A MEANDER CATCHMENT

1.0 Hydrology

The Meander River catchment has a drainage area of approximately 1500 Km^2 which is subject to the most intensive rates of irrigation and water use in the Basin.

Rainfall in the area is dominated by topography particularly in the region of the Great Western Tiers which form the southern boundary of the catchment. The rainfall gradients are also represented in the runoff from the catchment with much higher per unit area runoff in the higher elevations than in the valley base. There is a general trend towards lower rainfall and runoff as one travels from west to east across the catchment.

Natural stream flows appear to be sustained throughout the year in this catchment probably as a direct result of the deep soils and the substantial ground water storage available in the area.

1.1 Historical Background

On the Meander River at Meander township and on the Liffey River at Carrick, daily read river levels were undertaken as early as the 1920's. At Deloraine, measurement of river level was commenced in 1954. Measurement of river level or flow at other stations generally commenced much later, in the 1970' and 1980's.

Tributary	Station Name	Station Number	Period of Record	Catchment Area (Km^2)
Meander River	Meander downstream Warners Ck	18224	1982 - 1991	159
	Western Creek downstream Dale Brook	18213	1975 - 1992	151
	Jackeys Creek	18221	1982 - 1995	29
	Meander at Meander	23	1921 - 1930	192
	Meander at Deloraine	162	1954 - 1995	475
	Meander at Westwood House	163	1955 - 1970	1269
	Quamby Brook	18226	1985 - 1995	82
	Liffey upstream Lake Highway	178	1956 - 1964	3
	Liffey River upstream West Channel	18209	1975 - 1990	155
	Liffey River at Carrick$^+$	164	1982 - 1995	224$^+$
	Meander at Strath Bridge	852	1985 - 1995	1012

$^+$ Sites with altered catchments due to water diversions for irrigation schemes or HEC operations.

1.2 Catchment Yields and Distribution of Flows

There are no major storages in the catchment so that, apart from the irrigation period (Nov - Mar), the flows monitored in the Meander River catchment are essentially natural flows. During the irrigation period pumping has a significant effect on flows in the river. The major land use effects on water yields are likely to have occurred during pioneering times when there was substantial clearing of low lying areas. The effects of current land uses (eg plantation forestry) on water yields are unknown.

Excluding diversions into the Basin from Great Lake, the Meander River contributes on average some 35% of the total outflow at Launceston.

Annual Yields

Figures 1.1a to 1.1f show the average annual, average winter, and average summer flows at key monitoring sites throughout the catchment. All sites exhibit a high variability in average flow from year to year.

Flows in Jackeys Creek and Western Creek are highly correlated. Winter flows appear to be the most variable while there are relatively consistent average annual and average summer flows in the two catchments. Nevertheless, winter flows tend to provide the dominant component of annual flow volumes.

During the period of the study Western Creek flows were not monitored continuously. Average flows at Jackeys Creek during the study period were generally representative of average annual and average winter conditions. However, average summer flows were substantially larger than usual.

Average flows at Deloraine, Strathbridge, Quamby Brook and in the Liffey River tend to tell a similar story. All are dominated by the more variable winter inflows with the study period representing the winter and annual average flow conditions quite well, but the summer period poorly.

Monthly Yields

The variability of monthly flows in rivers of the Meander catchment is shown in Figures 1.2a to 1.2f which provide box and whisker plots for each of the study sites.

Box and whisker plots for Jackeys Creek and Western Creek (Figures 1.2a and 1.2b) exhibit strong seasonal patterns generally peaking in July to August. There is some slim evidence for larger groundwater storage in the Western Creek catchment than in Jackeys Creek since flows tend to be maintained at higher levels for longer periods towards the end of the winter months. In general the variability about median monthly flow is quite symmetric suggesting a simple random occurrence of rainfall events, however, September exhibits a strong asymmetric variation consistent with the chance occurrence of high flow events perhaps driven by intense low pressure systems.

At Deloraine and Strathbridge monthly average flow variability is again strongly seasonal, with large variations - particularly during winter months (Figures 1.2c and 1.2d).

Monthly flows in Quamby Brook are very highly seasonal with the period February through April having very low flows most of the time (Figure 1.2e). December and January are also months of potentially very low flows, but the limited record from this site seems to indicate that January is generally a month in which flows recover compared with the general trend. Flows in the winter months are highly variable in both the high and low flow directions. October appears to be a month in which there is a high potential for large flows but which most of the time has little flow compared with September. This rapid drop off seems to indicate a general lack of groundwater storage in the catchment.

In the Liffey River flows are again highly seasonal (Figure 1.2f). The Liffey exhibits very high variability in flows during the July through September period.

