BUREAU OF METEOROLOGY
QUEENSLAND REGIONAL OFFICE

FLOODS ASSOCIATED WITH SEVERE TROPICAL CYCLONE JOY

DECEMBER 1990 - JANUARY 1991

INTRODUCTION

Most of the estimated $300 million damage attributed to Severe Tropical Cyclone Joy resulted from the high intensity rainfalls along the Central Queensland coast and the subsequent extensive flooding of river systems between Ingham and Rockhampton.

High level flooding of the Mackenzie and Fitzroy Rivers in particular caused high rural damages during the last week of December and the first week of January. The flooding at Rockhampton during the second week of January was the third highest since records began in about 1860. About 260 homes were flooded and all road, rail, and fixed-wing air transport links to and from Rockhampton were cut.

Six lives were lost in the aftermath of Cyclone Joy.

FLOOD WARNING SERVICES

The Flood Warning Centre in Brisbane issued 192 flood warnings during December and January. Many of these were for flooding of river systems on the north and central Queensland coast affected by Cyclone Joy and its rain depression. Flood warning services progressively widened to include other areas of the State by the end of January as conditions continued to deteriorate in the Gulf rivers and inland river systems.

Flood warnings were provided for coastal streams between Cooktown and Ingham from 23 December 1990, as this part of the coastline came under the influence of JOY. Warnings for coastal streams between Townsville and Mackay commenced at 8pm on 25 December, and for Mackay to St Lawrence at midnight on 26 December.

Flood warnings were provided for the Tully, Herbert, Haughton, Burdekin, Don, Pioneer, Connors River, Funnel Creek, Isaac, Mackenzie and Fitzroy Rivers in the weeks following JOY's crossing of the coast near AYR on 26 December.

River height predictions were provided for a number of key locations including Mackay and Rockhampton. Services for these areas are discussed in more detail later in this report.

FLOODING

Main flooding and damage was in coastal streams between Townsville and Rockhampton, where rainfalls exceeded 500 millimetres in the period 23 December to 7 January. In the Bowen to St Lawrence area, rainfalls for the same period totalled

1000 to 2000 millimetres, with rainfall stations in the Mackay hinterland and in coastal districts immediately to the south of Mackay recording over 2000 millimetres.

Johnstone Rivers (Innisfail)

River levels in the North and South Johnstone Rivers peaked below minor flood level on the 24 and 25 December.

Tully River

River levels in the lower Tully River around Euramo initially peaked near minor flood level on the 25 December. Flooding re-commenced in the Tully River in the week commencing Friday 10 January. Several moderate flood peaks occurred in the Tully River between the 10 and 15 January, with water levels slightly above the Bruce Highway at Euramo.

Herbert River

The Herbert River peaked below minor flood level around the Christmas period. More serious flooding developed in the Herbert River from the 10 January. Three flood episodes occurred between the 10 and 15 January, causing near major flooding at Ingham and major flooding downstream at Halifax and neighbouring communities. The highest peak at Gairloch was 11.32 metres on Saturday 12. Floodwaters entered the main street of Ingham which required the commercial area to take precautions, but was mainly restricted to flooding of house yards in low lying residential areas.

The Hinchinbrook Shire Council provide a local Flood Information Service during flood events which is closely coordinated with the Bureau's service.

Haughton River

The town of Giru on the lower Haughton River floodplain was inundated several times during December and January. Four major flood peaks were recorded up to 17 January. The highest was 2.40 metres on Friday 4 January. Further flooding of Giru occurred in early February.

Burdekin River

Minor flooding persisted in the lower Burdekin River and its tributaries until mid-January. A series of peaks were recorded at Inkerman Brisge between Ayr and Home Hill.

Severe flooding of the lower Burdekin River followed in the first week of February.

The Burdekin Shire Council closely monitored the recently installed ALERT system in the lower Burdekin catchment, and provided detailed flood warnings for their area. The ALERT system is a joint project between the Bureau and the Council, and was installed only a few weeks before JOY. The Bureau Flood Warning Centre maintains close contact with Council officers during operational flood warning periods.

