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

Tasmania

Hydrological Analysis of the Montagu River Catchment

A report forming part of the requirements for State of Rivers reporting

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December, 2003

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Preferred Citation:

DPIWE (2003) *State of the River Report for the Montagu River Catchment.* Water Assessment and Planning Branch, Department of Primary Industries, Water and Environment, Hobart. Technical Report No. WAP 03/09

ISSN: 1449-5996

The Department of Primary Industries, Water and Environment

The Department of Primary Industries, Water and Environment provides leadership in the sustainable management and development of Tasmania's resources. The Mission of the Department is to advance Tasmania's prosperity through the sustainable development of our natural resources and the conservation of our natural and cultural heritage for the future.

The Water Resources Division provides a focus for water management and water development in Tasmania through a diverse range of functions including the design of policy and regulatory frameworks to ensure sustainable use of the surface water and groundwater resources; monitoring, assessment and reporting on the condition of the State's freshwater resources; facilitation of infrastructure development projects to ensure the efficient and sustainable supply of water; and implementation of the *Water Management Act 1999*, related legislation and the State Water Development Plan.

Hydrological Analysis of the Montagu River Catchment

1. Historical Background

1.1 Catchments and Drainage Systems

The Montagu River catchment is located in the northwest corner of the state and occupies an area of approximately 470 km^2. The Welcome and Duck River catchments border the western and eastern extent of the Montagu catchment respectively while to the south the catchment is bordered by the Arthur River catchment. The northern extent of the catchment is bordered by about 20 km of Bass Strait coastline. The location of the catchment and drainage network is shown in Figure 1.1.

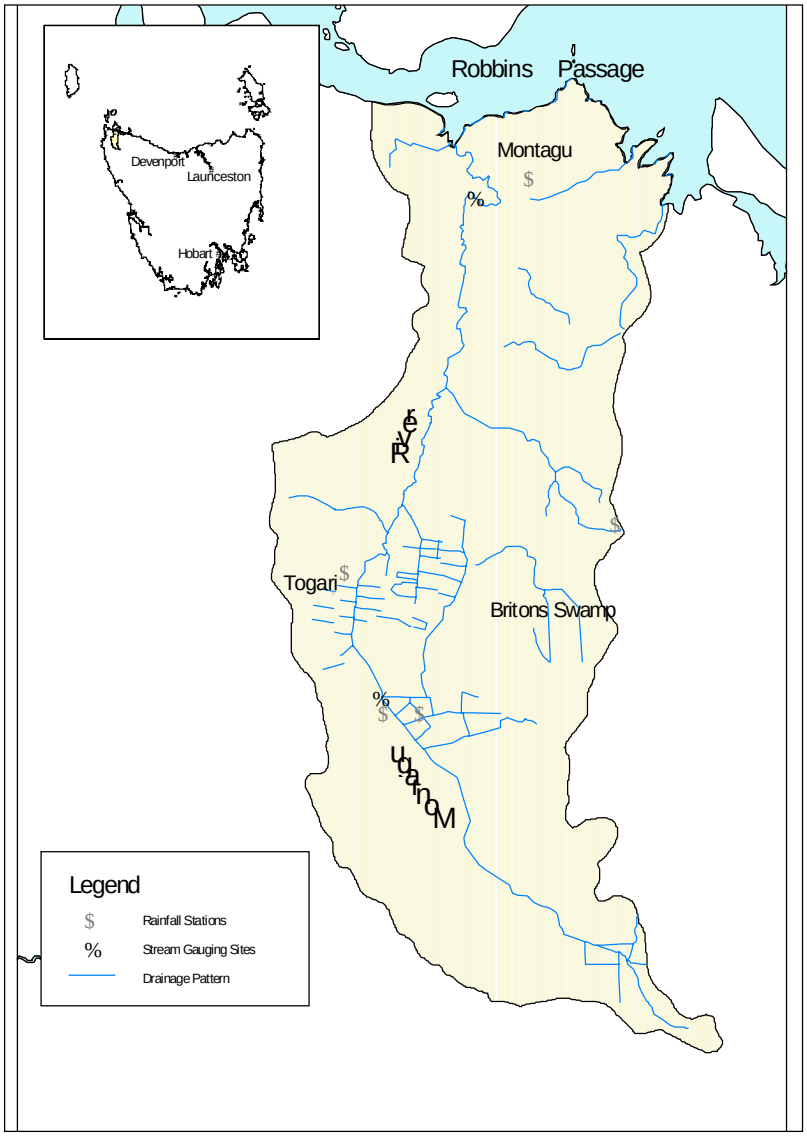

Figure 1.1 Hydrological set up of Montagu River catchment.