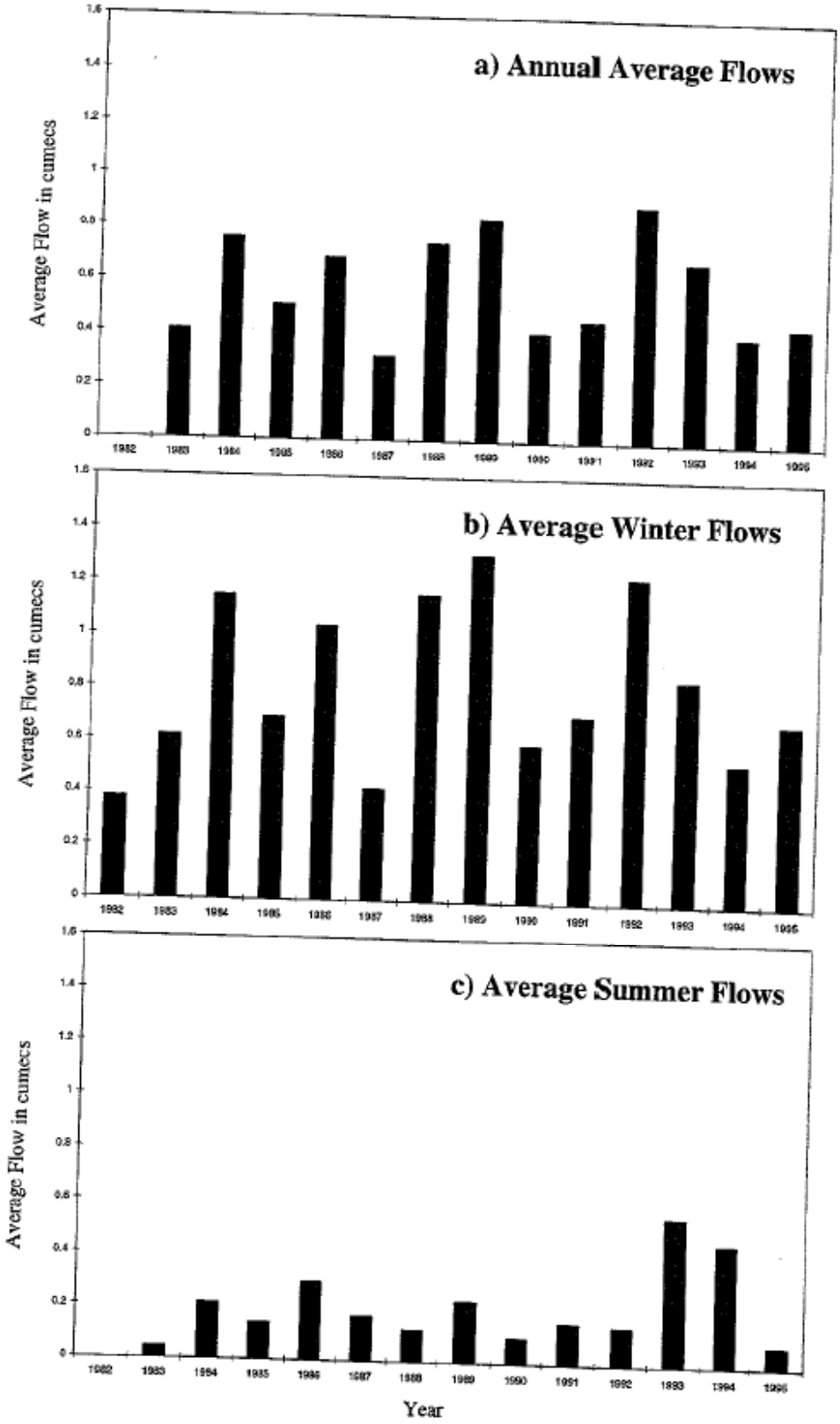

Figure 1.1a Average annual, winter and summer flows in Jackeys Creek.

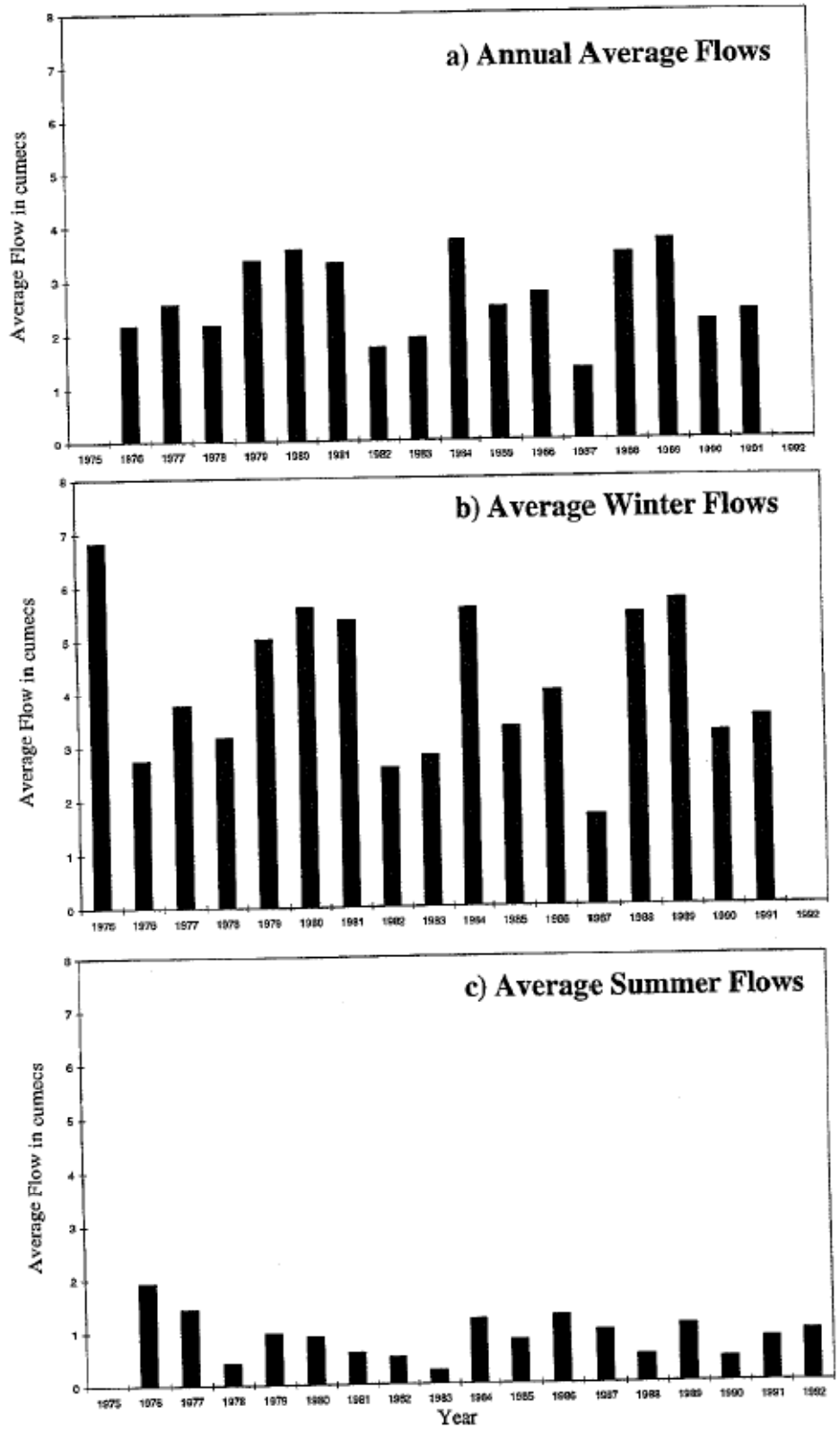

Figure 1.1b Average annual, winter and summer flows in Western Creek.

