

## CYCLONE WINIFRED FLOODING

### Introduction

Heavy rain commenced along the far north tropical coast between Cairns and Townsville during the afternoon of Saturday 1st February, with peak rainfall intensities being recorded between noon and midnight. Some of the higher 12 hour rainfalls for this period included Ravenshoe 309 mm and Cardstone 375 mm.

Major flooding occurred in the Tully and Herbert Rivers with the Herbert River at the Gairloch gauge (near Ingham) rising to a peak of 12.22 metres which is only 0.38 metres lower than the record 1967 flood. Flood levels in parts of Halifax are reported to have been the highest in 60 years. There was also minor flooding in the North and South Johnstone Rivers and the Burdekin River.

As the low, formerly Cyclone Winifred moved further westward, general heavy rains were recorded over the headwaters of the Diamantina, Thomson, Barcoo, Bulloo and Warrego Rivers. Rainfalls for the 72 hours ended Wednesday 5 February totalled up to 150 mm in the headwaters of the Diamantina and Thomson Rivers and 100 mm in the headwaters of the Bulloo and Warrego Rivers, but with isolated falls up to 140 mm. As a result, there was major flooding in the Thomson River and upper reaches of Cooper Creek, moderate flooding in the Diamantina and Bulloo Rivers and minor flooding in the Warrego River.

The most significant flooding was in the Tully and Herbert Rivers and this is discussed together with a review of the performance of the flood warning system for these rivers.

### Tully-Herbert River Floods

#### Rainfall

Rainfalls for the 24 hour period to 9 am Sunday 2 February are shown as an isohyetal map in Figure 1. The heaviest rainfalls occurred in the headwaters of the South Johnstone, Tully and Murray Rivers and in the eastern tributaries of the Herbert River above the gorge. To the north and west of this area rainfall amounts decreased markedly.

For flood forecasting purposes, the rainfall for Herbert River catchment is assessed in three regions - (i) the Herbert River above Gleneagle, (ii) the drainage area between Gleneagle and Abergowrie Bridge and (iii) the area below Abergowrie Bridge to Gairloch near Ingham. The temporal distribution of the rainfall for these subcatchments is shown in Figure 2. The rainfalls are averaged using statistical weighting factors applied to the rainfall amounts reported by the floodwarning rain stations. Figure 2 illustrates the high rainfall intensities which occurred up to midnight Saturday 1 February as Cyclone Winifred was crossing the coast.

#### Flooding

##### Herbert River

Both the Herbert and Tully Rivers peaked at major floods levels during Sunday 2 February. The Herbert River at the Gairloch Gauge peaked at 12.22 metres at 3 pm Sunday causing extensive inundation of Ingham and Halifax and

adjacent agricultural (primarily sugar cane) areas. From the records of flood peaks held by the Bureau of Meteorology, the Winifred flood at Gairloch is the fourth highest flood since 1956. Flood heights for these floods are:

PEAK HEIGHTS ON GAIRLOCH GAUGE

1	14 March 1967	12.60 metres
2	7 March 1956	12.27 metres
3	7 March 1977	12.25 metres
4	2 February 1986	12.22 metres

The 1967 flood is the highest flood on record. It can be seen from these heights that the Winifred flood is only 0.38 metres lower than the record 1967 flood and almost the same as the 1956 and 1977 floods. However, this is not the case for further up river at Abergowrie Bridge and Gleneagle where flood levels were much lower. The peak flood heights are:

FLOOD PEAKS FOR:	MARCH 1967	MARCH 1977	FEBRUARY 1986
Gleneagle	About 19.75	16.2	13.25
Abergowrie Bridge	20.0	18.6	16.5

The 1967 flood height for Gleneagle is estimated because the gauges were washed away by the floodwaters, but this flood was a remarkable 6.5 metres higher than the peak of the Winifred flood.

