Late Holocene channel adjustment and discontinuity in the lower Macquarie River, central New South Wales

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Abstract

Downstream declines in discharge and stream power are inherent features of many Australian lowland rivers that experience channel breakdown and floodplain wetlands on their lower reaches. The Macquarie Marshes are an alluvial system of anastomosing and discontinuous channels with wetlands on the lower Macquarie River. While contemporary processes of avulsion in the system are relatively well understood, this research investigated mechanisms of channel discontinuity (i.e. channel breakdown and reformation) and channel adjustment in the southern Macquarie Marshes which have not been studied in detail in this type of system. Morphometric analysis of discontinuous reaches of the Macquarie River using digital terrain data derived from a light detection and ranging (LiDAR) survey was coupled with sedimentological analysis and optically stimulated luminescence (OSL) dating of a Late Holocene meander cut-off to determine the characteristics and timing of channel adjustment. Sinuosity declined from 1.6 to 1.28, channel depth declined from 2.49 m to 1.55 m downstream, and cross sectional area declined to <10 m² in the breakdown zone of each reach. Channel reformation occurs where floodplain gradients allow small tributaries to converge, increasing local stream power and eventually reforming the trunk stream. Sediment deposited in the breakdown zone of each reach forms a lobe-shaped splay with a steepened downstream end, which can instigate knickpoint retreat and reconnection of reaches of the river. The mechanisms of channel discontinuity are controlled by intrinsic feedbacks and threshold exceedance. Evidence of a shift in the style of channel adjustment in the southern Marshes has also been observed. Levees that have developed over the top of ridge and swale, point bar topography, indicate a significant decline of lateral migration and a dominance of vertical accretion and associated periodic avulsion (i.e. a lower energy system). The cut-off was actively meandering and depositing bedload point bar deposits 0.989 ± 0.137 ka, before being overlain by progressively fining sediments as the process of cut-off abandonment progressed. This indicates that the shift to a lower energy system has occurred within the last ~1000 years and is unrelated to European settlement and disturbance in the catchment. The geomorphic model of Late Holocene evolution developed in this research may be applicable to other similar fluvial systems in dryland-lowland settings.

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