DEPARTMENT *of*
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Tasmania

Hydrological Analysis Of The Ringarooma Catchment

A Report Forming Part Of The Requirements for State of Rivers Reporting

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1 Historical Background

Catchments and Drainage System

The Ringarooma River begins at the foothills between Ben Nevis, which is part of the Ben Lomond ranges and Mount Maurice to the north (Figure 1 - drainage map). By the time it reaches the township of Branxholm, the catchment has grown to include drainage from the Maurice River and Legerwood Rivulet on the west and inflows from Federal Creek, the Dorset River and New River from the east.

Between Branxholm and Moorina, most of the increased flow is due to inputs from the Cascade River and the Weld River on the south-eastern side of the catchment. Only minor creeks drain the northern side of the river in this section.

Between Moorina and the sea, the only major tributary entering the Ringarooma River is the Wyniford River which collects runoff from the northern slopes of the Blue Tiers. Many of the creeks entering the river downstream of the Wyniford junction are small and frequently stop flowing during the summer.

Water Races

The development of sluice mining late last century, which carried on past the middle of this century, resulted in the construction of a complex network of water races in the catchment. The most notable of these is the 56 km long Ringarooma Race which delivered water from the Maurice River (elevation of 290m) to the Briseis Tin Mine at Derby. This is an obvious feature of the landscape and can be clearly seen from several roads around Ringarooma.

Another important water race is the Mt Cameron Water Race, which is about 37 km long and was used to supply the Dorset Dredge at Black Duck Lagoon up until the early 1970's. Other smaller races are scattered throughout the area and have generally fallen into disrepair.

Dams

Several dams have been built in the Ringarooma catchment. The Frome Dam, east of Moorina on the Frome River was built in 1908 to supply a power station for the Endurance Tin Mining Company (Steane, 1972). It is a rock-fill dam 182m long and 18m high. As well as generating power for the mine, the water was transported to Pioneer via a race to supply the town and the mine. Races above the dam were also constructed to extend the catchment and collect runoff from the headwaters of the Wyniford and Weld rivers.

There have been two dams built across the Cascade River. The original Cascade Dam (the Briseis Dam), was a rock-fill dam built about 4 km upstream of the Ringarooma River junction in about 1928. During the infamous flood of 1929, it burst and killed fourteen people in Derby. A review of the dam failure was presented at the Hydrology and Water Resources Symposium (Livingston, 1993). The dam was rebuilt in 1934 to supply the Briseis Tin Mine in Derby and has a capacity of about 3,600 megalitres. Following the final closure of the Briseis Mine in the mid-50's the storage was virtually unused for about 20 years. In the mid-70's plans to utilise this asset for agricultural irrigation emerged and this storage is now used to supply the Winnaleah Irrigation Scheme, which services 45 irrigators. In the 1997/98 season, the scheme supplied 4,900 ML.

The Mount Paris Dam, was constructed in the headwaters of the Cascade River in 1936. It was built of reinforced concrete slabs, 250m long and 16.5m high. The dam was built with a capacity of about 1,340 megalitres to provide a water supply for the local mining community. Mining ceased in the Derby area in 1967 and the use of the dam as a storage also ceased. In 1970 and again in 1984 the dams' outlet pipe was blocked, causing it to fill. It was subsequently emptied and a hole $2.5m^2$ was blasted in the dam to prevent further blockages. In the early 1990's a review was carried out to establish the feasibility of increasing the irrigation capacity of the Winnaleah Scheme by restoring the dam. The review found that the demolition of the dam was the preferred option. Today the dam structure remains but additional holes have been cut in the wall for public safety in case of extreme flooding.

River Monitoring
While existing records of river level in the Ringarooma River date from as far back as 1921, most sites where readings have been taken have only a relatively short series of data. In some instances the period of record is for six months, while the maximum period of record is from the site 'Ringarooma @ Moorina' which has river level data from 1977 to present. While many sites may still have gauge boards, Ringarooma at Moorina is the only site that is currently fully maintained with a shaft encoder and recording instruments.