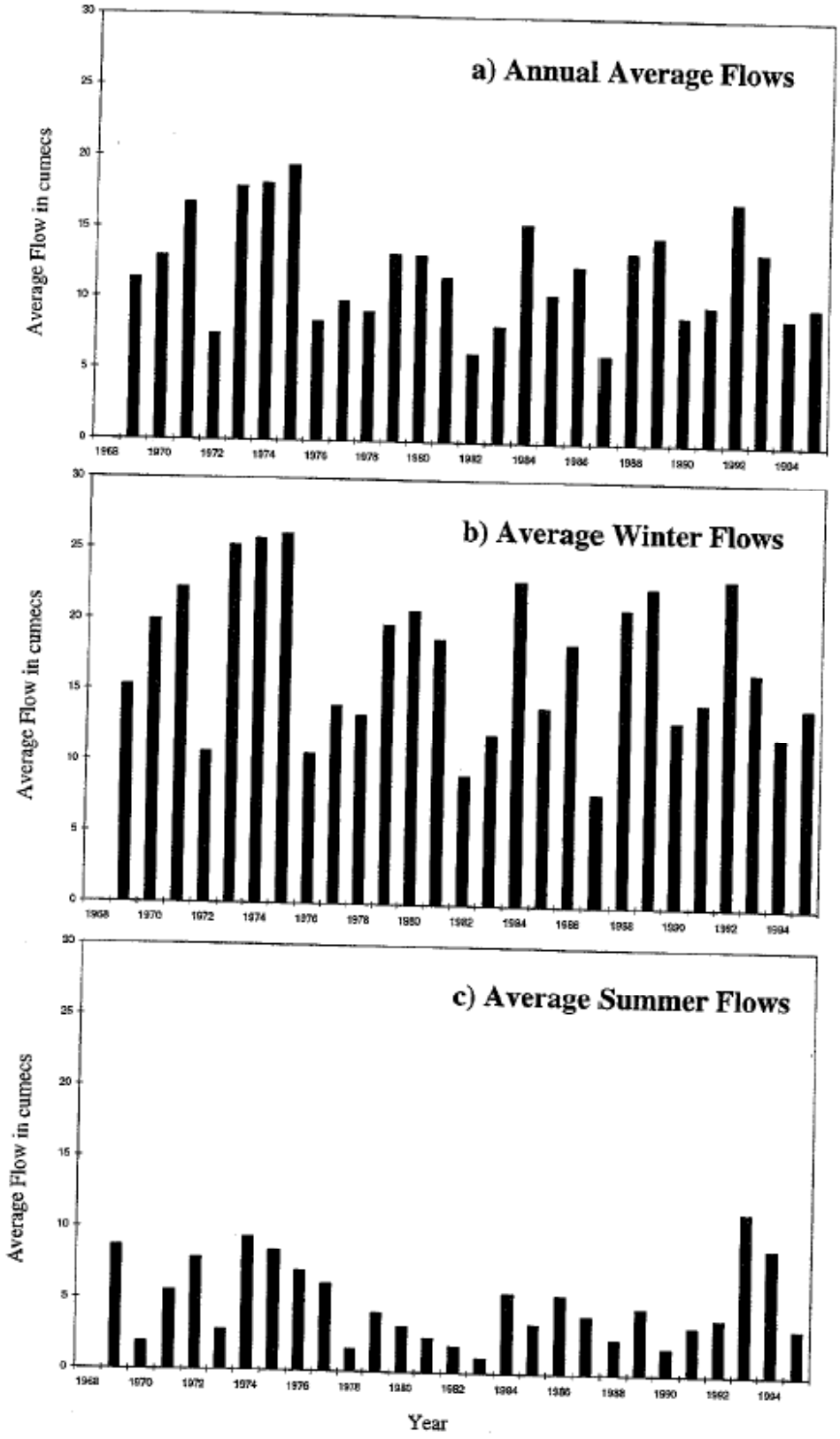

Figure 1.1c Average annual, winter and summer flows in the Meander at Deloraine.

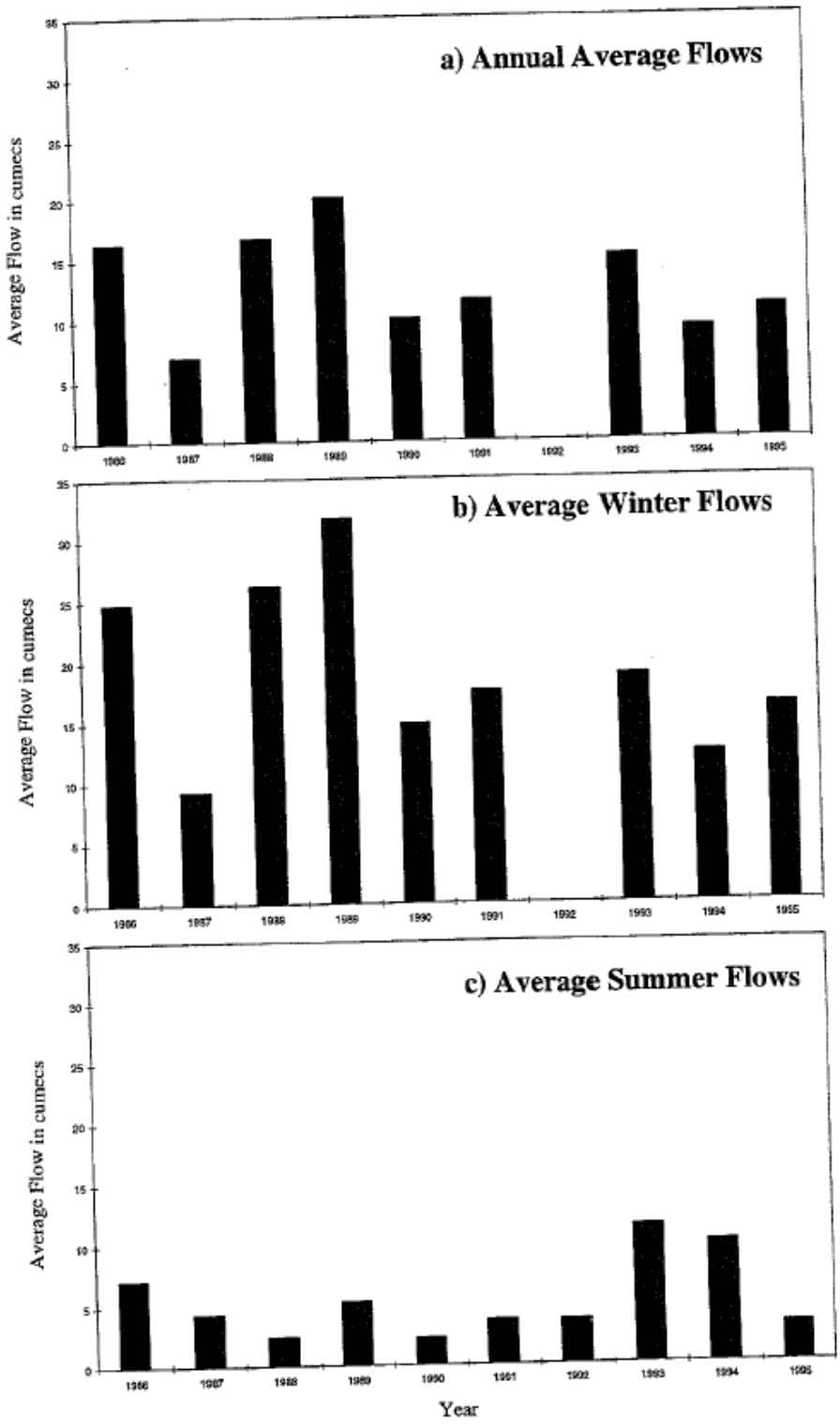

Figure 1.1d Average annual, winter and summer flows in the Meander at Strath Bridge.

