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

Tasmania

Hydrological Analysis of the North Esk Catchment

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

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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.

1 Historical Background

Catchments and Drainage Systems

The North Esk catchment occupies an area of 1064 km^2. Much of the catchment is undulating, especially in the east on the slopes of the Ben Lomond Ranges and in the central region surrounding Mt Barrow and its foothills. Apart from Launceston and its environs, there are no population centres of significant size located in the catchment. The largest towns are Nunamara, Burns Creek and Upper Blessington. The North Esk River catchment is composed of two major drainage systems the North Esk River, draining the southern and eastern areas of the catchment, and the St. Patricks River, which drains the northern region.

The source of the North Esk River is located on the northern slopes of Ben Nevis, part of the Ben Lomond Ranges. From there, it travels in a southerly direction until it reaches the confluence with the Ford River where it turns to the west. Several smaller tributaries contribute flow, Burns Creek, Musselboro Creek and Weavers Creek, from the North, and Pig Run Creek and River O'Plain Creek from the South, before the flow increases dramatically at the confluence with the St. Patricks River. After joining with the St. Patricks River the North Esk River continues in a westerly direction, picking up flow from Distillery Creek and Rose Rivulet, before flowing through Launceston and eventually into the River Tamar.

The St. Patricks River rises on the foothills between Mt. Maurice and Ben Nevis. The river hooks around Mt. Barrow and its foothills and by the time it reaches Nunamara, the catchment grows to include drainage from Camden Rivulet, Barrow Creek and Coquet Creek to the South, and Patersonia Creek, which collects runoff from Eagle Hawk Tier and Mt Arthur. The river then travels south and drains into the North Esk River near Watery Plains.

Rainfall and Climate

The distribution of rainfall in the North Esk catchment is dictated mainly by topography, with highest rainfall occurring around Ben Nevis and associated ranges. The average annual rainfall at Launceston, the lowest point in the catchment, is around 720 mm, compared with 1300 – 1400 mm at Mt Barrow and on the slopes of Ben Nevis. Throughout the catchment, highest monthly rainfall totals occur in July and August and lowest totals occur 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.

Strong winds (greater than 50 km/h) are most likely to occur during late winter and spring. The weather becomes quite unsettled during these months and sudden bursts of strong, cold wind and mountain snow can occur. The climate becomes more stable during summer and autumn.

Water Usage and Diversions

There is only a small amount of water abstracted from the North Esk River for agricultural use, as permanent water allocations currently allow for approximately 9 ML/day (0.104 cumecs) to be taken during the irrigation (summer) period (DPIWE unpublished data). There is also another 1.25 ML/day (0.014 cumecs) allocated under a temporary water licence for irrigation. Also, the Esk Water Authority is licensed to abstract 10,036 megalitres a year (33 ML/day, 0.382 cumecs, for 314 days per year) for its water treatment plant at Chimney Saddle.

There is only a small amount of water abstracted from St Patrick's River for agricultural use, as permenant water allocations currently allow for about 0.3 ML/day (0.003 cumecs) to be taken during the summer irrigation period (DPIWE unpublished data). However, Esk Water Authority is licensed to abstract 14,140 megalitres a year (45ML/day, 0.521 cumecs, for 314 days per year) from the river at Nunamara for Launceston domestic use. This water is extracted via a canal that links to Distillery Creek. In reality, the Nunamara flume abstracts closer to 15,300 ML/year, with water abstracted every day of the year at an average of 42 ML/day (0.486 cumecs). Combined with the North Esk offtake at Chimney Saddle the offtake provides 66% of domestic water for the Tamar Valley (Launceston City Council pers. comm.).
A summary of the direct summer takes from the North Esk River and St Patricks River combined is presented in the following table. Note that water takes for fish farms are non-consumptive, they do not represent a net loss from the river.

Table 1.1 Summary of licensed summer water allocations in the North Esk Catchment

Intended Use	Daily Rate (ML/day)
Irrigation	10.105
Stock & Domestic	0.002
Fish Farm	44.4
Industrial	0.022
Town Water Supply	120
Total	**210.529**

2 Monitoring in the Catchment

Bureau of Meteorology

As part of the statewide rainfall monitoring network, the federal Bureau of Meteorology currently operates 15 stations in the North Esk catchment. They also have records for a number of stations that are no longer operational. All data can be obtained from the Bureau of Meteorology.

Table 2.1 Bureau of Meteorology Rainfall Stations in the North Esk Catchment

Station Number	Station Name
91072	Launceston (King Meadows)
91088	St Patricks River (Trout Creek Farm)
91104	Launceston Airport
91181	Launceston (Filtration Plant)
91197	Musselboro (Elverton)
91198	Mt Barrow (South Barrow)
91225	Burns Creek (Janefield)
91263	Corra Linn
91271	Nunamara Offtake (St Patricks River)
91280	Hoblers Bridge
91301	Nunamara (Hunting Ground Road)
91302	Diddleum (St Patricks River)
91305	Targa (Priors Road)
92081	Upper Blessington (Heathcote)
92109	Upper Blessington

River Monitoring

There is currently only one stream-gauging site operational in the North Esk catchment at the Ballroom site. Data has been collected there since 1923, although there are significant holes in the data prior to 1927. Continuous water quality sampling has been conducted at this site since early 1996. This data is discussed in another section.

