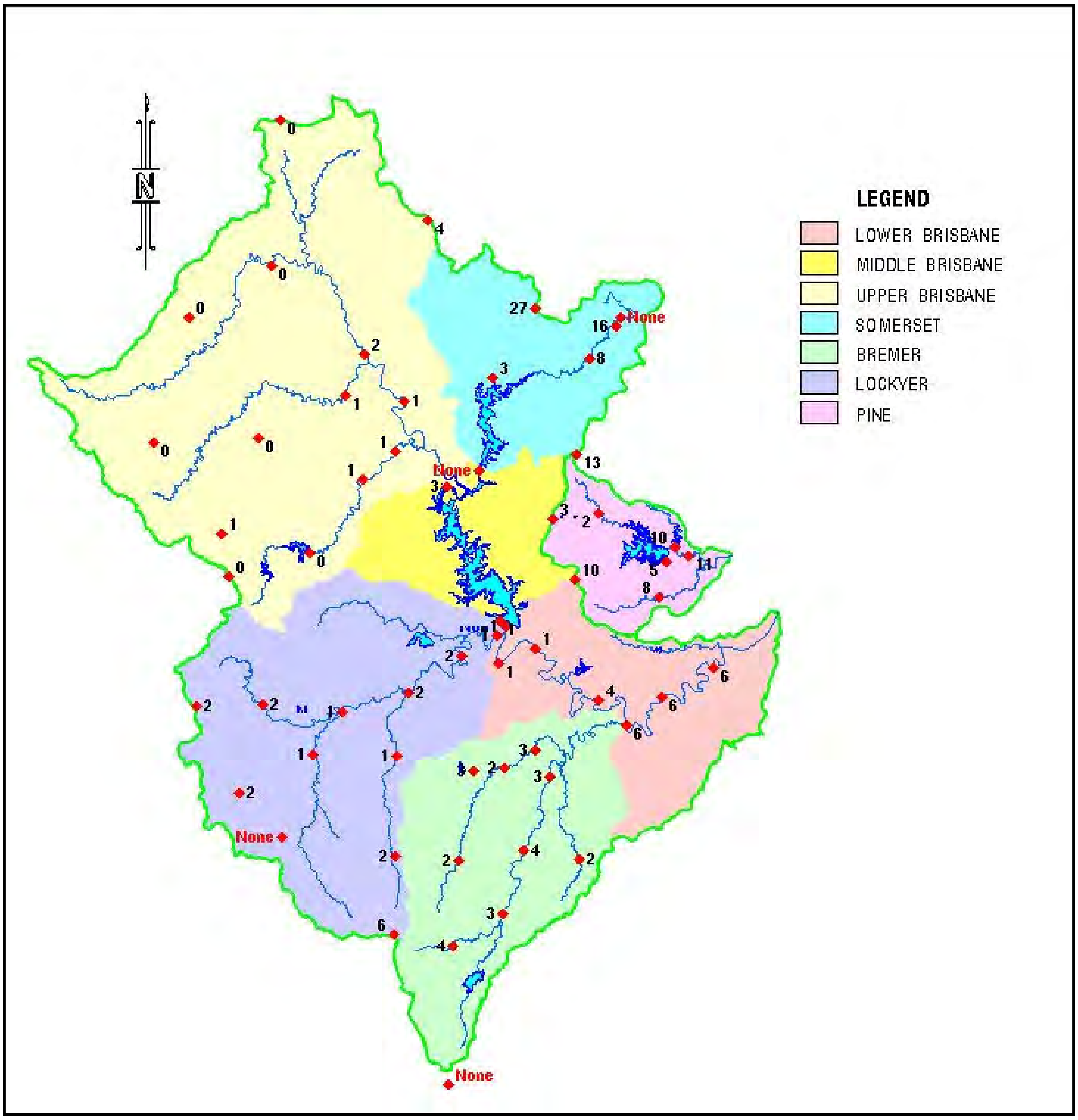
In the 24 hours to 09:00 on Friday 8 October 2010, isolated falls of up to 25mm were recorded in the Emu Creek catchment, upstream of Wivenhoe Dam. Elsewhere through the region, falls were generally below 10mm.

Rainfall in 24 hours to 09:00 09/10/2010



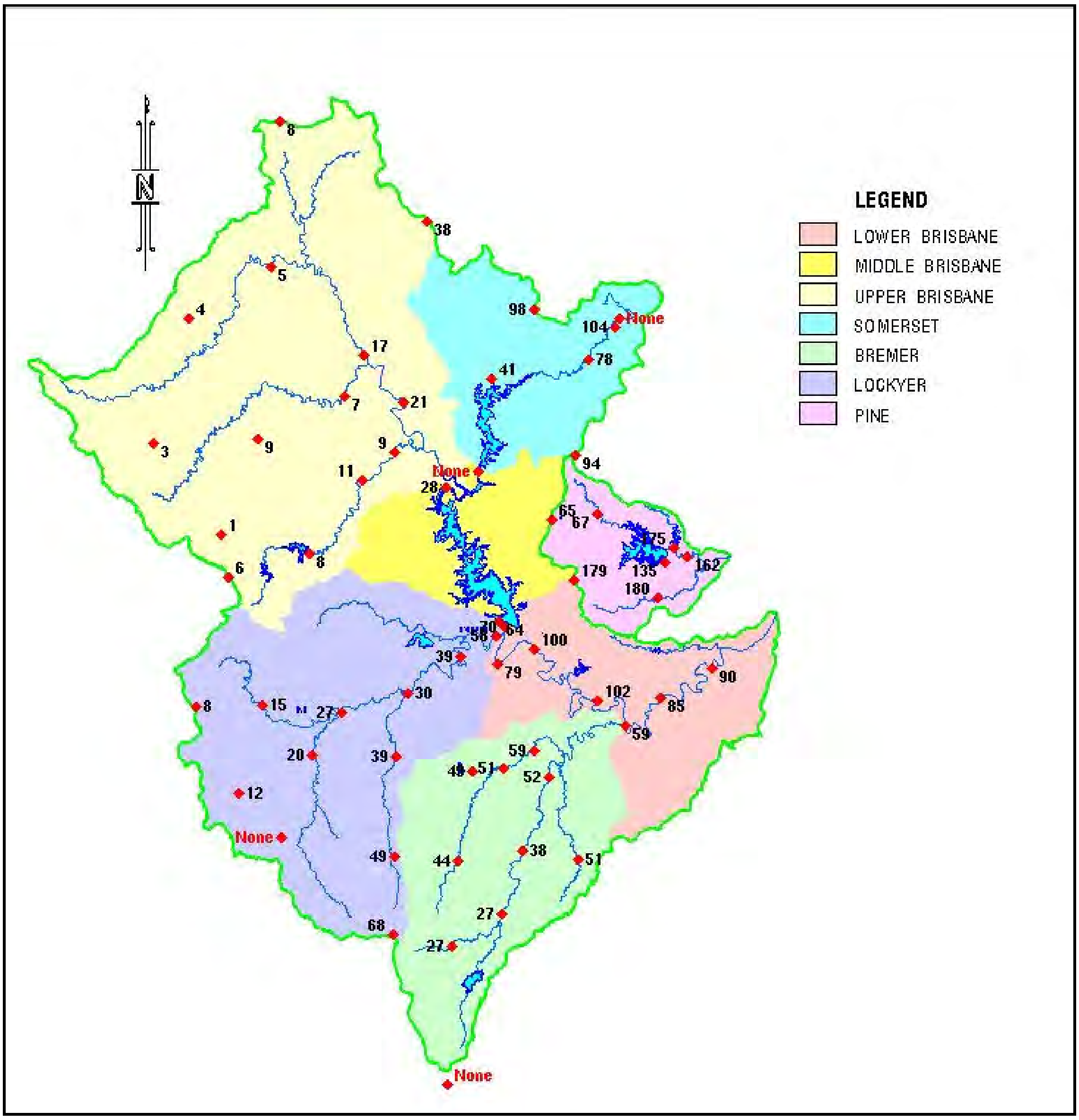
Compared with the previous 24 hour period, rainfall generally increased throughout the region in the 24 hours to 09:00 on Saturday 9 October 2010. The highest recorded rainfall in the period occurred in the upper reaches of the Stanley River, with widespread 40mm to 60mm of rainfall recorded in the Brisbane River upstream of Wivenhoe. In catchments downstream of Wivenhoe Dam, falls were generally below 25mm.

Rainfall in 24 hours to 09:00 10/10/2011



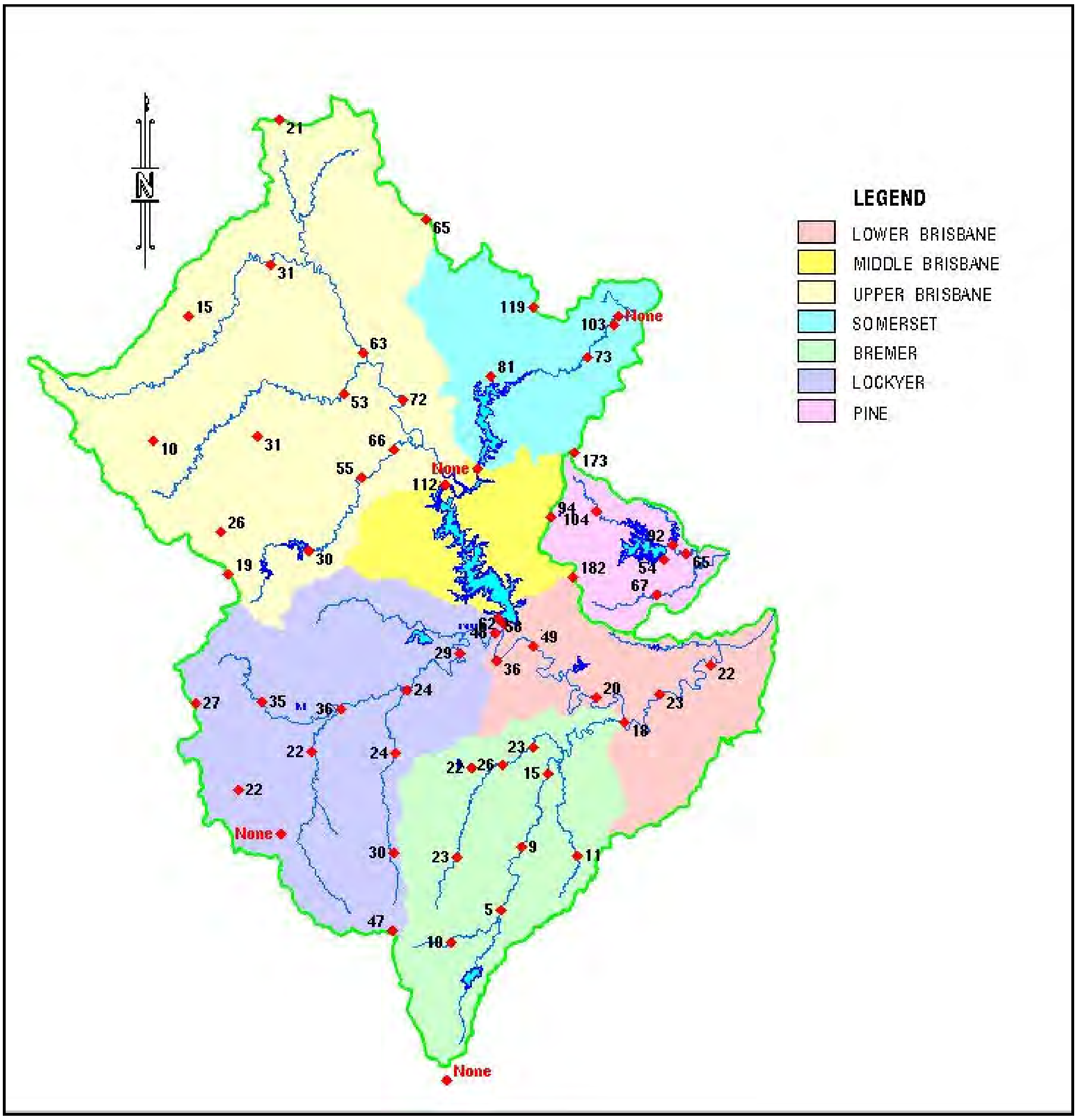
Rain generally eased in the 24 hours to 09:00 on Sunday 10 October 2010, with a few higher falls in the headwaters of the Stanley River.

Rainfall in 24 hours to 09:00 11/10/2010



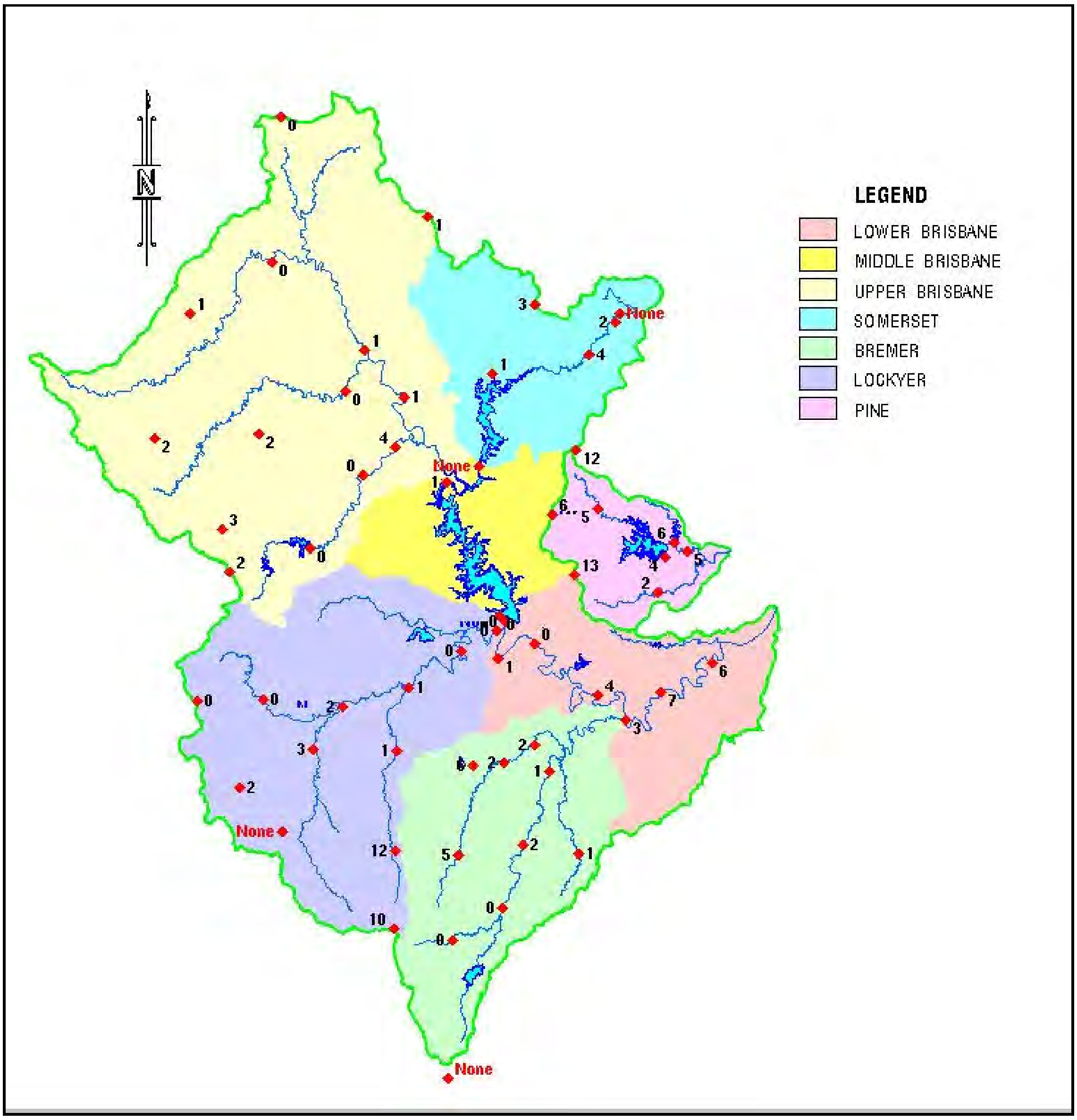
In the 24 hours to 09:00 on Monday 11 October 2010, rainfall was widespread with the heaviest rainfall recorded in the headwaters of the Stanley River, in the North Pine catchment and in the Brisbane River below Wivenhoe Dam. Rainfall totals of up to 180mm were recorded in these areas. Totals in the Brisbane River upstream of Wivenhoe Dam were generally below 20mm, however, rainfall in the Lockyer and Bremer catchments of up to 60mm was also recorded in the period.

Rainfall in 24 hours to 09:00 12/10/2010



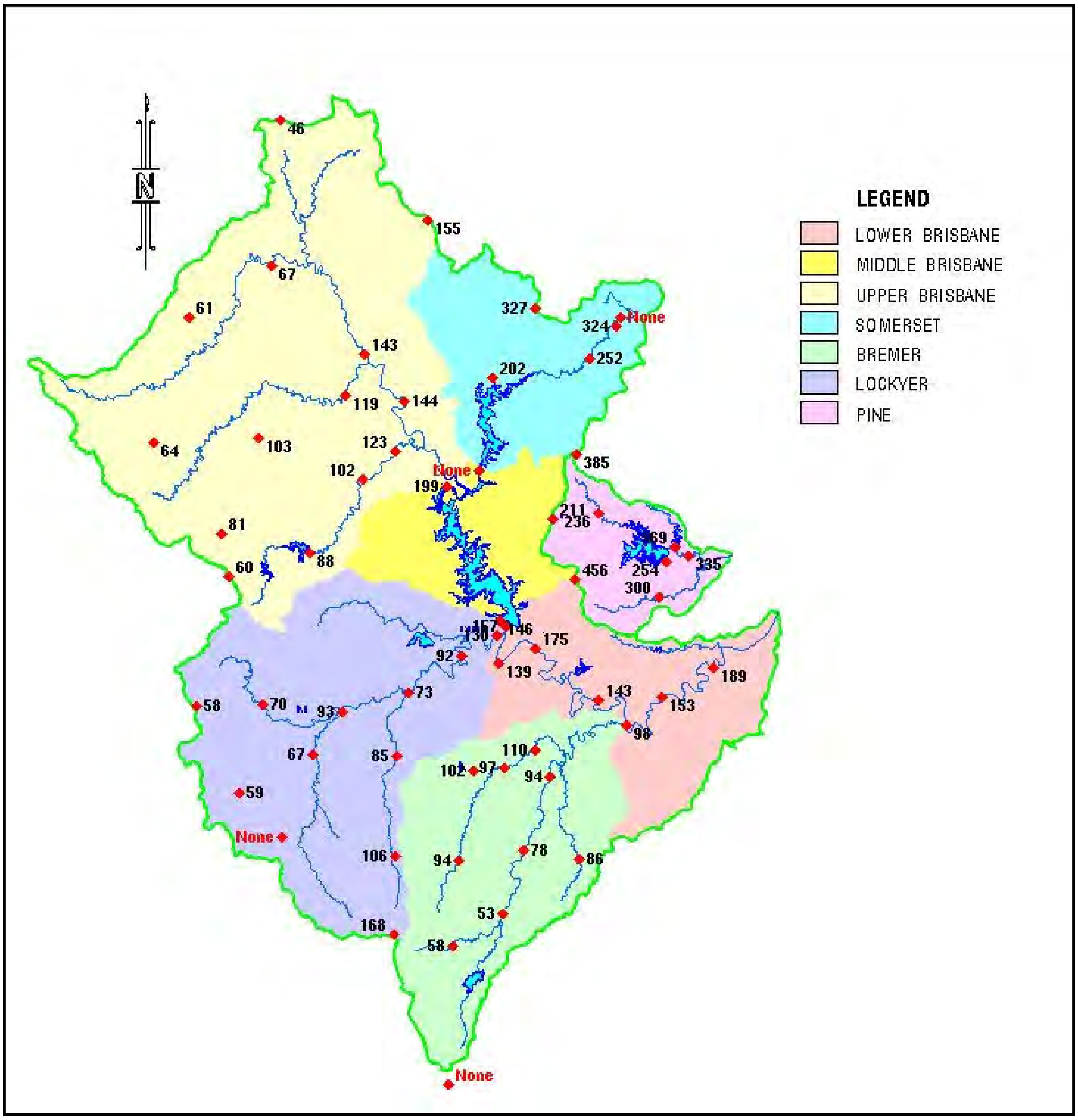
Heavy rain continued throughout the region in the 24 hours to 09:00 on Tuesday 12 October, especially high in the Stanley River and North Pine catchments with totals again of up to 180mm recorded. Elsewhere in the region, rainfall totals in the Upper Brisbane River were heaviest in the lower part of the catchment, while totals in catchments downstream of Wivenhoe Dam were generally below 40mm.

Rainfall in 24 hours to 09:00 13/10/2010



In the 24 hours to 09:00 on Wednesday 13 October 2010, rain generally eased through the region.

Rainfall in six days to 09:00 13/10/2010



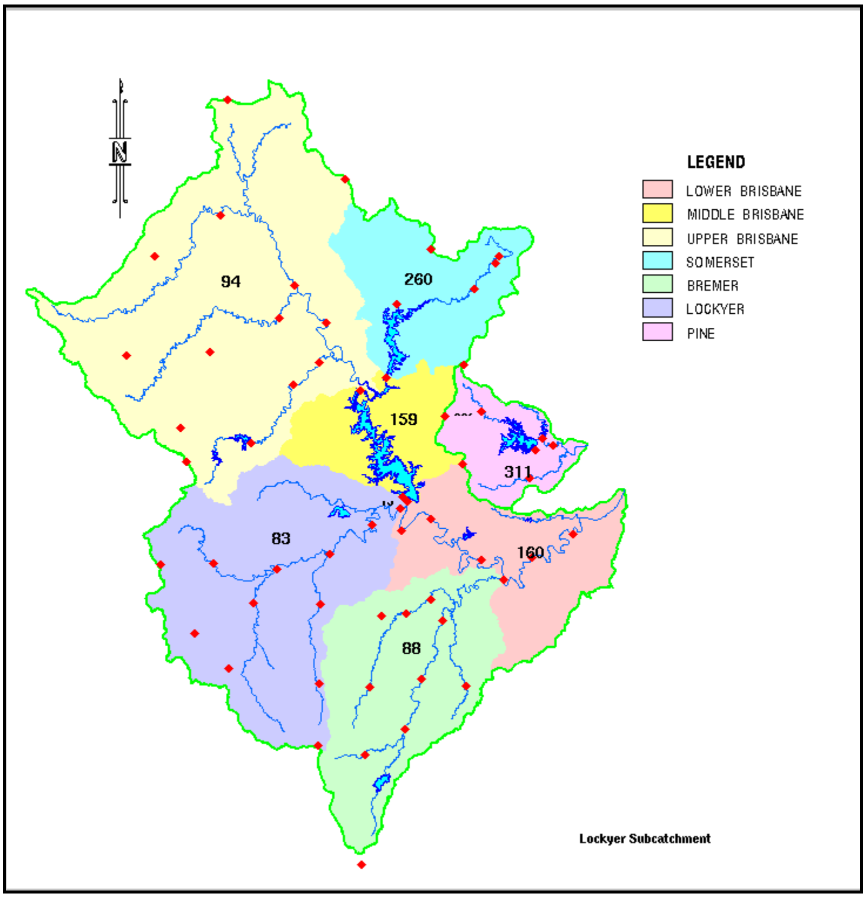
The highest totals were recorded in the headwater areas of the Stanley River and along the D’Aguilar Range from Mt Mee to Mt Glorious. Elsewhere through the Stanley, Upper Brisbane and Mid Brisbane catchments, rainfall totals – while still significant – were half those recorded at elevated stations.

The period of heaviest rainfall was in the 48 hours up to 09:00 on Sunday 10 October 2010. Similar heavy rainfall was recorded in the Lockyer and Bremer catchments where the totals over the period tended to be more uniform. In the Lower Brisbane region, rainfall totals in urban areas were half of those recorded around the towns of Fernvale and Lowood.

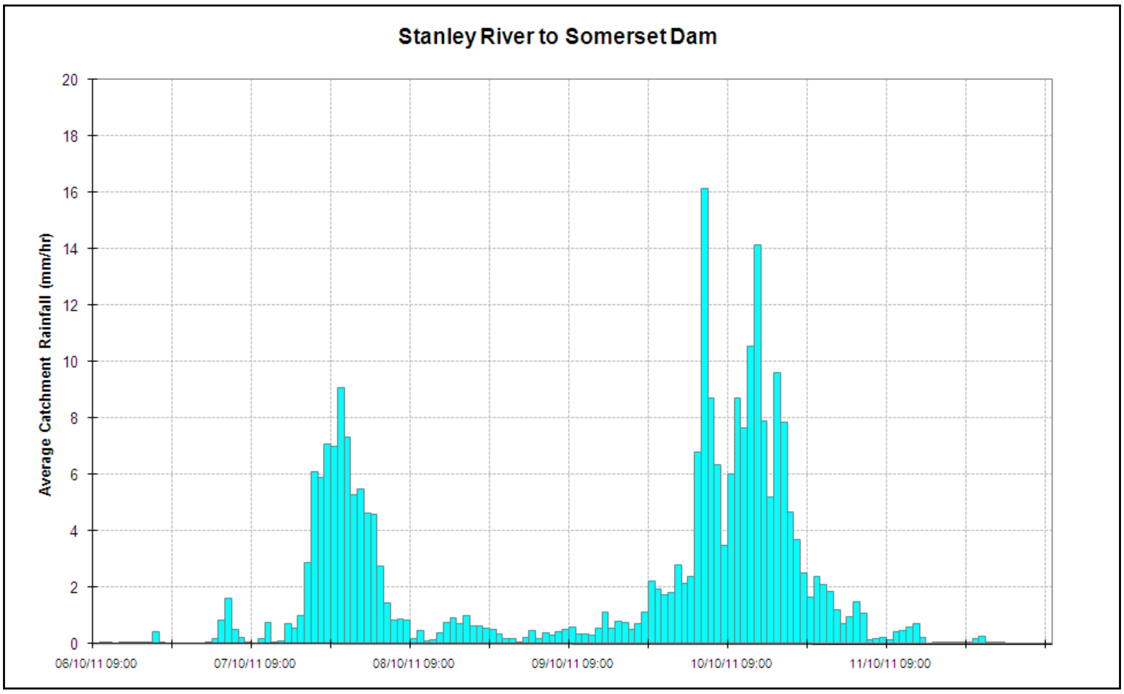
4.5 October Event – Average Catchment Rainfall

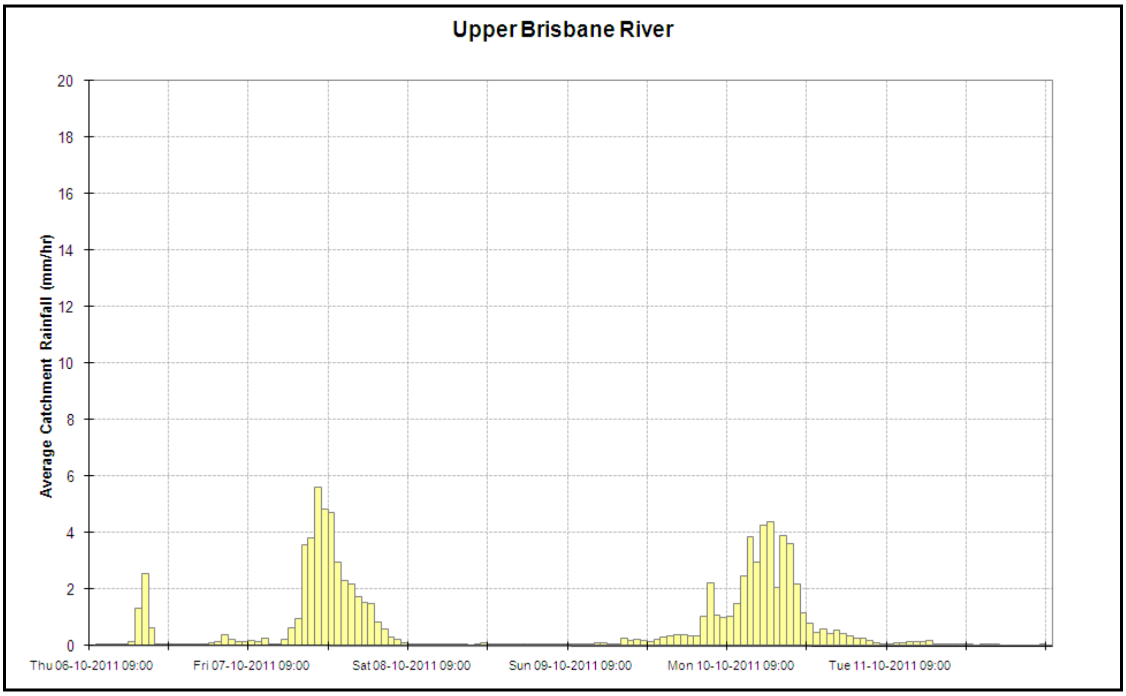
The average rainfall for each sub catchment in the Brisbane basin is determined by a applying a weighting to the rainfall depth at each available station within the sub catchment. The Upper Brisbane catchment excludes the Somerset catchment and is represented by a weighted average of the Upper and Middle Brisbane catchments. A summary of catchment average rainfall for the October Event is shown in the table and map below.

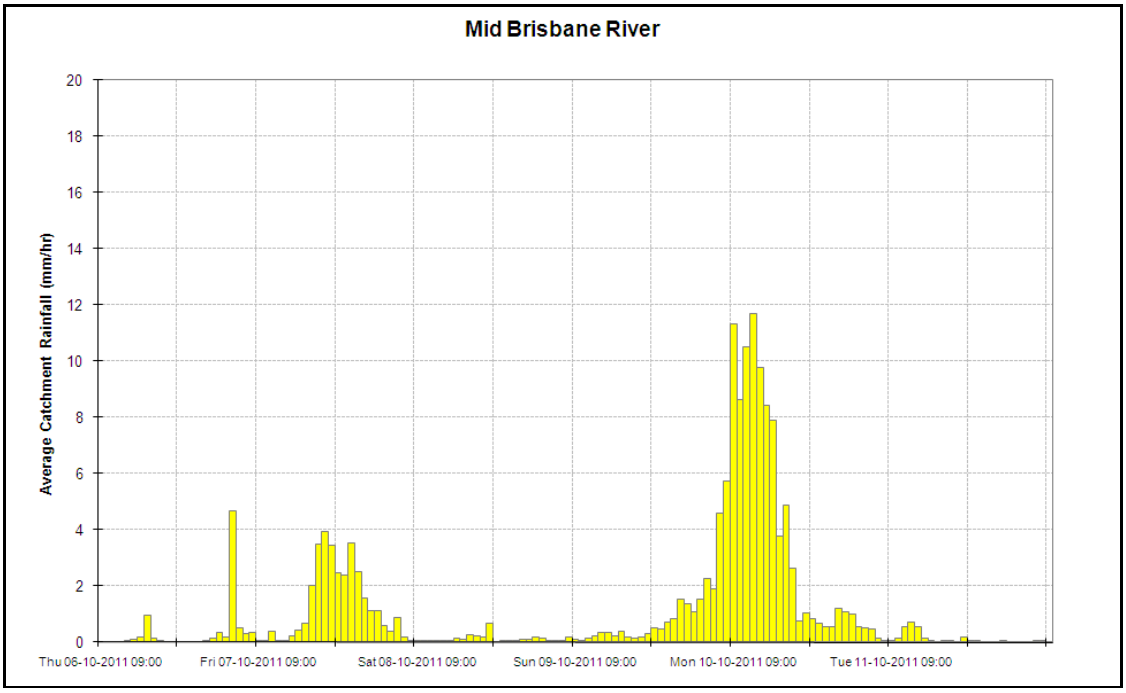
Period Ending 09:00	Stanley		Upper Brisbane		Lockyer		Bremer		Lower	
	Period	∑	Period	∑	Period	∑	Period	∑	Period	∑
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
06/10/2010	4	4	7	7	4	4	1	1	13	13
07/10/2010	76	80	37	44	18	23	19	20	20	32
08/10/2010	11	90	1	45	2	24	3	24	5	37
09/10/2010	70	160	17	62	28	52	45	68	86	123
10/10/2010	97	257	47	109	28	80	17	85	32	156
11/10/2010	3	260	1	110	3	83	3	88	4	160
12/10/2010	0	260	0	110	0	83	0	88	0	160
13/10/2010	0	260	0	110	0	83	0	88	0	160
14/10/2010	0	260	0	110	0	83	0	88	0	160

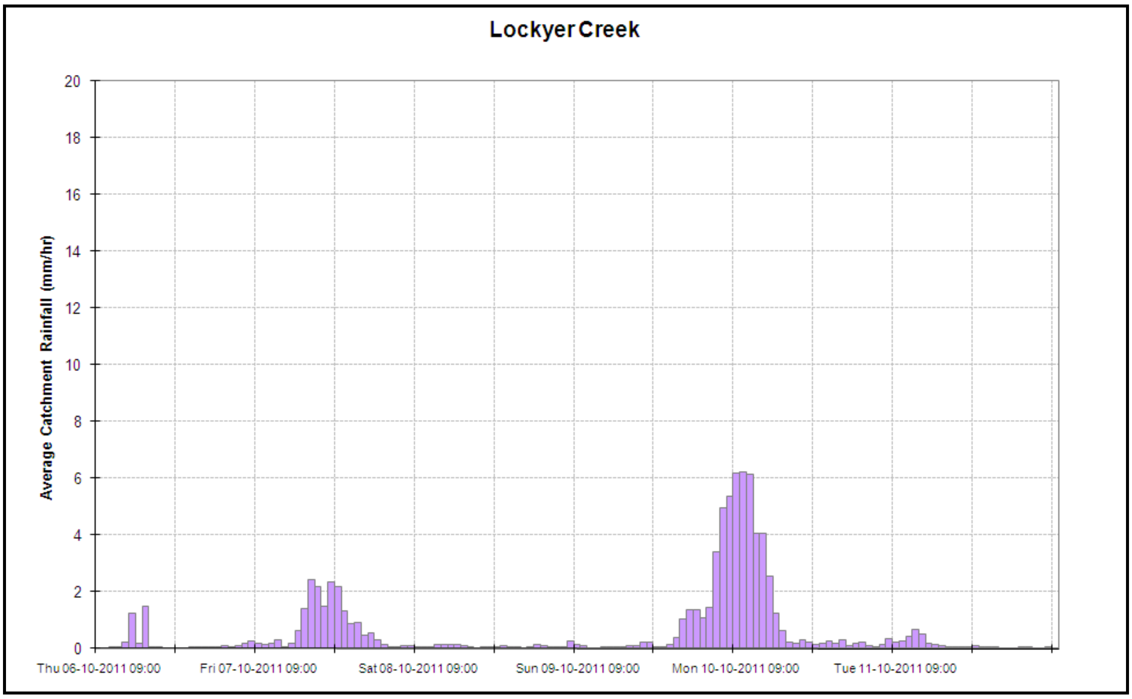


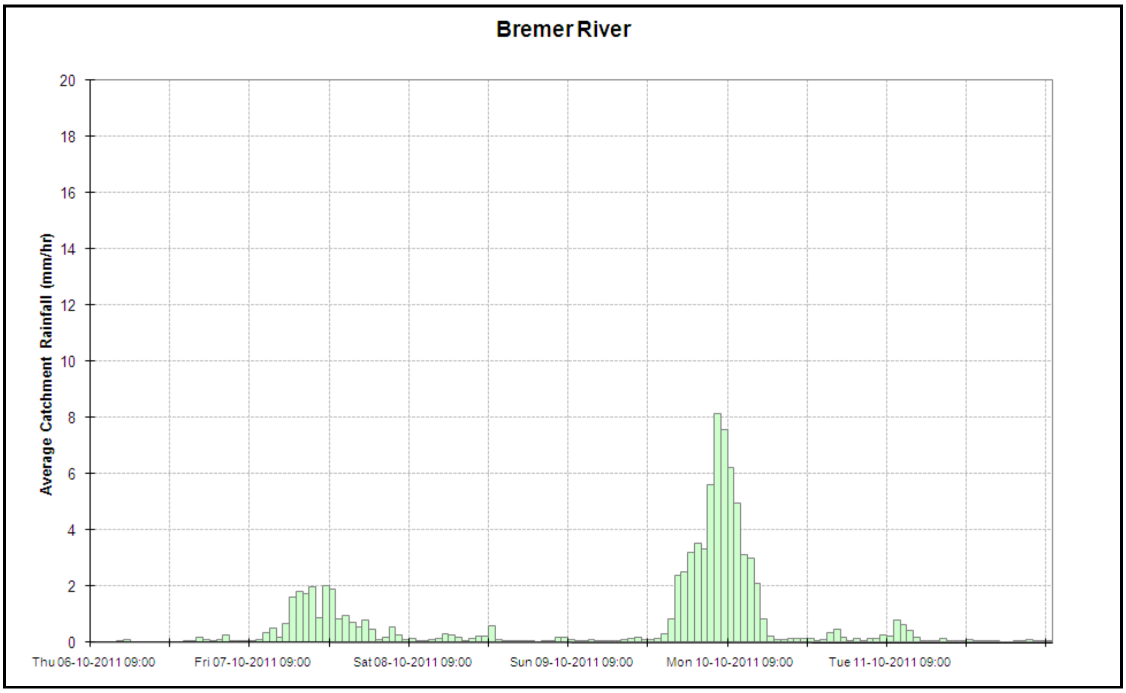
Following are the catchment average rainfall hyetographs for the October Event. These hyetographs do not necessarily reflect the localised, high intensity rainfall that was recorded throughout the Basin at various times and locations. Catchment rainfalls can include hourly intensities at individual stations which are up to five times the catchment average.

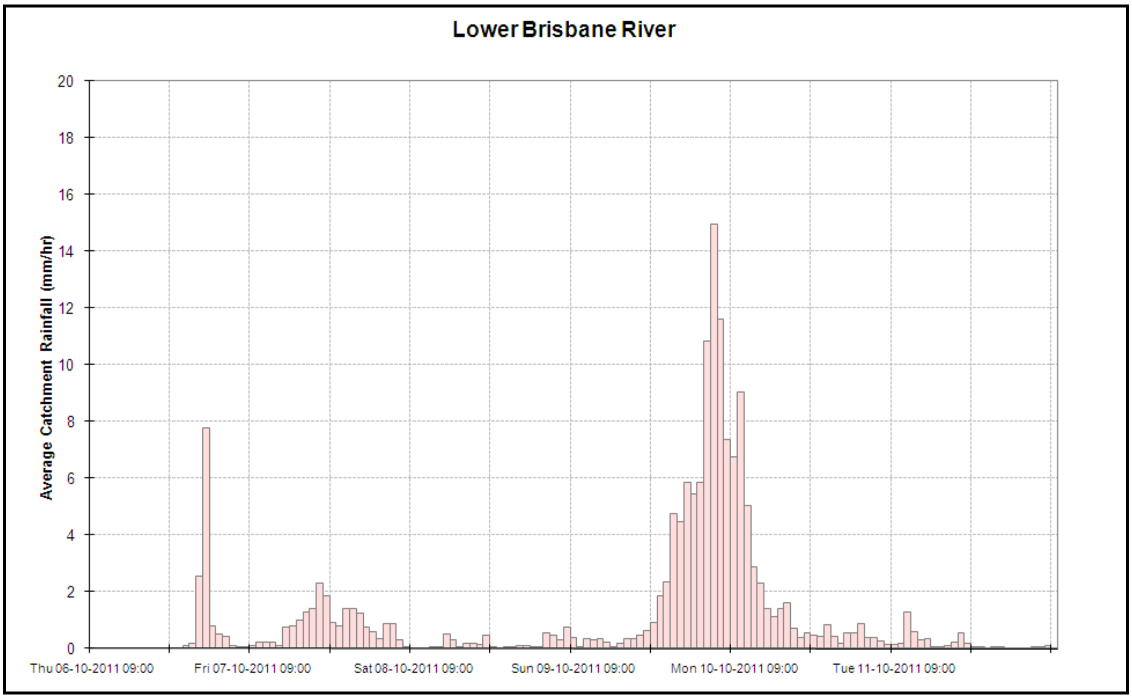





Mid Brisbane River
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
Thu 06-10-2011 09:00
Fri 07-10-2011 09:00
Sat 08-10-2011 09:00
Sun 09-10-2011 09:00
Mon 10-10-2011 09:00
Tue 11-10-2011 09:00


Lockyer Creek
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
Thu 06-10-2011 09:00
Fri 07-10-2011 09:00
Sat 08-10-2011 09:00
Sun 09-10-2011 09:00
Mon 10-10-2011 09:00
Tue 11-10-2011 09:00


Bremer River
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
Thu 06-10-2011 09:00
Fri 07-10-2011 09:00
Sat 08-10-2011 09:00
Sun 09-10-2011 09:00
Mon 10-10-2011 09:00
Tue 11-10-2011 09:00


Lower Brisbane River
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
Thu 06-10-2011 09:00
Fri 07-10-2011 09:00
Sat 08-10-2011 09:00
Sun 09-10-2011 09:00
Mon 10-10-2011 09:00
Tue 11-10-2011 09:00

The average catchment rainfall graphs clearly show two distinct bursts of rainfall during the October Event:

- A short low intensity period in the 12 hours to approximately 06:00 on Thursday 7 October 2010, and;
- A longer more intense period of rainfall over a 36 hour period ending in the early hours of Monday 10 October 2010.

4.6 October Event – Event Water Levels

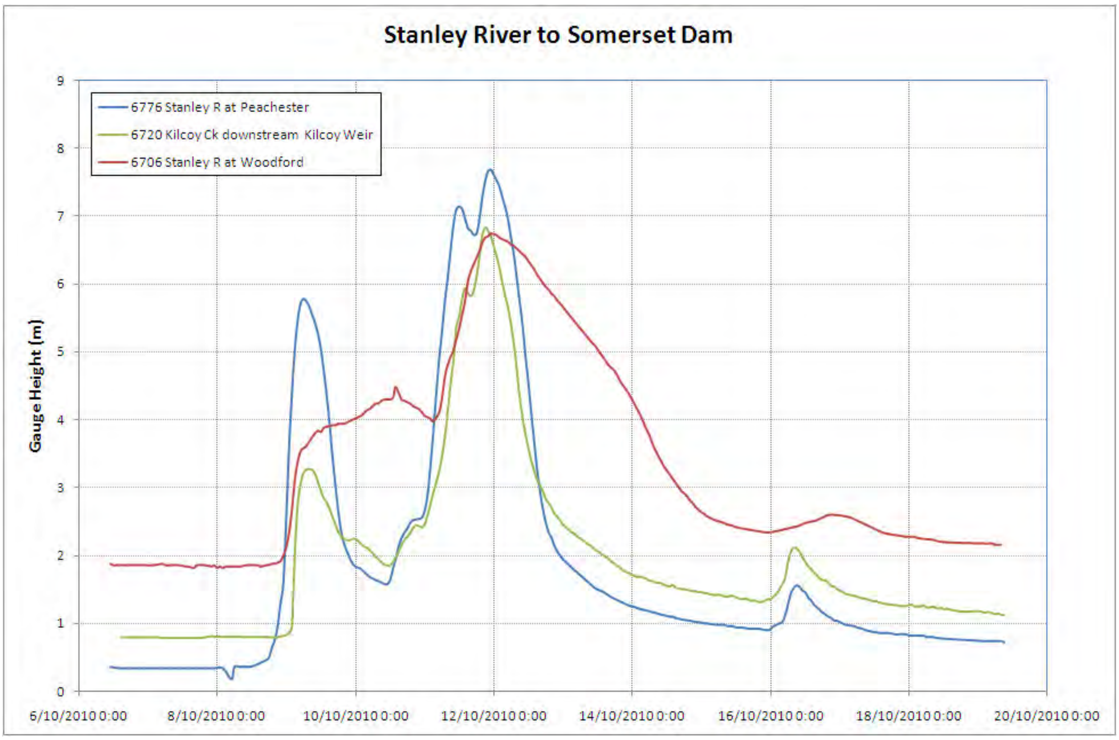
The table below shows the peak water levels reached at selected gauges during this Event.

