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STATE WATER PROJECTS



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

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MENT OF NATURAL RESOURCES

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

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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 m AHD.

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	<ul style="list-style-type: none">• SEQWB may wish to consider formal access to BoM weather briefings prior to and during major heavy rainfall weather events.
2	9.2.2	<ul style="list-style-type: none">• A mechanism needs to be found to ensure the maximum availability of ALERT station #2168, David Trumpy Bridge²• Radio communication from Somerset Dam need to be improved as a matter of priority.
3	9.2.4	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> The rating curves for a number of stations downstream of Wivenhoe Dam need to be reviewed to ensure consistency between the stations.
7	17	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Consideration should be given to the operation of Somerset Dam in the event of no or minimal inflows into Wivenhoe Dam.
12	18.5	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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: Somerset³

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 m³/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 m³/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 m³/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 (\approx 1.0 metre rise) and North Pine (\approx 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 (FSL 67.0 m)	64.02	75.4	43	35	47	150	112	Inclusive of Somerset catchment
			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.

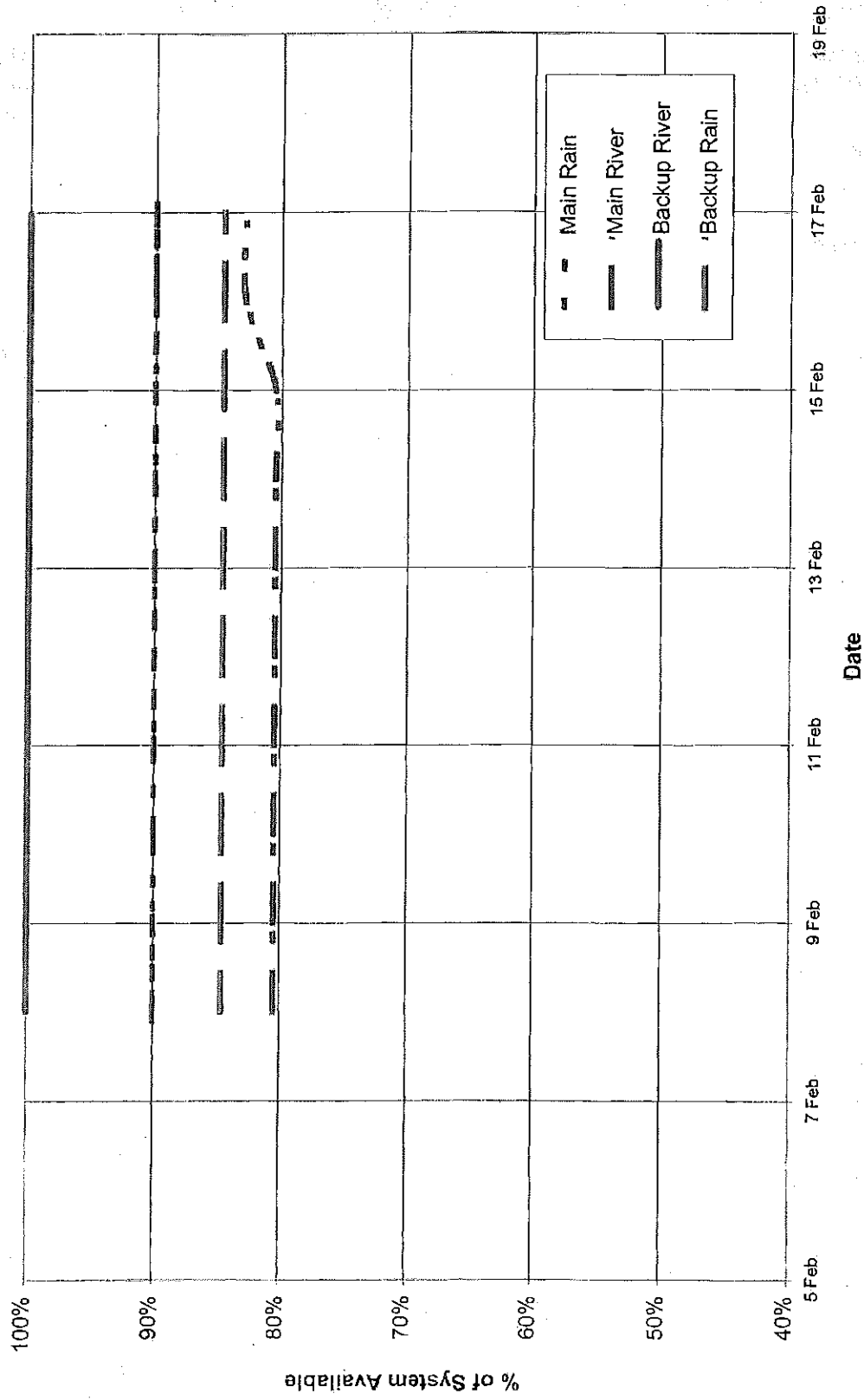
9.2.2 Performance of ALERT Stations during the February 1999 Event

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

Performance of SEQWB ALERT System
8 February 1999 - 17 February 1999



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 Somerset Dam
- #6593 headwater &
- #6594 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 Lowood (A) &
- 6650 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.

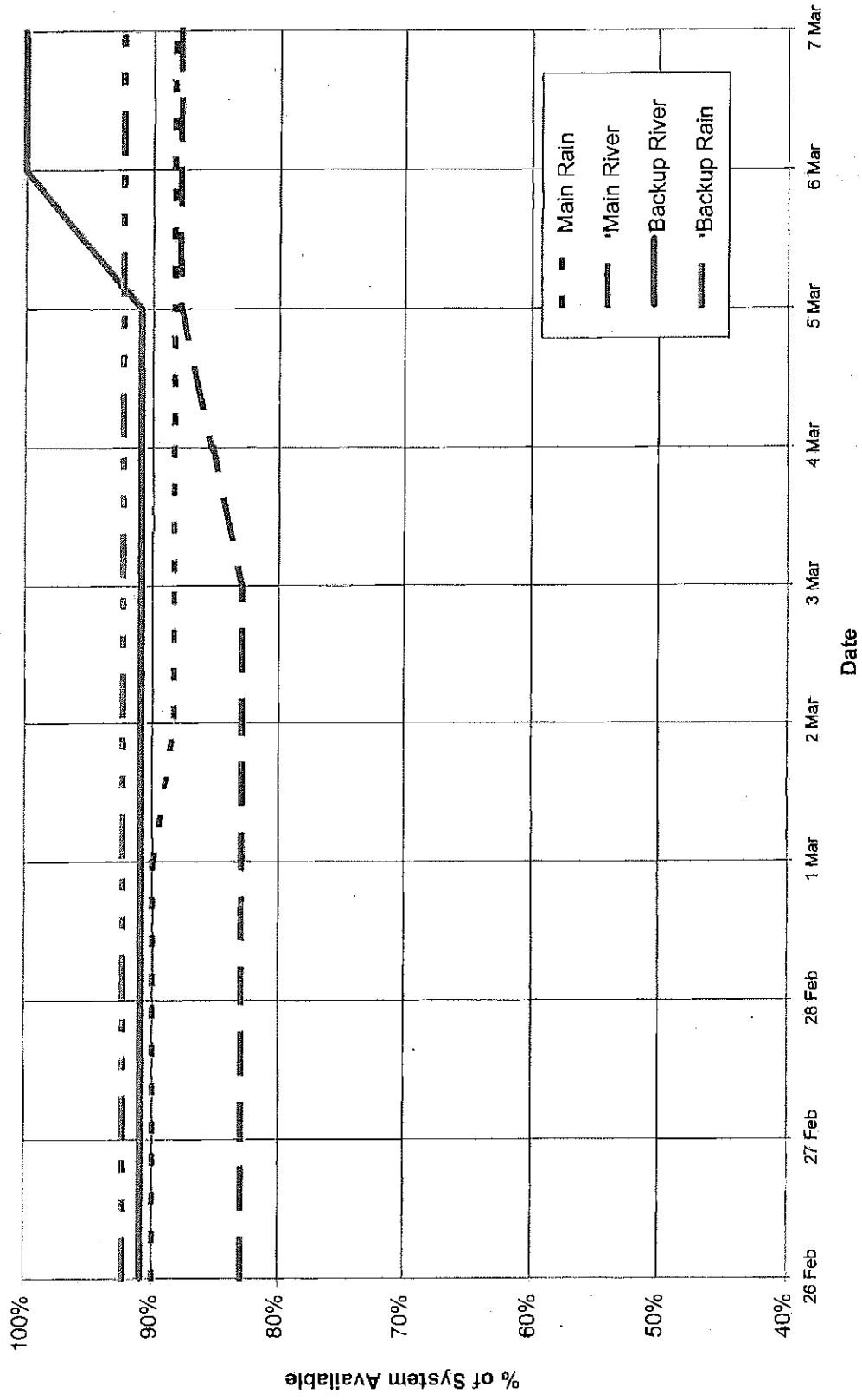
The overall station availability might have been lower but for some preventative maintenance of the ALERT station batteries. During the February 1999 event, when it was thought Cyclone Rona might head down the coast and generate a second flood, DNR requested that SEQWB check the batteries at each station.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

Performance of SEQWB ALERT System
26 February 1999 - 7 March 1999



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	76	- 16%
		#6649	68	- 25%
Moogerah Dam	116	#6623 Tarome	110	- 5%
Mt Mee	158	#6690	123	- 22%
		#6701	123	- 22%
Peachester Woodford Rd	275	#6775	197	- 28%
Pechey Forestry	108	#6511 Mt Pechey (A)	95	- 12%
		#6513 Mt Pechey (B)	95	-
Somerset Dam BVRT	60	#6593 (OOA)	-	-
		#6574 Caboonbah	96	+ 60%
		#6590 (OOA)	-	-
Tarome	121	#6623	110	- 9%
Toogoolawah PO	97	#6604	93	- 4%
Yarraman PO	60	#6540	37	- 38%
Crows Nest	97	#6596	75	- 23%
Long Pocket CSIRO	81	#6730 Jindalee	153	+ 89%
Wivenhoe Dam	87	#6639	87	0
		#6636	44	- 49%
		#6641	82	- 6%
		#6643	84	- 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	<p>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.</p> <p>The advantage of this proposed station is that it is already the site of an existing DNR river height station.</p>

Location	Reason for Inclusion
Upstream of Kholo Bridge	<p>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.</p> <p>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 m³/sec to 550 m³/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.</p>
Upstream of Burtons Bridge	<p>Similar reasoning to Kholo with the bridge becoming trafficable when the flow drops below 250 m³/sec. Careful management is required to ensure the bridge stays open at this target discharge.</p>
Buaraba Creek	<p>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.</p> <p>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.</p>
Splityard Creek	<p>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 m³/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.</p>

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

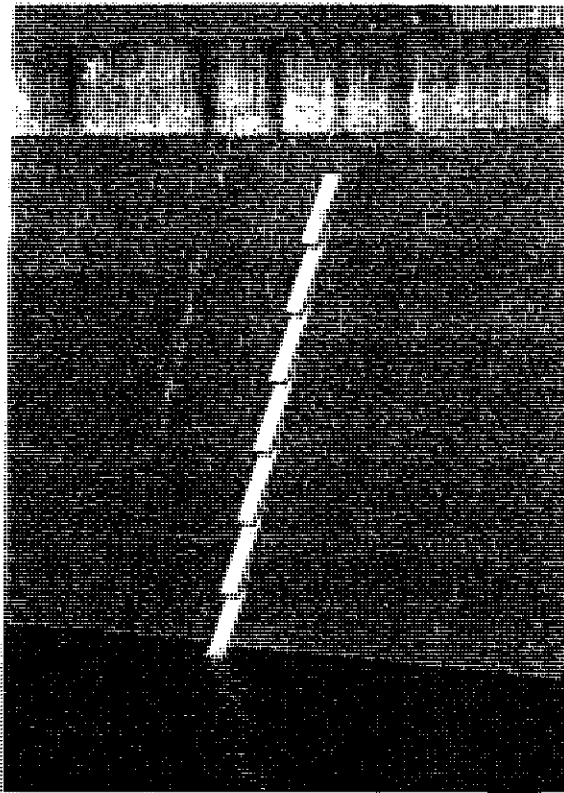


Figure 9.1 Existing Wivenhoe Dam Gauge Boards

It is recommended that a better system be devised for reading Wivenhoe Dam levels to an accuracy consistently better than $\pm 5\text{mm}$. 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 m³/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	Advice of prospective closure of Colleges Crossing (see also ICC)
Brisbane City Council	Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings. To advise of developing situation. Once it was determined that flows would be non-damaging, little further communication took place.	Dam Supervisors at North Pine Dam contacted local police about closure of downstream crossings. 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	<p>Advice of mobilisation</p> <p>Advised of operational strategy on a daily basis as per FCC Log</p> <p>Discussions were also had with SEQWB Chairman on possible options for dam operations.</p>	<p>Advice of mobilisation</p> <p>Advised of operational strategy on a daily basis as per FCC Log</p>

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 or 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 m³/sec To maintain College's Crossing open
- 250 m³/sec To maintain Burton's Crossing open
- 550 m³/sec To maintain Kholo Bridge open
- 1800 m³/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 another 150mm 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 m³/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 m³/sec) and the Lockyer (peak 950 m³/sec at O'Reilly's, 375 m³/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
8 th February	1200 hrs	Operators mobilised to site and ready for operations
		Event builds up with water levels in dams rising towards Full Supply Level
9 th 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 m ³ /sec by 1140 hrs on 12 th March as Lockyer flow decreases.

Interaction Curve - Wivenhoe & Somerset Dams

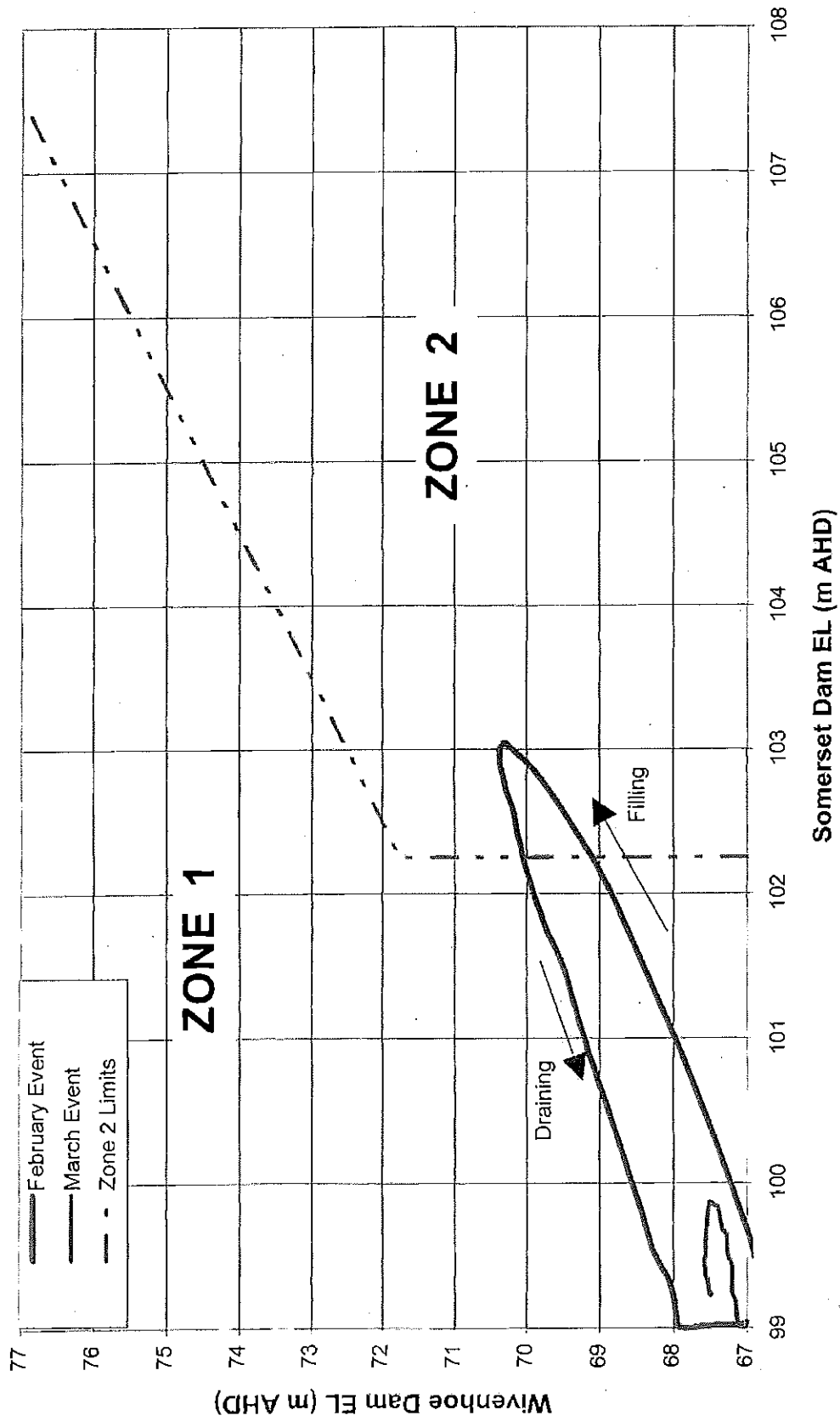


Figure 12.1

Date & Time		Activity
9 th 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.
10 th 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.
11 th February	0210 hrs	FLOODOPS runs predict need to hold release for Mt Crosby criterion until about 0000 hrs 14 th 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
11 th 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 12 th 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
14 th February commencing at 1100 hrs until 15 th 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.
15 th 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.
16 th 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 18 th . If discharge reduced, it would take until 23 rd to drain. After some discussion convinced JM to keep status quo at least until following morning.
17 th 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 18 th . Designed to bring Burton's out of water by morning.
18 th February	1900 hrs	Began final closure of Wivenhoe at 30 minute intervals. Closure completed by 2130 hrs
19 th 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

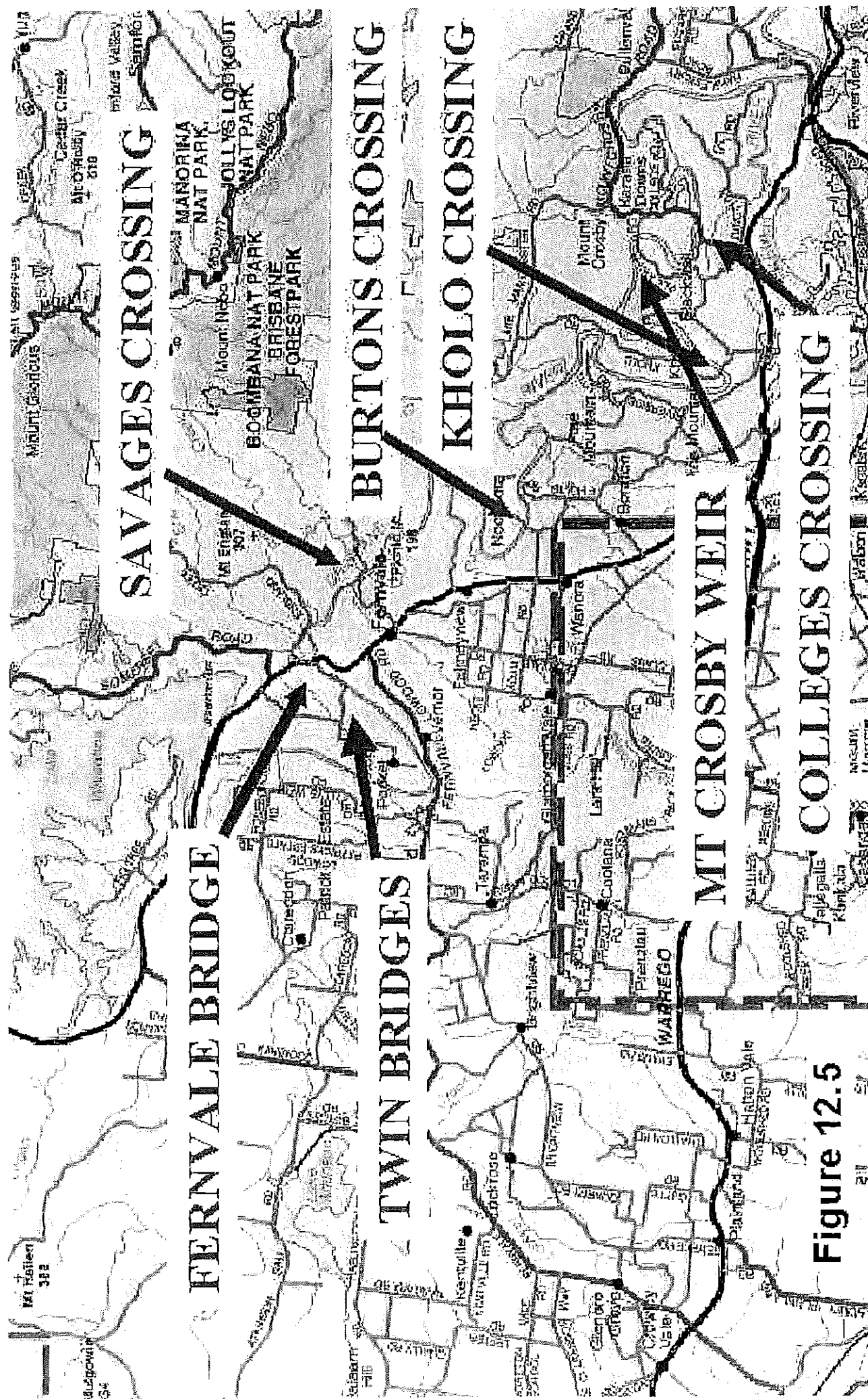
- (a) As discussed in Section 18.1, some 'experimentation' was necessary into the required gate openings for the side gates (Nos. 1 & 5) during the course of the event. It was found that the side gates had to be opened earlier than indicated in the Manual of Flood Operations to limit the impact of the 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 m³/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 shown in Figures 12.3 and 12.4, which were taken at approximately 1400 hrs on Friday 12th February.



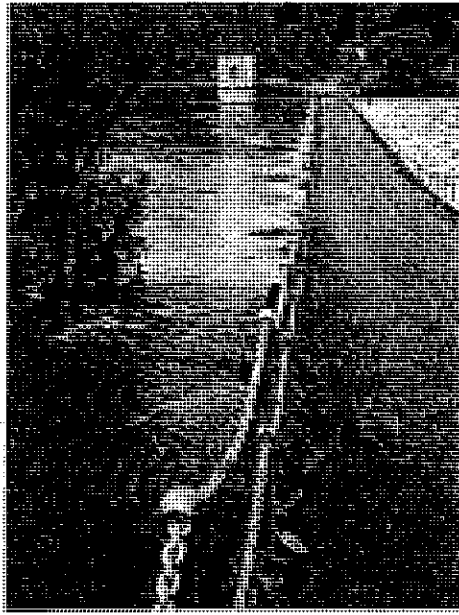


Figure 12.3 & 12.4 Mt Crosby Weir Bridge – 1400 hrs Friday 12th February
Fernvale Bridge, with an immunity of approximately 2000 m³/sec remained opened at all times during the event with a small clearance between the underside of the bridge beams and the flow. This clearance was less than 200 mm at times.

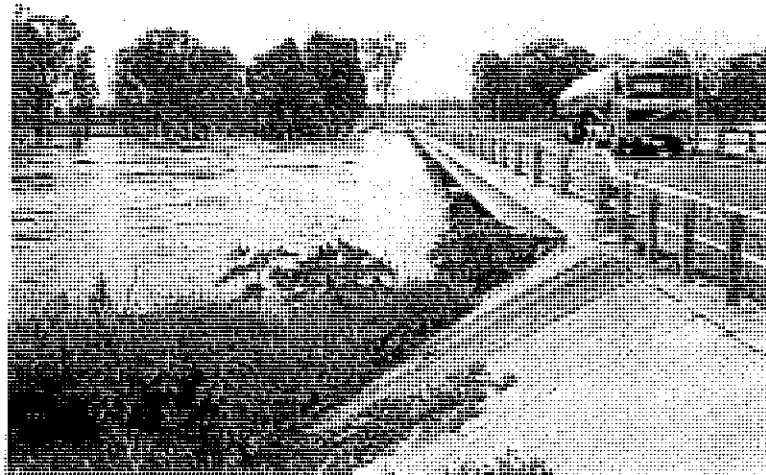


Figure 12.6 Fernvale Bridge 1430 hrs Friday 12th February

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.

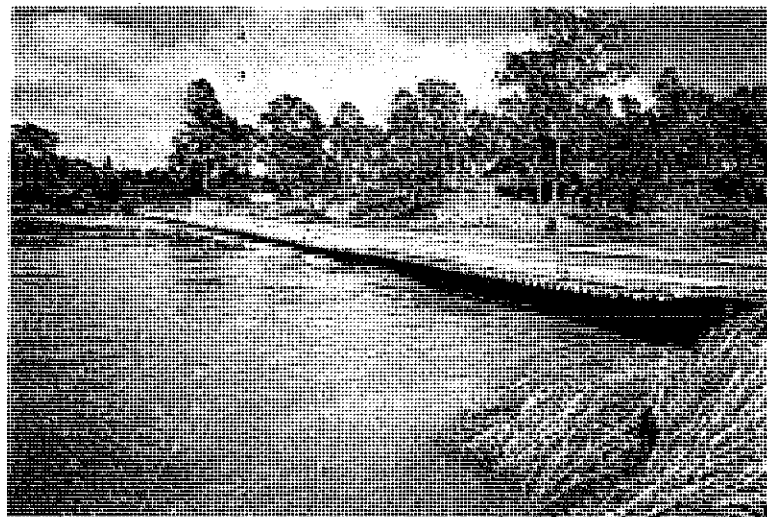


Figure 12.7 Kholo Bridge Tuesday 16th February

12.6 Discharge Strategy Development for Somerset Dam

Date & Time		Activity
8 th February	1300 hrs	Operators mobilised to site and ready for operations
9 th 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
9 th 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 9 th 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)
10 th February	1200 hrs	Wivenhoe peaks at EL 70.38 mAHD (ALERT)
11 th 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.
12 th February	2028 hrs	Sluice K opened to increase rate of draining of Somerset Dam.
13 th February	0908 hrs	Somerset regulators now above water. Tailwater EL 69.3mAHD
14 th 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.
15 th 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.
18 th 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 m³/sec.

Because the peak outflow from Lockyer Creek was approximately 135 m³/sec, the discharge from Wivenhoe was initially held at 50 m³/sec until 2030 hours on the 4th March when it was reduced to 30 m³/sec to ensure that the peak of the Lockyer would not inundate College's Crossing. Releases were then progressively increased to 170 m³/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
28 th February	2050	Initial runs of hydrological models indicate a maximum inflow of approximately 80 m ³ /sec and a reservoir rise of 0.2 metres.
1 st 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
2 nd 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.
2 nd March (continued)	1630	Dam Supervisor, Wivenhoe told to stand down for night following a final reading at 1700 hrs.
3 rd 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 17 th March to drain. (refer: Fax to SEQWB 3 rd 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.
4 th 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
5 th 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
6 th March		Ongoing monitoring of levels and discharges at Mt Crosby, O'Reilly's weir, etc. ... checking flows will not overtop College's crossing
	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
8 th 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
9 th 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.
10 th 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
10 th 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
14 th March	0930	Somerset crest gates closed, continued 24 hour releases through Somerset hydro station
15 th 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
16 th March	1300	Reduction of regulator flow to 30 m ³ /sec
18 th 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)

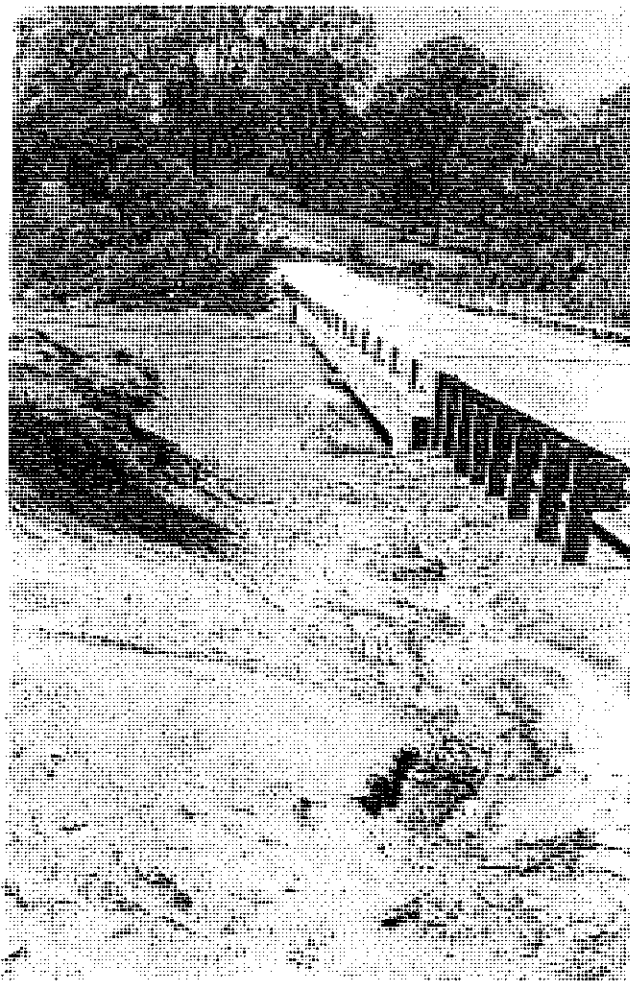


Figure 13-13.1 Colleges Crossing from Left Bank during March Event



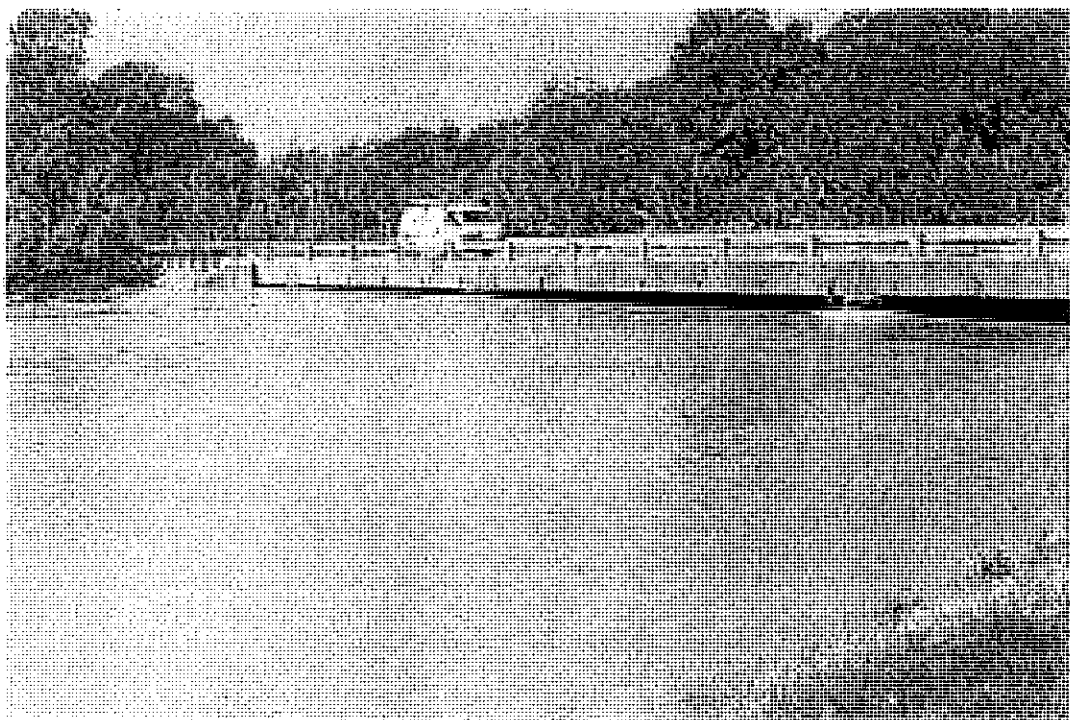


Figure 13-2 Main Span of Colleges Crossing from Upstream during March Event

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
7 th February		Heavy rain in catchment overnight with some minor rises recorded. Downloaded periodically to lap top through the night.
8 th 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
9 th 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
10 th February	0100	Rang Duty Police officer to advise of imminent NP release; Rang PSC at home & at work – no answer.
	0330	Reviewed hydrological 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
12 th 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 $16 \text{ m}^3/\text{sec}$)
	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.
13 th 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
28 th 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.
1 st 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
2 nd 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
3 rd 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
4 th 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
5 th March	0522	Gate E shut as water level falls through EL 39.56 m
5 th 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