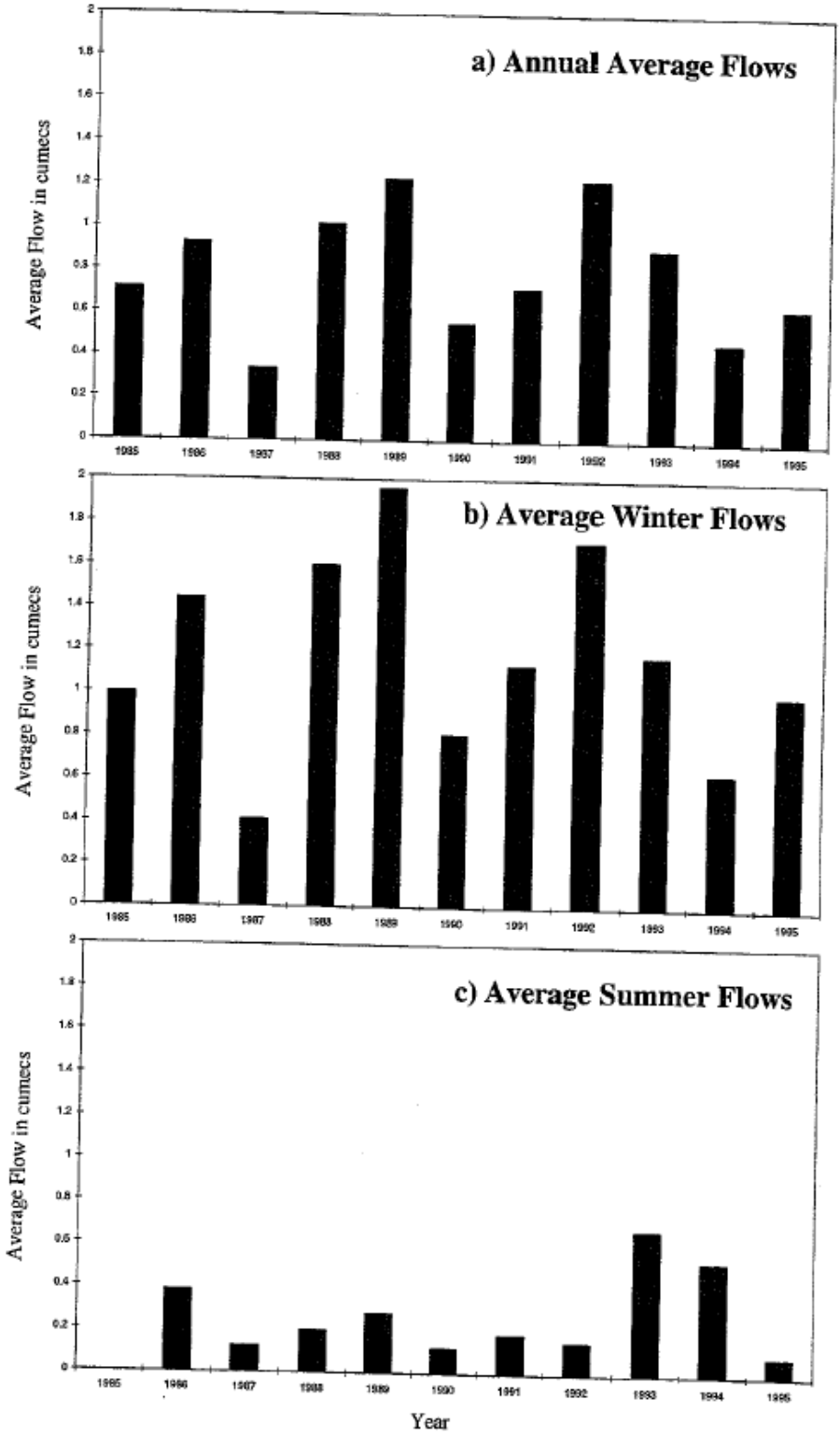

Figure 1.1de Average annual, winter and summer flows in Quamby Brook.

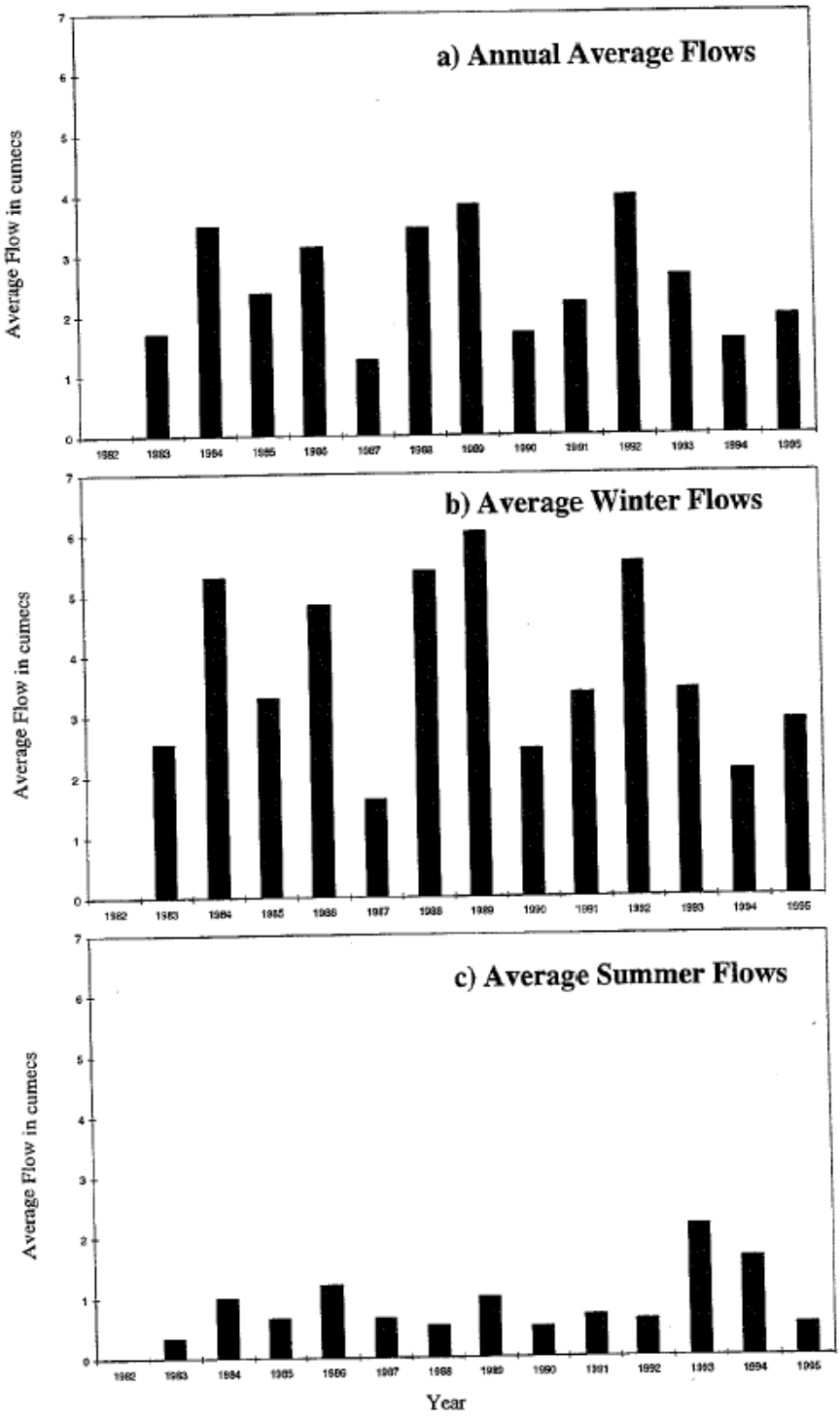

Figure 1.1f Average annual, winter and summer flows in the Liffey River.

