DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Tasmania

Hydrological Analysis of Rivers in the Great Forester Catchment

A Report Forming Part of the Requirements for State of Rivers Reporting

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Hydrological Analysis of the Great Forester Catchment

1 Historical Background

Catchments and Drainage System

The Great Forester River originates on the northwestern slopes of Mt. Maurice (elevation 1121m) and flows north past Mt. Stronach (elevation 497m) towards the coast. At Wonder Valley, the river turns west and meanders across the coastal plains before entering Bass Strait east of Bridport (Figure 1.1). The general topography is hilly inland grading down to flat coastal plains characterised by extensive sand dunes.

The catchment is bounded to the south and west by the St Patricks and Brid catchments, and to the east by the Ringarooma catchment. Major tributaries of the Great Forester are Hogarth Rivulet (which enters upstream of Tonganah), the Arnon River (draining the eastern side of the catchment around Tuldeena) and Pearly Brook (draining land west of Mt Horror). Lower down on the floodplain the Oxberry Creek enters from the east and Tuckers Creek joins the river at Adam's Cut with pickup from the area north of Scottsdale.

Unlike the Ringarooma catchment, which has been impacted by a multitude of drainage and diversion works, principally due to mining activities, the majority of the Great Forester catchment is relatively free of large scale drainage works. Most of the middle and upper reaches of the river have only had minor works carried out to improve small farm drainage.

As the lower reaches of the Great Forester are wide floodplain areas, many parts are swampy. As a result, many landowners have constructed drainage works to reclaim some of the swampy land on the floodplain. One of the more notable of these works was carried out in the 1920's, when the Great Forester was diverted from its original outlet to the sea near Bridport by excavating a drain in a more direct line to the coast 4km to the east (Jordan, 1973). This is known as 'Adam's Cut' and reduced the rivers length by more than 7km and increasing the gradient of the river such that 325 ha of land could be reclaimed.