Although the upstream peak flood heights for the Winifred flood were metres lower than for both the 1967 and 1977 floods, the high intensity rain below the Herbert River gorge caused the flood levels at Ingham to be similar. As shown in figure 2, an average of 184 mm fell in the lower reaches for the 24 hours to 9 am Sunday and most of this was in just 15 hours to midnight Saturday. In contrast, the 1967 rainfall over the same local area was less than 70 mm in the 24 hours prior to the Gairloch peak. The 1967 flood was mostly due to floodwater moving downstream from areas above Abergowrie Bridge and Gleneagle.

The high intensity rainfall in the lower Herbert River catchment resulted in a very rapid rise to the peak at Gairloch. This can be seen on Figure 3 which shows the stage hydrographs (river height versus time) for the Herbert River floodwarning river height stations. During the early hours of Sunday, the river level at Gairloch was rising at over 0.5 metre per hour and was already 12 metres at 9 am.

Herbert River levels had commenced falling by Sunday afternoon, although a second rise to 13.25 metres was recorded at Gleneagle early on Monday 3 February. This did not cause renewed rises at Ingham but did prolong the major flooding at Ingham and Halifax until Tuesday.

Tully River

The Tully River at Euramo peaked at 9.09 metres at about 4 pm Sunday 2 February which is the highest since 1967. This height causes the Bruce Highway to be inundated to a depth of about 1 metre in the vicinity of the main road bridge. The record flood of 1967 reached 9.37 metres. Two other floods have exceeded 9 metres in the past 20 years - these being 9.05 metres in March 1977 and 9.01 metres in April 1982.

## Performance of the Flood Warning System

### Observations

The flood warning service is primarily based on special observations of rainfall and river heights provided by a network of volunteer observers, together with the routine meteorological observations used for general forecasting services. The dedication and public spirit of the floodwarn observers was again proven particularly through the night hours of Saturday and early Sunday morning when conditions were difficult and hazardous.

Unfortunately some telephone communications were disrupted overnight Saturday which reduced the number of heavy rainfall observations at a critical time of flood prediction analysis. This problem is difficult to overcome and perhaps the only solutions would involve either emergency radio communications capability for manual observers or an automatic radio telemetry network.

The severity of the weather conditions demonstrated the value of the remote rainfall digital indicators (connected to a tipping bucket rain gauge) which have been provided by the Bureau at most floodwarn rain stations in far north Queensland. These allow rainfall readings to be safely taken indoors. Some data was lost from stations where remote indicators have not yet been installed because conditions were considered too dangerous to venture outside to the manual rain gauge.

### Communications

This event highlighted the vulnerability of phone communications in disaster areas. In addition to the disruption of some telephone services discussed above, some delays in both inward receipt of data and outward promulgation of flood warnings was caused by the congestion of the telephone network in the aftermath of the cyclone. A specific problem identified after the event was that the Ingham Police did not receive two key flood warnings sent by phonogram because their telephone was continuously busy. To minimise future occurrences of this problem, the Bureau has requested the Police Department to implement a previously agreed procedure of promulgating floodwarnings to police stations using their internal message switching system.

Apart from these problems with the telephone network, the dissemination of flood warnings via telex proceeded without significant delays. The telex distribution of flood warnings is comprehensive and includes disaster authorities, Shire Councils, and television and radio stations.

### Warning Services

#### Herbert River

Floodwarnings issued by the Floodwarning Centre for the Herbert River were initially qualitative - that is the river level predictions were described in terms of minor, moderate and major flooding. To assist the community in interpreting this information, the Hinchinbrook Shire Council has provided landholders with a card titled "Herbert River Flood Heights" (see Figure 4) which details the extent of flooding in Ingham and Halifax for various heights on the Gairloch gauge.

Critical warnings issued on Sunday morning contained specific height forecasts for the Gairloch gauge and were formulated in close consultation with Hinchinbrook Shire Council.