The Montagu River originates southeast of Montagu Swamp and flows roughly north through the heavily modified drainage areas of Togari and Montagu Plains. Farnhams Creek, Fixtures Creek and Moores Creek are the main tributaries of the Montagu River, and these streams are ephemeral.

1.2 Rainfall

Rainfall monitoring at two sites in the catchment shows that annual average rainfall varies spatially from about 950 mm and 1300 mm. While there is a general trend of increasing rainfall from the north to the south, this is unlikely to be related to changes in elevation, as the township of Togari (35m AHD) is only 10 m higher than Montagu Plains (25m AHD). The pattern of average monthly rainfall distribution is similar for the two sites (Figure 1.2), and is distinctly seasonal with highest rainfall occurring during July and August and lowest rainfall occurring during January and February.

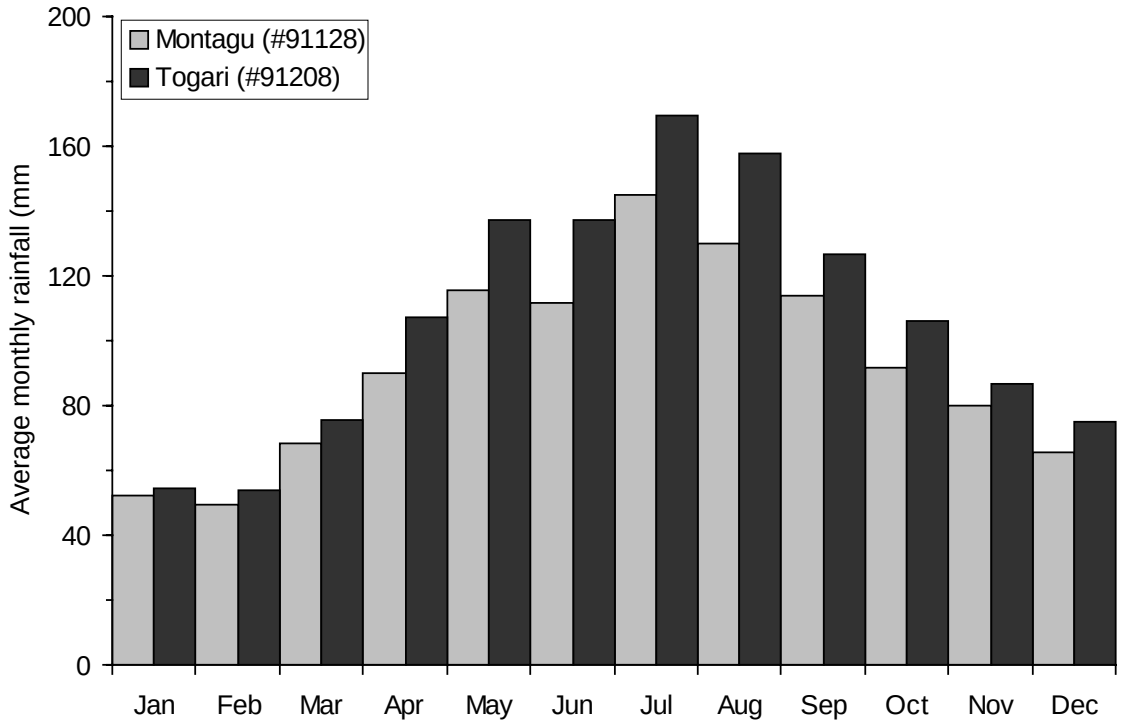

Figure 1. 2 Average monthly rainfall at selected sites in the Montagu River catchment.

1.3 Water Usage and Diversions

Land use practices in the catchment are mainly irrigated pasture, forestry, and some rural residential development. Water usage in the catchment is primarily for irrigation purposes. Direct offtakes and farm dams are the main sources of water in the Montagu catchment during the dry summer months. Over 90% of the licensed water allocation within the Montagu catchment is for the purpose of irrigation (Table 1.1) and therefore water demand is highest during the peak of the irrigation season.