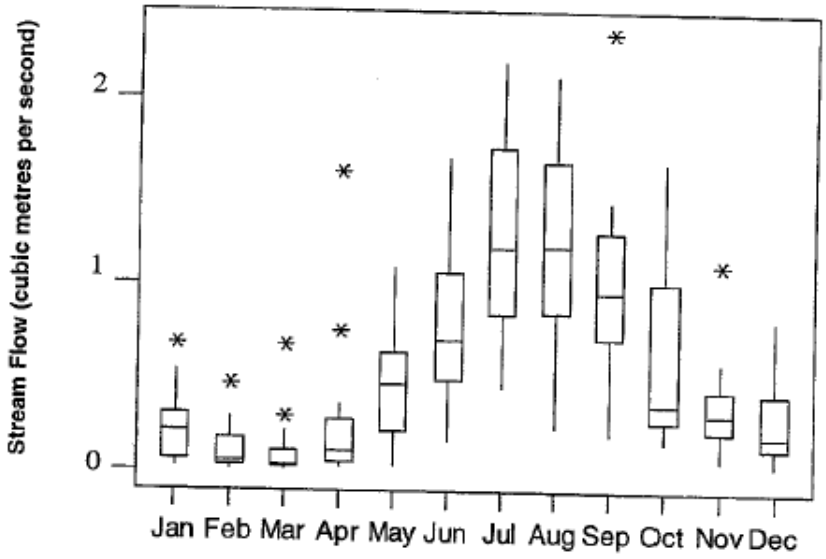

Figure 1.2a **Monthly Flows - Jackeys Creek d/s Jackeys Marsh**

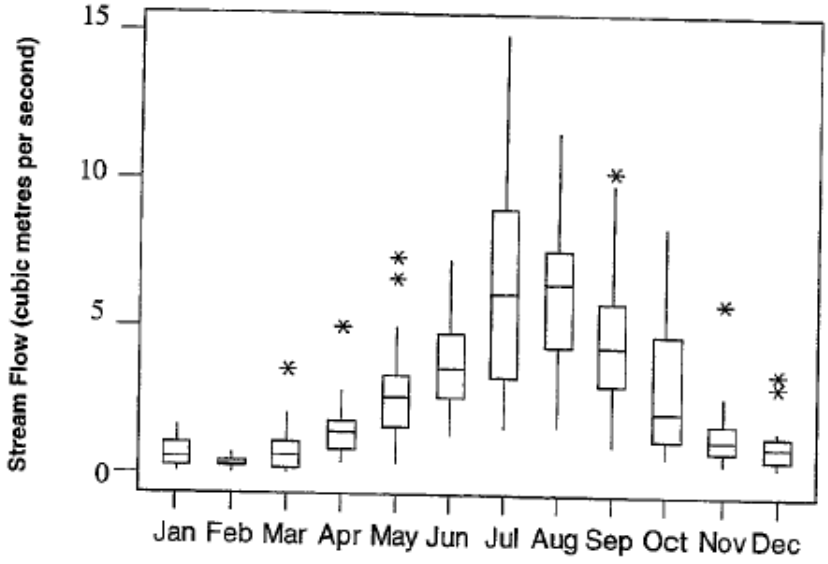

Figure 1.2b **Monthly Flows - Western Creek d/s Dale Brook**

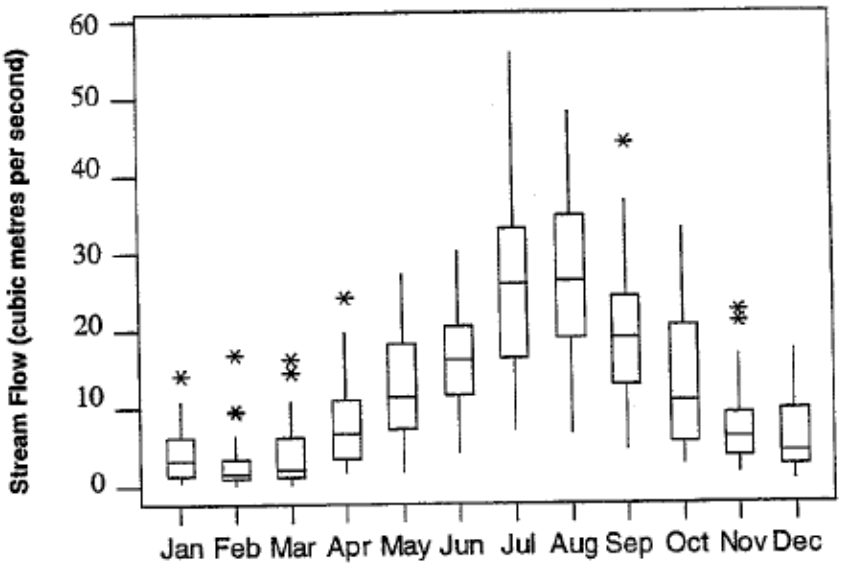

Figure 1.2c Monthly Flows - Meander River at Deloraine

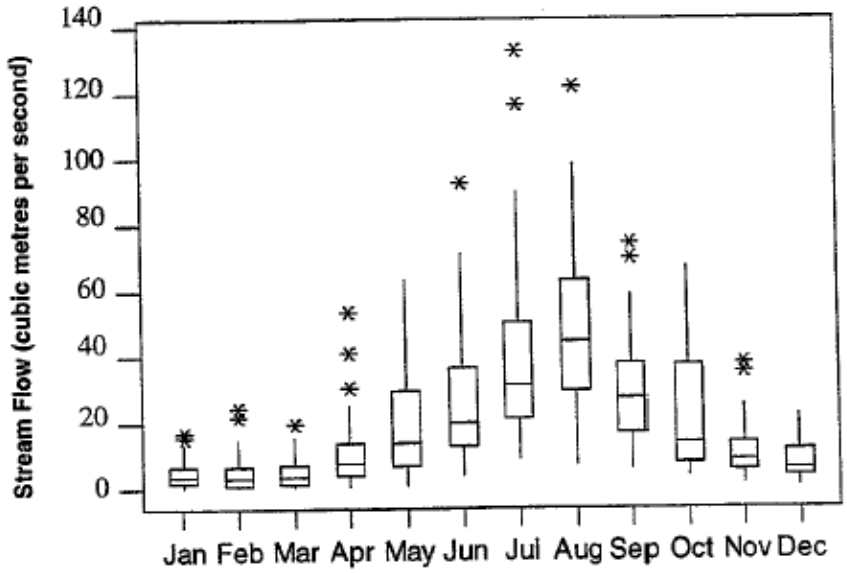

Figure 1.2d Monthly Flows - Meander River at Strath Bridge

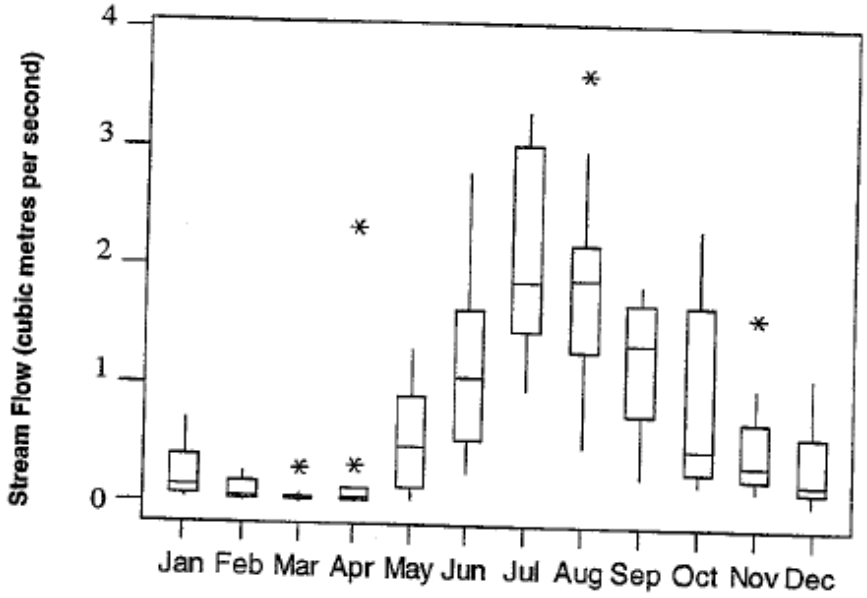

Figure 1.2e **Monthly Flows - Quamby Brook d/s Eden Rivulet**

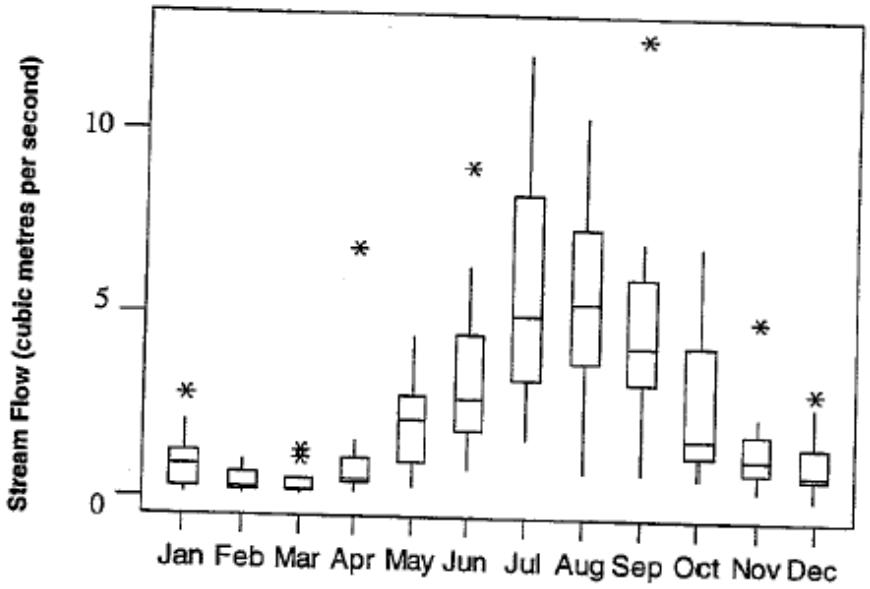

Figure 1.2f **Monthly Flows - Liffey River at Carrick**

1.3 Floods

Flood frequency curves were derived for both Meander River at Deloraine and at Strathbridge (Figures 1.3a and 1.3b). In each case skew was insignificant at the 95% level and a 2 parameter log normal curve was fitted. Reasonably large error bands are evident for each site probably due to the influence of the small annual flood peaks in the recorded series (not shown in the figures). Unfortunately the non-linear logarithmic scale used in these plots tends to distort the visual presentation of error bands. Nevertheless, the "eye fit" of the distribution to the high flow series is considered excellent in each case.

Flood frequency curves were also derived for the Jackeys Creek and Western Creek sites (Figures 1.3c and 1.3d).

1.4 Inputs to Catchment Flows

The Cressy-Longford Irrigation Scheme diverts water from the Brumby Creek through West Channel for extraction by irrigators. Water which is not extracted by the Scheme drains into the Liffey River. This excess water sustains flows in the lower Liffey through the summer, when flows in the upper reaches of the catchment may be much reduced.

2.0 Water Quality

2.1 Historical Data