Herbert River warnings commenced at 4 pm on Saturday 1 February with a prediction of significant stream rises causing local flooding and traffic disabilities for coastal streams between Innisfail and Ingham. Heavy rains continued in the catchment and qualitative warnings were renewed at 7.45 pm and 10.30 pm. A top priority warning was issued at 4.45 am Sunday and predicted that the river level at Gairloch would reach 12 metres that night with major flooding and levels similar to those in March 1977. Landholders and residents were warned to expect rapid river rises during Sunday morning between Abergowrie and Halifax.

The next warning at 10.15 am Sunday predicted Gairloch to reach 12.3 metres at noon and peak at about 12.5 metres later in the afternoon. It also indicated that the rapid rises in the river levels in the Upper Herbert above the gorge would not increase the predicted heights at Gairloch.

The 3.45 pm Sunday warning reported that the Gairloch reading of 12.22 m at 3 pm was near the peak level. The Herbert River warning was again renewed at 10 pm Sunday and continued twice daily during the week as river levels fell.

#### Tully River

Quantitative warnings containing predicted heights at Euramo are given for the Tully River when the river level at Euramo has reached 7 metres and is rising. The Euramo forecast is based on a technique which assesses the effect of the past 9 hour rain on the existing height at Euramo.

Floodwarnings for the Tully River were current from Thursday 30 January. A priority warning was issued at 11 am Saturday 1 February which forecast renewed rises as a result of Cyclone Winifred changing direction towards the coast. The warning was updated at 4.15 pm, 6.45 pm and 10 pm Saturday. The 6.45 pm warning predicted Euramo to exceed 8.5 metres by 3 am Sunday and the 10 pm warning predicted 8.70 metres by 6 am Sunday.

At 4.30 am Sunday, the Tully River warning was renewed with a prediction of 8.9 metres by noon Sunday with major flooding and the subsequent warning at 9.30 am indicated that this would be the peak height. Euramo peaked slightly higher than expected at 9.09 metres at 4 pm Sunday. Flood warnings were continued on Sunday and during the next week until river levels fell below flood level.

#### Accuracy of River Height Forecasts

Comparison of the predicted and observed river heights for both the Herbert and Tully Rivers shows that the height predictions were very accurate, generally within about 0.2 metre.

For the Herbert River, the top priority warning issued at 4.45 am Sunday 2 February provided an excellent indication of the type of flooding that would be expected in that it predicted flood levels similar to those of March 1977. The forecast peak of about 12.5 metres given in the 10.15 am Sunday warning was 0.28 metres above the actual peak.

More importantly, this warning advised that the predicted peak at Gairloch would not be increased as a result of the rising river levels in the upper Herbert River. Despite this, incorrect reports of further 1 to 2 metre rises were broadcast during Sunday afternoon and evening causing a great deal of needless concern amongst Ingham and Halifax residents.

### Post-Flood Debriefing

During the week of February 10th to 14th, senior staff from the Flood Warning Centre in Brisbane held meetings with police, State Emergency Service and Shire Council officers in Ingham and Tully to discuss the performance of the total flood warning system during the Winifred flood.

Problem areas were identified and follow-up action proposed to overcome these in future.

