River Ter at Lyons Hall, Essex

[TL 738 108]

Highlights

The River Ter, Essex, illustrates the relationships between river discharge and channel dimensions for a lowland river. The river channels in the Ter catchment have a size and riffle spacing adjusted to relatively frequent flows.

Introduction

This reach of the Ter is representative of a lowland stream with a distinctive, flashy flood regime. Previous work on the frequency of bankfull discharge on alluvial streams in a variety of environments has suggested a recurrence interval for discharge at bankfull condition of somewhere between 1 and 3 years in the annual series. Variations in the frequency of bankfull discharge were found along the Ter in a study by Harvey (1969). Flood regime stream segments appear to exhibit adjustment to the 1–2 year flood but with less frequent flooding downstream. In this study by Harvey, the Ter was compared with the Nar (Norfolk) and the Wallop Brook (Hampshire) to facilitate understanding of the relationship between the size of river channel cross-sections and river discharge.

Description

The River Ter, Essex, drains a low-lying catchment (of area 77.8 km^2) to the gauging station at Crabbs Bridge [TL 876 107] which has a cover of glacial till, and has a very low mean discharge but high flood peaks. Daily, monthly and annual discharge variability are also high. The site clearly demonstrates those characteristic features of a lowland stream, including pool–riffle sequences, bank erosion and bedload transport, which are adjusted to the particular pattern of flood frequency.

Harvey (1969), employed a qualitative classification of events based on degrees of bed material movement and morphological change. Moderate events which redistribute bed material occur between 14 and 30 times per year, while major controlling events which change the overall channel form occur from 0.5 to 4 times per year. This difference in frequency may reflect the different thresholds of erosion for bed and bank materials, and these thresholds are of significance in the context of river management. Hey (1976) argued that channel instability occurs if flow regulation increases the frequency of exceedance of threshold shear stress. This may not be the case if a different higher threshold is important for bank erosion, and the sum of several bed material movements is therefore not morphologically equivalent to one major event.

On the Ter, despite great apparent variation downstream, bankfull conditions appear to occur more frequently upstream (Figure 6.11). This suggests that there may be some degree of association between the discharge character and the bankfull frequency. Since bankfull has variations in frequency, it appears that stream channels may be adjusted to differing hydrological regimes in different ways, although on average the return period of bankfull discharges was 1.8 years on the River Ter (Harvey, 1969).

Interpretation

It is an over-simplification to assume a constant return period for bankfull discharge. Harvey (1969) attributed the systematic variation in bankfull frequency to hydrological regime. Flashy streams experience more frequent overbank flooding upstream, which could be related to a downstream increase in flood duration.

It is important to understand the relationship between channel geometry and river discharge, because measurements of channel cross-section area (channel capacity) and channel width can be employed to give estimates of flood frequency at ungauged sites (Wharton *et al.,* 1988). These equations were developed from extensive fieldwork on UK rivers, and allow estimates to be made of discharges at a range of return periods from morphological measurements. Caution may be required when using these channel geometry equations, especially in defining bankfull capacity and in ensuring that the chosen site has a natural cross-section.