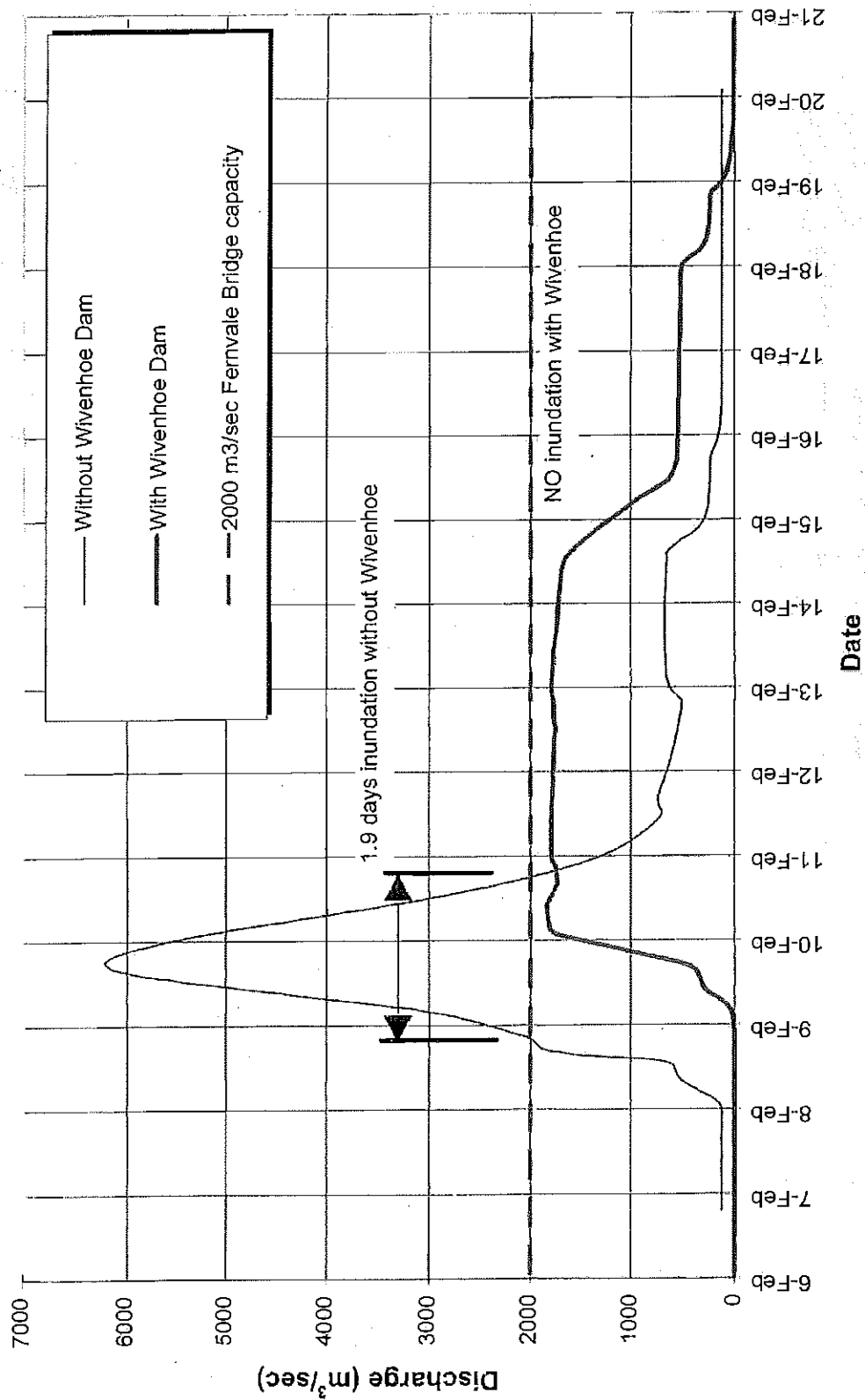
These results are typical of flood mitigation dams where the peak is mitigated but the duration is prolonged. The inundation periods for Burtons and Kholo bridges would have been marginally longer had it not been for the fact that both Wivenhoe and Somerset were significantly drawn down prior to the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

16.2 The Effect on Urban Flooding

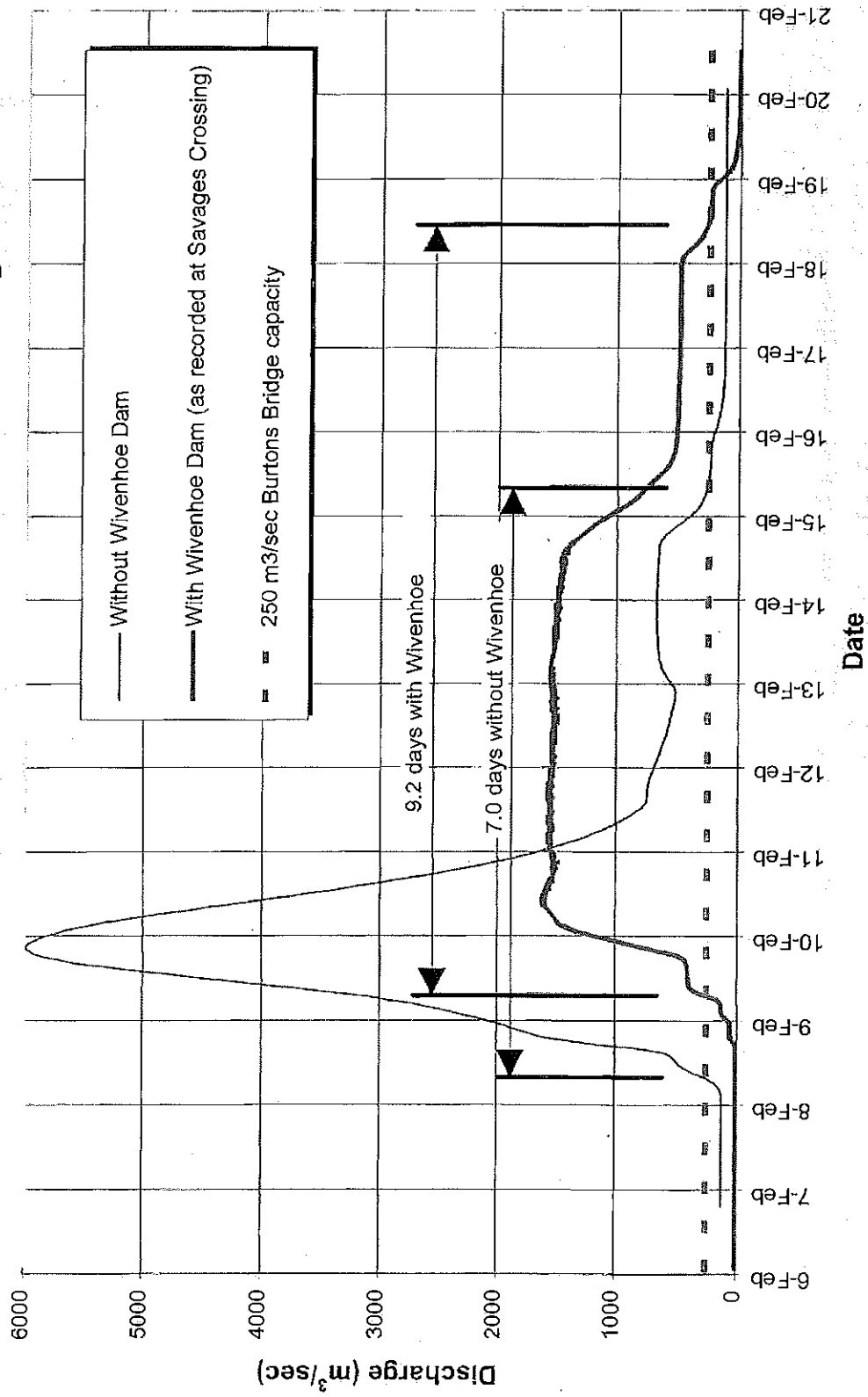
The effect of urban flooding is summarised in Figures 16.5 to 16.7. These figures provide the flood heights at Moggill, Jindalee and the Port Office gauge. Significant flood damages begin to occur in Brisbane once the discharge exceeds approximately 4000 m³/sec and the City Gauge level exceeds about 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.

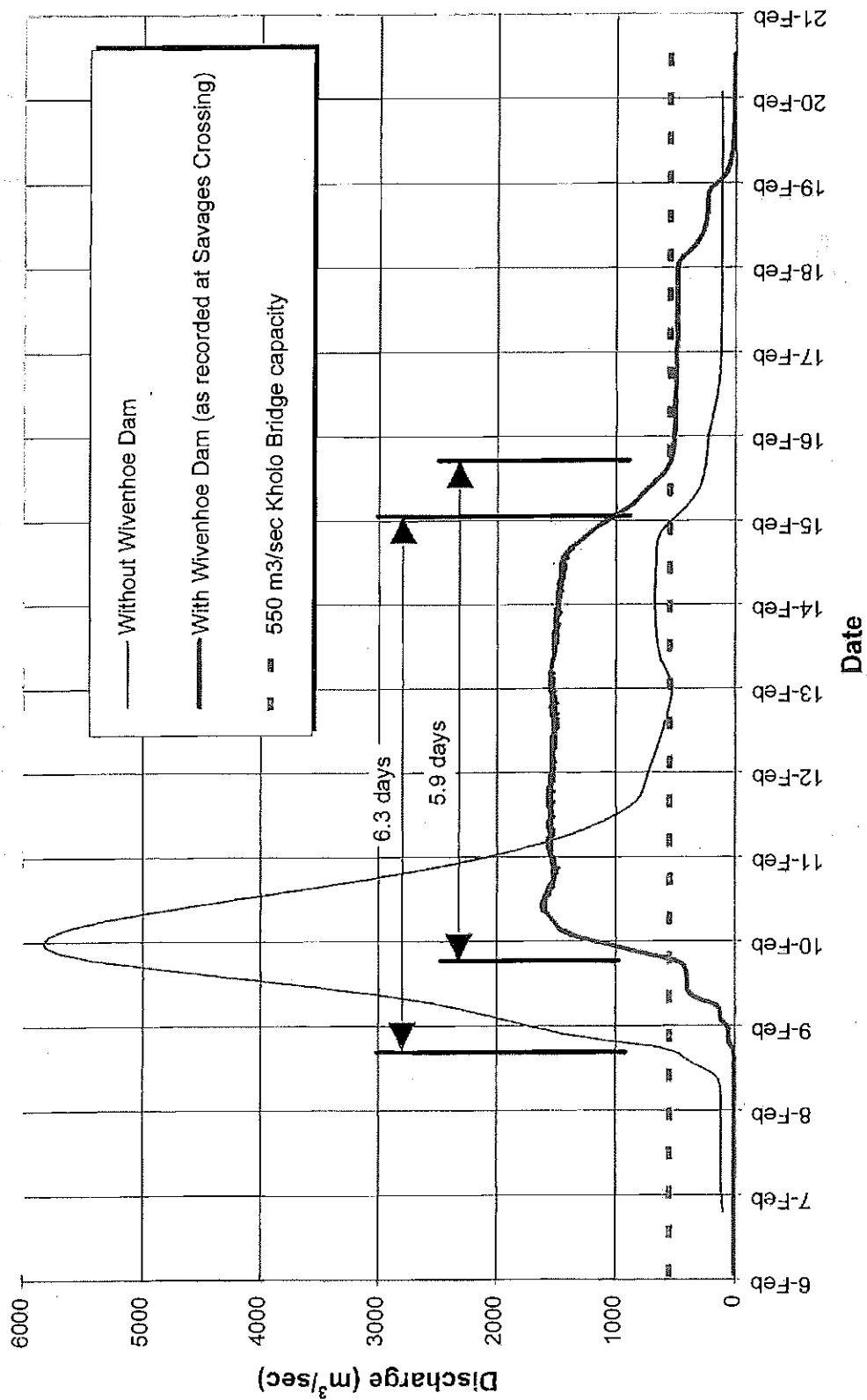
February 1999 Flood Event Comparison of Discharges at Fernvale Bridge



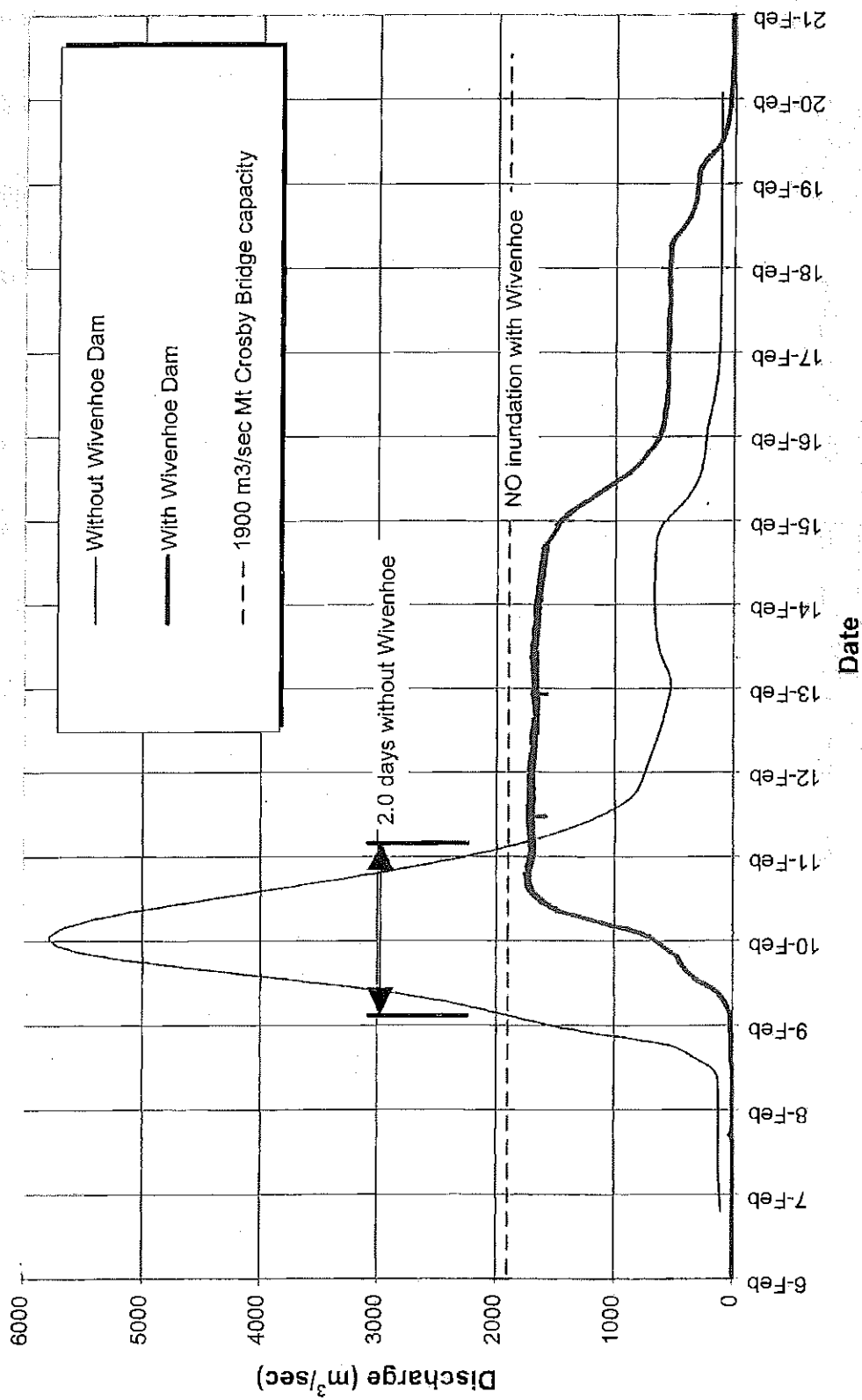
February 1999 Flood Event Comparison of Discharges at Burton's Bridge



February 1999 Flood Event Comparison of Discharges at Kholo Bridge



February 1999 Flood Event Comparison of Discharges at Mt Crosby Bridge



With Wivenhoe Dam in place the February event avoided perhaps \$100 million worth of flood damages⁷ 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 m³/sec to 550 m³/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

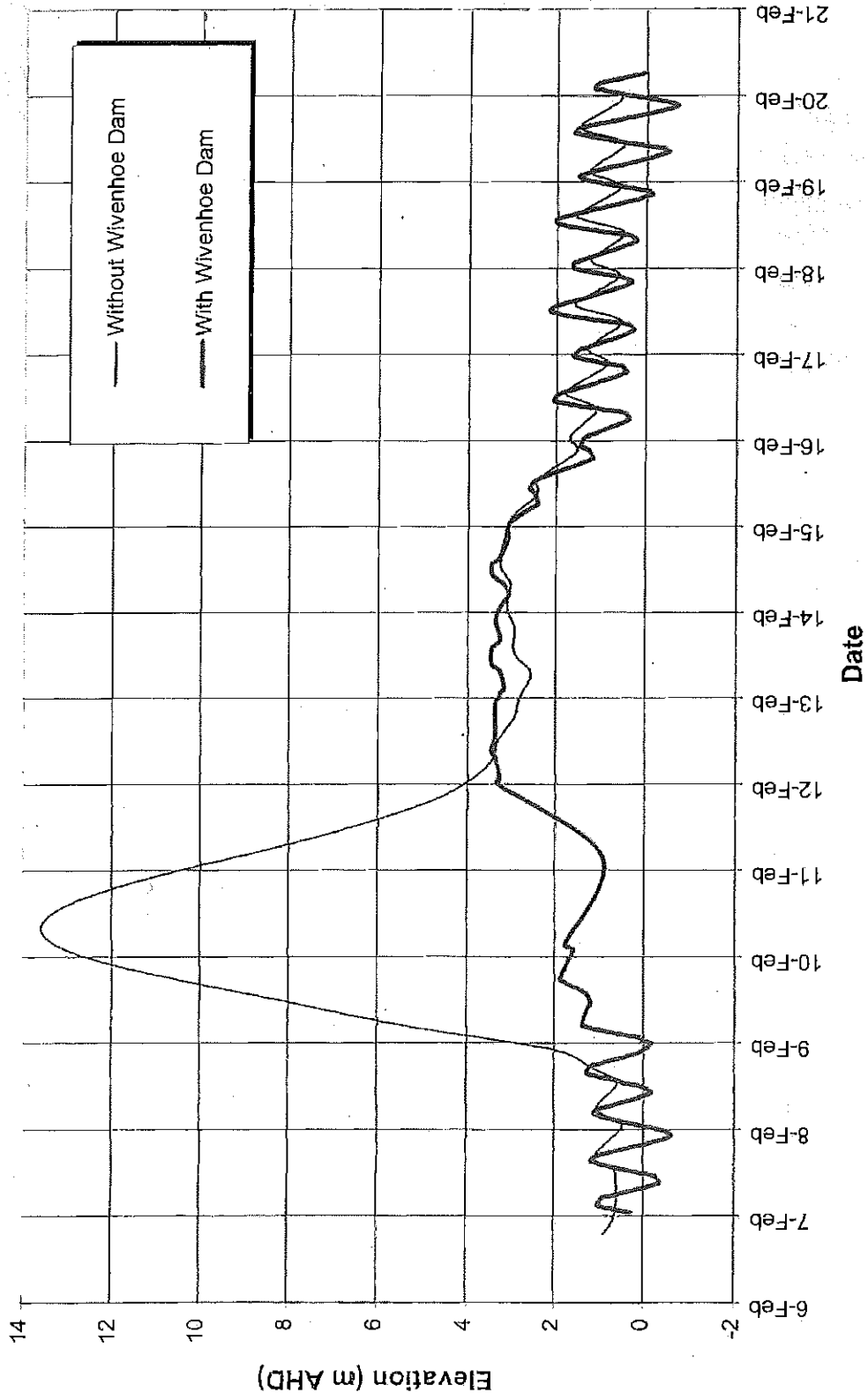
Completion of these two flood events means that consideration should now be given to the commissioning of the Real Time Flood Model. The operators of the dams now have had significant experience in the operation of the model and parts of it have performed creditably.

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:-

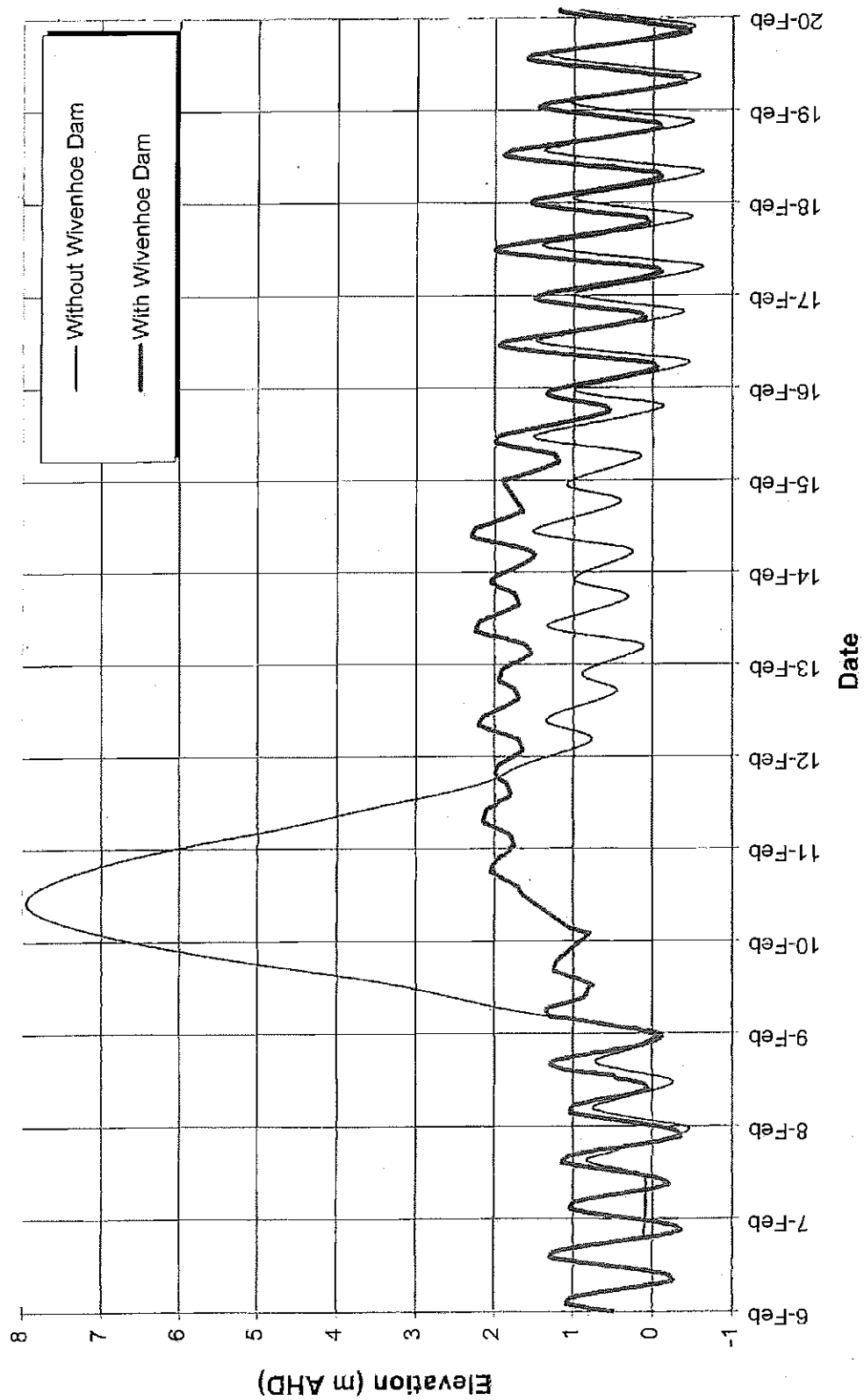
- (a) While FLOODCOL has been shown to be relatively reliable, there are still a number of 'bugs' that need to be fixed. These include the input of 'Wivenhoe Dam gate and regulator data and the soil moisture accounting models;
- (b) Arrangements need to be made for the ongoing maintenance of the Real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

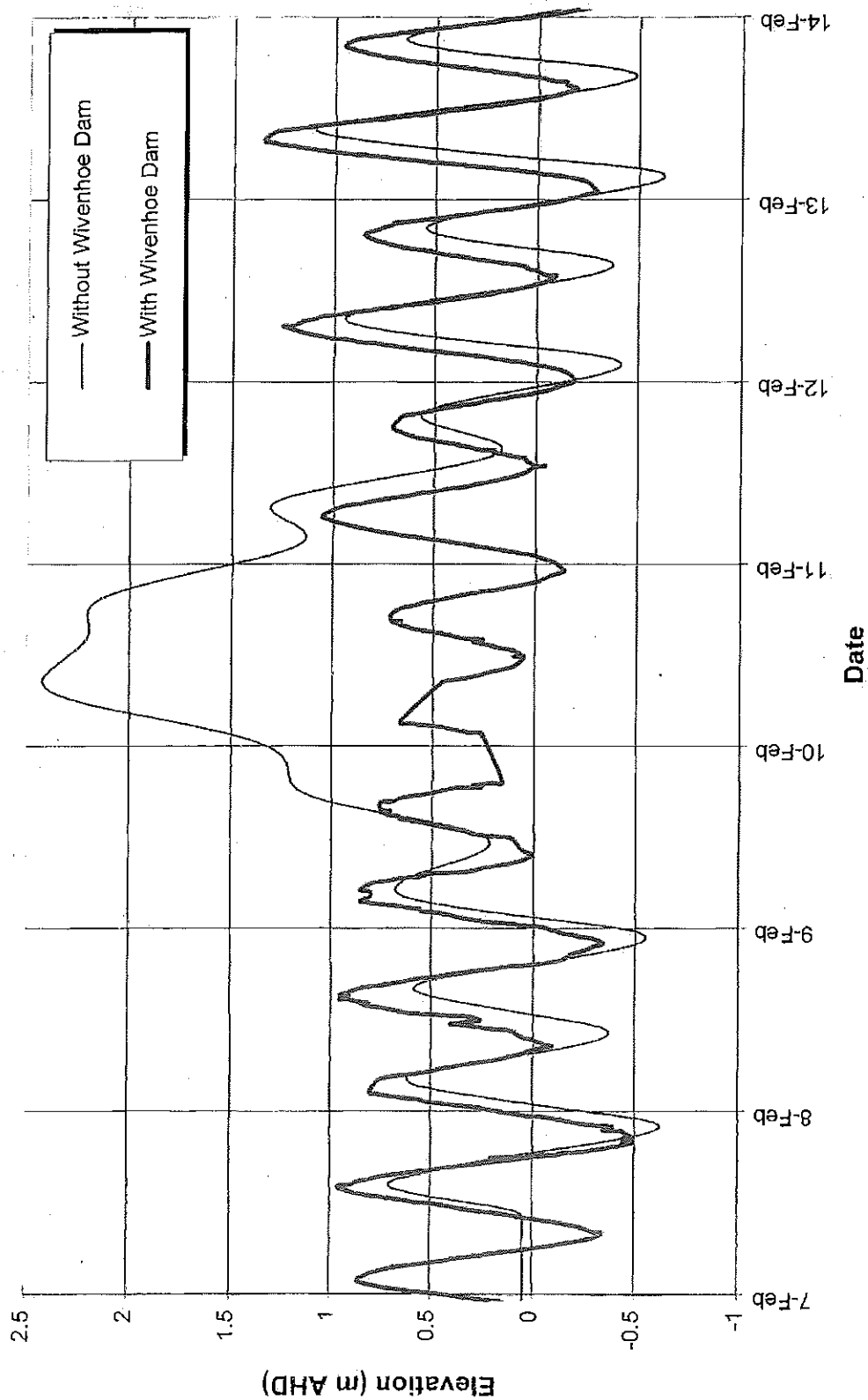
**February 1999 Flood Event
Comparison of Flood Levels at Moggill**



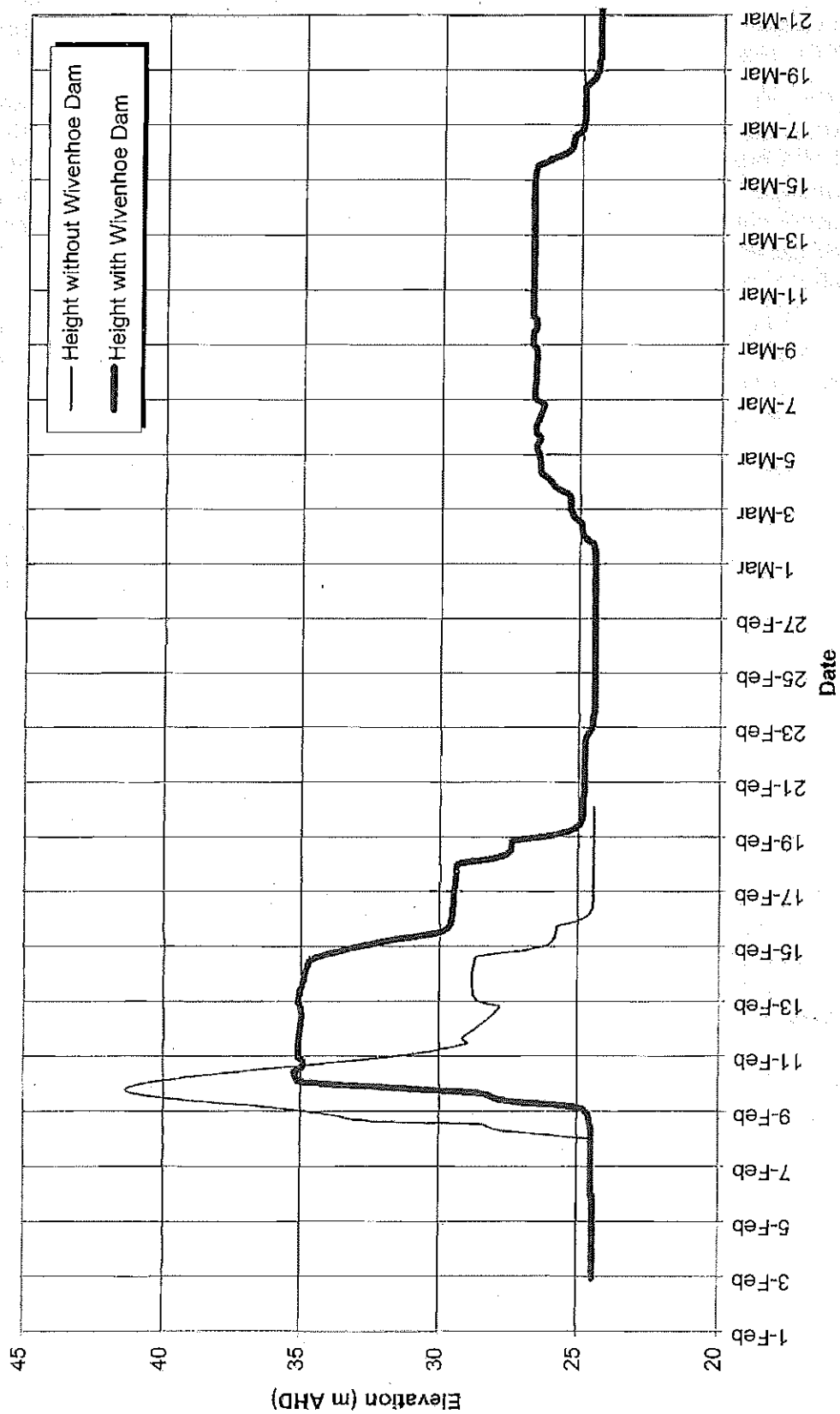
February 1999 Flood Event Comparison of Flood Levels at Jindalee



**February 1999 Flood Event
Comparison of Flood Levels at Port Office**



February & March 1999 Events Lowwood #6650 - Effect of Wivenhoe Dam



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 /OSF/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

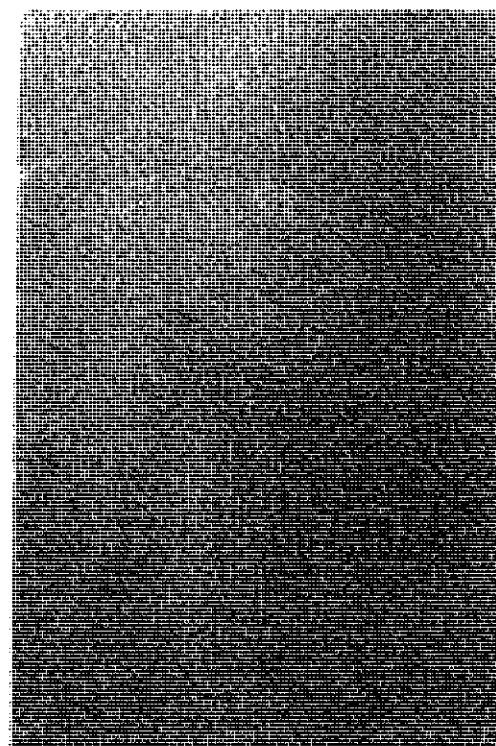
18. RECOMMENDATIONS FOR CHANGES TO THE FLOOD OPERATIONS MANUALS

18.1 Wivenhoe Dam Gate opening Sequences

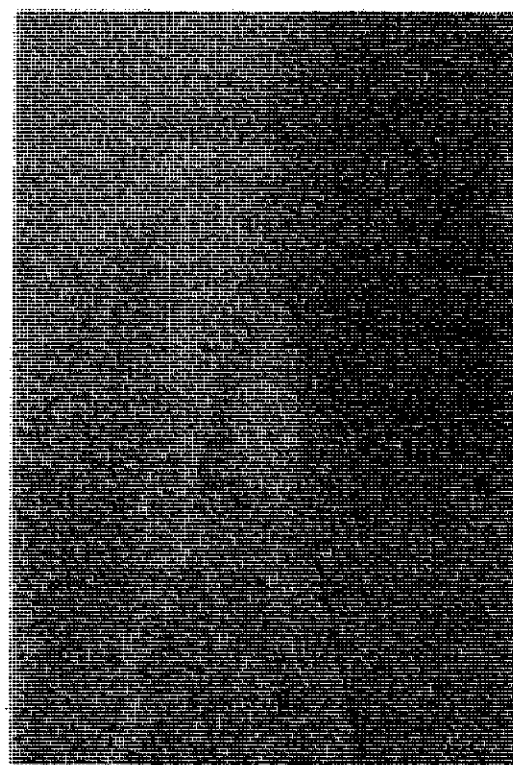
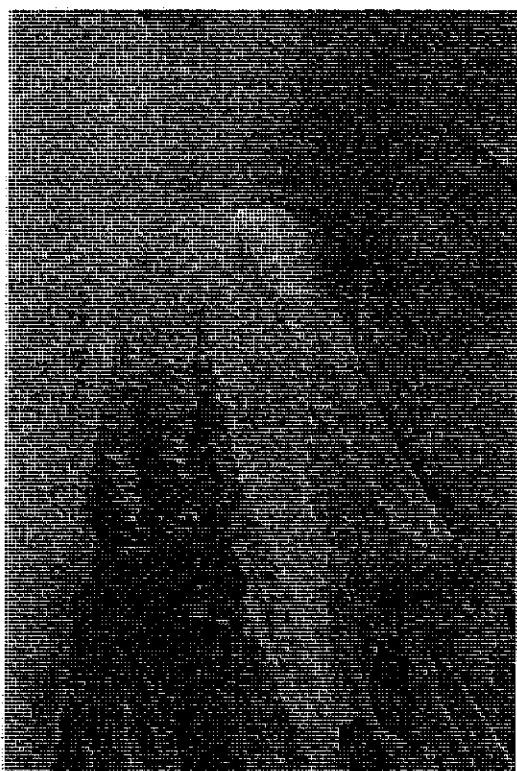
One of the principal proposed changes to the Wivenhoe Dam and Somerset Dam Manual is in the recommended gate opening sequence for Wivenhoe Dam.