Don River

The Don River near Bowen responded to bursts of heavy rain throughout the period from 26 December when JOY crossed the coast until the 4 January. Flood peaks at the Bowen Pump Station were generally about 5 metres, which causes moderate flooding of farming lands in the Don River delta. Higher floods occurred in the first week of February. Close contact was maintained between the Bowen Shire Council and Bowen SES. These organisations were using real-time information from the Don River ALERT system installed in cooperation with the Bureau.

Proserpine River

River rises in the lower Proserpine River were below minor flood level because the new Peter Faust Dam was near empty at the start of the event.

Pioneer River

The Pioneer River at Mackay had a series of sharp river rises and flood peaks during the period 27 December to 4 January in response to periods of heavy rain in the Mackay hinterland. Main flood peaks recorded were:

Thursday 27 Dec	1100	6.95 metres	(Moderate)
Saturday 29 Dec	2000	6.90 metres	(Moderate)
Sunday 30 Dec	1100	7.60 metres	(Major)
Thursday 3 Jan	1400	7.40 metres	(Major)
Friday 4 Jan	1500	7.00 metres	(Moderate)

The higher peaks occurred with the high tide. Flood levels were below the levee protection for Mackay, although the 7.6 metre peak caused some "street" flooding of the Cremorne area. A flood level of 7.8 metres at Mackay starts to cause more serious flooding. There was obviously severe local and drainage problem flooding throughout the period at Mackay, and considerable attention was placed on the high risk of serious flooding from the Pioneer River.

Flood warnings were current for the area almost continuously from 25 December. Warnings were updated at about 3 hourly intervals during critical periods. Forecast heights/times were given for the river level at Mackay, and these were accurate within about 0.2 metres. The largest prediction error was an over-estimate of 0.4 metres (predicted 7.4m, peak was about 7 metres).

The Bureau Flood Warning Centre worked in close consultation with Ulman & Nolan engineers who provide advice to Mackay City Council as to detailed flood effects and preventative actions.

THE ROCKHAMPTON FLOOD

In the days and weeks following the coastal crossing of Tropical Cyclone Joy near Ayr on the 26 December, the City of Rockhampton experienced its most damaging flood in thirty seven years. The Fitzroy River at Rockhampton finally reached a peak of 9.3

metres on Saturday 12 January which is the third highest since records began in about 1860.

The Fitzroy River basin covers an area of some 140,000 square kilometres to the east of the Great Dividing Range in central Queensland. Its major tributaries are the Nogoa, Comet, Isaac, Connors, Mackenzie and Dawson Rivers.

As was the case for the Cyclone Charlie flood almost three years ago, the 1991 flood at Rockhampton was primarily caused by high rainfalls and flood runoff from the Isaac-Connors system to the north of Rockhampton, together with lesser flows from the Mackenzie, lower Dawson and the Rockhampton area.

Fitzroy Basin Rainfalls

Flood rains were recorded along the central Queensland Coast between Townsville and Rockhampton from about the 23 December to the 6 January, caused by Cyclone Joy and its continuing rain depression after crossing the coast near Ayr on Boxing Day. The attached table shows 24 hourly rainfalls (to 9am) for key stations in or adjacent to the Fitzroy drainage basin.

Within the fortnight of rain in the area, two periods of heavy rain occurred which contributed significantly to the Rockhampton flood. The first period was from the 27 to the 30 December where rainfalls were typically 150 to 250 millimetres per day in coastal areas from Rockhampton northwards. The highest one day total reported from within the Isaac-Connors system was 458 millimetres at Blue Mountain (30 kilometres inland from Sarina) for the 24 hours ending 9am 30 December.

Three day totals (to 9am Sunday 30 December) in the Isaac-Connors River system included Blue Mountain 831 millimetres, Nebo 366 millimetres and Carfax 297 millimetres. The Rockhampton district also recorded very high rains in the same period with totals of Rockhampton 495 millimetres, Yaamba 627 millimetres and Mt Morgan 514 millimetres.

The second burst of heavier rain was from the 2 to the 5 January with Blue Mountain recording a four day total of 717 millimetres. Rockhampton received a further 192 millimetres in the four days to 9am Saturday 5 January. Showers and thunderstorms persisted for the next week.

