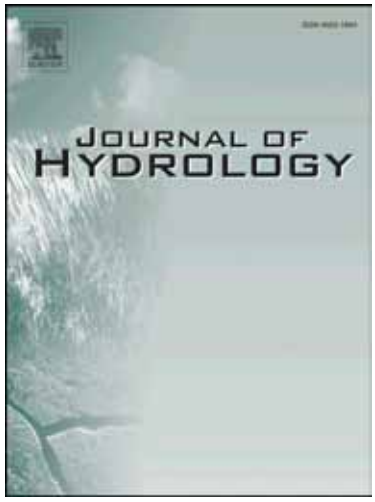

Research papers

Numerical modelling of hydro-morphological processes dominated by fine suspended sediment in a stormwater pond

Mingfu Guan, Sangaralingam Ahilan, Dapeng Yu, Yong Peng, Nigel Wright

PII: S0022-1694(17)30759-X
DOI: https://doi.org/10.1016/j.jhydrol.2017.11.006
Reference: HYDROL 22364

To appear in: *Journal of Hydrology*

Received Date: 23 May 2017
Revised Date: 7 September 2017
Accepted Date: 3 November 2017

Please cite this article as: Guan, M., Ahilan, S., Yu, D., Peng, Y., Wright, N., Numerical modelling of hydro-morphological processes dominated by fine suspended sediment in a stormwater pond, *Journal of Hydrology* (2017), doi: https://doi.org/10.1016/j.jhydrol.2017.11.006

Numerical modelling of hydro-morphological processes dominated by fine suspended sediment in a stormwater pond

Mingfu Guan[1*], Sangaralingam Ahilan[2], Dapeng Yu[1], Yong Peng[3†], Nigel Wright[4]

[1] Department of Geography, Loughborough University, Loughborough, UK

[2] Centre for Water Systems, University of Exeter, Exeter, UK

[3] State Key Laboratory for Hydraulics and Mountain River Engineering, Sichuan University, China

[4] Faculty of Technology, De Montfort University, Leicester, UK

ABSTRACT: Fine sediment plays crucial and multiple roles in the hydrological, ecological and geomorphological functioning of river systems. This study employs a two-dimensional (2D) numerical model to track the hydro-morphological processes dominated by fine suspended sediment, including the prediction of sediment concentration in flow bodies, and erosion and deposition caused by sediment transport. The model is governed by 2D full shallow water equations with which an advection-diffusion equation for fine sediment is coupled. Bed erosion and sedimentation are updated by a bed deformation model based on local sediment entrainment and settling flux in flow bodies. The model is initially validated with the three laboratory-scale experimental events where suspended load plays a dominant role. Satisfactory simulation results confirm the model's capability in capturing hydro-morphodynamic processes dominated by fine suspended sediment at laboratory-scale. Applications to sedimentation in a stormwater pond are conducted to develop the process-based understanding of fine sediment dynamics over a variety of flow conditions. Urban flows with 5-year, 30-year and 100-year return period and the extreme flood event in 2012 are simulated. The modelled results deliver a step change in understanding fine sediment dynamics in stormwater ponds. The model is capable of quantitatively simulating and qualitatively assessing the performance of a stormwater pond in managing urban water quantity and quality.

[*] Corresponding to: Dr. Mingfu Guan, Research Fellow, Department of Geography, Loughborough University, UK, m.guan@lboro.ac.uk, and

[†] Dr. Yong Peng, Associate Professor, College of Water Resources and Hydropower, Sichuan University, China, pengyongscu@foxmail.com