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 m³/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 m³/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 m³/sec. It is also capable of pumping water out of Wivenhoe at a rate in excess of 280 m³/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

APPENDIX A

ABBRIDGED FCC EVENT LOGS

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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 Goondwindi 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 EL 64.11 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 & Warill 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 m³/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 Gato 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

APPENDIX A

ABBRIDGED FCC EVENT LOGS

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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 Gorlan 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 > 8000 @ 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 m ³ /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 see 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 m ³ /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

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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	Vin 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.

APPENDIX A

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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	17:28	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 1835 at 4:50. Likely to open another gate at 11:40 to increase discharge to 1885 with aim of 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@
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 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

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Date	Time	Action/Comment
Thu 11/02/99		102.035 (deck level of Dagular highway bridge. He asked be advised of Somerset level as it came in. PA advised him he would be visiting Femvale 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 Tiltmarsh 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) [REDACTED]
Thu 11/02/99		[REDACTED]
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	Femvale bridge is 2.26 below kerb on bridge same as at 10:30. Sevages 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	Femvale 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	Femvale 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 Tallow (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	23:08	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 m ³ /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 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 MAHD
Mon 15/02/99	17:30	Fax from Somerset (R Titmarsh) Sluice gate closed at 17:08. Lake level at EL 99.025 MAHD
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

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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 Tiltmarsh 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 Tiltmarsh (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

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Date	Time	Action/Comment
Wed 17/02/99	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	???
	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
	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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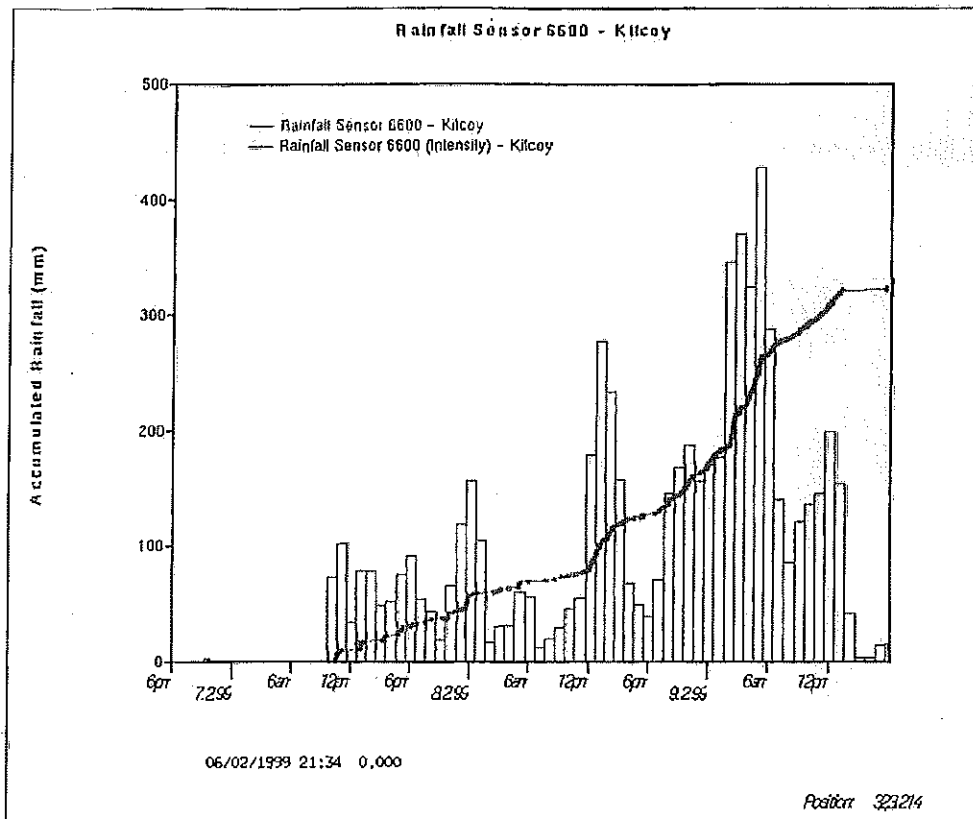
Date	Time	Action/Comment
	6:01	Wivenhoe, Doug rang; Lake EL 67.12 @ 6:00
	6:28	Somerset, Rob Titmarsh rang; Lake EL 99.01 @ 6:30
	7:00	Wivenhoe WL 67.10; Doug Grigg reports there is still 0.6m over Burton's Bridge. Request to Doug to check bridge at 9:00 AM
	7:10	Rob Titmarsh @ Somerset; Hydro station 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

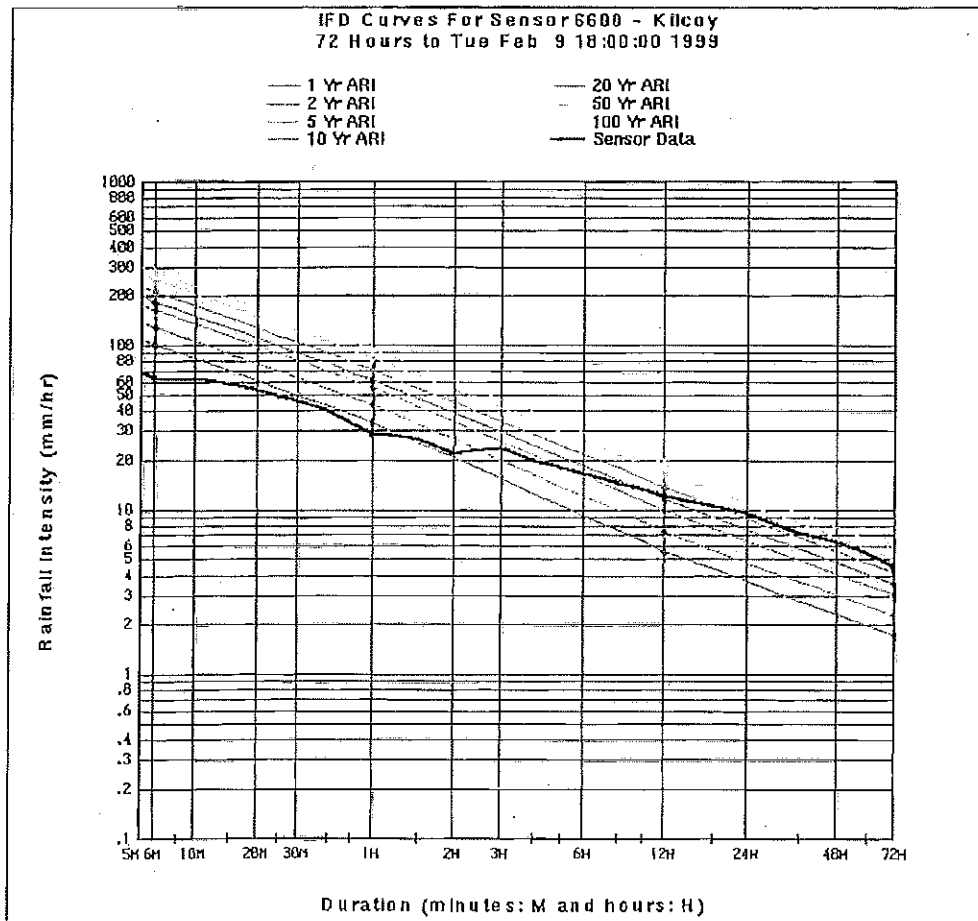
**REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR
FEBRUARY 1999 EVENT**

APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

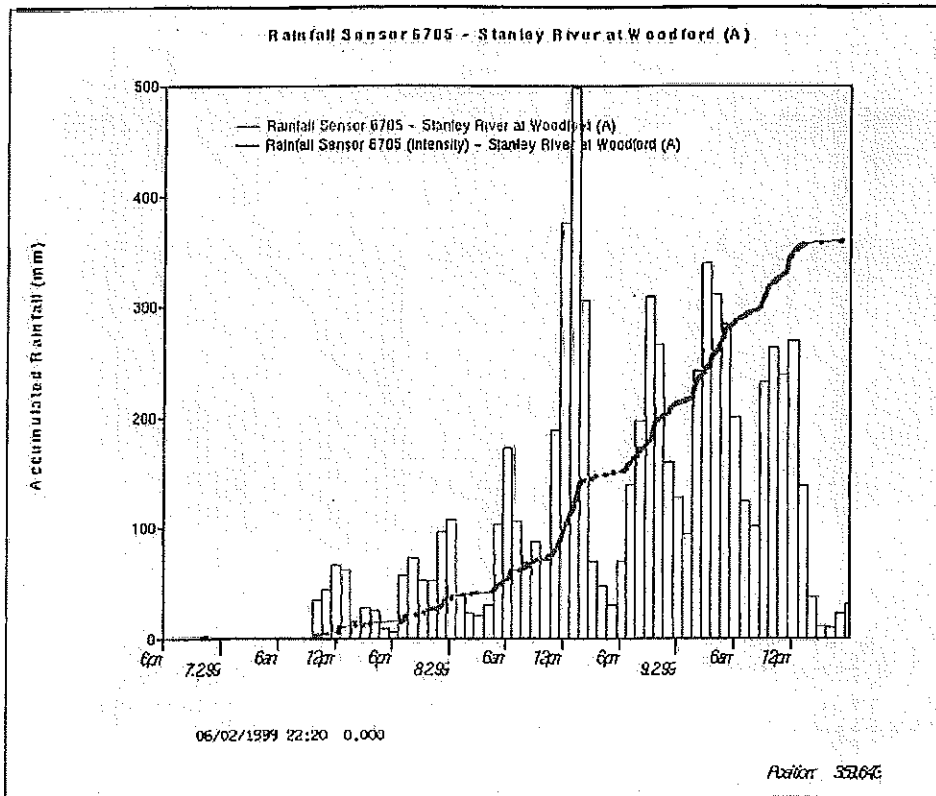


Somerset Catchment - Rainfall Sensor 6600 - Kilcoy

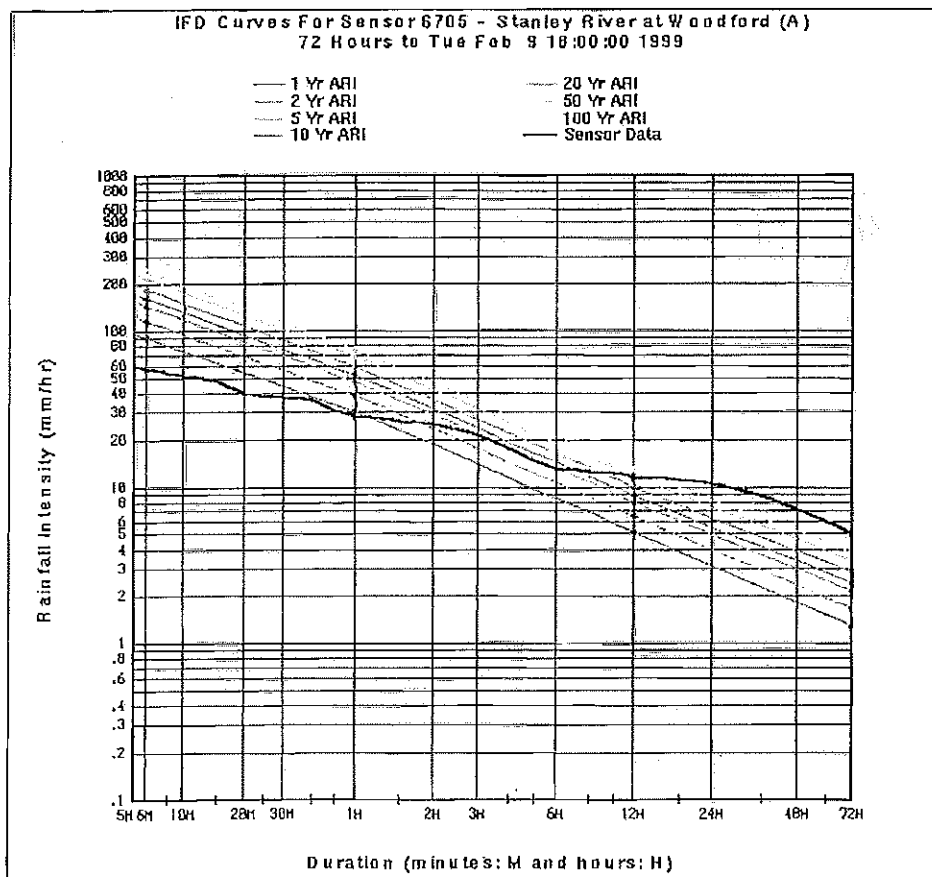


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Cumulative Rainfalls & IFD Curves for February 1999 Event

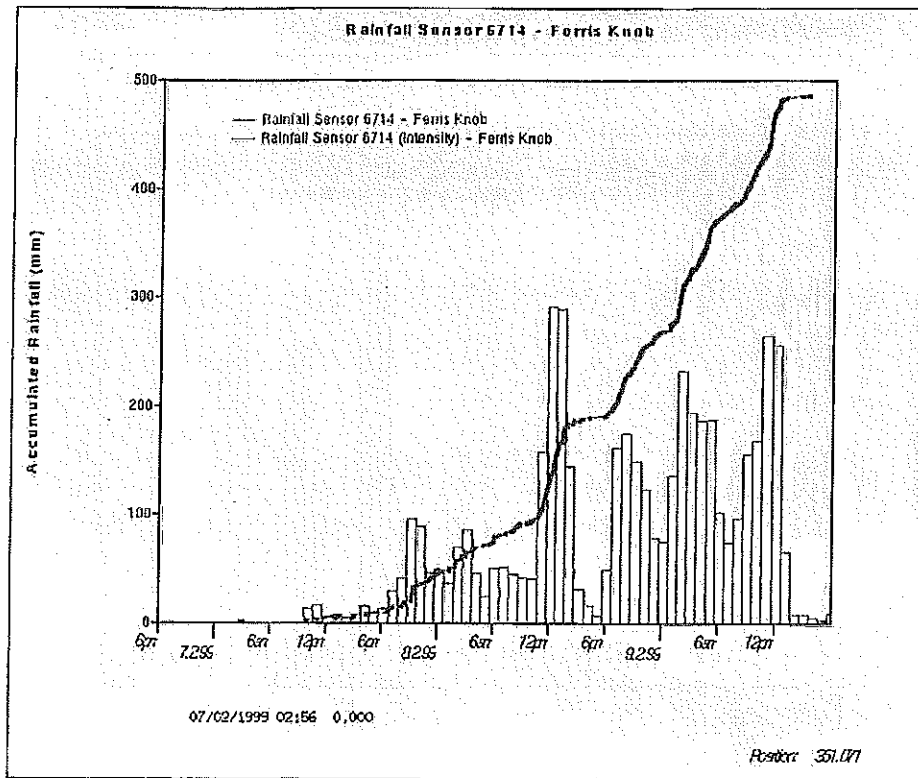


Somerset Catchment - Rainfall Sensor 6705 - Stanley River at Woodford (A)

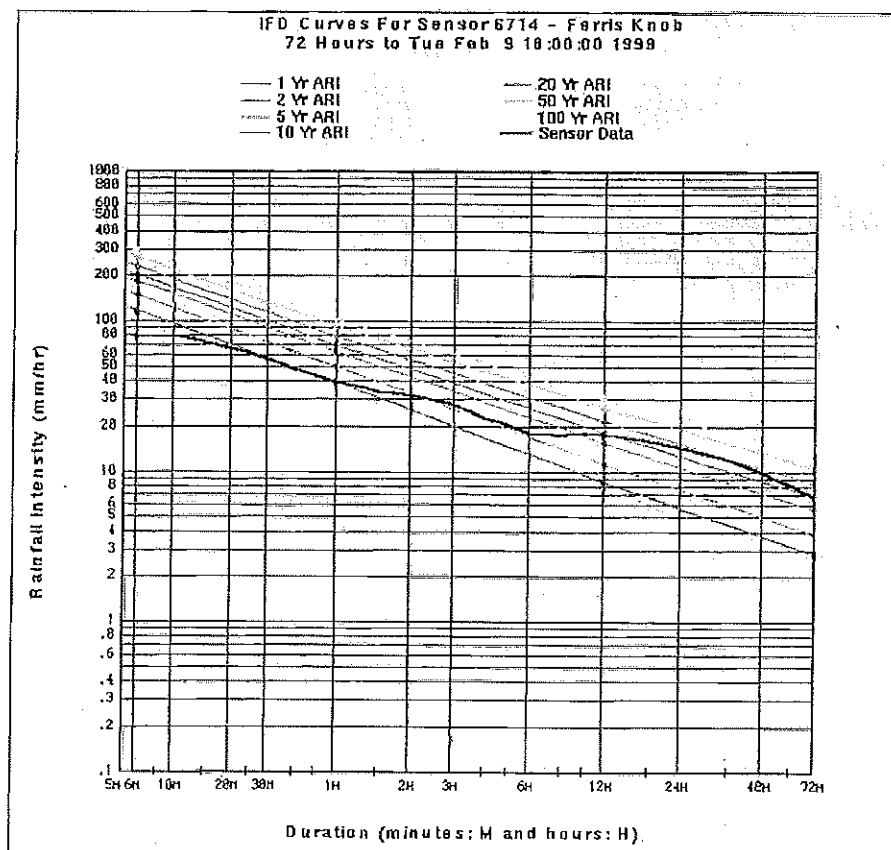


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

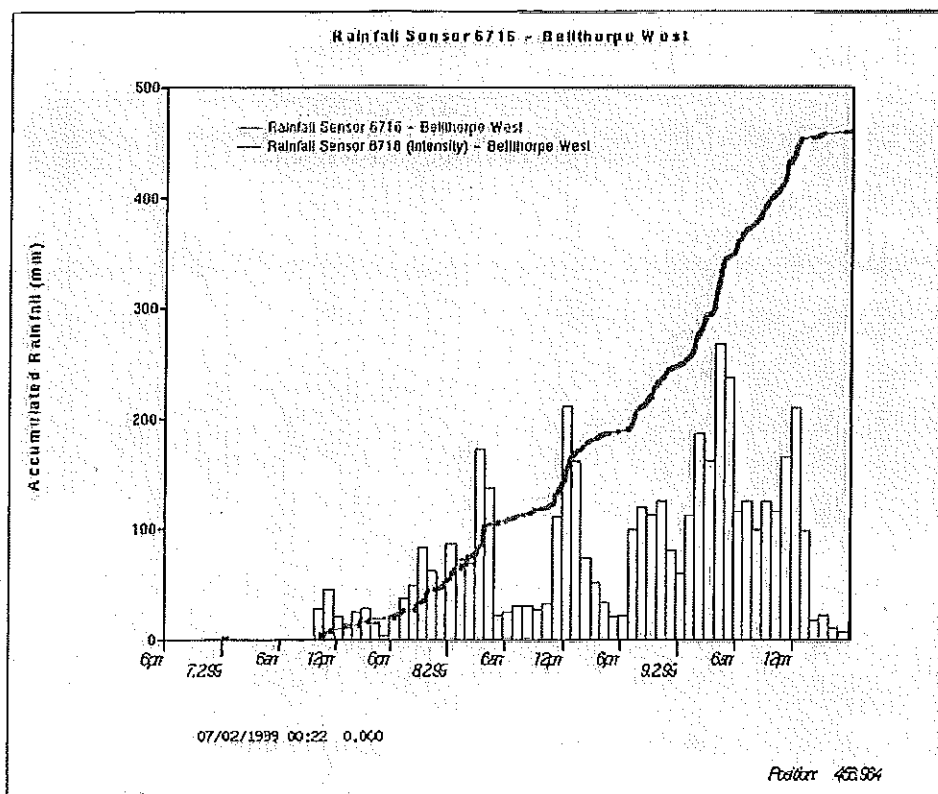


Somerset Catchment - Rainfall Sensor 6714 - Ferris Knob

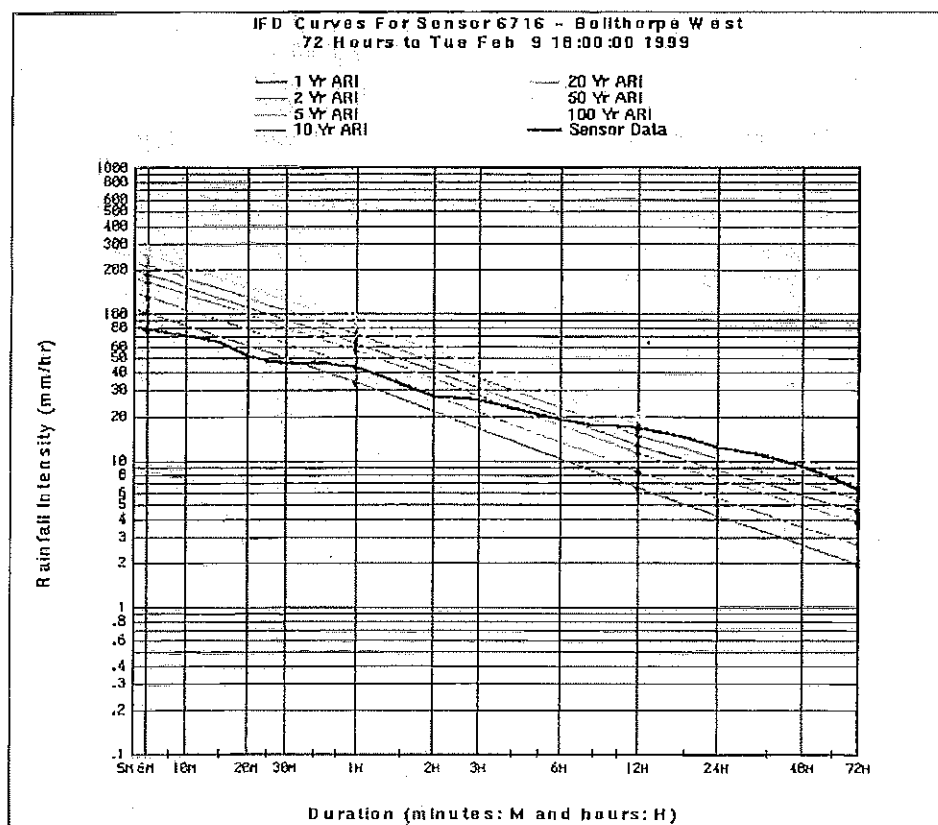


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

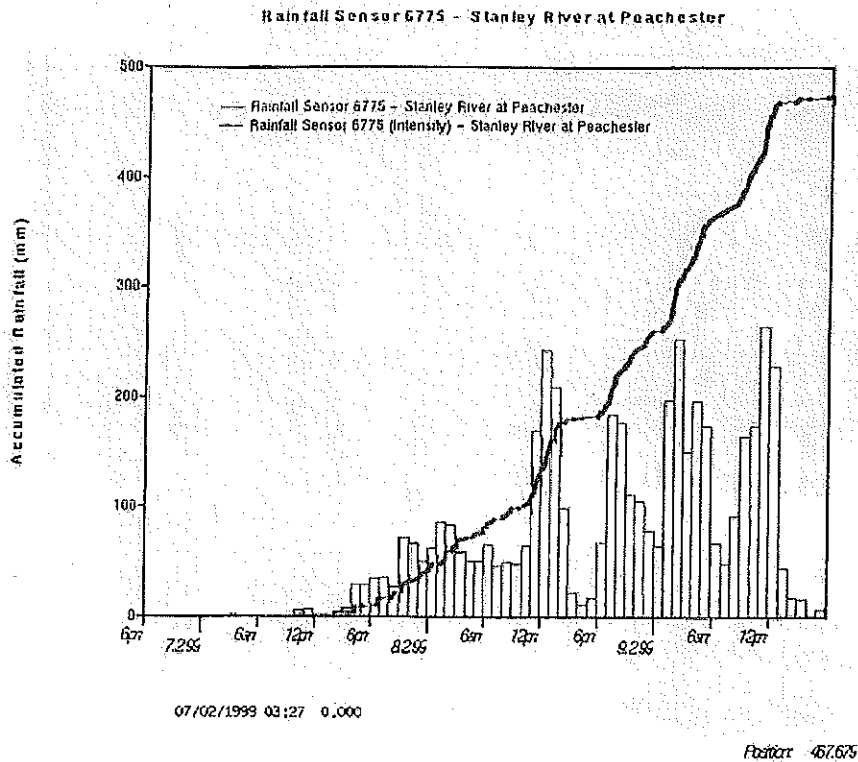


Somerset Catchment - Rainfall Sensor 6716 - Bellthorpe West

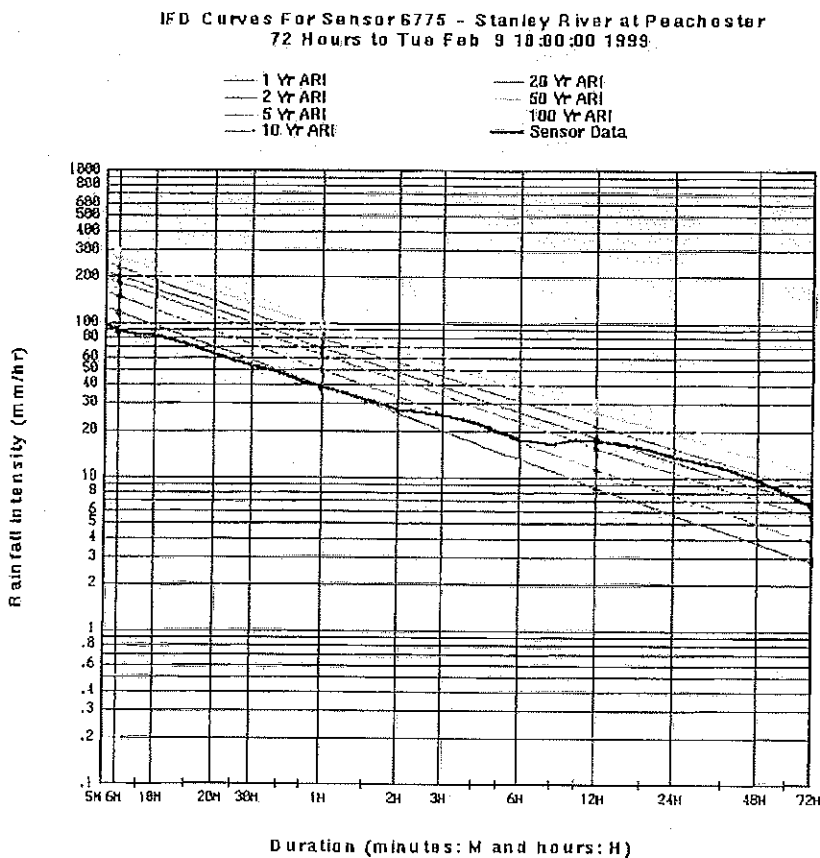


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Cumulative Rainfalls & IFD Curves for February 1999 Event