STATION	DATE/TIME	PEAK FLOW (m3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
PEACHESTER	11/10/2010 22:00			7.68
WOODFORD	11/10/2010 22:00			6.73
KILCOY	11/10/2010 21:00			6.83
SOMERSET DAM INFLOW	11/10/2010 12:00	2,860	286,000	
SOMERSET DAM OUTFLOW	12/10/2010 04:00	1,140	285,000	101.37
COOYAR CK	16/10/2010 06:00			3.43
LINVILLE	11/10/2010 21:00			5.18
DEVON HILLS	12/10/2010 00:00			6.21
BOAT MT	09/10/2010 19:00			3.12
GREGOR CK	11/10/2010 21:00			6.79
ROSENTRETTERS	12/10/2010 02:00			3.32
WIVENHOE DAM INFLOW	11/10/2010 16:00	2,980	628,000	
WIVENHOE DAM OUTFLOW	14/10/2010 04:00	1,490	623,000	69.61
HELIDON	13/10/2010 02:00			1.04
TENTHILL	16/10/2010 14:00			1.62
GATTON	12/10/2010 09:00			4.43
MULGOWIE				
SHOWGROUND WEIR	12/10/2010 04:00			4.87
WARREGO HWY				
GLENORE GROVE	12/10/2010 13:00			5.14
LYONS BRIDGE	12/10/2010 10:00			7.43
RIFLE RANGE RD				
BUARABA CK	12/10/2010 00:00			7.45
OREILLYS WEIR	14/10/2010 07:00			11.28
LOWOOD PUMP STATION	14/10/2010 09:00			9.99
SAVAGES CROSSING	14/10/2010 10:00			10.59
BURTONS BRIDGE				
LAKE MANCHESTER				

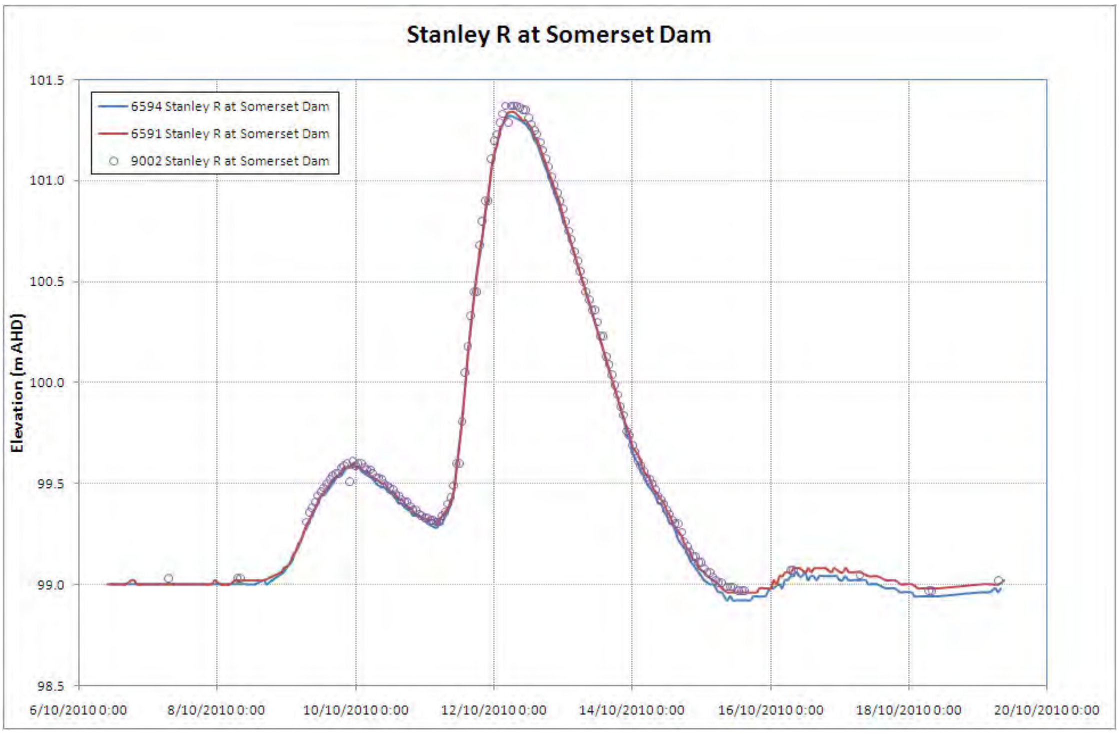
STATION	DATE/TIME	PEAK FLOW (m3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
KHOLO BRIDGE				
MT CROSBY WEIR	14/10/2010 21:00			11.38
COLLEGES CROSSING				
ADAMS BRIDGE	11/10/2010 02:00			3.18
STOKES CROSSING	11/10/2010 16:00			3.60
SPRESSERS BRIDGE	11/10/2010 22:00			3.13
KUSS RD	11/10/2010 18:00			6.75
WWTP	13/10/2010 16:00			2.25
ROSEWOOD	11/10/2010 22:00			5.36
FIVE MILE BRIDGE	12/10/2010 02:00			5.63
WALLOON				
MOOGERAH DAM	06/10/2010 09:00			154.91
JUNCTION WEIR				75.95
HARRISVILLE	11/10/2010 23:00			2.05
CHURCHBANK WEIR	12/10/2010 07:00			0.59
GREENS RD	12/10/2010 10:00			4.42
AMBERLEY				
PEAK CROSSING	11/10/2010 02:00			2.43
LOAMSIDE	09/10/2010 11:00			5.83
ONE MILE BRIDGE	12/10/2010 01:00			10.67
HANCOCKS BRIDGE	12/10/2010 08:00			6.81
IPSWICH	07/10/2010 13:00			2.25
MOGGILL	15/10/2010 19:00			2.56
JINDALEE				
BRISBANE	11/10/2010 12:00			1.58
BAR	11/10/2010 12:00			1.35

4.7 October Event – Height Hydrographs

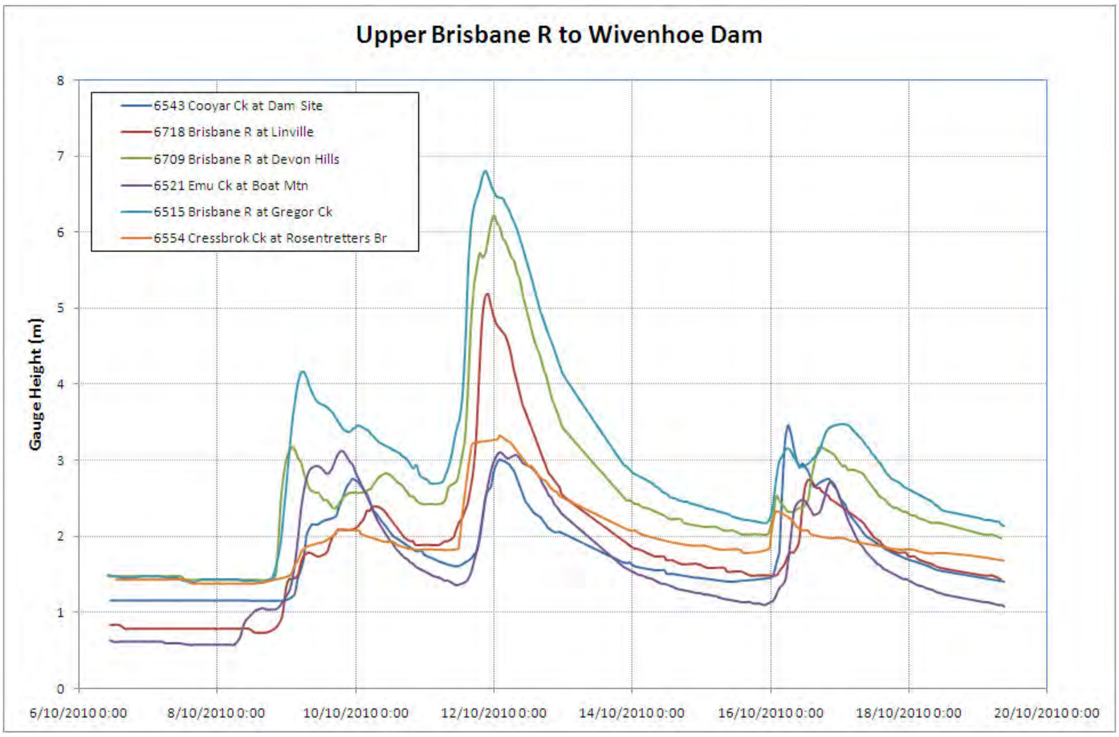
Height hydrographs for selected key stations within the Brisbane River Basin are plotted below. During the Event, basic data-checking is carried out by Duty Technical Assistants.



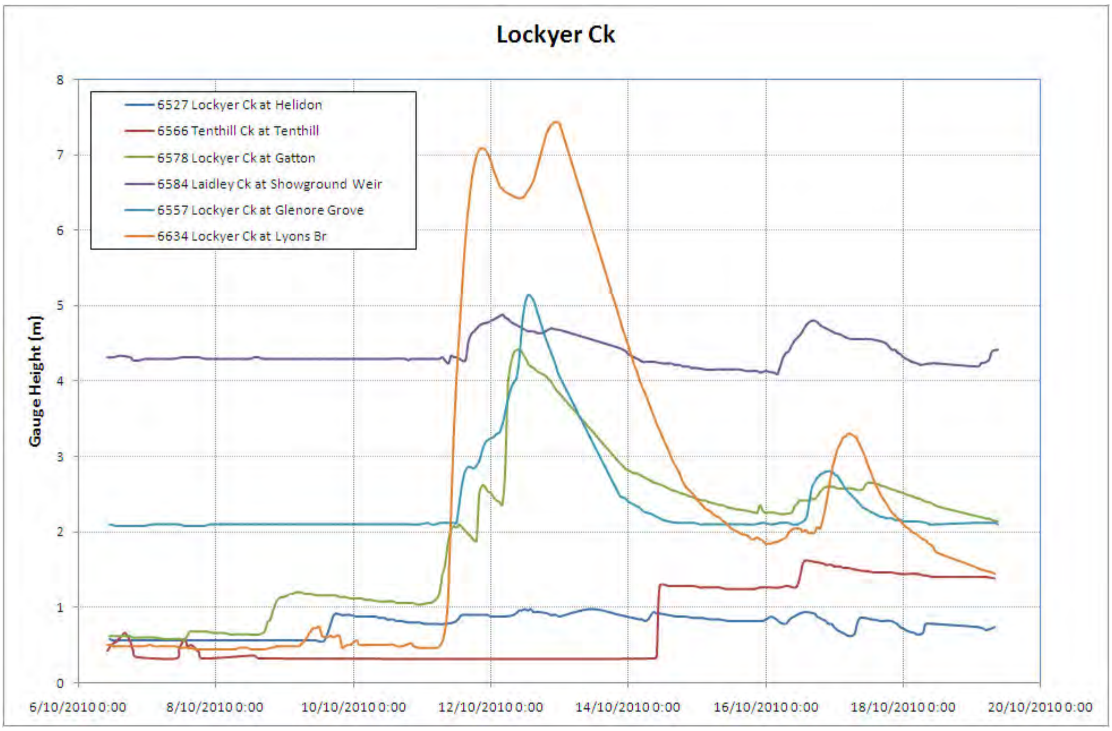
The three gauges illustrated above, worked well during the event. The Stanley River at Woodford is a key gauging station.



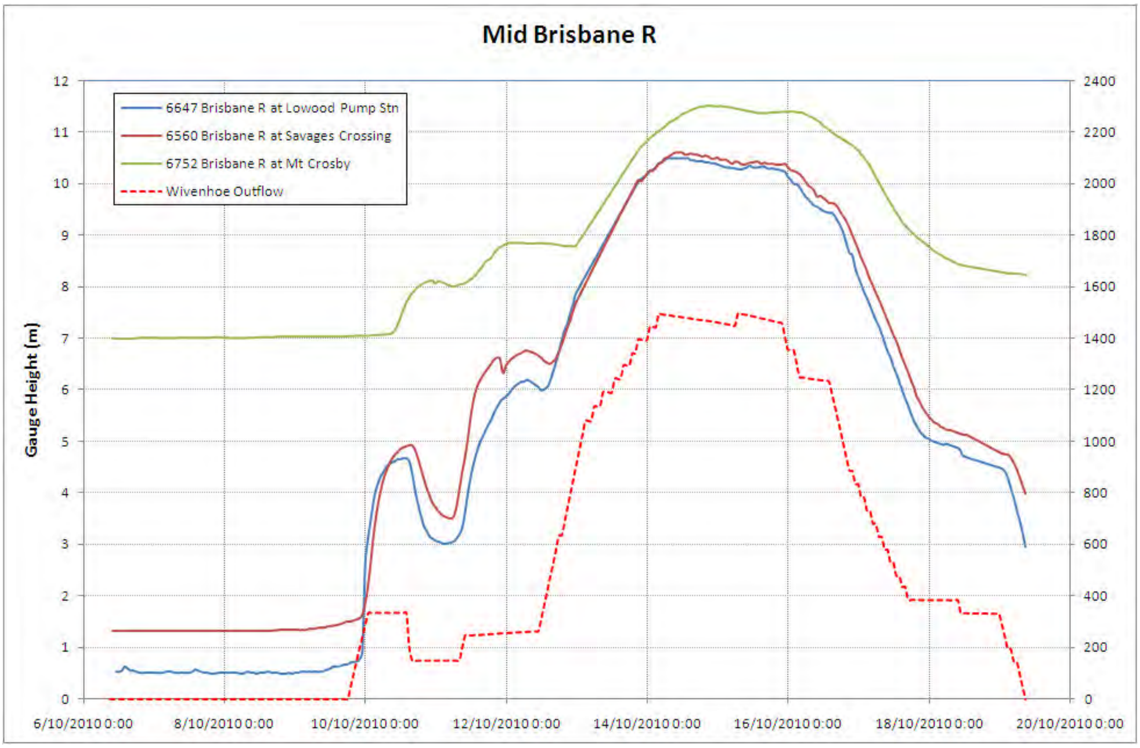
The two automatic gauges appear to have slightly under-read the rainfall when compared with the manual readings. However, this difference did not have impact upon dam operations.



The key gauge at Gregors Creek represents nearly 75% of the catchment to the Dam. All gauges upstream of Wivenhoe Dam appear to have worked well during the event.



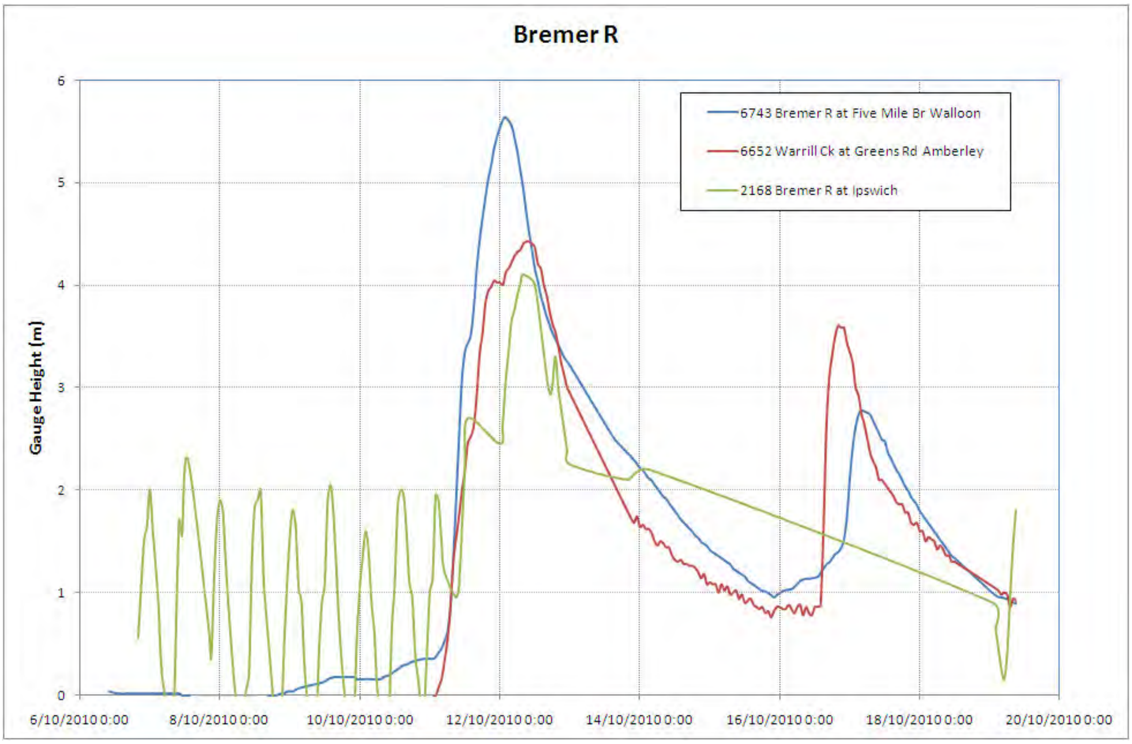
Most of gauges in Lockyer Creek worked well during the Event with the exception of Tenthill during the early stages. The Tenthill gauge was repaired during the Event.



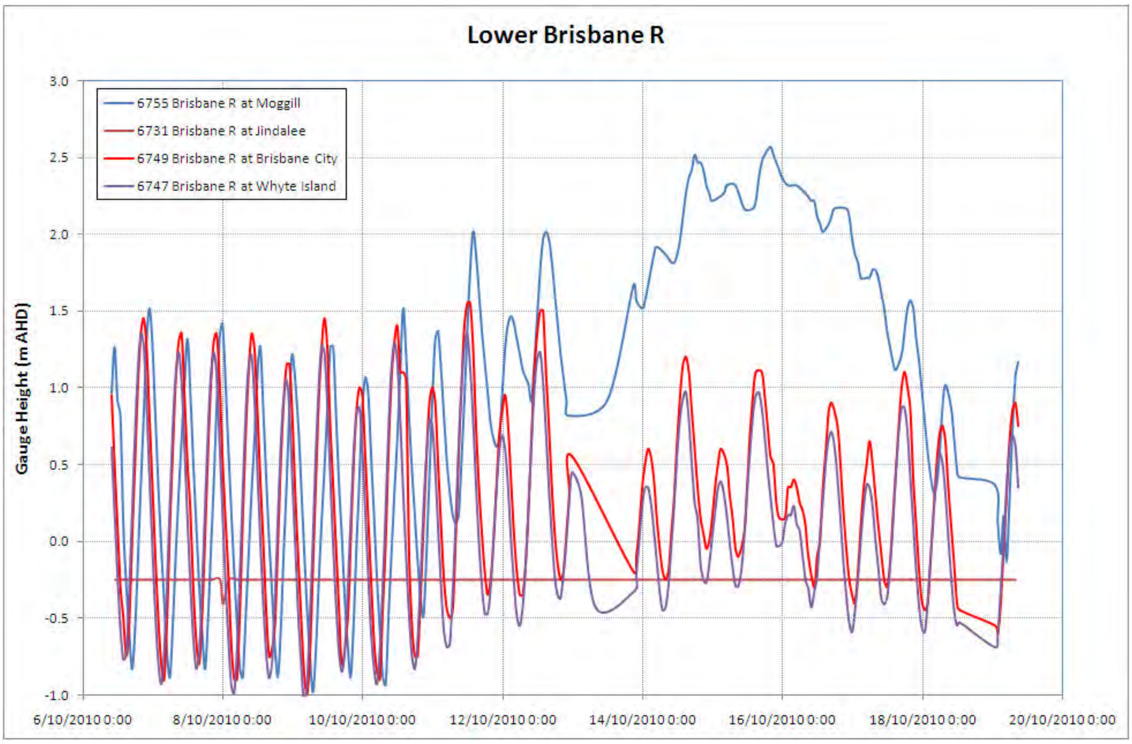
Lowood Pump Station is located just downstream from the junction of the Brisbane River and Lockyer Creek. Further downstream, the Savages Crossing ALERT gauge slaves off the DERM water level station.

The DERM water level station is considered to be a more accurate representation of the combined Lockyer and Brisbane flow than the upstream station at Lowood.

These gauges, as well as the gauge at Mt Crosby, appear to have worked well during the event.



Walloon and Amberley are key gauging stations and appear to have worked well during the Event. As illustrated above, the Bremer River at David Trumpy Bridge is affected by backwater.

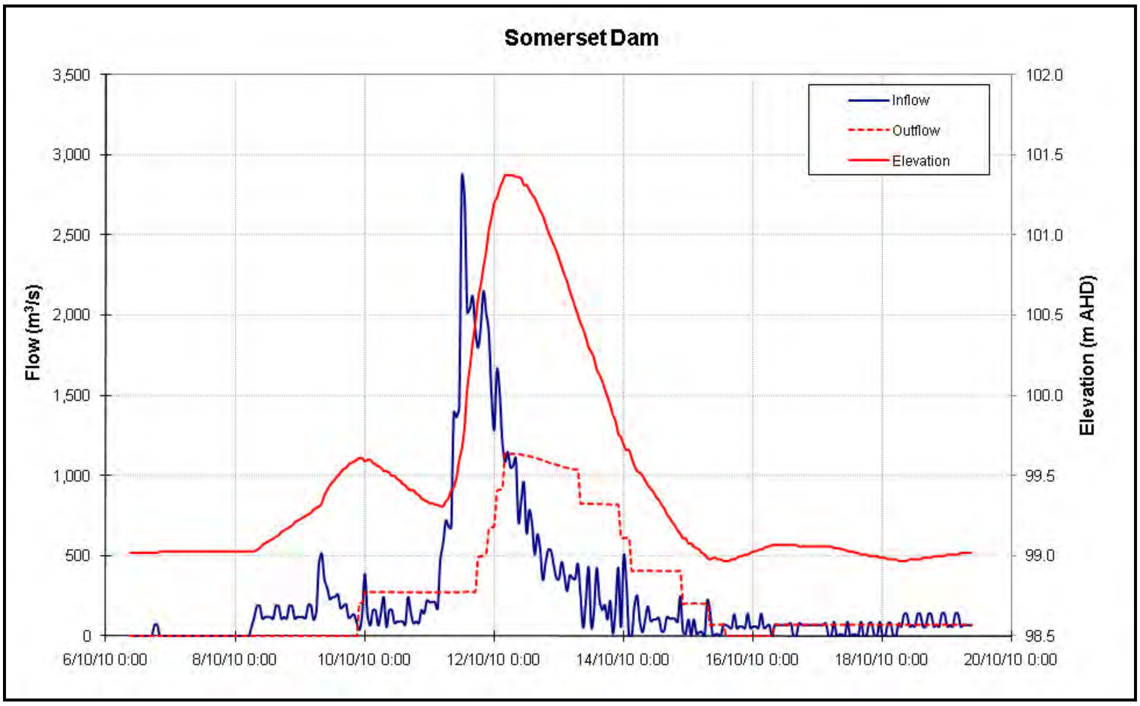


The lower Brisbane River gauges are affected by tidal influences, however, they still appear to have worked well during the Event.

4.8 October Event – Dam Inflows and Outflows

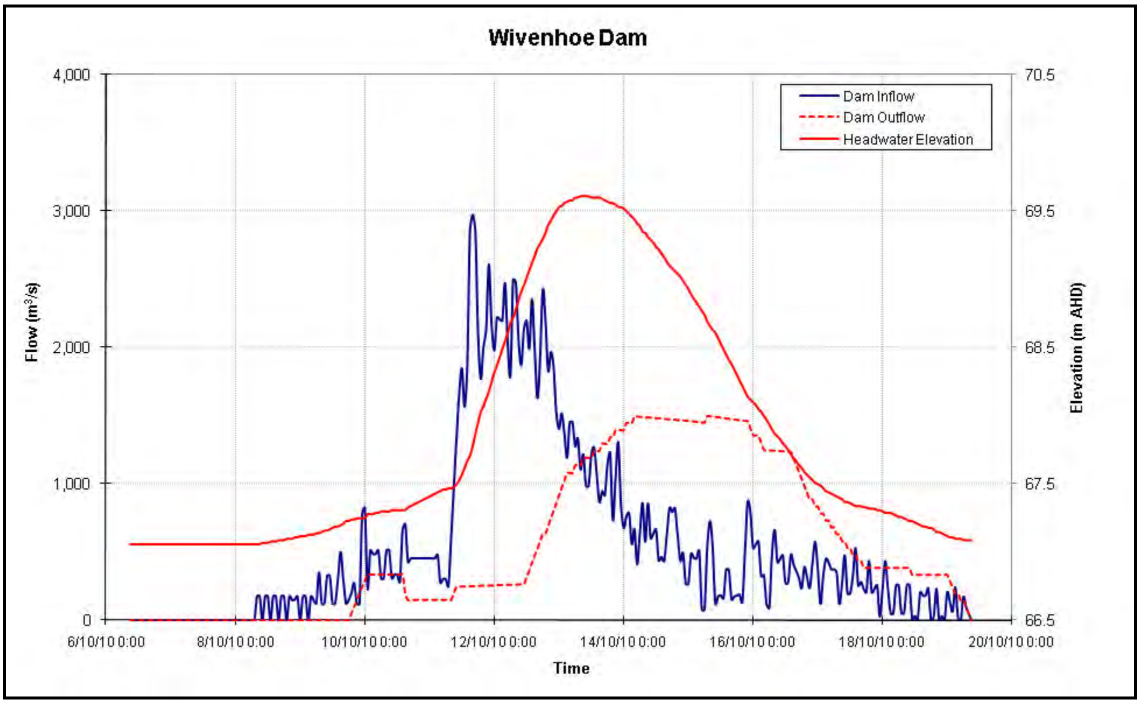
The inflows and outflows from Somerset and Wivenhoe Dams are shown in the table and figures below. Note that the Wivenhoe figures include Somerset outflows and the inflow to the Dams has been estimated by reverse routing which tends to be mathematically unstable, hence the sawtooth appearance of the inflows in the graphs below.

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
SOMERSET DAM INFLOW	11/10/2010 12:00	2,860	286,000	
SOMERSET DAM OUTFLOW	12/10/2010 04:00	1,140	285,000	101.37
WIVENHOE DAM INFLOW	11/10/2010 16:00	2,980	628,000	
WIVENHOE DAM OUTFLOW	14/10/2010 04:00	1,490	623,000	69.61



The inflow into Somerset Dam is characterised by a single peak of approximately 2,860m^3/s at 12:00 on Monday 11 October 2010. The peak of the outflow of 1,135m^3/s occurred at 14:00 on Tuesday 12 October 2010.

Somerset Dam reached its maximum water level of 101.37m AHD early in the morning of Tuesday 12 October.



Similarly to Somerset Dam, the inflow into Wivenhoe Dam is characterised by a single peak of approximately 3,000m^3/s on the afternoon of Monday 11 October 2010. The peak of the outflow of 1,493m^3/s occurred three days later in the early hours of Thursday 14 October 2010.

Wivenhoe Dam reached its maximum water level of 69.61m AHD at 04:00 on Thursday 14 October 2010.

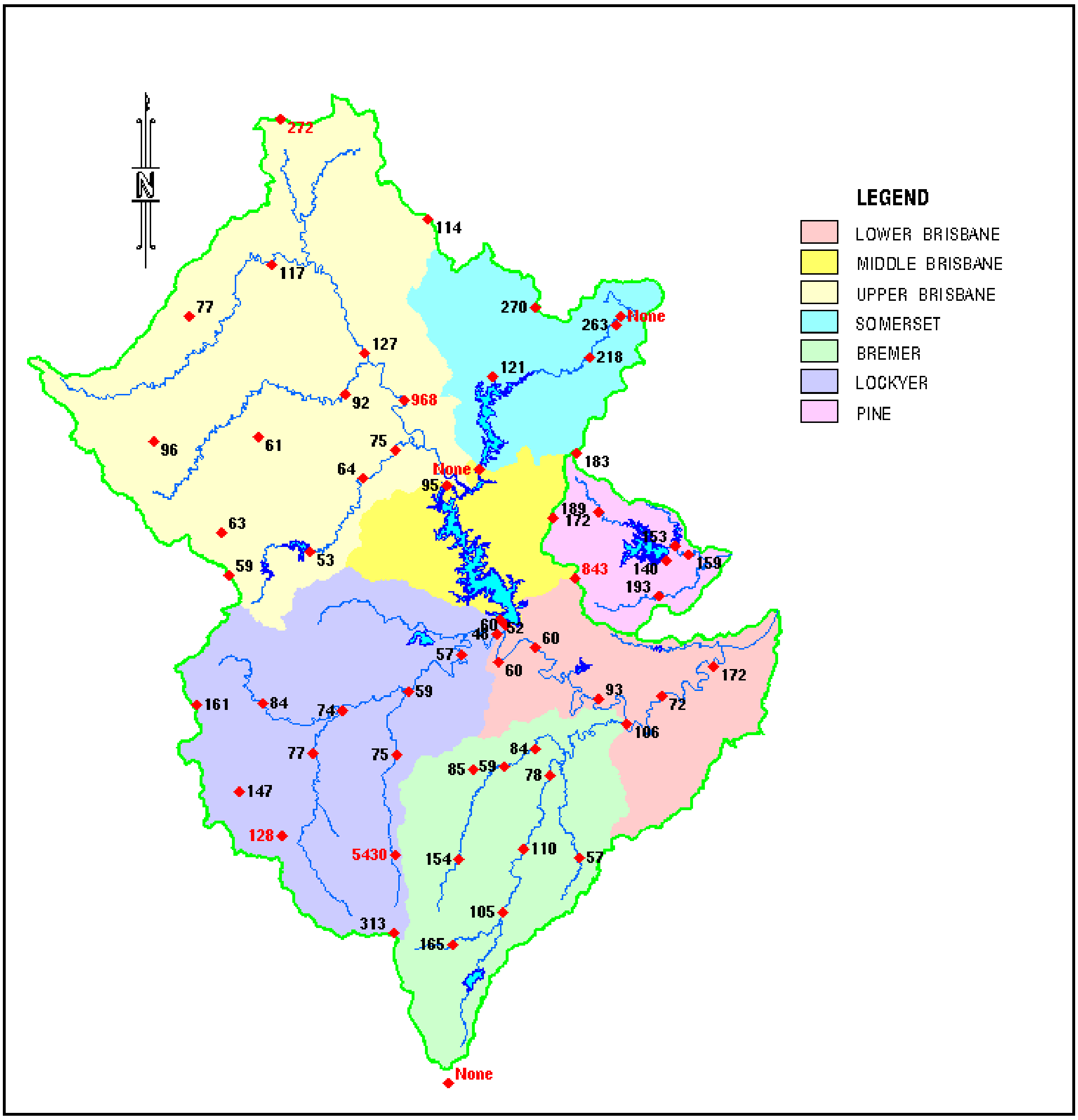
4.9 Early December Event – Overview

The early December Event has a designated start date of 09:00 on Wednesday 1 December 2010 for the purposes of providing event data. Dam releases for the Event commenced on Monday 13 December 2010 and concluded on Thursday 16 December 2010.

Only small releases from Somerset and Wivenhoe Dams occurred during this period. Accordingly, only basic rainfall and water level data has been reported for this time as comprehensive data is of little value in assessing the Event.

4.10 Early December Event – Rainfall

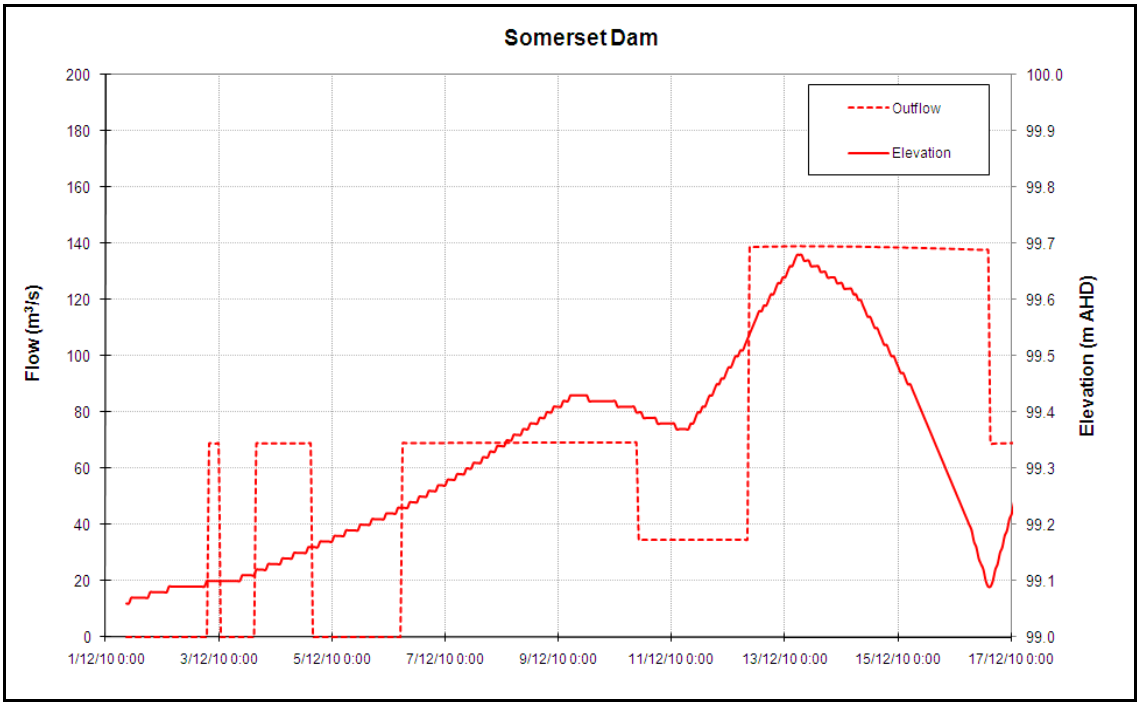
Rainfall in the Brisbane River catchment during this event was of low intensity and scattered throughout the Basin. The diagram below summarises the 15 days of rainfall from 09:00 on Wednesday 1 December 2011.



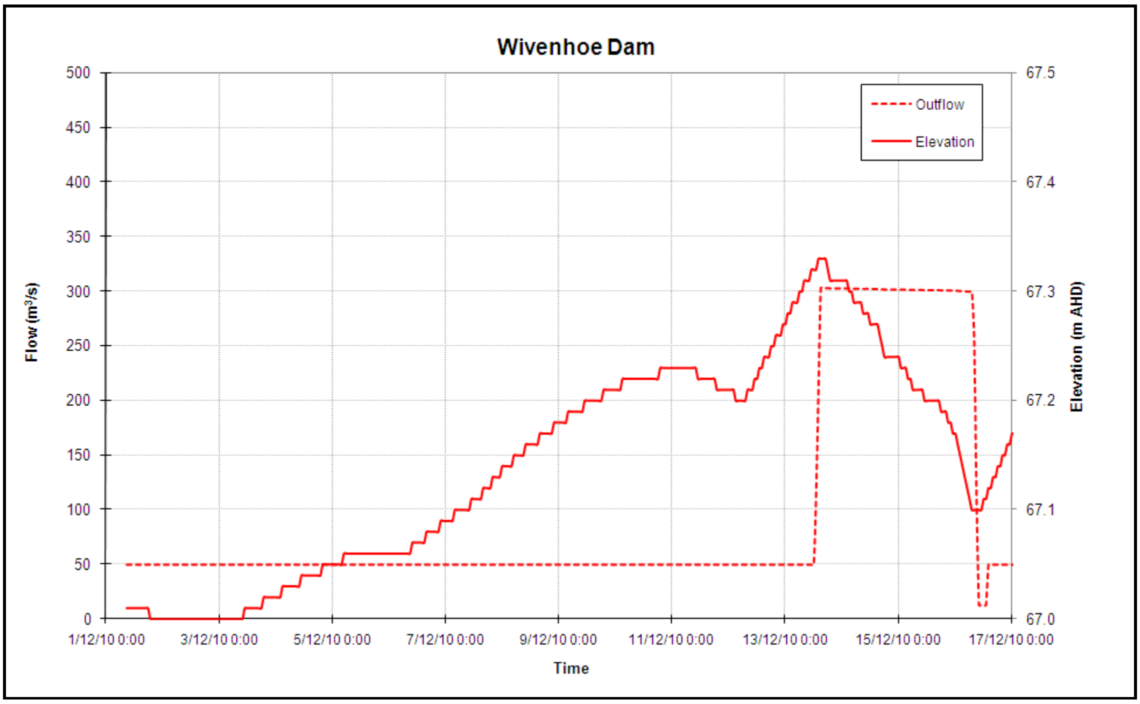
4.11 Early December Event – Dam Inflows and Outflows

The inflows and outflows from Somerset and Wivenhoe Dams are outlined in the table and figures below. Note, the Wivenhoe figures include Somerset outflows and the inflow to the dams has been estimated by reverse routing.

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
SOMERSET DAM INFLOW	13/12/2010 02:00	280	107,000	
SOMERSET DAM OUTFLOW	13/12/2010 14:00	140	93,000	99.68
WIVENHOE DAM INFLOW	13/12/2010 15:00	400	113,000	
WIVENHOE DAM OUTFLOW	13/12/2010 15:00	300	127,000	67.33



In the afternoon of Monday 13 December, Somerset Dam reached its maximus water left of 99.68mm AHD. The corresponding outflow from the Dam was 140m^3/s.



At 15:00 on Monday 13 December, Wivenhoe Dam's maximum water level of 67.33m AHD was reached, with a corresponding release of 300m^3/s.

4.12 Mid December Event – Overview

The Mid December Event has a designated start date of 09:00 16 December 2010 for the purposes of providing event data. The Event's dam releases commenced on Friday 17 December 2010 and concluded on Friday 24 December 2010.

The Mid December Event was a relatively significant event with the peak outflow from Wivenhoe Dam in the order of 1,500m^3/s. Accordingly, comprehensive rainfall and water level data has been reported to allow a detailed assessment of the event.

4.13 Mid December Event – Base Rainfall Data

The following rainfall tables and maps show the daily event rainfall recorded in the Brisbane River Basin. On the maps "None" signifies no rainfall reports were received from the station during the period. Figures in red also indicate errors in the data.