River level has also been monitored at 8 other sites in the past. However, at the majority of these sites data is available only for short time periods.

Table 2.2 Stream Flow Monitoring Sites in the North Esk Catchment

Station Number	Station Name	Period of Record	Catchment Area (km^2)
401	Distillery Creek	21/3/1991 – 12/1/1995	
329	Musselboro Creek above North Esk	23/8/1990 – 27/9/1995	
330	Musselboro Creek above View Banks	8/2/1991 – 4/4/1991	
331	Musselboro Creek below Mt. Barrow	16/1/1991 – 20/1/1994	
76	North Esk at Ballroom	19/3/1923 - present	362.6
241	North Esk at Cora Linn	16/6/1962 – 14/5/1996	870
444	St. Patricks at Nunamara Offtake	14/11/1991 – 13/1/1995	
118	St. Patricks River at Nunamara	1/7/1944 – 30/4/1992	296
318	Coquet Creek at Tasman Highway	21/12/1989 – 21/8/1991	

3 Catchment Yields and Distribution of Flows

Catchment Yields

Figures 3.1 to 3.2 show the total annual, non-irrigation season and irrigation season flows at the North Esk at Ballroom site. Blank sections of the plots indicate periods for which there was no flow data recorded. Annual total flows at the Ballroom site are highly variable and they do not follow an obvious cyclical pattern. Flow conditions in the irrigation season are influenced by the flow conditions present in the North Esk River catchment during the preceding non-irrigation season. An above average non-irrigation season flow is, in most cases, followed by an above average flow during the irrigation season. Similarly, a below average irrigation season mean flow is usually preceded by a below average non-irrigation season flow.

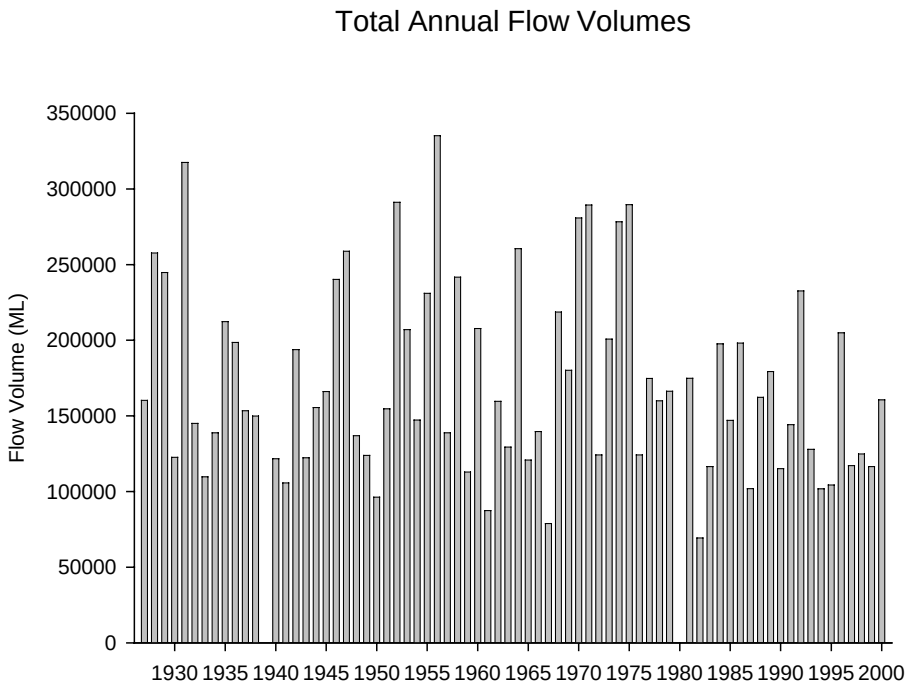

Figure 3.1 Total Annual Flow Volumes in the North Esk at Ballroom (ML)