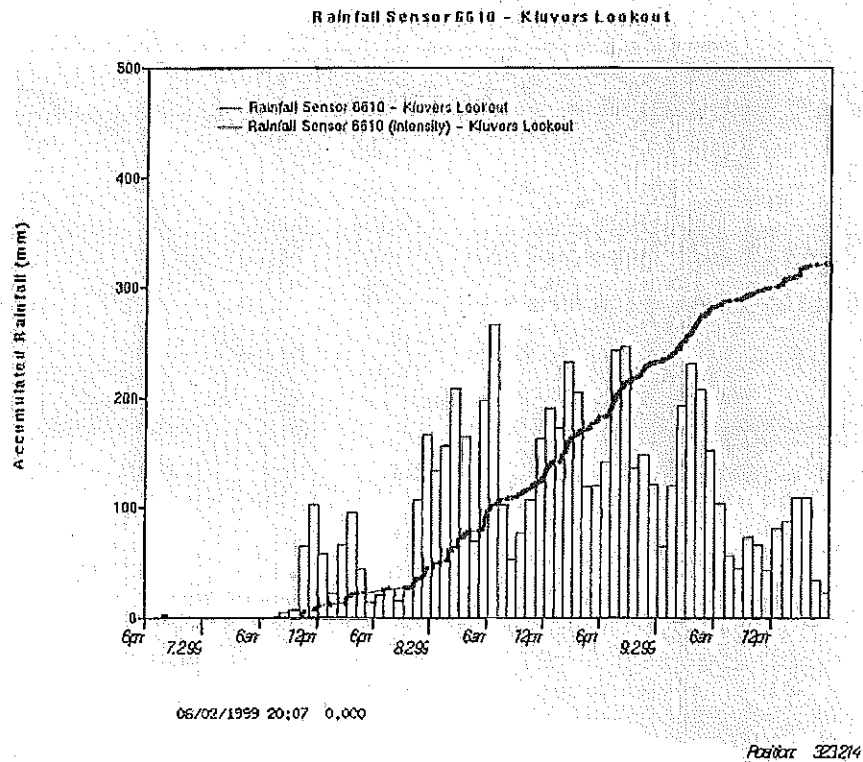


Somerset Catchment - Rainfall Sensor 6775- Stanley River at Peachester

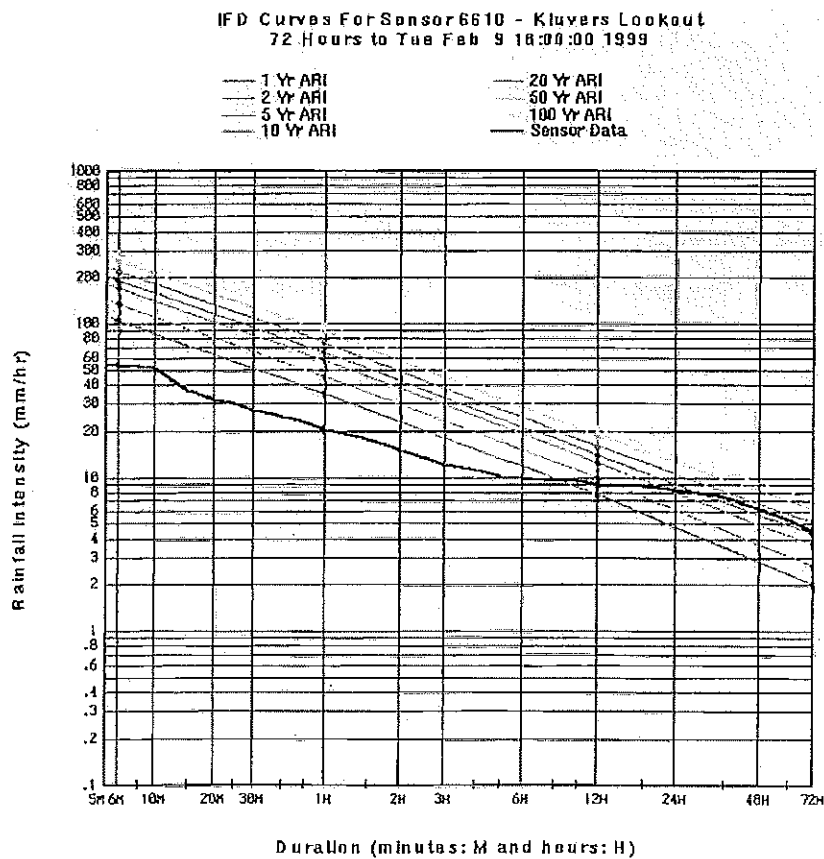


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Cumulative Rainfalls & IFD Curves for February 1999 Event

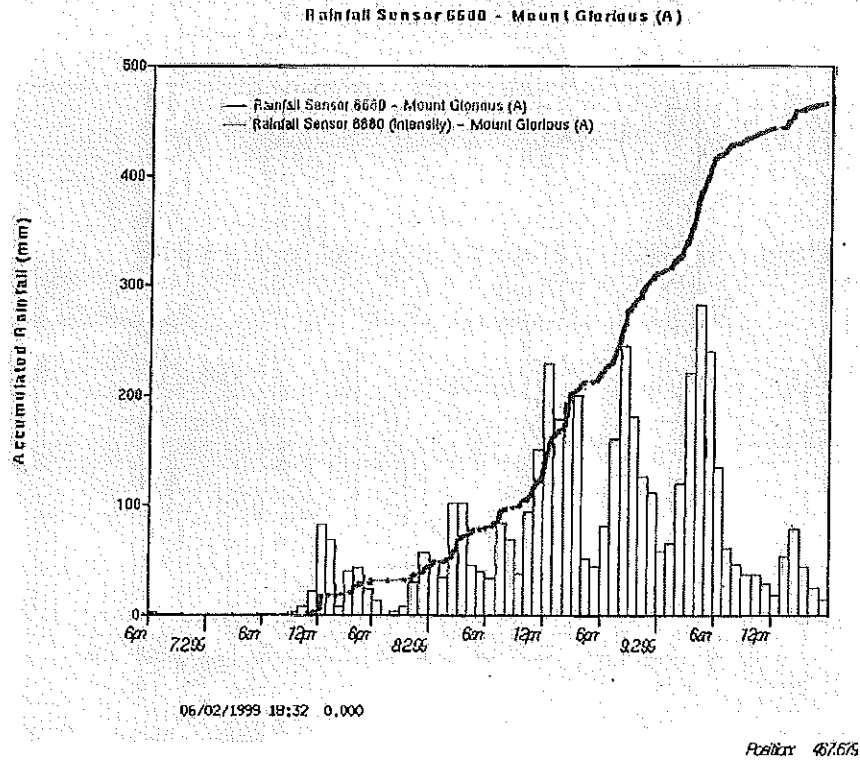


Pine Catchment - Rainfall Sensor 6610 - Kluvers Lookout

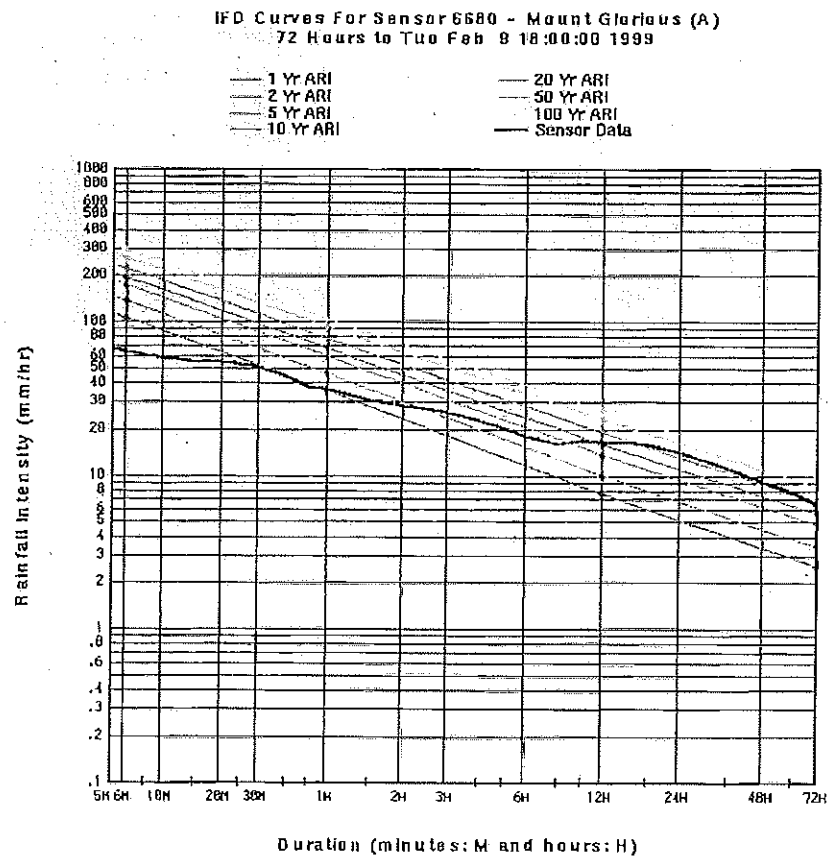


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Cumulative Rainfalls & IFD Curves for February 1999 Event

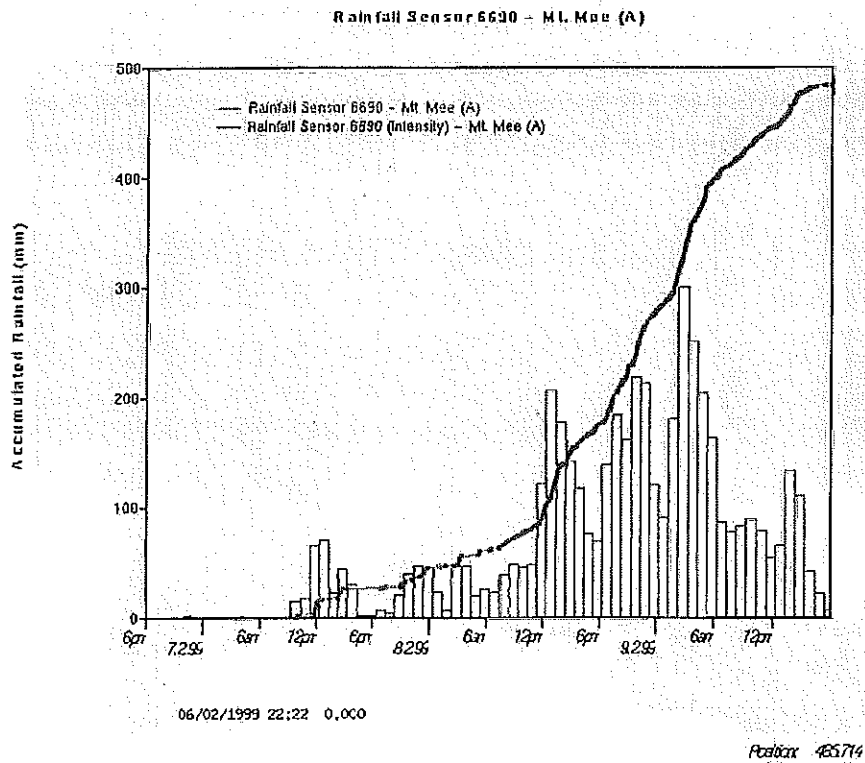


Pine Catchment - Rainfall Sensor 6680 - Mount Glorious



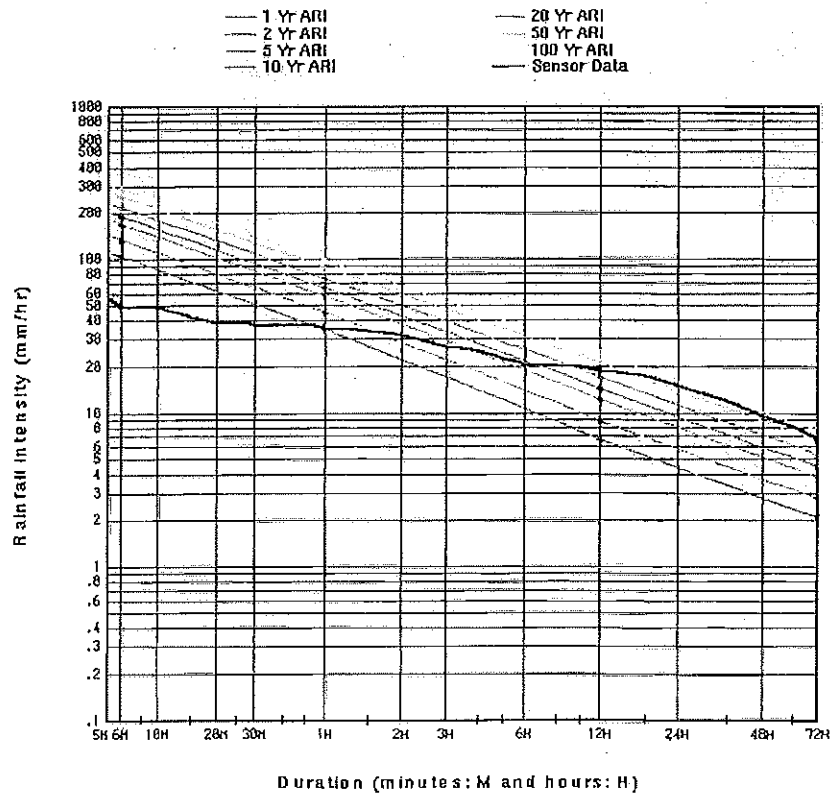
APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event



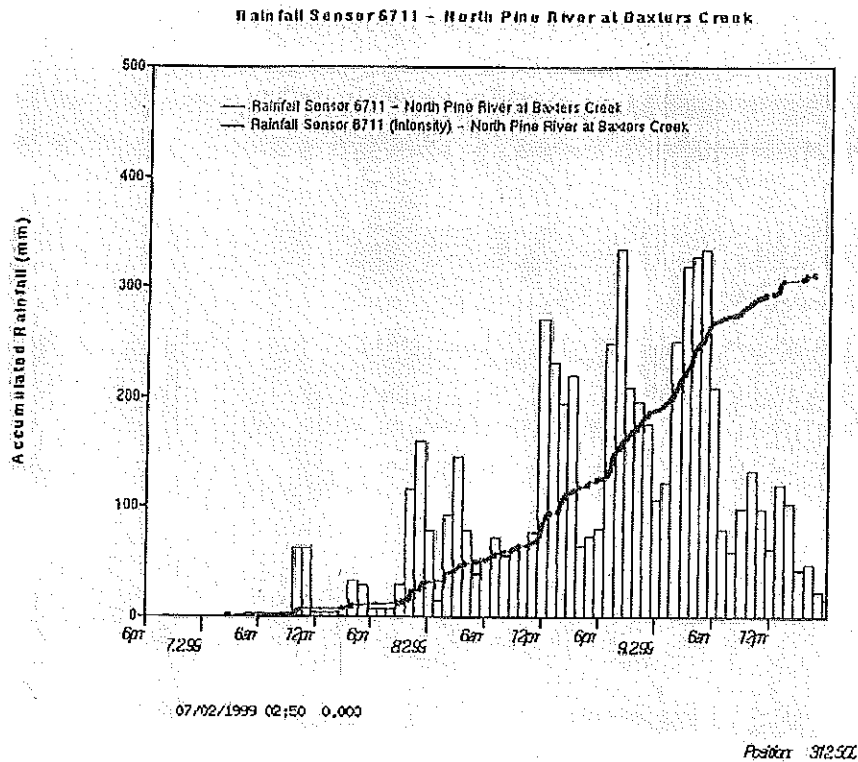
Pine Catchment - Rainfall Sensor 6690 - Mount Mee

IFD Curves For Sensor 6690 - Mt. Mee (A)
72 Hours to Tue Feb 9 18:00:00 1999

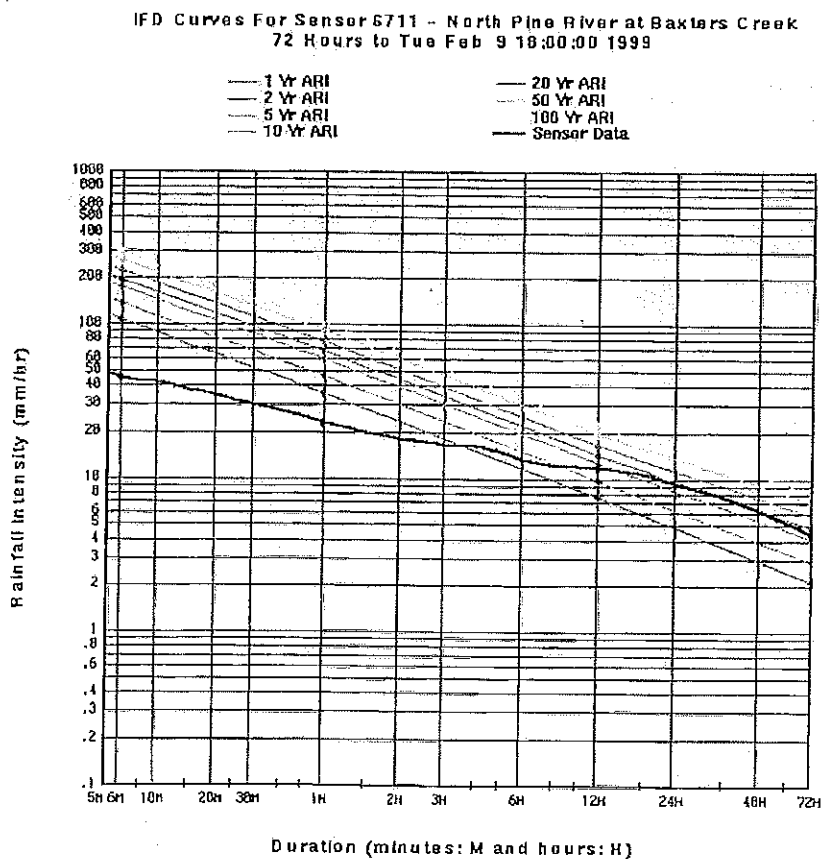


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Cumulative Rainfalls & IFD Curves for February 1999 Event