Rainfall in 24 hours to 09:00											
ALERT ID	Station	17 Dec	18 Dec	19 Dec	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	Total	Comment
6775	Peachester										OOA
6714	Ferris Knob	36	7	4	55	0	0	10	2	114	
6705	Woodford-P	50	26	3	91	0	1	11	4	186	

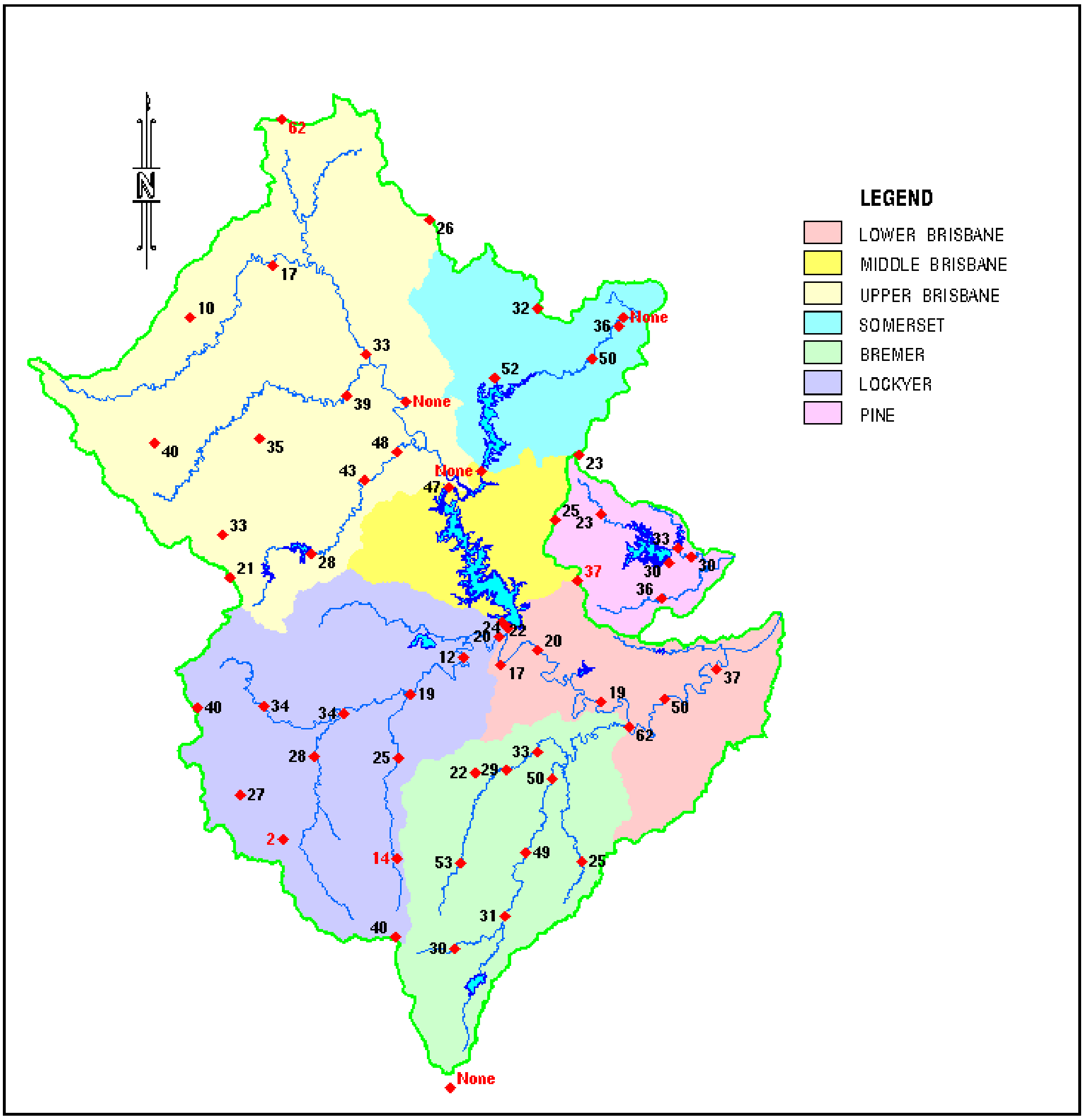
Rainfall in 24 hours to 09:00											
ALERT ID	Station	17 Dec	18 Dec	19 Dec	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	Total	Comment
6702	Woodford-B	50	26	3	91	0	1	11	4	186	
6600	Kilcoy	52	35	0	77	0	0	7	0	171	
6593	Somerset Dam HW-P	54	36	8	104	0	0	20	0	222	Double counting
6590	Somerset Dam HW-B	27	18	5	51	0	0	10	0	111	
6602	Top of Brisbane	43	3	7	46	0	0	12	0	111	
6540	Yarraman	10	15	3	51	0	0	19	5	103	
6542	Cooyar Ck	17	1	27	83	0	0	11	0	139	
6717	Linville	19	8	15	94	0	0	13	0	149	
6708	Devon Hills	33	8	2	93	0	0	13	1	150	
6529	St Aubyns	40	5	2	50	0	0	29	17	143	
6621	Nukinenda	35	19	1	47	1	0	13	20	136	
6520	Boat Mountain	39	12	1	54	0	1	16	4	127	
6514	Gregor Ck-P	25	24	1	79	0	0	13	1	143	
6517	Gregor Ck-B										OOA
6596	Crows Nest	33	10	2	45	0	0	23	7	120	
6780	Perseverance	0	0	9	6	2	2	2	0	21	Under reading
6782	Ravensbourne	66	5	4	43	0	0	27	6	151	
6523	Cressbrook Dam	28	8	2	40	0	0	14	7	99	
6553	Rosentretters Br	43	11	1	41	0	0	16	1	113	
6604	Toogoolawah	48	15	2	45	1	0	14	1	126	
6574	Caboonbah	47	16	2	48	0	0	15	0	128	
6636	Wivenhoe Dam HW-B	22	0	4	43	0	0	19	0	88	
6643	Wivenhoe Dam TW-P	24	0	3	44	0	0	20	0	91	
6641	Wivenhoe Dam TW-B	25	0	3	46	0	0	19	1	94	
6598	Toowoomba	40	4	8	36	0	0	10	2	100	
6526	Helidon	33	3	11	36	0	0	34	1	118	
6617	Little Egypt	27	1	18	35	0	0	20	1	102	
6606	West Woodbine	6	1	18	39	1	0	44	1	110	
6565	Tenthill	28	5	0	1	0	0	42	0	76	
6577	Gatton	34	1	8	38	0	0	45	1	127	
6619	Mt Castle	40	4	7	39	0	0	52	6	148	
6615	Thornton	14	0	9	31	0	0	37	1	92	
6583	Showground Weir	25	2	6	35	0	0	26	2	96	
6556	Glenore Grove	19	1	8	40	0	0	22	2	92	
6633	Lyons Br-P	12	0	3	37	0	0	16	1	69	
6630	Lyons Br-B	13	0	2	42	0	0	17	1	75	
6568	O'Reillys Weir	20	0	3	42	0	0	17	1	83	
6646	Lowood-B	18	0	5	43	0	0	16	1	83	

Rainfall in 24 hours to 09:00											
ALERT ID	Station	17 Dec	18 Dec	19 Dec	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	Total	Comment
6649	Lowood-P	17	0	4	39	0	0	14	0	74	
6559	Savages Crossing	20	0	3	42	0	0	22	0	87	
1730	Lake Manchester	26	0	3	44	0	0	19	0	92	
6751	Mt Crosby	19	0	4	39	0	0	13	0	75	
2059	Colleges Crossing	30	0	10	50	0	0	15	0	105	
6580	Adams Br	53	8	13	30	0	0	23	1	128	
2192	Franklyn Vale										OOA
2065	Grandchester	34	2	5	42	0	0	22	3	108	
6736	Kuss Rd	22	0	5	30	0	0	16	1	74	
2068	Tallegalla	35	0	16	40	0	0	21	0	112	
6733	Rosewood	29	1	6	32	0	0	21	1	90	
6550	Five Mile Bridge	33	0	11	35	0	0	20	0	99	
6623	Tarome-P	30	1	5	41	0	0	23	23	123	
6562	Kalbar Weir	31	1	5	31	0	0	22	3	93	
6571	Harrisville	49	5	15	34	0	0	17	2	122	
6651	Greens Road	50	2	10	38	0	0	20	1	121	
6739	Washpool	25	3	19	35	0	0	16	0	98	
2062	Peak Crossing	36	7	17	40	0	0	16	0	116	
2055	Loamside	39	4	10	39	0	0	22	0	114	
2160	One Mile Br	43	0	12	43	0	0	15	0	113	
2040	Churchill	37	1	12	39	0	0	14	0	103	
2035	Brassall (Hancock	41	1	10	33	0	0	9	0	94	
2106	Lyons										OOA
2145	Ripley	10	2	0	2	0	0	0	0	14	Under reading
2050	Bundamba (Barclay)	49	0	13	42	0	0	14	0	118	
2045	Bundamba (Hanlon)	44	0	8	17	0	0	5	0	74	
6754	Moggill-P	62	0	9	41	0	0	13	0	125	
2150	Opossum	39	1	10	38	0	0	10	0	98	
2116	Carole Park	61	1	8	57	0	0	12	0	139	
1518	Wacol	73	0	8	49	1	21	10	0	162	
2102	Jingle Downs	12	1	10	34	0	0	9	1	67	
2104	Greenbank	15	6	9	48	0	0	10	0	88	
2108	Forestdale	8	5	14	29	1	1	6	0	64	
2114	Calamvale	19	0	9	65	0	0	9	1	103	
1736	Inala	16	0	8	60	0	1	8	0	93	
2020	Corinda High	53	0	2	58	0	1	12	0	126	
2138	Mt Gravatt	10	2	2	41	4	2	7	0	68	
1548	Holland Park West	43	2	3	56	3	0	11	0	118	
1554	East Brisbane	39	0	7	57	1	0	12	0	116	
1836	Eight Mile Plains	26	0	12	65	0	1	9	0	113	

Rainfall in 24 hours to 09:00											
ALERT ID	Station	17 Dec	18 Dec	19 Dec	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	Total	Comment
1803	Wishart	22	0	4	56	0	1	8	0	91	
1706	Carindale	29	0	7	55	0	0	11	0	102	
1596	Camp Hill	38	0	9	55	4	1	11	0	118	
1830	Mansfield	24	1	3	55	1	3	8	1	96	
1739	Lytton	32	0	7	50	0	1	14	0	104	
1527	Hemmant	30	0	8	43	6	6	14	0	107	
2141	Ransome	20	0	11	55	0	1	16	0	103	
1755	Manly	21	0	8	46	1	0	15	0	91	
1742	Pullenvale	47	0	3	60	0	1	12	0	123	
1515	Kenmore Hills	33	1	7	59	0	1	12	4	117	
6730	Jindalee	50	0	2	50	0	0	10	0	112	
1749	Toowong	43	1	5	65	0	1	16	0	131	
6748	Brisbane City	37	0	9	50	0	0	12	0	108	
1507	Three Ways	26	0	4	65	0	1	15	0	111	
1718	Gold Ck Res	23	0	3	69	19	0	15	0	129	
1533	Enoggera Dam	20	0	5	61	0	0	13	2	101	
1512	Mt Coot-tha	28	0	9	58	1	1	14	0	111	
1578	Alderley	21	0	5	56	0	0	14	0	96	
1524	Bowen Hills	27	4	7	51	1	0	14	0	104	
2285	Steiglitz Wharf	17	44	12	55	0	0	14	0	142	
2086	Marburg	34	1	11	36	0	0	17	1	100	
2074	Stokes Crossing	38	1	20	37	0	0	21	3	120	
2080	Spressers Bridge	30	1	9	37	0	0	23	1	101	
2083	Rosewood WWTP	27	0	7	34	0	0	21	1	90	
2071	Churchbank Weir	32	1	0	1	0	0	0	1	35	Under reading
2077	Greys Plains Rd	23	4	17	34	0	0	32	1	111	
1837	Wynnum Bowls	22	0	6	43	0	1	14	0	86	
1838	Luggage Point	31	1	7	49	0	0	9	1	98	
1840	Chandler	20	1	4	54	1	1	11	0	92	
1841	Bulimba	39	0	9	59	0	1	14	0	122	
6585	Sandy Creek Road	30	0	9	38	0	0	42	0	119	
6588	Upper Sandy Creek	43	2	9	46	0	0	42	4	146	
2089	Harrisville-B	48	4	16	36	0	0	18	2	124	
2092	Rosewood-B	31	1	7	37	1	0	24	1	102	
2095	Bellbird Park	21	2	12	47	0	0	13	1	96	
2011	Buaraba	23	0	3.4	44	0	0	30.3	2.9	103.6	
2006	Hays Landing	19.4	0.4	1.8	56.2	0	0	27	0.4	105.2	
2004	Pohlman Range	26	29	0.4	86.2	0	0	17.6	0.6	159.8	
5356	Mt Alford										Did not work
6656	Bill Gunn Dam	11	9	3	10	8	9	27	3	80	

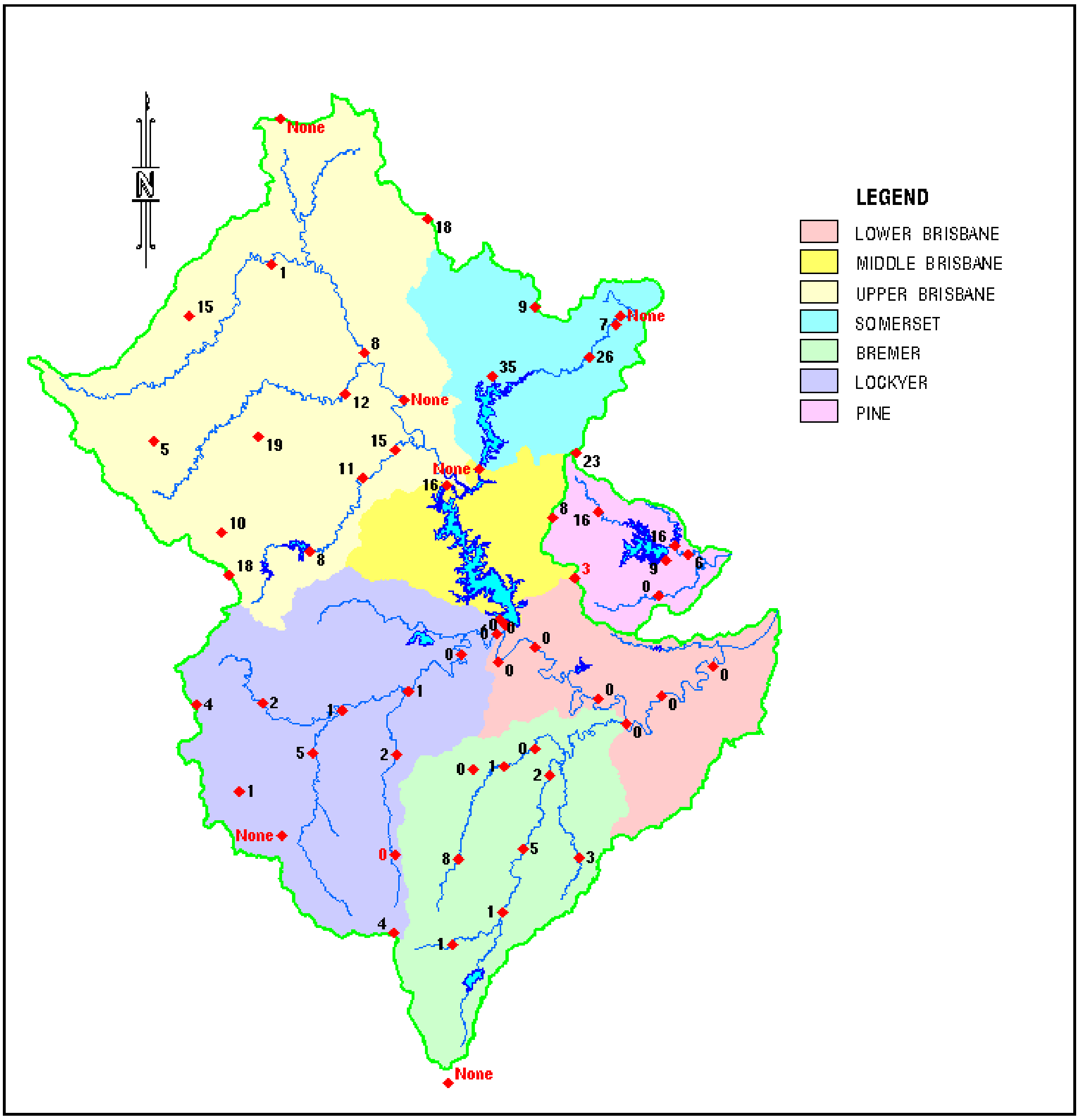
Rainfall in 24 hours to 09:00											
ALERT ID	**Station**	**17 Dec**	**18 Dec**	**19 Dec**	**20 Dec**	**21 Dec**	**22 Dec**	**23 Dec**	**24 Dec**	**Total**	**Comment**
6658	Lake Clarendon Dam	19	4	8	43	0	0	38	3	115	
6555	Atkinson Dam	8	0	4	44	0	0	22	1	79	
6624	Moogerah Dam	26	2	6	45	0	0	26	13	118	
6609	Monsildale	28	7	25	52	0	0	14	2	128	
6612	Mt Stanley	25	14	27	116	0	0	15	1	198	
6607	Lindfield	25	4	5	101	0	1	11	5	152	
6603	Blackbutt	15	8	3	60	0	0	19	6	111	
6601	Mt Binga	34	19	2	62	0	0	28	15	160	
6613	Hazeldean	51	61	0	77	0	0	25	1	215	
6614	Westvale	0	8	1	77	0	0	13	0	99	
6605	Eskdale										Not yet installed
6611	Redbank Creek	56	7	3	47	0	0	15	9	137	
6100	Mt Mowbullan	21	2	0	1	0	0	0	2	26	
6427	Maleny	33	18	20	83	0	0	16	12	182	
5425	Hume Lane	35	8	5	66	0	1	21	3	139	
6400	Bald Knob	39	8	10	64	0	1	16	4	142	
6716	West Bellthorpe	32	9	5	57	0	1	10	11	125	
6701	Mt Mee-B	23	23	2	63	0	1	23	4	139	
6690	Mt Mee-P	23	23	2	63	0	0	24	3	138	
6680	Mt Glorious-P	28	3	2	65	0	0	38	1	137	
5423	Landsborough	67	7	12	74	0	2	36	4	202	
6608	Jimna	26	18	30	54	0	2	8	1	139	
2194	Wilsons Peak	10	0	1	34	0	0	55	10	110	
6774	Wilsons Peak-P										OOA

Rainfall in 24 hours to 09:00 17/12/2010



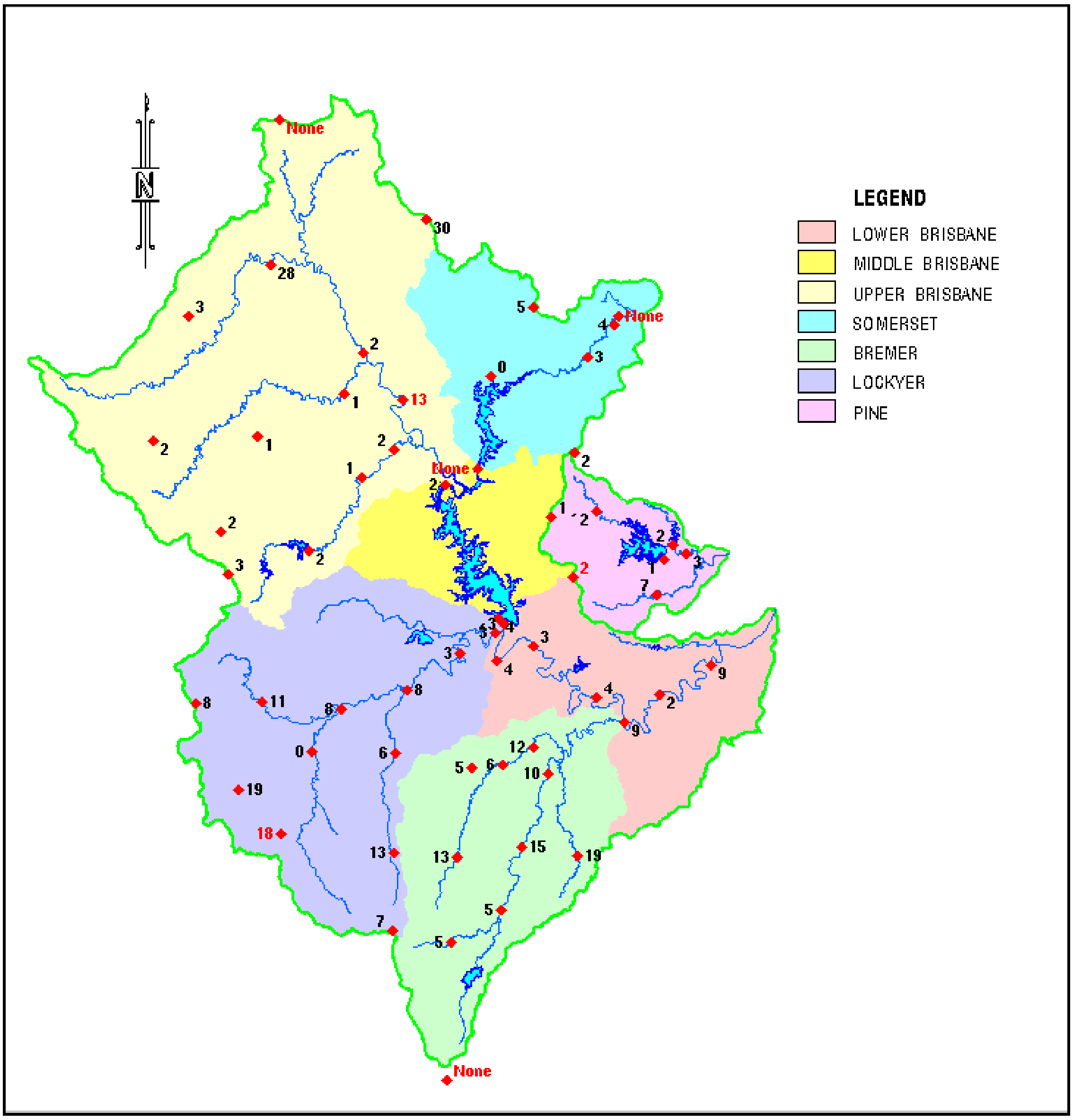
In the 24 hours to 09:00 on Friday 17 December 2010, widespread rainfall was recorded throughout the Brisbane River catchment, with falls of up to 50mm recorded.

Rainfall in 24 hours to 09:00 18/12/2010



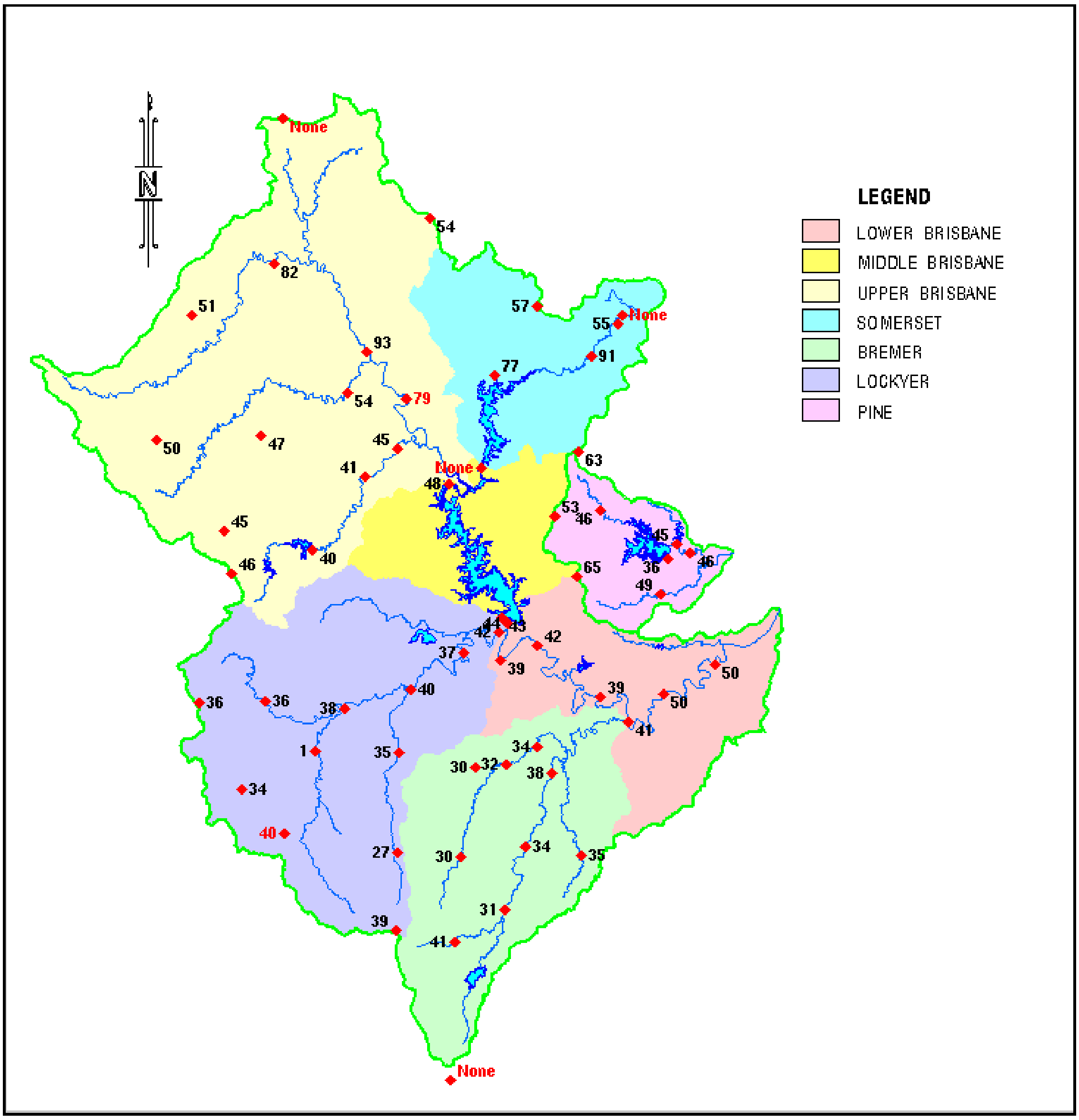
In the 24 hours to 09:00 on Saturday 18 December 2010, rainfall had generally eased, especially in the catchments downstream of Wivenhoe, however isolated falls of up to 35mm were recorded around Kilcoy.

Rainfall in 24 hours to 09:00 19/12/2010



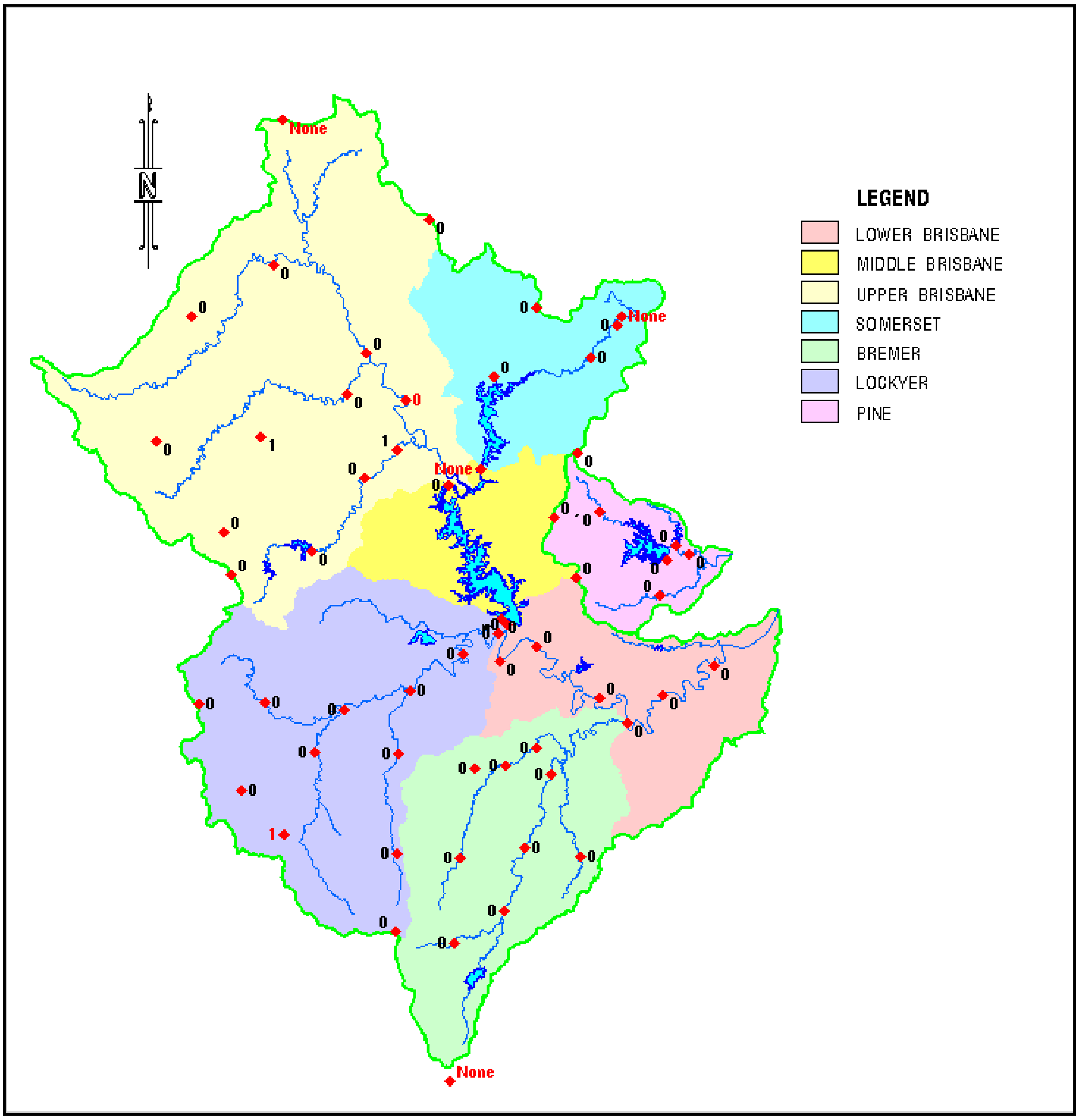
Only light rain was recorded throughout the region in the 24 hours to 09:00 on Sunday 19 December. Isolated higher totals of up to 30mm were recorded in the Stanley River catchment.

Rainfall in 24 hours to 09:00 20/12/2011



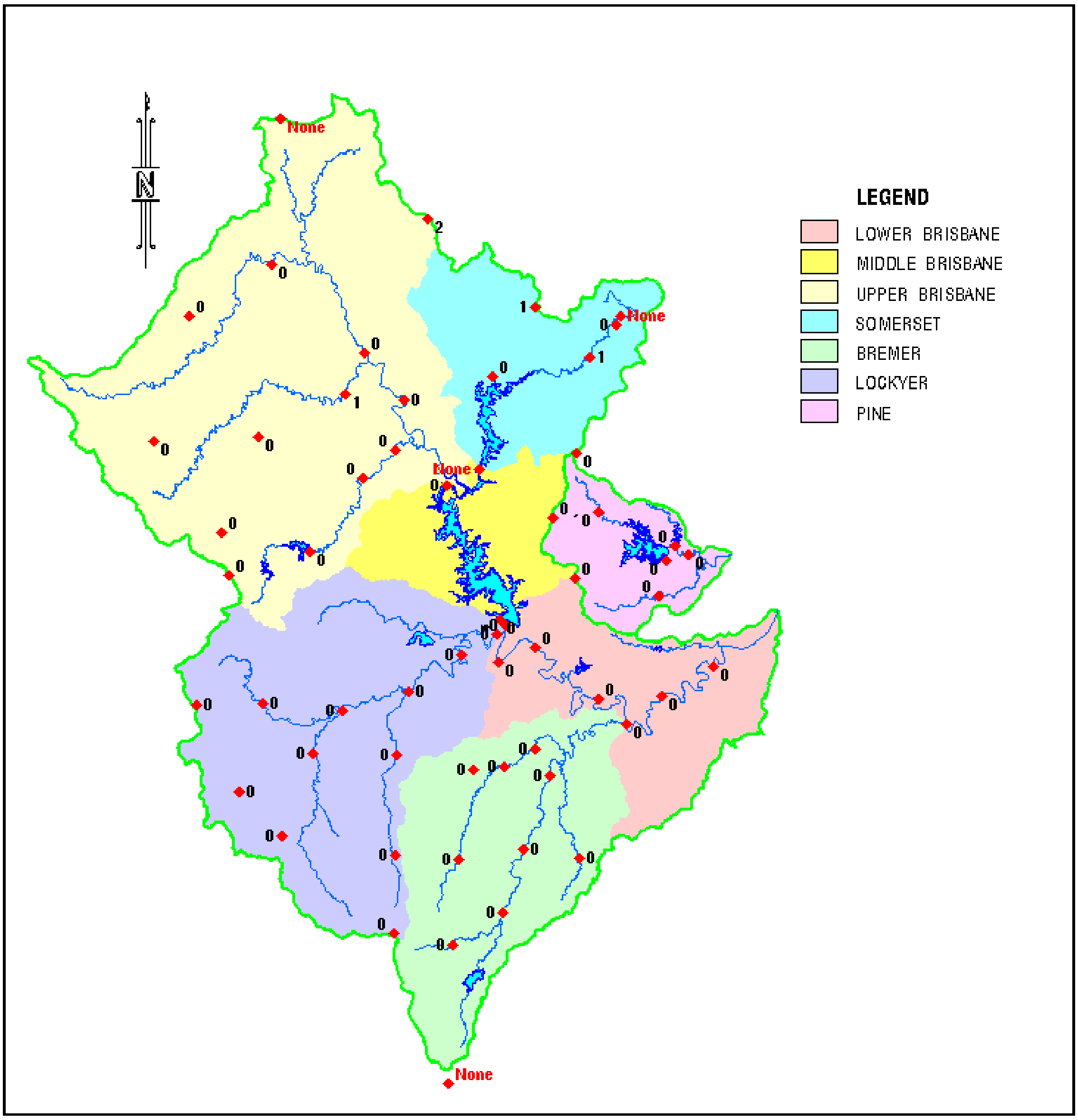
Rainfall in the 24 hours to 09:00 on Monday 20 December was more widespread and much heavier than the rainfall during the previous 24 hour period. Falls of up to 91mm were recorded in the Stanley catchment. In the Upper Brisbane catchment, widespread falls of between 40mm to 90mm were recorded. Downstream of Wivenhoe Dam, falls were generally less, ranging from between 35mm to 50mm.

Rainfall in 24 hours to 09:00 21/12/2010



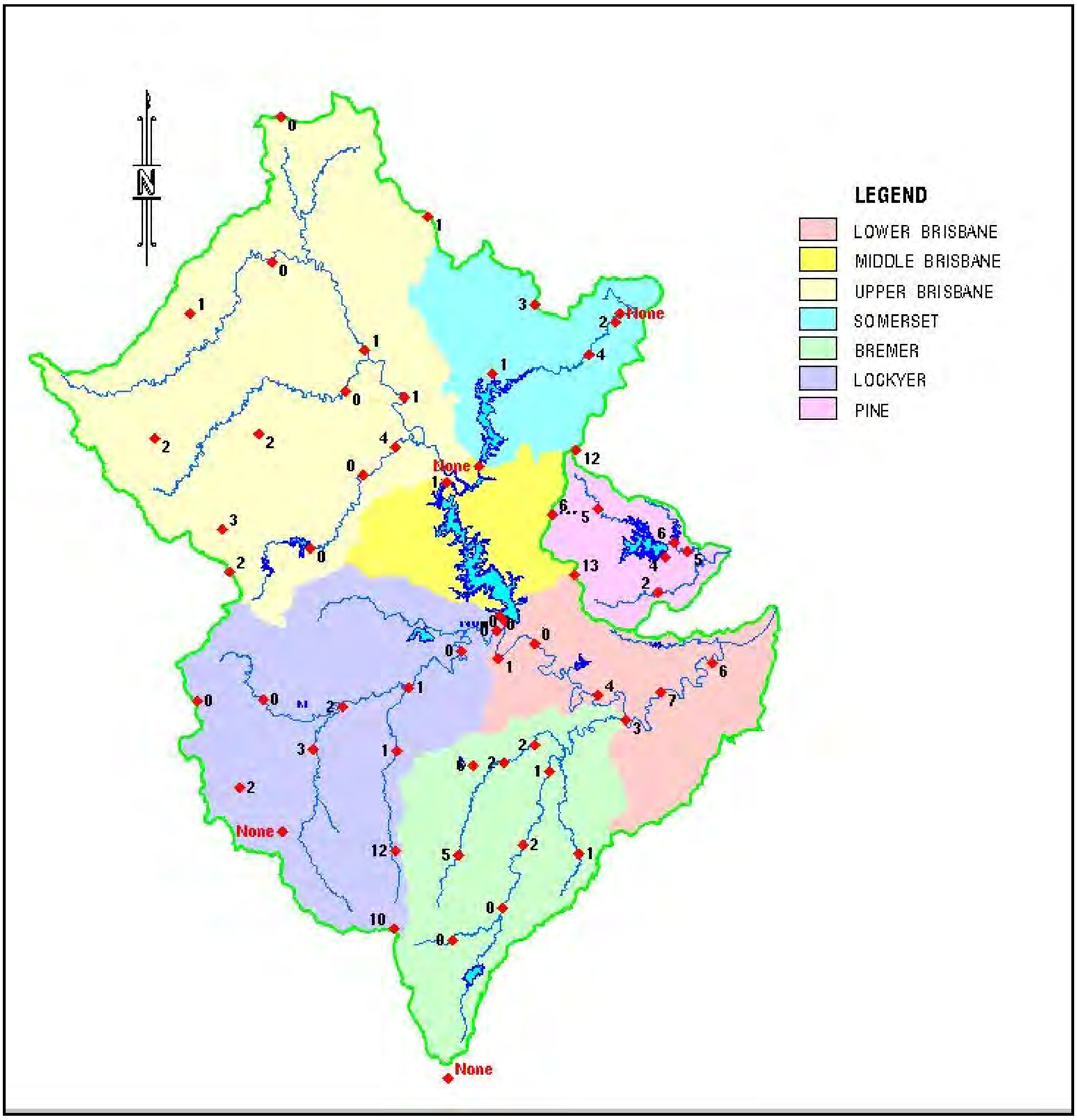
No significant rainfall was recorded in the region in the 24 hours to 09:00 on Tuesday 21 December 2010.

Rainfall in 24 hours to 09:00 22/12/2011



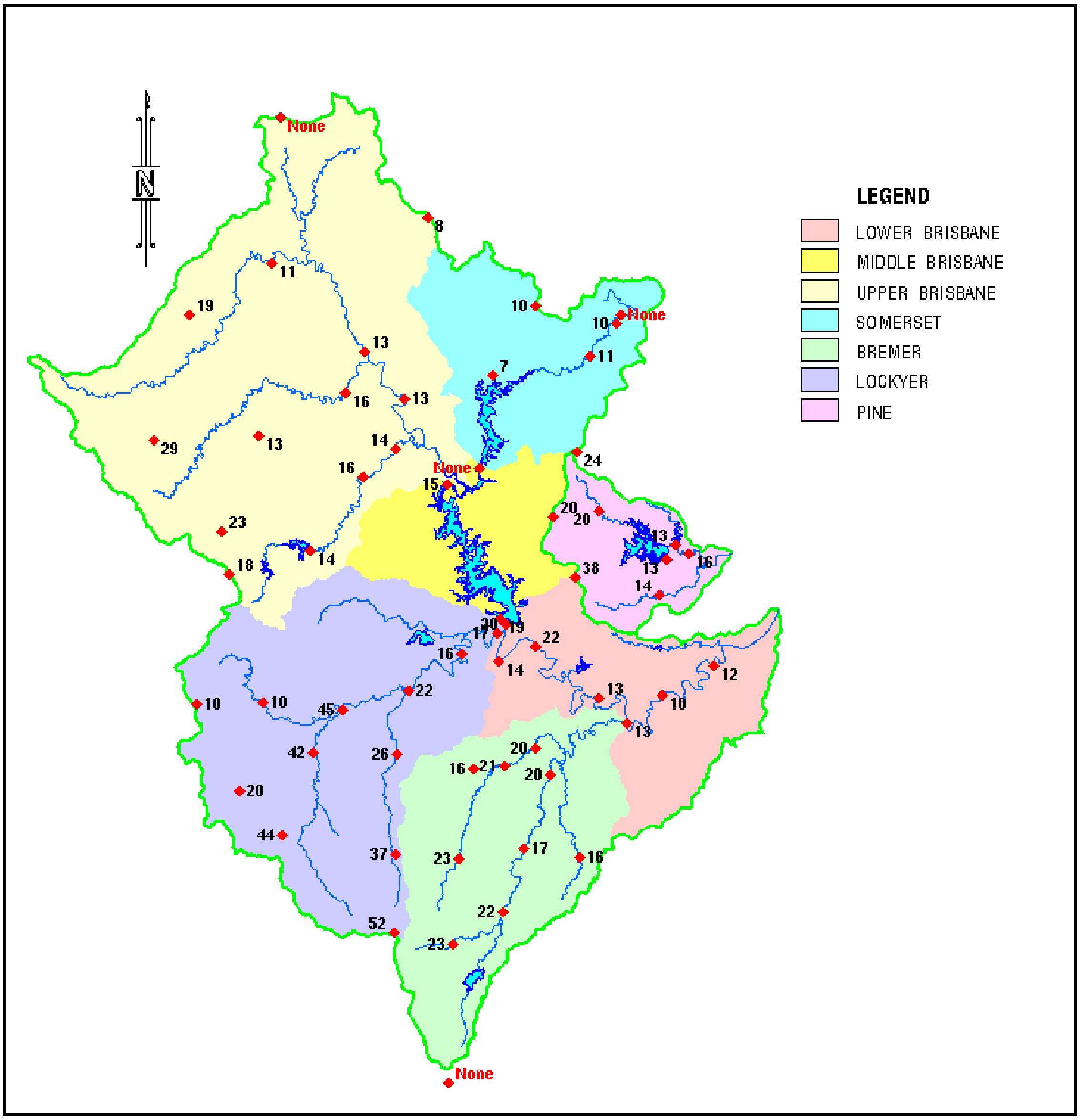
No significant rainfall was recorded in the region in the 24 hours to 09:00 on Wednesday 22 December 2010.

Rainfall in 24 hours to 09:00 23/12/2010



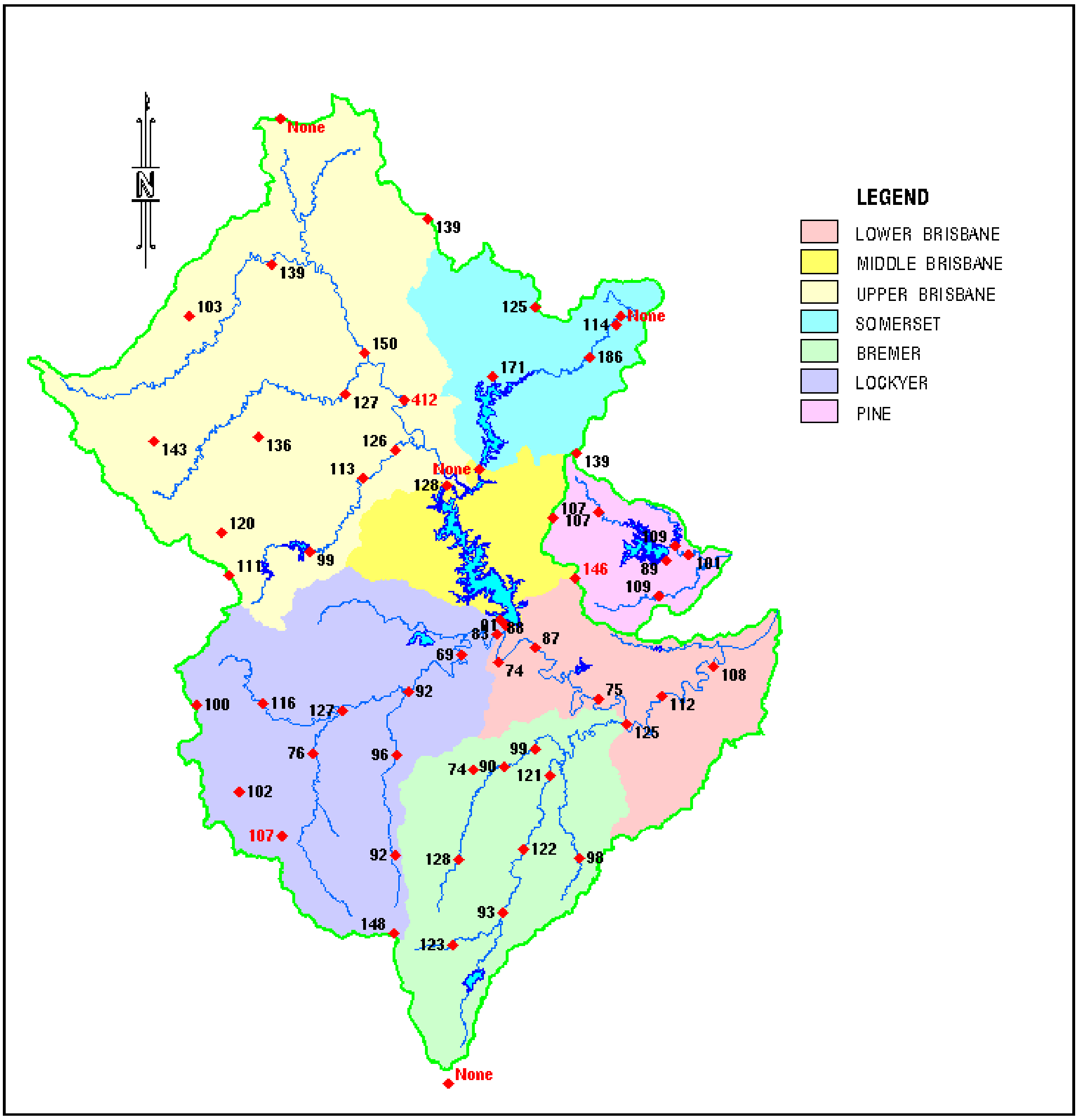
In the 24 hours to 09:00 on Thursday 23 December, rainfall totals were generally less than 10mm.

Rainfall in 24 hours to 09:00 24/12/2010



In the 24 hours to 09:00 on Friday 24 December, rainfall recommenced with widespread totals ranging from 10mm to 50mm. The highest totals in this period were recorded in the Lockyer Creek catchment.

Rainfall in eight days to 09:00 24/12/2010



The map above shows the distribution of rainfall during the eight day period to 09:00 on Friday 24 December 2010.

The highest totals were recorded in the headwater areas of the Stanley River. In the Upper Brisbane catchment, the rain was widespread with event totals of between 100mm and 150mm. In Lockyer Creek, event totals ranged from 70mm in the lower reaches to nearly 150mm in the headwaters of Laidley Creek. Totals in the Bremer and Lower Brisbane catchments were generally in the range of between 75mm to 125mm.

4.14 Mid December Event – Average Catchment Rainfall

Average rainfall for each sub catchment in the Brisbane Basin is determined by applying a weighting to the rainfall depth at each available station within the sub catchment. The Upper Brisbane catchment excludes the Somerset catchment and is a weighted average of the Upper and Middle Brisbane catchments. A summary of catchment average rainfall for the Mid December Event is shown in the table and figure below.