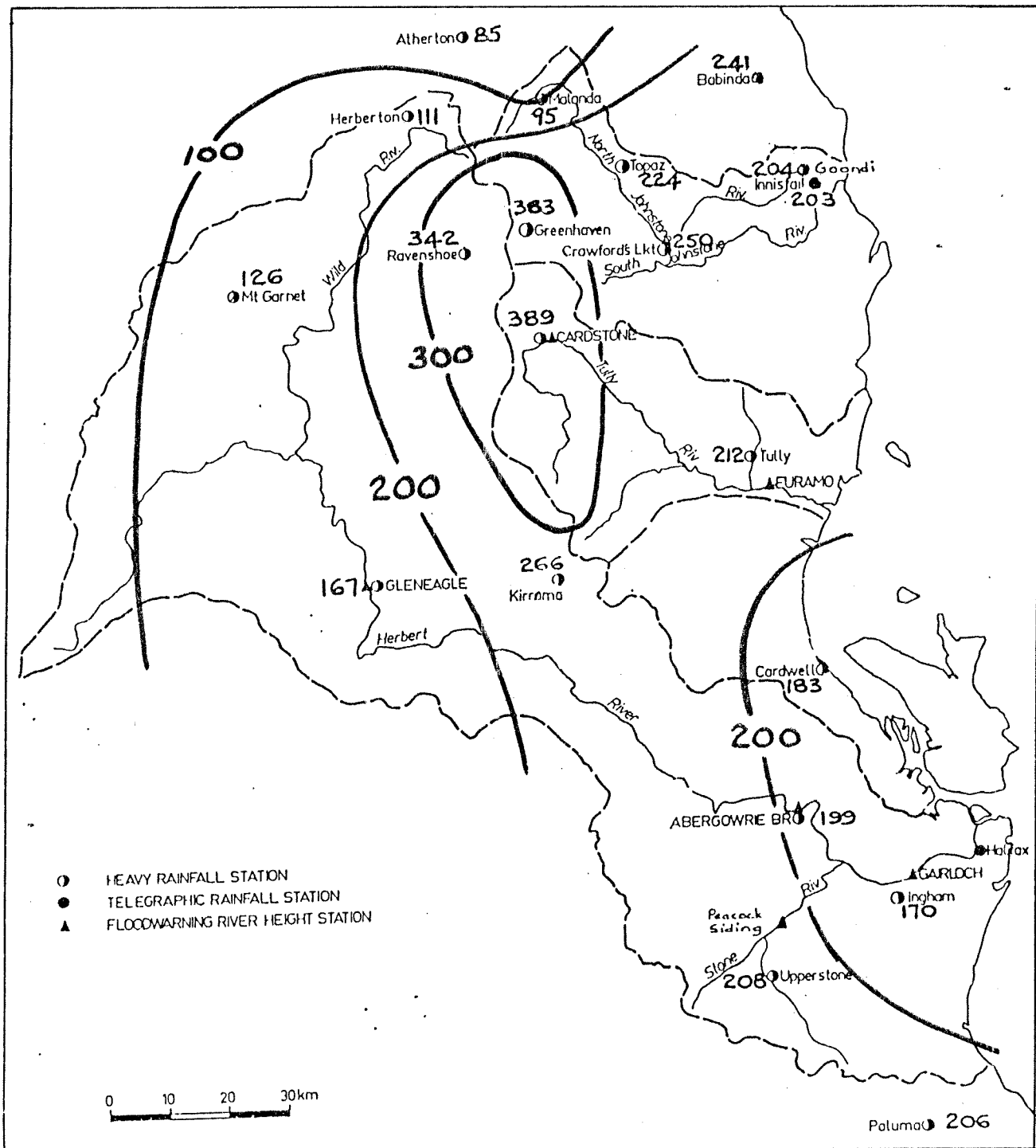


Fig 1. Rainfall isohyets (mm) for the 24 hours ended 0900 Sunday 2/2/1986

