River Clyde Meanders, South Lanrkshire

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Highlights

Large-scale active meanders are comparatively rare in lowland Britain, particularly those that have created a floodplain over several centuries and have been subject to only minor river engineering during their development. Such a site is provided on the River Clyde at its confluence with the much smaller Medwin Water near Carstairs.

Introduction

Active meandering rivers are characteristic of many valley floors in the British Lowlands. The progressive migration of these meandering channels generates a sequence of alluvial deposits which become incorporated into the floodplain created by the active river (Wolman and Leopold, 1957; Allen, 1970). The history of the progressive migration of the river is thus recorded in the floodplain sedimentary record. The confluence of the River Clyde with the very much smaller Medwin Water near Carstairs in Lanarkshire provides an unusually good opportunity to examine these processes of floodplain formation because the site has been subject to river engineering only on a minor scale since 1935. This, when combined with a very detailed historical record of channel migration (from maps and aerial photographs), means that this site offers great potential for detailed investigation of floodplain history and alluvial stratigraphy (Brazier *et al.,* 1993) on a major river of Scotland.

Description

The first accurately surveyed map available for the site is that produced by the Caledonian Railway Company, dated 1848. Since then, the Six-inch Ordnance Survey County Series (surveyed in 1858, 1896 and 1909) and the National Grid Metric Edition at 1 : 10 000 (1977) provide the most accurate basis for recording and interpreting channel change. Aerial photographs between 1948 and 1991 provide an excellent record of channel migration at a much finer temporal resolution.

Using these sources, four main geomorphic units can be identified at this site (Figure 2.11):

1. the active channel;
2. mid-channel and marginal sand/gravel bars;
3. the floodplain post-dating 1848;
4. the floodplain pre-dating 1848.

This site at present comprises six major meanders on the River Clyde and five smaller meanders on the Medwin Water. The Clyde meanders within the site extend over 3.2 km and include bends at various stages of development from gently curved to highly tortuous with incipient cutoffs. The meanders on the Medwin Water are, by contrast, much smaller in scale (channel widths typically < 10 m) but display patterns of development similar to those on the Clyde.

At present the active channel continues to migrate and rework its floodplain subject to minor river training works (such as rock revetment) which are undertaken by the Scottish Office under the Land Drainage (Scotland) Acts of 1930 and 1935. The bars found within and adjacent to the channel comprise point bars (on major bends); mid-channel bars (where the channel locally divides) and lateral or side bars. The surfaces of these bars are embroidered by transient bedforms (mainly dunes and ripples) which are destroyed and reform during high stage flows. Individual units comprising the floodplain since 1848 include partially infilled oxbow channels and meander scroll topography which records the positions of former point bars. The remainder of the pre-1848 flood-plain is composed of similar units, but the topographic expression of these earlier infilled channels and meander scrolls is much more subdued.

The map of channel change compiled from maps and aerial photographs reveals a pattern of progressive downstream migration of individual meander bends, the precise direction being determined by the distribution and rate of bank erosion (Figure 2.12). Since the highest rates of meander movement generally occur just downstream of the apex of the meander bend, many bends 'rotate' as part of the migration process (Hooke, 1977). The rates of migration have been faster in the upper and middle reaches than in the lower reaches at this site at bends 1, 4 and 5 (Figure 2.12). Thus the channel (between points A and B at bend 1) migrated a total distance of *c.* 280 m in 129 years and also rotated such that in 1994 it threatened to breach the neck of bend 2 (Figure 2.12). Much lower rates of channel migration have been recorded in bends 6–9 and in the vicinity of the railway bridge the channel has been virtually stable since 1848. Bend 4 passed through a phase when the channel divided, thereby creating an island which was identifiable on the 1896 and 1909 maps. Eventually the eastern channel became the dominant one, completing an eastward shift of the main channel, with complete abandonment of the western channel sometime before 1948 (Figure 2.12).