Table 1.1 A summary of water allocations in the Montagu River catchment.

Source	**Intended Use**	**License Volume (ML)**
Montagu River & tributaries	Irrigation	1010
	Stock & Domestic	98
	Total	1108

Data source: WIMS: Water Information Management System, http://wims.dpiwe.tas.gov.au .

2. Hydrological Monitoring in the Catchments

2.1 Rainfall Monitoring

As part of the statewide rainfall-monitoring network, the Bureau of Meteorology currently operates two stations in the Montagu catchment (Table 2.1). The Bureau also has historical records for a further 3 stations that are no longer operational. A summarised version of the rainfall data can be accessed from the Internet site http://www.bom.gov.au or from the regional Bureau of Meteorology office at Hobart. The rainfall data is also available in Hydrol database in DPIWE.

Table 2.1 Bureau of Meteorology rainfall stations in the Montagu River catchment.

Station	Station Name	AHD (m)	Start Record	End Record
91208	Togari (Renison Road)	35	31/12/1965	Current
91209	Montagu Swamp	100	30/09/1951	09/03/1954
91110	Eighteen Mile Camp	100	31/03/1954	28/04/1967
91128	Montagu (Montagu Road)	25	31/08/1961	Current
91217	Christmas Hills	60	12/12/1972	30/07/1991

AHD: Australian Height Datum in metres.

2.2 River Flow Monitoring

There are two locations in the Montagu River where flow monitoring has taken place, and only one of these is currently maintained and operated (Table 2.2). The flow data that is available for the Montagu River at Togari (14216) is discontinuous and the short period of record that is available (~5 years) is insufficient to support rigorous hydrological analysis. The following analysis and comments are therefore restricted to Montagu River at Montagu Road Bridge (site 14200).

Table 2.2 Stream flow monitoring sites in the Montagu River catchment.

Site	Site Name	Area (km^2)	Start Record	End Record
14200	Montagu River at Montagu Road Bridge	323	27/05/1967	Current
14216	Montagu River at Togari	142	01/01/1973	16/10/1990

3. Catchment Yields and Distribution of Flows

3.1 Catchment Yields

The historical annual discharge volumes at Montagu River at Montagu Road Bridge (14200) are shown in Figure 3.1. Blank sections in the figure indicate periods for which no data was recorded. The annual discharge volume for this site (which is near to the catchment outlet) ranges from 42,800 to 248,000 ML, with an annual average for the 27 years of record of 123,000 ML. The estimated average annual yield for the catchment is 179,000 ML.

As can be seen in Figure 3.2, the seasonal flow pattern in the Montagu River is quite distinct. The winter discharge volumes range from 38,500 to 210,800 ML and during most years are vastly higher than the summer discharge volumes. The total summer discharge volume in the Montagu River (as recorded at site 14200) is in the range 4,000 to 38,000 ML with an average volume of 13,600 ML. The estimated average catchment yields for the summer and winter periods respectively, are 19,800 ML and 160,300 ML.