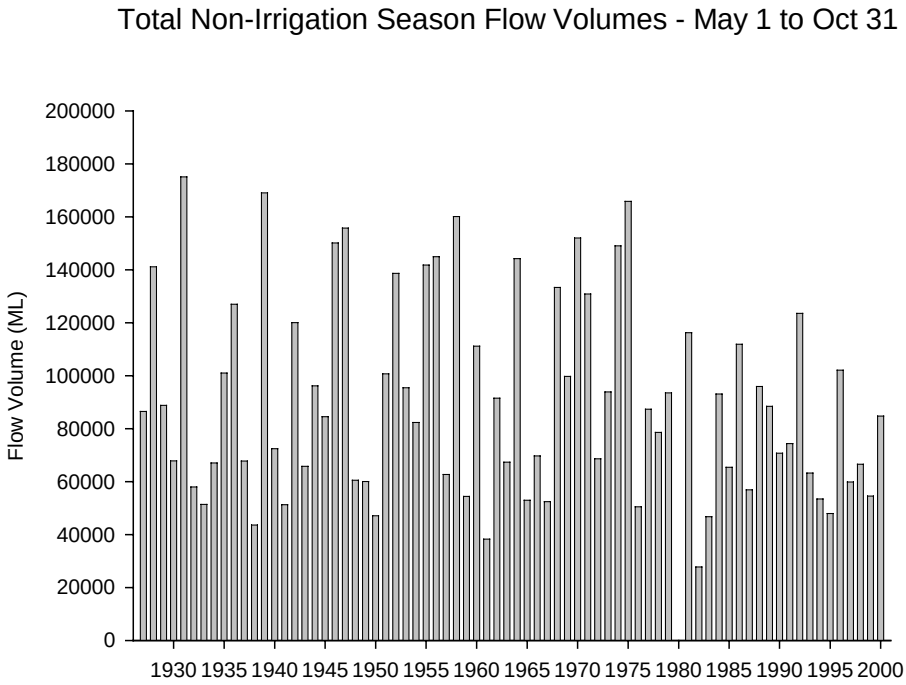

Figure 3.2 Total Non-Irrigation Season Flow Volumes in the North Esk at Ballroom (ML)

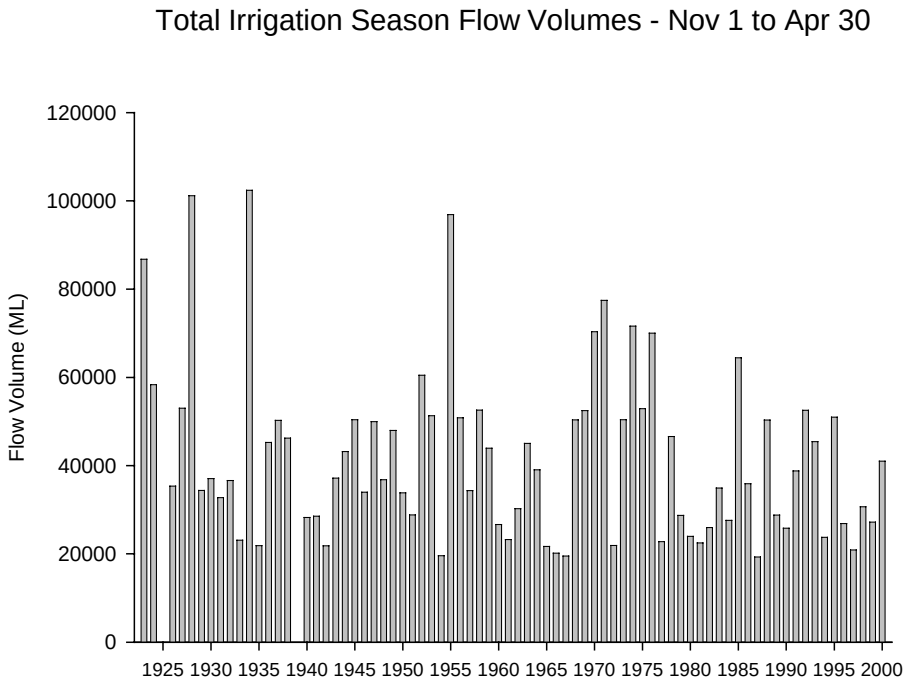

Figure 3.3 Total Irrigation Season Flow Volumes in the North Esk at Ballroom (ML)

Monthly Yields

The variability of monthly flows in the North Esk catchment is illustrated in Figures 3.4 to 3.7, which provide box and whisker style plots for data from four sites. 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.

All box and whisker plots illustrate a strong seasonal pattern, with flows peaking in the period July through to September. Lowest flows are experienced between January and April. The gradual pick up in flows down the North Esk River is illustrated by the increase in flow from North Esk at Ballroom to North Esk River at Watery Plains and then to North Esk River at Corra Linn. The St Patricks River is responsible for most of the flow pick up between the North Esk River at Ballroom and North Esk River at Watery Plains sites.

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. The pattern of monthly flows in the North Esk catchment is similar to those found in other rivers in Tasmania's northeast (ie. Ringarooma River and Great Forester River).