Climate and Rainfall

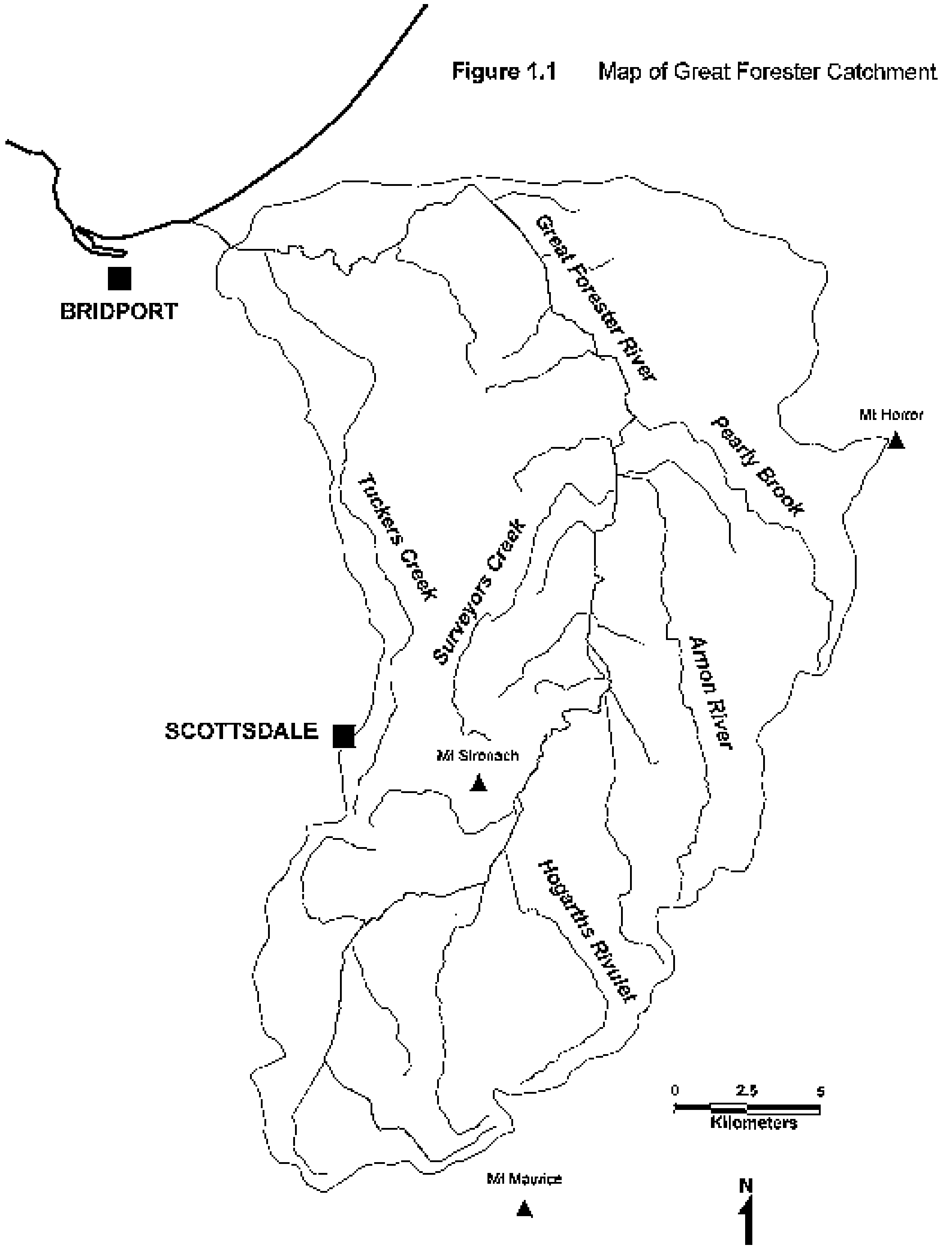
Although the climatic conditions of the northeast region are generally influenced by its proximity to the sea. The distribution of rainfall is mainly controlled by topographic changes, with highest rainfall occurring around the Ben Nevis and associated ranges. Nearer the coast, annual average rainfall is about 750 - 800 mm (cf Bridport) increasing to around 1200 mm near the top of the catchment at South Springfield (cf Diddleum). Rainfall statistics for five significant sites in the northeast are presented in Appendix 1, and show that highest monthly totals occur in July and August and lowest in February and March.

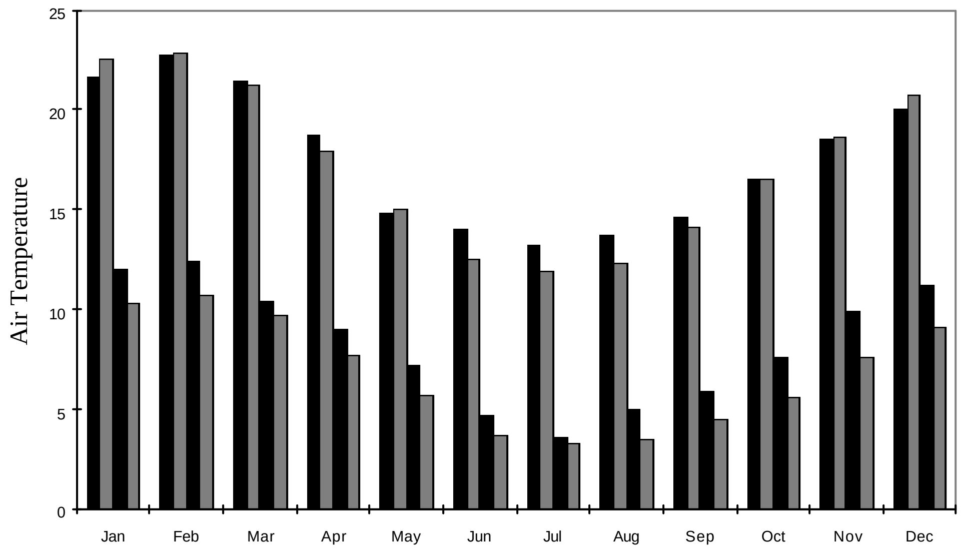
Thunderstorms can occur throughout the catchment at any time of year, however they are most prevalent during summer and autumn when there is a greater frequency of north to north-westerly winds creating uplift of warmer air from the coast.