Local flooding at Rockhampton

Severe local flooding was generated in the areas of heavy rain. The Fitzroy River at Rockhampton rose quickly during Saturday 29 December and overnight to reach 7.45 metres by late Sunday. This was primarily produced by high runoff from the local streams flowing into the Yaamba to Rockhampton reach of the Fitzroy River. A river level of 7.3 - 7.4 metres was maintained at Rockhampton until Thursday 3 January when slow rises commenced with the arrival of the leading edge of the upstream floodwaters.

First flood peak at Rockhampton

The first period of heavy rain in the coastal districts between Rockhampton and Mackay caused river levels in the upper Connors River and Funnel Creek to rise rapidly to major flood levels during Thursday 27 and Friday 28 December. The Connors River at Cardowan peaked at 16.8 metres during the morning of Sunday 30 which is about 2.3 metres less than the Cyclone Charlie flood of March 1988.

Peak flows from the Connors-Isaac system extended to the Mackenzie River at Tartrus during Sunday and Monday. The peak flood level at Tartrus was 18.1 metres early on New Years Day (Tuesday). At this station, flood levels had exceeded the March 1988 flood by 0.2 metres.

The flood peak travelled down the Mackenzie during the first few days of January to reach the Fitzroy River at Riverslea overnight on Thursday 3 January. Combined flows from the lower Dawson River and the Mackenzie River produced a flood peak of 27.2 metres at this station. This peak extended to Yaamba by Sunday 6 January (16.5 metres), and Rockhampton recorded its first peak of 9.15 metres on Monday 7 January. By this time, all road and rail links to Rockhampton were cut, and several hundred people had been evacuated from residential properties. The Rockhampton airport was closed from Saturday 5 January.

Second flood peak at Rockhampton

Rockhampton's second flood peak was again generated in the Connors and Isaac River system. The renewed onset of very heavy rains in this area during 2-5 January resulted in high volume flood runoff from the upper Connors River with levels slightly higher than those experienced five days earlier. The Mackenzie River at Tartrus peaked at 18.0 metres on Sunday 6 January, only ten centimetres below its first peak.

The Fitzroy River at Riverslea had fallen less than 1.5 metres when it began to rise again early on Monday 7 January. The final peak at Riverslea was 28.04 metres on Tuesday night. Major flood levels downstream at Yaamba and Rockhampton remained almost steady in the days following their first peak before commencing very slow rises with the second floodwaters. Yaamba finally peaked at 16.65 metres on Thursday 10 January. At Rockhampton, flood levels peaked for the second time at 9.30 metres on Saturday 12 January, fifteen centimetres higher than the Monday peak.

By 9am Monday 14 January, water levels at Rockhampton had fallen about half a metre and cleanup operations were well underway.

Comparison with previous floods at Rockhampton

The Rockhampton flood peak of 9.3 metres was the third highest since records began in about 1860. The highest on record is the January 1918 flood of 10.11 metres, followed by the 9.40 metre flood of February 1954. (See attached figure showing a plot of the river heights recorded in each of these events).

In terms of duration of flooding, the 1991 Rockhampton flood is similar to the 1954 flood. For example, the 1954 flood and the 1991 flood remained above 8 metres for about 13 days. Whilst this is a significant period for flood operations, it is worth noting that the 1918 flood remained above 8 metres for 26 days, and above 9 metres continuously for 13 days.

Fitzroy River Flood Warning System

The Bureau of Meteorology provides flood warning services for the Fitzroy River basin. A network of volunteer rainfall and river height observers provide reports to the Bureau computer systems via a terminal connected to the observers' telephones. The river height reports are collated automatically into bulletins which are sent to police, radio stations, State Emergency Service and local authorities.

The rainfall and river height data is analysed by the Bureau's Flood Warning Centre in Brisbane. Flood warnings for the Fitzroy River and its tributaries are issued to the authorities active in flood operations, including those listed above. River height predictions are given for the Fitzroy River at Rockhampton.