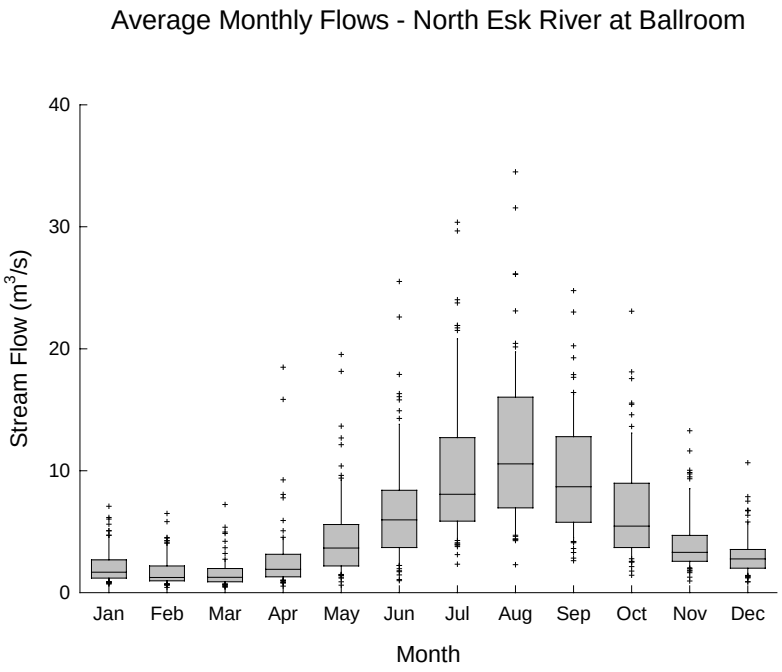

Figure 3.4 Monthly Flow Analysis from North Esk River at Ballroom

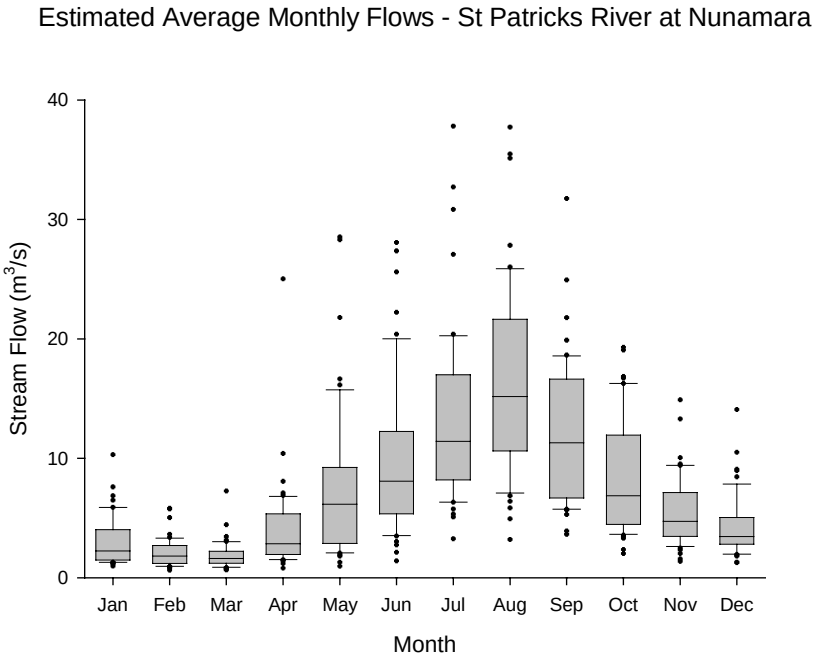

Figure 3.5 Monthly Flow Analysis from St Patricks River at Nunamara

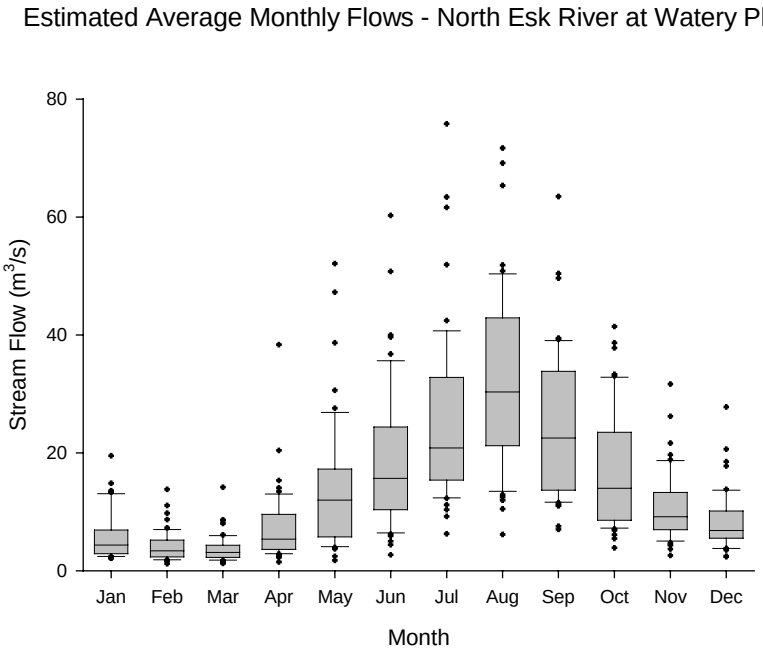

Figure 3.6 Monthly Flow Analysis from North Esk River at Watery Plains

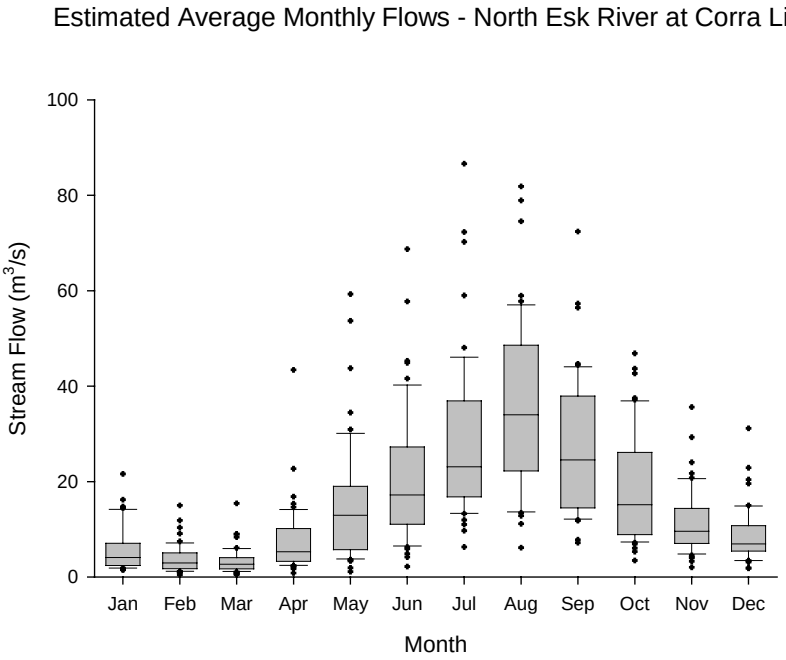

Figure 3.7 Monthly Flow Analysis from North Esk River at Corra Linn

4 Comparison between Study Period & Historical Data

The following bar chart is a comparison between the flow conditions experienced at the North Esk at Ballroom site during the study period and the historical record. In general, the study was conducted in drier than average flow conditions, although flows were higher than historical flows for January and February and significantly higher in October and November.

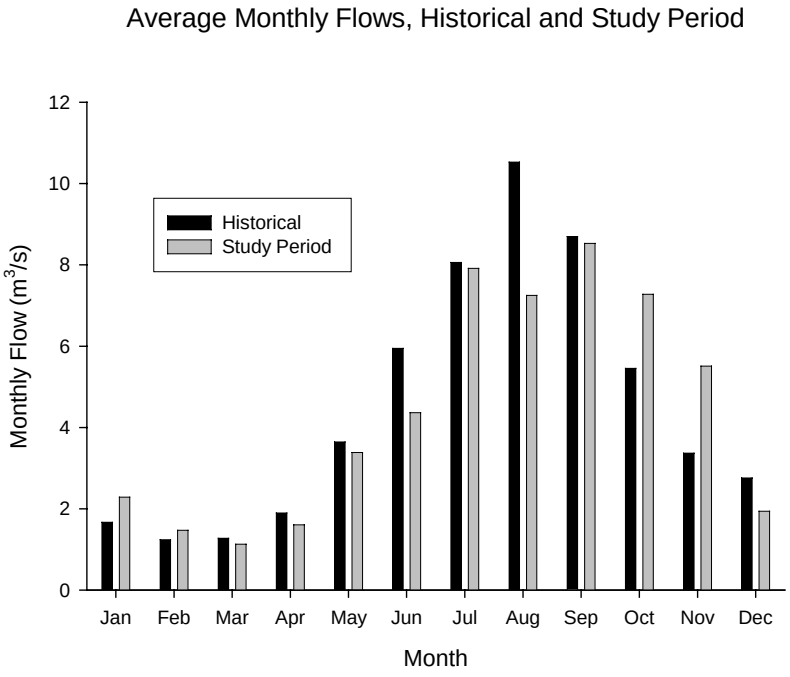

Figure 4.1 Comparison of Monthly Flows for the North Esk River at Ballroom

5 Droughts and Low Flows

Several hydrographs were analysed to describe the recession flows for the North Esk River at Ballroom. 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.

The recession curve for the North Esk River at Ballroom is described by the following equation;

$$\text{Flow} = 1.88747 + 4.66158 \times 0.99954^{\text{Time(Minutes)}} - 0.00004 \times \text{Time(Minutes)}$$

and is presented graphically in Figure 5.1. The upper part of the recession curve is comprised mostly of surface water, as flow drops the surface flow contribution gradually decreases until the flow is comprised almost entirely of groundwater flow, depicted on the lower section of the curve. The curve demonstrates that it takes approximately 20 days for the flow to recede from 6.5 m^3/s to 1 m^3/s, during summer.