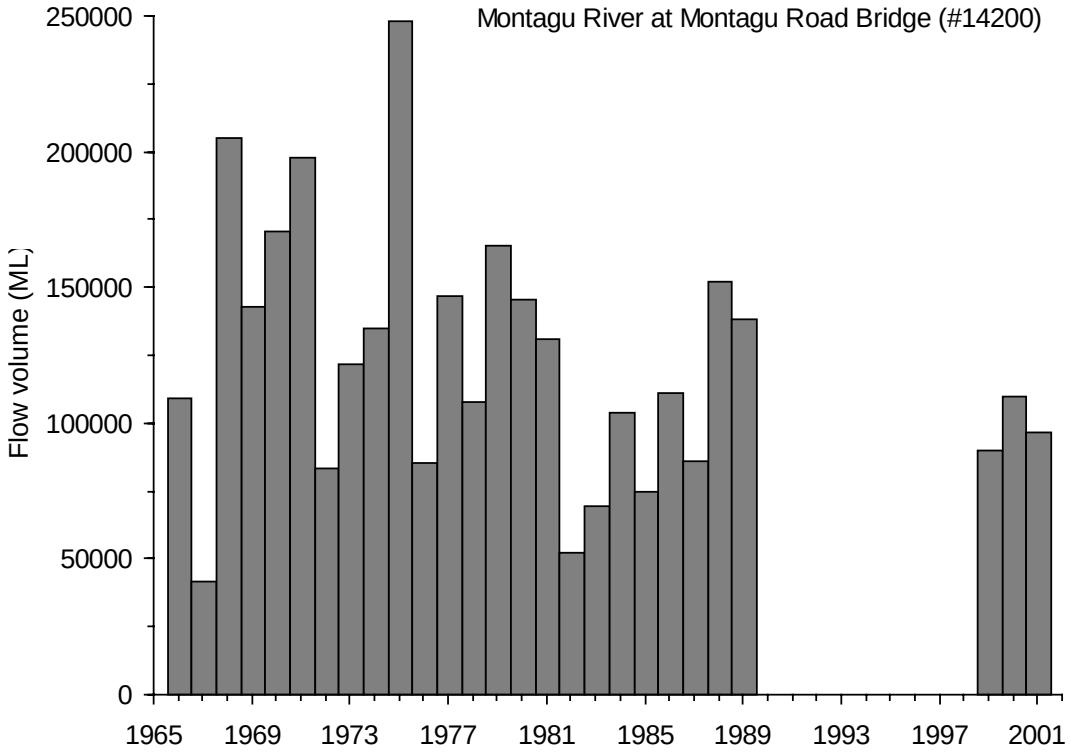

Figure 3.1 Annual flow volumes at Montagu River at Montagu Road Bridge.

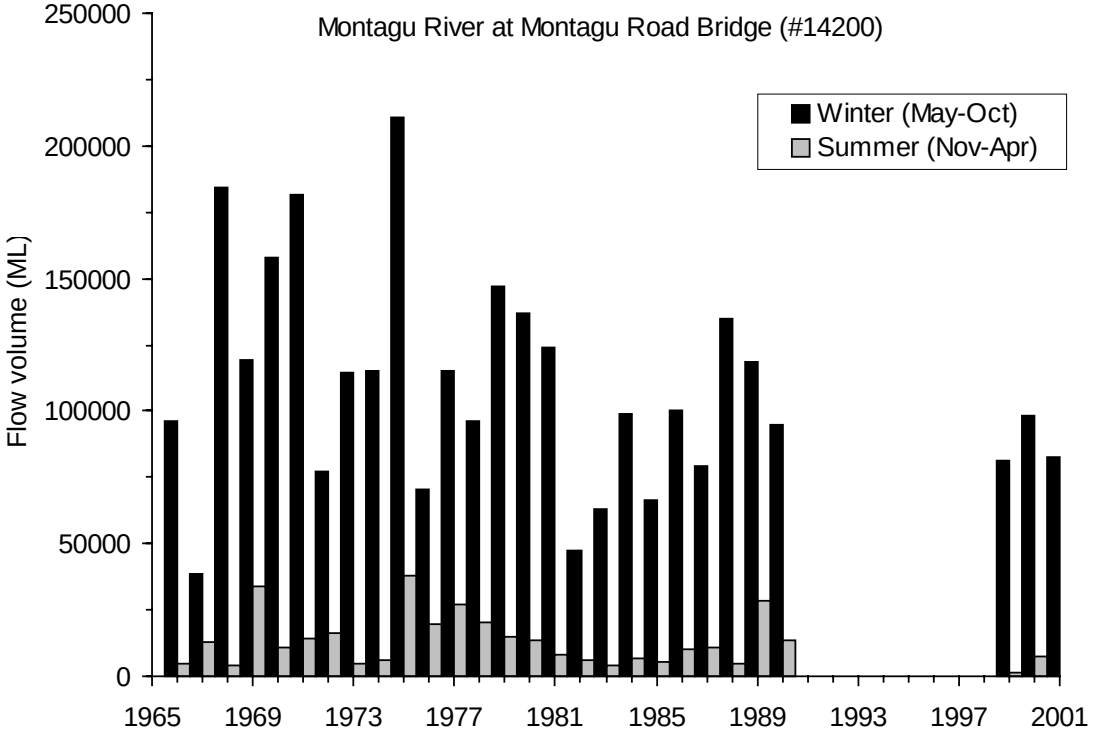

Figure 3.2 Seasonal flow volumes at Montagu River at Montagu Road Bridge.