Period Ending 09:00	Stanley		Upper Brisbane		Lockyer		Bremer		Lower	
	Period	∑	Period	∑	Period	∑	Period	∑	Period	∑
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
17/12/2010	0	0	0	0	0	0	0	0	0	0
18/12/2010	22	22	11	11	2	2	3	3	0	0
19/12/2010	4	27	6	17	9	11	10	14	6	6
20/12/2010	73	99	54	71	34	45	34	48	44	51
21/12/2010	0	99	0	71	0	45	1	49	0	51
22/12/2010	1	100	0	71	0	45	6	55	0	51
23/12/2010	11	111	0	71	27	72	29	84	14	65
24/12/2010	3	115	0	71	4	76	13	97	0	65

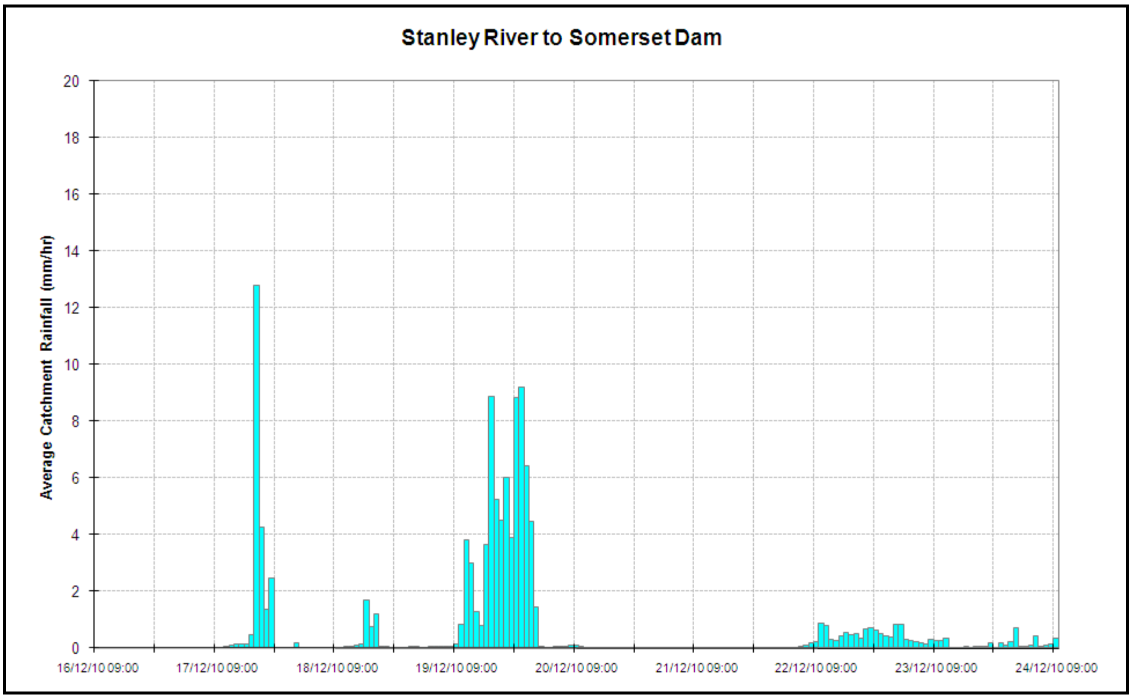
The catchment average rainfalls for the Mid December Event are included on the following pages. These hyetographs do not necessarily reflect the localised high intensity rainfall that was recorded across the Basin at various times and locations. Catchment rainfalls can include hourly intensities at individual stations which are up to five times the catchment average.

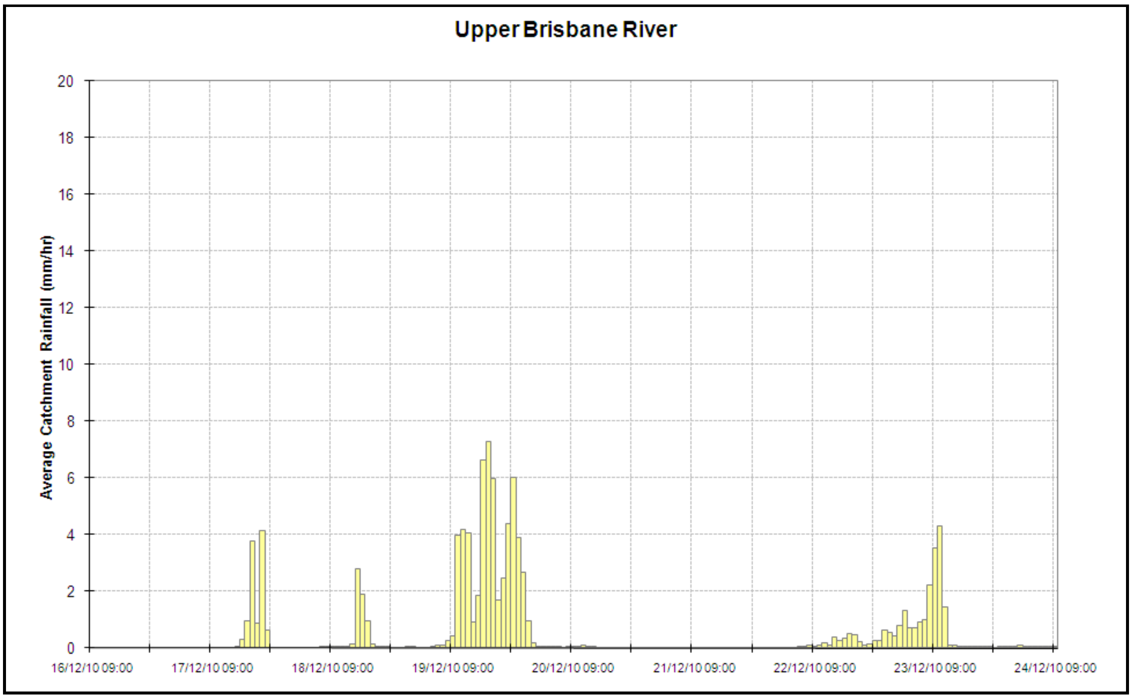
The hyetographs clearly show two to three distinct bursts of rainfall during the Event that can be described as follows:

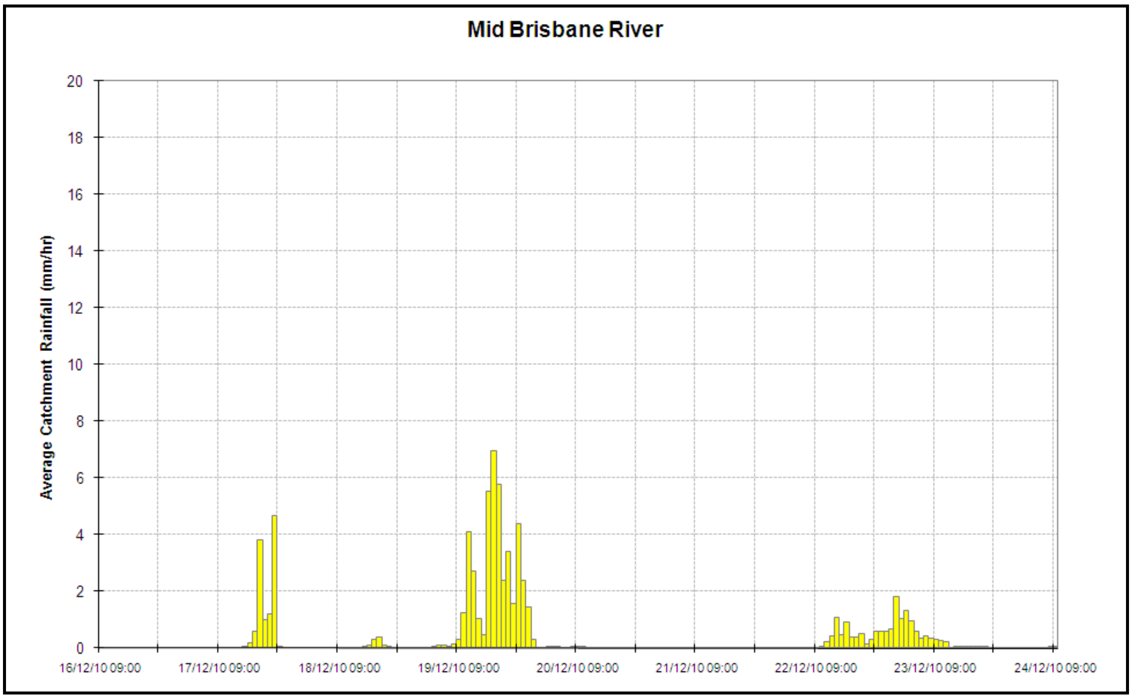
- A short intense period in the 12 hours to approximately 18:00 on Friday 17 December, concentrated in the Stanley catchment with less rainfall in the Upper Brisbane catchment;

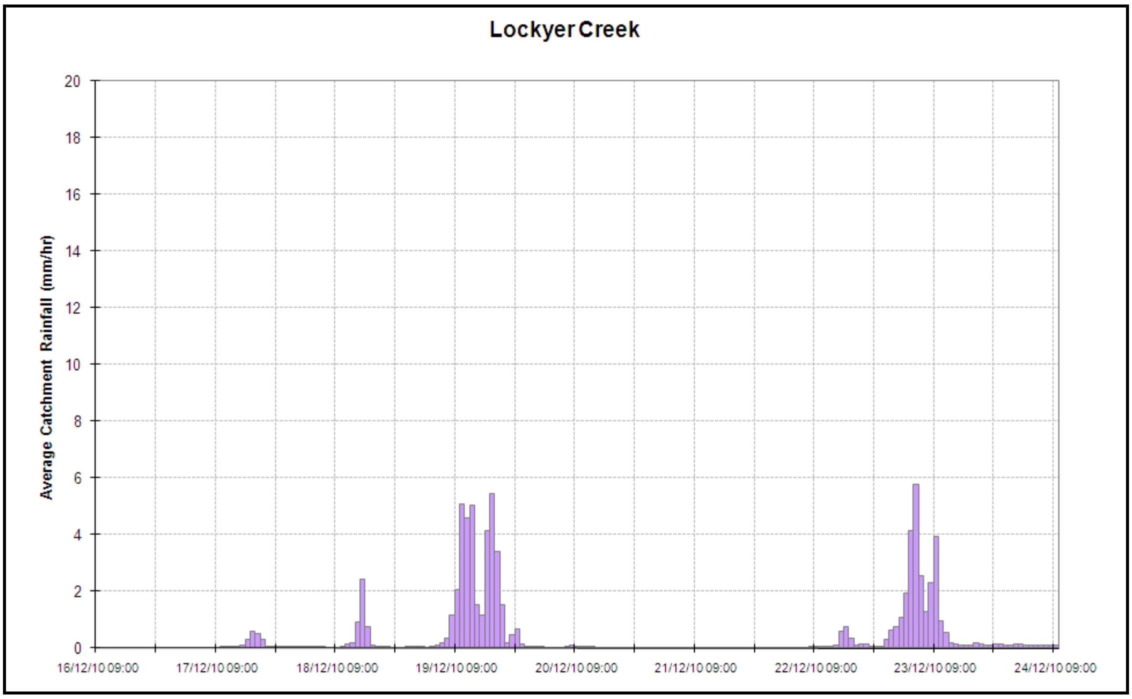
- Longer and more widespread of rainfall over a 12 to 18 hour period ending late on Sunday 19 December 2010, and;

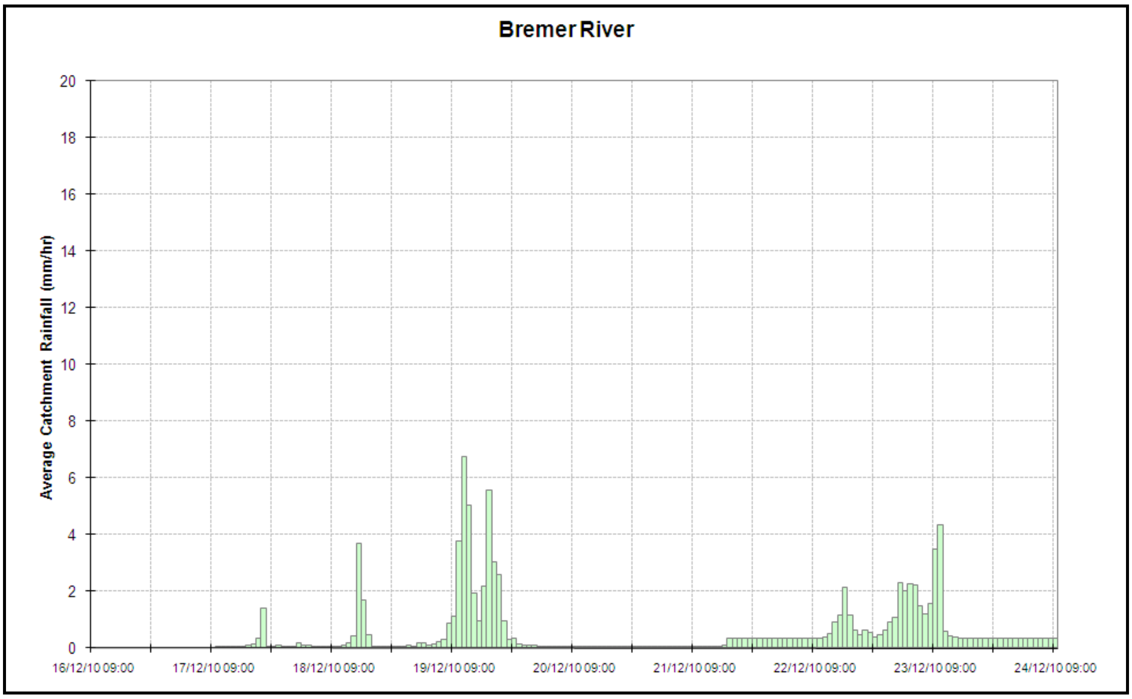
- A period of widespread low intensity rainfall in the 24-hour period ending approximately 09:00 on Thursday 23 December 2010.


Stanley River to Somerset Dam
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00

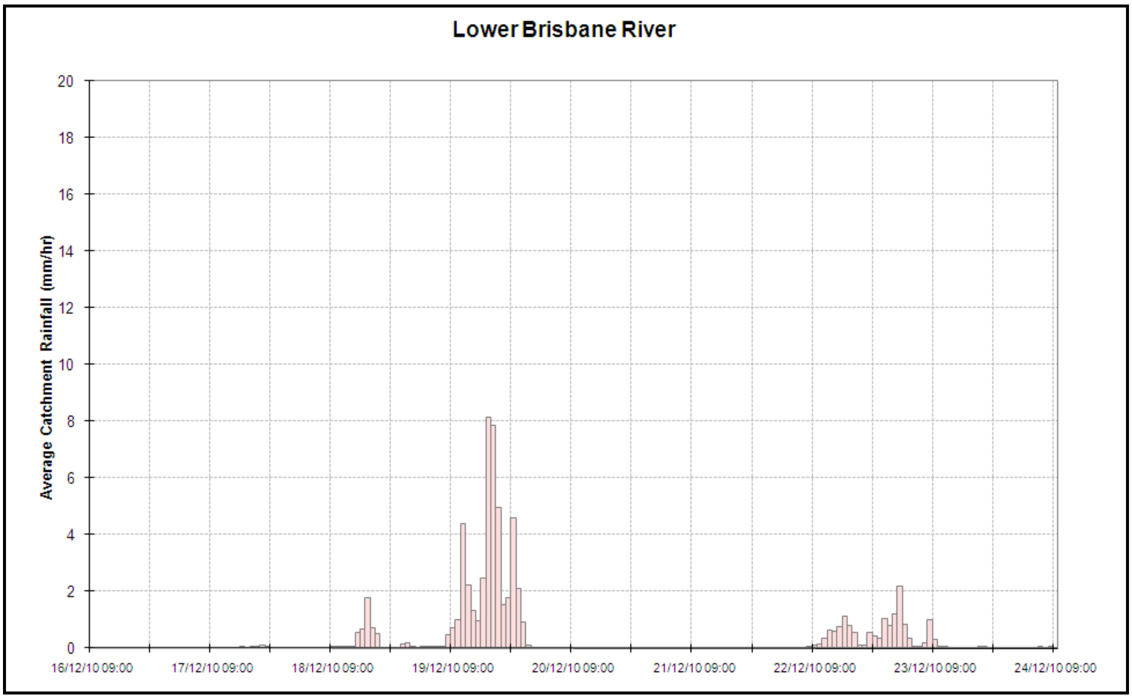

Upper Brisbane River
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00


Mid Brisbane River
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00


Lockyer Creek
Average Catchment Rainfall (mm/hr)
20
18
16
14
12
10
8
6
4
2
0
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00



Bremer River
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00



Lower Brisbane River
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
16/12/10 09:00
17/12/10 09:00
18/12/10 09:00
19/12/10 09:00
20/12/10 09:00
21/12/10 09:00
22/12/10 09:00
23/12/10 09:00
24/12/10 09:00

4.15 Mid December Event – Event Water Levels

The table below shows the peak water levels reached at selected gauges during this Event.

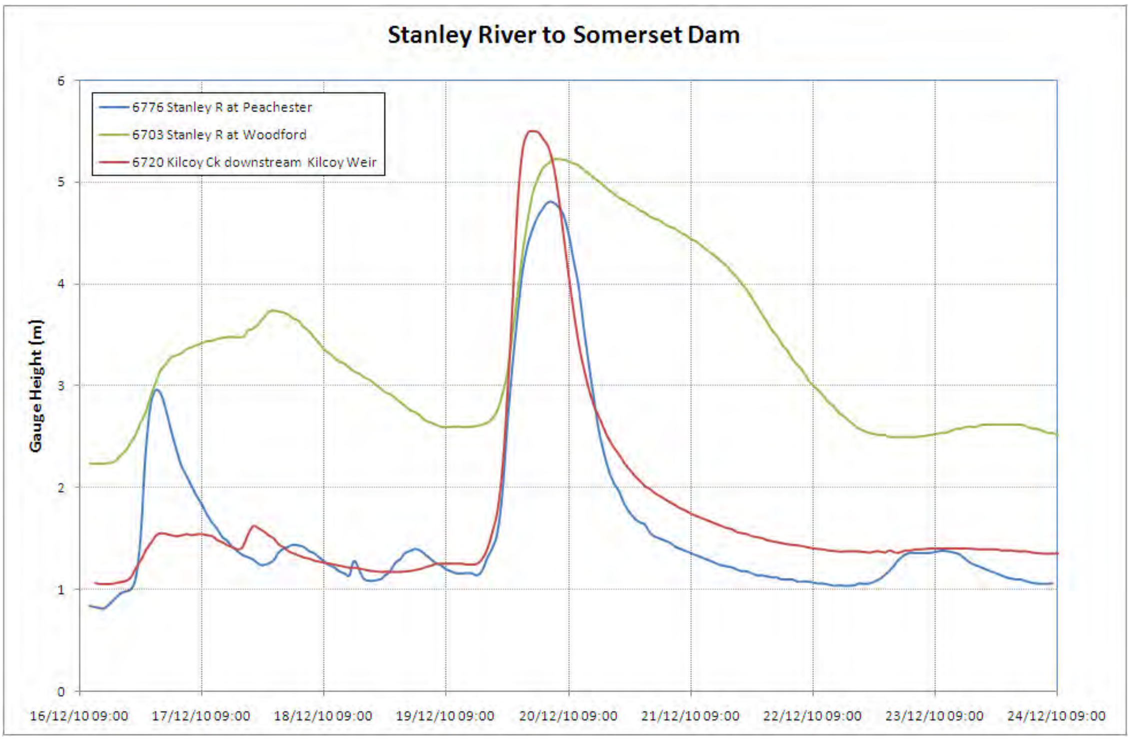
STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
PEACHESTER	20/12/2010 05:00			4.81
WOODFORD	20/12/2010 06:00			5.22
KILCOY	20/12/2010 02:00			5.50
SOMERSET DAM INFLOW	20/12/2010 02:00	1,040	145,000	
SOMERSET DAM OUTFLOW	20/12/2010 14:00	410	136,000	100.42
COOYAR CK	20/12/2010 01:00			5.53
LINVILLE	20/12/2010 02:00			6.23
DEVON HILLS	20/12/2010 03:00			6.81
BOAT MT	20/12/2010 08:00			5.00
GREGOR CK	20/12/2010 06:00			7.58
ROSENTRETTERS	20/12/2010 06:00			2.72
WIVENHOE DAM INFLOW	20/12/2010 12:00	1,880	374,000	
WIVENHOE DAM OUTFLOW	21/12/2010 19:00	1,460	328,000	68.24
HELIDON	16/12/2010 22:00			4.91
TENTHILL	23/12/2010 13:00			3.76
GATTON	20/12/2010 04:00			10.05
MULGOWIE				
SHOWGROUND WEIR	23/12/2010 16:00			6.06
WARREGO HWY	24/12/2010 00:00			4.85
GLENORE GROVE	20/12/2010 08:00			9.60
LYONS BRIDGE	20/12/2010 16:00			11.38
RIFLE RANGE RD	20/12/2010 18:00			11.04
BUARABA CK	20/12/2010 22:00			4.22
OREILLYS WEIR	21/12/2010 23:00			11.12
LOWOOD PUMP STATION	22/12/2010 00:00			10.25
SAVAGES CROSSING	22/12/2010 04:00			10.34
BURTONS BRIDGE	22/12/2010 08:00			8.54
LAKE MANCHESTER	20/12/2010 11:00			51.21
KHOLO BRIDGE	17/12/2010 22:00			4.61
MT CROSBY WEIR	22/12/2010 14:00			11.20
COLLEGES CROSSING	22/12/2010 16:00			8.96
ADAMS BRIDGE	16/12/2010 17:00			4.38
STOKES CROSSING	16/12/2010 20:00			4.23
SPRESSERS BRIDGE	17/12/2010 03:00			3.20
KUSS RD	19/12/2010 23:00			6.86
WWTP	20/12/2010 02:00			7.13
ROSEWOOD	20/12/2010 03:00			5.33

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
FIVE MILE BRIDGE	20/12/2010 08:00			5.48
WALLOON	20/12/2010 09:00			6.43
MOOGERAH DAM	20/12/2010 02:00			155.54
JUNCTION WEIR	19/12/2010 16:00			77.01
HARRISVILLE	20/12/2010 07:00			4.94
CHURCHBANK WEIR	20/12/2010 06:00			1.85
GREENS RD	20/12/2010 16:00			5.28
AMBERLEY	20/12/2010 12:00			6.06
PEAK CROSSING	20/12/2010 02:00			2.54
LOAMSIDE	20/12/2010 12:00			3.13
ONE MILE BRIDGE	20/12/2010 13:00			12.14
HANCOCKS BRIDGE	20/12/2010 13:00			8.31
IPSWICH	20/12/2010 13:00			3.96
MOGGILL	22/12/2010 13:00			2.97
JINDALEE	22/12/2010 11:00			1.86
BRISBANE	23/12/2010 11:00			1.83
BAR	23/12/2010 11:00			1.65

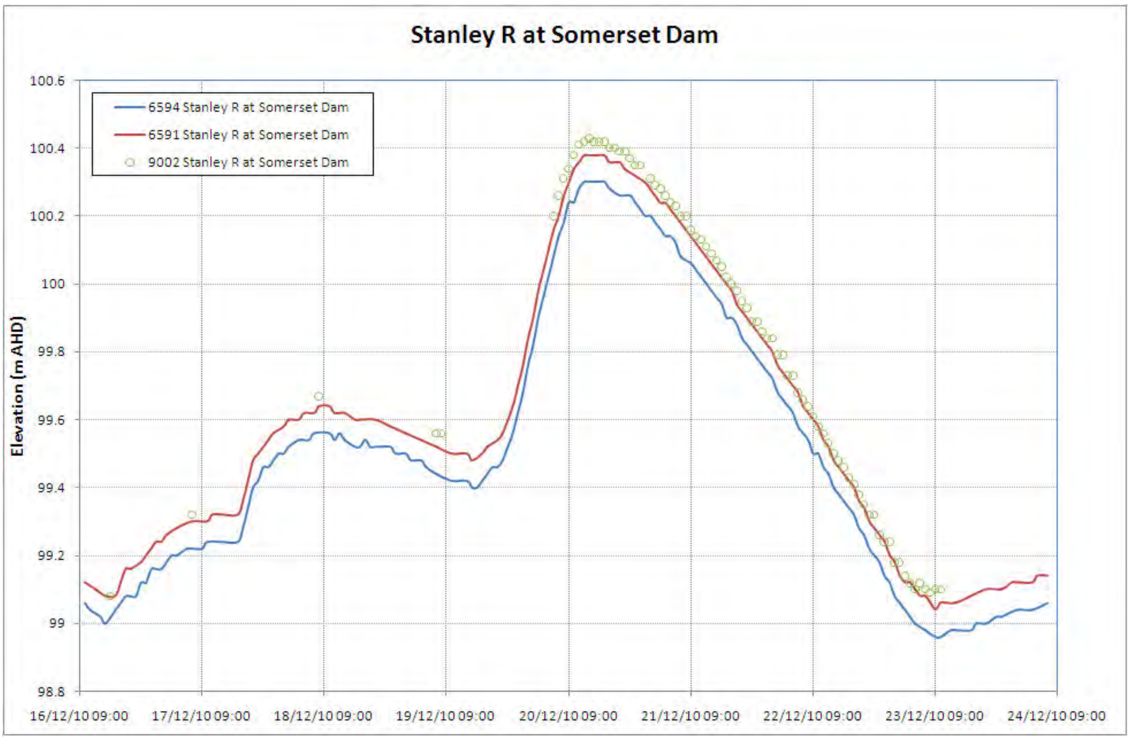
4.16 Mid December Event – Height Hydrographs

Height hydrographs for selected key stations within the Brisbane River Basin are plotted below. During the Event, basic data checking is carried out by the Duty Technical Assistants.

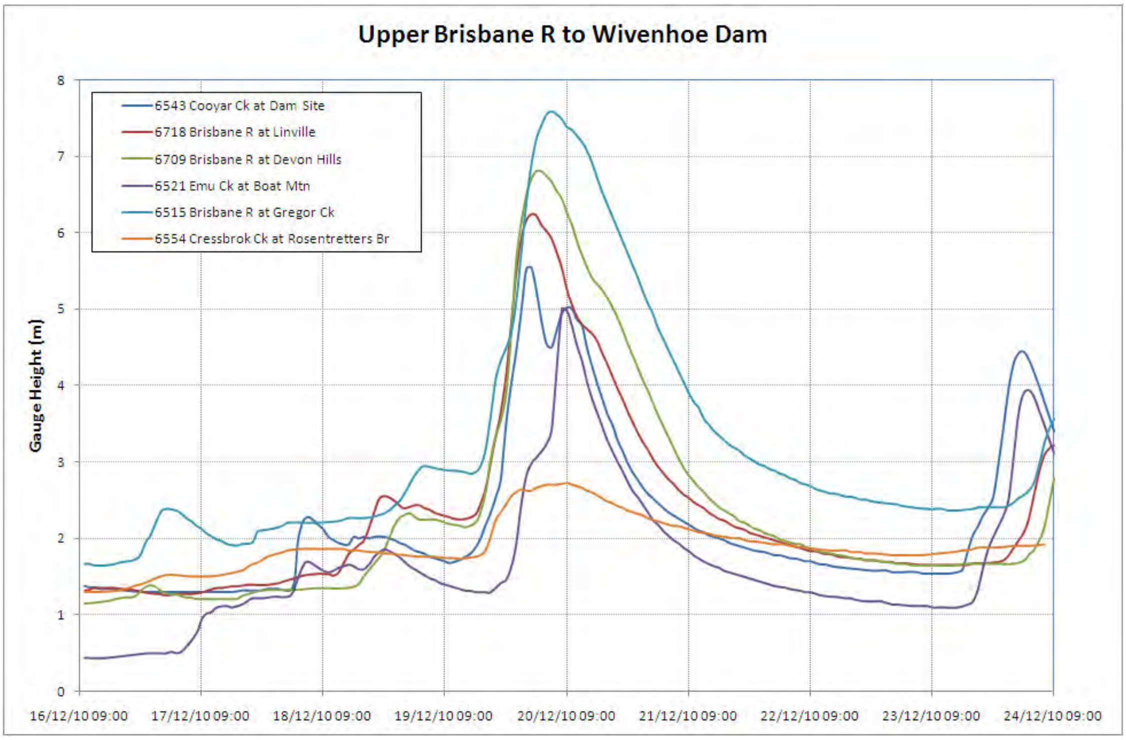
There are three gauges upstream of Somerset Dam which are monitored during floods. Each of these gauges appears to have worked well during the Event. The Stanley River at Woodford is a key gauging station upstream of Somerset Dam, even though it only represents approximately 20% of the Dam's catchment.



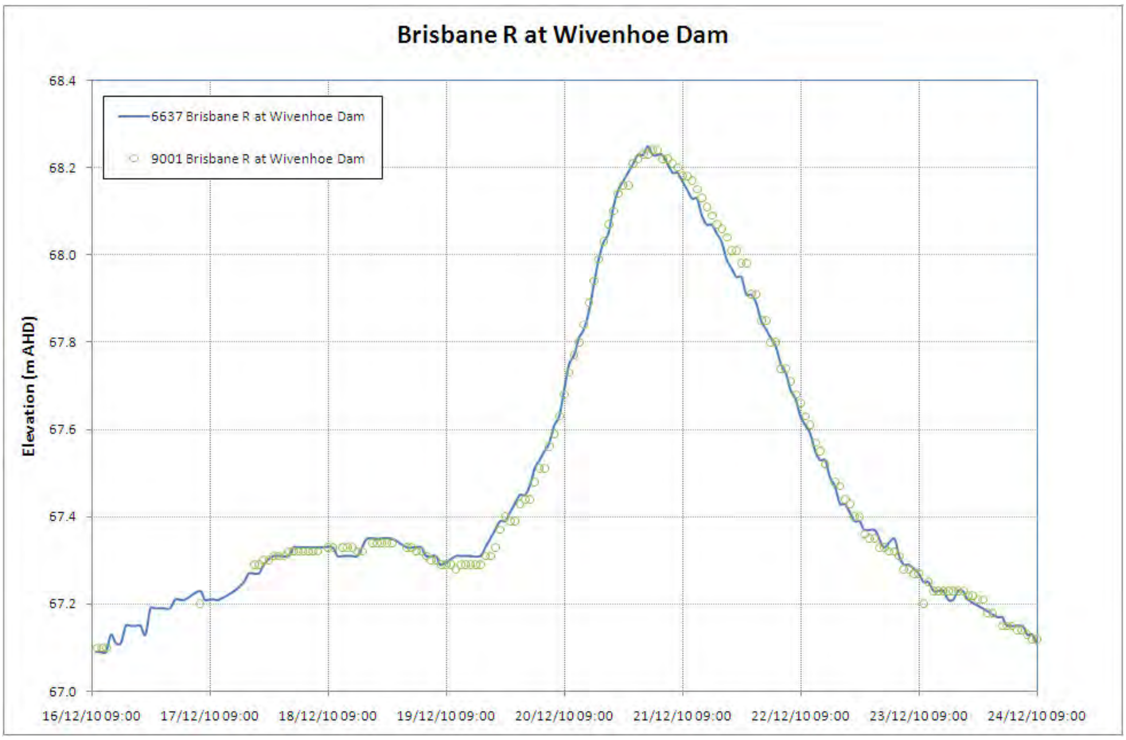
The three gauges worked well during the Event. The Stanley River at Woodford is a key station even though it only represents about 20% of the Dam's catchment.



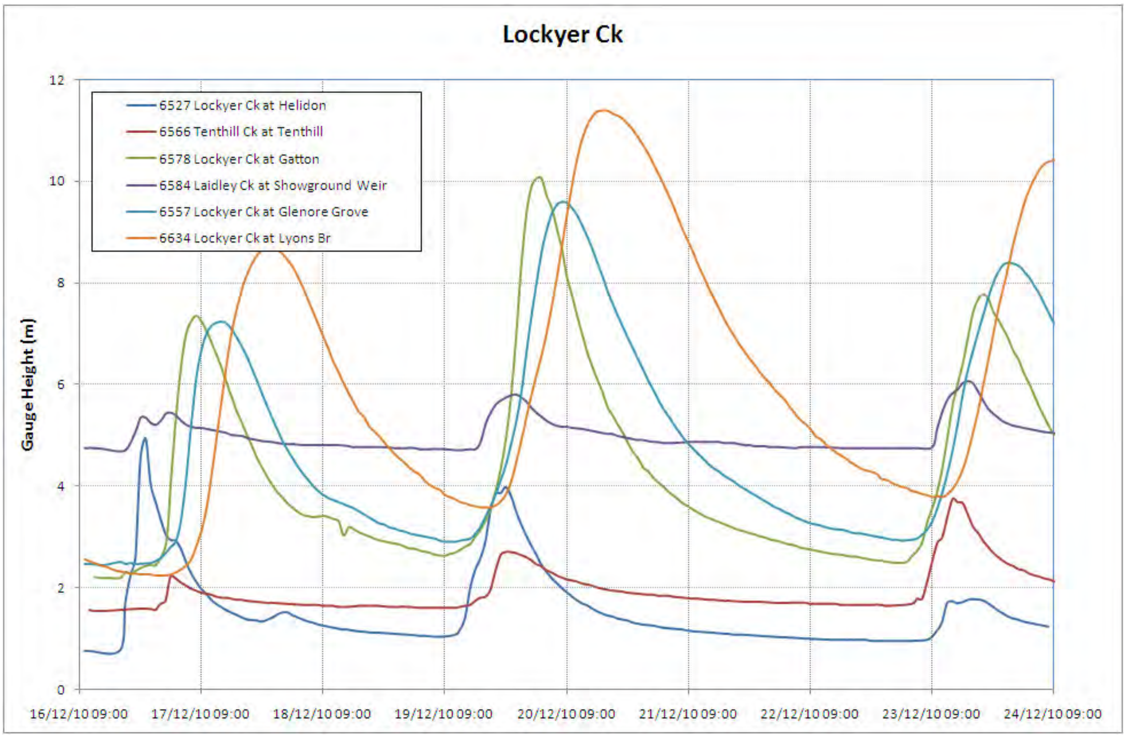
The two automatic gauges appear to have slightly under read when compared with the manual gauge board readings, however, this difference did not have impact upon dam operations.



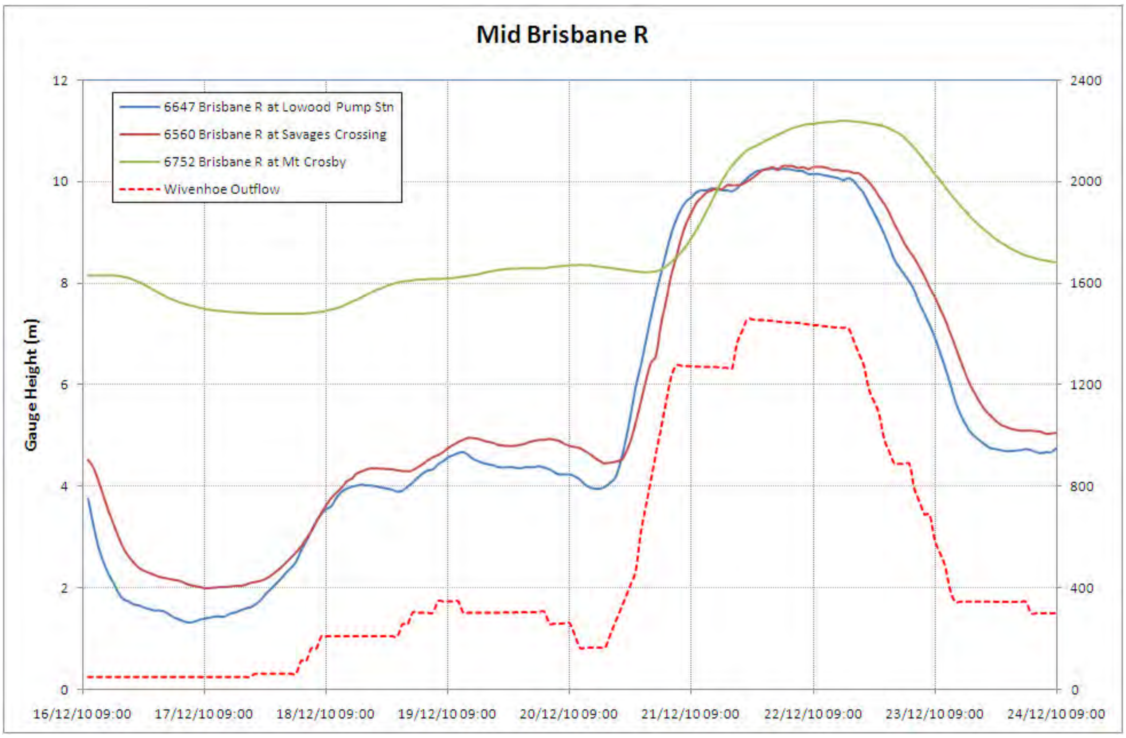
The key gauge at Gregors Creek represents almost 75% of the Dam's catchment. These gauges appear to have worked well during the event.



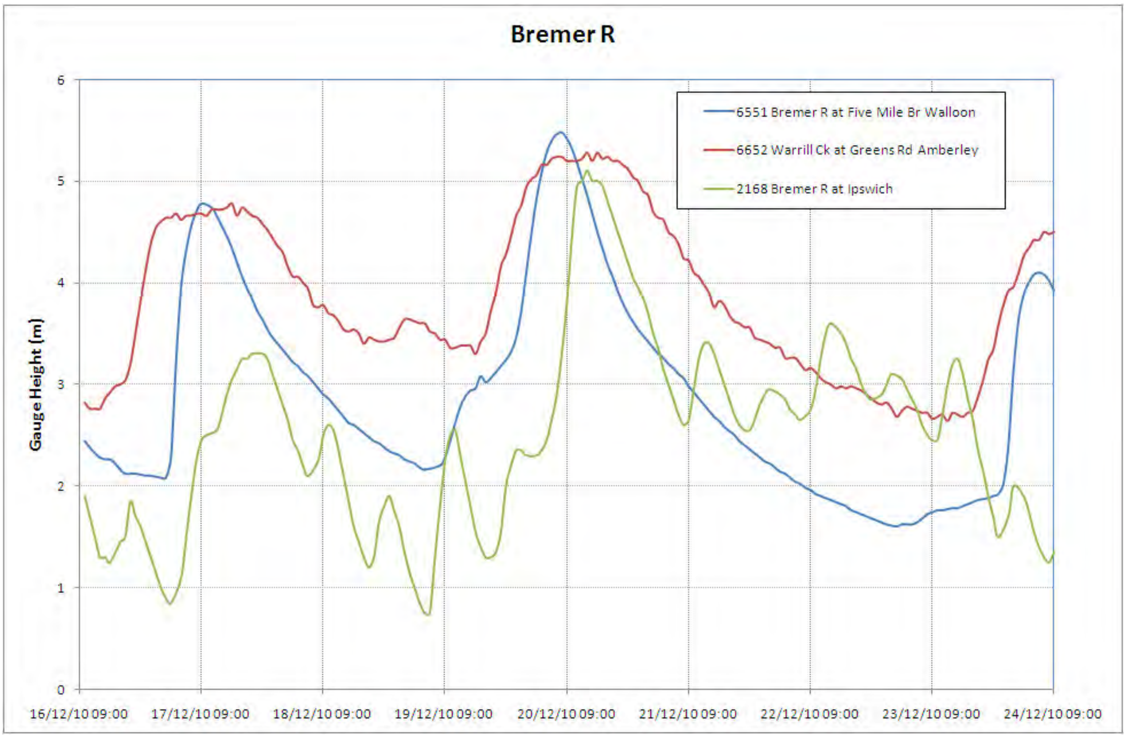
This gauge was installed just prior to the Event and appears to have worked well during the Event.



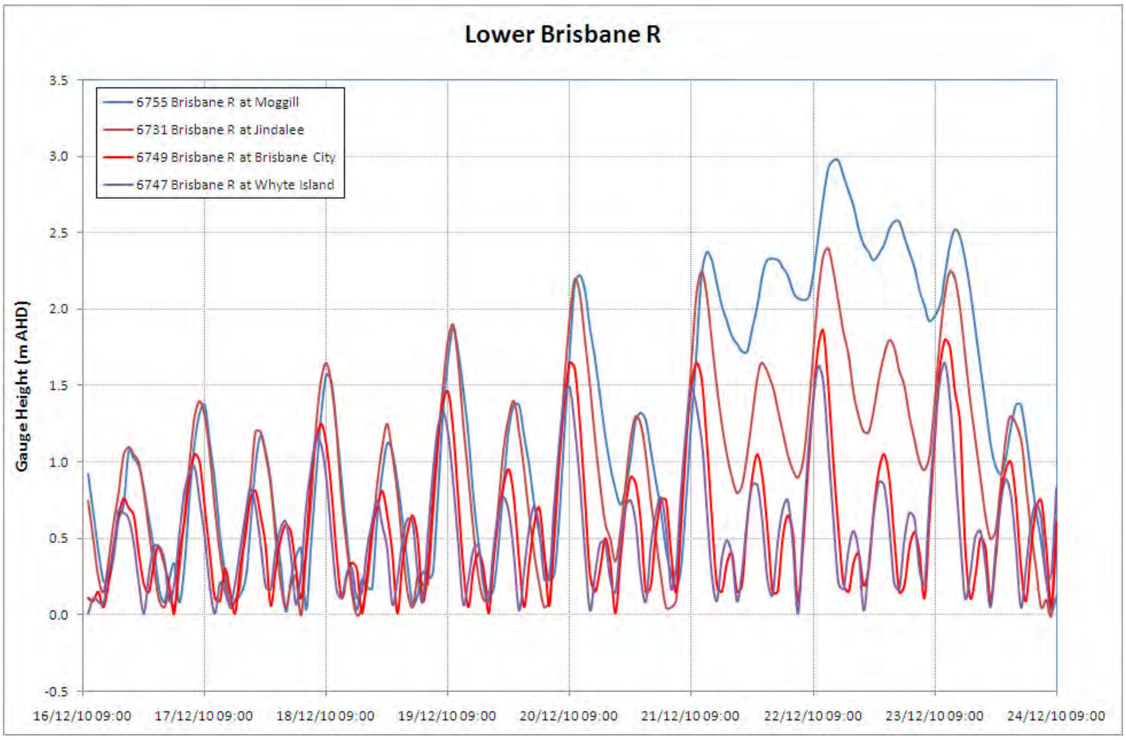
Each of the gauges shown above worked well during the Event.



Each of the gauges shown above worked well during the Event.



Each of the gauges shown above worked well during the Event. The Bremer River at David Trumpy Bridge (Ipswich) is affected by backwater from the Brisbane River.

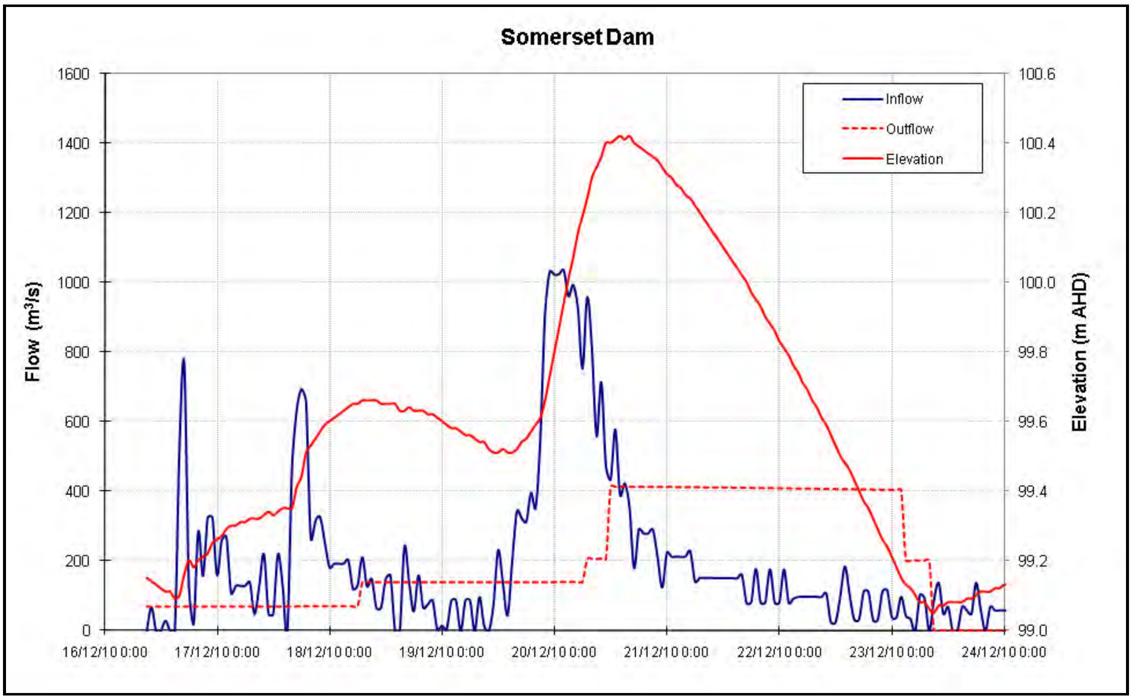


Each of the gauges shown above worked well during the Event. These gauges are affected by tidal influences.