The development of tortuous river patterns invariably leads to a tightening of meander bends. If the necks of successive bends are severed by this process, sections of channel are abandoned to create oxbow lakes (Lewis and Lewin, 1983). At this site in the River Clyde, for example, at bend 3 the neck of the meander loop was cut through, at some time between 1858 and 1896 by the upstream and downstream bends migrating towards each other. The resultant abandoned channel formed an oxbow lake, which is still infill-ing with fine sediment transported into that lake by overbank floods. Other well-documented meander cutoffs can be found on the Medwin Water, bend 10 being an excellent example which was abandoned between 1848 and 1858.

Not all of the palaeochannels found on the floodplain owe their origin to this simple process. The palaeochannel which resembles a cutoff meander of the former River Clyde (bend 11 in (Figure 2.12)) is the former channel of the Medwin Water, which altered its point of confluence as a result of river capture by the migrating River Clyde between 1909 and 1977. Coring some of these abandoned channels (e.g. bends 10 and 11) has revealed an alluvial stratigraphy comprising at least four major facies (Werritty and Kirkbride, 1992):

1. gravel and sand (former channel-bed lag deposits);
2. interlaminated fine sand/silt (overbank sedimentation during major floods);
3. silty/clay lacustrine facies (sediment transport into temporary lake during minor floods);
4. coarser laminated sands and silts deposited in standing water after the disappearance of the perennial oxbow lake.

In terms of present-day processes, the 2–3 m high dominantly sandy banks are locally subject to high rates of erosion. This is evidenced by well-developed point bars and extensive aprons of material derived from bank collapse on the outer banks at several meander bends. These typically sandy banks have little cohesion; thus bank retreat recommences as soon as the apron of sediment is removed by high winter flows. The bed materials of both the River Clyde and the Medwin Water are locally well-sorted sands and gravels. The gravels generally form lag deposits on the point bars while the sands contribute to the upper part of the floodplain sequence. In some reaches there is a temporary division of the main channel flow, but these are small-scale features within an overall planform which is dominated by meanders.