Temperatures throughout the catchment are influenced by distance from the coast rather than topographic variation, with inland areas experiencing greater extremes than those nearer the coast. The difference between the coastal temperature and inland areas is clearly shown in Figure 1.2, which compares average maximum and minimum temperatures at Bridport (elevation 0m) with Scottsdale (elevation 200m). Although maximum air temperatures are very similar during much of the year, the average monthly minimum temperature is always lower at Scottsdale.

State of Rivers Great Forester River Hydrological Analysis

Figure 1.1 Map of Great Forester Catchment





Solid bars represent maximum and minimum monthly temperature for Bridport
Hatched bars represent maximum and minimum monthly temperature for Scottsdale

Figure 1.2 Average Maximum and Minimum Temperatures at Bridport and Scottsdale

2. Monitoring in the Catchment

Bureau of Meteorology

As part of the Statewide rainfall monitoring network, the federal Bureau of Meteorology does not currently operate any stations in the Great Forester catchment. However, there are several stations located relatively close to the catchment boundaries, and these are shown in Table 2.1. These stations are primarily maintained for flood warning and climate monitoring purposes. The data from these, and all other sites in Tasmania can now be accessed on the world-wide web at www.bom.gov.au.

Station Number	Name
091086	Ringarooma (Fry Street)
091257	Trenah (Wattle Banks)
091219	Scottsdale (West Minestone Rd)
091284	Bridport (Emma St)

Table 2.1 Bureau of Meteorology rainfall stations

Rivers and Water Supply Commission / DPIWE

There have been two sites where river level has been monitored in the past. At Tonganah the level of the Great Forester river was recorded daily between 1922 and 1930 by Hydro Electric Department. No records have been collected at this site since.

The site on the Great Forester river 2km upstream of the Forester Road Bridge is currently operated by the Department of Primary Industries, Water and Environment (DPIWE). Records of river flow have been collected at this site since 1970. Water quality monitoring has also been periodically undertaken at this site in the past (most data collected between 1974 - 1979). This data is discussed in a later section.

3. Monthly Flows

The variability of monthly flows in the Great Forester catchment is shown in Figure 3.1, which provides a box and whisker style plot for data from the monitoring site at Great Forester 2km upstream of the Forester Rd Bridge (19201). The plots display the median (or the middle of the data) as a line across the inside of the box. The bottom and top edges of the box mark the first and third quartiles respectively, indicating the middle 50% of the data. The ends of the whiskers show the spread of the data and together enclose 95% of the data. The dots beyond the whiskers indicate the high and low extrema.

The box and whisker plot shows a 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. A recent survey of water use in the catchment was carried out in 1996/97. This survey showed that approximately 41 megalitres (0.5 cumecs) is extracted from the Great Forester River, and 20 megalitres (0.25 cumecs) is extracted from tributaries. During the study period Hop growing in the catchment was significantly reduced and it is likely that extractions from the system would be less than those recorded in the survey.

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. Compared to the Ringarooma, the Great Foresters' pattern of monthly flows is very similar, but the volume is approximately 1/3 of that experienced in the Ringarooma River.