4.17 Mid December Event – Dam Inflows and Outflows

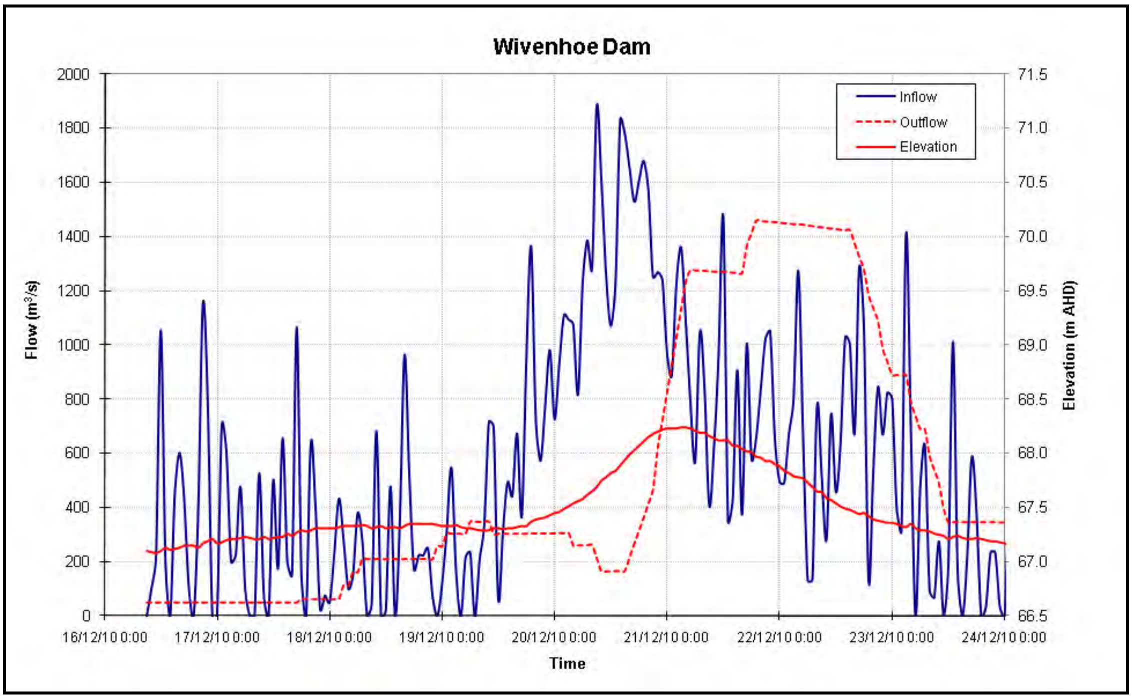
The inflows and outflows from Somerset and Wivenhoe Dams are outlined in the table and figures below. Note that the Wivenhoe figures include Somerset outflows. The inflow to the Dams has been estimated by reverse routing.

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
SOMERSET DAM INFLOW	20/12/2010 02:00	1,040	145,000	
SOMERSET DAM OUTFLOW	20/12/2010 14:00	410	136,000	100.42
WIVENHOE DAM INFLOW	20/12/2010 12:00	1,880	390,000	
WIVENHOE DAM OUTFLOW	21/12/2010 19:00	1,460	358,000	68.24



The Somerset Dam inflow is characterised by a series of small peaks between Thursday 16 and Monday 20 December. The largest peak of approximately 1,000m^3/s occurred late on Monday 20 December 2010.

In the afternoon of Monday 20 December, Somerset Dam reached its maximum water level of 100.42m AHD. The peak outflow from Somerset Dam during the Event was slightly more than 400m^3/s.



Similar to Somerset Dam, the inflow into Wivenhoe Dam is characterised by a series of small peaks between Thursday 16 and Monday 20 December. The largest peak of approximately 1,800m^3/s occurred late on Monday 20 December 2010. The peak outflow of 1460m^3/s occurred approximately 24 hours later on the evening of Tuesday 21 December 2010.

Wivenhoe Dam reached its maximum water level of 68.24m AHD at 19:00 on Tuesday 21 December 2010.

4.18 Late December Event – Overview

The Late December 2010 Flood Event has a designated start date of 09:00 on Friday 24 December 2010 for the purposes of providing event data. Dam releases during the Event commenced on Sunday 26 December 2010 and concluded on Sunday 2 January 2011.

The Late December Event was a relatively significant event with peak outflow from Wivenhoe Dam during the event in the order of 1,500m^3/s. Accordingly, comprehensive rainfall and water level data has been reported to allow for a detailed assessment.

4.19 Late December Event – Base Rainfall Data

The following rainfall tables and maps show the daily rainfall recorded in the Brisbane River Basin during this Event. In the maps "None" signifies no rainfall reports were received from the station during the period. Figures in red also indicate errors in the data.

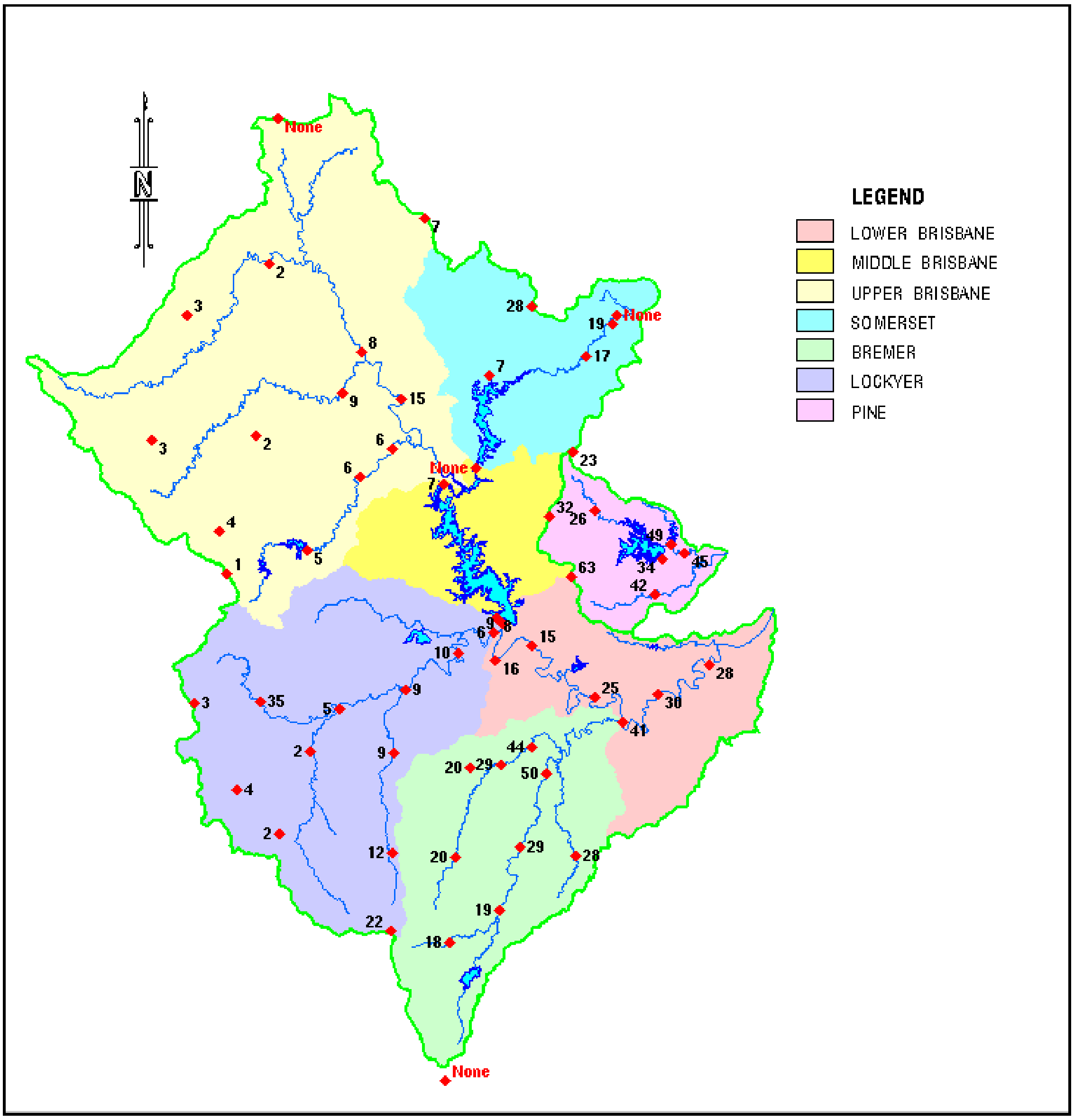
Rainfall in 24 hours to 09:00											
ALERT ID	**Station**	**26 Dec**	**27 Dec**	**28 Dec**	**29 Dec**	**30 Dec**	**31 Dec**	**01 Jan**	**02 Jan**	**Total**	**Comment**
6775	Peachester										Out of action
6714	Ferris Knob	10	20	34	25	1	0	6	20	135	
6705	Woodford-P	14	25	33	12	1	0	1	29	132	
6702	Woodford-B	14	25	33	12	1	0	1	29	132	
6600	Kilcoy	7	18	25	7	1	0	1	10	106	
6593	Somerset Dam HW-P	18	76	44	6	0	0	2	12	178	Double counting
6590	Somerset Dam HW-B	9	38	22	3	0	0	1	6	89	
6602	Top of Brisbane	2	10	36	10	0	0	0	6	76	
6540	Yarraman	11	39	19	1	1	0	0	7	89	
6542	Cooyar Ck	15	35	27	6	0	0	0	8	97	
6717	Linville	16	38	33	14	0	0	1	3	113	
6708	Devon Hills	20	33	33	13	0	0	1	10	118	
6529	St Aubyns	9	42	12	0	0	0	0	8	77	
6621	Nukinenda	12	37	5	2	0	0	0	2	61	
6520	Boat Mountain	20	38	27	5	0	0	0	3	102	
6514	Gregor Ck-P	15	33	28	7	0	0	0	5	104	
6517	Gregor Ck-B										Out of action
6596	Crows Nest	9	51	11	1	0	0	0	2	82	
6780	Perseverance	0	3	2	2	0	0	0	17	34	
6782	Ravensbourne	11	57	11	4	0	0	0	17	118	
6523	Cressbrook Dam	6	42	13	0	0	0	0	1	67	
6553	Rosentretters Br	9	37	12	1	0	0	0	3	68	
6604	Toogoolawah	12	43	20	3	0	0	0	5	90	
6574	Caboonbah	11	37	22	3	0	0	0	6	91	
6636	Wivenhoe Dam HW-B	8	40	20	0	0	0	0	0	76	
6643	Wivenhoe Dam TW-P	8	42	24	0	0	0	0	1	87	
6641	Wivenhoe Dam TW-B	8	41	23	0	0	0	0	1	81	
6598	Toowoomba	13	64	38	0	0	0	0	8	127	
6526	Helidon	14	68	29	1	0	0	0	6	120	
6617	Little Egypt	9	61	43	0	0	0	0	2	126	
6606	West Woodbine	11	62	54	0	0	0	0	2	132	
6565	Tenthill	10	56	20	0	0	0	0	6	94	
6577	Gatton	11	55	16	2	0	0	0	8	102	
6619	Mt Castle	28	78	71	0	0	0	0	27	227	
6615	Thornton	20	75	44	0	0	0	0	11	168	
6583	Showground Weir	13	56	18	0	0	0	0	2	105	
6556	Glenore Grove	8	49	8	0	0	0	0	2	83	
6633	Lyons Br-P	7	47	11	0	0	0	0	2	77	

Rainfall in 24 hours to 09:00											
ALERT ID	Station	26 Dec	27 Dec	28 Dec	29 Dec	30 Dec	31 Dec	01 Jan	02 Jan	Total	Comment
6630	Lyons Br-B	8	51	12	1	0	0	0	1	84	
6568	O'Reillys Weir	8	46	24	0	0	0	0	0	84	
6646	Lowood-B	12	52	18	0	0	0	0	2	96	
6649	Lowood-P	9	46	12	0	0	0	0	3	87	
6559	Savages Crossing	10	44	25	0	0	0	0	3	97	
1730	Lake Manchester	9	52	26	0	0	0	0	5	124	
6751	Mt Crosby	8	45	26	1	0	0	0	4	109	
2059	Colleges Crossing	24	55	34	0	0	0	0	4	159	
6580	Adams Br	14	81	36	0	0	0	0	2	159	
2192	Franklyn Vale										Out of action
2065	Grandchester	24	77	21	1	0	0	0	6	151	
6736	Kuss Rd	14	60	16	0	0	0	0	2	113	
2068	Tallegalla	23	71	17	0	0	0	0	6	152	
6733	Rosewood	13	60	16	0	0	0	0	2	122	
6550	Five Mile Bridge	12	56	18	0	0	0	0	2	136	
6623	Tarome-P	19	76	64	0	0	0	0	9	187	
6562	Kalbar Weir	17	73	35	0	0	0	0	6	150	
6571	Harrisville	14	73	34	0	0	0	0	1	151	
6651	Greens Road	10	55	13	0	0	0	0	0	135	
6739	Washpool	15	68	23	0	0	0	0	1	135	
2062	Peak Crossing	12	61	27	0	0	0	0	0	140	
2055	Loamside	10	59	13	0	0	0	0	0	140	
2160	One Mile Br	9	55	21	0	0	0	0	1	156	
2040	Churchill	9	52	21	1	0	0	0	0	131	
2035	Brassall (Hancock	2	34	18	0	0	0	0	4	111	
2106	Lyons										Out of action
2145	Ripley	0	0	4	0	0	0	0	1	10	Under reading
2050	Bundamba (Barclay	9	49	18	0	0	0	0	1	136	
2045	Bundamba (Hanlon	6	35	16	0	0	0	0	1	94	
6754	Moggill-P	12	40	24	0	0	0	0	4	121	
2150	Opossum	12	45	19	0	0	0	0	2	130	
2116	Carole Park	10	55	25	1	4	0	1	1	165	
1518	Wacol	11	23	27	1	0	0	0	4	124	
2102	Jingle Downs	14	54	20	0	0	0	0	5	145	
2104	Greenbank	21	62	18	0	0	0	0	6	173	
2108	Forestdale	18	56	0	0	5	2	1	0	135	
2114	Calamvale	19	60	21	1	0	0	1	4	175	
1736	Inala	9	58	25	0	0	0	0	3	171	
2020	Corinda High	18	48	25	0	0	0	0	4	146	
2138	Mt Gravatt	9	37	0	0	0	0	3	3	105	

Rainfall in 24 hours to 09:00											
ALERT ID	Station	26 Dec	27 Dec	28 Dec	29 Dec	30 Dec	31 Dec	01 Jan	02 Jan	Total	Comment
1548	Holland Pk West	25	37	27	1	0	0	0	6	145	
1554	East Brisbane	14	44	32	0	0	0	0	2	129	
1836	Eight Mile Plains	16	72	26	0	0	0	0	6	186	
1803	Wishart	9	65	29	0	0	0	1	4	169	
1706	Carindale	33	63	31	1	0	0	1	6	192	
1596	Camp Hill	23	40	33	0	0	0	1	4	156	
1830	Mansfield	9	33	34	0	0	0	2	8	138	
1739	Lytton	8	49	52	1	0	0	2	18	172	
1527	Hemmant	10	36	22	2	0	0	3	6	111	
2141	Ransome	11	64	34	1	0	0	1	9	167	
1755	Manly	12	53	51	1	0	0	1	8	173	
1742	Pullenvale	13	53	21	0	0	0	1	12	138	
1515	Kenmore Hills	8	32	26	0	0	0	1	8	120	
6730	Jindalee	22	47	15	0	0	0	0	3	122	
1749	Toowong	8	63	32	1	0	0	1	3	145	
6748	Brisbane City	7	53	27	1	0	0	1	5	122	
1507	Three Ways	19	65	26	3	0	0	3	26	201	
1718	Gold Ck Res	13	63	29	2	0	0	2	21	176	
1533	Enoggera Dam	8	61	28	3	0	0	2	14	163	
1512	Mt Coot-tha	8	59	30	1	0	0	1	14	179	
1578	Alderley	9	36	33	2	0	0	2	8	135	
1524	Bowen Hills	7	35	35	1	0	0	1	8	116	
2285	Steiglitz Wharf	16	85	62	0	0	0	1	2	184	
2086	Marburg	14	56	17	0	1	0	0	1	117	
2074	Stokes Crossing	16	77	34	0	0	0	0	2	162	
2080	Spressers Bridge	18	70	19	0	0	0	0	2	141	
2083	Rosewood WWTP	16	68	15	0	0	0	0	2	138	
2071	Churchbank Weir	0	1	1	0	0	0	1	0	4	Under reading
2077	Greys Plains Rd	22	91	39	0	0	0	0	5	188	
1837	Wynnum Bowls	8	52	52	0	0	0	1	8	158	
1838	Luggage Point	7	20	55	1	0	0	3	11	133	
1840	Chandler	9	36	28	0	0	0	1	7	124	
1841	Bulimba	7	40	36	1	0	0	1	8	125	
6585	Sandy Creek Road	12	69	24	1	0	0	0	11	118	
6588	Upper Sandy Creek	15	67	13	4	0	0	0	10	129	
2089	Harrisville-B	15	77	31	0	0	0	0	2	156	
2092	Rosewood-B	15	69	18	0	0	0	0	3	140	
2095	Bellbird Park	14	51	18	0	0	0	0	3	132	
2011	Buaraba	10.2	58.9	13	0.1	0	0	0	7.2	105	
2006	Hays Landing	8.9	44	26.6	1.1	0	0	0.2	3.2	95.8	

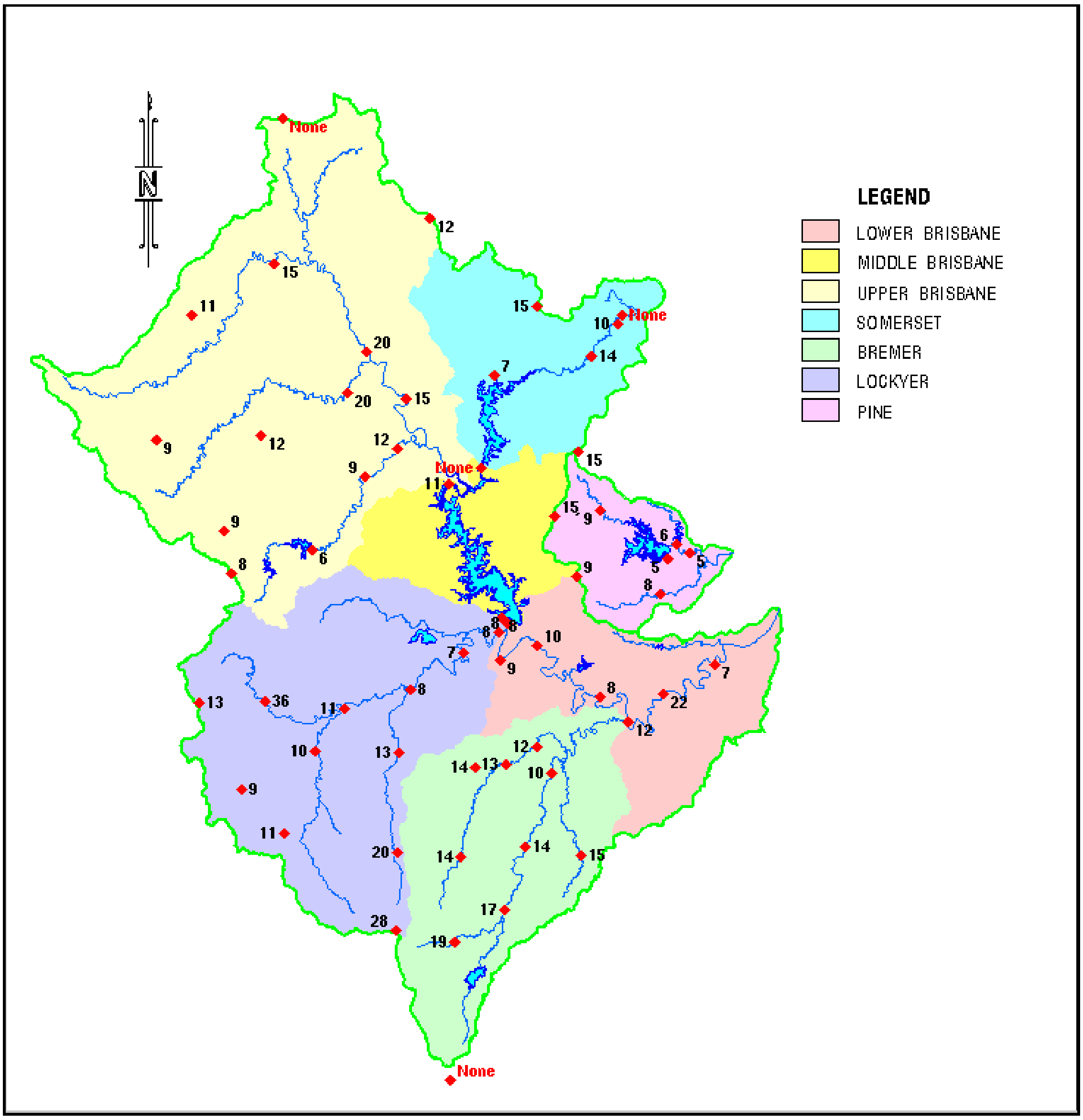
Rainfall in 24 hours to 09:00											
ALERT ID	**Station**	**26 Dec**	**27 Dec**	**28 Dec**	**29 Dec**	**30 Dec**	**31 Dec**	**01 Jan**	**02 Jan**	**Total**	**Comment**
2004	Pohlman Range	14	32.5	32.2	8.5	0.2	0	0.6	12.2	116.9	
5356	Mt Alford										Did not work
6656	Bill Gunn Dam	15	61	18	1	0	0	0	5	117	
6658	Lake Clarendon Dam	11	65	12	2	0	0	0	6	104	
6555	Atkinson Dam	9	56	11	0	0	0	0	4	89	
6624	Moogerah Dam	18	78	66	0	0	0	0	9	199	
6609	Monsildale	13	27	47	14	0	0	1	5	114	
6612	Mt Stanley	23	37	41	11	0	0	0	4	137	
6607	Lindfield	12	30	37	17	0	0	8	11	130	
6603	Blackbutt	18	37	27	4	0	0	1	18	121	
6601	Mt Binga	10	44	10	1	0	0	0	9	78	
6613	Hazeldean	12	37	38	3	0	0	0	13	116	
6614	Westvale	10	23	31	2	0	9	0	0	83	
6605	Eskdale										Not yet installed
6611	Redbank Creek	10	51	11	1	0	0	0	8	103	
6100	Mt Mowbullan	13	70	22	0	1	0	0	12	140	
6427	Maleny	16	19	45	55	4	0	22	34	257	
5425	Hume Lane	7	21	31	24	0	0	0	8	110	
6400	Bald Knob	11	20	52	51	2	0	14	25	234	
6716	West Bellthorpe	15	31	37	39	1	0	10	8	171	
6701	Mt Mee-B	15	29	42	11	0	0	4	16	145	
6690	Mt Mee-P	15	29	42	11	0	0	4	16	145	
6680	Mt Glorious-P	9	59	38	11	0	0	6	48	234	
5423	Landsborough	9	23	61	35	0	0	17	19	205	
6608	Jimna	12	26	35	15	0	0	2	9	132	
2194	Wilsons Peak	22	85	72	1	0	0	0	19	213	
6774	Wilsons Peak-P	0	0	0	0	7	13	2	0	22	Under reading

Rainfall in 24 hours to 09:00 25/12/2010



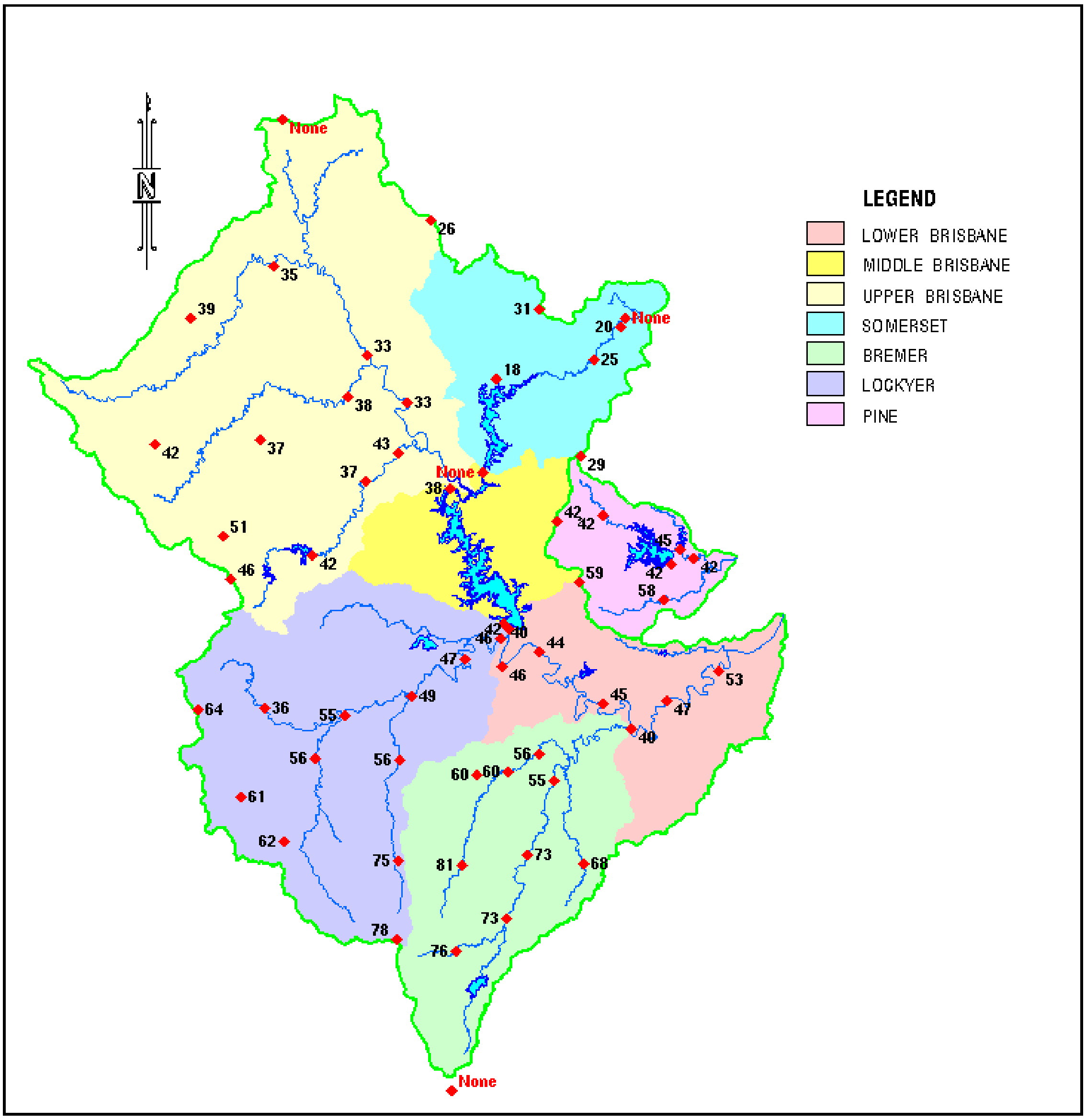
In the 24 hours to 09:00 on Saturday 25 December 2010, rainfall recorded in the Basin tended to be generally less than 10mm. Isolated higher totals of up to 30mm were recorded in the Stanley catchment and falls of up to 50mm were recorded in the Bremer system.

Rainfall in 24 hours to 09:00 26/12/2010



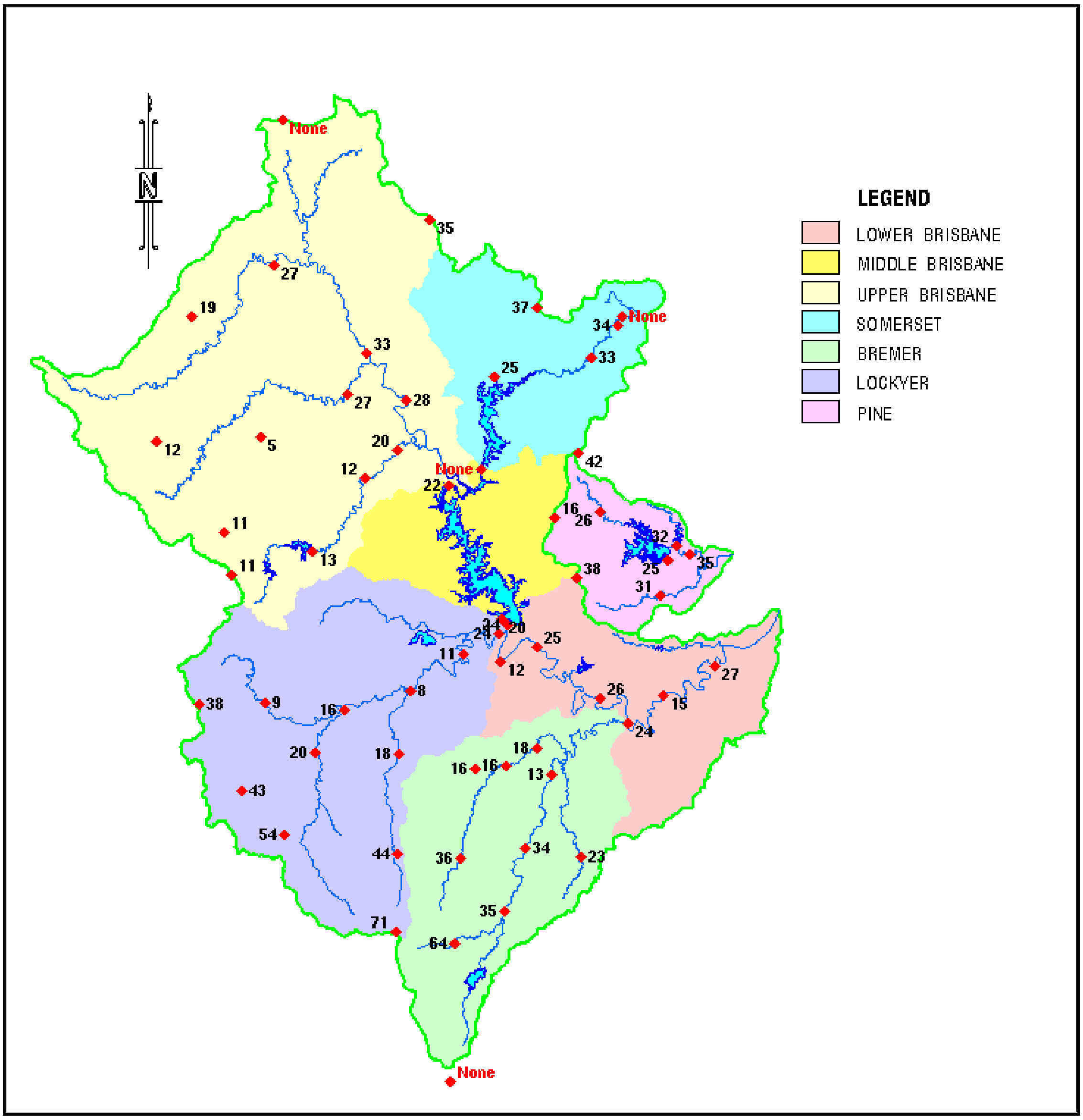
In the 24 hours to 09:00 on Saturday 18 December 2010, widespread rainfall occurred however generally less than 25mm was recorded throughout the region.

Rainfall in 24 hours to 09:00 27/12/2010



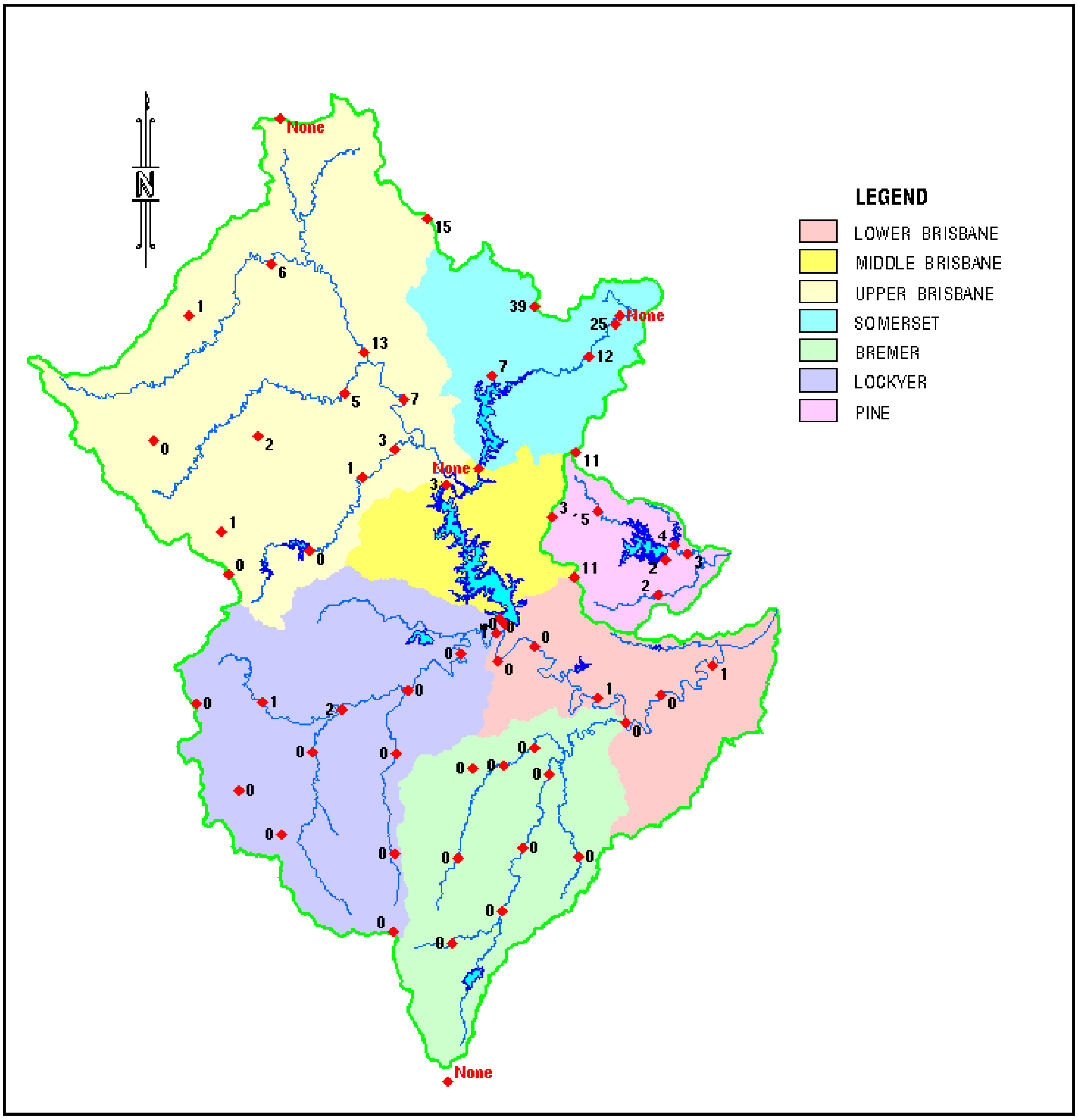
Rainfall was widespread throughout the Basin in the 24 hours to 09:00 on Monday 27 December. The highest totals were recorded in the Lockyer and Bremer systems and falls in the Stanley catchment and Upper Brisbane catchment ranged from between 20mm to 50mm.

Rainfall in 24 hours to 09:00 28/12/2011



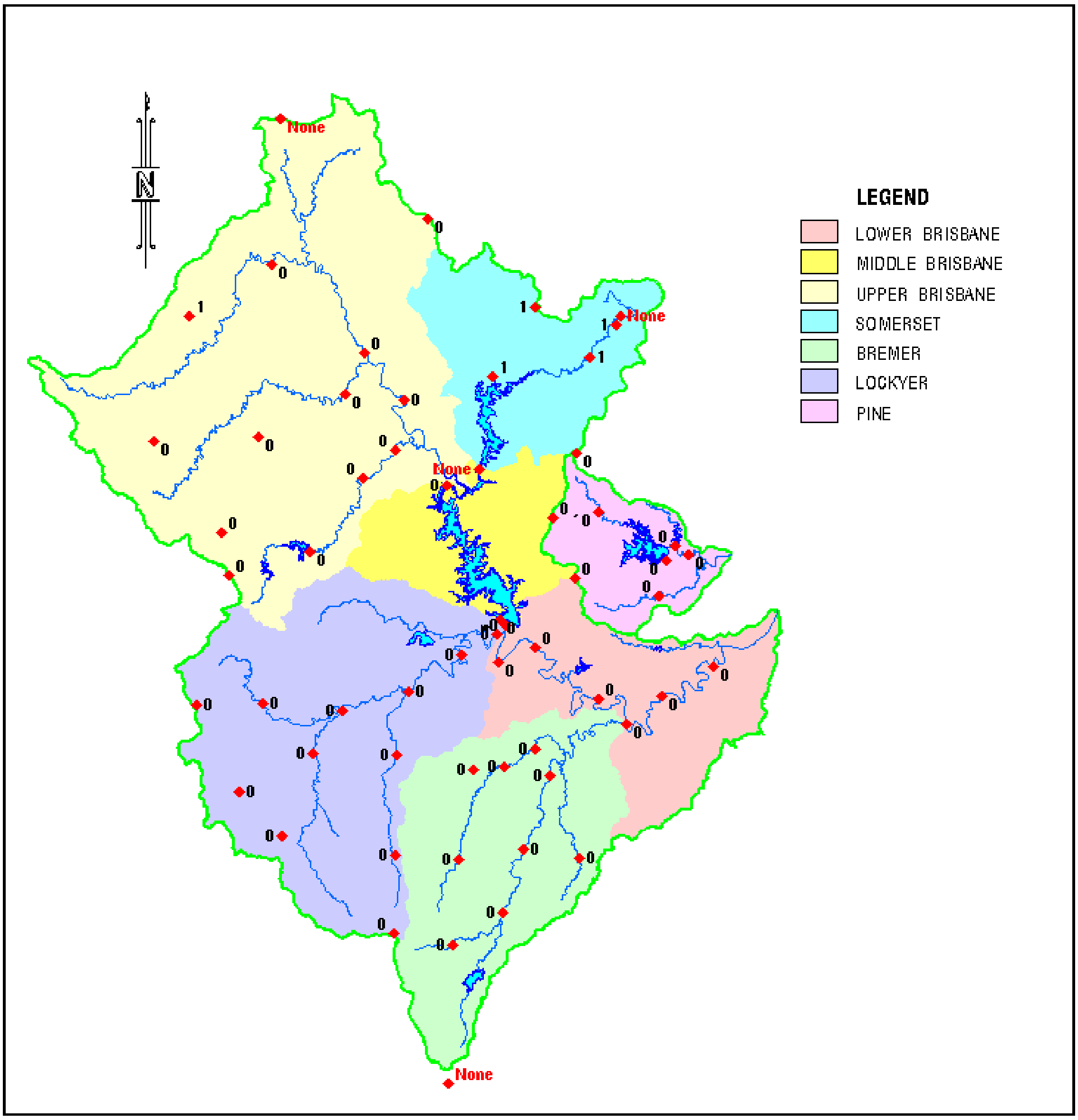
Compared to the previous 24 hour period, rainfall in the 24 hours to 09:00 on Tuesday 28 December was similarly widespread, with the higher totals recorded in the Stanley and the Upper Brisbane catchments. Isolated heavy falls occurred in the headwaters of Tenthill and Warrill Creeks.

Rainfall in 24 hours to 09:00 29/12/2010



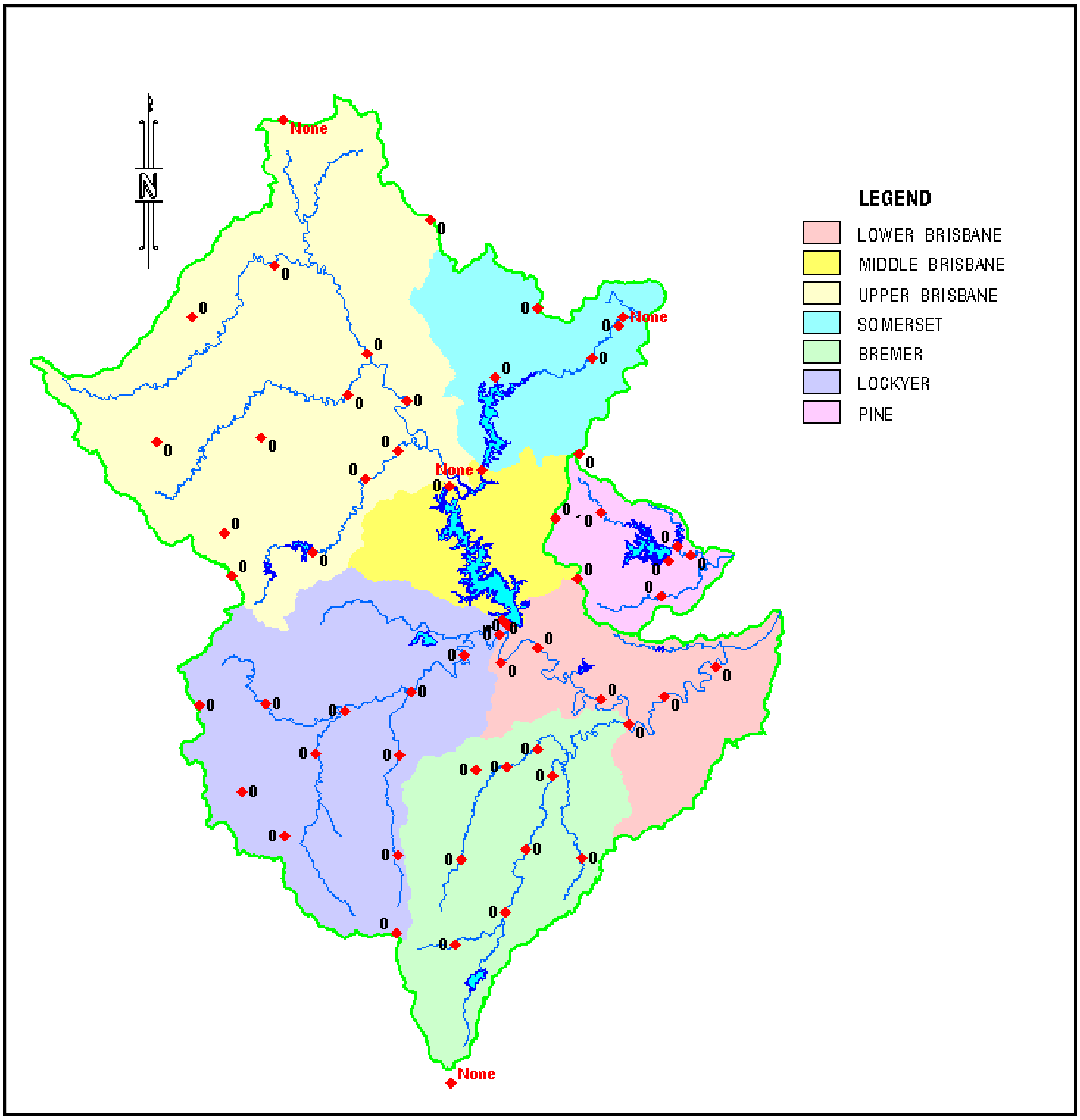
Rainfall in the Basin was generally insignificant in the 24 hours to 09:00 on Wednesday 29 December although some isolated heavier falls up to 40mm were recorded in the Stanley River catchment.