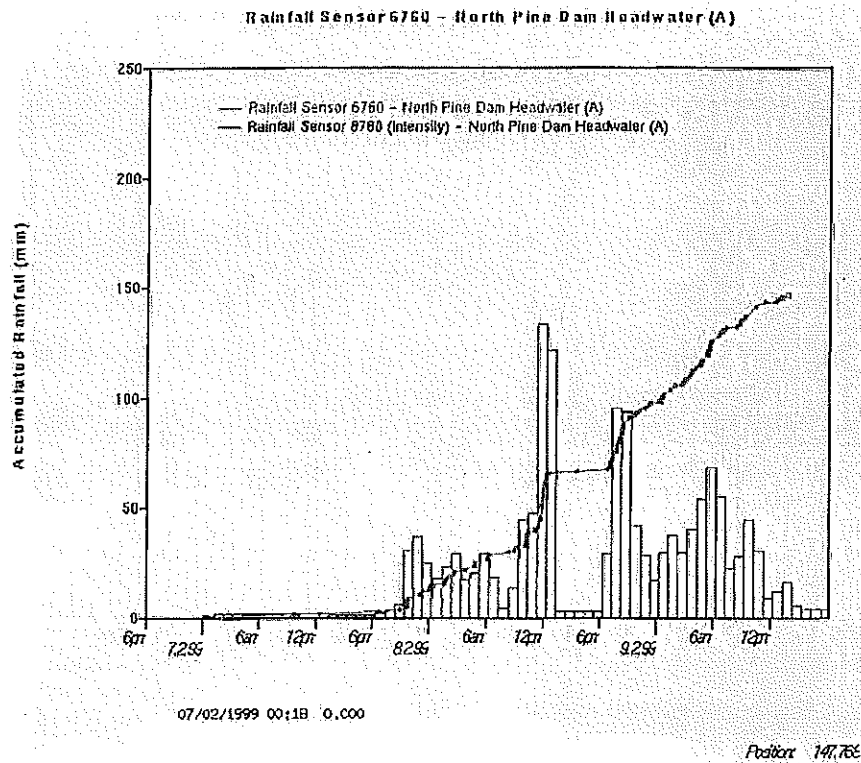


Pine Catchment - Rainfall Sensor 6711 - North Pine River at Baxters Creek

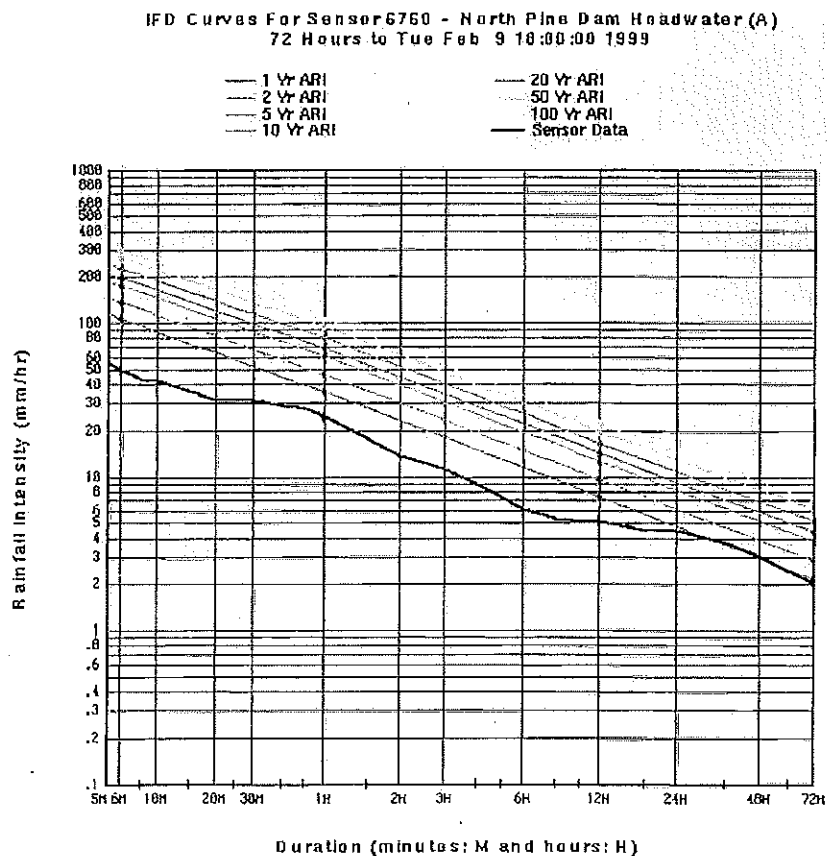


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

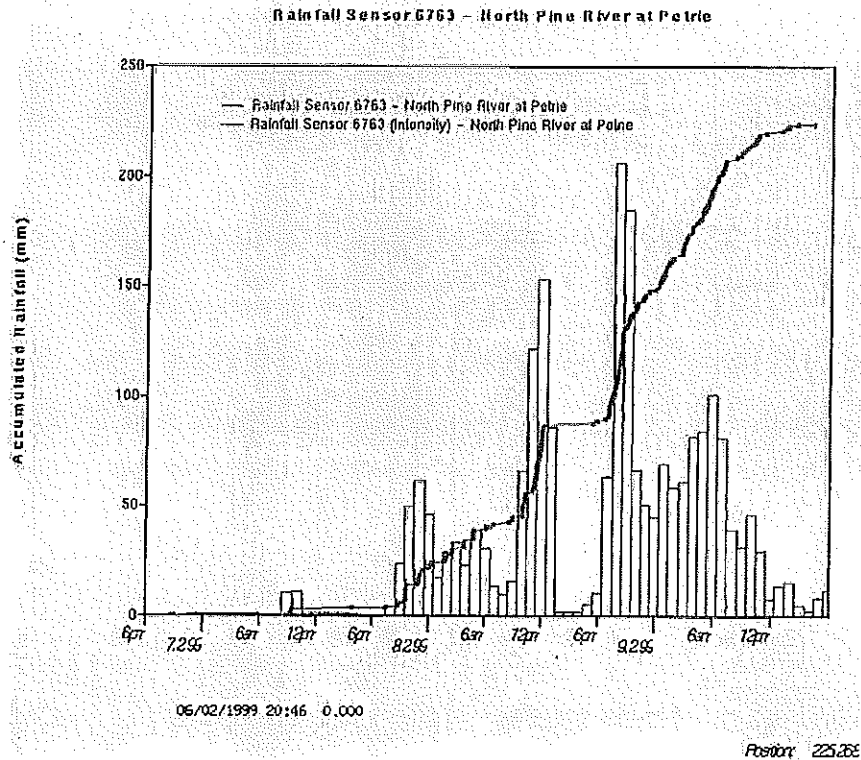


Pine Catchment - Rainfall Sensor 6760 - North Pine Dam Headwater

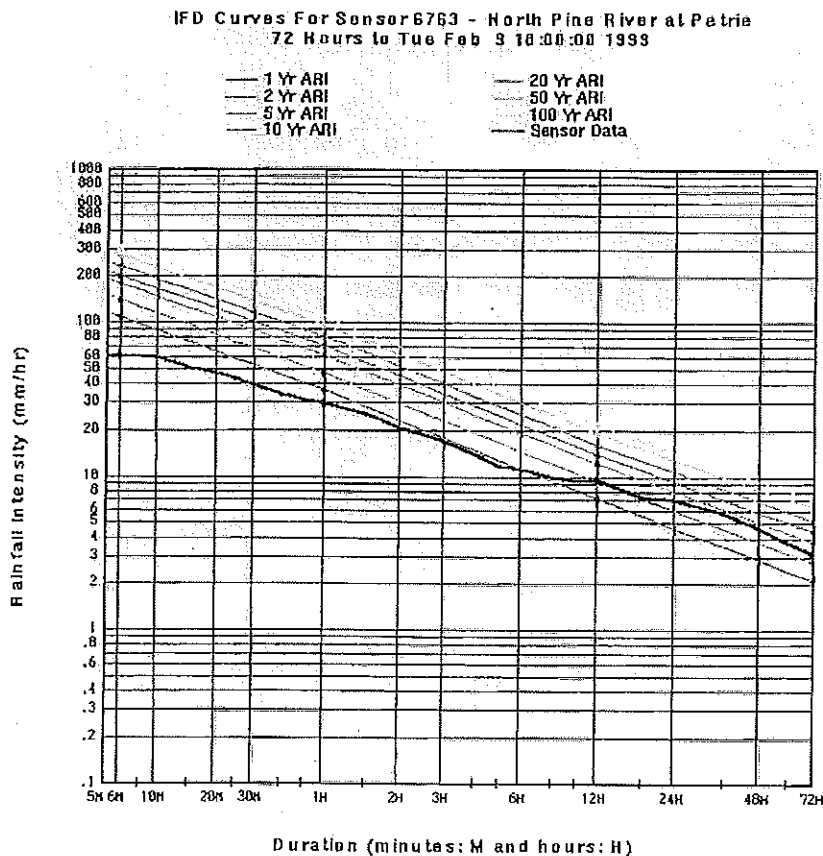


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

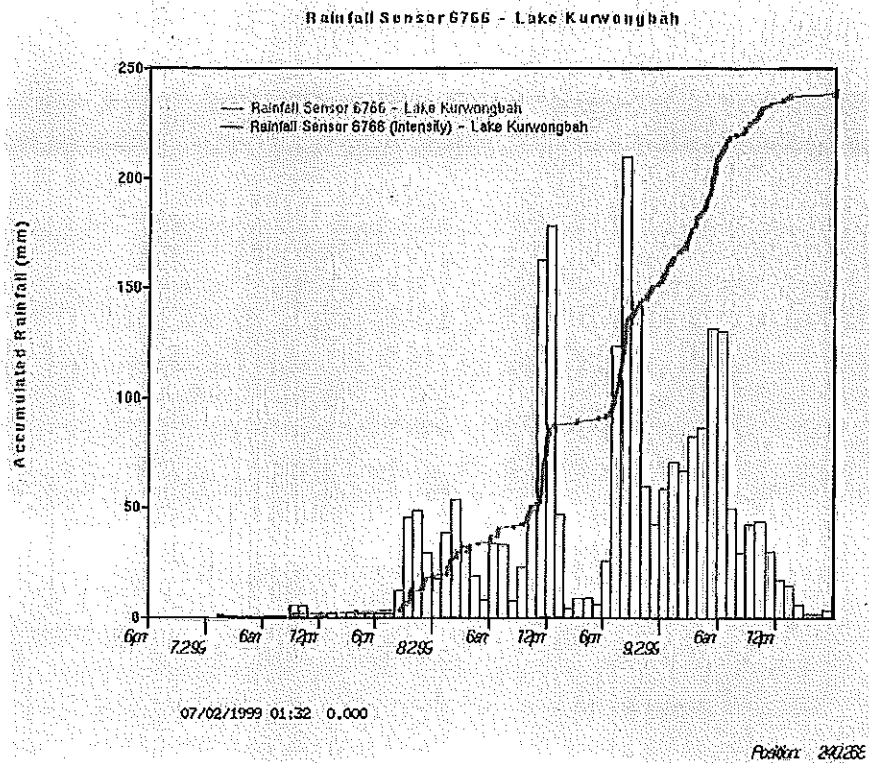


Pine Catchment - Rainfall Sensor 6763 - North Pine River at Petrie

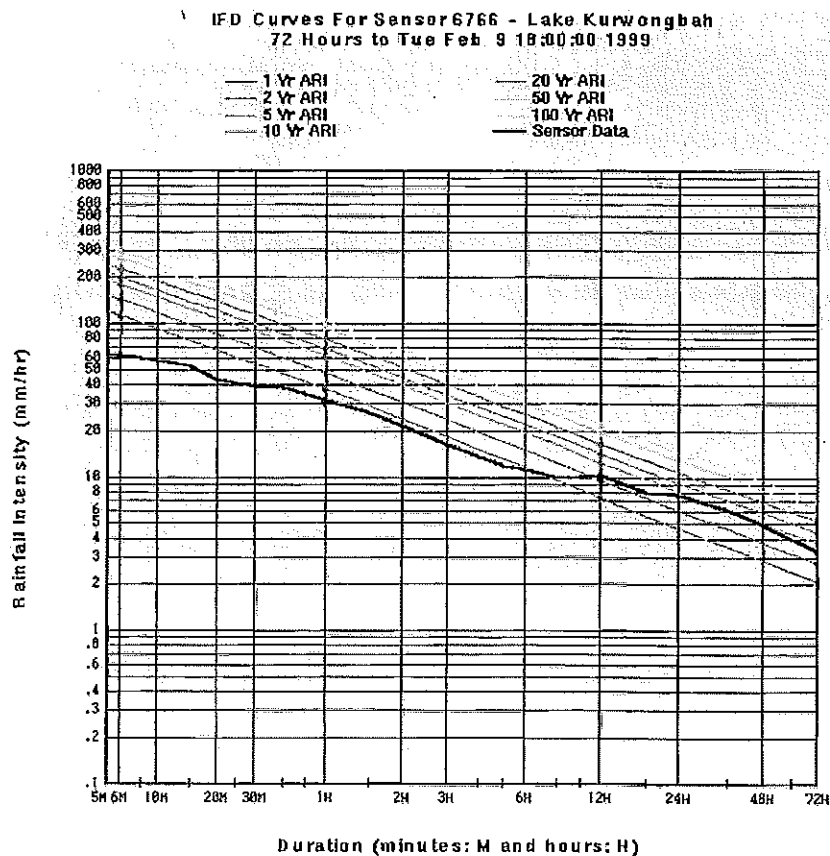


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

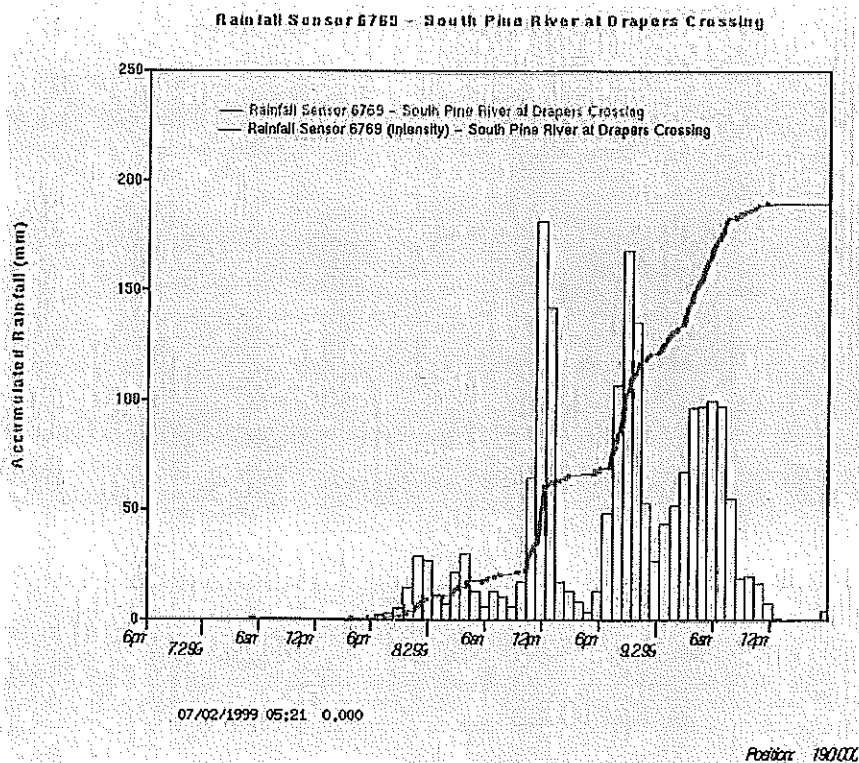


Pine Catchment - Rainfall Sensor 6766 - Lake Kurwongbah

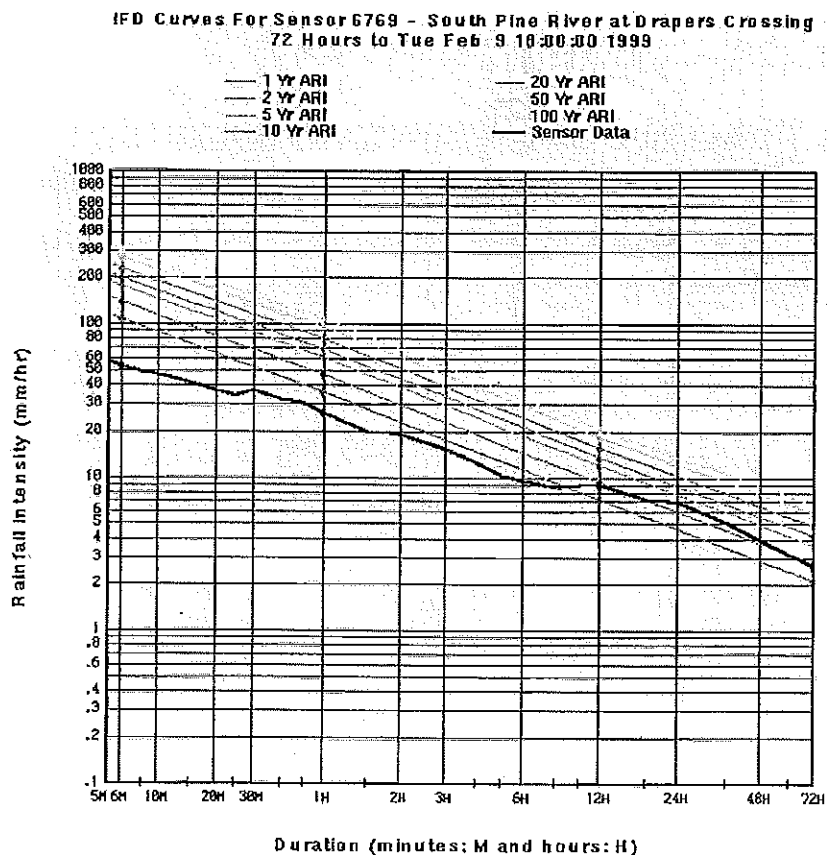


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

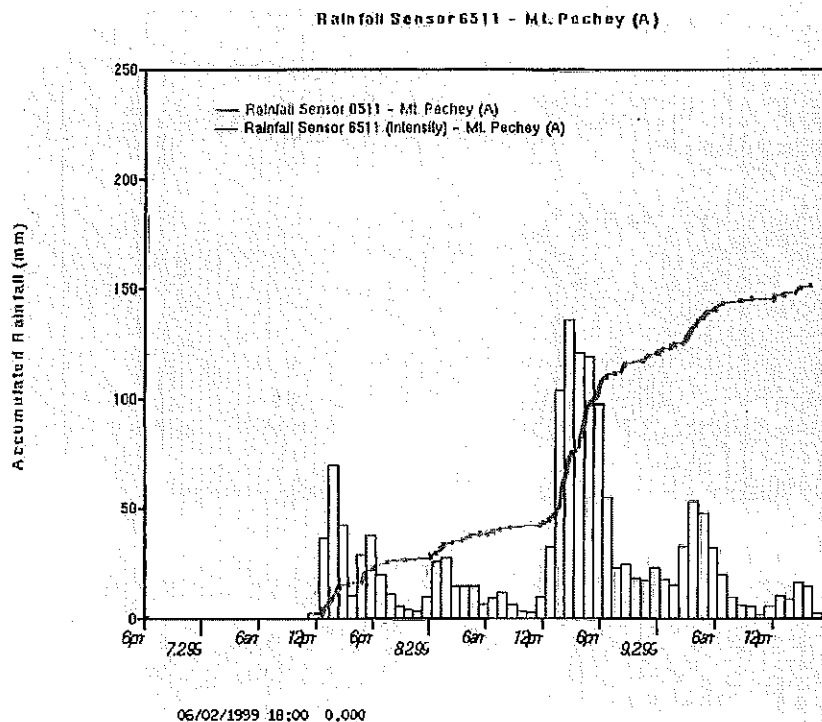


Pine Catchment - Rainfall Sensor 6769 - South Pine River at Drapers Crossing

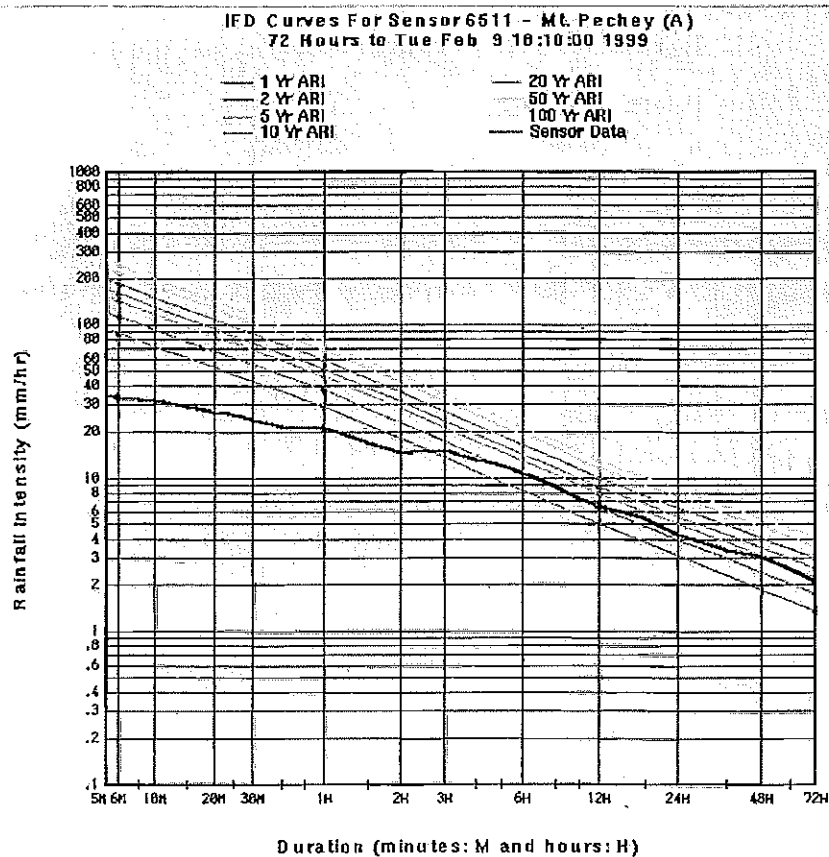


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Cumulative Rainfalls & IFD Curves for February 1999 Event

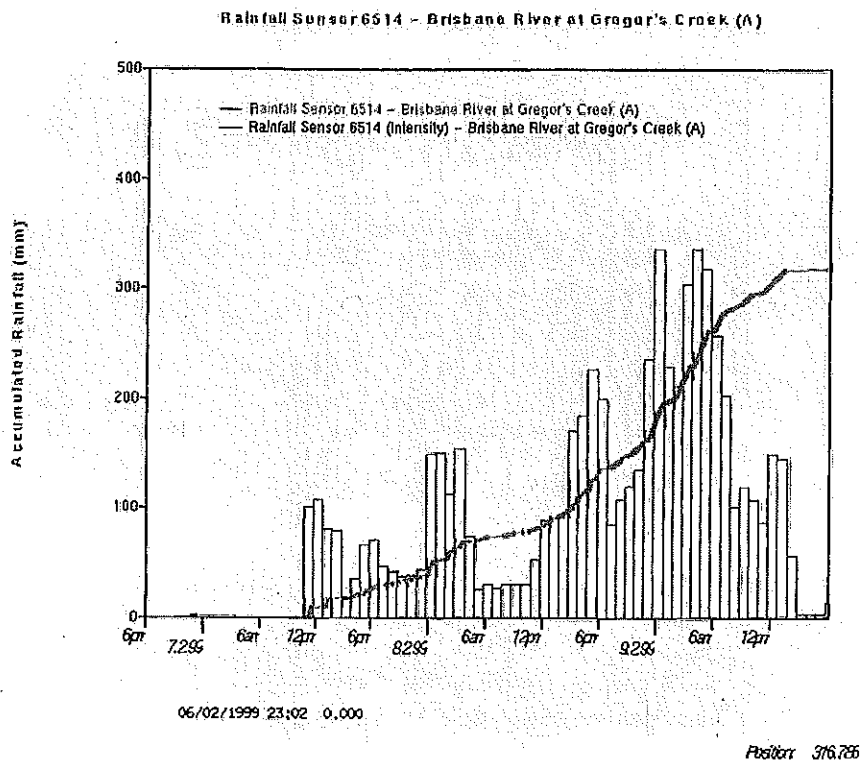


Upper Brisbane Catchment - Rainfall Sensor 6511 - Mount Pechey

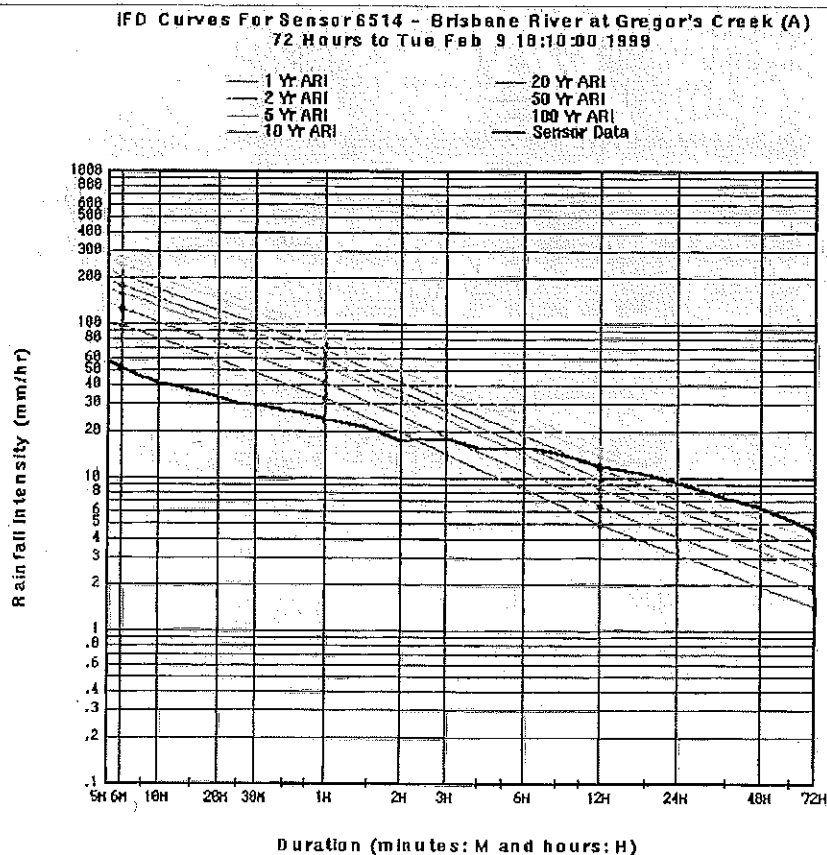


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Cumulative Rainfalls & IFD Curves for February 1999 Event

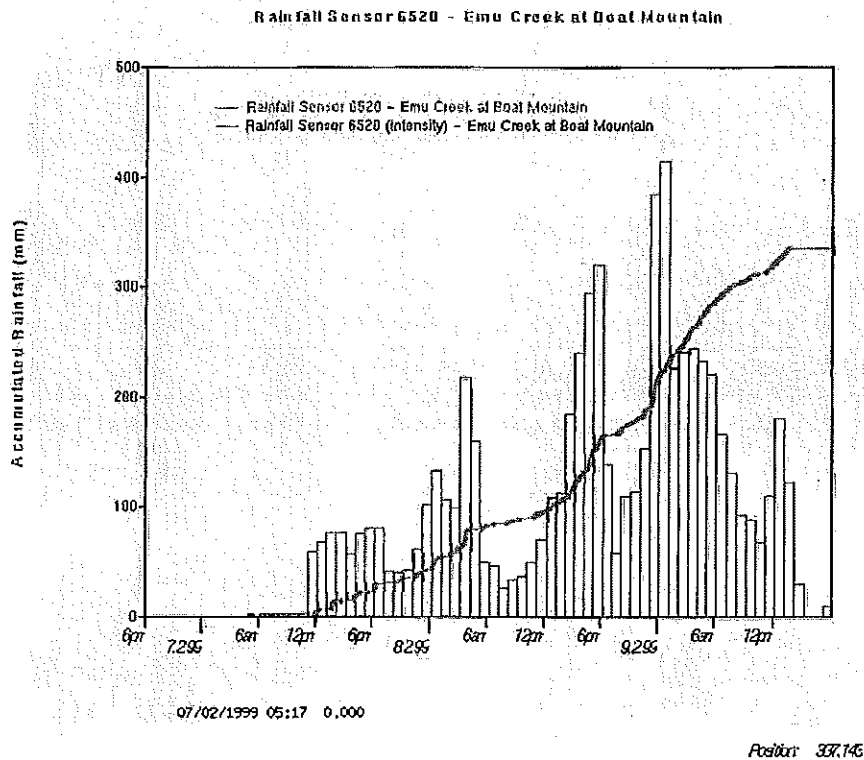


Upper Brisbane Catchment - Rainfall Sensor 6514 - Brisbane River at Gregor's Creek

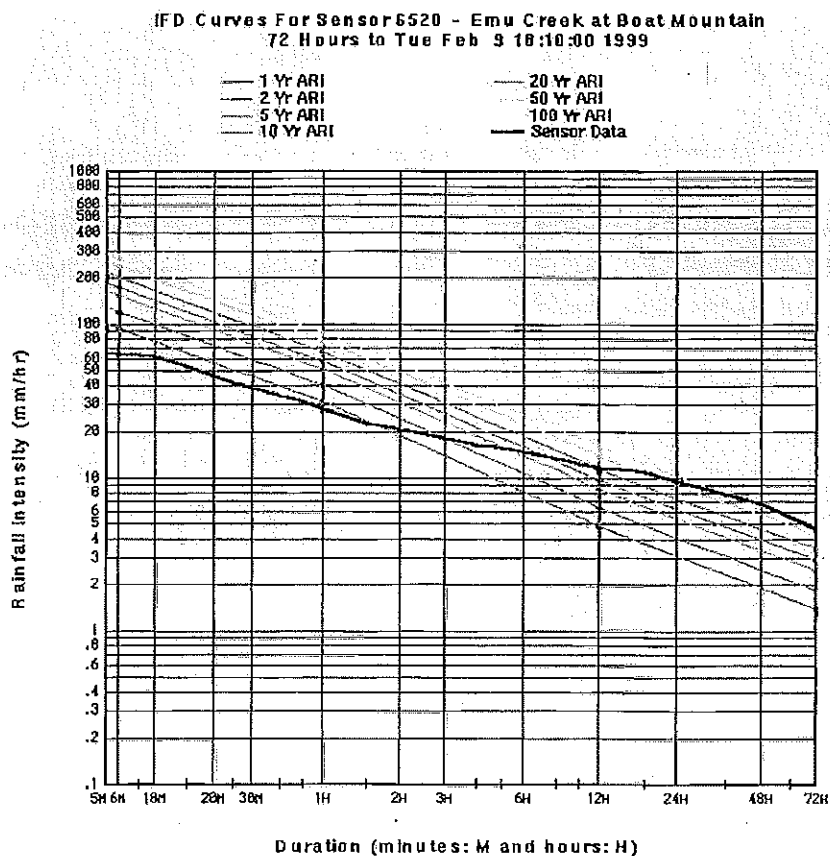


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

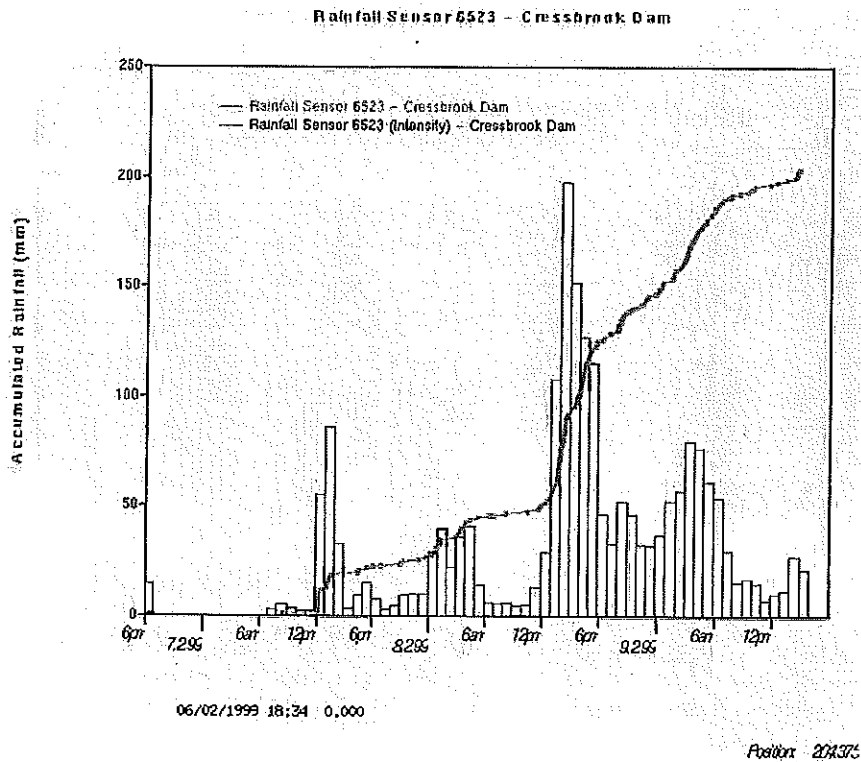


Upper Brisbane Catchment - Rainfall Sensor 6520 - Emu Creek at Boat Mountain

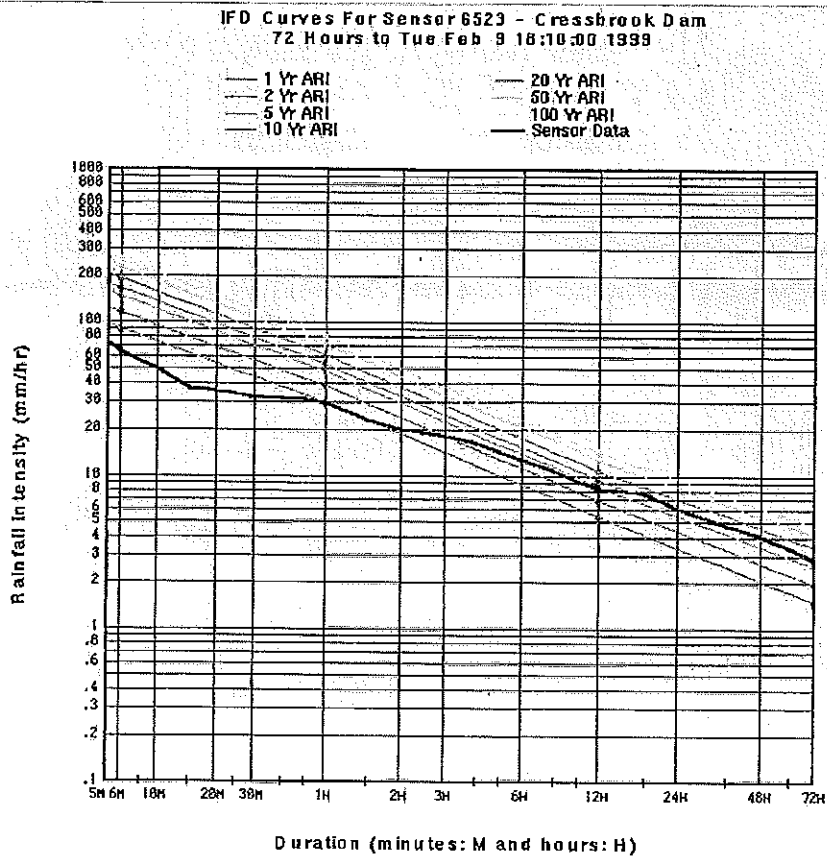


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Cumulative Rainfalls & IFD Curves for February 1999 Event

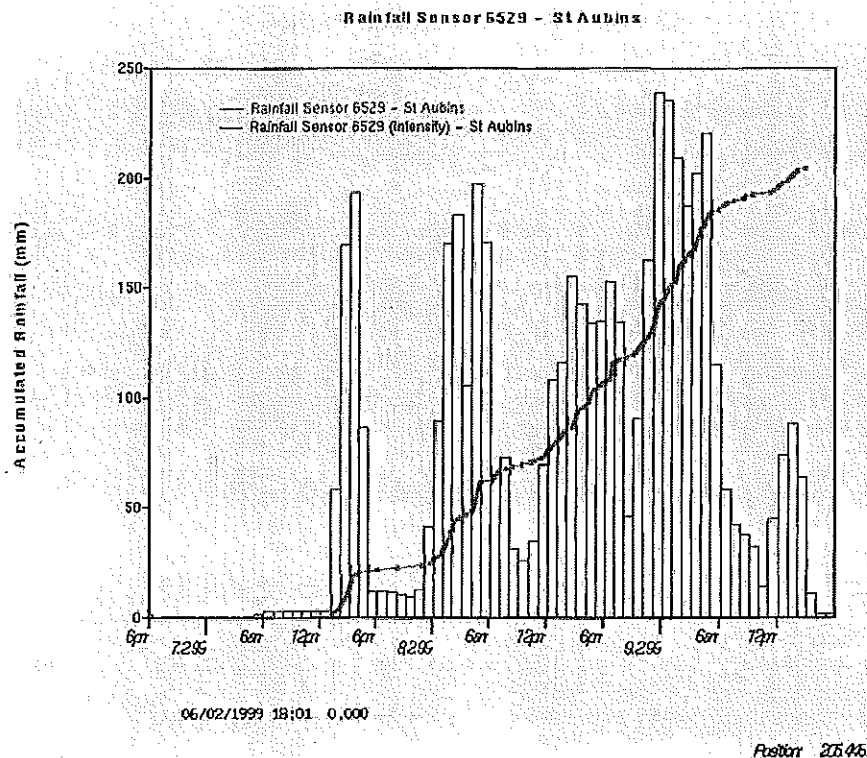


Upper Brisbane Catchment - Rainfall Sensor 6523 - Cressbrook Dam

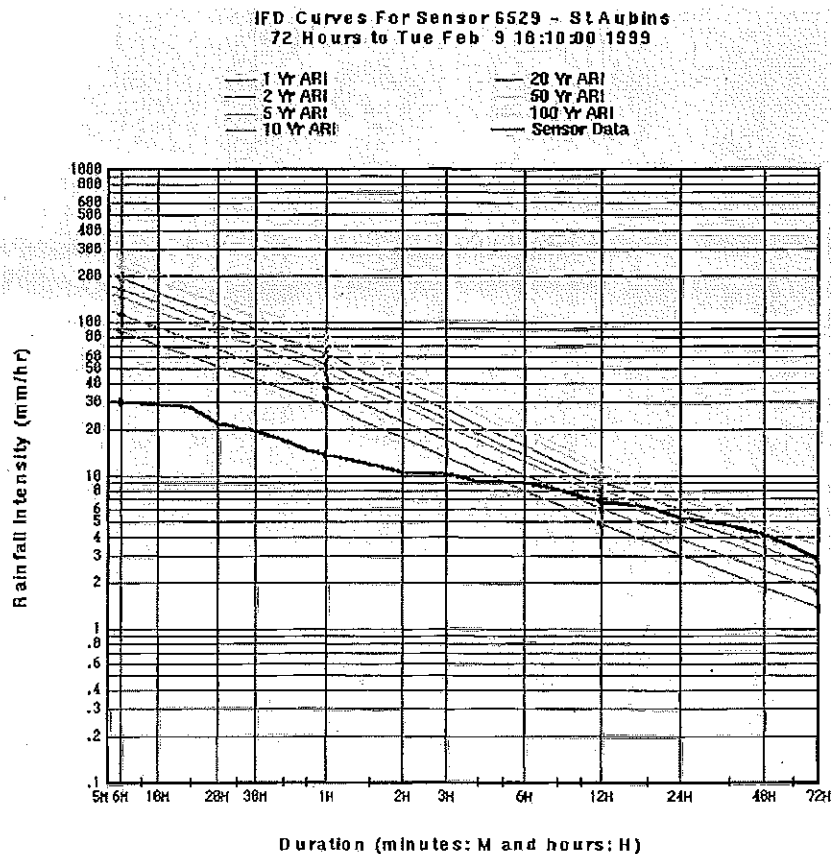


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Cumulative Rainfalls & IFD Curves for February 1999 Event

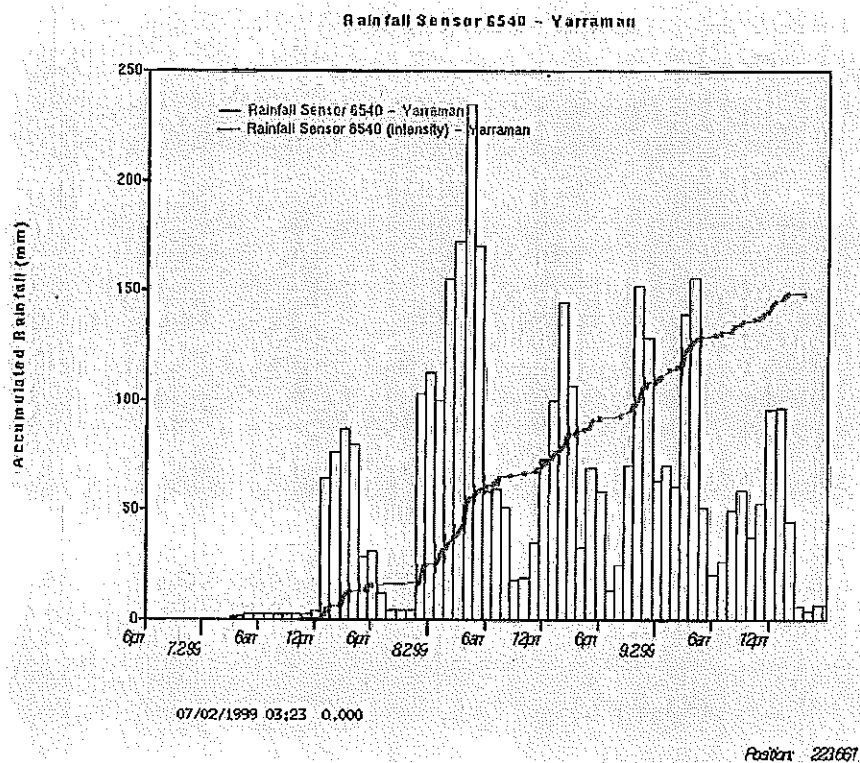


Upper Brisbane Catchment - Rainfall Sensor 6529 - St Aubins

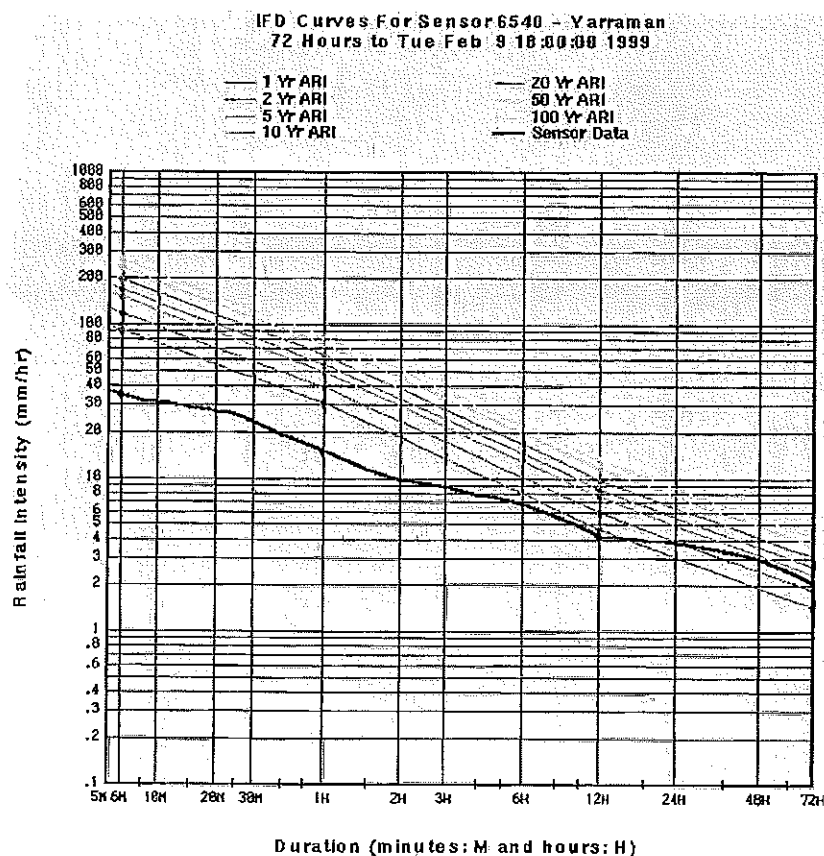


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Cumulative Rainfalls & IFD Curves for February 1999 Event