The following table provides a summary of sites in the Ringarooma River catchment. Ringarooma at Moorina is the site used to illustrate various features of the catchment hydrology in the following sections.

TABLE 1.1 Stream Flow and Stream Height Monitoring Sites in the Ringarooma catchment.

Station No.	Name	Period of Record
19223	Federal Creek u/s Ringarooma	9/5/90 - 25/6/92
19219	Dorset River at Ruby Flats Rd	31/12/87 - 27/3/90
19216	Maurice River d/s South Maurice River	31/12/87 - 25/6/92
19215	Maurice River u/s Ringarooma River	31/12/87 - 17/10/90
19217	South Maurice River above Water Race	31/12/87 - 25/6/88
88	Ringarooma River at Branxholm	1/7/37 - 10/10/88
30	Ringarooma River at Moorina	8/6/77 - present
30	Ringarooma River at Moorina (daily read)	1921 - 1929
19218	Ringarooma River at Ringarooma Rd Bridge	31/12/87 - 21/4/88
19213	Cascade River d/s Cascade Dam	1/8/85 - 13/7/90
19210	Cascade River u/s Cascade Dam	5/1/84 - 24/9/96
19222	Cascade Reservoir (Lake level)	15/5/90 - 25/9/96
19211	Cascade River u/s Mt Paris Dam	18/7/85 - 24/8/94

At times these measurements are not always useful indicators of flow due to changes in the channel such as growth and obstruction by vegetation, aggradation and scouring of river beds, etc. Such changes can cause unstable relationships between gauge height and flow. Bearing this in mind, the following summary has been prepared for data collected at the currently maintained site on the Ringarooma at Moorina. This site also has the best quality data, allowing meaningful and confident analysis.

2 Monthly Flows

The variability of monthly flows in the Ringarooma catchment is shown in Figure 2, which provides a box and whisker style plot for data from the monitoring site at Moorina (Site 30).

The box and whisker plot shows the strong seasonal pattern with flows peaking in the period July through to September. Lowest flows are experienced between January and April. This period also corresponds to the peak irrigation demand from the river. The monthly flows may appear to be variable especially in the winter months, but when compared to other areas such as the South Esk, the monthly flows can be viewed as relatively consistent or regular. Note that monthly flows for the Ringarooma are based on 21 years of record while statistics from some sites in the South Esk are based on more than 56 years of record.