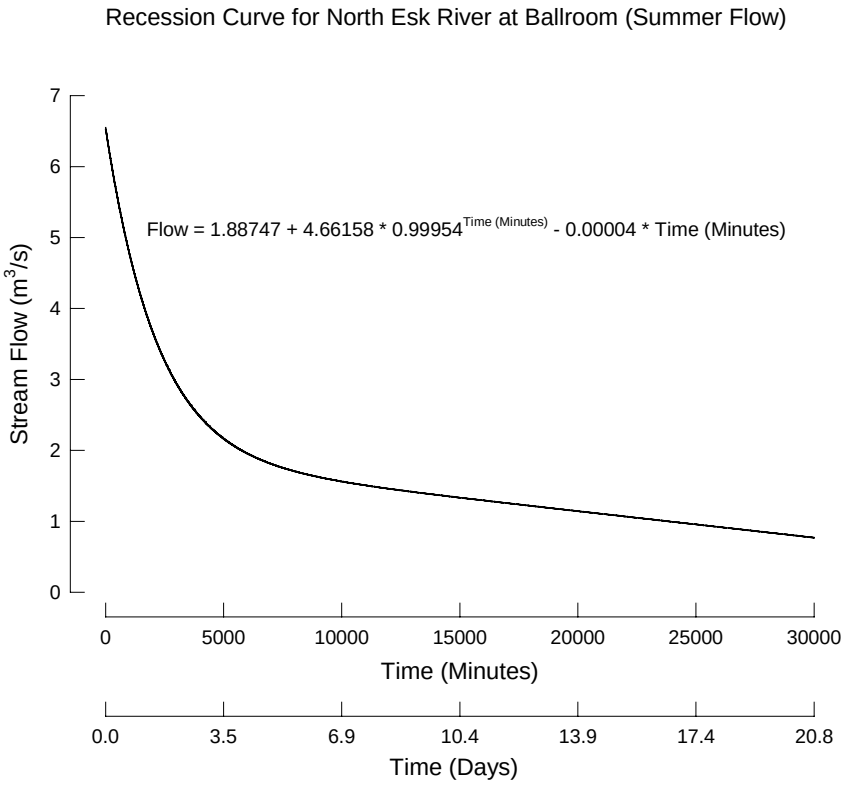

Figure 5.1 Recession Curve for North Esk River at Ballroom

Low flow frequency curves have been derived for a range of durations from 1 day through 90 days (Figures 5.2 to 5.7). 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 1.0 cumecs will occur in any given year is approximately 80%, while over a longer period such as ninety days this probability decreases to around 30%.

This information has implications for the establishment of environmental flow allocations for the North Esk River and for the assessment of risk in supply of water from the river 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.