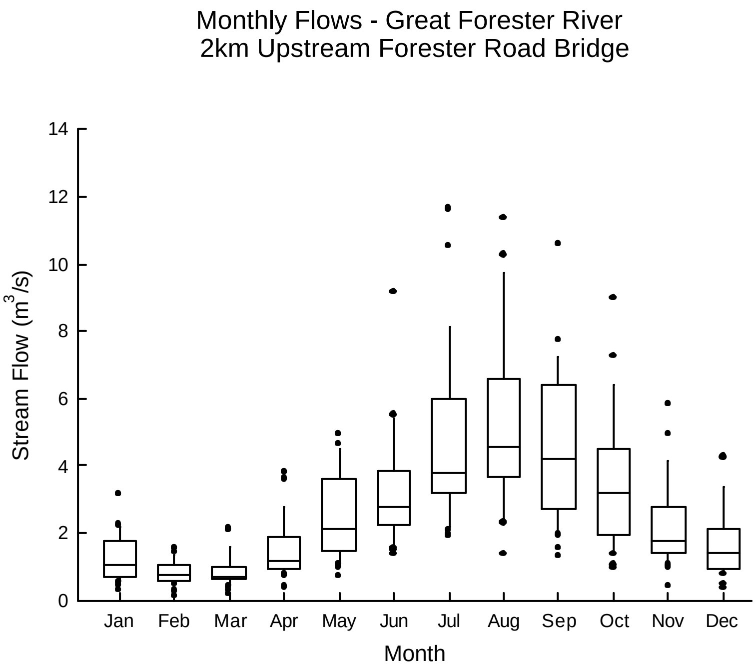


Figure 3.1 Monthly Flow Analysis from Great Forester River 2km upstream of the Forester Rd Bridge (Site #19201)

4. 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 4.1). During the study, all months apart from September and October experienced less flow than the historical record. This was especially marked during the five months from March to August. This indicates that in general terms the study was conducted in drier than average conditions.

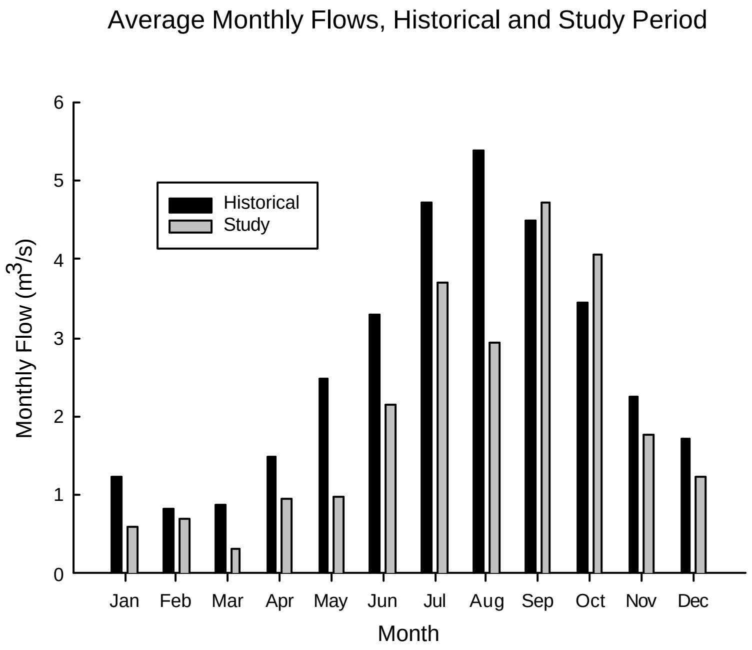


Figure 4.1 Comparison of monthly flows for the Great Forester River 2km upstream of the Forester Rd Bridge, (Historical Record vs Study Period).

5. Floods

Flood frequency analysis of flows in Great Forester River 2km upstream of the Forester Rd Bridge were carried out. The sample coefficient of skew was insignificant at the 95% level, as a result a 2 parameter log normal distribution was fitted. The results of this analysis are shown in Figure 5.1. 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 approximately 70 cumecs or more will occur (river height of about 2.87m). (b) in any given year there is a 50% chance that a flood of approximately 35 cumecs or more will occur (river height of about 1.62m).

During the present study there was a moderate flood which occurred on September 23rd, which had a peak flow of approximately 62 cumecs (corresponding river height of about 2.72m 2km upstream of Forester Rd Bridge). Examining Figure 5.1, it can be concluded that a flood of this magnitude has a 15% to 20% chance of occurring in any given year. This corresponds to an annual exceedence probability (A.E.P.) of 1:5 to 1:7.