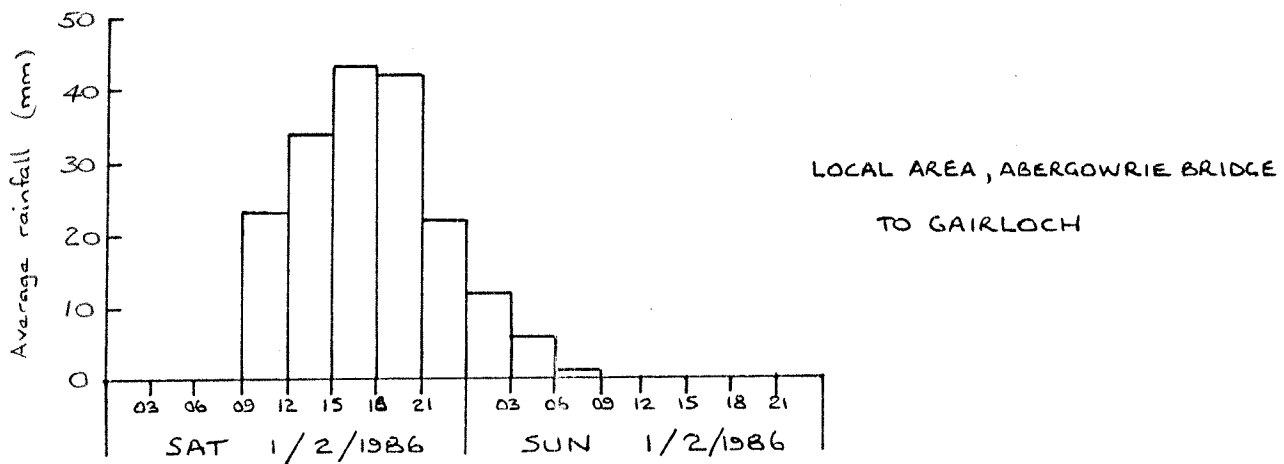
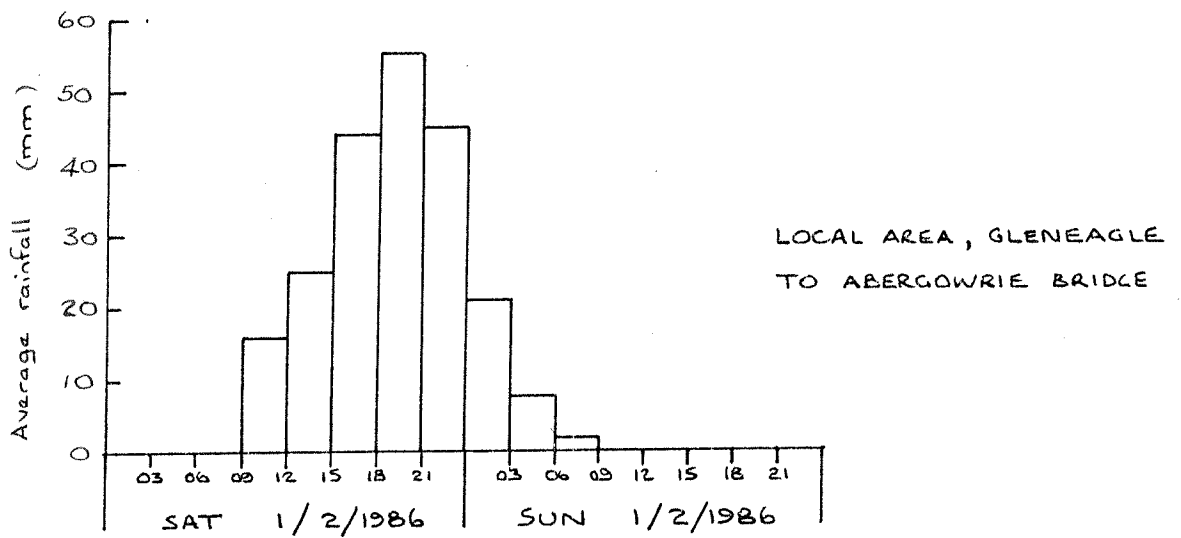
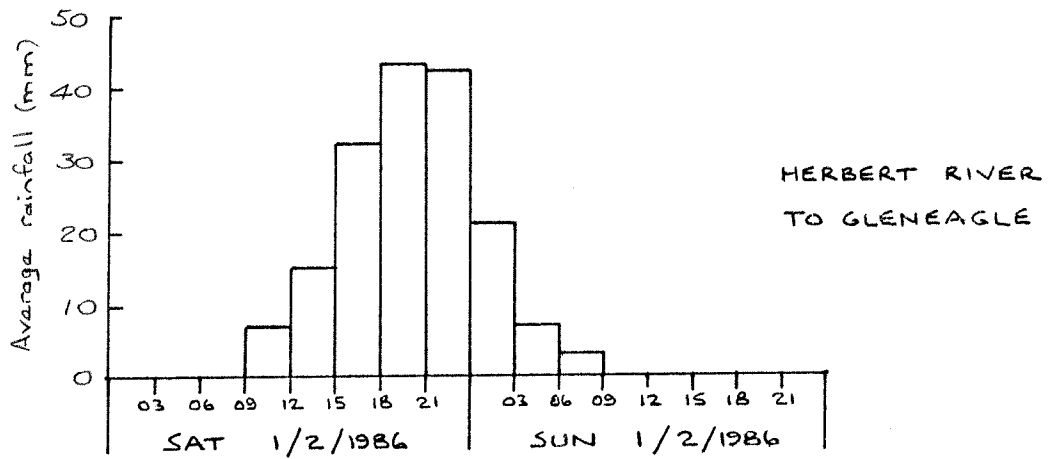


