THE BIG FLOOD:
WILL IT HAPPEN AGAIN?

What causes river bank mass failures?

The scalloped river bank erosion in the Lockyer Creek resulted from wet-flow bank mass failures. These form after prolonged floods which have saturated the bank. When floodwaters recede, water drains out of the bank through sand layers lying above clay loam layers, leading to the collapse of the bank into the channel.

Mass failures typically form in mid to lower catchment zones, but there does not appear to be any critical bank height or bank slope associated with their occurrence.

Mass failures occurred in the Lockyer catchment in the 2011 floods and then formed in new locations in the 2013 floods. Once formed, subsequent floods may deposit sediment into the hollows to rebuild the bank. Mass failures generally do not retreat or keep eroding into the floodplain. Therefore they do not require management unless property is at risk.

FURTHER READING

Croke, J., Denham, R., Thompson, C., and Grove, J. 2014 Evidence for self-organised criticality (SOC) in river bank mass failures; a matter of perspective? Earth Surface Processes and Landforms http://dx.doi.org/10.1002/esp.3688

Grove, J.R. Croke, J., and Thompson C. 2013.Quantifying different riverbank erosion processes during an extreme flood event. Earth Surface Processes and Landforms. http://dx.doi.org/10.1002/esp.3386

Thompson, C., Croke, J., Grove, J., and Khanal, G. 2013. Spatio-temporal changes in river bank mass failures in the Lockyer Valley, Queensland, Australia. Geomorphology 191:129-141. http://dx.doi.org/10.1016/j.geomorph.2013.03.010

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Quantifying different riverbank erosion processes during an extreme flood event

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ABSTRACT: Riverbank erosion is a major contributor to catchment sediment budgets. At large spatial scales data is often restricted to planform channel change, with little information on process distributions and their sediment contribution. This study demonstrates how multi-temporal LiDAR and high resolution aerial imagery can be used to determine processes and volumes of riverbank erosion at a catchment scale. Remotely sensed data captured before and after an extreme flood event, enabled a digital elevation model of difference (DoD) to be constructed for the channel and floodplain. This meant that: the spatial area that could be assessed was extensive; three-dimensional forms of bank failures could be mapped at a resolution that enabled process inference; and the volume and rates of different bank erosion processes over time could be assessed. A classification of riverbank mass failures, integrating form and process, identified a total of 437 mass failure polygons throughout the study area. These were interpreted as wet flow mass failures based on the presence of a well defined scarp wall and the absence of failed blocks on the failure floor. The failures appeared to be the result of: bank exfiltration, antecedent moisture conditions preceding the event, and the historic development of the channel. Using one-dimensional hydraulic modelling to delineate geomorphic features within the main boundary of the macrochannel, an estimated 1 466 322 m^2 of erosion was interpreted as fluvial entrainment, occurring across catchment areas from 30 to 1668 km^2. Only 8% of the whole riverbank planform area was occupied by mass failures, whilst fluvial entrainment covered 33%. A third of the volume of material eroded came from mass failures, even though they occupied 19% of the eroded bank area. The availability of repeat LiDAR surveys, combined with high-resolution aerial photography, was very effective in erosion process determination and quantification at a large spatial scale. Copyright © 2013 John Wiley & Sons, Ltd.

KEYWORDS: LiDAR; bank erosion; sapping; wet flow; mass failure