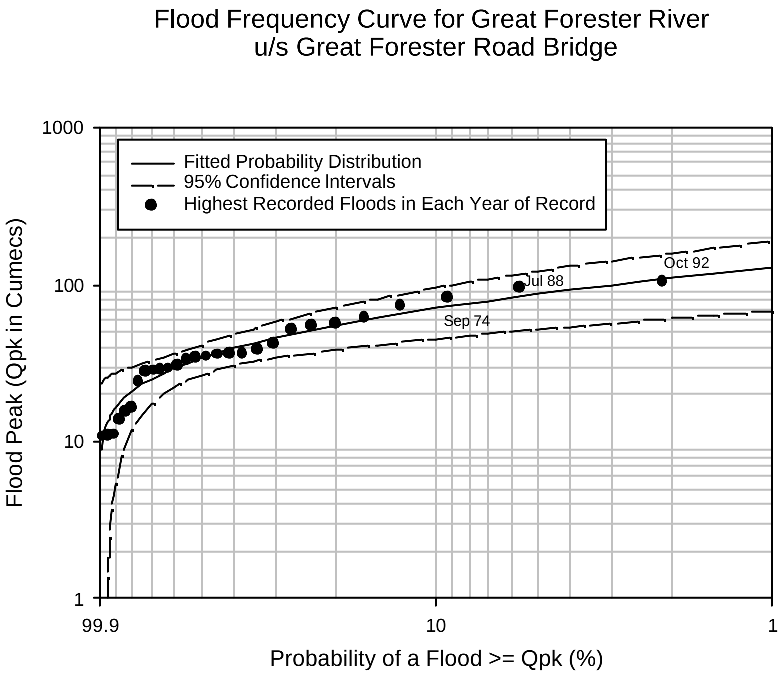


Figure 5.1 Flood frequency Curve for Great Forester River 2km upstream of the Forester Rd Bridge.

6. Droughts and Low Flows

Several hydrographs were analysed to describe the recession flows for the Great Forester River 2km upstream of the Forester Rd Bridge. 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 decrease of flow in the river. The recession curve basically reflects groundwater discharge to the river and how groundwater storage influences and sustains flows in rivers.

Analysis of recession curves for the Great Forester River 2km upstream of the Forester Rd Bridge identified different recession behaviour for winter and summer. The recession curves are presented graphically in Figure 6.1. It seems possible that this difference is due to the underlying geology of the district and could be explained by the presence of either 2 ground water storages or the presence of a significant upper soil storage providing additional base flow in winter. Additional field investigation is required to confirm the accuracy of these assumptions.

The following equations describe the recession curves:

Winter

$$\text{Flow} = 1.092 + 3.159 * 0.9992^{\text{Time (Minutes)}} + 2.286 * 0.9999^{\text{Time (Minutes)}}$$

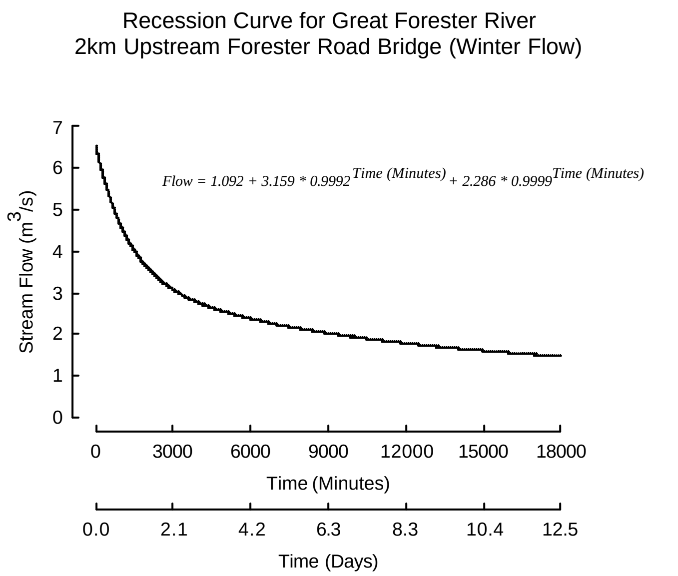
Summer

$$\text{Flow} = 0.2274 + 4.7814 * 0.9985^{\text{Time (Minutes)}} + 1.3205 * 0.9998^{\text{Time (Minutes)}}$$