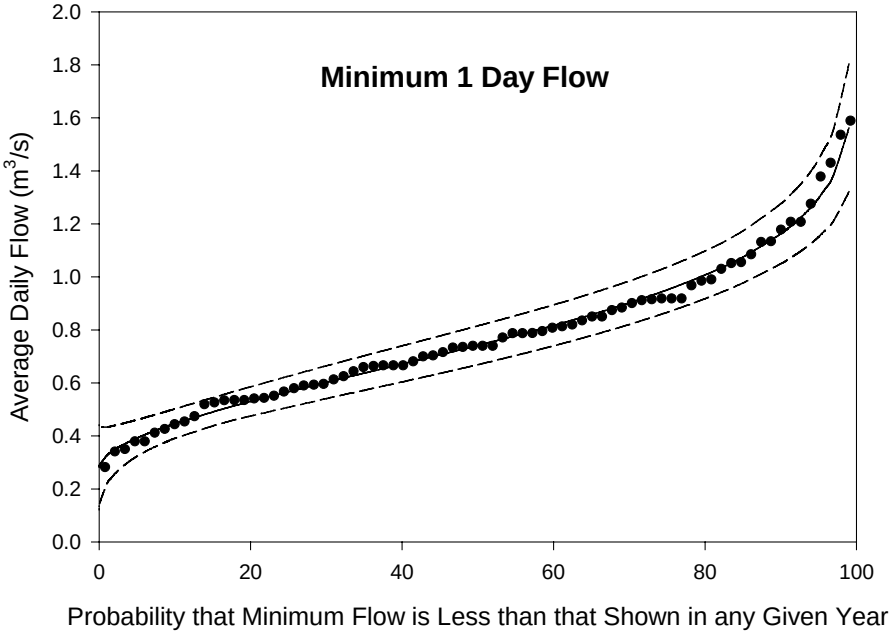

Figure 5.2 Low Flow Frequency Curve for a 1 day Flow Duration

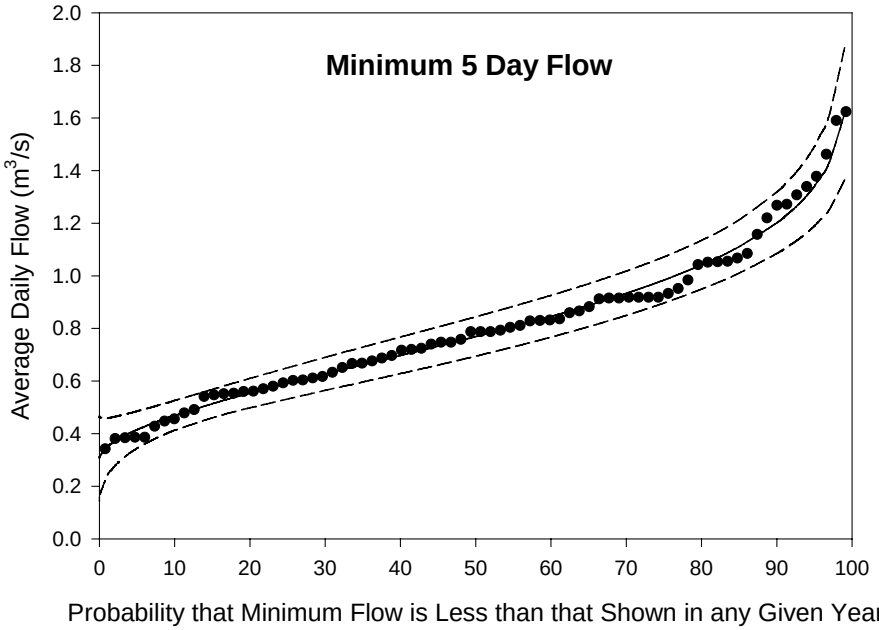

Figure 5.3 Low Flow Frequency Curve for a 5 day Flow Duration

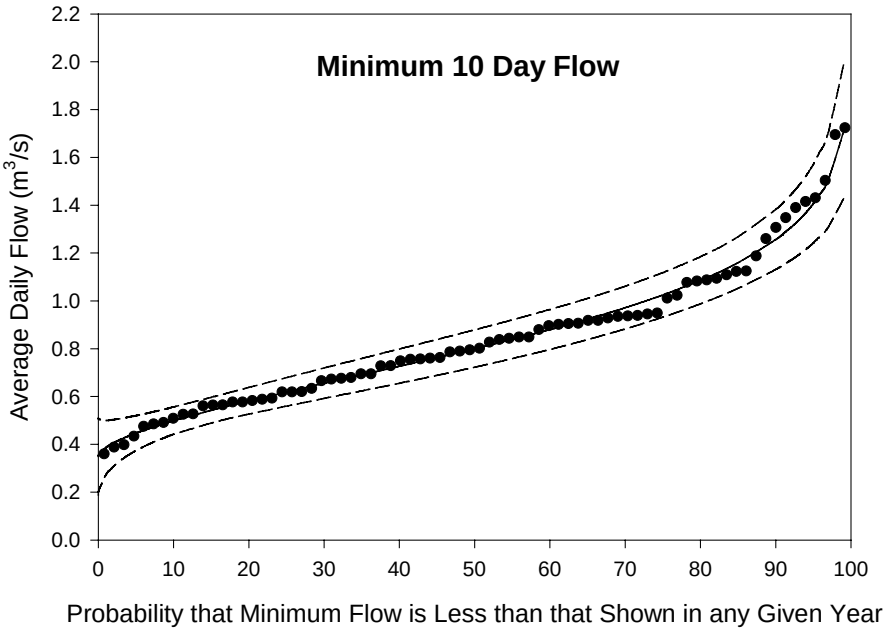

Figure 5.4 Low Flow Frequency Curve for a 10 day Flow Duration

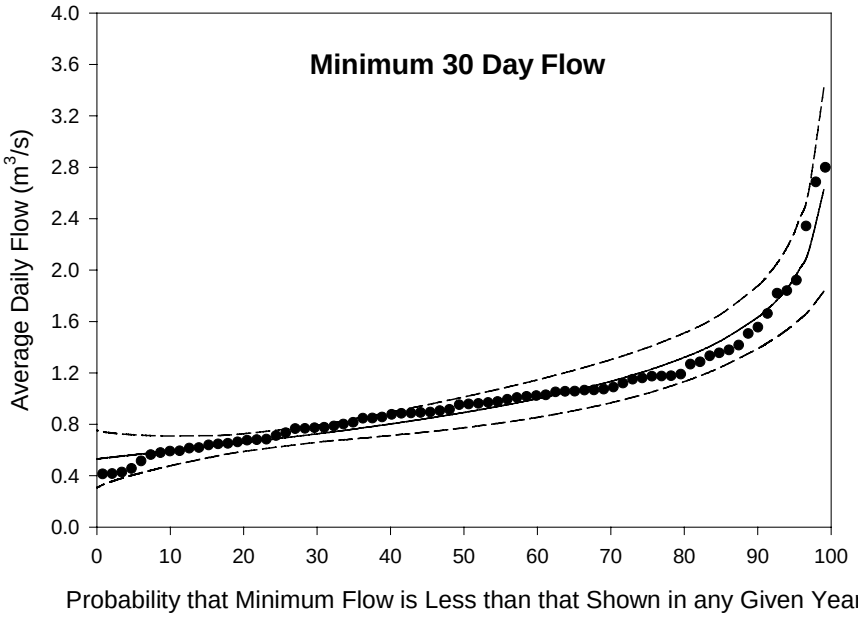

Figure 5.5 Low Flow Frequency Curve for a 30 day Flow Duration

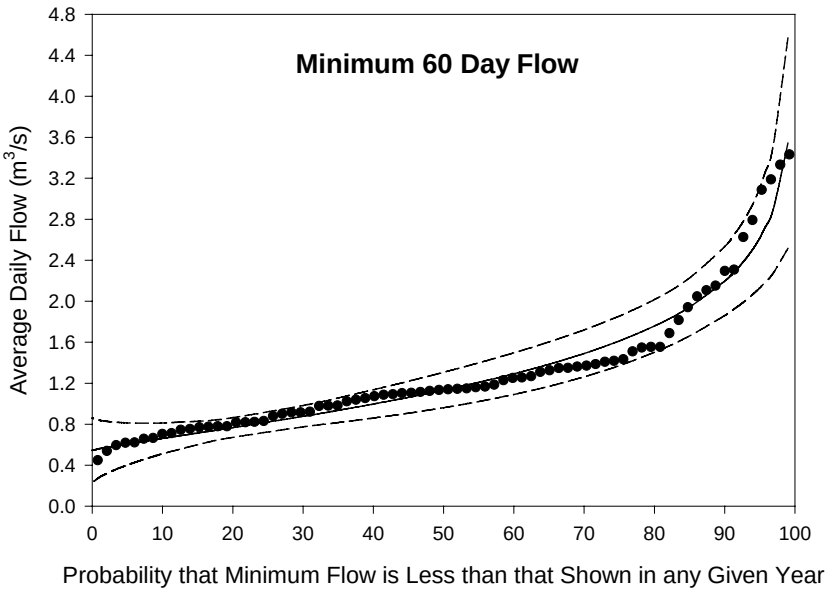

Figure 5.6 Low Flow Frequency Curve for a 60 day Flow Duration

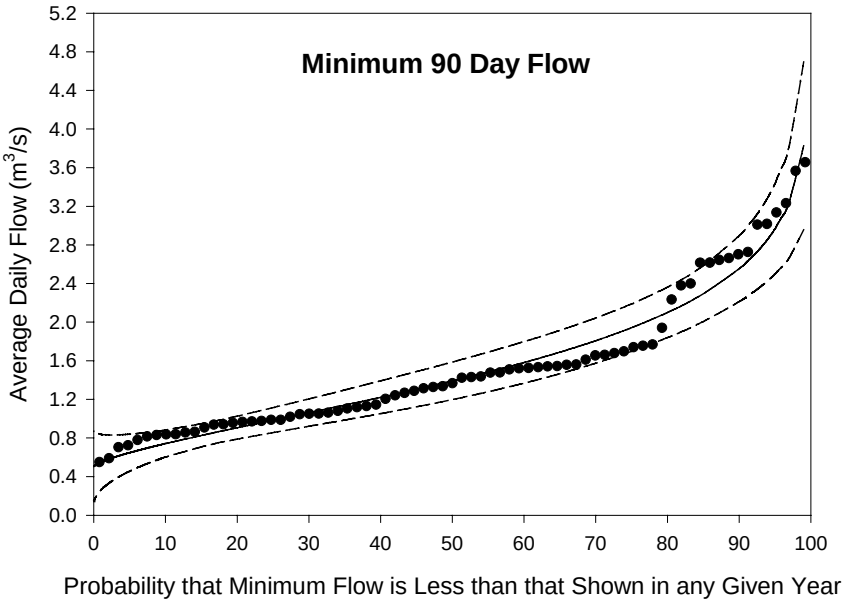

Figure 5.7 Low Flow Frequency Curve for a 90 day Flow Duration

6 Floods

A flood frequency analysis of flows at the North Esk at Ballroom site was undertaken. A 2-parameter log normal distribution was fitted to the annual maximum flows. The results of this analysis are presented in Figure 6.1. 