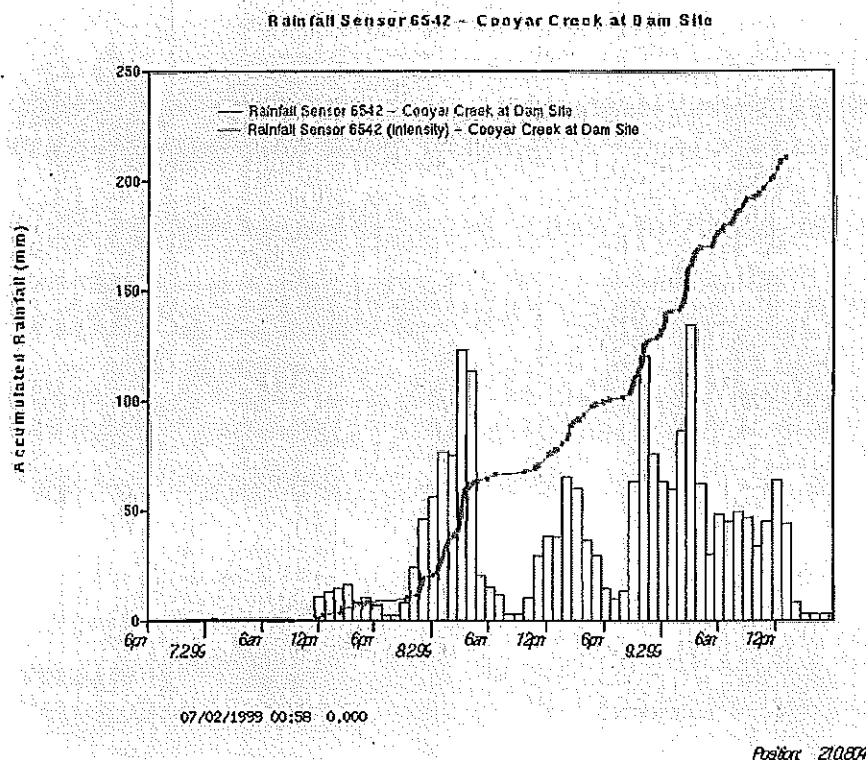


Upper Brisbane Catchment - Rainfall Sensor 6540 - Yarraman

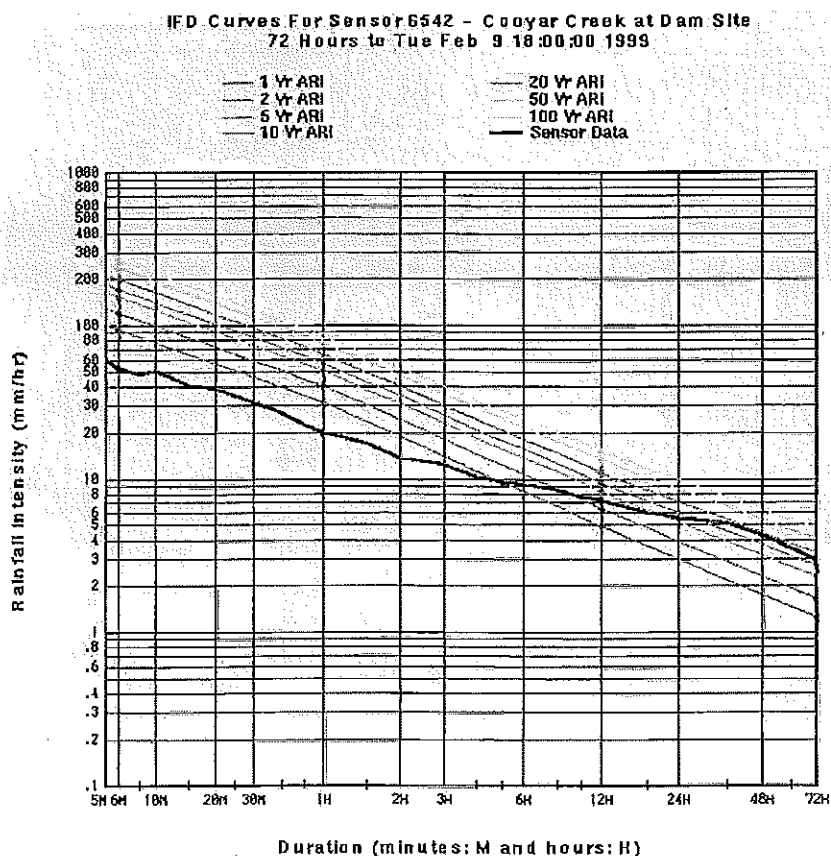


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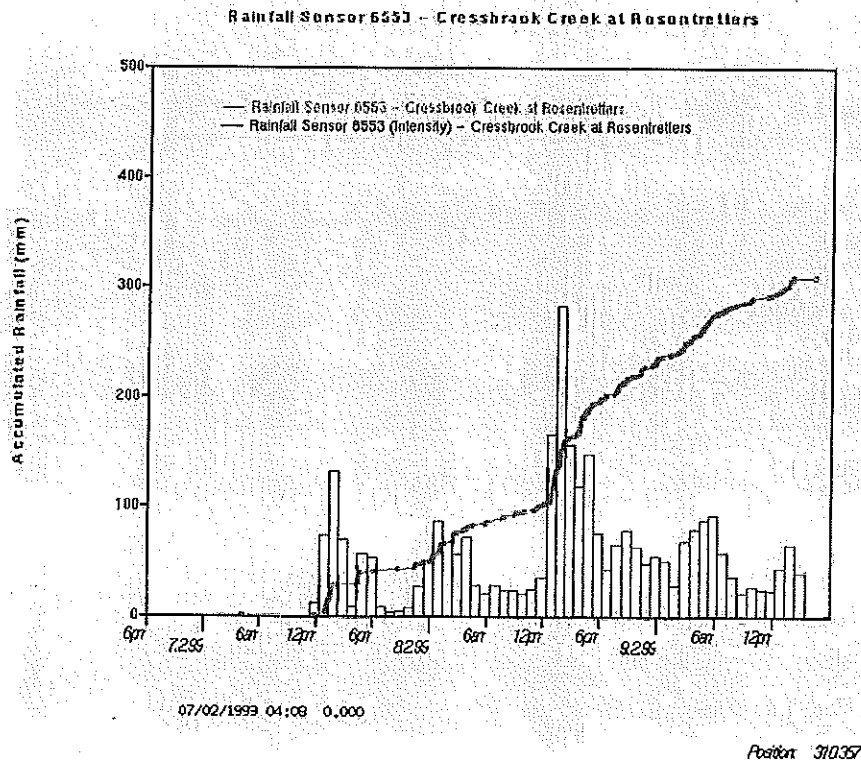


Upper Brisbane Catchment - Rainfall Sensor 6542 - Cooyar Creek at Dam Site

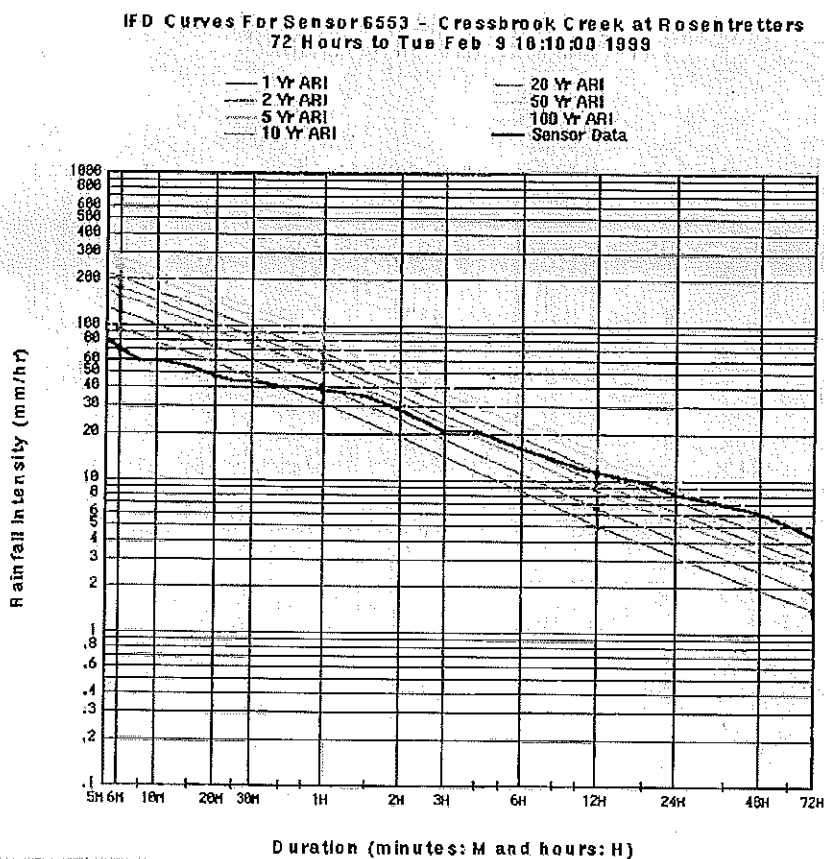


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Cumulative Rainfalls & IFD Curves for February 1999 Event

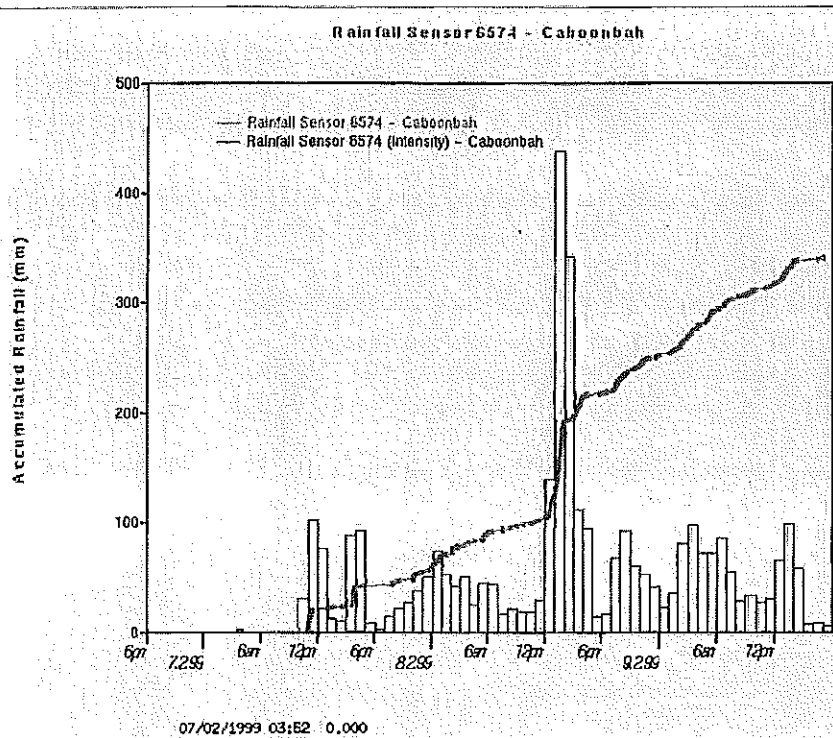


Upper Brisbane Catchment - Rainfall Sensor 6553 - Cressbrook Creek at Rosentretters

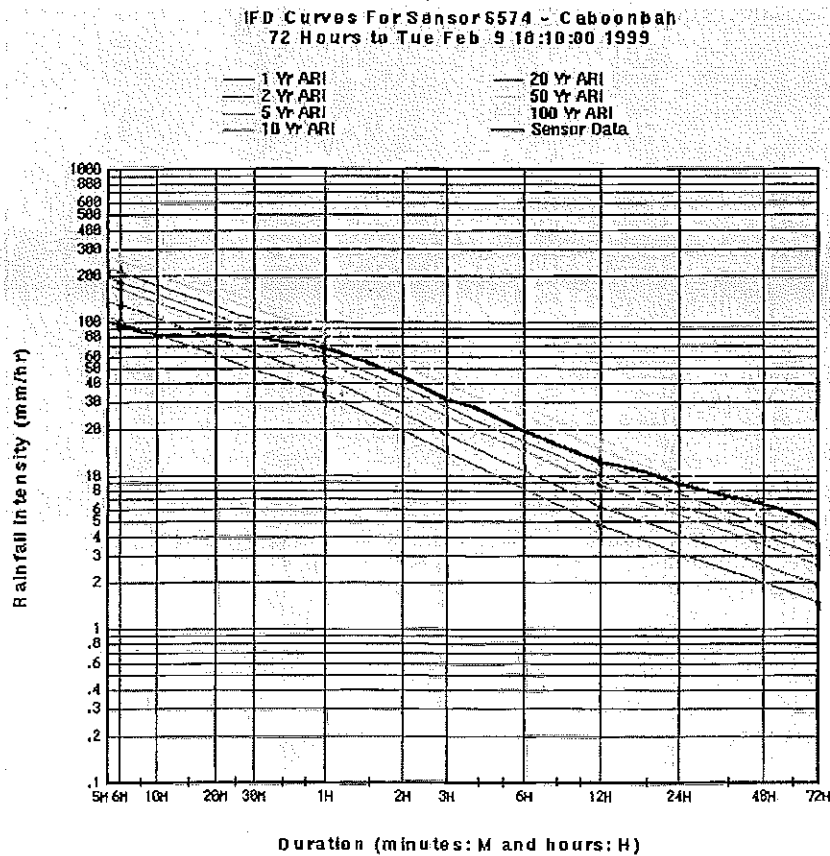


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Cumulative Rainfalls & IFD Curves for February 1999 Event

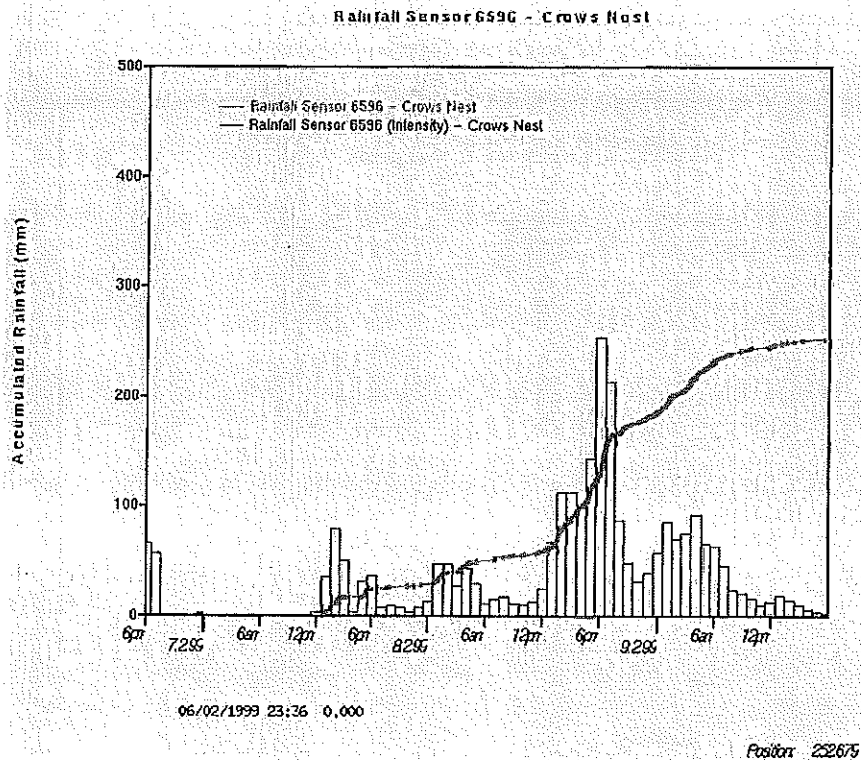


Upper Brisbane Catchment - Rainfall Sensor 6574 - Caboonbah

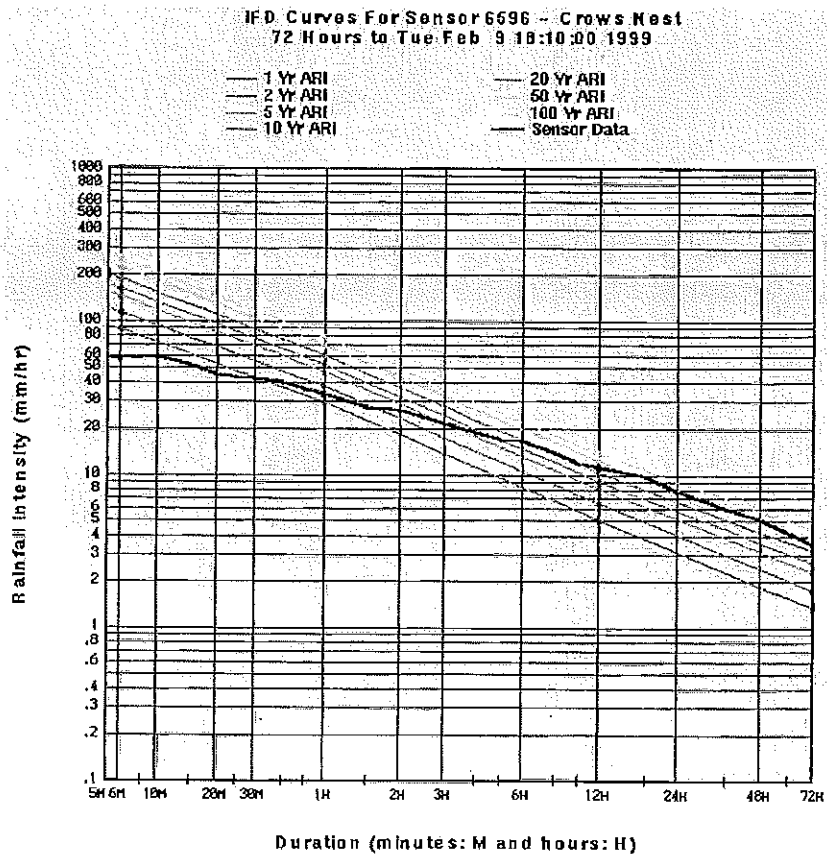


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event

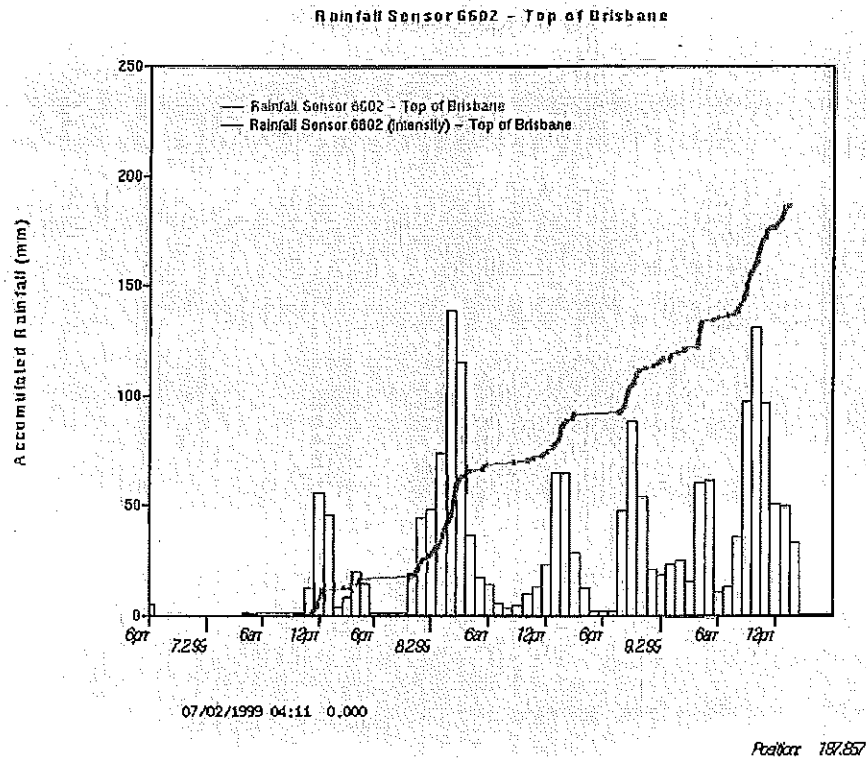


Upper Brisbane Catchment - Rainfall Sensor 6596 - Crows Nest

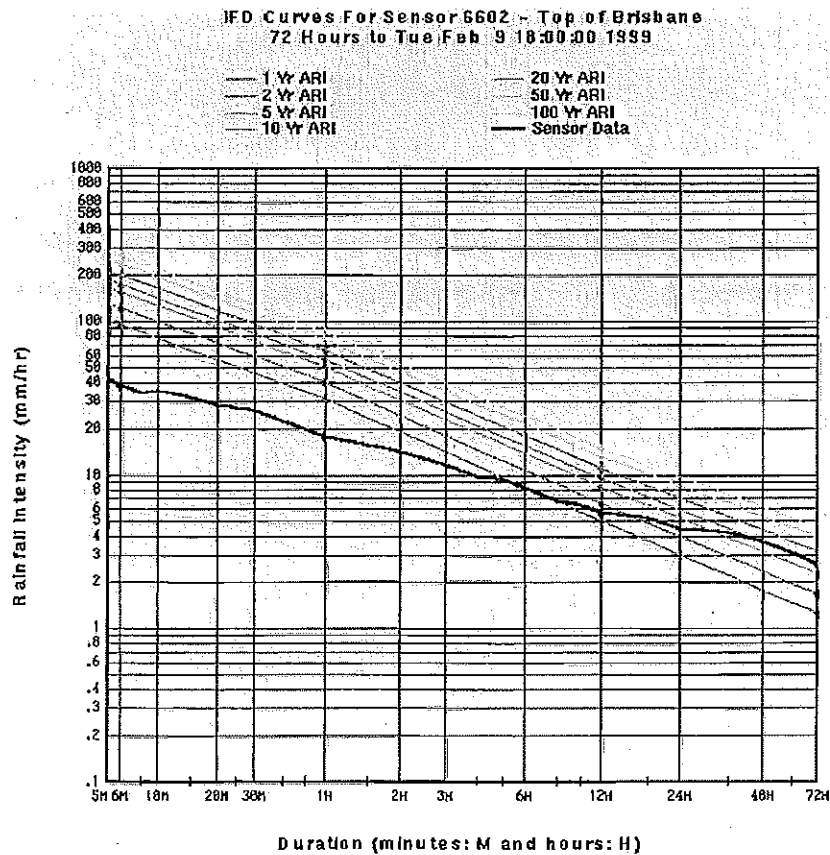


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Cumulative Rainfalls & IFD Curves for February 1999 Event

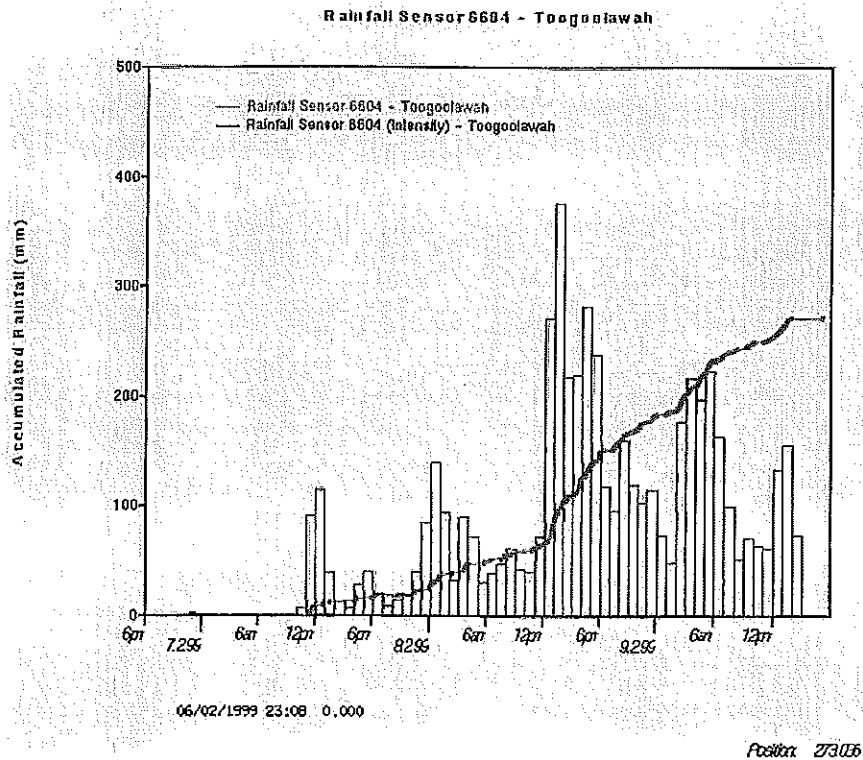


Upper Brisbane Catchment - Rainfall Sensor 6602 - Top of Brisbane

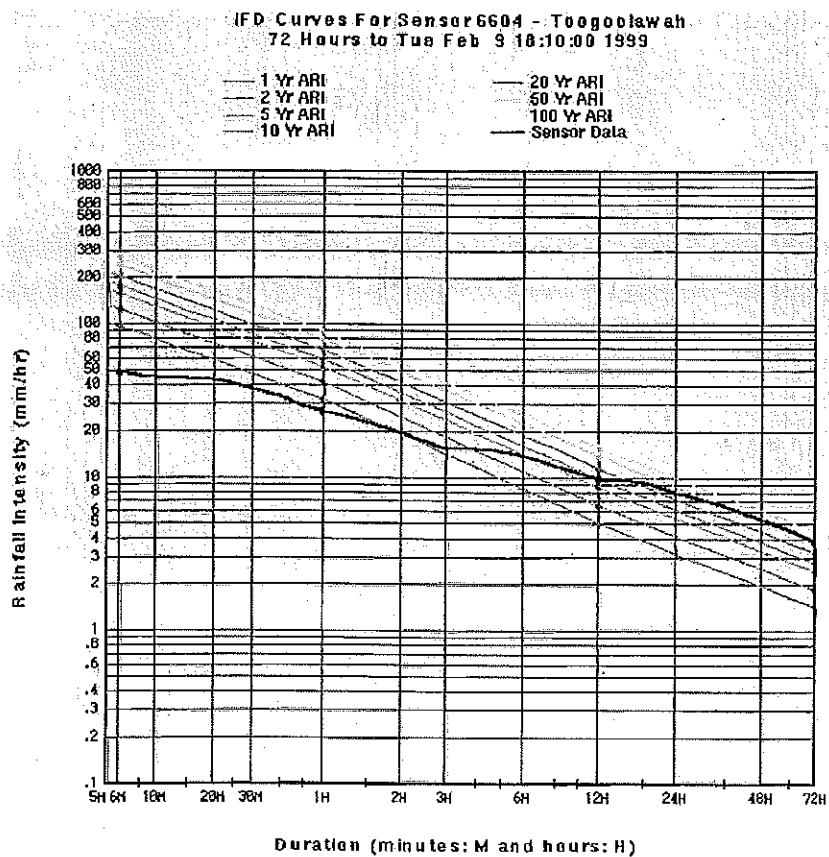


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Cumulative Rainfalls & IFD Curves for February 1999 Event

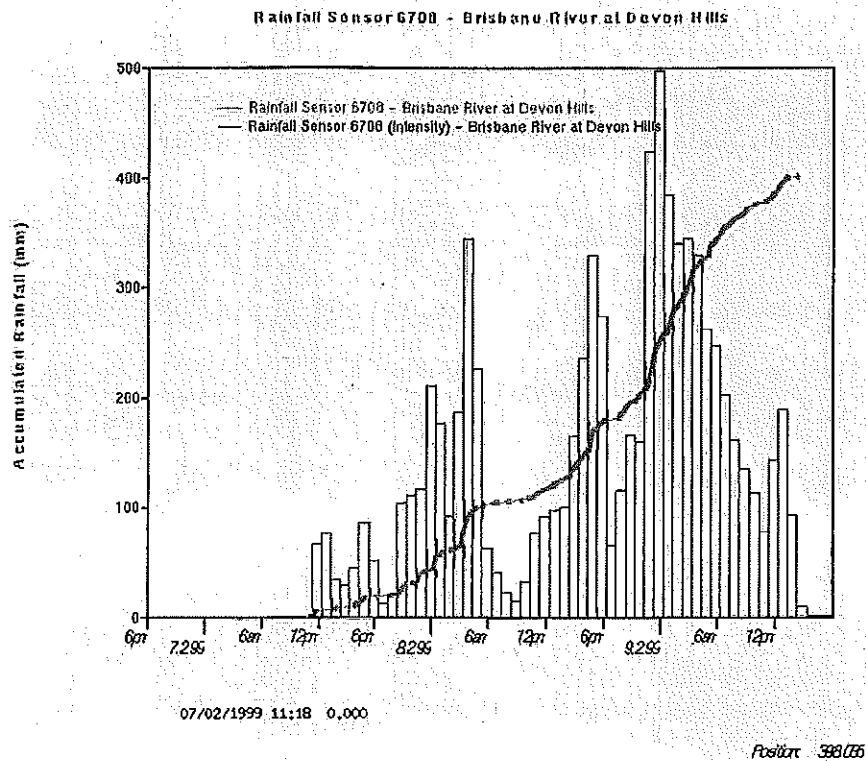


Upper Brisbane Catchment - Rainfall Sensor 6604 - Toogoolawah

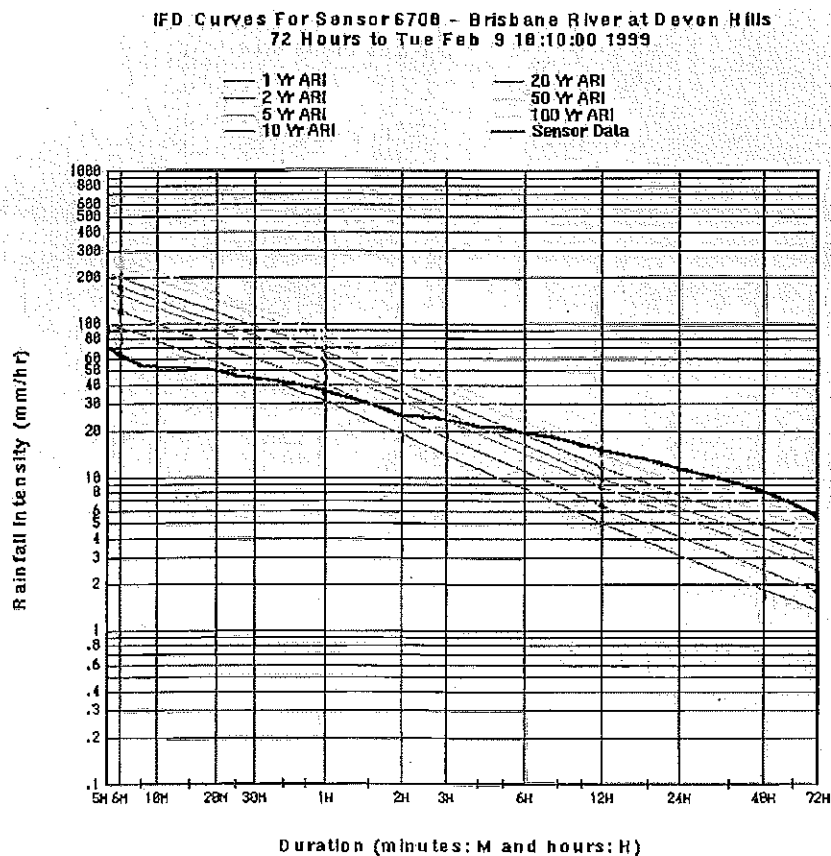


APPENDIX B

Cumulative Rainfalls & IFD Curves for February 1999 Event



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

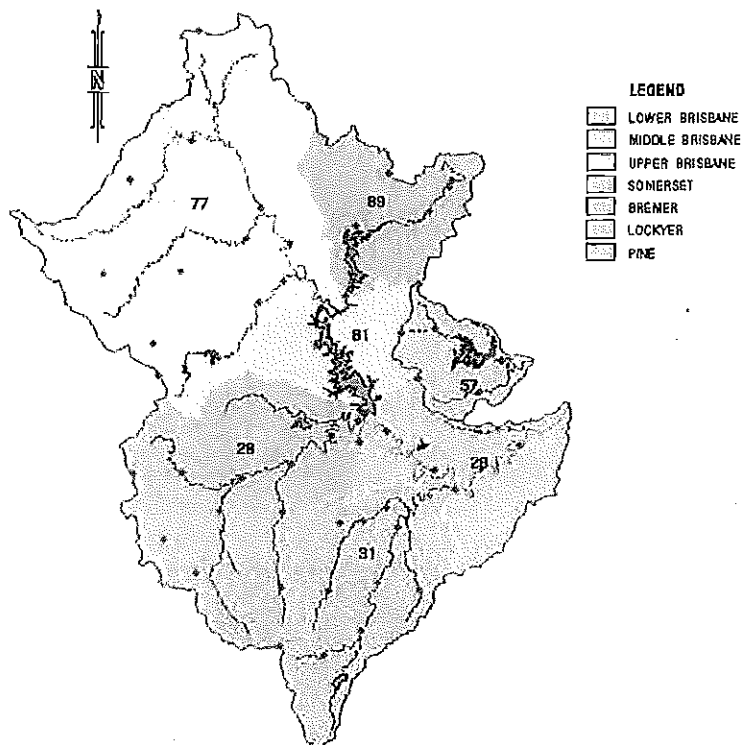


APPENDIX C

CATCHMENT RAINFALLS FOR FEBRUARY 1999 EVENT

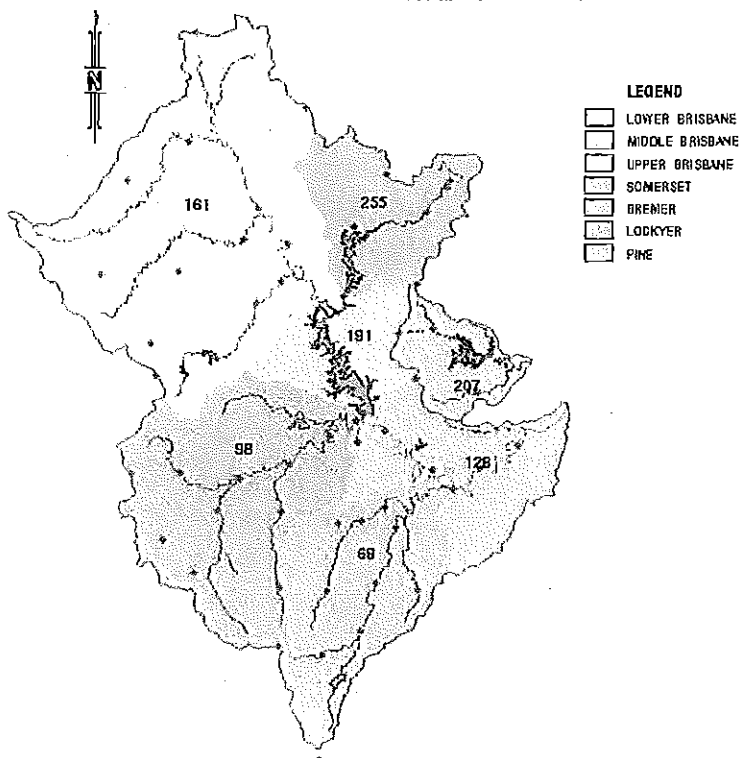
APPENDIX C **Sub-Catchment 24 hour Total Rainfall for February 1999 Event**