The upper part of the recession curve contains mainly subsurface flow (runoff) while the lower section is more representative of groundwater discharge to the river. The curves demonstrate that the base

flow in winter months is approximately 1.1 cumecs, while in summer this base flow is reduced further to approximately 0.23 cumecs. Also worthy of note is the steep decline of the recession curve in summer. This indicates a lack of soil moisture or subsurface water, leading to a rapid return or recession to the base flow.
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 0.5 cumecs will occur is approximately 80%, while over a longer period such as ninety days this probability decreases to 5 to 10%.

This information has implications for the establishment of environmental flow allocations for the Great Forester 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.



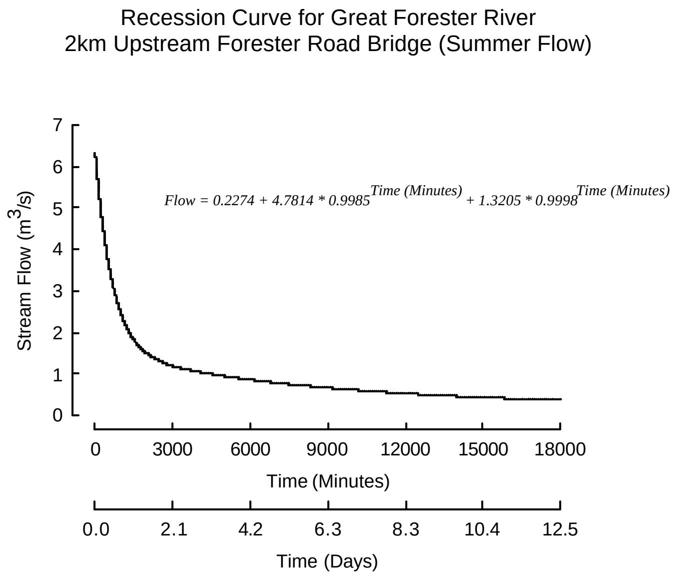
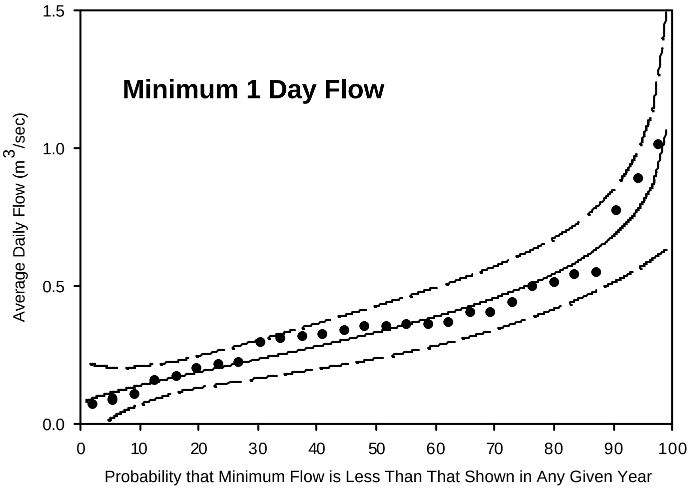
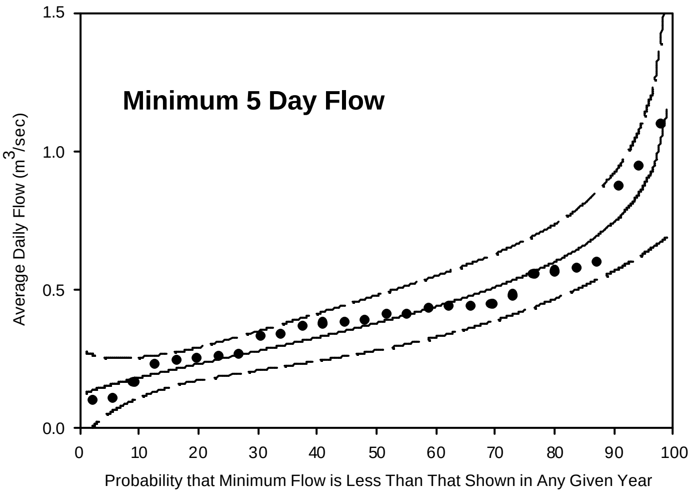
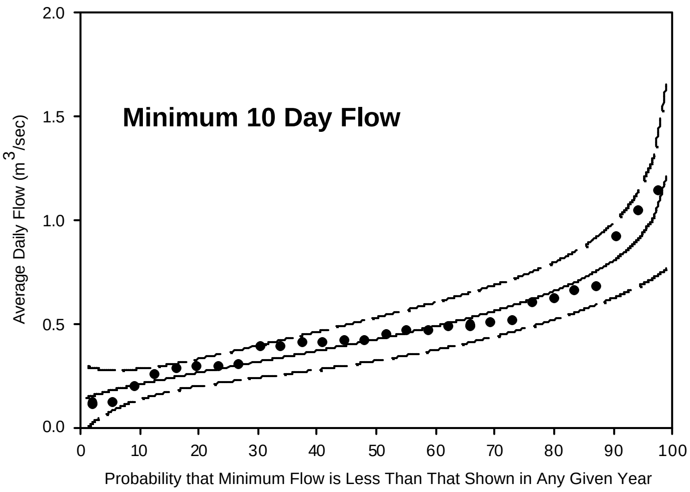