3.2 Monthly Yields

The variability of monthly flows in the Montagu River at site 14200 is shown in Figure 3.3, which provides box and whisker plots of monthly average flow data. The horizontal line across the box represents the median flow whereas the bottom and top edges of the box mark the first and third quartiles respectively. The ends of the whiskers show the spread of 95% of the data. The crosses beyond the whiskers indicate high and low outliers.

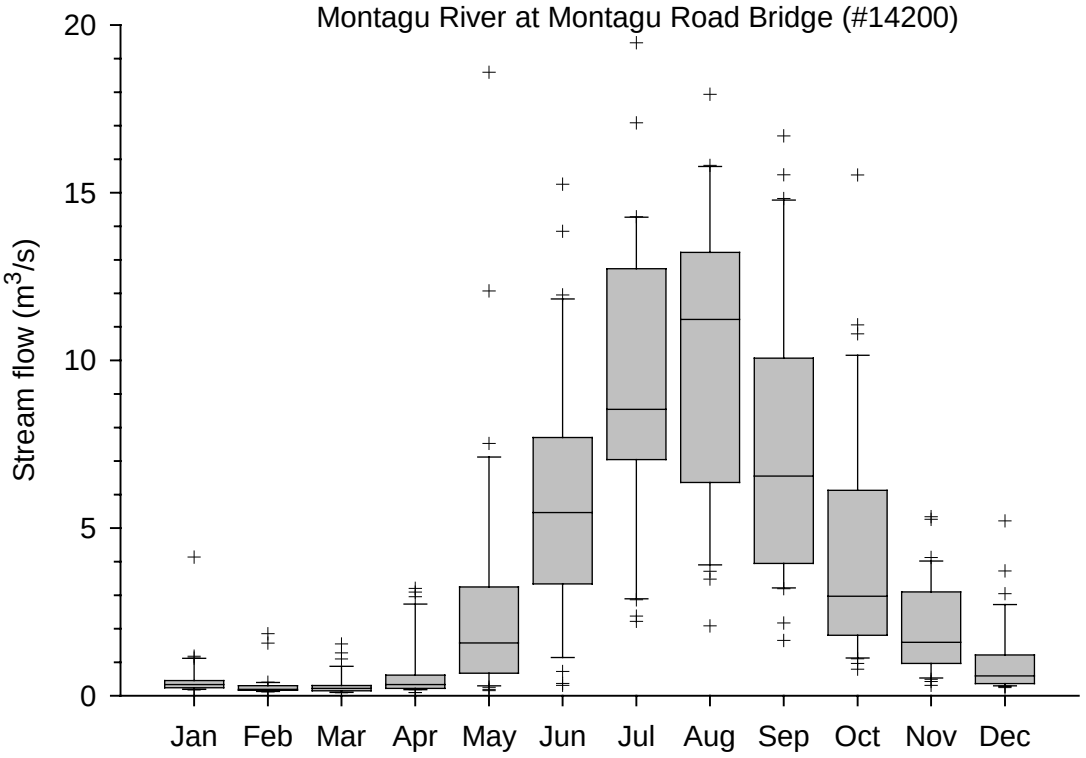

Figure 3.3 Monthly flow analysis from Montagu River at Montagu Road Bridge.

Monthly flow in the Montagu River at Montagu Road Bridge demonstrates a typical seasonal pattern of variation, with instantaneous flows generally in excess of 4 m^3/s during the winter and early spring periods followed by flows less than 1 m^3/s during the summer and early autumn.

4. Comparison between Study Period and Historical Data

Figure 4.1 compares monthly average flow at the Montagu River at Montagu Road Bridge (site 14200) during the study period (1999-2001) with the record preceding the study. The graph shows that for all months barring October and November, average monthly flows during the period of the study were less than the historical record, in some cases (January, April and May) average monthly flows were less than half the historical average. The overall monthly average flows during the study period were approximately 19% lower than the historical average flows.