As part of this study on water quality of the Meander River catchment, some investigation was made into the location of historical data with a view to updating the State database currently managed by the Dept. of Primary Industry and Fisheries. This mainly involved sifting through the archives of the Dept. of Environment and Land Management and old record from the Rivers and Water Supply Commission and checking it against what is currently on the State database.

The conclusion of this search was that very little historical information is available on the rivers in the Meander catchment. What data was available from the State database and other departmental archives mainly centers on bacterial water quality and dissolved oxygen. The data generally covers several sites in the upper Meander and its tributaries and was collected between 1973 and the present. One site on the Meander (u/s Warners Creek) has more comprehensive data, which was collected as part of a water monitoring program funded through the Australian Water Resources Council between 1974 and 1984. No other substantial data was located.

Data on temperature, biochemical oxygen demand (BOD), suspended solids and dissolved oxygen were collected at most sites, with some also having a substantial record on general ions and bacteria. Temperature in the upper catchment sites generally ranged from a minimum around August of 5 ^{o}C to a maximum in February of 17 ^{o}C. At Porters Bridge in the lower Meander, the summer maximum from this data was about 4 ^{o}C higher.

The data on suspended solids is difficult to interpret in the absence of flow information. However, the data does show that average suspended solids concentrations are generally less than 2 mg/L in the headwaters, but can reach levels as high as 50 mg/L most probably during