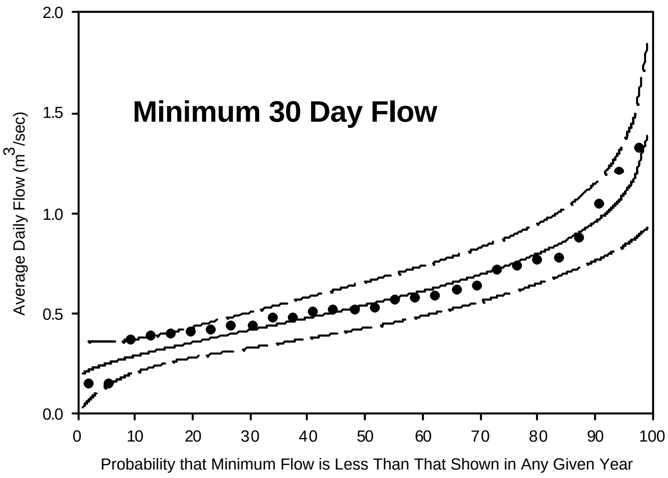
Figure 6.1 Recession Curve for Great Forester River 2km upstream of the Forester Rd Bridge.

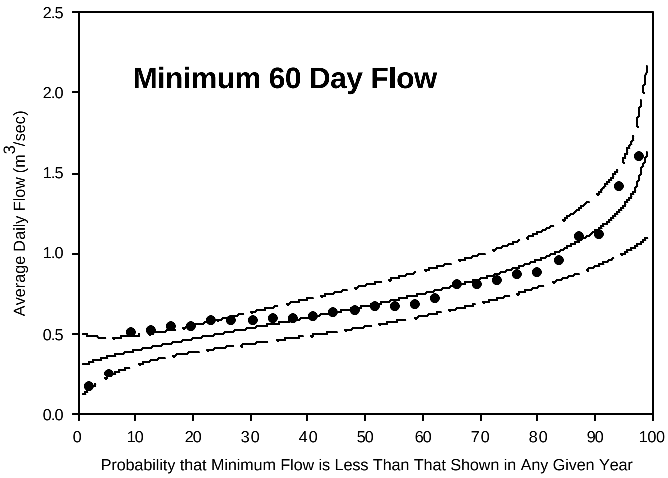


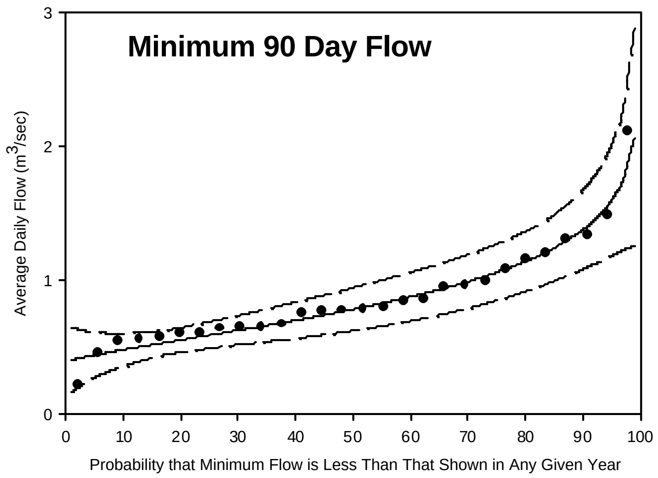




Figures 6.2 (a-c) Low flow frequency curves for the Great Forester River u/s Forester Rd Bridge. Each graph shows the probability that any given minimum flow will occur at each time period







Figures 6.2 (d-f) Low flow frequency curves for the Great Forester River u/s Forester Rd Bridge. Each graph shows the probability that any given minimum flow will occur at each time period

7. References

Bureau of Meteorology, Monthly Weather Review Tasmania 1998 (January through December)

Jordan, W.M. (1973) Tasmanian Water Resources Survey - Report No. 14 on the Great Forester and Tomahawk Rivers. Rivers and Water Supply Commission, October 1973.

Appendix 1

Rainfall statistics for five significant sites in the northeast

Bridport - Post Office

Site No. 091007 - Opened in January, 1912.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	44.0	42.6	41.8	66.2	81.2	81.7	87.9	86.3	66.0	68.0	53.3	54.0	780
Median	40.5	37.5	38.4	53.3	67.4	72.3	81.6	80.3	68.2	63.1	51.7	49.8	773
Highest	137.7	192.0	135.8	249.6	224.1	192.8	218.2	248.0	171.0	174.2	115.0	149.4	1128
Lowest	5.4	0.0	1.4	1.6	1.8	12.4	6.0	17.7	3.0	4.1	11.4	1.0	387
Years	84	83	84	84	84	84	82	84	82	81	83	81	78

Scottsdale - West Minestone Rd