24 Hours to 08/02/1999 09:00:00



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

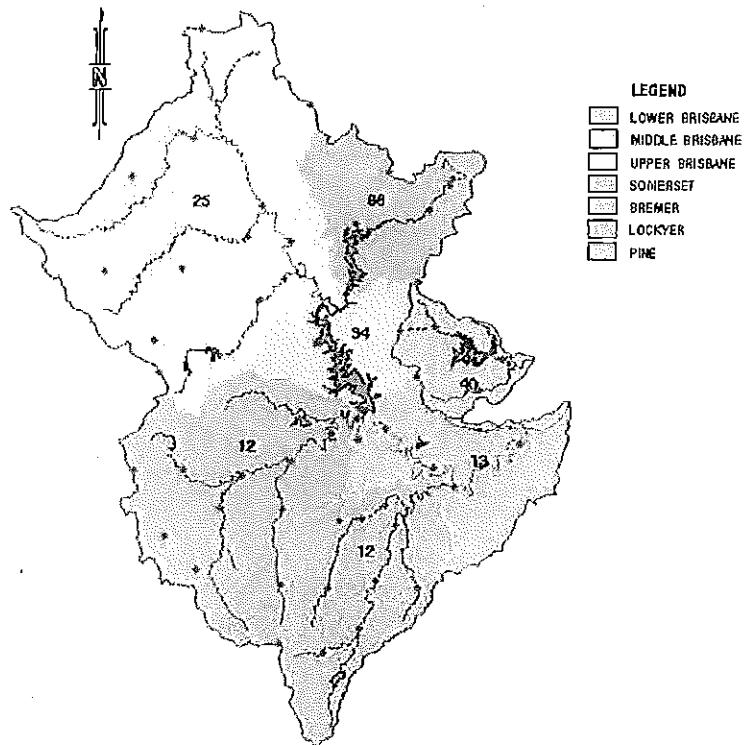
24 Hours to 09/02/1999 09:00:00



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

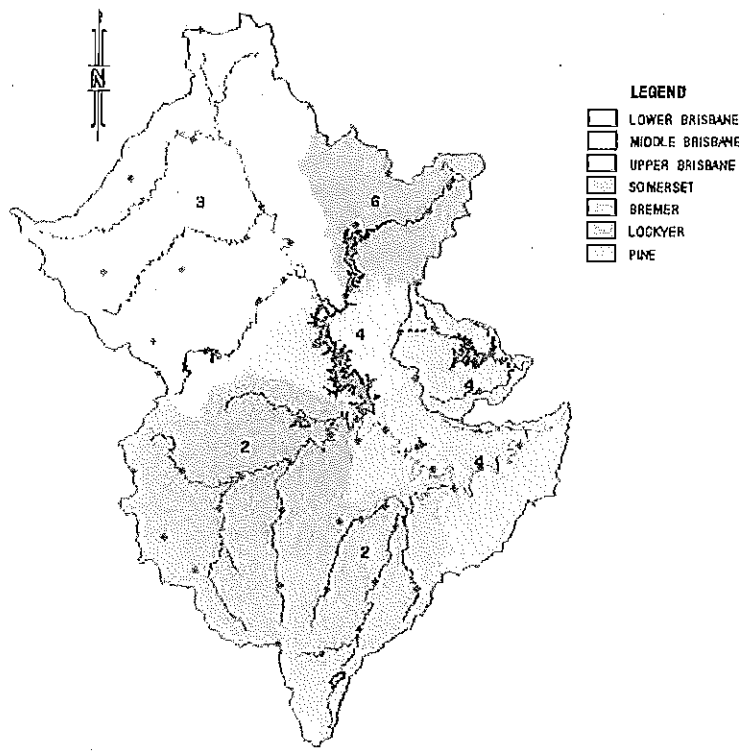
APPENDIX C **Sub-Catchment 24 hour Total Rainfall for February 1999 Event**

24 Hours to 10/02/1999 09:00:00



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

24 Hours to 11/02/1999 09:00:00

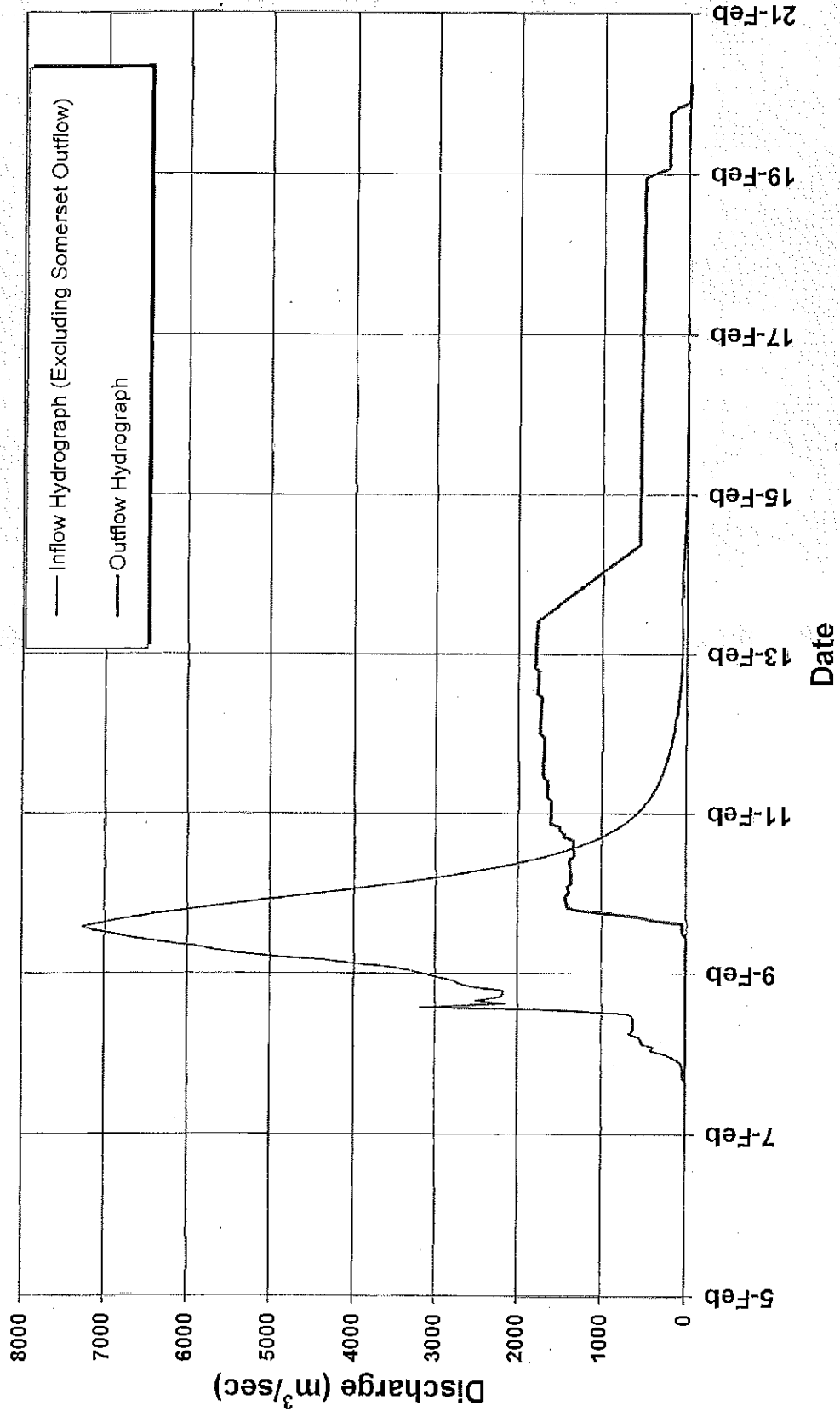


Sub-Catchment 24hr Total Rainfall to 9:00am 11/2/99

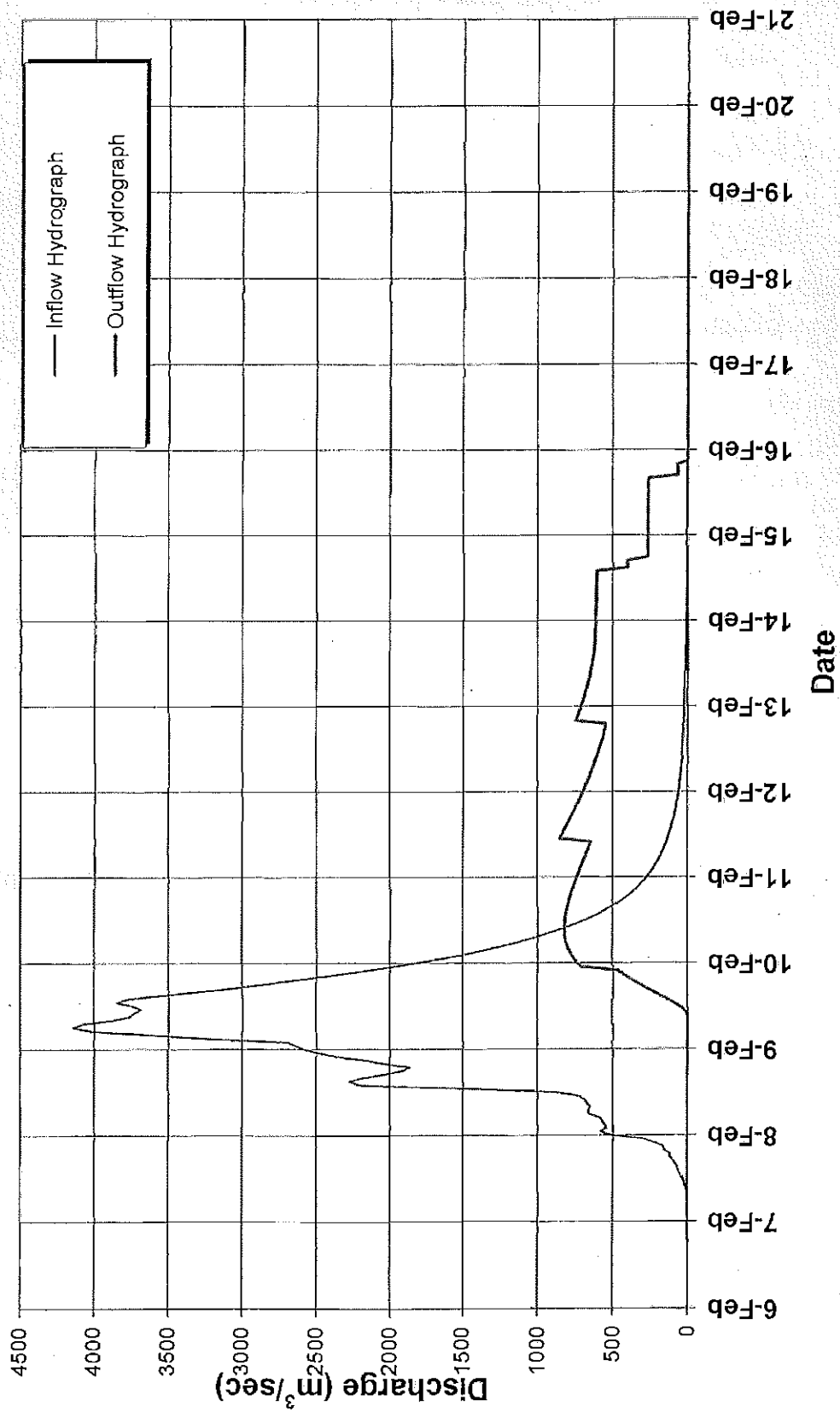
APPENDIX D

INFLOW and OUTFLOW HYDROGRAPHS FOR FEBRUARY 1999 EVENT

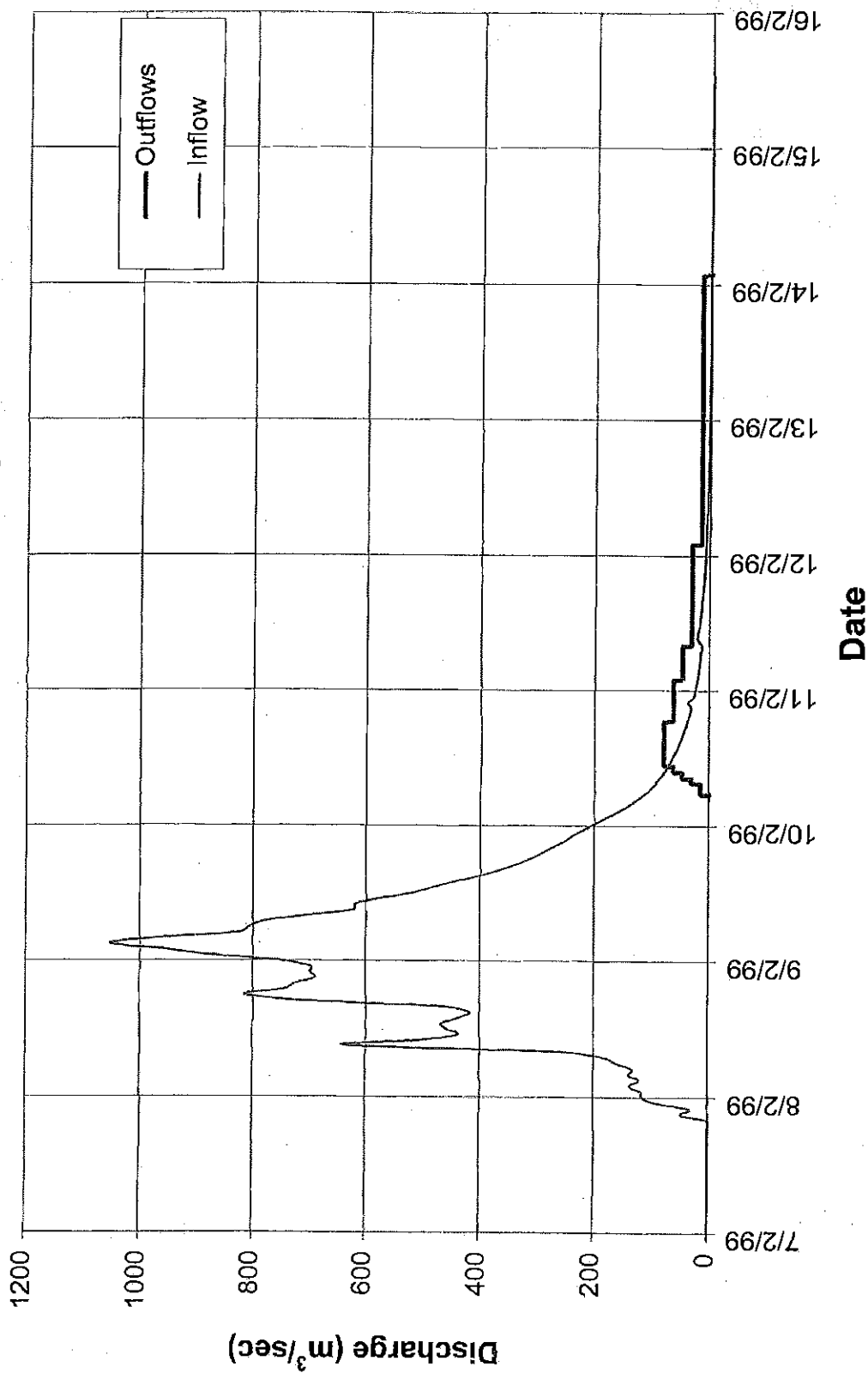
Wivenhoe Dam - February 1999 Event



Somerset Dam - February 1999 Event



North Pine Dam - February 1999 Event



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 Gorlan) 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%
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.14m. Regulator 1 to 50% @ 13:30 & Regulator 2 to 50% @ 14:00.
	14:18	
	14:22	Rob Titmarsh @ Somerset: 2 regulators 50% opened O/C
		Doug Grigg @ Wivenhoe Dam checked in. Splityard @ EL 159.8 Campers in 4 vans @ Twin Bridges warned
	14:55	
	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
		John Ruffini discussed situation with Peter Allen regarding current flood. Decided on 12 hr. shifts for Data Collectors.
	15:45	
	15:50	Malcolm Lane @ North Pine Dam rang. Reported Lake Level having reached 39.65 - 39.70 (Rob Gorlan)
	16:00	Rob Titmarsh @ Somerset: Lake level EL 99.21
		Doug Grigg @ Wivenhoe Dam: Lake level EL 67.19m. Tailwater checked. Twin Bridges checked again. No problems.
	16:15	
	17:00	Rob Gorlan @ 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
02-Mar-99	21:45	Somerset: Two scenarios run. One 50mm extra over 48 hrs and 0mm over the next 48 hrs. Both are within operational
	22:10	bands of regulators. If continue on this path send Rob T. 11:30 at (?????) of an track. 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
	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. Fax from North Pine: GB 39.710; BCC 39.714; Digital 39.715. Gate 'A' opened at 4:10am. Lake EL
	4:20	39.716
	5:12	Fax from North Pine: GB 39.710; BCC 39.715; Digital 39.714. Rob Titmarsh from Somerset Dam 'phoned. Lake level EL 99.35 @ 06 00. 1.0mm of rain since 22:00 last night.
	6:10	Fax from North Pine: Gate setting & Lake Level log. Readings @ 06 00:- GB 39.710; BCC 39.713; Digital 39.712
	6:22	Doug Grigg @ Wivenhoe Dam: Lake level EL 67.16m. @ 06 00 hrs. Little/no rain.
	6:32	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	Spiltyard still pumping out of Wivenhoe Dam with about 2m to go. Water level in Spiltyard = 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 M.Lane Nth Pine - requested permission to exercise to exercise cone valve regulators - OK given - just open & close
	7:19	David Gill - SEQWB - update on storages & releases - unknown projections for Wed weather
	7:37	R.Titmarsh @ Somerset - WL 99.37 & no rain for last 2 hrs
	8:00	Fax from North Pine: GB 39.70; BCC 39.703; Digital 39.704. - 0.2mm hourly rain @ 8:00
	8:27	R.Titmarsh @ Somerset - WL 99.38 - mist only
	9:07	Fax from North Pine: GB 39.70; BCC 39.699; Digital 39.702. - 0.2mm hourly rain
	9:15	Malcolm Lane - North Pine: WL 39.968 - request to shut Gate 'A'
	9:57	Somerset EL 99.39 - No rain
	10:00	Fax from North Pine: GB 39.69; BCC 39.695; Digital 39.696. - 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

APPENDIX E

ABRIDGED VERSION OF FLOOD CONTROL CENTRE LOG SHEETS

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
03-Mar-99	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
		Sensor Invest. Request form faxed to Seqwb - 6591 - Somerset Dam Headwater (B) no longer agrees with
	17:25	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 39.718; Digital 39.712 - no rain
	23:15	Gate 'D' shut - confirmed by Brett Schultz
	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 87.24, Splityard 164.00, Twin Bridges 8cm clear
		PA discussed draining options for Wivenhoe with J.Tibaldi. JT is keen <u>not</u> to have the dams staffed if we
	7:52	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
		182.40=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
		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
	9:00	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 87.33 @ 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
		North Pine EL 39.677. The reading 30min prior was 39.682, 30 min prior 39.673, 30 min prior 39.684 -
	18:00	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
04-Mar-99	18:00	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
	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 to 1.0m
	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
	16:00	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	Spiltyard 165.60
	7:00	Somerset 99.52 - No Rain
	8:00	Wivenhoe 67.54
	10:20	Wivenhoe 67.54, Spiltyard 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 ³ =>13.6cumecs
	14:00	Wivenhoe 67.54, Spiltyard 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, Spiltyard 161.0 (15mm rain)
	18:00	Wivenhoe 67.59, Spiltyard 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	Spiltyard 158.4
	22:00	Wivenhoe 67.59
09-Mar-99	0:00	Wivenhoe 67.59, Spiltyard 158.4
	3:00	Wivenhoe 67.56
	6:00	Wivenhoe 67.51
	6:30	Spiltyard 165.6 & pumping
	7:00	Somerset 99.36 - Hydro releasing 1170ML per day (13.54 cumecs)
	8:00	Wivenhoe 67.51
	8:20	Spiltyard 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, Spiltyard 163.0
	12:00	Somerset 99.35, 9mm Rain overnight
	14:00	Wivenhoe 67.53, Spiltyard 162.0
	15:00	Somerset 99.33
	16:00	Somerset 99.32
10-Mar-99	17:00	Wivenhoe 67.52, Spiltyard 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
	0:00	Wivenhoe 67.52, Spiltyard 161.2
	6:00	Wivenhoe 67.48, Spiltyard 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
10-Mar-99	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
	12:00	at 12:00 Wivenhoe Lake level 67.47; Spiltyard level 165.4
	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)
	15:10	Andrew Maughan - Wivenhoe 67.47 (cf Alert:67.44)
	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
	18:00	Wivenhoe W.L. 67.45 @ 16:00 (A. Maughan) (cf Alert 67.40 (#6640) @ 18:00), Spiltyard 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.
	18:00	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 0.06m above weir crest @ 17:00. Alert #6569 at 17:00 approx 24.60

CTF on current rating curve would be $24.60 - (24.0 + 0.08) = 0.52\text{m}$ 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 measurement required. Note: Sensor in FCC dropped 0.1m - supports theory of power surge.
11-Mar-99	0:00	Doug Grigg Wivenhoe EL 67.42m, Splityard 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
		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	11:00	Mt Crosby gauge BCC 7.61 and constant. BCC currently using between 400-450 ML/day
JR	11:15	7 day forecasts checked. Possible +60mm on Sunday. Radar confirms weather in the North.
JR	11:30	
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
		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	19:00	
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
		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.
PA	9:05	
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 16:00
		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	15:20	John Tibaldi rang from Ipswich (home). Queried whether current downpour was affecting North Pine Dam (No)
NA	16:50	
DC	16:53	Reng M. Lane, North Pine. Digital reading 39.602. Gauge board just over 39.60.
		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.
DC	16:00	Wivenhoe event log fax received
NA	16:30	
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
		Andrew Maughan. Wivenhoe Dam EL 67.17 @ 18:00, Splityard 163.10, Mt Crosby @ 7.61m (cf Alert @ 7.60) & Colleges Crossing at 0.47m on temporary gauge board (down from 0.49 yesterday & 14cm under deck)
PA	18:00	
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
		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.
KN, DC	8:00	

MARCH 1999 Event

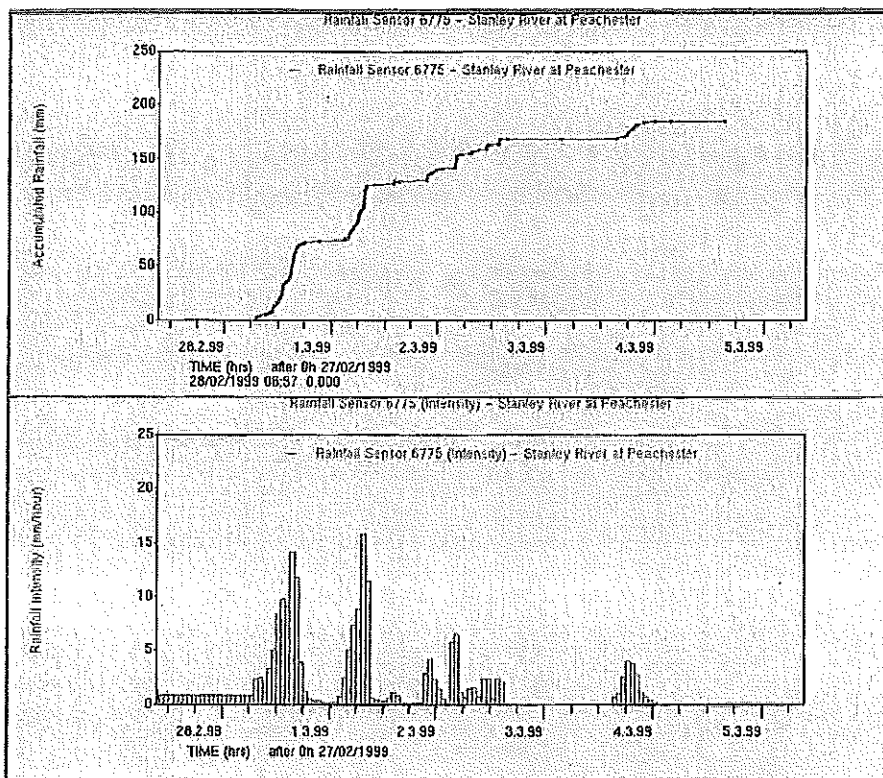
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Date	Time	Action/Comment
DC	9:00	Wivenhoe EL 67.10, Splityard 162.6
KN	9:30	Confirm fax from Rob Titmarsh regarding closure of all crest gates on Somerset Dam
KN	10:00	Malcolm Lane phoned from North Pine Dam. Gauge Board 39.60, BCC 39.603, Digital 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

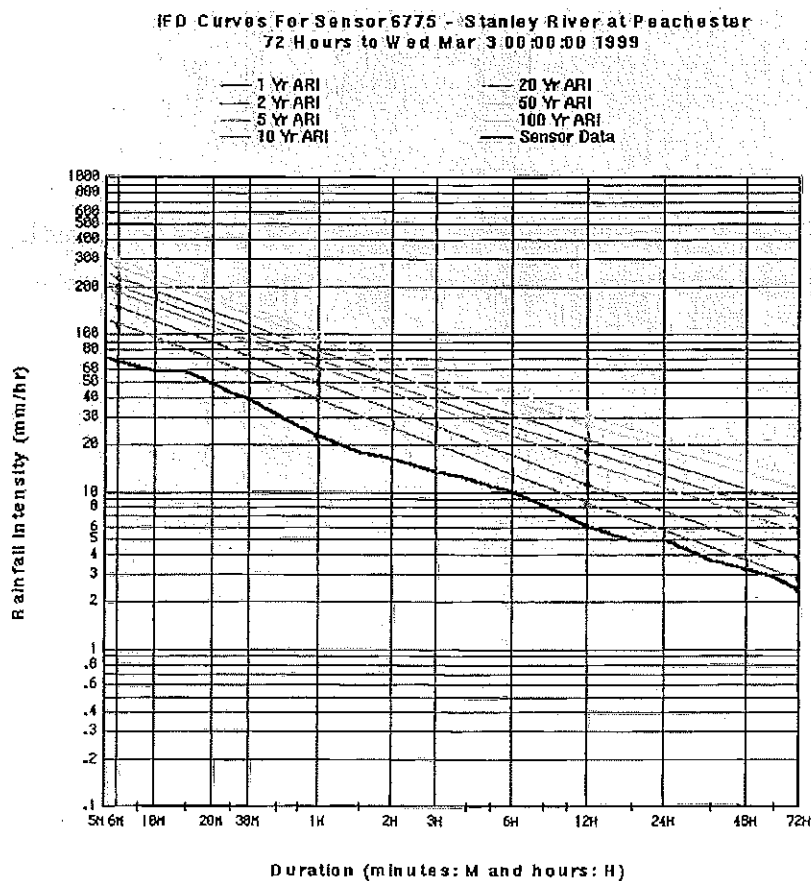
APPENDIX F

**REPRESENTATIVE CUMULATIVE RAINFALL AND IFD CURVES FOR
MARCH 1999 EVENT**

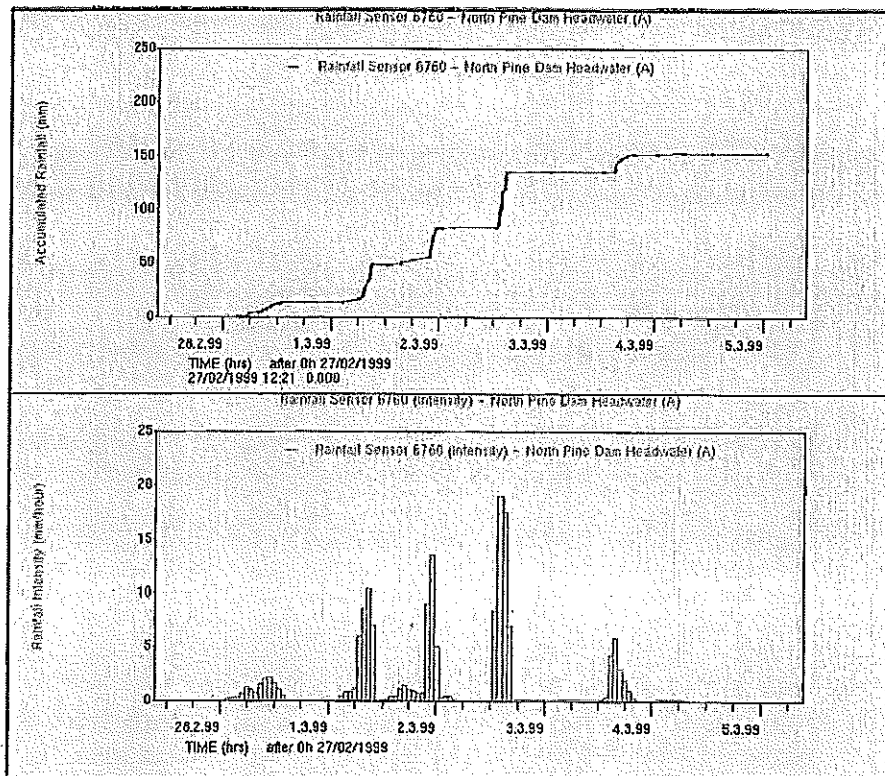
APPENDIX F- Cumulative Rainfalls & IFD Curves for March 1999 Event



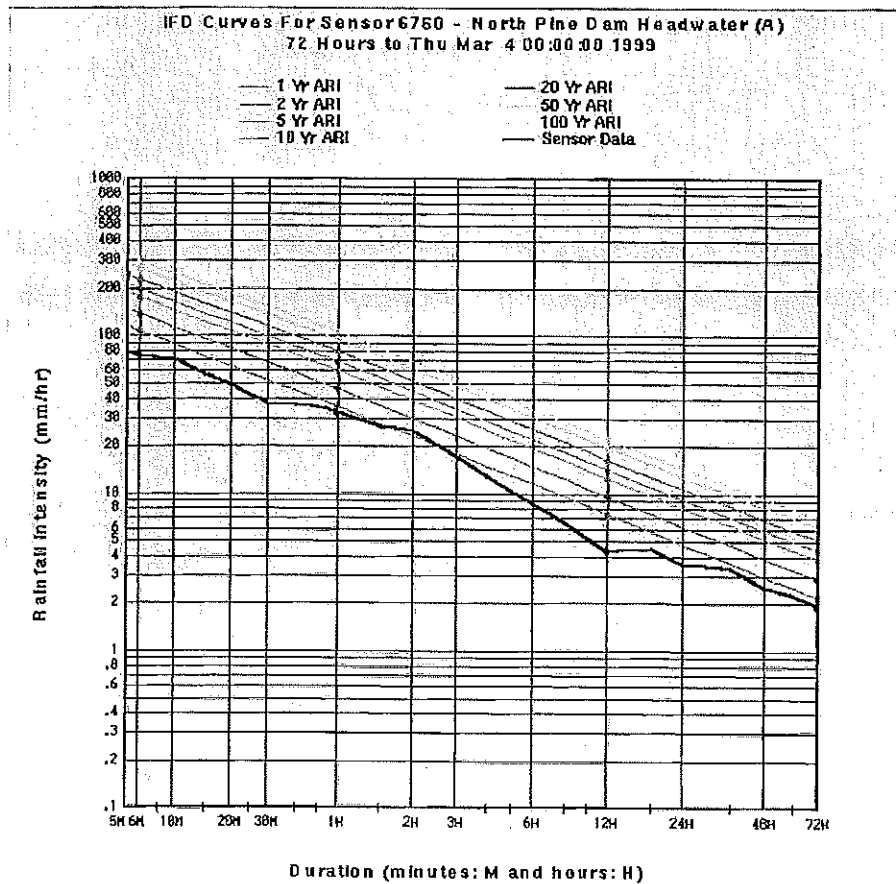
Somerset Catchment Rainfall Sensor 6775 - Stanley River at Peacheater