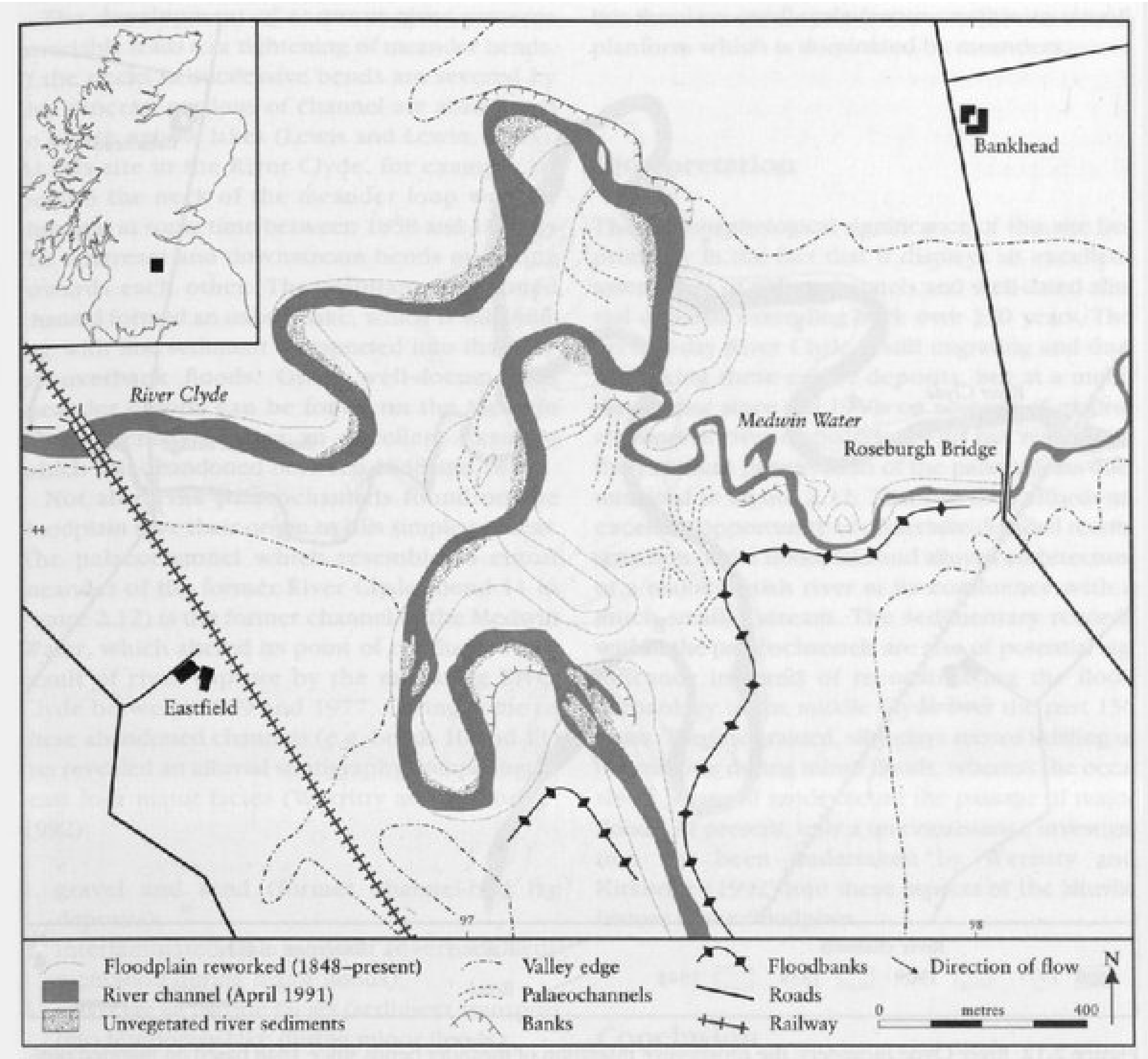
Interpretation

The geomorphological significance of this site lies primarily in the fact that it displays an excellent assemblage of palaeochannels and well-dated alluvial deposits extending back over 150 years. The present-day River Clyde is still migrating and thus reworking these earlier deposits, but at a much slower rate since the 1930s on account of modest amounts of river engineering. This has resulted in the excellent preservation of the palaeoforms documented in (Figure 2.12). This site thus affords an excellent opportunity to undertake detailed reconstruction of the floodplain and alluvial architecture of a major British river at its confluence with a much smaller stream. The sedimentary records within the palaeochannels are also of potential significance in terms of reconstructing the flood chronology of the middle Clyde over the past 150 years. The fine-grained, silty clays record infilling of the oxbows during minor floods, whereas the occasional lenses of sands record the passage of major floods. At present, only a reconnaissance investigation has been undertaken by Werritty and Kirkbride (1992) into these aspects of the alluvial history of the floodplain.