Site No. 091219 - Opened in March, 1971.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	61.4	41.9	54.9	88.6	108.4	103.9	128.0	121.3	100.8	85.8	74.2	73.3	1040
Median	61.8	38.8	50.2	84.6	108.6	90.4	116.6	112.1	105.1	81.4	67.2	67.0	1057
Highest	134.4	109.2	146.2	203.8	181.4	224.4	287.6	269.4	227.8	153.2	161.8	218.0	1426
Lowest	9.4	1.8	5.0	19.0	7.6	54.2	32.8	40.2	13.8	32.0	25.2	11.6	678
Years	27	27	28	28	27	27	27	28	27	27	27	27	25

South Springfield

Site No. 091093 - Historical data (31 years record)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	59	57	60	97	146	140	153	165	127	122	89	84	1299

Maximum Annual Total for record = 1875 mm

Minimum Annual Total for record = 809 mm

Jetsonville

Site No. 091045 - Historical data (49 years record)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	48	56	45	72	92	106	116	114	90	88	63	59	949

Maximum Annual Total for record = 1465 mm

Minimum Annual Total for record = 568 mm

Diddleum - Sowters Rd

Site No. 091270 - Opened in May, 1992.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	124.6	111.0	52.0	94.3	176.6	161.3	195.8	191.8	157.7	124.2	114.4	92.1	1536
Median	108.9	121.6	41.9	87.0	168.0	143.0	201.2	210.0	148.1	111.3	96.3	81.4	1555
Highest	228.0	164.0	143.4	53.0	355.6	232.4	261.6	347.0	257.7	231.6	199.4	164.6	1961
Lowest	70.0	52.2	7.8	53.2	52.8	93.8	103.1	105.8	51.2	64.6	89.2	13.6	1137
Years	6	6	6	6	6	7	7	7	6	6	6	6	5

 # Refer: Bureau of Met. 1998