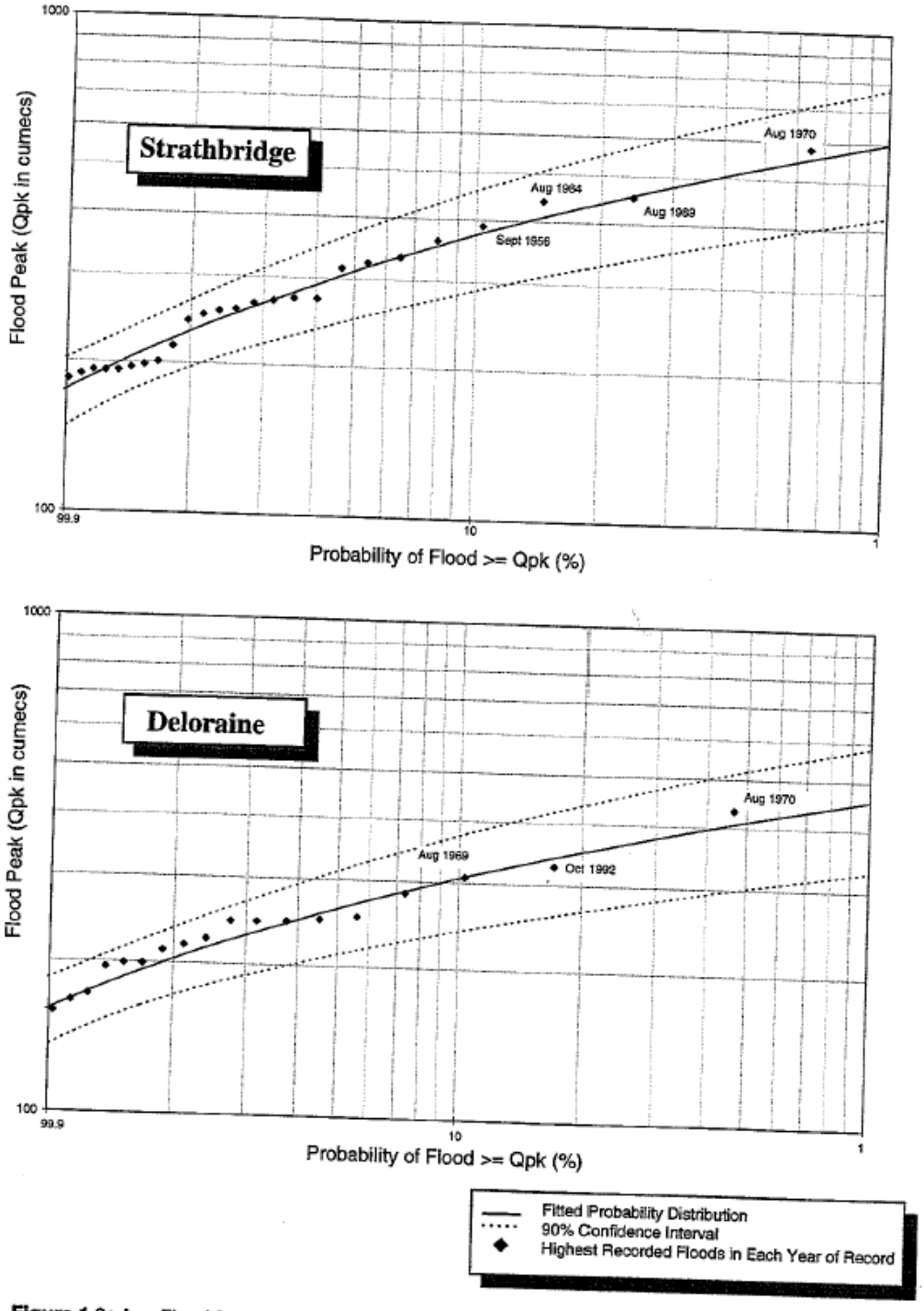

Figure 1.3a-b Flood frequency curves for the Meander River at Strath Bridge and at Deloraine.

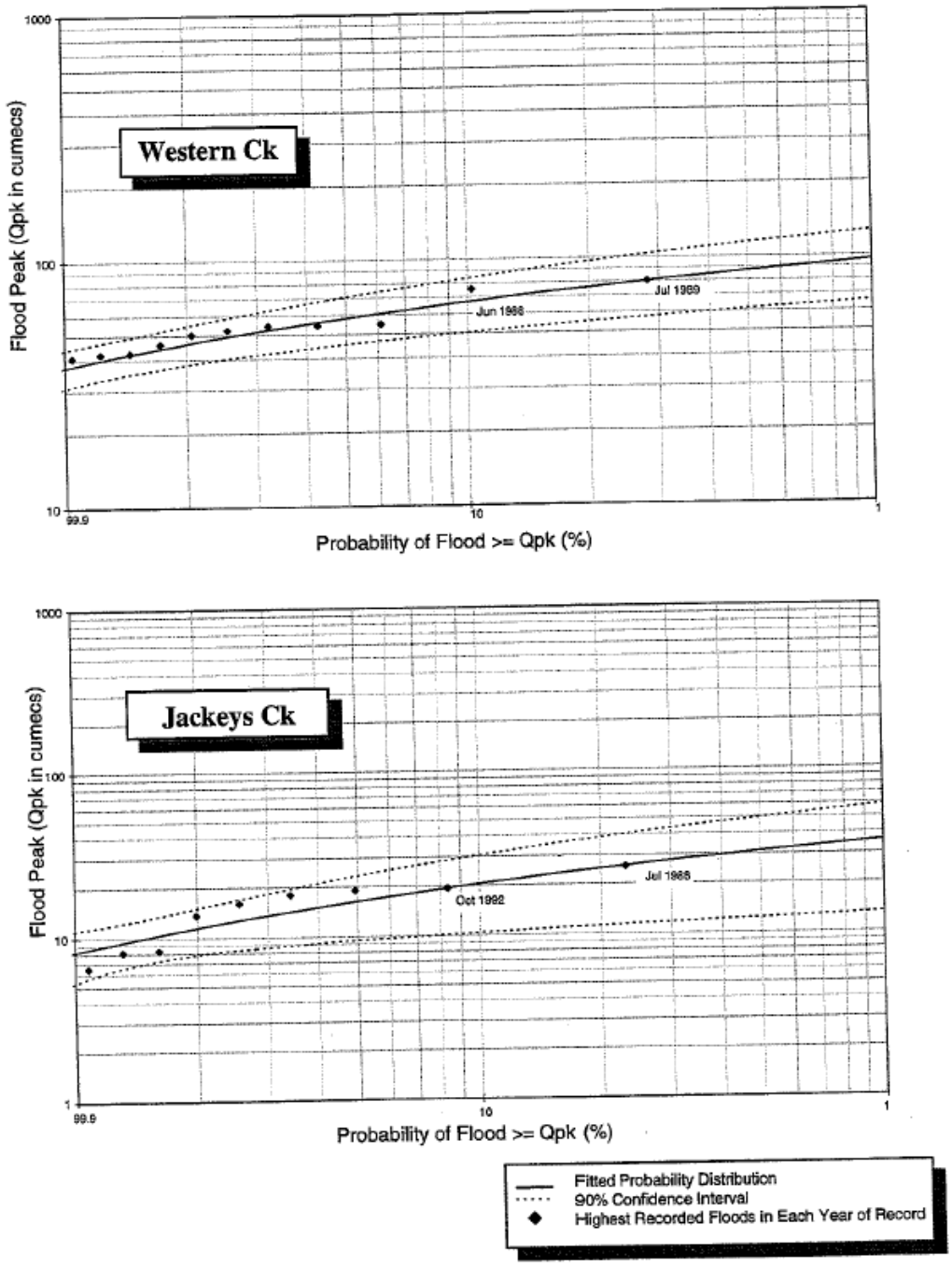

Figure 1.3c-d Flood frequency curves for the Western Creek and Jackeys Creek.

high flow events. At sites in the lower Meander River, average concentrations are around 5 mg/L with a maximum value recorded downstream of Deloraine of 454 mg/L.

BOD data give no indication that problems were found at any of the sites monitored, with values generally within the range 0.2 to 5 mg/L. Dissolved oxygen was measured in the headwaters at between 7 and 12.6 mg/L while lower down the Meander a minimum of 5 mg/L was recorded in mid-summer, a level which may cause some stress to aquatic biota (ANZECC, 1992).

Coliform data is centered on sites in the middle and lower reaches of the Meander River and broadly indicates that faecal contamination of the river is widespread.

A summary of all the data collected from other sources during this study and presently entered on the State database is to be collated and presented in a separate document. The following section will present and discuss the data collected during monthly monitoring in the catchment during this study. A table of the descriptive statistics for the data from each site is given in Appendix A.

The Present Study

During this study, water quality data on nutrients and general ions were collected routinely at 8 sites throughout the catchment (Figure 2.1). Sites are located at either existing stream flow monitoring stations or at locations where river level is monitored for the purposes of flood warning. In the Meander catchment river flow is presently recorded continuously by the Land and Water Resources Division at 5 sites (denoted by an * in Figure 2.1) and during the study the previously established site at Western Creek was re-opened. Annual nutrient loads at these sites could easily be estimated.