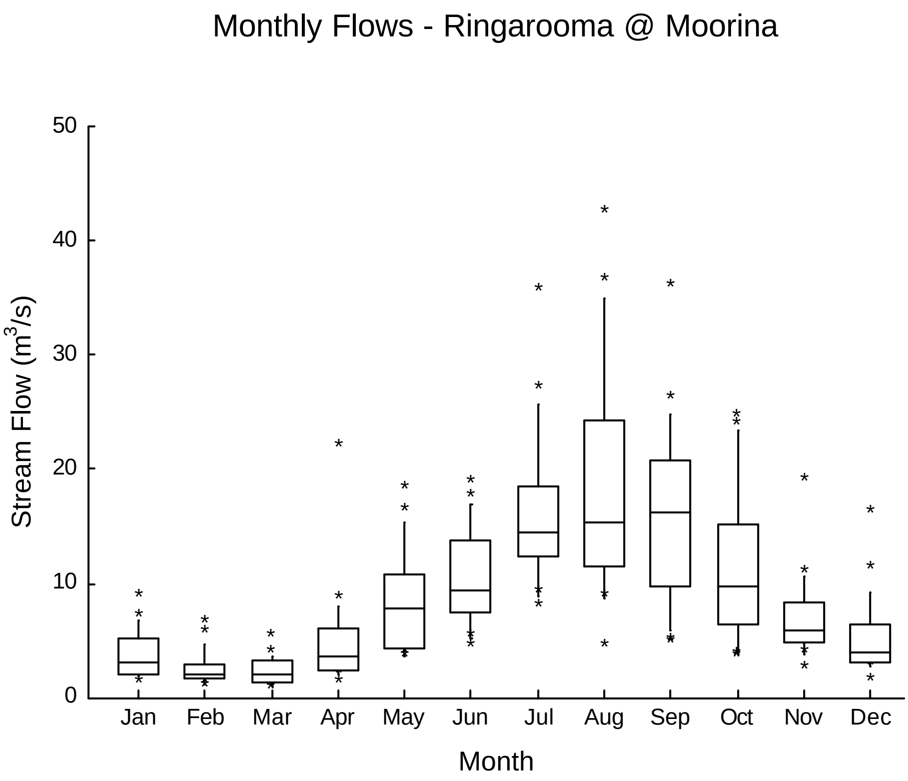


Figure 2 Monthly Flow Analysis from Ringarooma River at Moorina (Site #30).

3 Comparison of Monthly flows; Historical vs Study Period

The following bar chart demonstrates the type of season that was experienced in the study period compared to the historical record (Figure 3). During the study, all months apart from October experienced less flow than the historical record. This was especially marked during the first five months of the study and also in August. This indicates that in general terms the study was conducted in drier than average conditions.

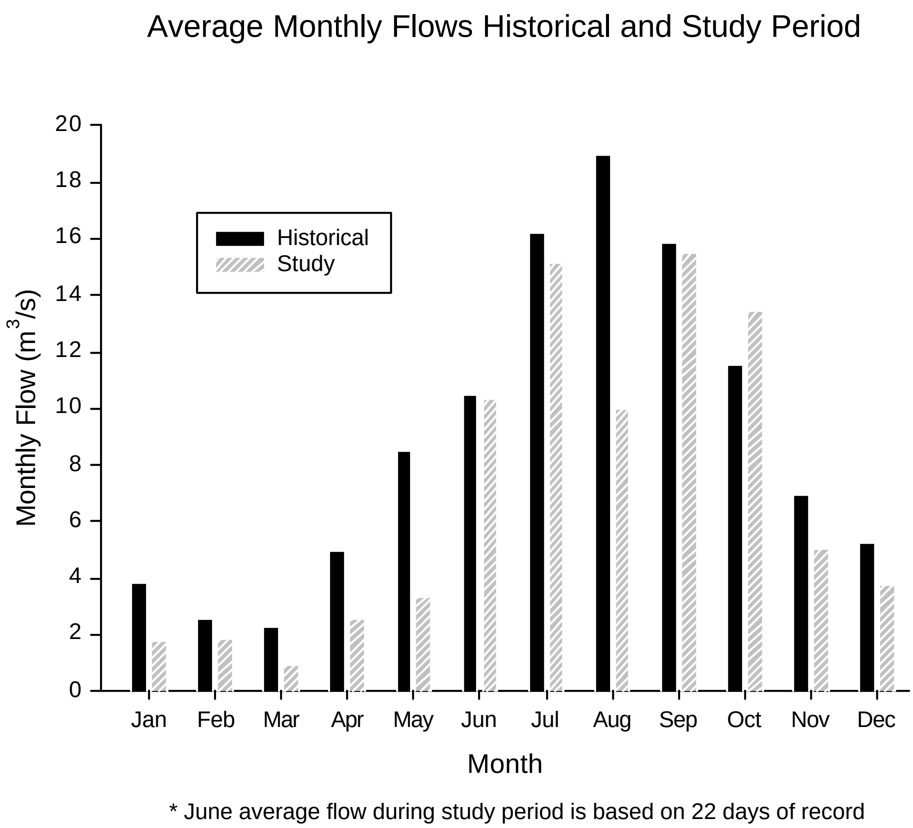


Figure 3 Comparison of monthly flows for the Ringarooma River at Moorina, (historical record vs study period).

4 Floods

Flood frequency analysis of flows in the Ringarooma River at Moorina were carried out. The sample coefficient of skew was insignificant at the 95% level so a 2 parameter log normal distribution was fitted. The results of this analysis are shown in Figure 4. As the plot is shown in logarithmic form, the vertical and horizontal grid lines are of unequal spacing. Some examples of how to read this graph are; (a) in any given year there is a 10% chance that a flood of 166 cumecs or more will occur (river height of about 4.79m). (b) in any given year there is a 50% chance that a flood of 103 cumecs or more will occur (river height of about 3.94m).