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



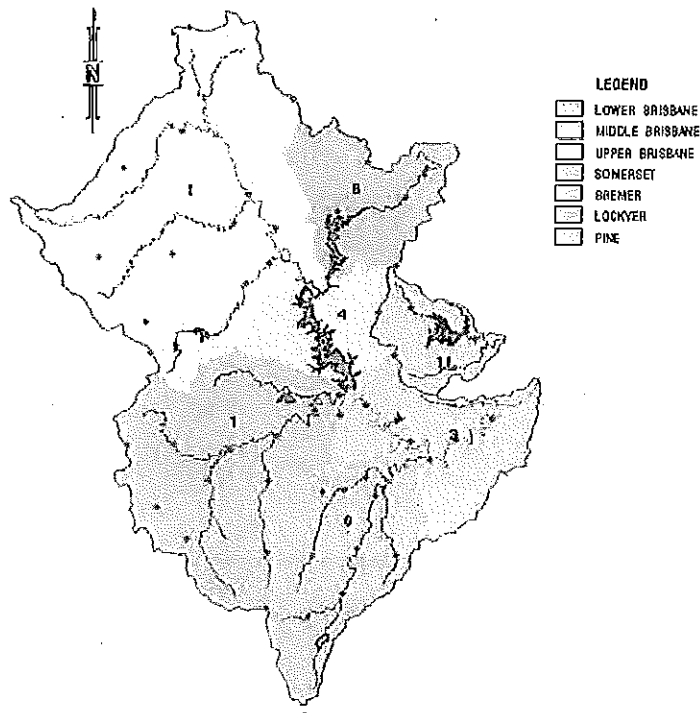
Pine Catchment Rainfall Sensor 6760 - North Pine Dam Headwater



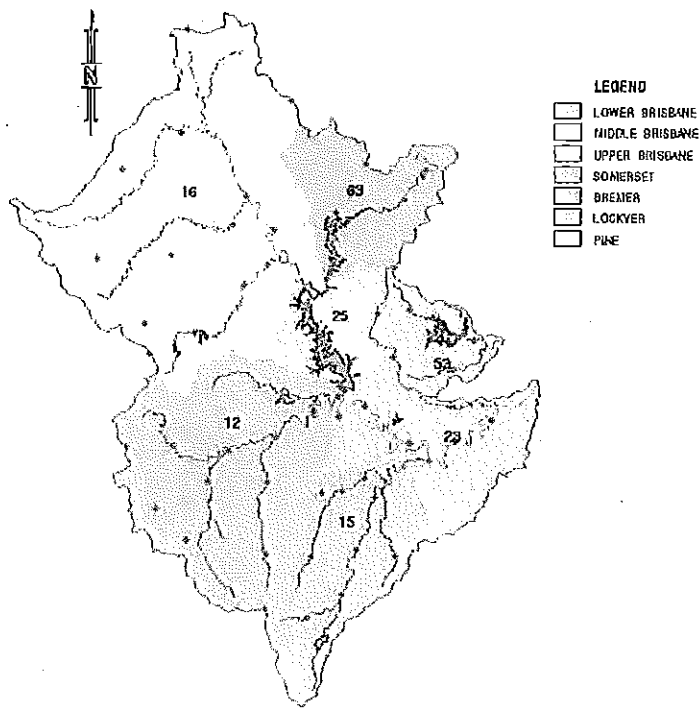
APPENDIX G

CATCHMENT RAINFALLS FOR MARCH 1999 EVENT

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



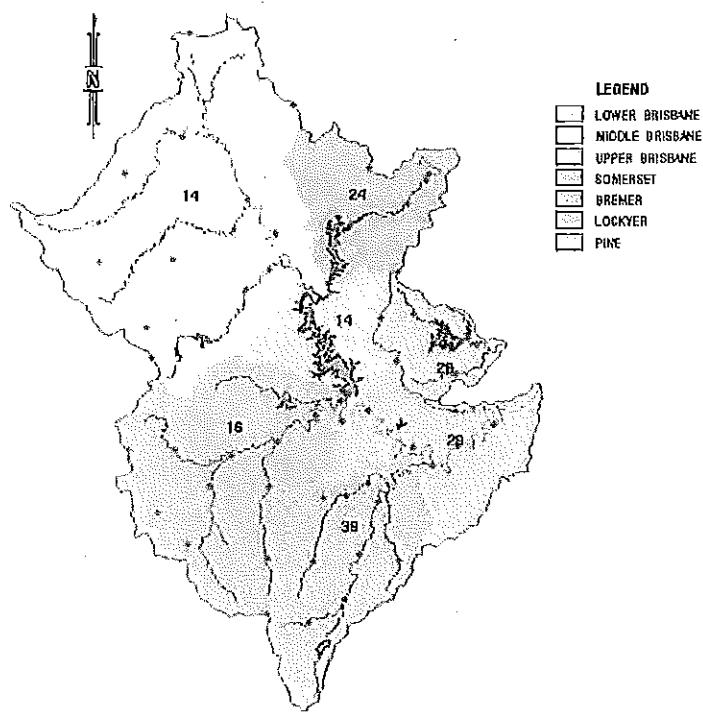
Sub-Catchment 24hr Total Rainfall to 9:00am 28/2/99



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

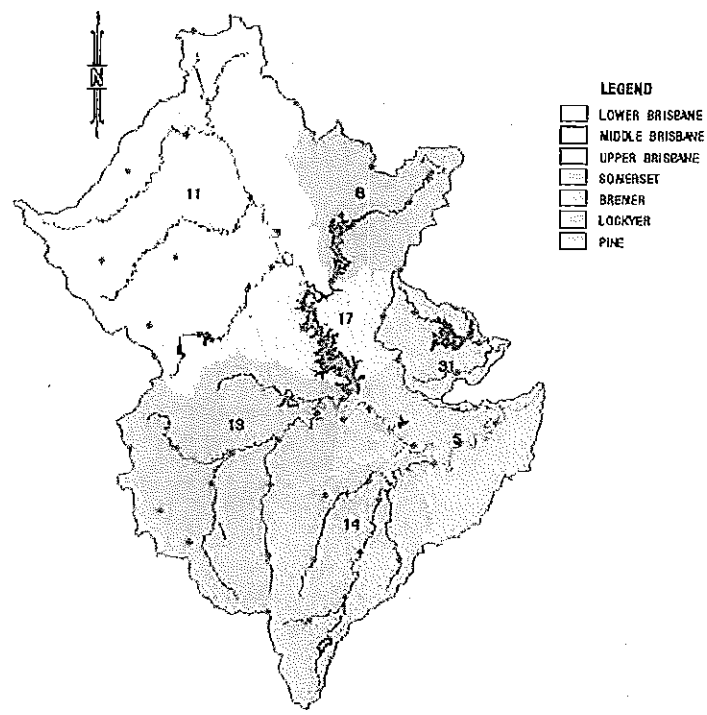
APPENDIX G
Sub-Catchment 24 hour Total Rainfall for March 1999 Event

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

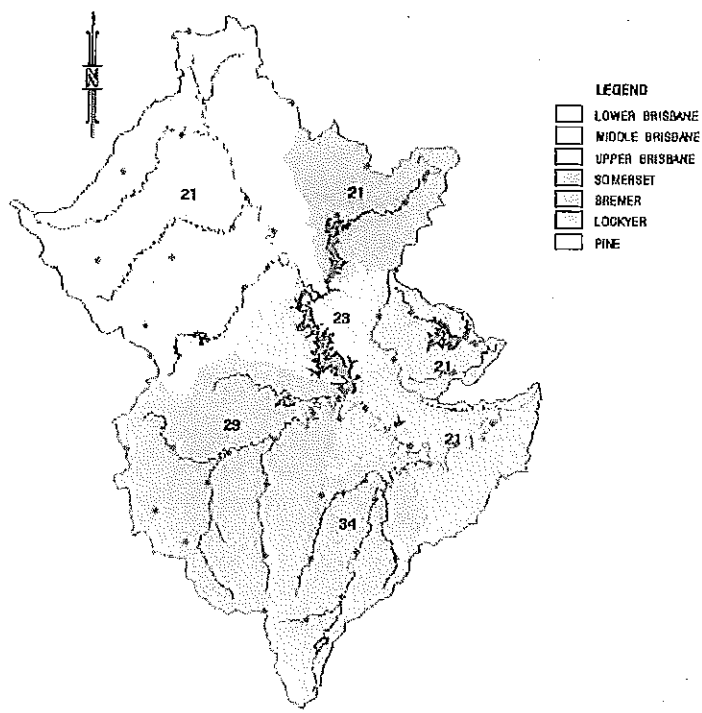


Sub-Catchment 24hr Total Rainfall to 9:00am 3/3/99

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



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

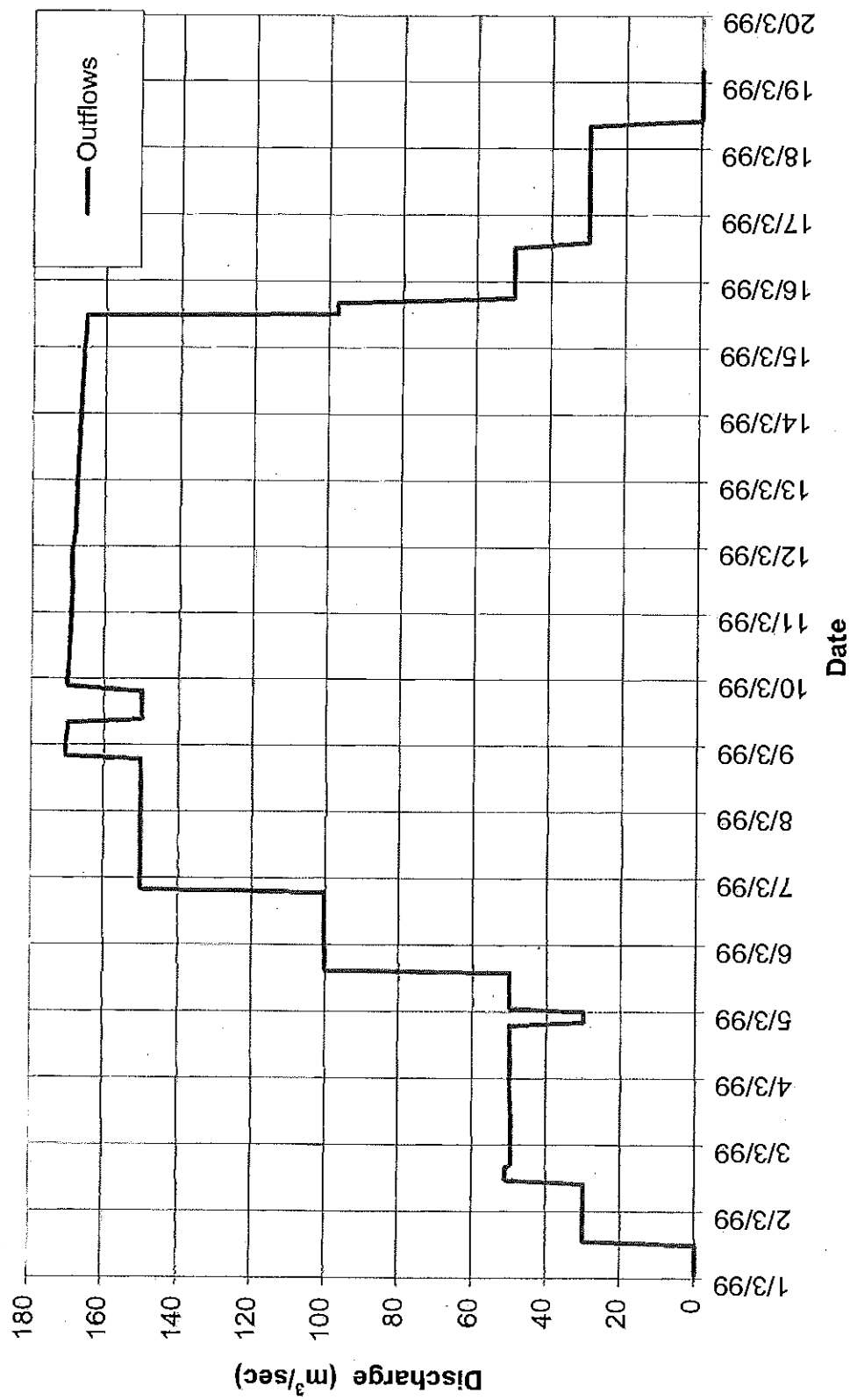


APPENDIX H

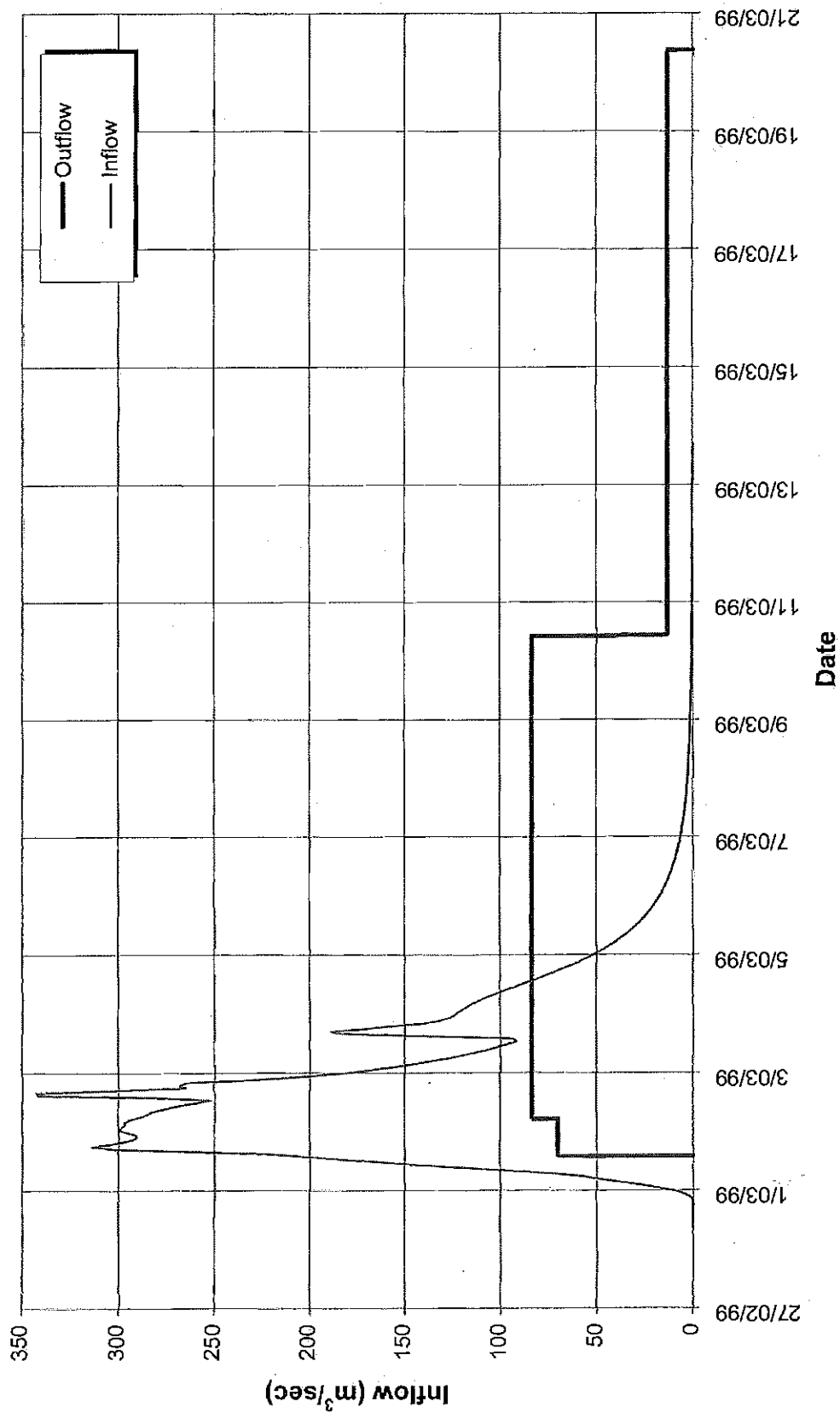
INFLOW and OUTFLOW HYDROGRAPHS MARCH 1999 EVENT

Wiv Q Graph

Wivenhoe Dam - Discharges March 1999 Event

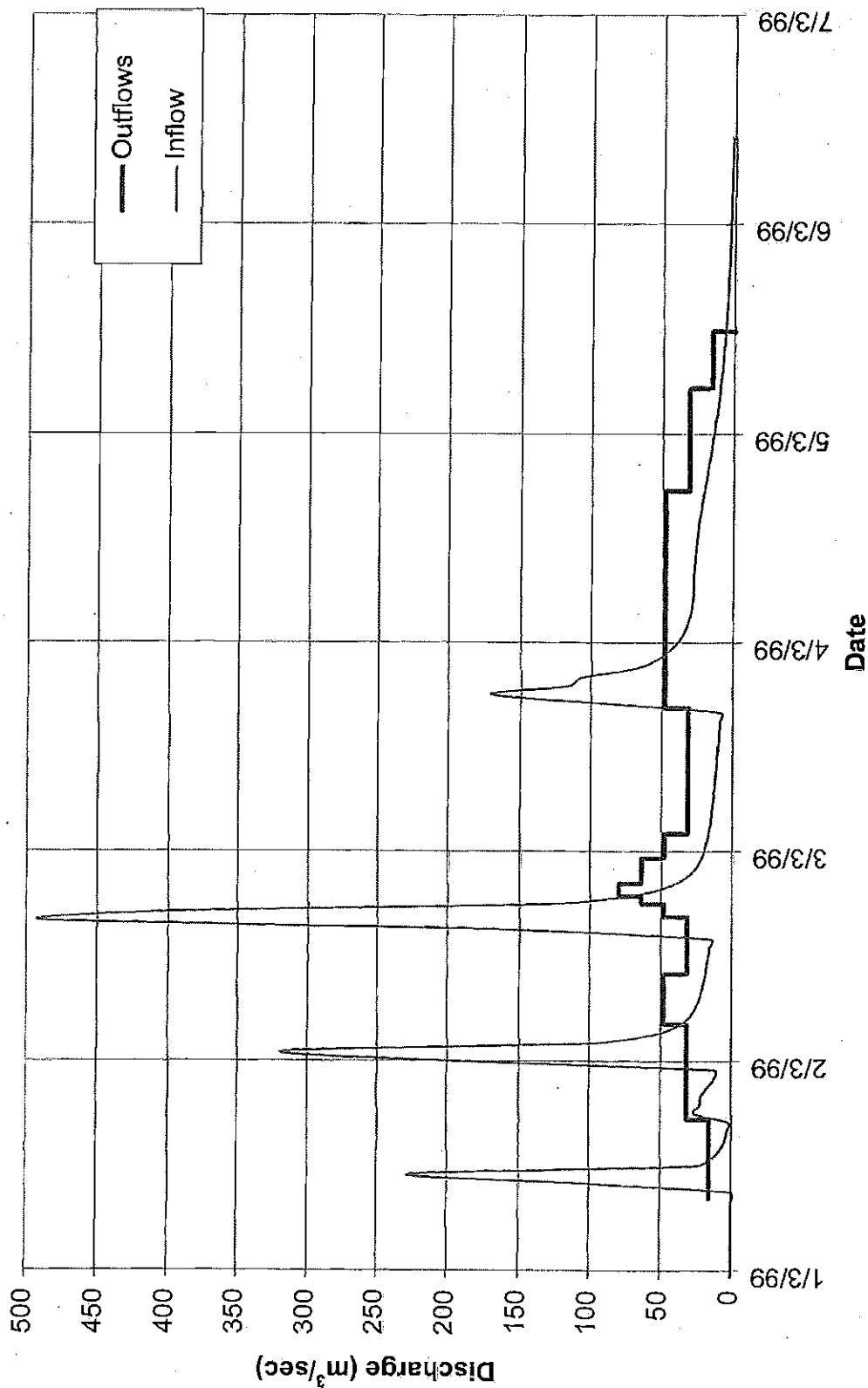


Somerset Dam - Inflows & Outflows - March 1999 Event



NP Q Graph

North Pine Dam Outflows - March 1999 event

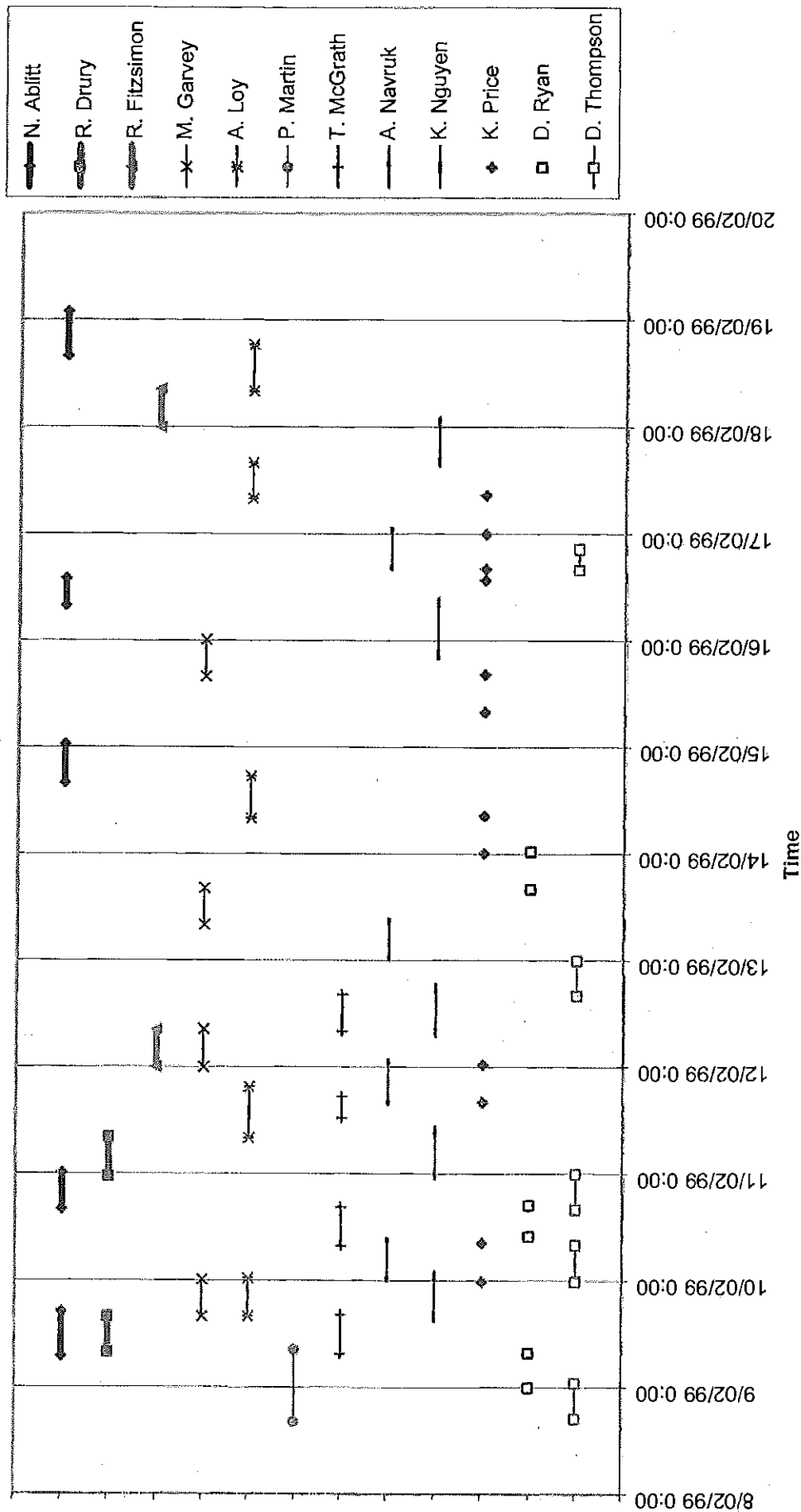


APPENDIX I

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

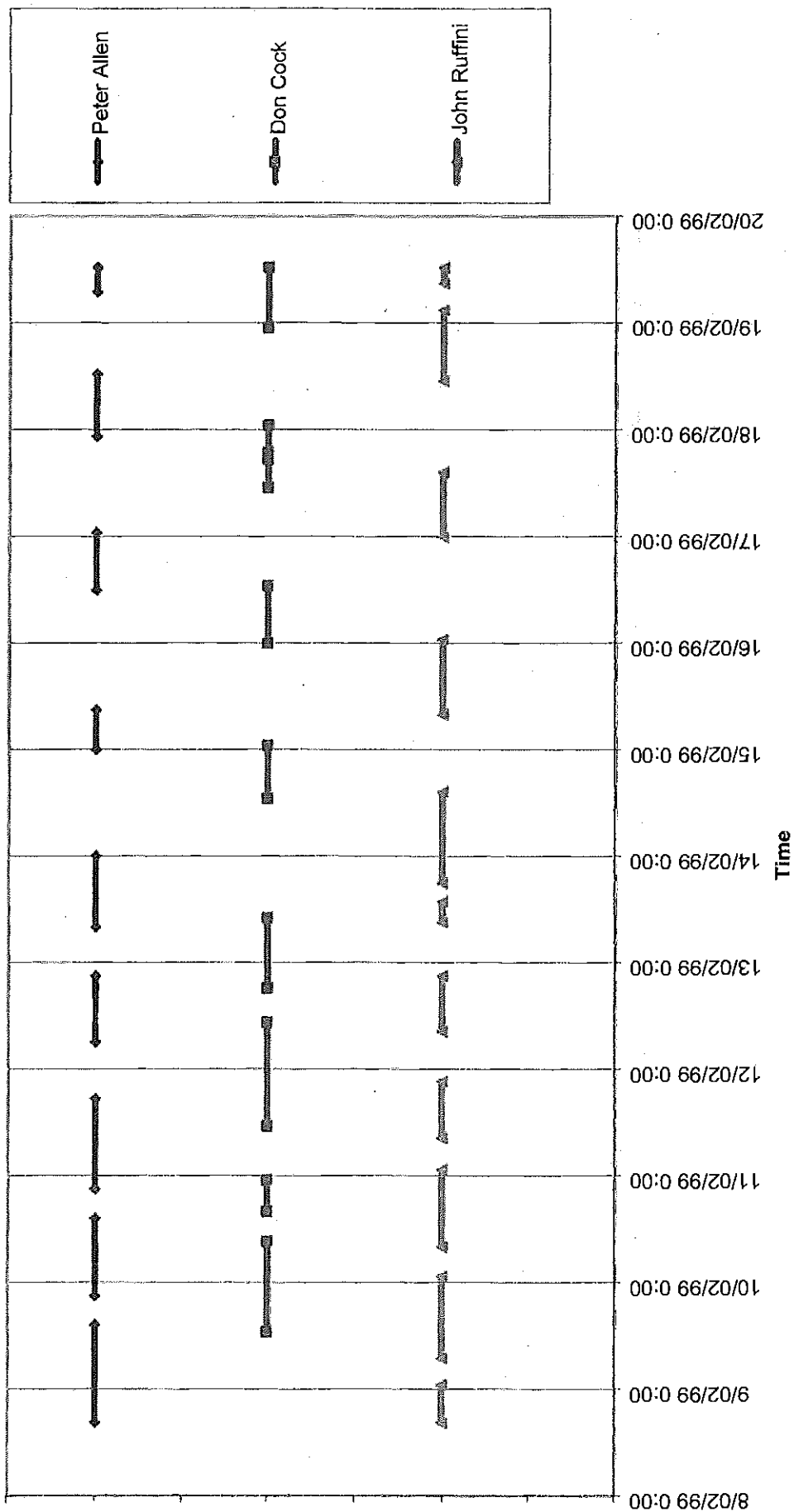
APPENDIX I

Data Collector Duty
February 1999 Flood Event



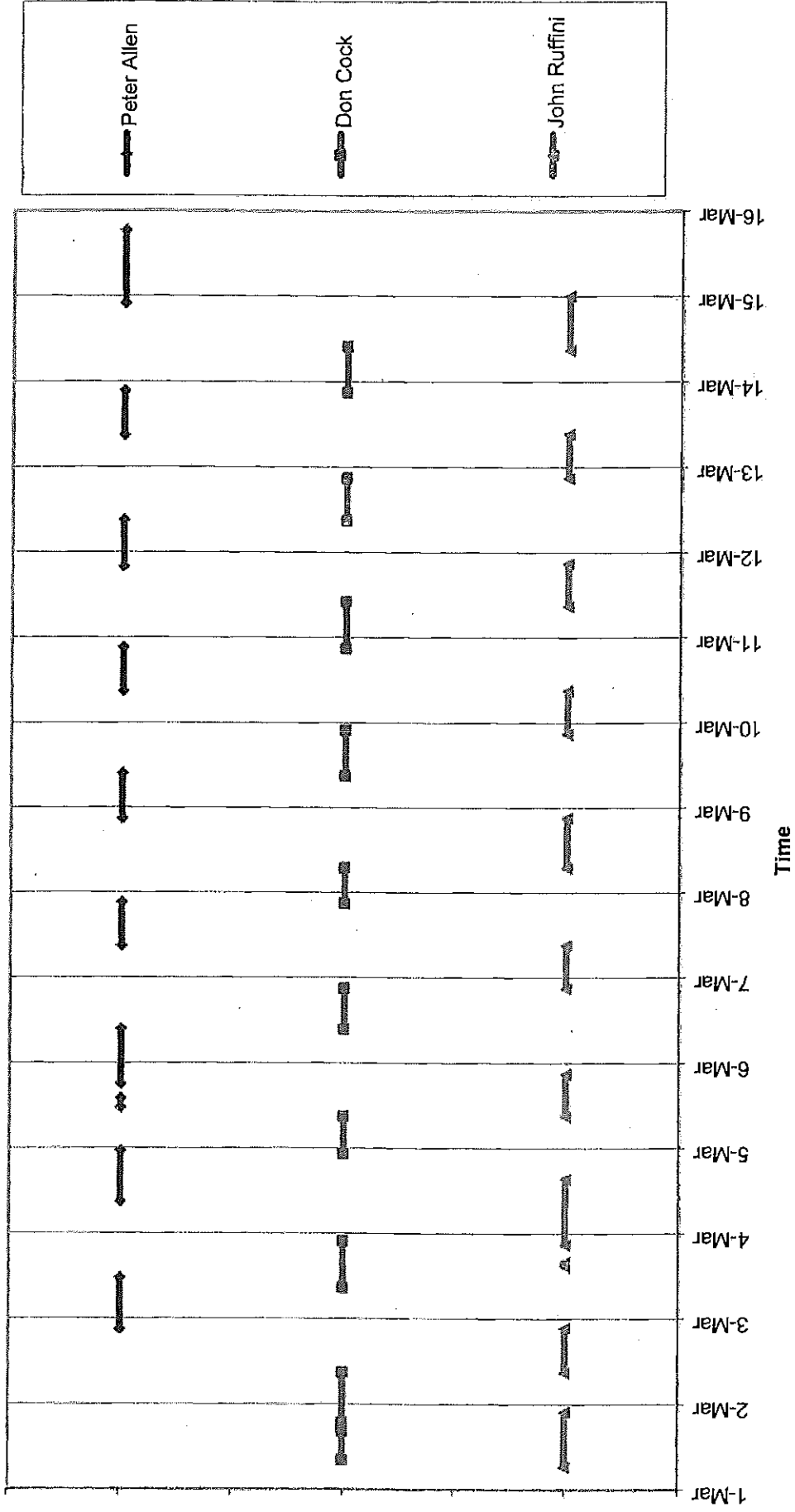
APPENDIX I

Duty Engineer Duty February 1999 Flood Event



APPENDIX I

Duty Engineer Duty March 1999 Flood Event



APPENDIX I

Data Collectors Duty March 1999 Event