The Bureau works closely with the Rockhampton City Council and the State Counter Disaster Organisation during flood periods. (For further details, refer to the Bureau of Meteorology booklet "Fitzroy Flood Warning System")

Bureau river height predictions for Rockhampton

A summary table of predictions made for Rockhampton is given. The warning of 1645 31 December provided approximately six days warning (to the Rockhampton peak) that a flood was expected with flood levels possibly higher than the March 1988 (8.4 metres). This was issued before key upstream stations had peaked. At this stage, the timing of the flood was estimated to be about Wednesday 9 January.

Subsequent predictions for Rockhampton were made difficult by the continuing rain in the catchment area (see Table 1), and were updated as the situation changed and upstream river station peaks were recorded. Considerable pressure was placed on the Bureau predictions in the days leading up to the first peak, with other predictions being generally at the 1954 flood level (9.40 metres), and higher.

The first quantitative prediction was given as 8.8 metres on Tuesday 8 or Wednesday 9 in the warning of Tuesday 1 January. The warning of Wednesday brought the timing of the peak forward to Monday or Tuesday. The Thursday warning (1630 hours 3 January) updated the peak to about 9 metres with a 3 to 4 day lead time. The Saturday 5 January prediction was updated to about 9.2 metres with a lead time of 1 to 2 days.

The river level at Rockhampton peaked at 9.15 metres overnight Friday and remained steady during Monday.

In the warning of 1030 the next day (Tuesday), a prediction that Rockhampton would commence to rise during Wednesday or Thursday and be ten to twenty centimetres higher than the 9.15 metre peak during Friday night and Saturday. The final flood peak was 9.30 metres early Saturday morning.

Interaction with External Organisations during Fitzroy Flood

Bureau flood warning staff provided regular briefings and information directly to Rockhampton City Council, Queensland Railways, Capricornia Electricity Board and State Emergency Service in addition to the flood warning and river height bulletin distribution.

A number of live or taped interviews were given to ABC Rockhampton (radio) in particular. The Bureau of Meteorology office at Rockhampton handled numerous enquiries throughout the flood period. Flood warnings and predictions were also available through the Bureau's telephone recording service (1190 in Brisbane, 1196 in Rockhampton).

SYSTEMS PERFORMANCE

The Bureau's Flood Warning Service is based on a range of different data collection and communication systems. The rainfall and river height data is processed by the Flood Warning Centre in Brisbane which formulates and issues the flood warnings and forecasts to the media, Police, State Counter Disaster Organisation/State Emergency Service, and local Councils, and several other organisations. Flood ALERT systems have been installed in the Johnstone Rivers (Innisfail), lower Burdekin River and tributaries (Ayr), and the Don river (Bowen). In each case, the ALERT system is jointly operated by the Bureau and local Shire Council. These systems automatically provide real-time rainfall and river height data through radio communications to a base station computer located at the Council offices. During the flooding associated with JOY, the ALERT systems proved to be of tremendous value to the Councils and the Bureau. Overall the ALERT systems functioned well, although there was a number of station failures which are being investigated.

In the other river basins, the primary data is obtained from a volunteer rain and river observer network maintained by the Bureau. Each observer is supplied with field equipment (rain gauge and/or river gauges), and a device for reporting each observation to the Bureau. This device, known as a ROT (Remote Observer Terminal), connects to the observer's telephone and enables direct transmission of reports to the Bureau computer. This system functioned without fault, apart from the odd failure of individual ROT's.

Some key river height information is also obtained through Water Resources Commission gauging stations which have a telephone-telemetry capability. For these, the Bureau computer telephones a device at the WRC Station and collects the current river height. These stations are proving to be a valuable contribution to the flood warning service. Most operated continuously through the floods, although there were a few individual station failures.

All of the above systems rely on Telecom telephone communications to the Bureau's Flood Warning Centre. In this event, telephone services remained reliable.

River height bulletins (up to 5 times daily) are automatically prepared and despatched via telex and facsimile by the Bureau's regional computer system (AROS).

This system enables river height and bridge level details to be received by the police, SES, media and local Councils within one hour of the Bureau receiving the reports. AROS also handles the dissemination of cyclone and flood warnings, and the routine weather forecast products. AROS enabled a timely and effective information flow between the Flood Warning Centre and the organisations involved in the flood warning and response system.