Rainfall in 24 hours to 09:00 30/12/2011



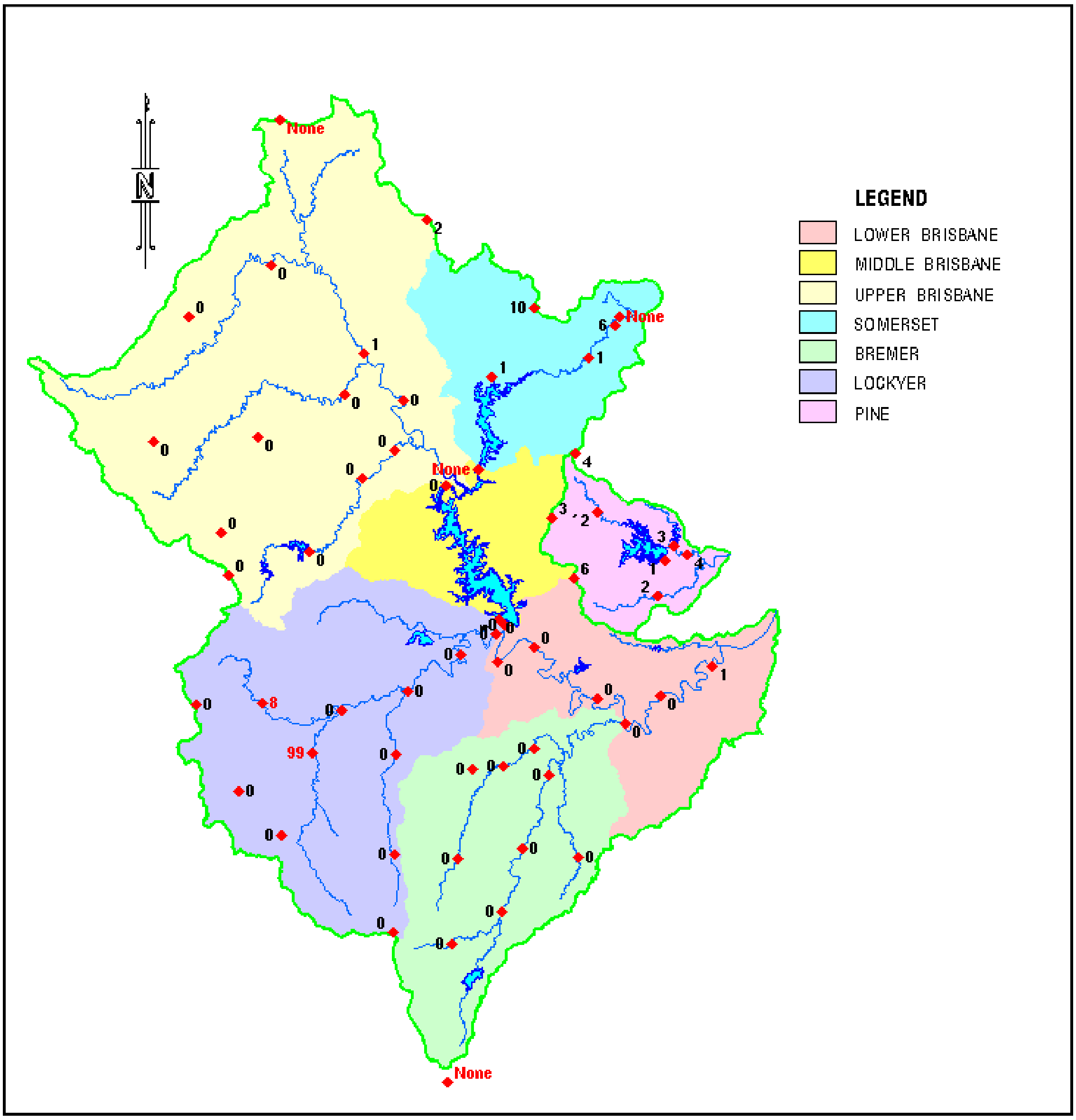
No significant rainfall was recorded in the region in the 24 hours to 09:00 on Thursday 30 December 2010.

Rainfall in 24 hours to 09:00 31/12/2010



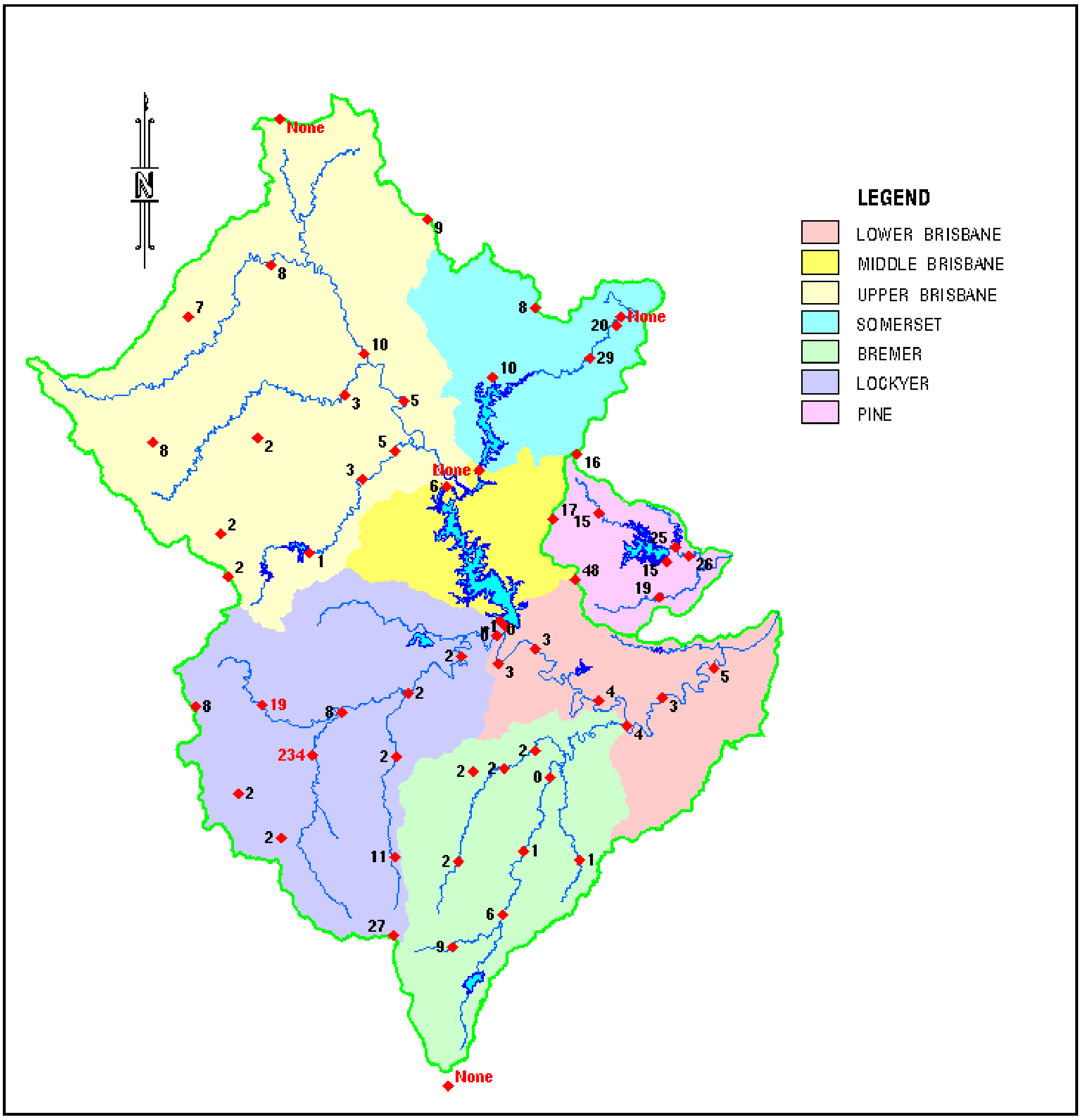
In the 24 hours to 09:00 on Friday 31 December, there was no rainfall recorded in the Basin.

Rainfall in 24 hours to 09:00 01/01/2011



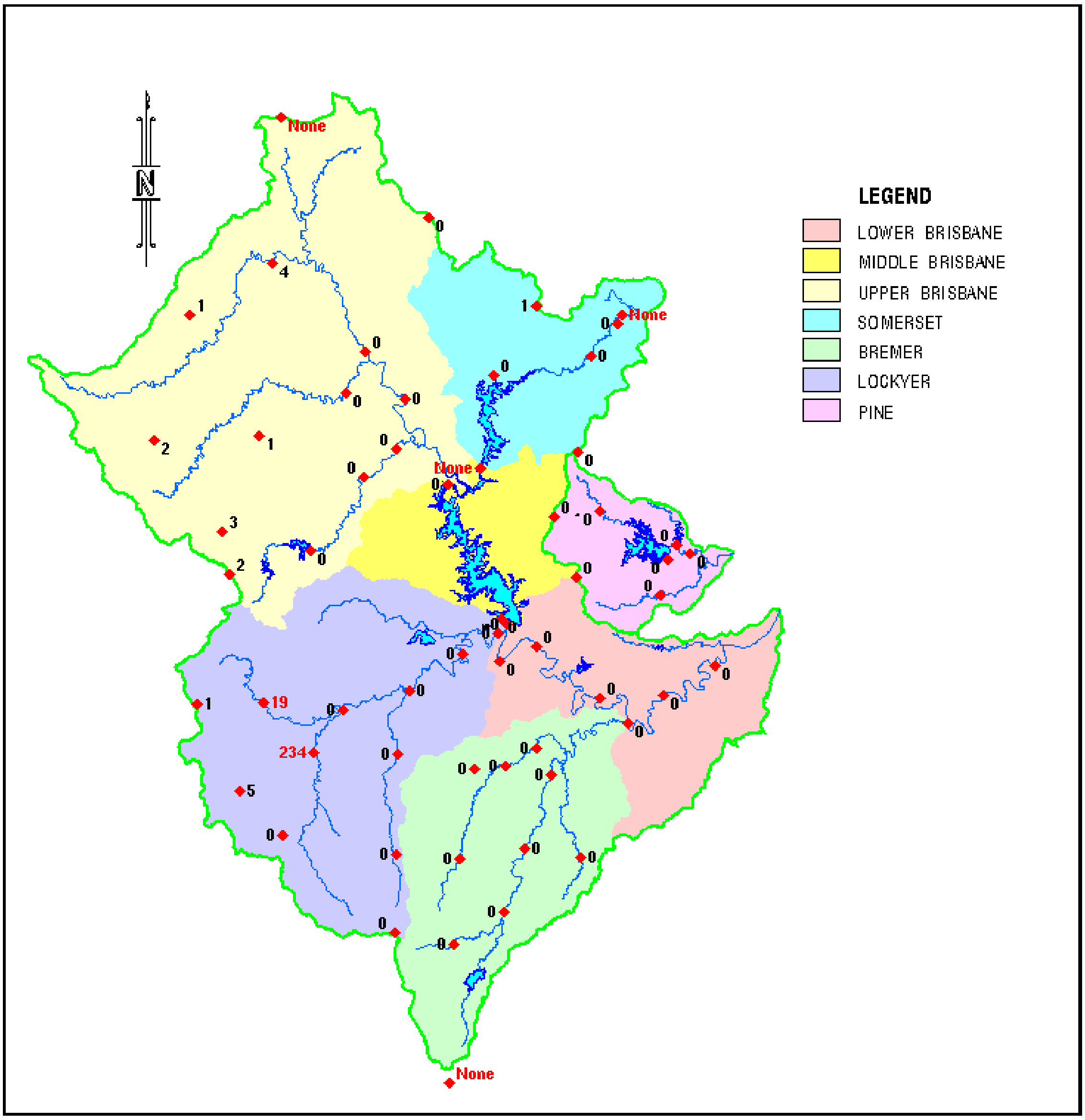
In the 24 hours to 09:00 on Saturday 1 January 2011, only isolated falls of up to 10mm were recorded in the Stanley catchment. There was no significant rainfall recorded elsewhere in the region.

Rainfall in 24 hours to 09:00 02/01/2011



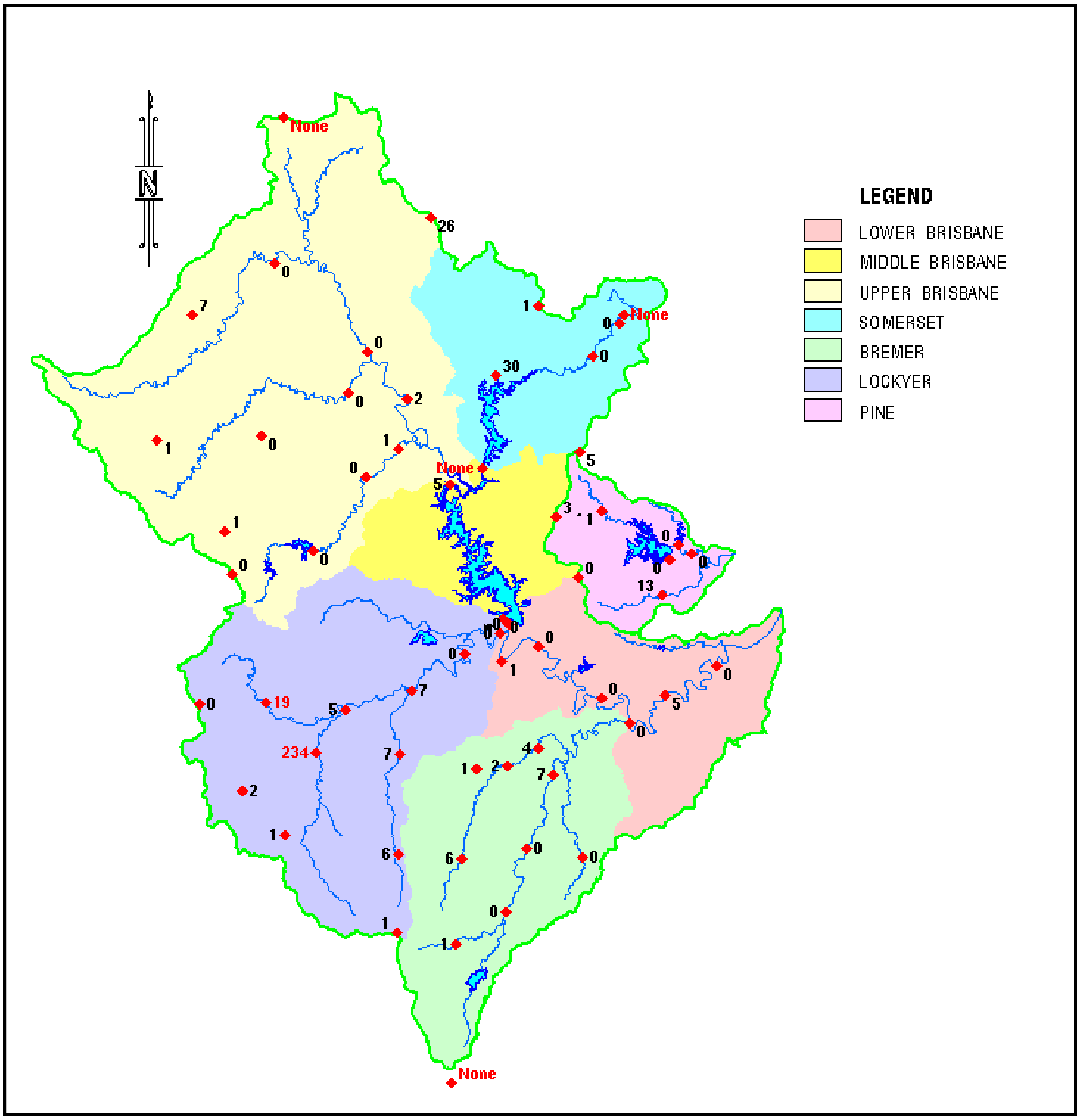
Only light rain was recorded in the Basin in the 24 hours to 09:00 on Sunday 2 January 2011. Higher totals of up to 50mm were recorded in the headwaters of the Stanley and Pine Rivers.

Rainfall in 24 hours to 09:00 03/01/2011



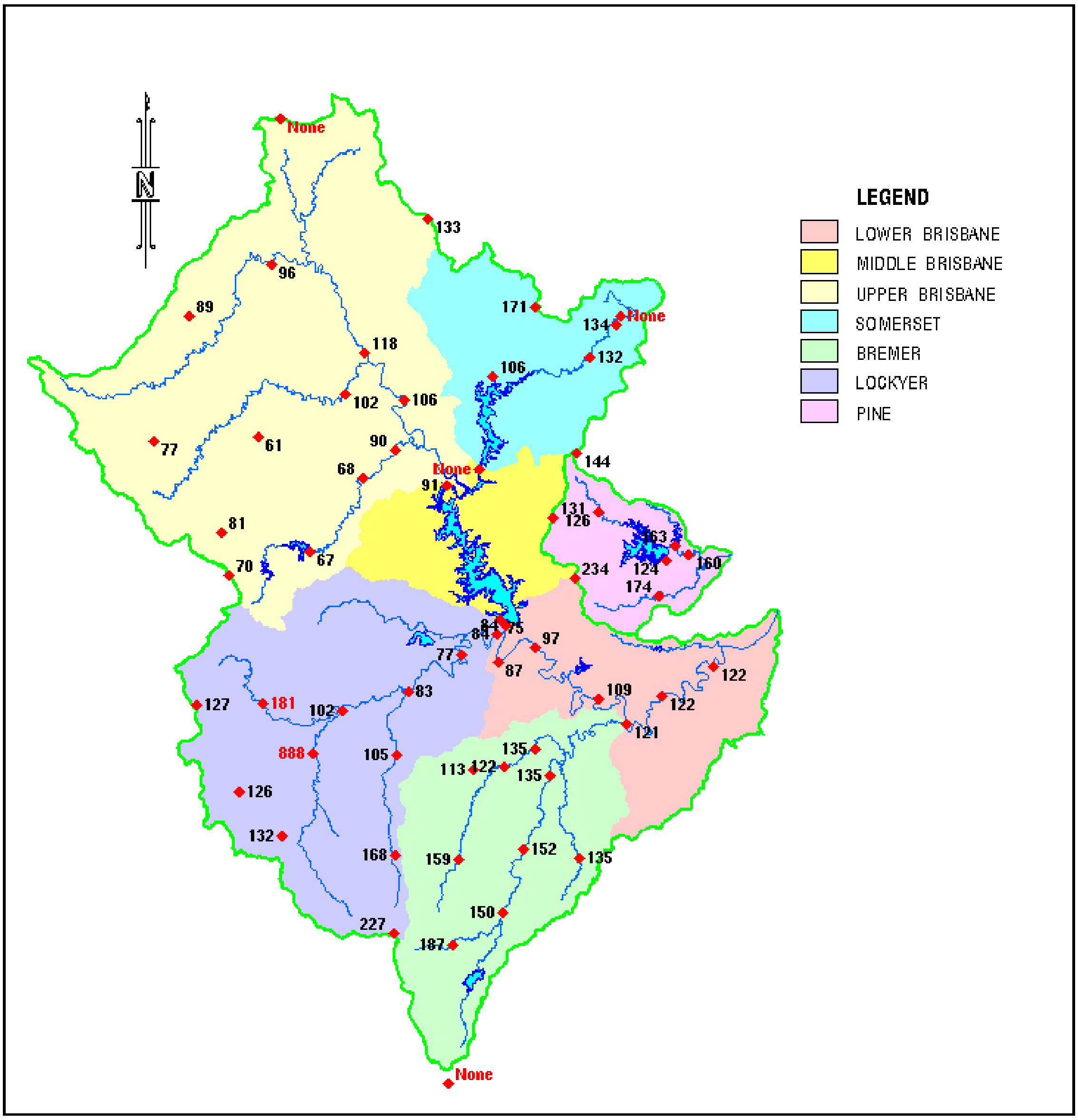
There was no significant rainfall recorded in the Basin in the 24 hours to 09:00 on Monday 3 January 2011.

Rainfall in 24 hours to 09:00 04/01/2011



There was no significant rainfall recorded in the Basin in the 24 hours to 09:00 Tuesday 4 January 2011 however some isolated falls were recorded in the Stanley catchment at Kilcoy and Jimna during the period.

Rainfall in 11 days to 09:00 04/01/2011



The map above shows the rainfall distribution during the 11-day period to 09:00 on Tuesday 4 January 2011.

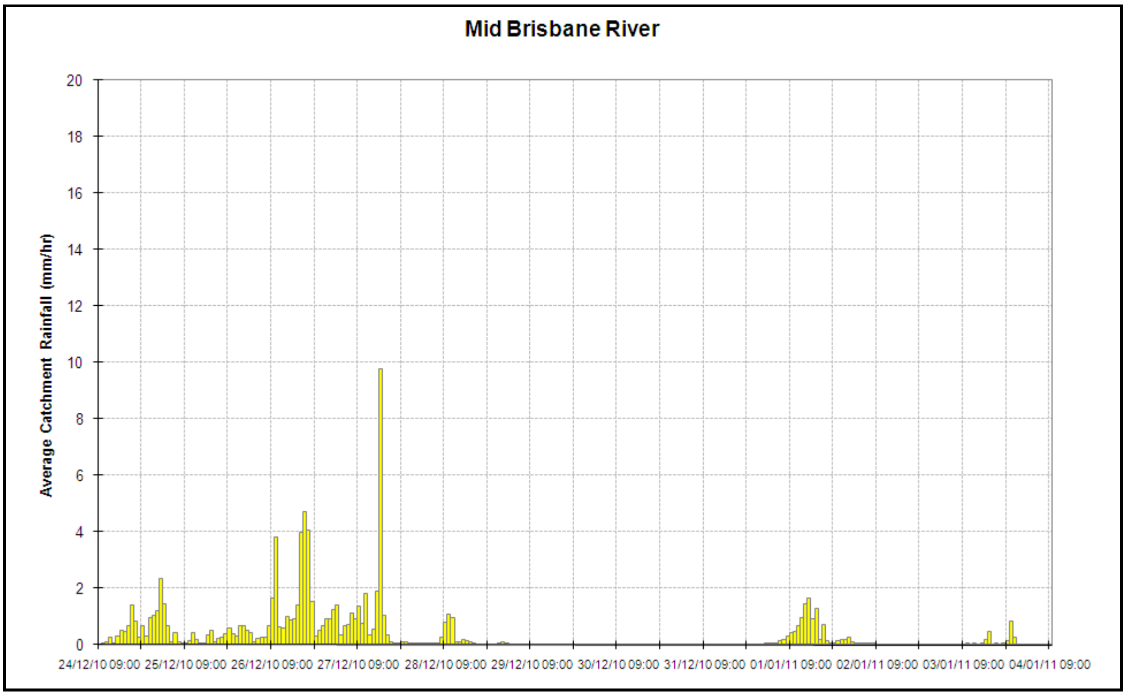
The highest rainfall totals were recorded in the headwater areas of Laidley Creek in the Lockyer system and around Mt Glorious near the junction of the Brisbane and Pine Basins. Rainfall was widespread in the Stanley River, with Event totals of between 100mm and 170mm recorded. In the Upper Brisbane catchment, the highest totals of up to 120mm were recorded in the mid reaches around Devon Hills. Totals in Lockyer Creek ranged from between 80mm in the lower reaches to almost 230mm in the headwaters of Laidley Creek. Totals in the Bremer and Lower Brisbane catchments were generally in the range of between 90mm to 150mm.

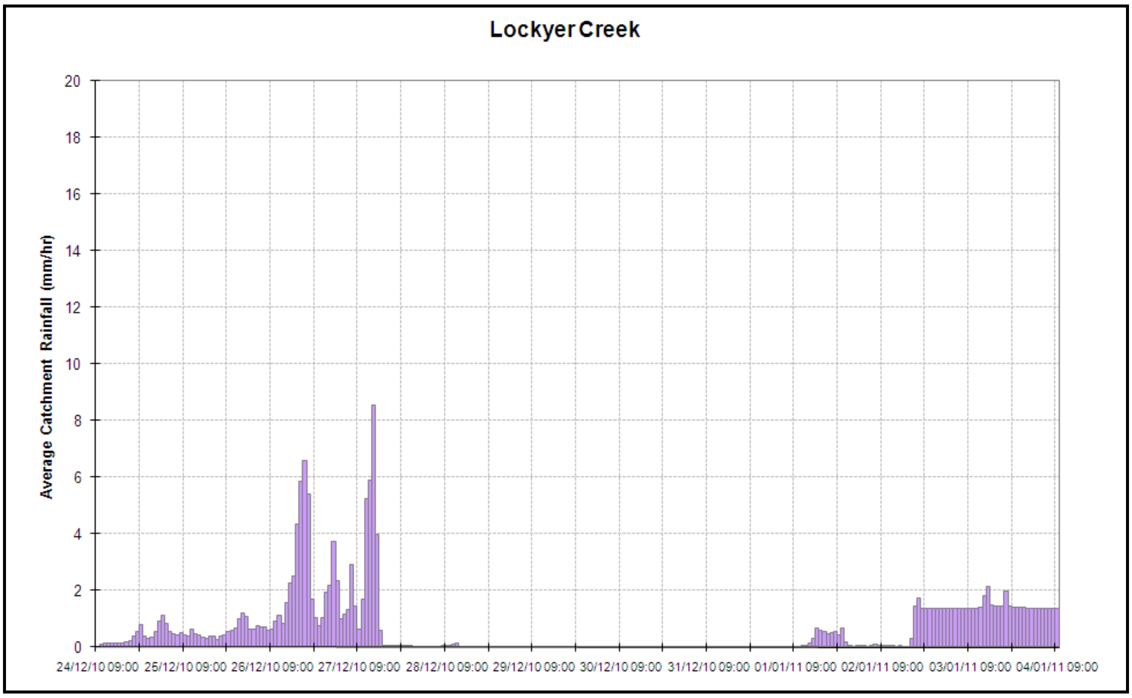
4.20 Late December Event – Average Catchment Rainfall

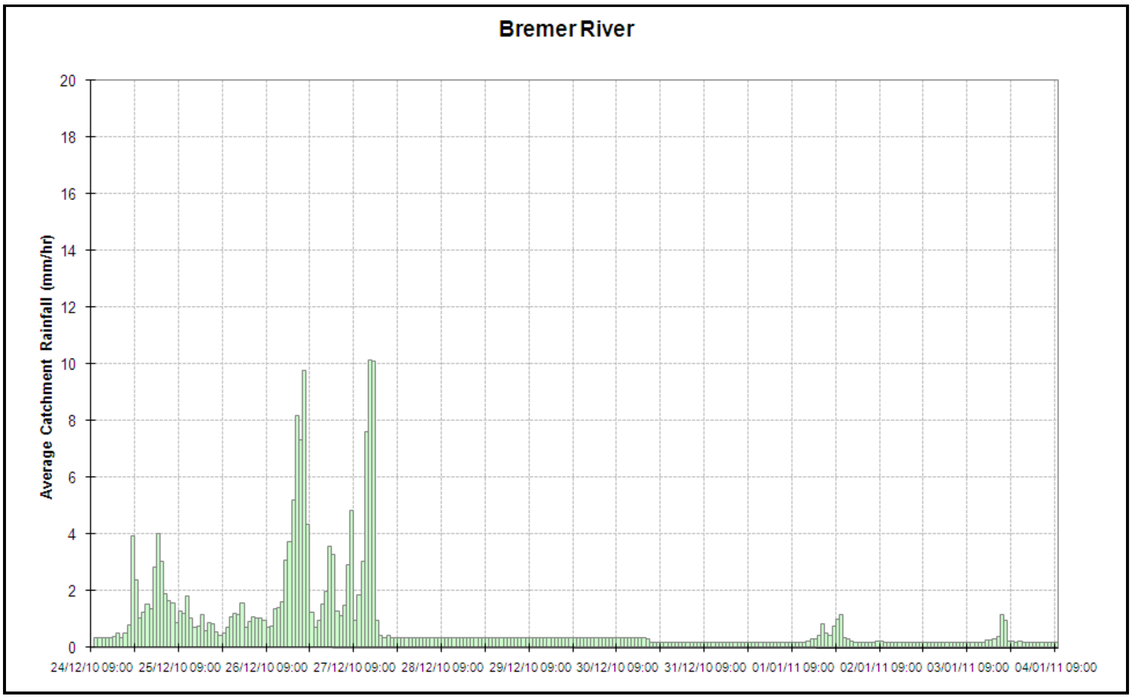
Average rainfall for each sub catchment in the Brisbane basin is determined byb applying a weighting to the rainfall depth at each available station within the sub catchment. The Upper Brisbane catchment excludes the Somerset catchment and is a weighted average of the Upper and Middle Brisbane catchments. A summary of catchment average rainfall for the Late December Event is shown in the table and figure below.

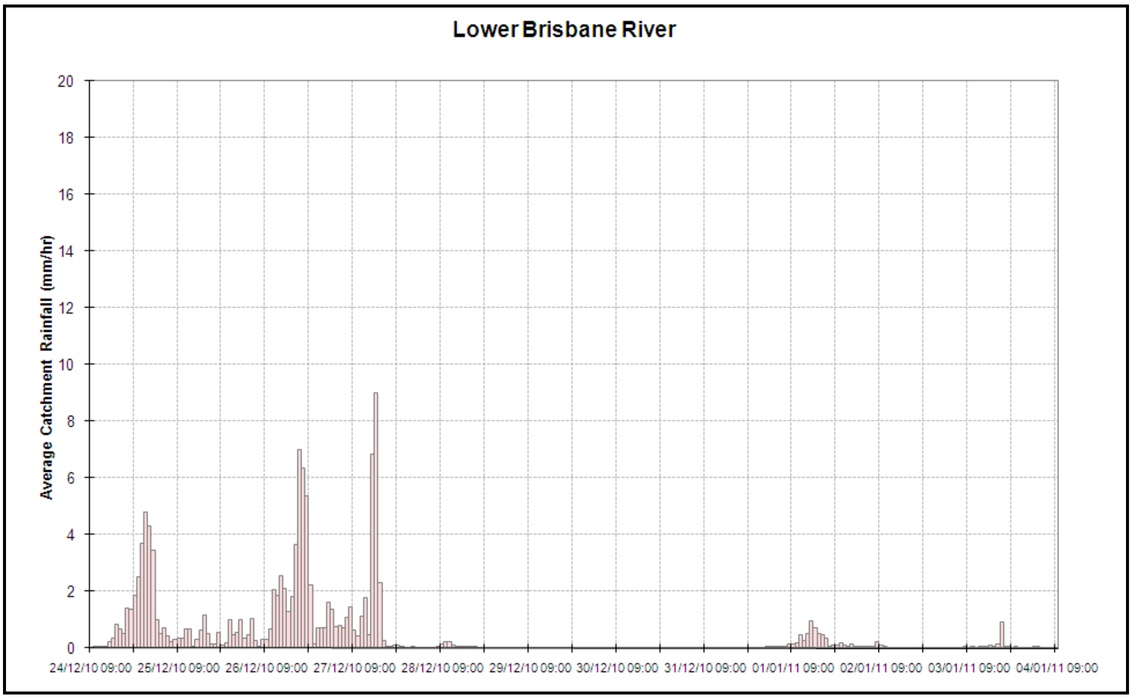
Period Ending 09:00	Stanley		Upper Brisbane		Lockyer		Bremer		Lower	
	Period	∑	Period	∑	Period	∑	Period	∑	Period	∑
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
25/12/2010	16	16	7	7	10	10	33	33	30	30
26/12/2010	12	28	12	19	14	24	23	56	11	41
27/12/2010	28	56	37	56	55	79	73	128	48	89
28/12/2010	33	90	20	76	26	105	40	169	23	112
29/12/2010	17	107	4	80	0	105	8	177	1	112
30/12/2010	1	107	0	80	0	105	8	185	0	112
31/12/2010	0	107	0	80	0	105	6	191	0	112
01/01/2011	4	111	0	80	0	105	5	195	0	113
02/01/2011	15	126	0	80	5	111	9	204	6	118
03/01/2011	0	126	0	80	23	134	5	209	0	119
04/01/2011	10	136	0	80	35	169	7	216	1	120

The catchment average rainfall for the Late December Event is shown on the following pages. These hyetographs do not necessarily reflect the localised high intensity rainfall that was recorded throughout the Basin at various times and locations. Catchment rainfalls can include hourly intensities at individual stations which are up to five times the catchment average.




Lockyer Creek
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
24/12/10 09:00
25/12/10 09:00
26/12/10 09:00
27/12/10 09:00
28/12/10 09:00
29/12/10 09:00
30/12/10 09:00
31/12/10 09:00
01/01/11 09:00
02/01/11 09:00
03/01/11 09:00
04/01/11 09:00


Bremer River
Average Catchment Rainfall (mm/hr)
0
2
4
6
8
10
12
14
16
18
20
24/12/10 09:00
25/12/10 09:00
26/12/10 09:00
27/12/10 09:00
28/12/10 09:00
29/12/10 09:00
30/12/10 09:00
31/12/10 09:00
01/01/11 09:00
02/01/11 09:00
03/01/11 09:00
04/01/11 09:00



4.21 Late December Event - Event Water Levels

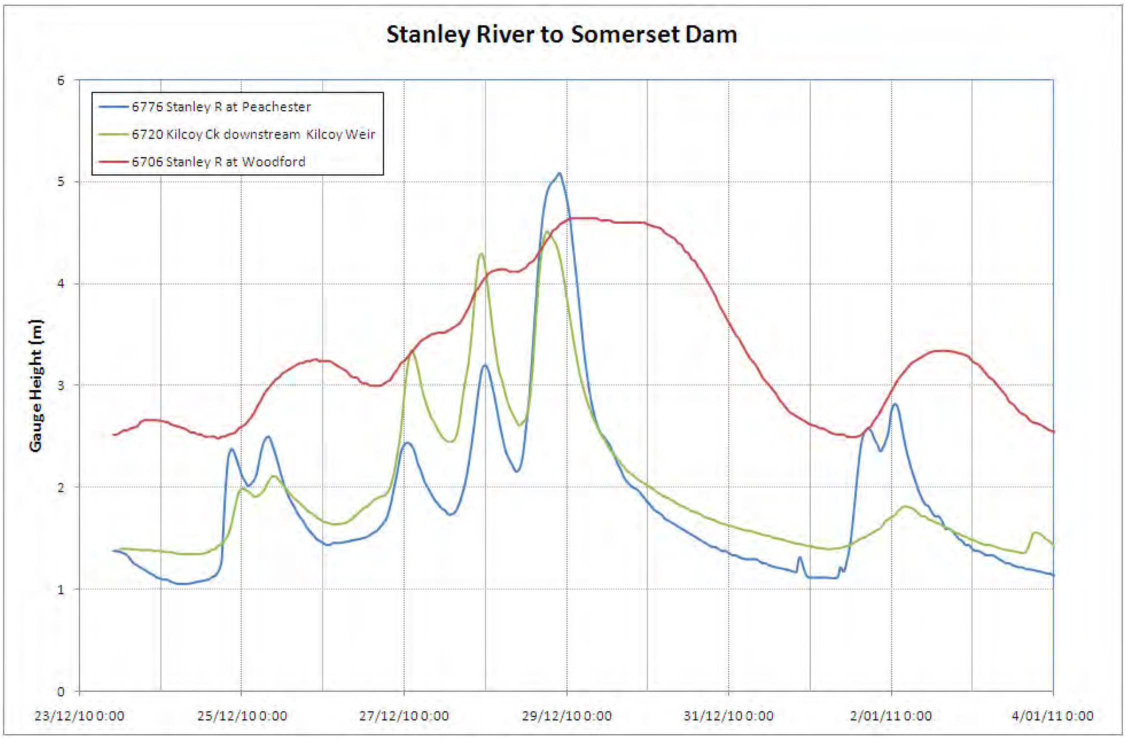
The table below shows the peak water levels reached at selected gauges during this event

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
PEACHESTER	28/12/2010 21:00			5.08
WOODFORD	29/12/2010 01:00			4.64
KILCOY	28/12/2010 18:00			4.50
SOMERSET DAM INFLOW	27/12/2010 17:00	700	126,000	
SOMERSET DAM OUTFLOW	29/12/2010 04:00	820	129,000	99.98
COOYAR CK	27/12/2010 18:00			6.97
LINVILLE	27/12/2010 22:00			6.09
DEVON HILLS	28/12/2010 01:00			6.62
BOAT MT	27/12/2010 20:00			5.58
GREGOR CK	28/12/2010 03:00			7.71
ROSENTRETTERS	27/12/2010 17:00			3.38
WIVENHOE DAM INFLOW	27/12/2010 16:00	2,200	513,000	
WIVENHOE DAM OUTFLOW	31/12/2010 03:00	1,590	481,000	69.93
HELIDON	27/12/2010 16:00			5.49
TENTHILL	27/12/2010 17:00			8.59
GATTON	27/12/2010 19:00			13.61
MULGOWIE	23/12/2010 09:00			1.72
SHOWGROUND WEIR	27/12/2010 20:00			9.33
WARREGO HWY	28/12/2010 02:00			6.37

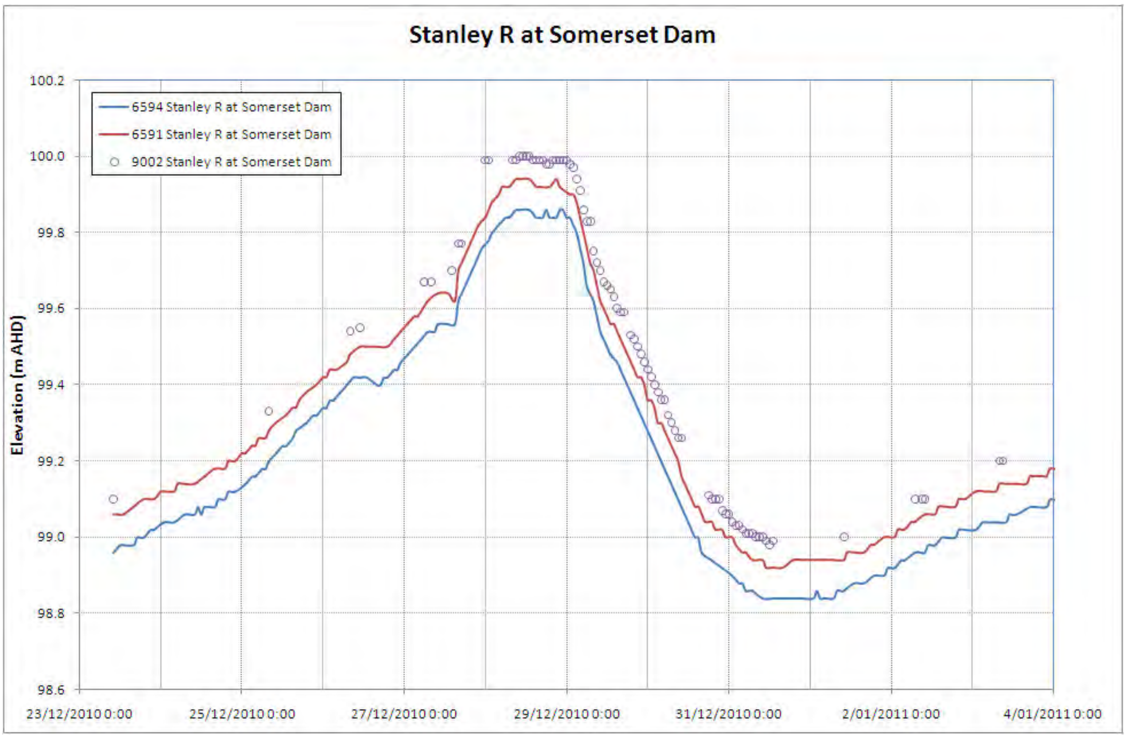
STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
GLENORE GROVE	27/12/2010 22:00			14.48
LYONS BRIDGE	28/12/2010 11:00			15.87
RIFLE RANGE RD	28/12/2010 13:00			15.88
BUARABA CK	28/12/2010 16:00			9.70
OREILLYS WEIR	29/12/2010 00:00			12.28
LOWOOD PUMP STATION	30/12/2010 05:00			10.77
SAVAGES CROSSING	30/12/2010 10:00			10.80
BURTONS BRIDGE	30/12/2010 11:00			8.78
L MANCHESTER	27/12/2010 23:00			51.55
KHOLO BRIDGE	30/12/2010 19:00			3.08
MT CROSBY WEIR	30/12/2010 18:00			11.62
COLLEGES CROSSING	30/12/2010 18:00			9.46
ADAMS BRIDGE	27/12/2010 17:00			4.67
STOKES CROSSING	27/12/2010 19:00			4.64
SPRESSERS BRIDGE	27/12/2010 18:00			3.77
KUSS RD	27/12/2010 00:00			7.42
WWTP	27/12/2010 02:00			7.65
ROSEWOOD	27/12/2010 04:00			6.08
FIVE MILE BRIDGE	27/12/2010 09:00			6.98
WALLOON	27/12/2010 11:00			8.02
MOOGERAH DAM	27/12/2010 18:00			157.12
JUNCTION WEIR	27/12/2010 18:00			79.91
HARRISVILLE	27/12/2010 22:00			5.76
CHURCHBANK WEIR	28/12/2010 03:00			2.80
GREENS RD	28/12/2010 11:00			7.29
AMBERLEY	28/12/2010 12:00			8.24
PEAK CROSSING	27/12/2010 02:00			4.19
LOAMSIDE	27/12/2010 07:00			5.58
ONE MILE BRIDGE	28/12/2010 08:00			15.73
HANCOCKS BRIDGE	28/12/2010 08:00			12.88
IPSWICH	27/12/2010 17:00			8.53
MOGGILL	27/12/2010 17:00			3.26
JINDALEE	27/12/2010 16:00			2.45
BRISBANE	23/12/2010 11:00			1.83
BAR	23/12/2010 11:00			1.65

4.22 Late December Event – Height Hydrographs

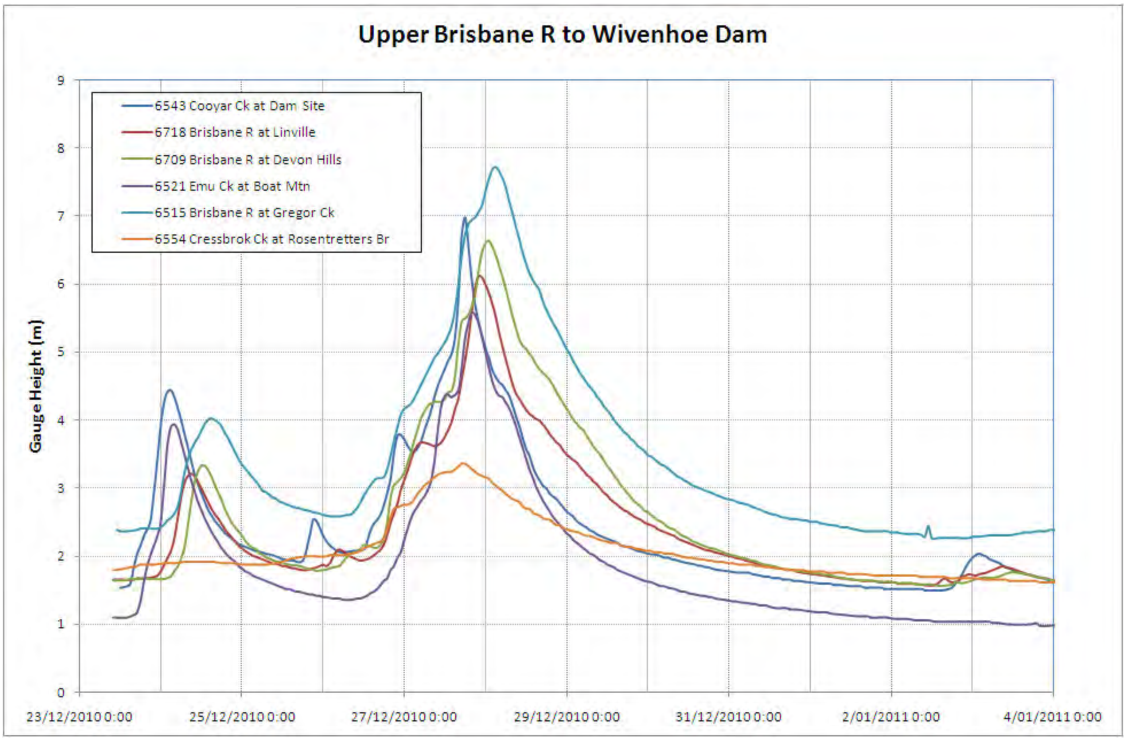
Height hydrographs for selected key stations within the Brisbane River Basin are plotted below. During the Event, basic data checking is carried out by the Duty Technical Assistants.