Fig 2. Average sub-catchment rainfall (mm) over the Herbert River for the 24 hour period ended 0900 Sunday 2/2/1986.

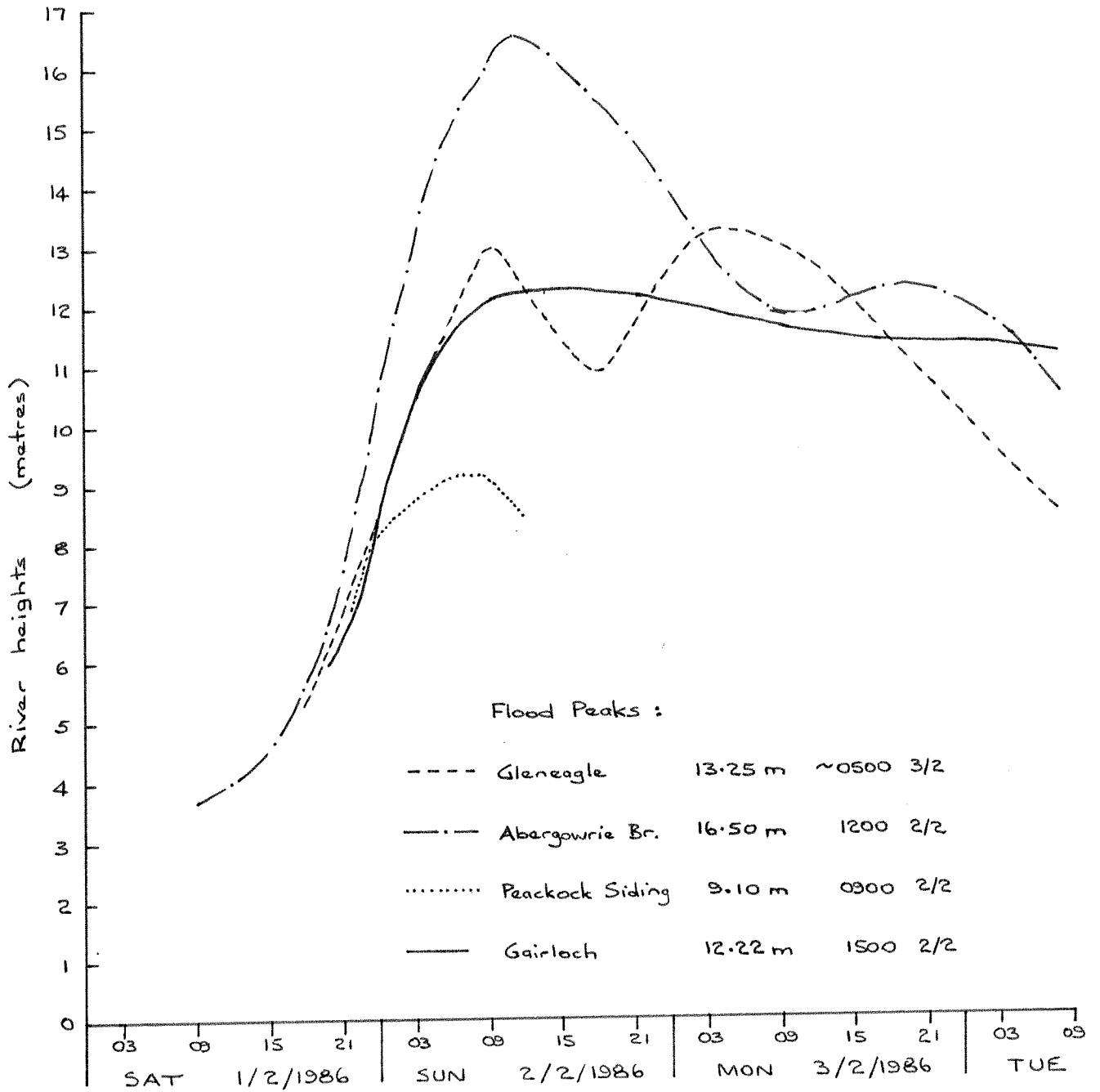


Fig 3. Harbert River flood hydrographs 1-4 February 1986



# HERBERT RIVER FLOOD HEIGHTS

Flood warnings issued by Hinchinbrook Shire Council are related to flood gauges at Abergowrie Bridge and Gairloch Bridge. Advance warnings of flood flows from the headwaters of the Herbert River are provided by river height readings from Glen Eagle Station.

In all cases river heights are given as depths of flow above the stream bed. At Abergowrie Bridge and Gairloch Bridge the river height when water is up to the bridge deck is:

Abergowrie Bridge: 10.0 m.

Gairloch Bridge: 4.1 m.

The following table shows significant heights at Gairloch Bridge and their probable effects in the area of Ingham and downstream.

Height at Gairloch in Metres.	Probable Effect
4.1	Water onto Gairloch Bridge
6.5	Water over Ingham Halifax Road at Halifax Washaway.
9.1	Water onto deck of Anabranch Bridge.
9.2	Water starts to flow through Palm Creek, Ingham.
9.4	Water over Bruce Highway at Gairloch Washaway.
9.6	Water 0.3 m deep on Anabranch Bridge.
10.7 - 11.0	Water starts to flow over Herbert Street, Ingham. Water starts to flow over Bruce Highway at Kingsbury Creek and over Halifax Road, Ingham. Water starts to flow over Townsville Road, Ingham.
12.6	1967 and 1977 type flooding.

The Bureau of Meteorology also issues flood warnings expressed in broad descriptive terms of minor, moderate or major flooding. The following table shows the river heights at Gairloch which correspond to these terms for each of the Ingham and Halifax areas.

Flood Description	River Height at Gairloch in Metres	
	Ingham	Halifax
Minor	9.5 to 10.5	6.5 to 9.0
Moderate	10.5 to 11.5	9.0 to 10.0
Major	11.5 and higher	10.0 and higher

The Council has available for free distribution a map indicating major flooding depths on properties in the town of Ingham. A k for plan No. 2198.

Distributed by —

HINCHINBROOK SHIRE COUNCIL

November, 1980

Telephones:

Council Office 76 2211

S.E.S. Building 76 2056

Fig. 4. Flood information brochure issued by Hinchinbrook Shire Council.

# The Winifred flood at Ingham



## How does it compare with past floods ?

- The Meteorological Bureau looks at Winifred's effects.

At 3 pm on Sunday, February 2, 1986, the Herbert River at Gairloch gauge peaked at 12.22 metres following heavy rains associated with tropical Cyclone Winifred.

This flood will be remembered as one of the highest floods in Ingham and it is of interest to compare it with past floods.