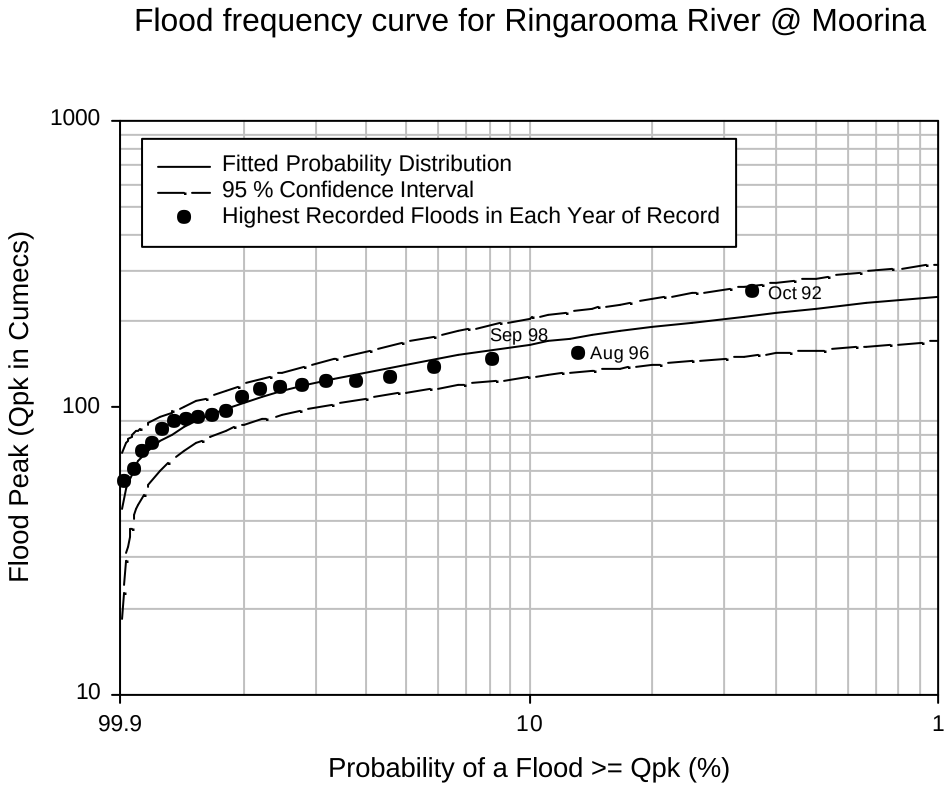


Figure 4 Flood frequency Curve for Ringarooma @ Moorina

On the 25th July 1988 the Ringarooma catchment received extremely heavy rains, which resulted in a river level rise in the Ringarooma River @ Moorina to approximately 7.2 m. This was an extremely rare occurrence. The highest gauged flow at this site is at 4.83 m with a flow of 181.9 cumecs. The rating for the site indicates that a river level of 7.2 m is equivalent to a flow of approximately 485 cumecs. From the flood frequency analysis a flow of this amount has a chance of occurring 1 year in 10,000. It should be noted that this flow is just outside the confidence limits of a 1 in 1,000 year flood. With a record of only 21 years it was considered unwise to use this value in the flood frequency analysis as it would increase the size of expected floods in any given year, as a result the next highest flow for the year 1988 was used.

Gauging stations elsewhere in the region were examined to determine if a similar event had occurred in July 1988. Both the Cascade River upstream of the Cascade reservoir and the North Esk River at Ballroom had the highest flow that year on the 25th July of 33 cumecs and 107 cumecs respectively. While both stations support the fact large flows occurred on that day, neither flow (especially in the Cascade River) was of the magnitude of that experienced on the Ringarooma River. This suggests that the heavier rainfall in the area must have been localised to the Ringarooma catchment. Researching the Bureau of Meteorology weather reviews show heavy rainfall was experienced in the North East of the state both early and late in July 1988. While no rainfall measurements for the specific area are available, at Gray near St Mary's, 118 mm fell during that month. There is no record of any loss of life or major damage caused by this flood although this may be due to the small population, minimal urbanisation and predominantly farmland and bush directly downstream of the gauging station.