At Meander township, the Bureau of Meteorology maintains a flood warning station, however this site is ungauged and only river level is recorded. No export estimates could therefore be made for this site.

Some flood sampling was carried out several kilometres downstream at Barrett's Bridge as this site encompasses a discrete section of the upper catchment and has been used in the past as a site for the collection of water quality data. However, this site is also ungauged and flows could not be easily estimated. The purpose of flood sampling at this site was to compare high flow nutrient concentrations coming from the upper catchment with those downstream at Deloraine.

At Quamby Brook at Westbury, no flow monitoring station exists, however for the purposes of nutrient load calculations, flow at this site was modelled using data from the upper site and scaling up based on catchment area. Data was also available on the time lag between flood peaks at the upper and lower sites from a Hydrolab remote logger deployed at Westbury during flooding, and this was used to adjust the modelled flow record in time. Sampling was carried out monthly during the latter half of the study, with some grab sampling also being carried out during high flow events.

Sites were visited on a monthly basis, with field collection commencing at some sites in mid-1992 and finishing in October 1995. The amount of record collected at each site varies as not all sites were monitored for the entire study period. The sites with less record are Jackeys Creek, Western Creek at Montana and Quamby Brook at Westbury.

The data discussed in the following sections is based on routine monthly visits and represents baseline conditions. The data from flood samples which were collected at various sites have

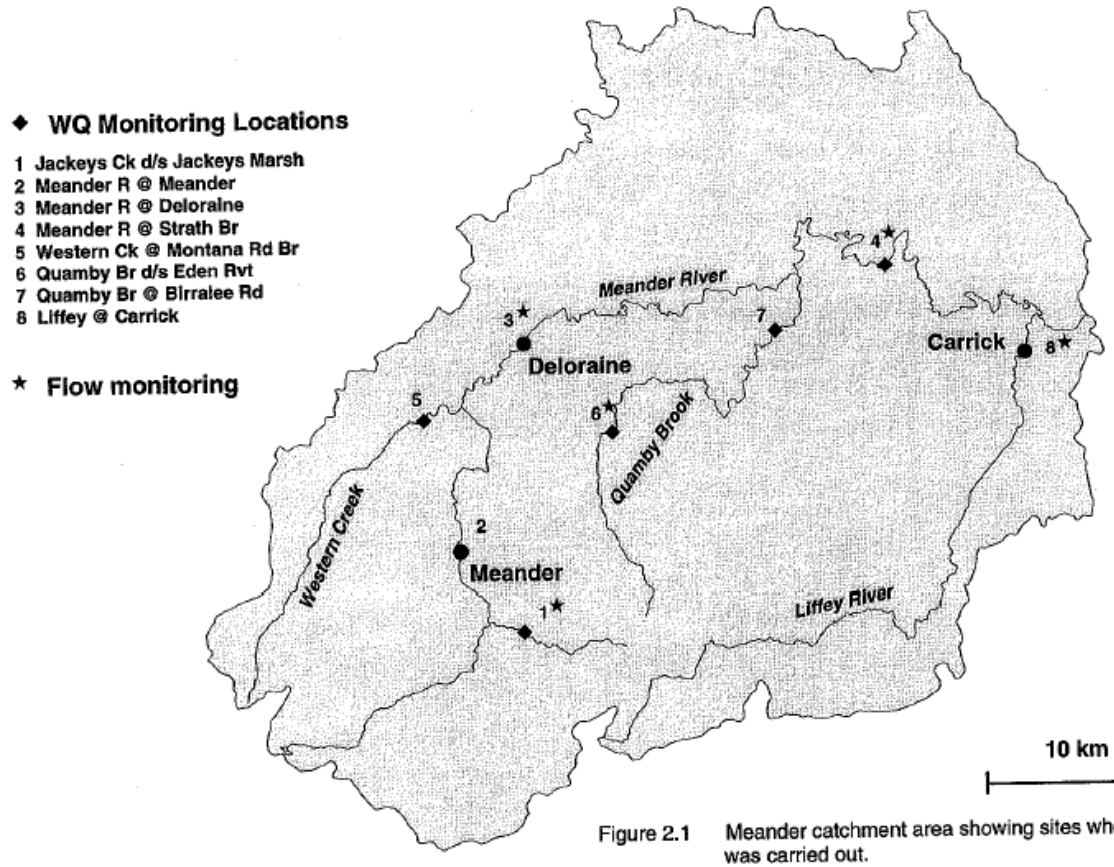

Figure 2.1 Meander catchment area showing sites where water monitoring was carried out.

been excluded, as the number of samples collected during high flow events at each site varied and their inclusion would significantly alter the data and make comparison between sites difficult. Data from flood sampling will be discussed in the section on flood water quality and nutrient export in the catchment.

Continuous data on Temperature and Electrical Conductivity and Turbidity was collected at one site in the Meander catchment (Meander at Strath Bridge)and will be discussed in the appropriate sections.

As mentioned above, a Hydrolab remote water quality logger was used to collect information during flood events and normal baseflow conditions. The instrument is a programmable multi-parameter logger which could collect data on temperature, pH, water depth, turbidity, conductivity and dissolved oxygen. The instrument is laboratory calibrated prior to field deployment and can be programmed to collect data at various time intervals for periods up to four weeks. Data on dissolved oxygen collected using this instrument will be presented in a later section of the report.

2.2 Physical Parameters

Temperature

Water temperature at all monitoring sites showed a distinct seasonal pattern (Figure 2.2) with temperatures ranging from a low in mid-winter of about 4-5 ^{O}C (generally around July) to a high in mid-summer of around 20 ^{O}C late January. More elevated sites show generally lower ranges with the site at Jackeys Creek showing lowest summer and winter temperatures of about 13 ^{O}C and 3.5 ^{O}C respectively. However data was only collected from a little more than a year at this site, a year during which the lowest summer and winter temperatures were recorded at all sites.

Temperature at sites which were monitored for the entire period of the study all tended to show that peak summer temperatures tended to increase over the length of the study. Winter lows did not change.

Equipment to collect continuous data on water temperature was installed at Strath Bridge in late May, 1994. The data, shown in Figure 2.3, shows several features which govern water temperature in the lower Meander River. During winter, increases in temperature occur when there are rainfall events in the catchment. This is clearly shown by the spikes in temperature which coincide with rises in river level. Lowest temperatures occur when baseflows are re-established.

Over the Spring and Summer period, temperature generally shows a steady increase from the winter lows of around 4.5 ^{O}C to highs in January of around 24 ^{O}C. The passage of cold fronts thorough the area also causes noticeable fluctuations in temperature at this site (refer temp. drop in mid September). During mid summer, significant rain events can cause up to a 9 ^{O}C drop in temperature (refer drop on January 18, 1995).

Electrical Conductivity

Electrical conductivity (EC) throughout the catchment is generally low, with most sites having a median EC below 100 μS/cm (Figure 2.4). The one exception is the lower Quamby Brook site, below the sewage treatment plant at Westbury.
The median EC at this site is 162 μS/cm with maximum readings of 332 μS/cm being measured. Although a percentage of this increase is due to STP effluent, conductivity throughout the brook was found to be slightly higher than rivers in the rest of the catchment.