FITZROY BASIN RAINFALLS

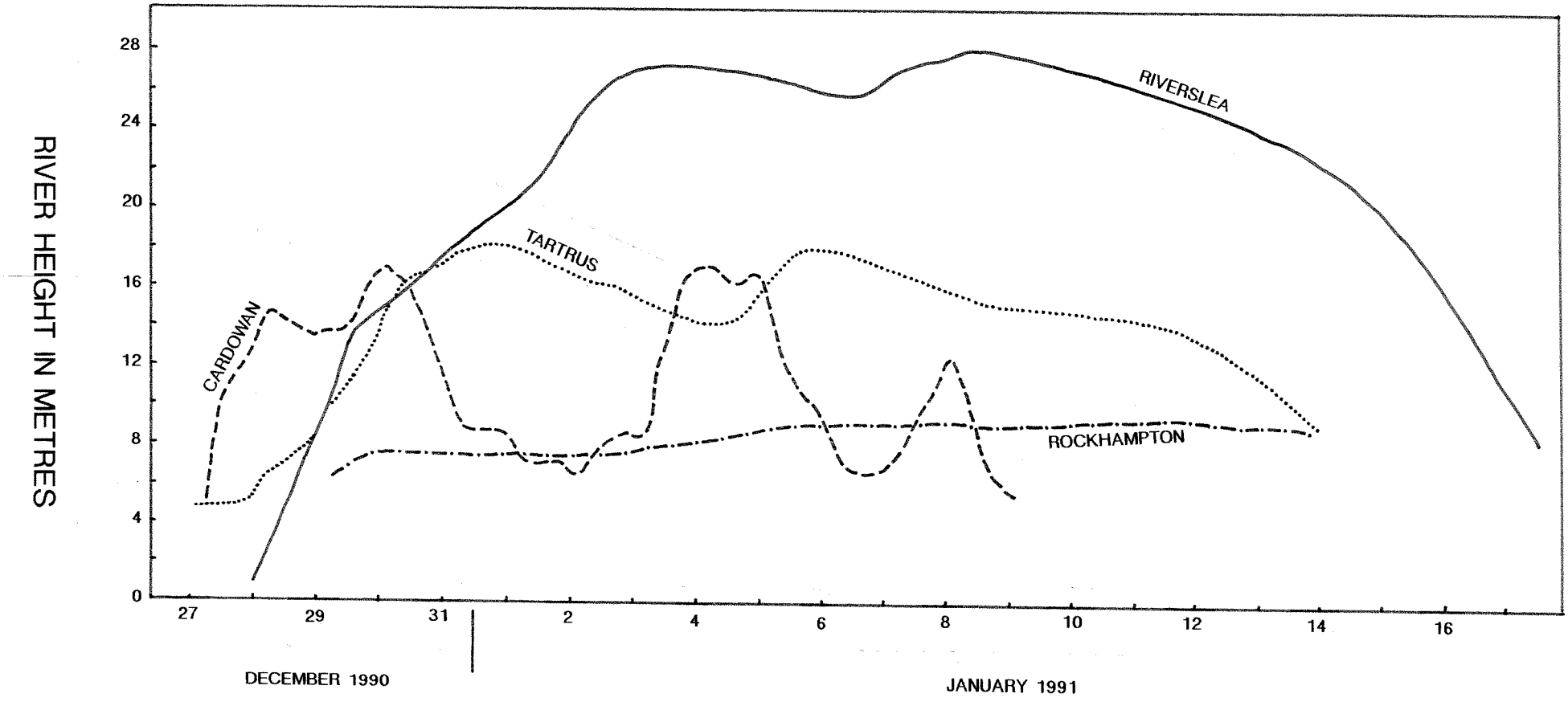
Station	Daily Rainfall(millimetres)										
	27/12	28/12	29/12	30/12	31/12	1/1	2/1	3/1	4/1	5/1	6/1
Marlborough	24[2]	125	171		81[2]		11[2]	11	66	105	
Byfield	12	208	183	165	31		48	17	100		11
Yaamba	7	256	237	134	23	5	7	8	83	66	4
Yeppoon	9	136	147	195	44	14	14	11	90	21	16
Rockhampton	7	163	192	140	20	12	18	40	77	57	5
Mt Morgan	8	169	241	104	14	4	10	10	71	94	8
Sarina	347	261					1052[4]	136	268		
Blue Mountain	281	206	167	458	82	71	108	124	295	190	69
Nebo	123[2]	70	29	267	38	20	41	60	131	33	
Carmila	122	193	192	205	83	61	44	66	410	29	5
Carfax	23	73	47	177	19	2	4	11	100		9
Moranbah	59	55	29	84	3		4	5	6		1
St Lawrence	37	152	232	90	73	9		21	100	75	22
Emerald	1	25	46	122	0.2		2	5	15	19	20
Clermont	18	94	52	14	2	2	2	8	29	4	12
Capella	7	55	50	17			8[2]	4	28	45[2]	45