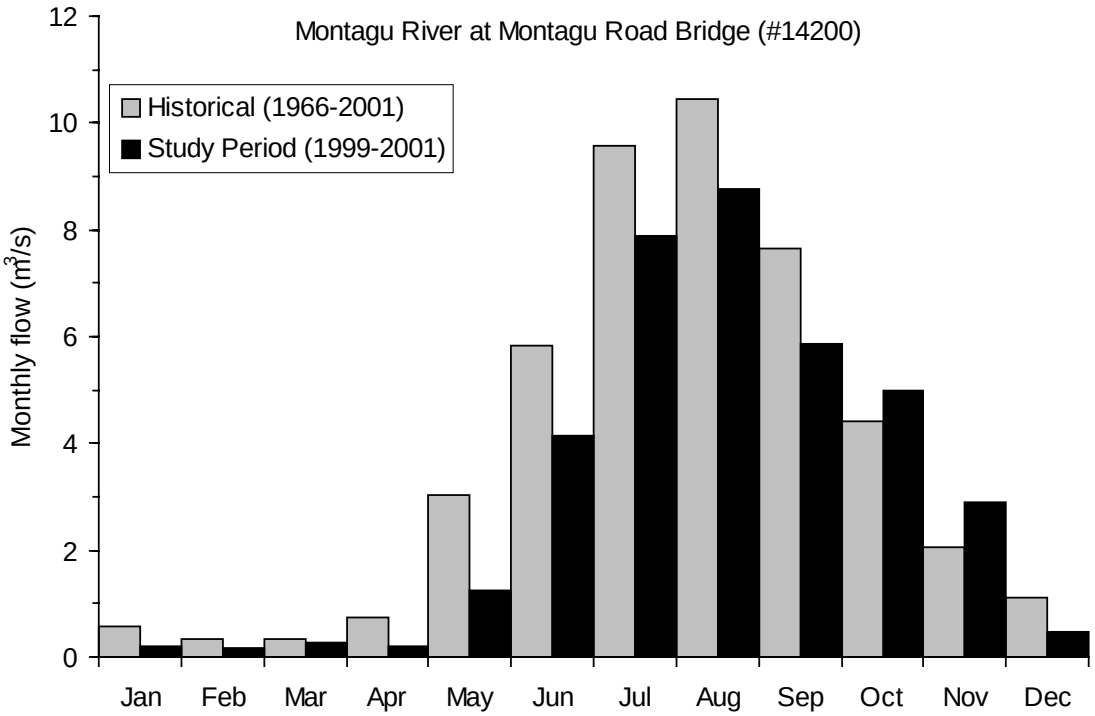

Figure 4.1 Comparison of monthly flows from Montagu River gauging site.

5. Recessions and Low Flows

Segments of peak flow hydrographs occurring during the study period were analysed to describe the recession flows for the Montagu River at Montagu Road Bridge (14200). The recession curves are segments of hydrographs, which show how the water storage in the river decreases over time following peak 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 also reflects the groundwater discharge to the river and how groundwater storage influences and sustains base flows in rivers.

The winter and summer recession curves for the Montagu River at Montagu Road Bridge are presented in Figure 5.1. The upper part of the recession curves is comprised mostly of surface water flow. With time, the surface flow contribution gradually decreases until the flow is comprised almost entirely of groundwater flow (or base flow) which is depicted on the lower section of the curves.