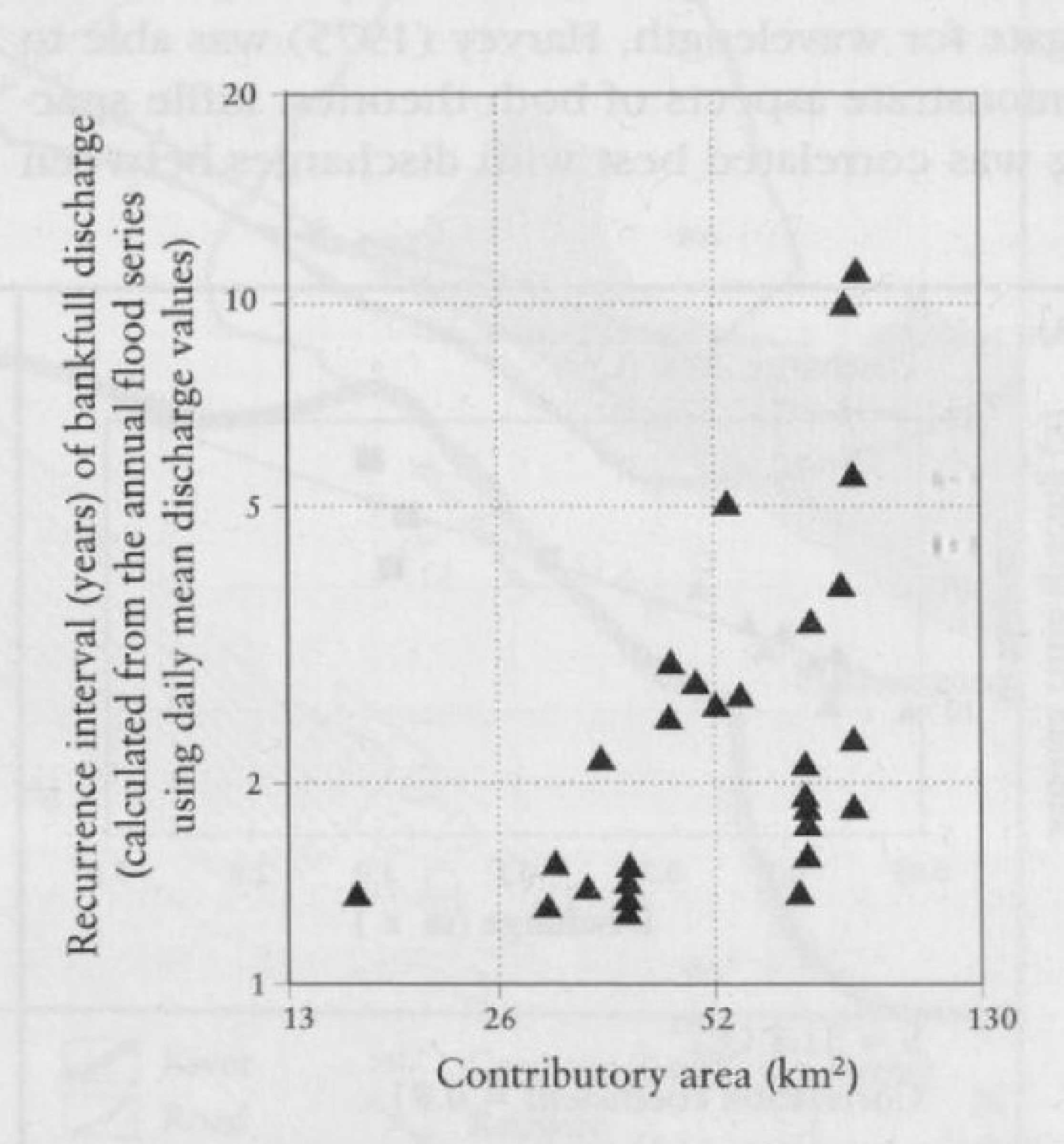
The Ter has also been used by Harvey (1975) to test the theories of Carlston (1965) and of Leopold and Wolman (1957, 1960). Leopold and Wolman (1957, 1960) argued that the meander wavelength was related more to channel width than to bank-full discharge while Carlston (1965) countered that, although bankfull discharge was poorly correlated, flows of greater frequency were more significant. By using median riffle spacing as a surrogate for wavelength, Harvey (1975) was able to demonstrate aspects of both theories. Riffle spacing was correlated best with discharges between the mean annual flood and the more frequently occurring Q_{20} (the discharge at which flows are exceeded 20% of the time) (Figure 6.12)(a). However, by assessing the surface water widths at Q_{20} and other flows, even stronger correlation coefficients were obtained (Figure 6.12)(b).

This reach of the Ter is important in the context of understanding how channel geometry is adjusted to discharge. The complexity of this relationship is illustrated by the systematic downstream variation in bankfull frequency on this stream, which exhibits typical features of many lowland streams.

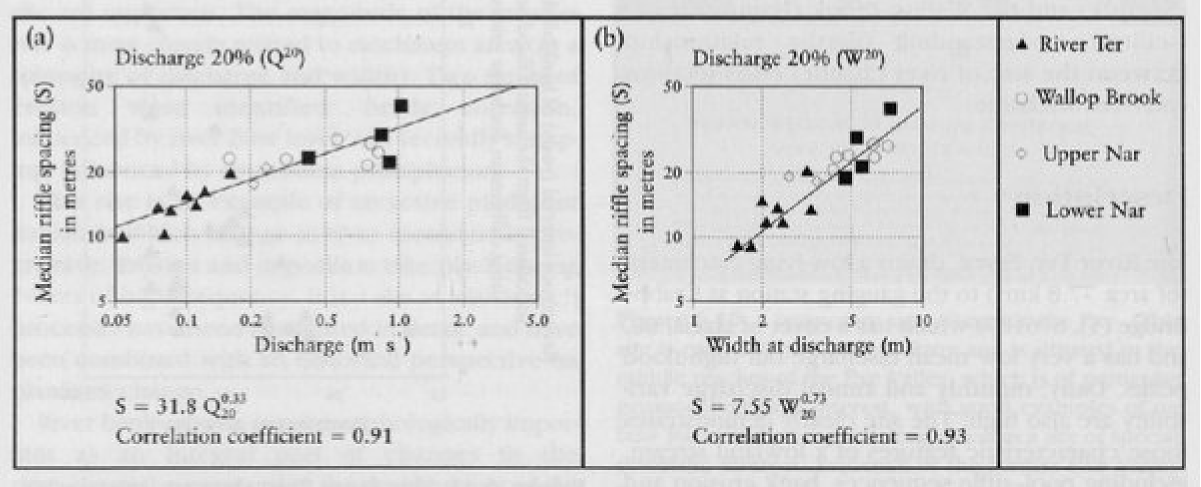
Conclusion

This is a lowland stream in which the relationships between channel form and discharge have been analysed. It is a catchment with a variable discharge regime but relatively rapid response of flows to rainfall. The channel size and characteristics are adjusted to a relatively frequent discharge.

References



(Figure 6.11) The River Ter, showing relationship between the bankfull recurrence interval and the catchment area. (After Harvey, 1969.)



(Figure 6.12) The River Ter, showing (a) the correlation of discharge frequency (Q_{20}) to median riffle spacing, and (b) the correlation of channel width at Q_{20} to median riffle spacing. (After Harvey, 1975.)