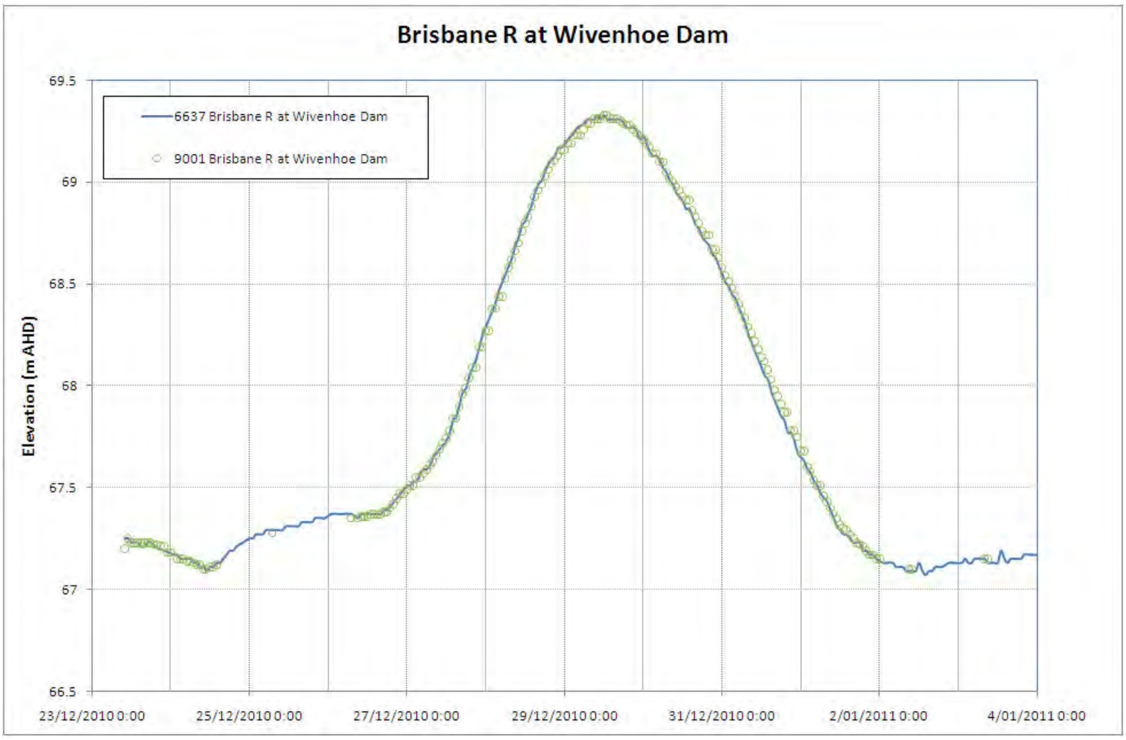
There are three gauges upstream of Somerset Dam which are monitored during flood events. Each of the three gauges appears to have worked well during the Event.



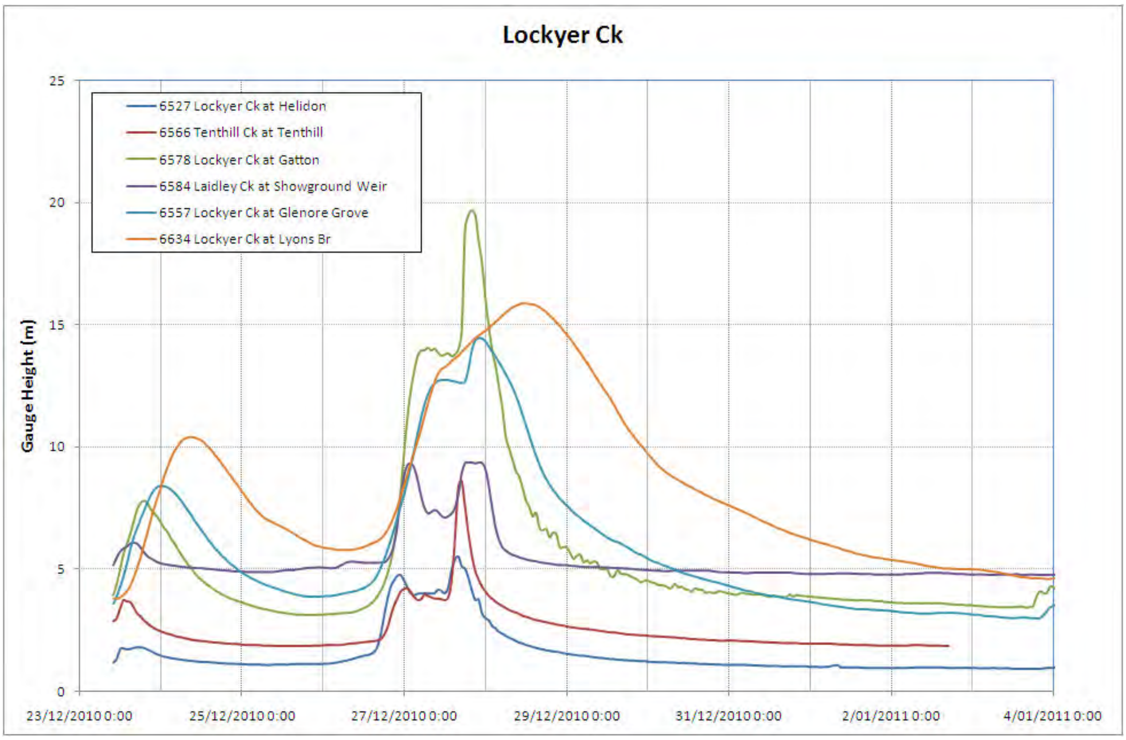
The two automatic gauges shown above appear to have slightly under read when compared with the manual gauge board readings. This difference did not have impact dam operations.



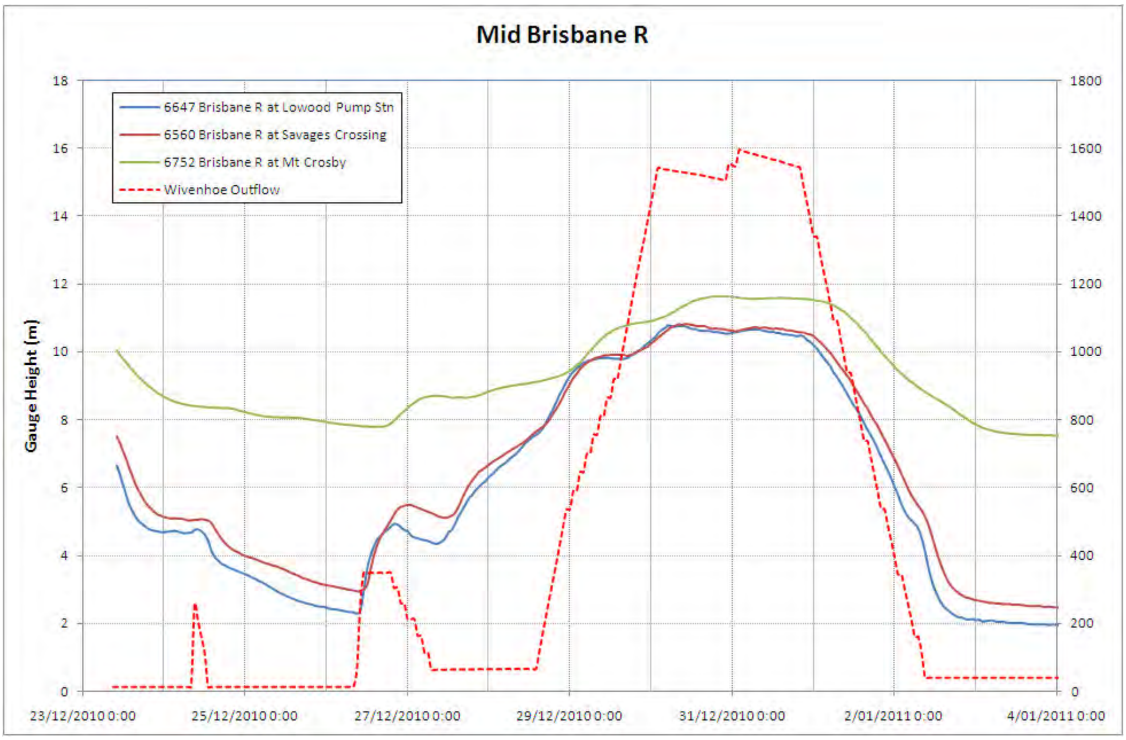
The gauges shown above appear to have worked well during the Event.



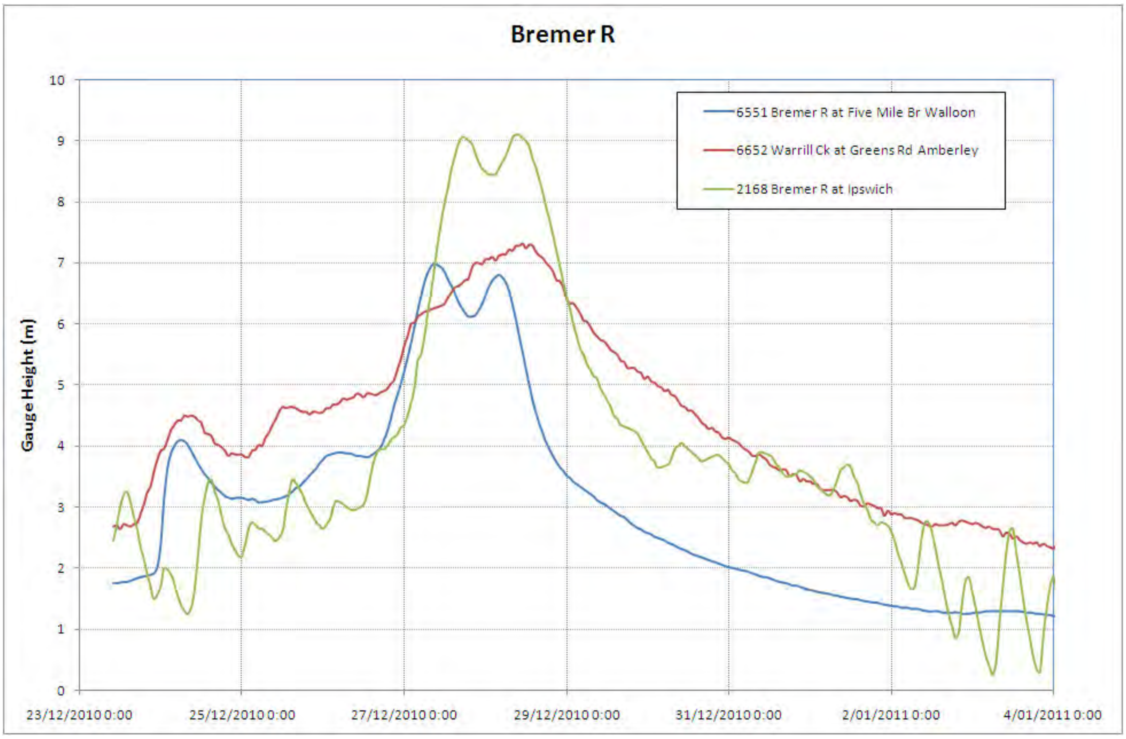
The gauges shown above appear to have worked well during the Event.



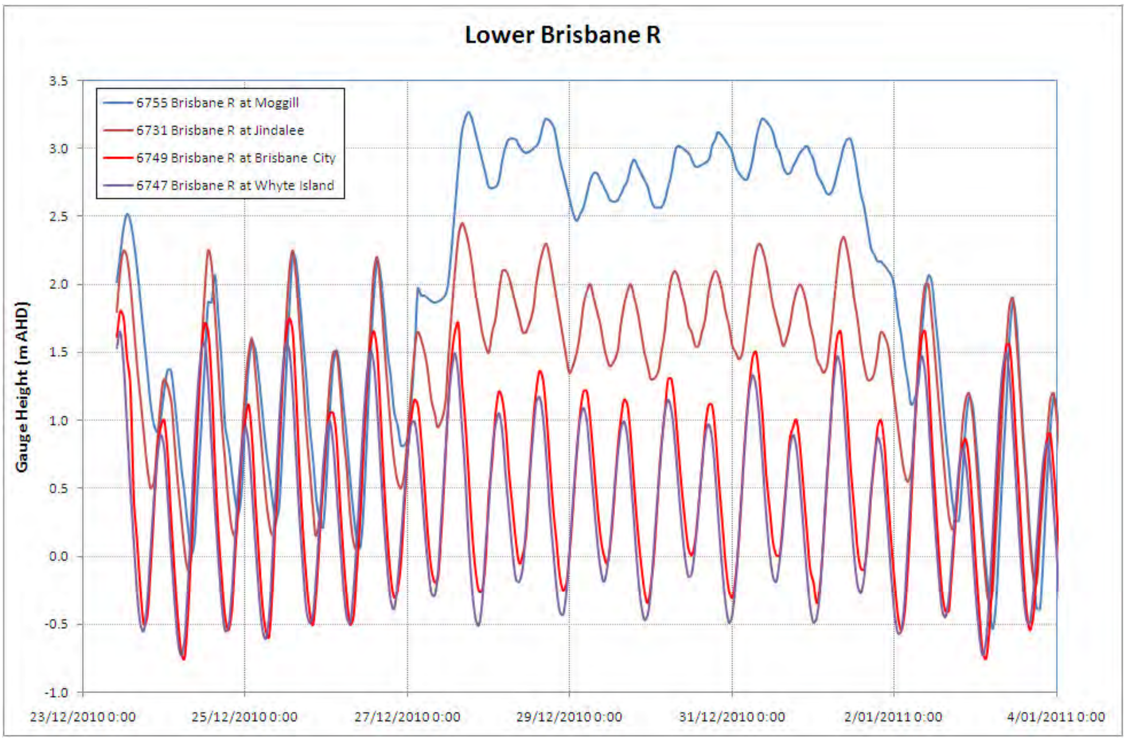
The gauges shown above appear to have worked well during the Event.



The gauges shown above appear to have worked well during the Event.



The gauges shown above appear to have worked well during the Event. The Bremer River at David Trumpy Bridge (Ipswich) is affected by backwater from the Brisbane River.

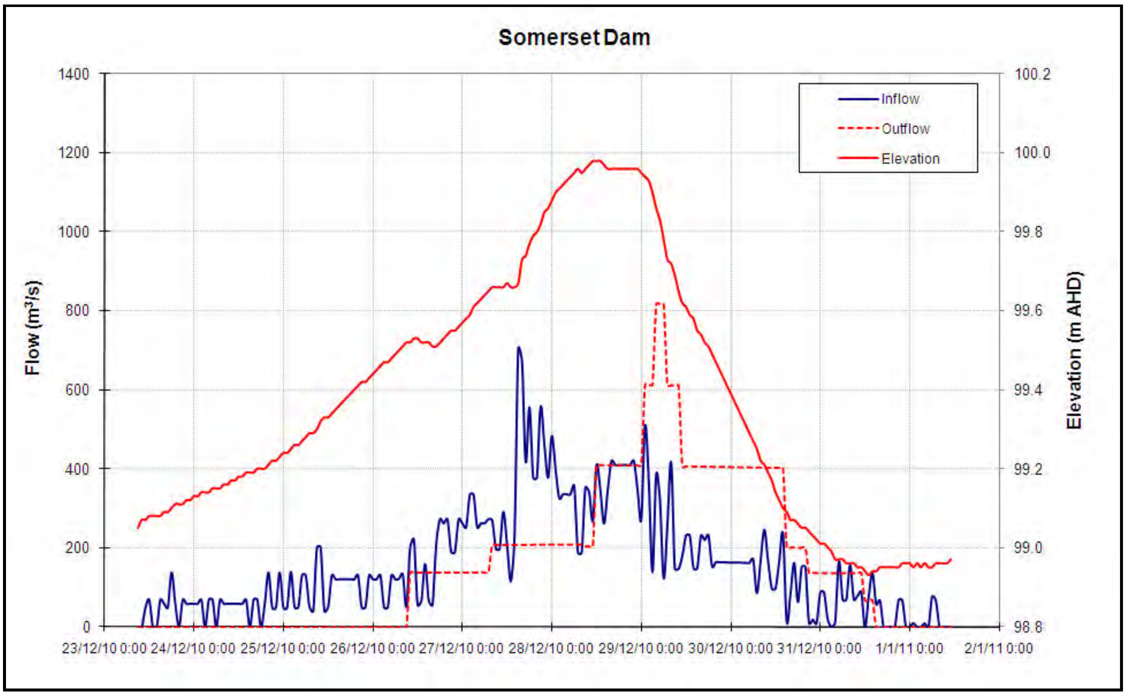


The gauges shown above appear to have worked well during the Event. These gauges are affected by tides.

4.23 Late December Event – Dam Inflows and Outflows

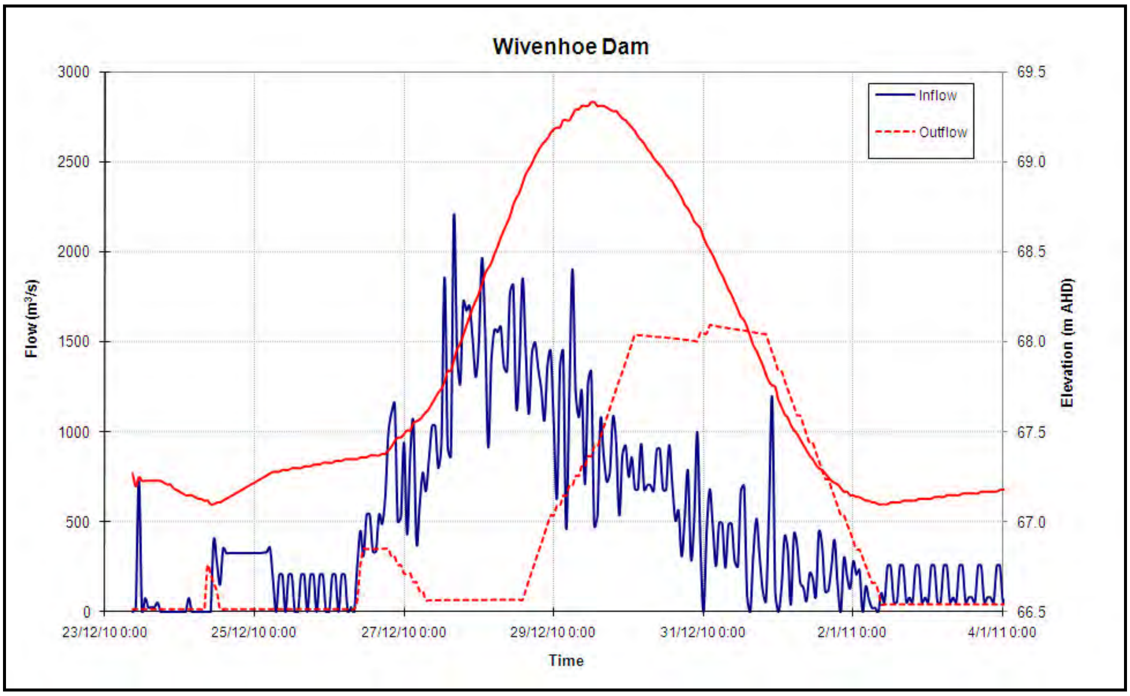
The inflows and outflows from Somerset and Wivenhoe Dams are outlined in the table and figures below. Note that the Wivenhoe figures include Somerset outflows. The inflow to the dams has been estimated by reverse routing.

STATION	DATE/TIME	PEAK FLOW (m^3/s)	FLOOD VOLUME (ML)	GAUGE HEIGHT (m)
SOMERSET DAM INFLOW	27/12/2010 17:00	700	126,000	
SOMERSET DAM OUTFLOW	29/12/2010 04:00	820	129,000	99.98
WIVENHOE DAM INFLOW	27/12/2010 16:00	2,200	513,000	
WIVENHOE DAM OUTFLOW	31/12/2010 03:00	1,590	481,000	69.93



The inflow into Somerset Dam is characterised by a series of small peaks of approximately 700m^3/s on Monday 27 December. The peak outflow of 820m^3/s occurred almost 36 hours later.

At 04:00 on Wednesday 29 December Somerset Dam reached its maximum water level of 99.98m AHD.



Similarly to Somerset, the inflow into Wivenhoe Dam is characterised by a relatively small flood peak of approximately 2,200m^3/s on the afternoon of Monday 27 December 2010. The peak of the outflow of 1,540m^3/s occurred close to 24 hours later on the evening of Friday 31 December 2010.

Wivenhoe Dam reached its maximum water level of 68.24m AHD at 19:00 on Tuesday 21 December 2010.

4.24 Other Data Sources

Other decision-making support tools examined and considered in conjunction with the modelling results included:

- 24-hour Quantitative Precipitation Forecasts (QPF) for North Pine, Somerset and Wivenhoe Dams provided by BoM twice daily, in the morning and afternoon.
- Weather radar (available via the BoM website and refreshed every 10 minutes).
- SILO Meteograms Forecast Rainfall (based on the BoM ACCESS Mode and available via the BoM Registered User Service).
- Interactive Weather and Wave Forecast Rainfall Maps (based on the BoM ACCESS Model and available via the BoM web site).
- Water and the Land Forecast Rainfall (based on an ensemble of several numerical weather prediction models and available via the BoM web site).

- Severe Weather Warnings issued by BoM.
- Flood Model Results (available via the BoM Registered User Service).
- Enviromon, the BoM replacement software for FloodCol. This includes all available ALERT stations in South East Queensland, including a large number of non-Seqwater stations.

The QPFs, received via fax and email, are considered to be the primary forecast tool. QPFs are provided by the BoM to give specific forecast information in relation to the dam catchment areas. Additionally, the data provided can be directly included in the Real Time Flood Model (RTFM). To a lesser extent, the information provided by SILO can also be included in the RTFM.

During the Event, detailed discussions were held with the BoM Flood Warning Centre. These discussions centred on model results as well as actual and projected inflows and outflows from dams. Similar discussions were held with Brisbane City Council (BCC). The details of these discussions can be found in the Event Log.

In addition to the sources listed above, the Department of Environment and Resource Management web sites were inspected to compare heights and flows at selected gauging stations.

5. FLOOD MODEL VALIDITY AND PERFORMANCE

5.1 Background

A real-time flood monitoring and forecasting system is used to monitor rainfall and water levels in the Dam catchments and to provide adequate, accurate and timely information to inform decision-making.

As the real-time rainfall and river height data is received in the Flood Operations Centre, a RTFM is used to estimate likely Dam inflows and evaluate a range of possible inflow scenarios based on forecast and recorded rainfall in the Dam catchments. It comprises a suite of hydrologic computer models that process real-time data. This data is used by Flood Operations Engineers to operate the Dams during flood events, in accordance with the Manual. The Manual's objectives and procedures ensure Dam releases are optimised in order to minimise the impact of flooding.

5.2 System description

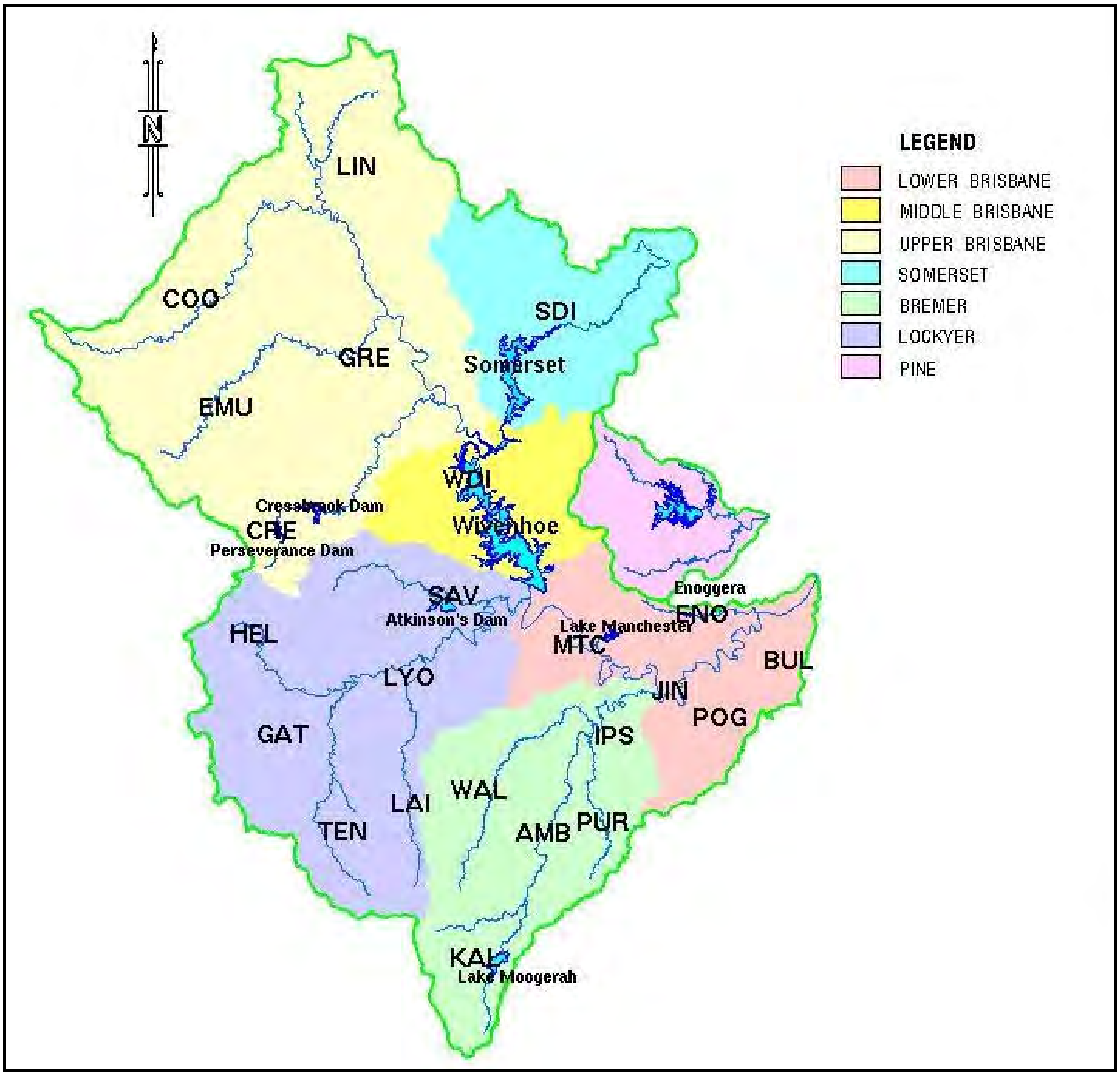
The current RTFM was developed in 1994 as part of the *Brisbane River and Pine River Flood Study, (DNR, 1994*) and consists of two integrated modules:

- FLOOD-Col;
- FLOOD-Ops.

FLOOD-Col is the data capture module, while FLOOD-Ops is the data analysis module of the RTFM. The RTFM:

- Automatically and continuously collects, filters and stores rainfall and water level data in real time;
- Assigns temporal and spatial distributions of actual and forecast rainfall for extension into the future;
- Evaluates the spatial and temporal distribution of antecedent catchment soil moisture conditions on a daily basis;
- Performs hydrologic routing of stream flows in an integrated environment;
- Provides estimates of storage performance and resulting downstream releases;
- Prepares summary output in textual and graphical format for storage operation and resulting downstream flood levels and flows.

The Flood-Ops component of the RTFM consists of a series of linked WT42 models as shown in the figure below.



Relevant statistics and model parameters relating to each Region as defined in the RTFM are shown in the table below.

Region Code	Stream gauge	AMTD (km)	Area (km^2)	Distance to outlet (km)	Model Parameters	
					Kc	m
	Upper Brisbane River					
COO	Cooyar Creek at Dam site	12.2	980	28.1	43.6	0.8
LIN	Brisbane River at Linville	282.4	1,061	23.2	20.6	0.8
EMU	Emu Creek at Boat Mountain	9.3	913	42.1	37.2	0.8
CRE	Cressbrook Creek at Cressbrook Dam	58.6	317	15.9	34.3	0.8
GRE	Brisbane River at Gregors Creek	251.7	973	25.0	20.1	0.8
	Stanley River					
SDI	Stanley River at Somerset Dam	7.2	1,328	42.6	60.3	0.8
	Middle Brisbane River					
WDI	Brisbane River at Wivenhoe Dam	150.4	1,429	49.1	108.5	0.8

Region Code	Stream gauge	AMTD (km)	Area (km^2)	Distance to outlet (km)	Model Parameters	
					Kc	m
SAV	Brisbane River at Savages Crossing	130.8	728	43.7	40.0	0.8
MTC	Brisbane River at Mt Crosby Weir	90.8	358	31.3	47.0	0.8
Lockyer Creek						
HEL	Lockyer Creek at Helidon	96.6	377	23.8	15.0	0.8
TEN	Tenthill Creek at Tenthill	14.6	465	37.7	19.0	0.8
LAI	Laidley Creek at Showground Weir	17.6	285	23.6	42.1	0.8
GAT	Lockyer Creek at Gatton	72.0	706	27.7	61.9	0.8
LYO	Lockyer Creek at Lyons Bridge	27.2	602	30.2	53.9	0.8
Bremer River						
WAL	Bremer River at Walloon	37.2	626	30.3	44.0	0.8
KAL	Warrill Creek at Kalbar	49.7	469	21.8	34.0	0.8
AMB	Warrill Creek at Amberley	8.7	449	25.0	35.0	0.8
PUR	Purga Creek at Loamside	6.8	223	23.6	49.0	0.8
IPS	Bremer River at Ipswich	16.9	265	23.4	15.7	0.8
Lower Brisbane River						
JIN	Brisbane River at Jindalee	49.1	390	21.0	29.4	0.8
POG	Brisbane River at Port Office Gauge	22.7	339	36.9	19.3	0.8
ENO	Enoggera Creek at Junction	0.0	82	16.4	9.1	0.8
BUL	Bulimba Creek at Junction	0.0	130	18.8	10.5	0.8

5.3 Model Performance

During floods, model outputs are compared with data from gauging stations in real time to assess their accuracy. Ultimately, the models' performance is measured by how well they estimate the volume of water flowing into the Dams. Therefore, a comparison of the modelled water level with the gauge board readings taken during the event is considered to be the best way to assess model performance.

While all models are run and flows generated at numerous locations during events, only the performance of the models at Somerset and Wivenhoe Dams is reported here.

During events, initial loss is adjusted to match the initial rise in the recorded water level at a particular location. Continuing loss rates were altered to ensure the overall shape and volume of the Flood Event was being matched to an acceptable level.

The scale factor allows the Flood Operations Engineer to interactively upscale or downscale the inflows to the Dams. Ideally, this should be 1.0 however values with +/-10% are considered acceptable.

5.4 October Event – Model Performance

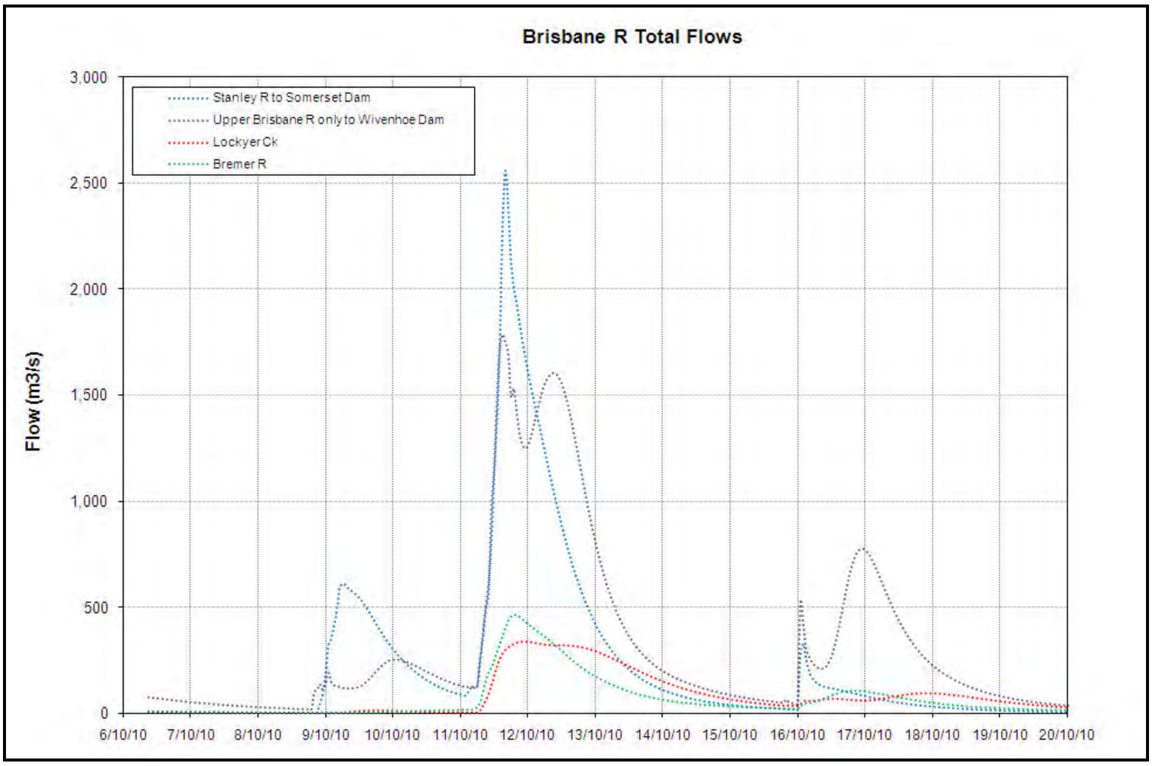
The table below shows the adopted model parameters for the October 2010 Flood Event.

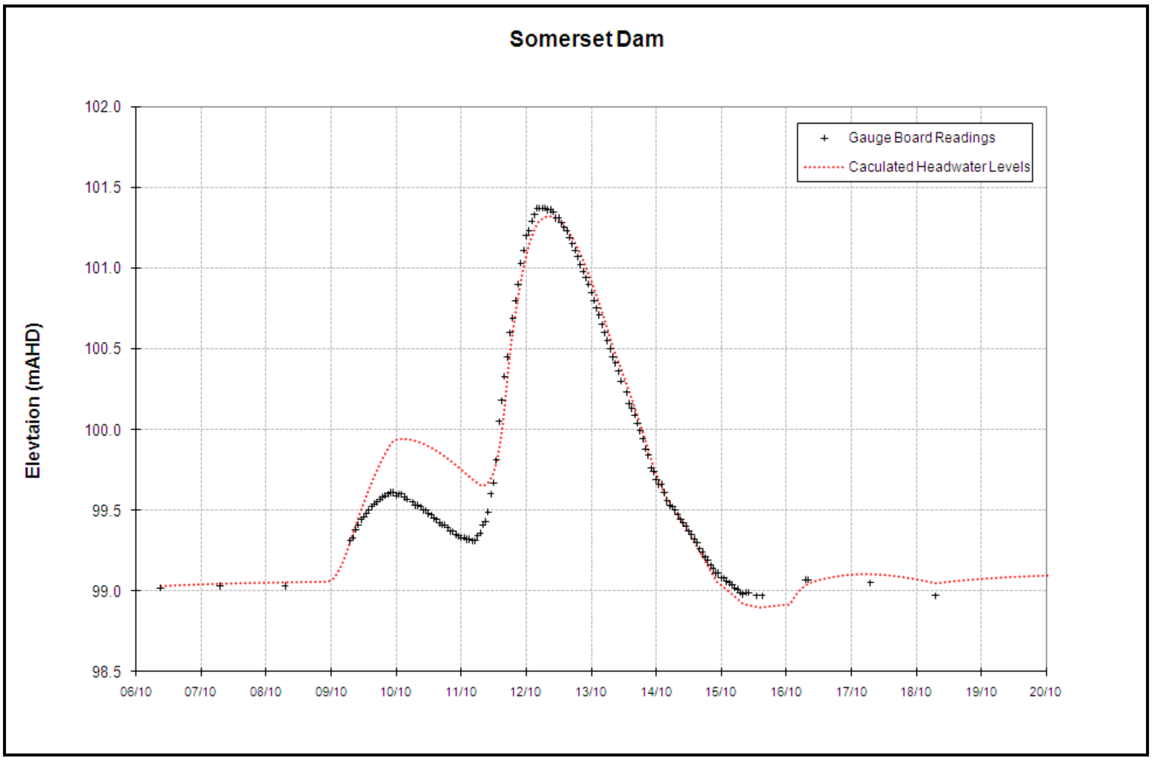
ADOPTED MODEL PARAMETERS – OCTOBER 2010								
Region code	Initial loss (mm)	Continuing Loss (mm/hr)	K_c	m	Baseflow			Scale Factor
					BR	BC	BM	
Stanley River to Somerset Dam								
SDI	25	2.2	60.3	0.8	0.975	0.002	1.0	**1.40**
Upper Brisbane River to Wivenhoe Dam								
COO	40	1.0	43.6	0.8	0.975	0.002	1.0	0.95
LIN	35	1.0	20.6	0.8				
EMU	35	1.0	37.2	0.8				
CRE	35	2.0	34.3	0.8				
GRE	30	1.9	20.1	0.8				
WDI	20	1.8	108.5	0.8				

The modelled flows at the key locations of Somerset Dam, Wivenhoe Dam, Lockyer Creek and Bremer River are shown in the table and figures below. Adopted initial losses were slightly lower than those assessed by the API model. Adopted continuing loss rates are within normally acceptable ranges.

The figures on the following pages and the table below contains calculated values which may not be exactly the same as those determined post-flood and reported in the Event Data section of this report.

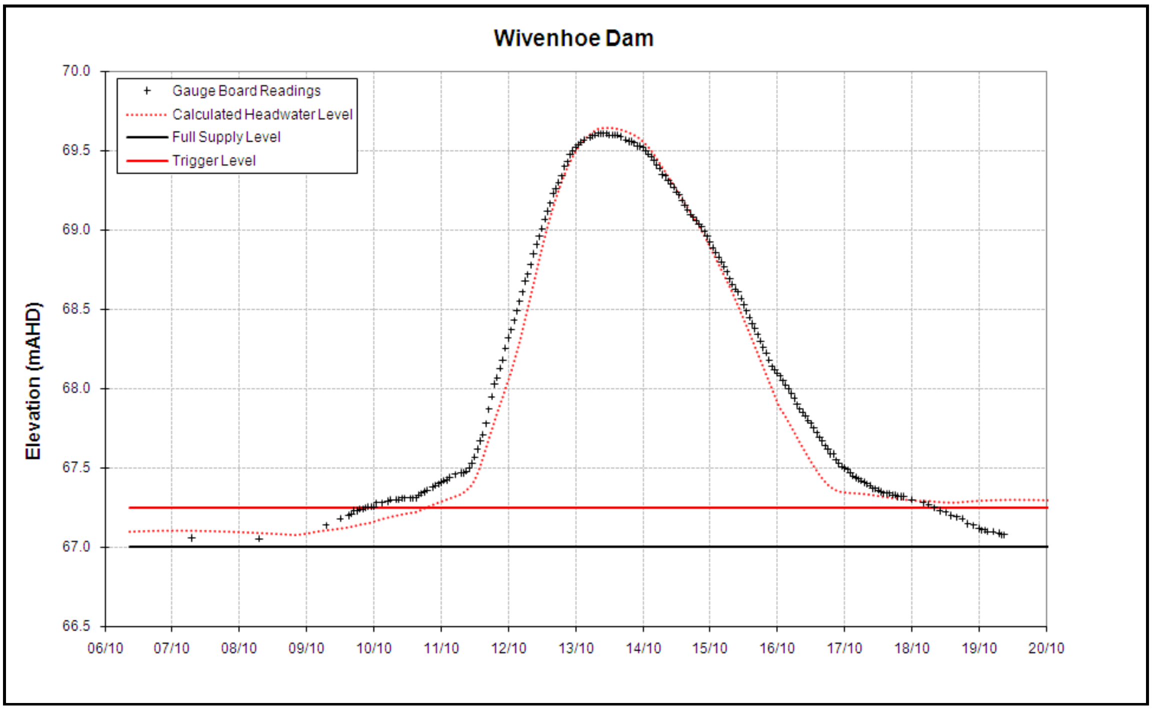
Location	Calculated	Date/Time	Value	Unit
Somerset Dam	Peak Inflow	11/10/2010 16:00	2,556	m3/s
	Peak Water Level	12/10/2010 08:00	101.32	m AHD
	Inflow Volume		281,963	ML
	Peak Outflow	12/10/2010 08:00	1,127	m3/s
	Outflow Volume		278,345	ML
Wivenhoe Dam	Peak Inflow	12/10/2010 09:00	2,729	m3/s
	Peak Water Level	13/10/2010 12:00	69.65	m AHD
	Inflow Volume		663,818	ML
	Peak Outflow	14/10/2010 04:00	1,508	m3/s
	Outflow Volume		933,116	ML
Lowood	Peak Flow including Wivenhoe	14/10/2010 10:00	1,638	m3/s
	Peak Flow excluding Wivenhoe	12/10/2010 05:00	335	m3/s
Moggill	Peak Flow including Wivenhoe	15/10/2010 02:00	1,667	m3/s
	Peak Flow excluding Wivenhoe	12/10/2010 14:00	565	m3/s





Initially the model overestimates the inflow to Somerset Dam and, as a result, overestimates the initial rise in the water level. This suggests the adopted initial loss was slightly too low.

Additionally, the adopted scale factor suggests the rainfall input is also low. However, timing of the peaks is reasonable which suggests the adopted model routing parameters are appropriate.



Overall, as reflected in the modelled water levels, the shape and volume of the inflow to Wivenhoe Dam appears to be satisfactory. The timing of the modelled rising limb of the water level is late, suggesting the storage factors (Kc and/or m) could be slightly reduced to produce a "better fit". Additionally, the recession falls away too quickly suggesting there is more runoff late in the Event from either unrecorded rainfall or additional baseflow. The adopted scale factor is within tolerable limits while modelled water levels are within 10mm of actual water levels over the entire Event.

Generally, the hydrologic models have satisfactorily reproduced the inflows to Somerset and Wivenhoe Dams during this Event.