During the present study there was a moderate flood which occurred on September 23rd, which had a peak flow of about 145 cumecs (corresponding river height of about 4.6m at Moorina). Examining Figure 4, it can concluded that a flood of this magnitude has a 20% to 30% chance of occurring in any given year. This corresponds to an annual exceedence probability (A.E.P.) of 1:3 to 1:5 year event.

5 Droughts and Low Flows

Several hydrographs were analysed to describe the recession flows for the Ringarooma River at Moorina. The recession segment of a hydrograph is that part which shows how the water storage in the river decreases over time following high river flows. Using several recession segments for the analysis, a 'recession curve' can be generated which represents the basic pattern of flow decreases in the river. The recession curve basically reflects groundwater discharge to the river and how groundwater storage influences and sustains flows in rivers.

The recession curve for the Ringarooma River at Moorina is described by the following equation;

$$\text{Flow} = 2.021 + 6.263 * 0.999879^{\text{Time (Minutes)}}$$

and is presented graphically in Figure 5. The upper part of the recession curve contains more surface and subsurface flow (runoff) while the lower section is more representative of groundwater discharge to the river. The curves demonstrates that once the flow recedes to 8 m^3/s on the recession limb it takes close to 19 days to return to a base flow of approximately 2 m^3/s.

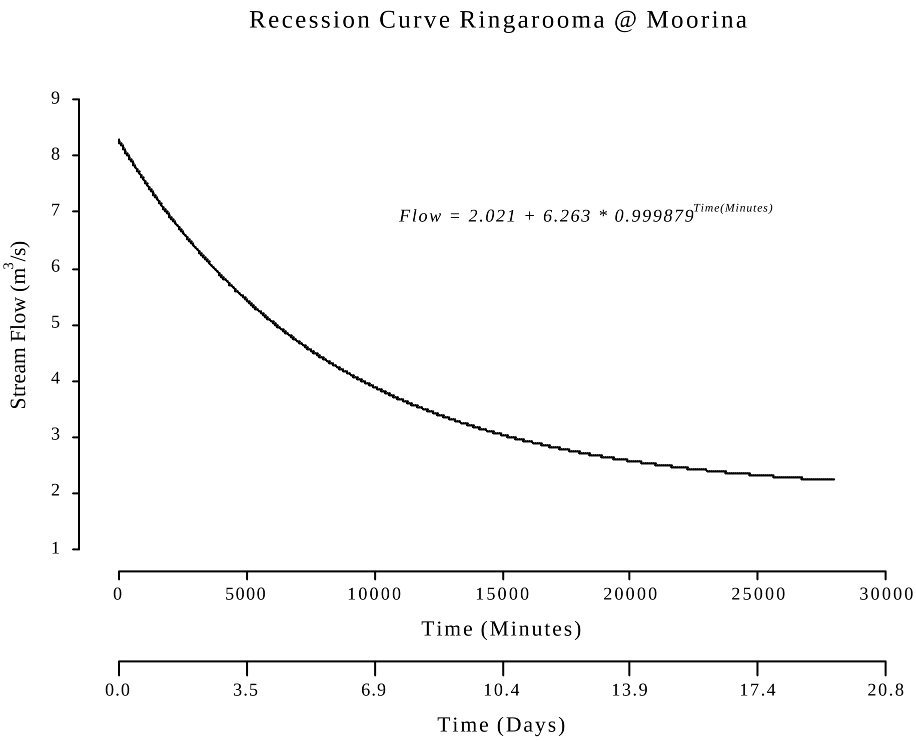
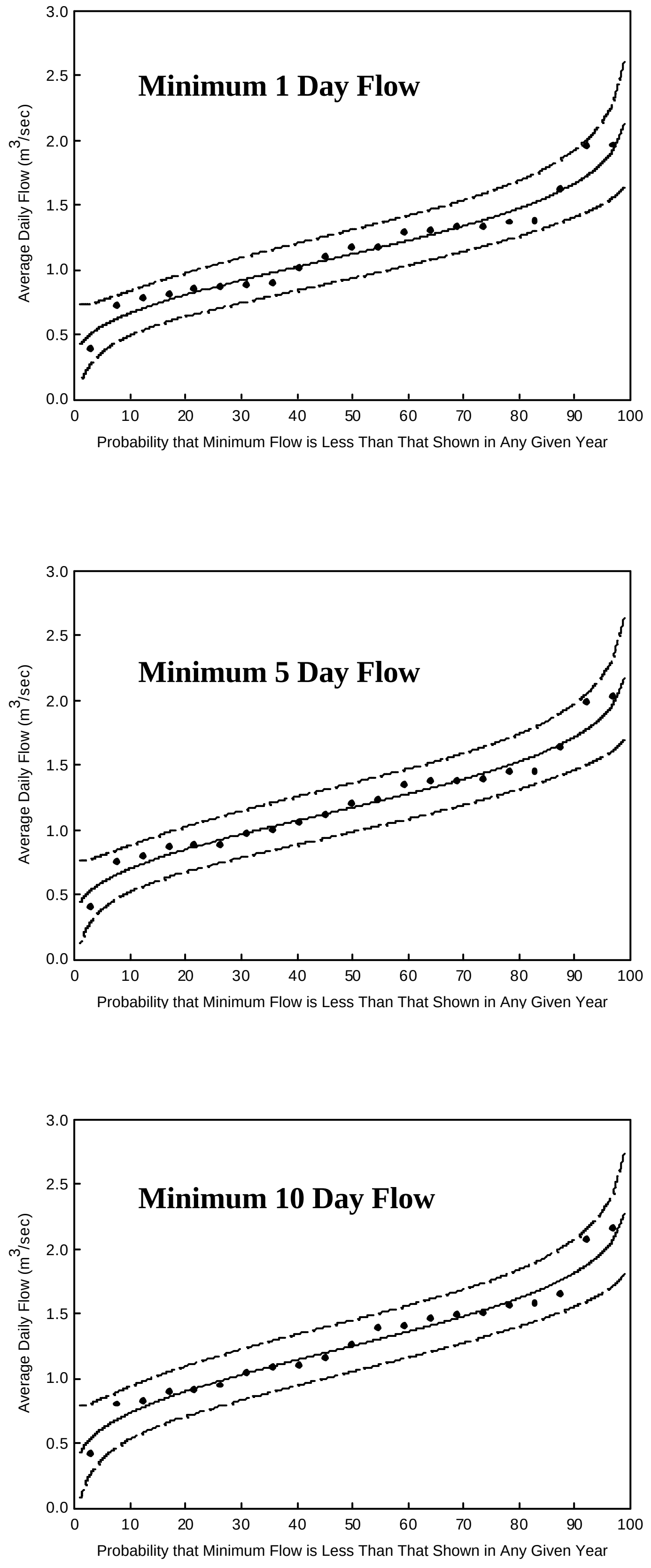