Notes:

1. Subscript used where rainfall total is for more than one day. For example, [2] indicates that rainfall is for 2 days.
2. Gaps can be either zero or NO REPORT.

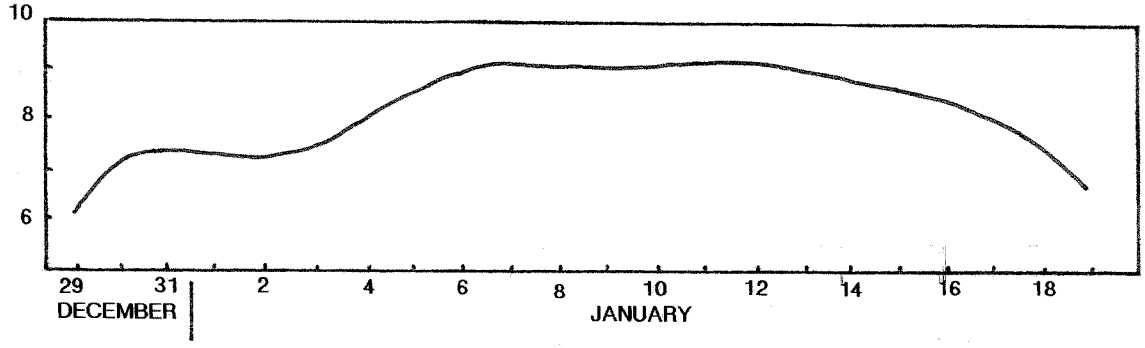
FITZROY RIVER BASIN

FLOOD HYDROGRAPHS - DEC 90 - JAN 91

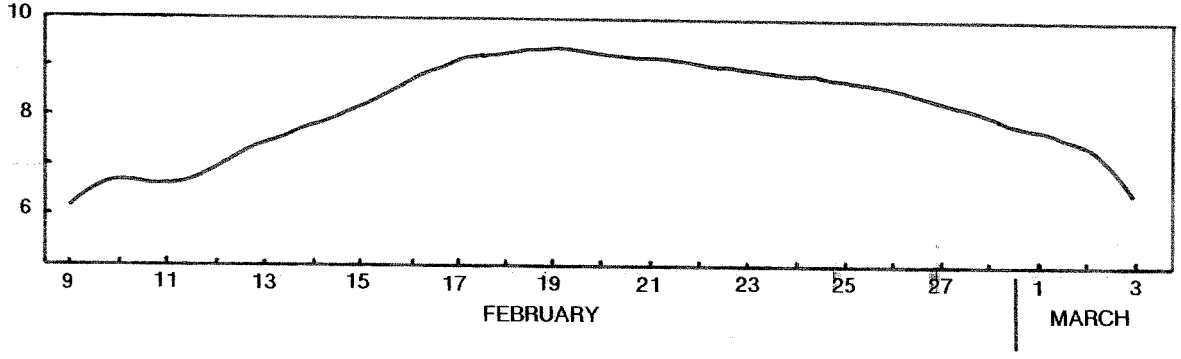


ROCKHAMPTON - RECORD FLOODS

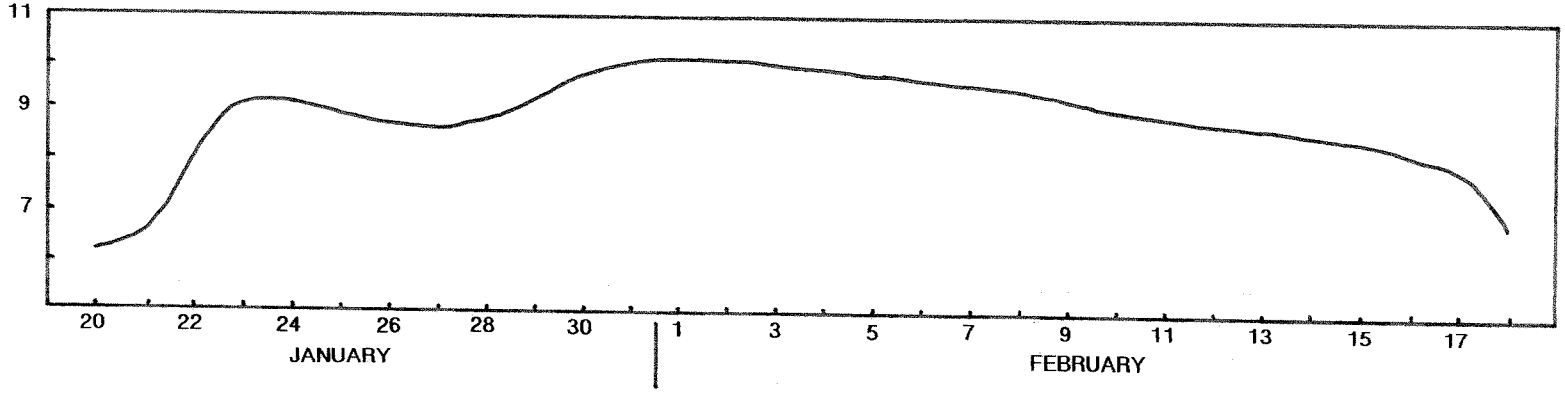
RIVER HEIGHT IN METRES



DEC 1990 - JAN 1991



FEB - MAR 1954



JAN - FEB 1918

FITZROY RIVER - DECEMBER 1990/JANUARY 1991
KEY RIVER HEIGHT PREDICTIONS FOR ROCKHAMPTON

Issue Date & Time		Rockhampton Prediction
31/12/1990	MON 1130	Expected to be similar but possibly higher than March 1988 8.40 metres by Wednesday 9/1/1991
01/01/1991	TUES 1130	Approximately 8.80 metres by 8 or 9/1/1991 (Reach 8.00 metres during Saturday 5/1/1991)
02/01/1991	WED 1130	Approximately 8.80 metres by 7 or 8/1/1991 (Reach 8.00 metres by late Friday 4/1/1991 or Saturday 5/1/1991)
03/01/1991	THURS 1200	Approximately 8.80 metres by 7/1/1991 (Reach 8.00 metres by late Friday 4/1/1991 or Saturday 5/1/1991)
03/01/1991	THURS 1630	Approximately 9.00 metres by 7/1/1991 (Reaching 8.50 metres by Friday 4/1/1991)
04/01/1991	FRI 1130	Approximately 9.00 metres overnight Sunday 6/1/1991 or Monday 7/1/1991
05/01/1991	SAT 1115	Approximately 9.20 metres overnight Sunday 6/1/1991 or Monday 7/1/1991
06/01/1991	SUN 1115	Close to its peak at 9.00 metres, slight rises of about 0.10 metres possible with high tide this afternoon. Floodwaters currently in the Mackenzie River will reach the Rockhampton area late this week. These floodwaters are not expected to cause renewed rises at Rockhampton, but will prolong major flooding into next weekend.
06/01/1991	SUN 1700	Close to its peak at 9.05 metres - generally remain steady overnight tonight and during Monday
06/01/1991	SUN 2145	Steady at 9.12 metres - close to peak generally remain steady although slight rises may continue through until Monday afternoon.
06/01/1991	MON 1700	Steady after peak of 9.15 metres today. Floodwaters not expected to cause renewed rises but will maintain major flooding into this weekend. Flood levels expected to remain generally steady this week.
08/01/1991	TUE 1030	The Rockhampton river level is expected to be about 10 to 20 centimetres higher than the Monday peak of 9.15 metres during Friday night and Saturday.