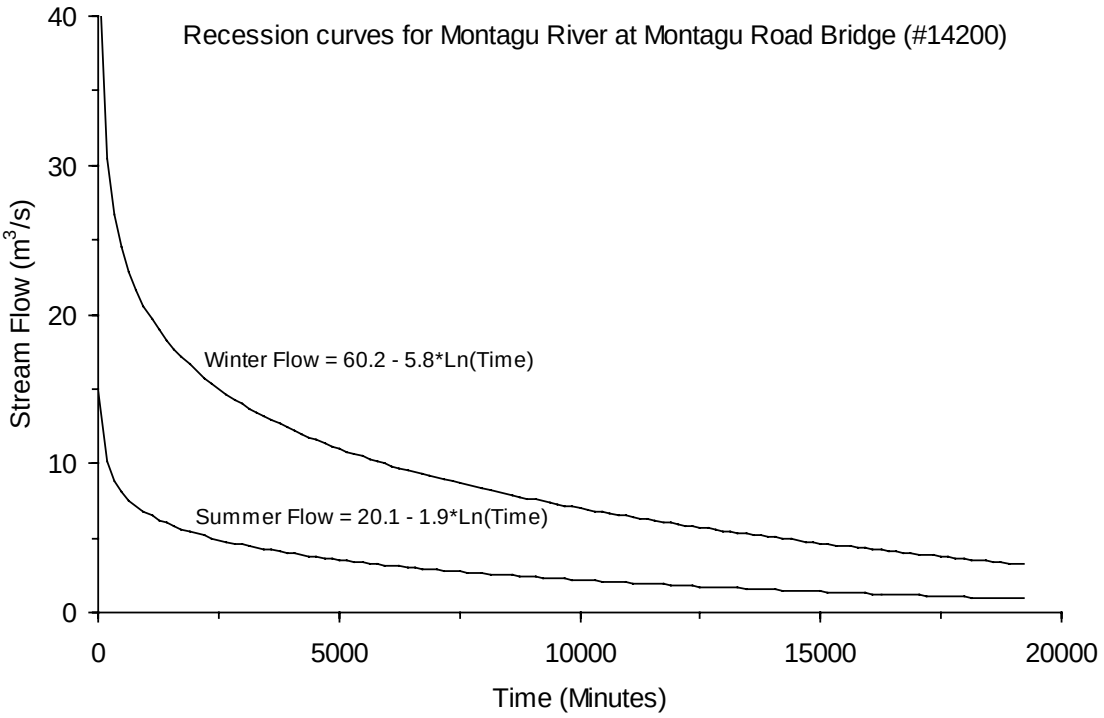

Figure 5.1 Recession curves for Montagu River at Montagu Road Bridge.

The flow recession at Montagu River at Montagu Road Bridge roughly follows a lognormal fitted curves described by the following equations:

*Winter Flow = 60.2 - 5.8*Ln(Time in minutes),* $R^2 = 0.94$

*Summer Flow = 20.1 - 1.9*Ln(Time in minutes),* $R^2 = 0.92$

The curves demonstrate that it takes approximately 20000 minutes (14 days) for the flow to recede from 40 m^3/s to 5 m^3/s during winter. During the summer the recession period was considerably shorter (8 days) for flows to recede from approximately 15 m^3/s to base flow of around 2 m^3/s.

Low flow frequency curves were derived for 10, 60 and 90 days durations (Figures 5.2). The curves are intended to indicate probability of minimum flow occurrence over various time periods. For example, the probability that a minimum average daily flow of 1.0 m^3/s will occur in any given year over 60 days is approximately 99%, while over a longer period such as 90 days this probability decreases to around 86%.