From the records of flood peaks held by the Bureau of Meteorology, the Winifred flood at Gairloch is the fourth highest flood since 1956.

Flood heights for these floods are:-

### Peak Heights on Gairloch Gauge

1. March 14, 1967	12.6 metres
2. March 7, 1956	12.27 metres
3. March 7, 1977	12.25 metres
4. February 2, 1986	12.22 metres

The 1967 flood is the highest flood on record.

It can be seen from these heights that the Winifred flood is only 0.38 metres (or 15 inches) lower than the 1967 flood and almost the same as the 1977 flood.

However, this is not the case for further up river at Abergowrie Bridge and Gleneagle where flood levels were much lower. The peak flood heights are:-

Flood Peaks for:	March 1967	March 1977	February 1986
Gleneagle	About 19.75	16.2	13.25
Abergowrie Bridge	20.00	18.6	16.5

The 1967 flood height for Gleneagle is estimated because the gauges were washed away by the floodwaters, but this flood was a remarkable 6.5 metres (or 21 feet) higher than the peak of the Winifred flood.

Looking at these figures for the 1967 and 1977 floods, one could wonder how the flood level at Gairloch was near to the level of both 1967 and 1977 when river levels at both Gleneagle and Abergowrie Bridge were metres lower.

The answer, of course, is that the distribution of rainfall over the catchment for the recent flood was very much different than for the previous occasions.

A very high rainfall, about an average of 184mm (or 7½ inches), fell in the lower reaches of the Herbert River below Abergowrie Bridge for the 24 hours to Sunday, February 2 and this, combined with rising flood levels at Abergowrie Bridge, caused the flood peak in Ingham.

Most of this rain fell in just 15 hours to midnight on Saturday and resulted in a rapid rise to the peak at Gairloch.

In contrast, the 1967 rainfall over the same local area between Abergowrie Bridge and Gairloch was less than about 70mm in the 24 hours before the Gairloch peak.

This flood in Ingham was mostly due to the floodwaters moving downstream from areas above Gleneagle and Abergow-

rie Bridge. The 1977 flood was also largely caused by rainfall in areas above Abergowrie Bridge.

Thus, the Winifred flood, although very similar in final peak flood height in Ingham, was very much different to the previous floods. The misunderstanding of the nature of the flood during the afternoon of Sunday, February 2, caused many wrong reports and a great deal of needless concern that Ingham residents could expect further 1 to 2 metre rises in the town as floodwaters moved downstream from the upper parts of the catchment.

These wrong reports continued despite the official floodwarnings given by the Bureau of Meteorology during the week-end.

Indeed, it is a credit to the staff of the Bureau of Meteorology Floodwarning Centre, that by 5 am on Sunday morning, floodwarnings were issued which predicted Gairloch to reach 12 metres with flood levels to be similar to those in March 1977.

The floodwarning issued at 10.15 am on Sunday predicted that Gairloch would reach 12.3 metres at noon and peak at about 12.5 metres late Sunday

afternoon.

More importantly, it was stressed in this warning that the rapid rises in river levels above the gorge would not increase the heights at Gairloch.

These warnings are prepared in close consultation with Hinchinbrook Shire Council and are issued directly by telex and urgent telegrams to the police, radio and television stations and to the State Emergency Service. They are based on rainfall and river height readings provided by a network of volunteer observers maintained by the Bureau of Meteorology.

Thanks must go to them for the valuable information they provided throughout Saturday night and Sunday in what can only be described as difficult and sometimes dangerous conditions.

The predictions proved to be correct. Gairloch peaked at 12.22 metres at 3 pm on Sunday and then continued falling slowly overnight Sunday and during the week.

History will repeat itself in Ingham and further similar floods will occur in the future. There are many lessons to be learned from this event.

## THE WINIFRED FLOOD AT INGHAM - HOW DOES IT COMPARE WITH PAST FLOODS?

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