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 100 cumecs or more will occur (corresponding to a river height of about 3.0 m at the stream gauge). (b) in any given year there is a 50% chance that a flood of approximately 72 cumecs or more occur (corresponding to a river height of about 2.6 m).

During the present study there was a moderate flood that occurred on July 21st, 2000, that had a peak flow of approximately 59 cumecs (corresponding to a river height of approximately 2.3 m at Ballroom). Examining Figure 6.1, it can be concluded that a flood of this magnitude has an 80% chance of occurring in any given year.

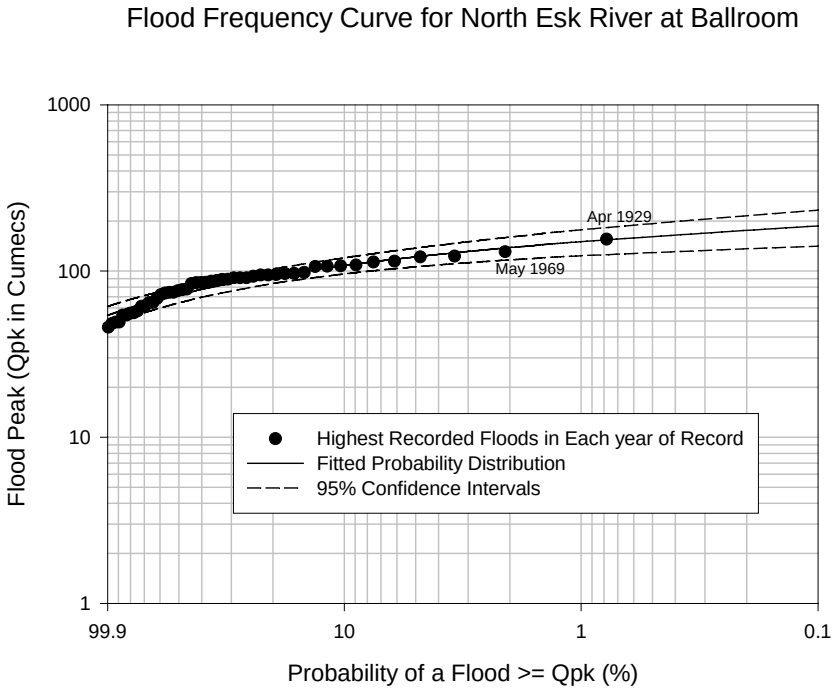

Figure 6.1 Flood Frequency Curve for North Esk at Ballroom