5.5 Early December Event – Model Performance

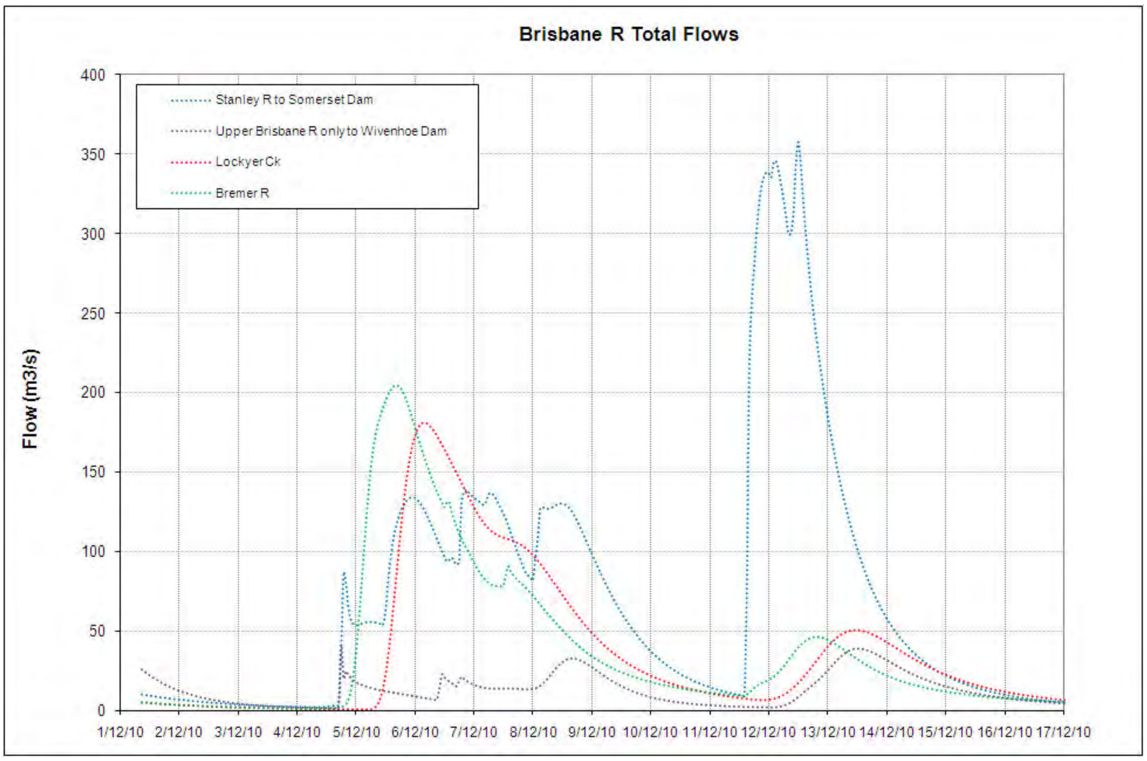
The table below shows the adopted model parameters for the Early December 2010 Event.

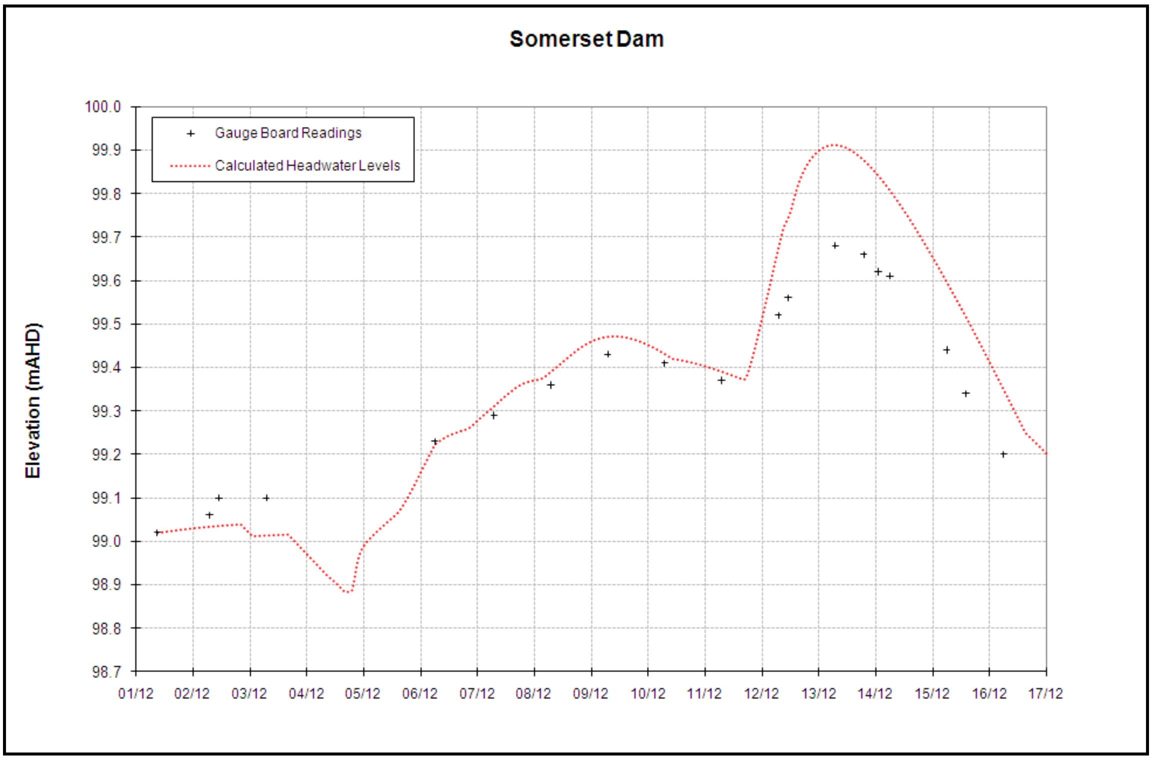
ADOPTED MODEL PARAMETERS – EARLY DECEMBER 2010								
Region code	Initial loss (mm)	Continuing Loss (mm/hr)	K_c	m	Baseflow			Scale Factor
					BR	BC	BM	
Stanley River to Somerset Dam								
SDI	45	1.7	60.3	0.8	0.975	0.002	1.0	0.95
Upper Brisbane River to Wivenhoe Dam								
COO	70	5.2	43.6	0.8	0.975	0.004	1.0	0.80
LIN	110	2.0	20.6	0.8				
EMU	70	5.2	37.2	0.8				
CRE	70	5.2	34.3	0.8				
GRE	100	2.0	20.1	0.8				
WDI	45	3.0	108.5	0.8				
Stanley River to Somerset Dam								
SDI	45	1.7	60.3	0.8	0.975	0.002	1.0	0.95

The modelled flows at the key locations of Somerset Dam, Wivenhoe Dam, Lockyer Creek and Bremer River are shown in the following table and figures. The figures in the table below are calculated values and may not be exactly the same as those determined post-flood and reported in the Event Data section of this report.

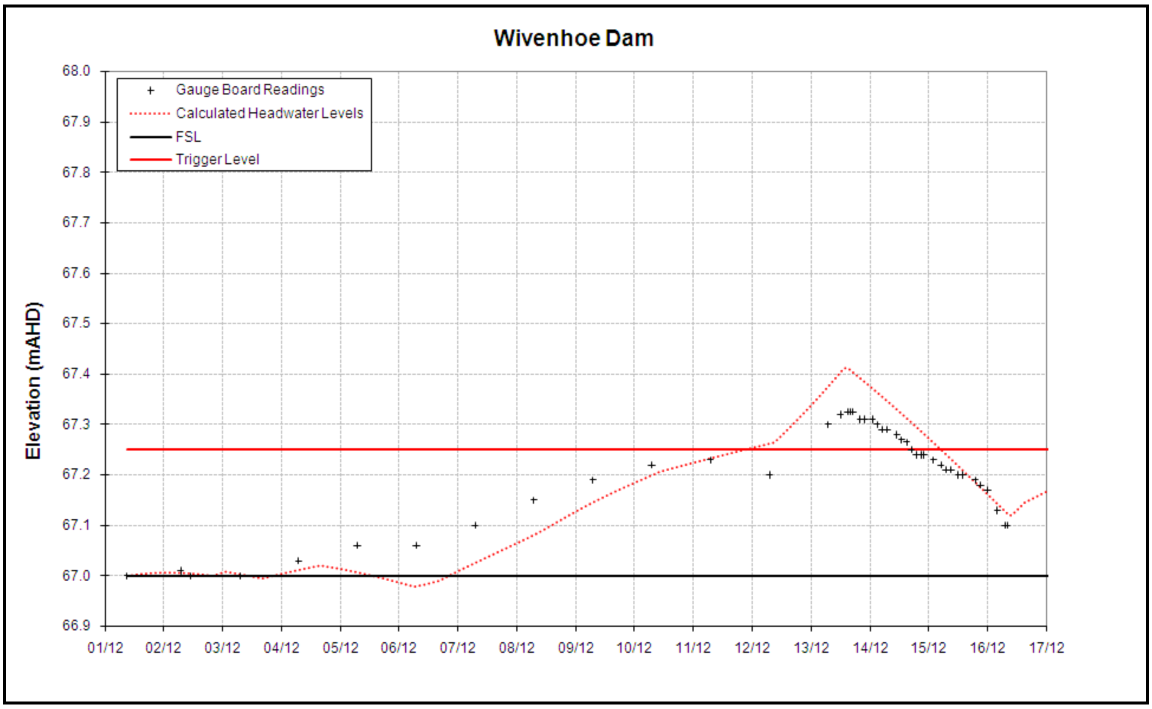
The early December inflows were relatively small. Modelling of small events tends to be more uncertain than in large events due to the sensitivity of the model to rainfall inputs and the fact that models have been primarily calibrated on larger floods. Adopted initial losses are much higher than those assessed by the API model. Adopted continuing loss rates are within normally acceptable ranges.

Location	Calculated	Date/Time	Value	Unit
Somerset Dam	Peak Inflow	12/12/2010 12:00	358	m^3/s
	Peak Water Level	13/12/2010 06:00	99.89	m AHD
	Inflow Volume		98,532	ML
	Peak Outflow	13/12/2010 06:00	139	m^3/s
	Outflow Volume		93,026	ML
Wivenhoe Dam	Peak Inflow	13/12/2010 12:00	178	m^3/s
	Peak Water Level	13/12/2010 14:00	67.35	m AHD
	Inflow Volume		111,218	ML
	Peak Outflow	13/12/2010 15:00	291	m^3/s
	Outflow Volume		96,470	ML
Lowood	Peak Flow including Wivenhoe	13/12/2010 21:00	340	m^3/s
	Peak Flow excluding Wivenhoe	06/12/2010 10:00	181	m^3/s
Moggill	Peak Flow including Wivenhoe	14/12/2010 13:00	355	m^3/s
	Peak Flow excluding Wivenhoe	06/12/2010 23:00	273	m^3/s





The performance of the model in estimating inflows to Somerset Dam is considered satisfactory although the modelled water level is approximately 200mm high at the peak of the Event. This has no significant impact on operational decisions. The inflow scale factor is within acceptable limits and the timing of the modelled inflow suggests routing parameters are appropriate. Modelled water levels are within 100mm of actual recordings over the entire Event.



Generally, the hydrologic models have satisfactorily reproduced the inflows to Somerset and Wivenhoe Dams during this Event, within the acceptable ranges of loss and routing parameters.

Overall, the model satisfactorily demonstrated the inflow to Wivenhoe Dam, especially considering the relatively small size of the Event. The routing parameters and scale factors adopted are also within acceptable tolerances.

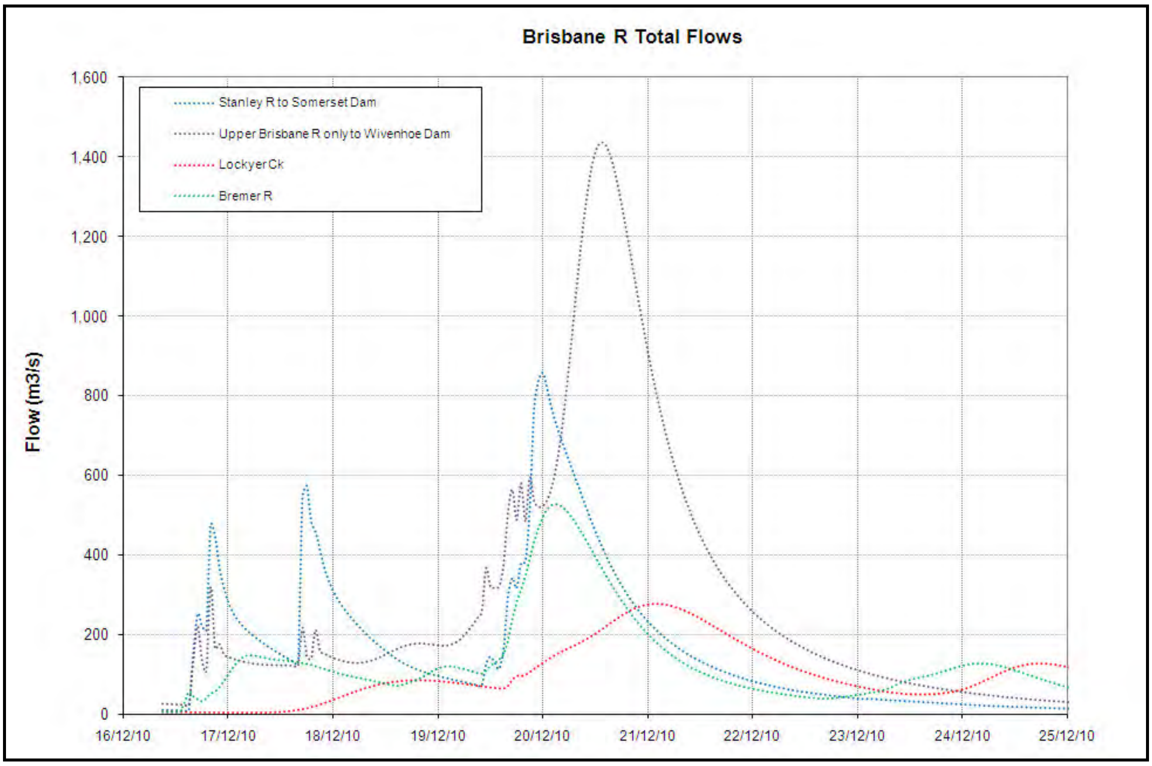
5.6 Mid December Event – Model Performance

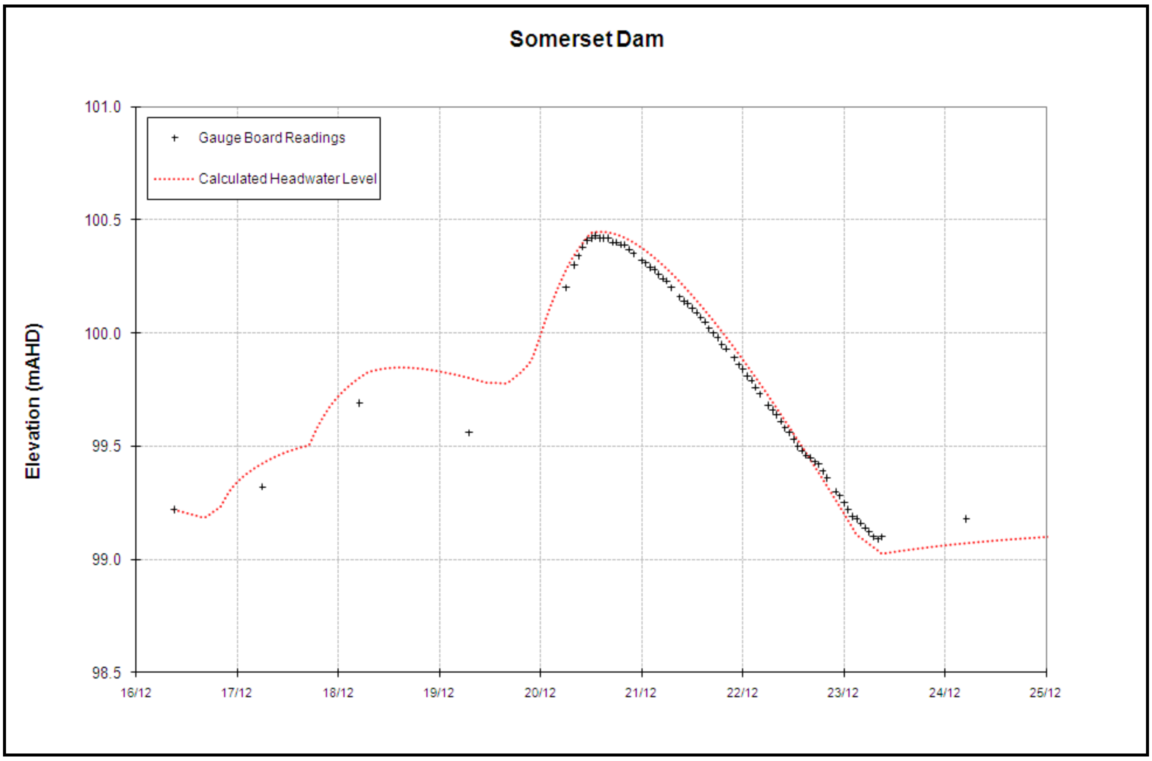
The table below shows the adopted model parameters for the Mid December 2010 Flood Event.

ADOPTED MODEL PARAMETERS – MID DECEMBER 2010								
Region code	Initial loss (mm)	Continuing Loss (mm/hr)	K_c	m	Baseflow			Scale Factor
					BR	BC	BM	
Stanley River to Somerset Dam								
SDI	10	1.5	60.3	0.8	0.975	0.005	1.0	1.0
Upper Brisbane River to Wivenhoe Dam								
COO	30	3.0	43.6	0.8	0.975	0.005	1.0	1.0
LIN	25	3.0	20.6	0.8				
EMU	30	2.0	37.2	0.8				
CRE	30	3.0	34.3	0.8				
GRE	25	3.0	20.1	0.8				
WDI	10	3.0	108.5	0.8				

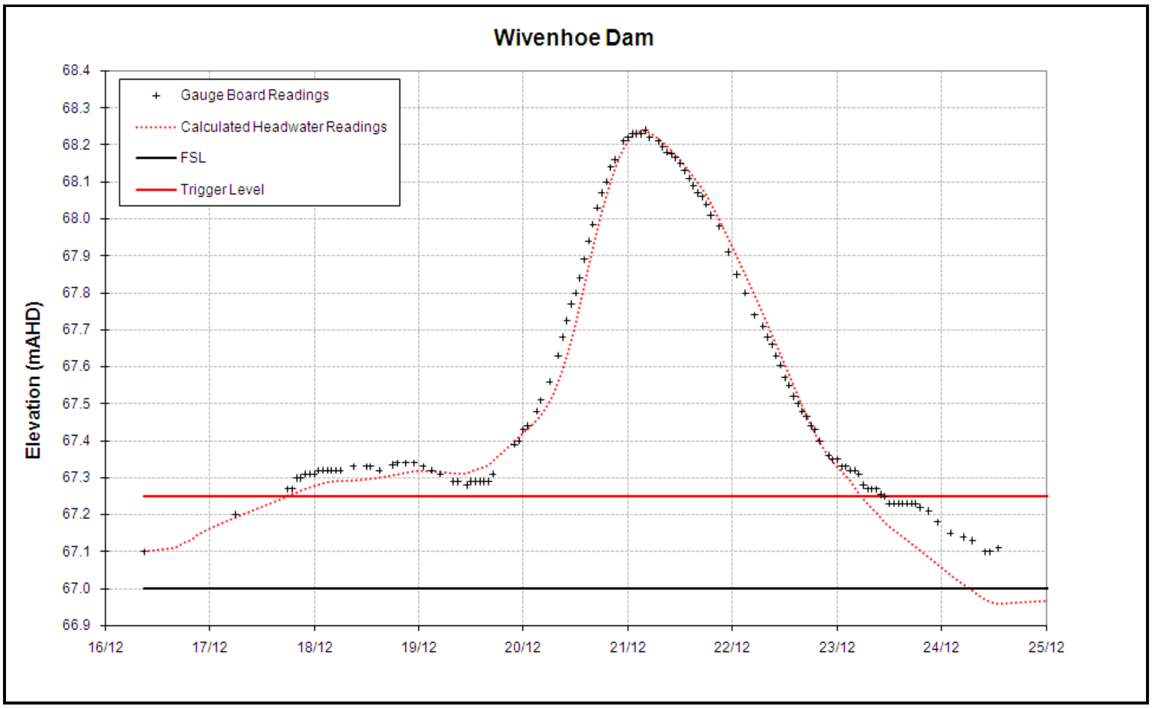
The modelled flows at the key locations of Somerset Dam, Wivenhoe Dam, Lockyer Creek and Bremer River are shown in the table and figures below. Adopted initial losses were 20mm lower in the Stanley and 10-15mm lower in the Upper Brisbane than those assessed by the API model while adopted continuing loss rates are within normally acceptable ranges. The figures in the table below are calculated values and may not be exactly the same those determined post-flood and reported in the Event Data section of this report.

Location	Calculated	Date/Time	Value	Unit
Somerset Dam	Peak Inflow	20/12/2010 00:00	856	m^3/s
	Peak Water Level	20/12/2010 14:00	100.45	m AHD
	Inflow Volume		133,320	ML
	Peak Outflow	20/12/2010 14:00	413	m^3/s
	Outflow Volume		155,656	ML
Wivenhoe Dam	Peak Inflow	20/12/2010 14:00	1,847	m^3/s
	Peak Water Level	21/12/2010 03:00	68.24	m AHD
	Inflow Volume		450,885	ML
	Peak Outflow	21/12/2010 19:00	1,462	m^3/s
	Outflow Volume		372,666	ML
Lowood	Peak Flow including Wivenhoe	22/12/2010 01:00	1,658	m^3/s
	Peak Flow excluding Wivenhoe	21/12/2010 08:00	278	m^3/s
Moggill	Peak Flow including Wivenhoe	22/12/2010 17:00	1,697	m^3/s
	Peak Flow excluding Wivenhoe	20/12/2010 03:00	605	m^3/s





Initially the model overestimates the inflow to Somerset Dam and, as a result, overestimates the initial rise in the water level. This suggests the adopted initial loss may be too low. The adopted scale factor of 1.00 suggests the rainfall input is accurate. The timing of the peaks is accurate which suggests the adopted model routing parameters are appropriate.



Overall, the shape and volume of the inflow appears to be satisfactory. The timing of the modelled water level on the rising limb is a little late however it is within acceptable tolerances. This suggests the storage factors (Kc and/or m) are also appropriate. Additionally, the recession falls away too quickly suggesting there is more runoff late in the Event from either unrecorded rainfall or additional baseflow. Modelled water levels are within 100mm of actual recordings over the entire Event.

Generally, the hydrologic models have satisfactorily reproduced the inflows to Somerset and Wivenhoe Dams during this Event, within acceptable loss and routing parameter ranges.

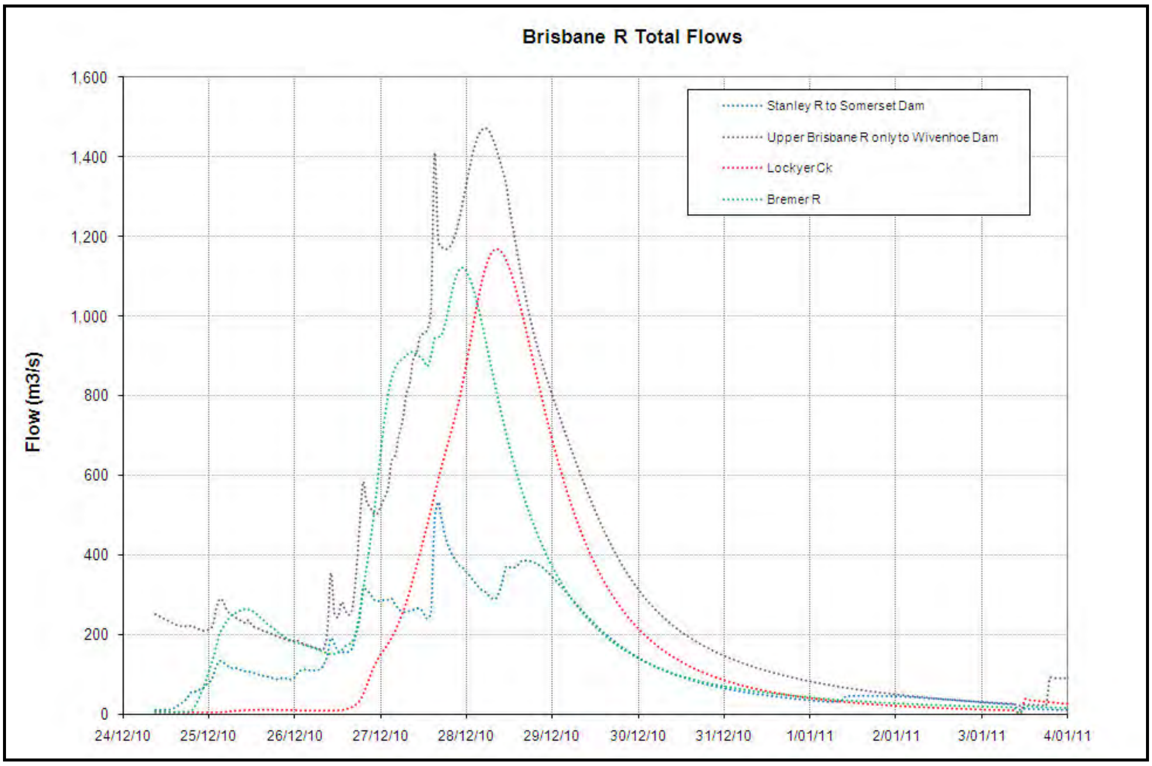
5.7 Late December Event – Model Performance

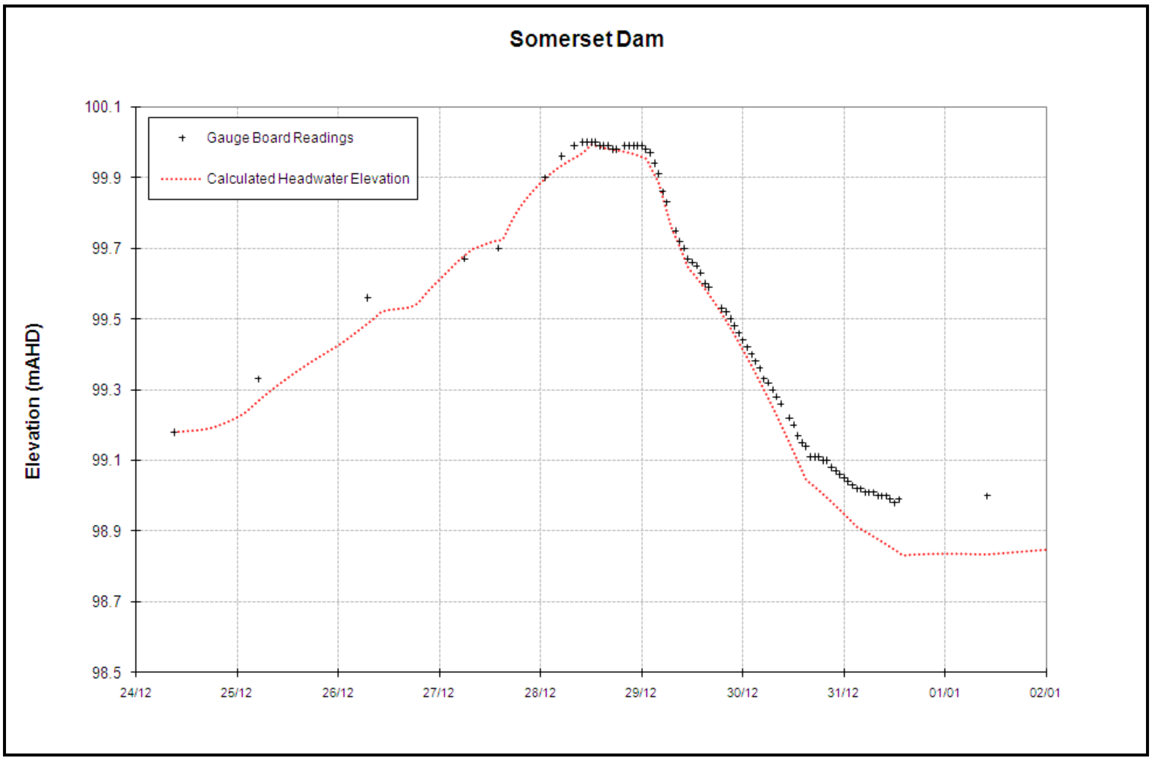
The table below shows the adopted model parameters for the Late December 2010 Flood Event.

ADOPTED MODEL PARAMETERS – LATE DECEMBER 2010								
Region code	Initial loss (mm)	Continuing Loss (mm/hr)	K_c	m	Baseflow			Scale Factor
					BR	BC	BM	
Stanley River to Somerset Dam								
SDI	10	0.3	60.3	0.8	0.975	0.005	1.0	1.00
Upper Brisbane River to Wivenhoe Dam								
COO	15	0.3	43.6	0.8	0.975	0.005	1.0	1.00
LIN	25	0.3	20.6	0.8				
EMU	10	0.3	37.2	0.8				
CRE	10	0.8	34.3	0.8				
GRE	10	1.5	20.1	0.8				
WDI	10	0.8	108.5	0.8				

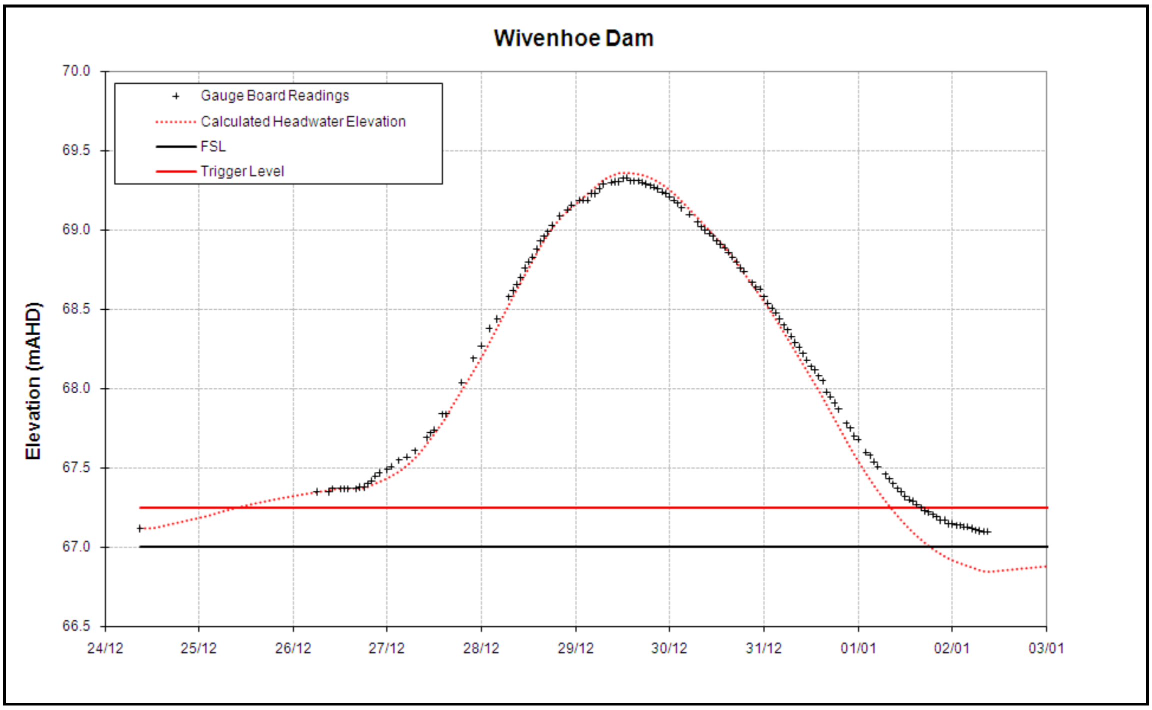
The modelled flows at the key locations of Somerset Dam, Wivenhoe Dam, Lockyer Creek and Bremer River are shown in the table and figures below. Adopted initial losses were 5 -10mm lower than those assessed by the API model, however, adopted continuing loss rates are within normally acceptable ranges. The figures in the following table are calculated values and may not be exactly the same those determined post-flood and reported in the Event Data section of this report.

Location	Calculated	Date/Time	Value	Unit
Somerset Dam	Peak Inflow	27/12/2010 16:00	532	m^3/s
	Peak Water Level	28/12/2010 12:00	99.99	m AHD
	Inflow Volume		127,072	ML
	Peak Outflow	29/12/2010 04:00	818	m^3/s
	Outflow Volume		151,854	ML
Wivenhoe Dam	Peak Inflow	28/12/2010 05:00	1,681	m^3/s
	Peak Water Level	29/12/2010 13:00	69.36	m AHD
	Inflow Volume		555,822	ML
	Peak Outflow	31/12/2010 02:00	1,591	m^3/s
	Outflow Volume		488,992	ML
Lowood	Peak Flow including Wivenhoe	30/12/2010 08:00	1,739	m^3/s
	Peak Flow excluding Wivenhoe	28/12/2010 14:00	1,168	m^3/s
Moggill	Peak Flow including Wivenhoe	31/12/2010 00:00	1,808	m^3/s
	Peak Flow excluding Wivenhoe	29/12/2010 05:00	1,453	m^3/s





Initially the model overestimates the inflow to Somerset Dam and, as a result, overestimates the initial rise in water level. This suggests the adopted initial loss is too low. Additionally, the adopted scale factor suggests the rainfall input is also low. However, timing of the peaks is reasonable which suggests the adopted model routing parameters are appropriate. Modelled water levels are within 100mm of actual levels over the entire duration of the Event.



Overall, the shape and volume of the inflow is satisfactory. The timing of the modelled water level is accurate suggesting the storage factors (Kc and/or m) are appropriate, as well as the loss and scale parameters. The recession falls away too quickly suggesting there is more runoff late in the Event from either unrecorded rainfall or additional baseflow. Modelled water levels are generally within 100m of actual recorded levels over the critical periods up to and well after the peak of the flood.

5.8 Conclusion

The performance of the hydrologic models during these Events is considered to be satisfactory given modelled water levels are within acceptable limits to the observed water levels at the Dams during the Events. There may be scope for further investigation of loss and routing parameters in smaller events. Additionally, the parameters in the baseflow model could be refined to better match the modelled recessions.

6. MANAGEMENT STRATEGIES FOR THE FLOOD EVENT

6.1 October 2010 Flood Event

The table below shows the mobilisation time and flood event commencement time for the October 2010 Flood Event.

Flood Event	Mobilisation Time	Flood Release Commencement
October 2010	06:30 - 09 October 2010	19:00 - 09 October 2010

The October 2010 Flood Event impacted Somerset and Wivenhoe Dams between Saturday 9 October 2010 and Tuesday 19 October 2010. The Event had an Annual Exceedance Probability [AEP] of less than 1 in 50 and can be categorised as a frequent flood event according to the Institution of Engineers Australia (Engineers Australia) national guidelines for the estimation of design flood characteristics (AR&R). .

The inflow into Somerset Dam during the Event is characterised by a single peak of approximately 2,860m^3/s at 12:00 on Monday 11 October 2010. The peak of the outflow of 1,135m^3/s occurred at 14:00 on Tuesday 12 October 2010 while the Dam's maximum water level of 101.37m AHD was also reached in the early morning of the same day.

Similarly, the inflow into Wivenhoe Dam is characterised by a single peak of approximately 3,000m^3/s on the afternoon of Monday 11 October 2010. The peak of the outflow of 1,493m^3/s occurred three days later in the early hours of Thursday 14 October 2010. At 04:00 on the same day, Wivenhoe Dam's maximum water level of 69.61m AHD was also reached.

Relevant event statistics are shown in the table below:

Location	Calculated	Date/Time	Value	Unit
Somerset Dam	Peak Inflow	11/10/2010 16:00	2,556	m3/s
	Peak Water Level	12/10/2010 08:00	101.32	m AHD
	Inflow Volume		281,963	ML
	Peak Outflow	12/10/2010 08:00	1,127	m3/s
	Outflow Volume		278,345	ML
Wivenhoe Dam	Peak Inflow	12/10/2010 09:00	2,729	m3/s
	Peak Water Level	13/10/2010 12:00	69.65	m AHD
	Inflow Volume		663,818	ML
	Peak Outflow	14/10/2010 04:00	1,508	m3/s
	Outflow Volume		933,116	ML
Lowood	Peak Flow including Wivenhoe	14/10/2010 10:00	1,638	m3/s
	Peak Flow excluding Wivenhoe	12/10/2010 05:00	335	m3/s
Moggill	Peak Flow including Wivenhoe	15/10/2010 02:00	1,667	m3/s
	Peak Flow excluding Wivenhoe	12/10/2010 14:00	565	m3/s

Generally, the hydrologic models appear to have satisfactorily reproduced the inflows to Somerset and Wivenhoe Dams during this Event. This flood was managed primarily to minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers. There were no known adverse impacts to urban areas downstream of Moggill as a result of the Flood Event.

Strategy W1 was used to manage the event at Wivenhoe Dam until the dam level exceeded 68.5m AHD, then Strategy W3 was used because the conditions for using Strategy W2 could not be satisfied. Strategy S2 was used to manage the event at Somerset Dam.

Clear flood mitigation benefits provided by Wivenhoe Dam during the Event included preventing the inundation of Mt Crosby Weir Bridge and reducing the peak flow in the Brisbane River at Moggill from a potential flow of 3,000m^3/s to an actual flow of around 1,500m^3/s. Damage tables supplied by the Brisbane City Council indicate a flow of 3,000m^3/s at Moggill could cause damage in the Brisbane area with a repair cost exceeding $5 million.

6.2 December 2010 Flood Events

The table below shows the mobilisation times and flood event commencement times for each of the December 2010 Flood Events.

Flood Event	Mobilisation Time	Flood Release Commencement
Early December 2010	07:00 - 11 December 2010	12:30 - 13 December 2010
Mid December 2010	10:00 - 17 December 2010	18:00 - 17 December 2010
Late December 2010	05:30 - 25 December 2010	09:00 - 26 December 2010

The Flood Operations Centre and the dams were appropriately staffed on a 24/7 basis from Event mobilisation to Event conclusion.

The Late December Event was the largest of the three flood events during this month, and had a similar peak inflow to and outflow from Wivenhoe Dam as the October 2010 Event. The Somerset Dam peak inflows and outflows across the three events were however significantly smaller than the October Event.

Across the three Events at Somerset Dam, the peak inflow was 1,000m^3/s and the peak outflow 820m^3/s. Across the three Events at Wivenhoe Dam, the peak inflow was 2,200m^3/s and the peak outflow 1,540m^3/s.

The December 2010 Flood Events impacted the Dams between Monday 13 December 2010 and Sunday 2 January 2011. The Events had an Annual Exceedance Probability [AEP] of less than 1 in 10 and can also be categorised as frequent flood events according to the Institution of Engineers Australia (Engineers Australia) national guidelines for the estimation of design flood characteristics (AR&R). .

Relevant event statistics are shown in the table below:

EARLY DECEMBER EVENT				
Location	**Calculated**	**Date/Time**	**Value**	**Unit**
Somerset Dam	Peak Inflow	12/12/2010 12:00	358	m^3/s
	Peak Water Level	13/12/2010 06:00	99.89	m AHD
	Inflow Volume		98,532	ML
	Peak Outflow	13/12/2010 06:00	139	m^3/s
	Outflow Volume		93,026	ML
Wivenhoe Dam	Peak Inflow	13/12/2010 12:00	178	m^3/s
	Peak Water Level	13/12/2010 14:00	67.35	m AHD
	Inflow Volume		111,218	ML
	Peak Outflow	13/12/2010 15:00	291	m^3/s
	Outflow Volume		96,470	ML
Lowood	Peak Flow including Wivenhoe	13/12/2010 21:00	340	m^3/s
	Peak Flow excluding Wivenhoe	06/12/2010 10:00	181	m^3/s
Moggill	Peak Flow including Wivenhoe	14/12/2010 13:00	355	m^3/s
	Peak Flow excluding Wivenhoe	06/12/2010 23:00	273	m^3/s

MID DECEMBER EVENT				
Location	**Calculated**	**Date/Time**	**Value**	**Unit**
Somerset Dam	Peak Inflow	20/12/2010 00:00	856	m^3/s
	Peak Water Level	20/12/2010 14:00	100.45	m AHD
	Inflow Volume		133,320	ML
	Peak Outflow	20/12/2010 14:00	413	m^3/s
	Outflow Volume		155,656	ML
Wivenhoe Dam	Peak Inflow	20/12/2010 14:00	1,847	m^3/s
	Peak Water Level	21/12/2010 03:00	68.24	m AHD
	Inflow Volume		450,885	ML
	Peak Outflow	21/12/2010 19:00	1,462	m^3/s
	Outflow Volume		372,666	ML
Lowood	Peak Flow including Wivenhoe	22/12/2010 01:00	1,658	m^3/s
	Peak Flow excluding Wivenhoe	21/12/2010 08:00	278	m^3/s
Moggill	Peak Flow including Wivenhoe	22/12/2010 17:00	1,697	m^3/s
	Peak Flow excluding Wivenhoe	20/12/2010 03:00	605	m^3/s

LATE DECEMBER EVENT				
Location	**Calculated**	**Date/Time**	**Value**	**Unit**
Somerset Dam	Peak Inflow	27/12/2010 16:00	532	m^3/s
	Peak Water Level	28/12/2010 12:00	99.99	m AHD
	Inflow Volume		127,072	ML
	Peak Outflow	29/12/2010 04:00	818	m^3/s
	Outflow Volume		151,854	ML
Wivenhoe Dam	Peak Inflow	28/12/2010 05:00	1,681	m^3/s
	Peak Water Level	29/12/2010 13:00	69.36	m AHD
	Inflow Volume		555,822	ML
	Peak Outflow	31/12/2010 02:00	1,591	m^3/s
	Outflow Volume		488,992	ML
Lowood	Peak Flow including Wivenhoe	30/12/2010 08:00	1,739	m^3/s
	Peak Flow excluding Wivenhoe	28/12/2010 14:00	1,168	m^3/s
Moggill	Peak Flow including Wivenhoe	31/12/2010 00:00	1,808	m^3/s
	Peak Flow excluding Wivenhoe	29/12/2010 05:00	1,453	m^3/s

Generally, it appears the hydrologic models satisfactorily reproduced the inflows to Somerset and Wivenhoe Dams during this Event. The flood events were managed primarily to minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers. There were no known adverse impacts to urban areas downstream of Moggill as a result of the December Events.

Strategy W1 was used to manage the events at Wivenhoe Dam until the dam level exceeded 68.5m AHD, then Strategy W3 was used because the conditions for using Strategy W2 could not be satisfied. Strategy S2 was used to manage the events at Somerset Dam.

7. CONCLUSIONS AND RECOMMENDATIONS

Seqwater is required to report on the effectiveness of the operational procedures contained in the Manual after each flood event. Generally the Manual's procedures were able to be applied very effectively during the October 2010 and the December 2010 Flood Events.

The October and December Events were of a scale that allowed the Manual's procedures to be used to safely contain the floods within the Dam. Any significant downstream urban damage was prevented, while the impact on rural areas downstream of the Dams was minimised.

Seqwater received a number of complaints from various stakeholders downstream of the Dams during and after the October and December Flood Events. Stakeholders suggested more water should be retained in the Dams during flood events to further minimise rural impacts (particularly in relation to bridge closures). Seqwater believes adopting this approach could potentially increase the risk of significant impacts occurring to urban areas below Moggill in a large flood event, and therefore does not recommend this approach be adopted.

Overall, the Manual continues to be an appropriate document to guide operational decision-making for flood events of the size experienced in October 2010 and December 2010.