Figure 5 Recession curve for the Ringarooma River at Moorina

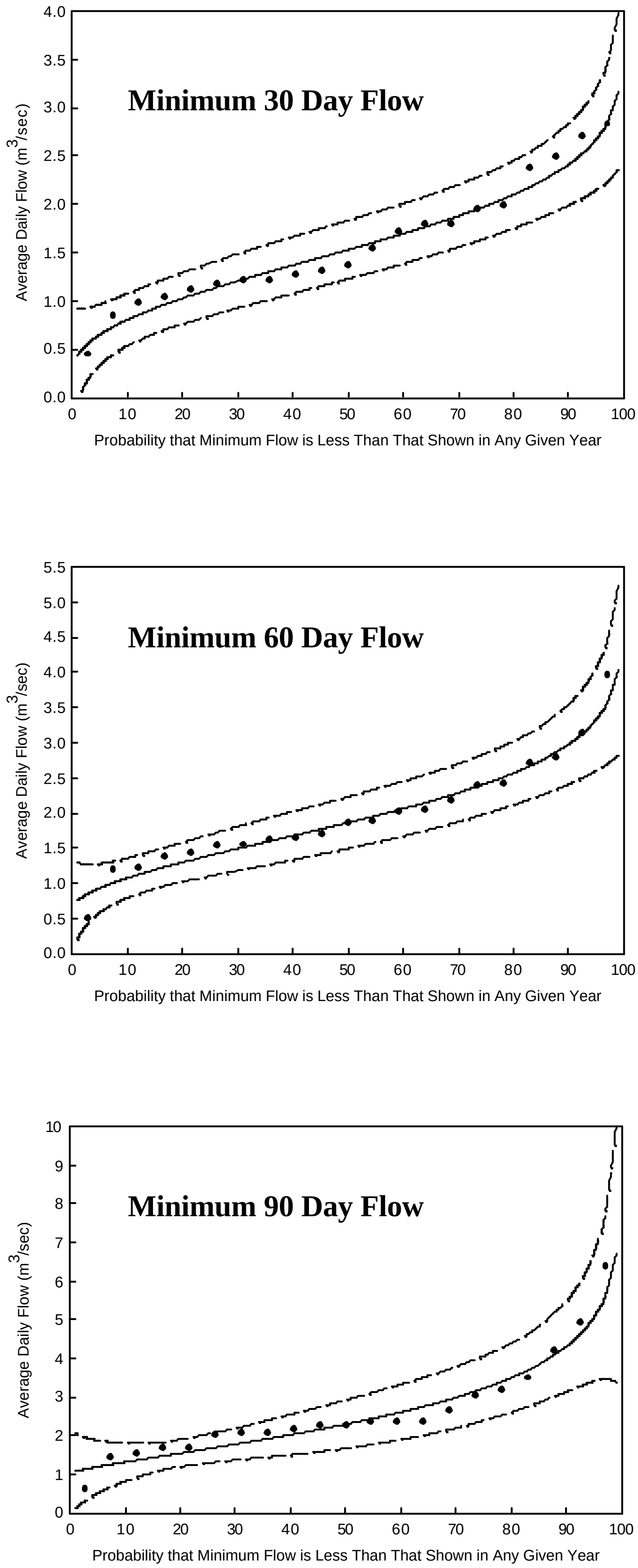
	Estimate	**Standard Error**
R	0.999879	0.000000644
B	6.263	0.0116
A	2.021	0.00934

Low flow frequency curves have been derived for a range of durations from 1 day through 90 days (Figures 6a to 6f). The curves give the probability that any given minimum flow will occur over various time periods. For example, over five days the probability that a minimum average daily flow of about 1.5 cumecs will occur is approximately 85%, while over a longer period such as ninety days this probability decreases to approximately 10%.

This information has implication for the establishment of environmental flow allocations for the Ringarooma River and for the assessment of risk in supply of water from the river for purposes such irrigation and domestic use. Such risks will also need to be taken into account during the Water Management Planning process to be carried out as part of the currently proposed water reforms.



Figures 6(a-c) Low flow frequency curves for the Ringarooma River at Moorina. Each graph shows the probability that any given minimum flow will occur at each time period.



Figures 6(d-f) Low flow frequency curves for the Ringarooma River at Moorina. Each graph shows the probability that any given minimum flow will occur at each time period.

6 References

Livingston, A.H. (1993) The failure of Brisies Dam. Hydrology and Water Resources Symposium, Newcastle, NSW June 30 - July 2, 1993.

Steane, J.D. (1972) Tasmanian Water Resources Survey - Ringarooma, Boobyalla, Great & Little Musselroe Rivers. Rivers and Waters Supply Commission Report No. 12