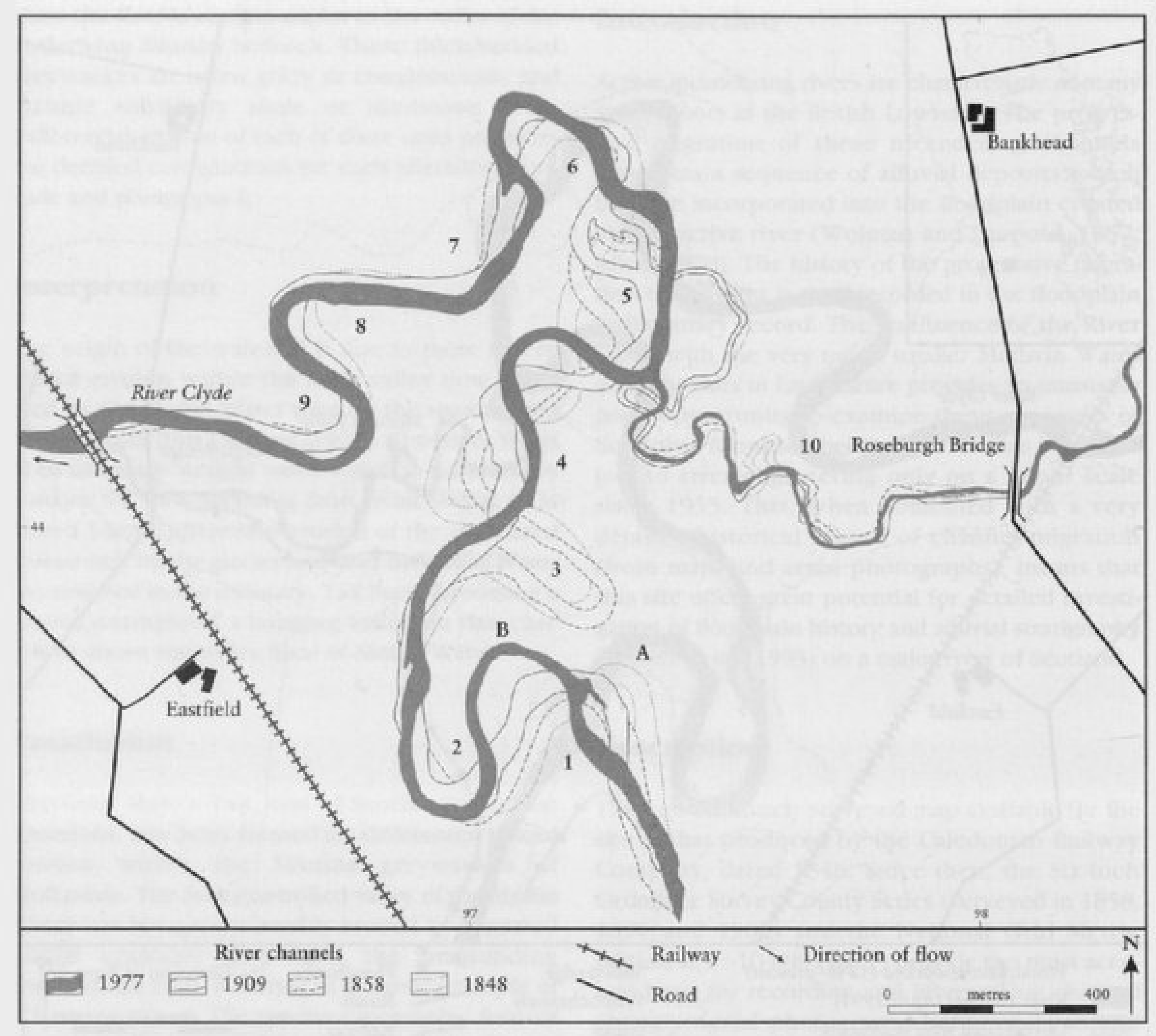
Conclusion

The confluence of the Medwin Water with the River Clyde provides an unusually good example of two active, sinuous lowland rivers of contrasting size which have not been subject to major river engineering schemes. Many of the large tortuous meanders on the River Clyde display considerable lateral activity, including a major cutoff within the past 100 years. The much smaller Medwin Water displays a similar channel pattern and has been subject to substantial channel change at its confluence with the Clyde during the past 150 years. The history of the development of the floodplain is exceptionally well-documented in maps and aerial photographs. Thus the detailed history of the valley floor adjacent to the main channels and the flood chronology of the middle Clyde can be reconstructed from the floodplain sediment record.

[References](#)



(Figure 2.11) River Clyde meanders. The channel (April 1991) is shown along with the floodplain sediments and landforms worked by the River Clyde and Medwin Water since 1848. Palaeochannels are now partly filled, but can still be identified on the floodplain surface. This site at present comprises six major meanders on the River Clyde and five smaller meanders on the Medwin Water. The Clyde meanders within the site extend over 3.2 km and include bends at various stages of development from gently curved to highly tortuous with incipient cutoffs. The, meanders on the Medwin Water are, by contrast, much smaller in scale (channel widths typically <10 m) but display patterns of development similar to those on the Clyde. (After Brazier et al., 1993.)



(Figure 2.12) River Clyde meanders: the progressive migration of meander bends since 1848 based on mapped positions of the active channel in 1848, 1858, 1909 and 1977. Note the downstream migration of most bends, and cutoffs to form oxbow lakes. (After Brazier et al., 1993.)