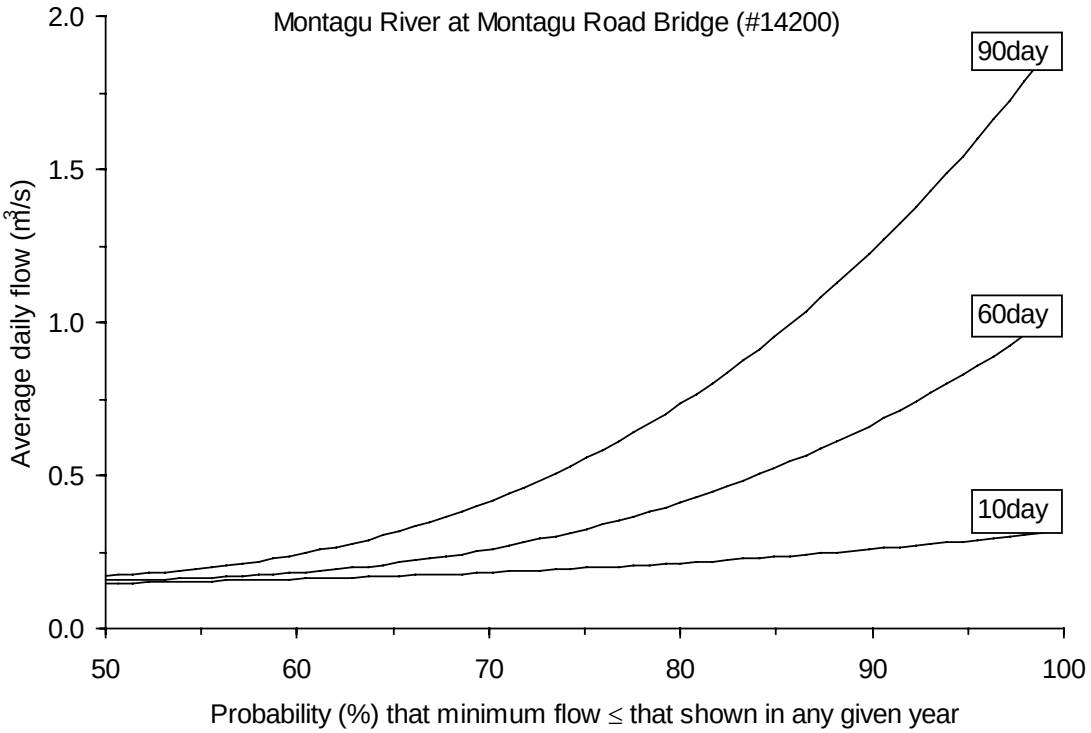

Figure 5.2 Low flow frequency curves for Montagu River gauging site.

This information has implications for the establishment of environmental flow allocations for the Montagu River catchment and for the assessment of risk in supply of water from the rivers for purposes such as 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 Water Management Act, 1999.

6. Floods

Flood frequency analysis of flows at Montagu River at Montagu Road Bridge site (14200) was carried out to indicate the likelihood of floods in the catchment. The result of this analysis is presented in Figure 6.1. An example of how to read this graph is that the magnitude of a 1 in 10-years flood event in the catchment is approximately 50 m^3/s (or conversely – there is a 1 in 10 year chance that a flood of 50 m^3/s or more will occur). During the study period, a discharge of 60 m^3/s (2.2 m river level) occurred on 02/10/2000, and this is equivalent to a 1 in 30-years flood event at this location in the river.

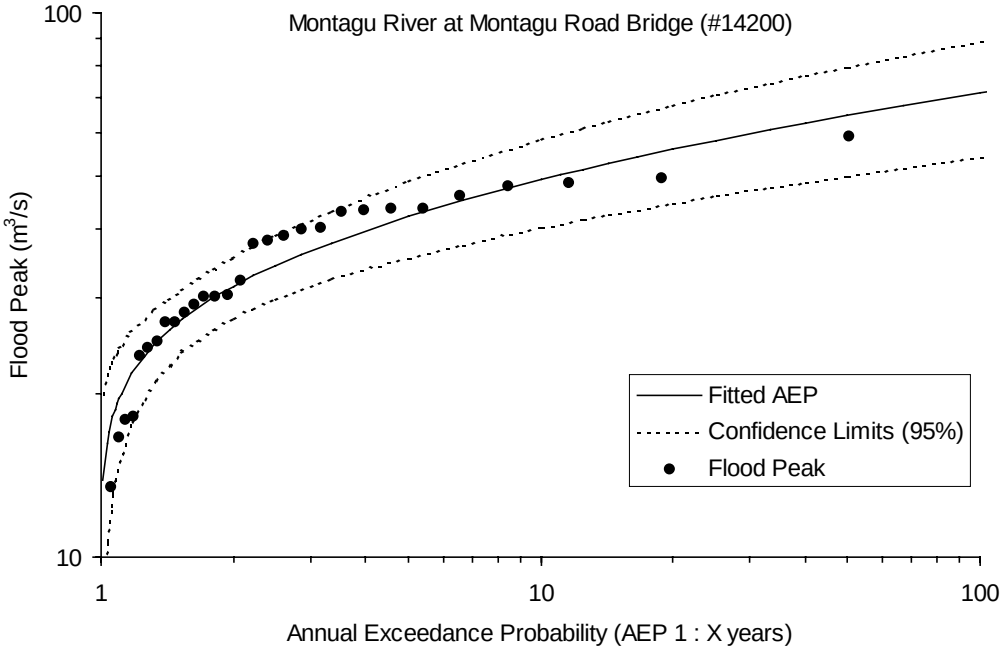

Figure 6.1 Flood frequency curves for Montagu River gauging site.

7. References

WIMS: Water Information Management System, http://wims.dpiwe.tas.gov.au

BOM, 2001. Bureau of Meteorology rainfall data, http://www.bom.gov.au

HYDROL: DPIWE Water Quantity and Quality Database.