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Impacts of Barge as Flexible Infrastructure on Riverbed Morphology

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Sediment accumulation at river confluences can severely compromise fairway stability and navigation safety. To provide a non-invasive alternative to dredging, a novel low-water training concept based on “flexible infrastructure” has recently been introduced, using temporarily anchored, ballasted barges to locally modify flow conditions and induce targeted bed erosion. This study evaluates the morphodynamic influence of barge location at the confluence and identifies hydraulic conditions under which this approach is most effective. A three-dimensional numerical model was developed in FLOW-3D, to evaluate scour and deposition patterns around deployed barge. Hydraulic and sediment transport calibration was performed using in situ ADCP velocity measurements and bathymetric surveys collected over a 10-day low-flow period. A series of numerical experiments was conducted using identical geometric configurations while varying boundary conditions (flow velocity and water depth) over low, mean, and high flow conditions. This study analyze the relative influence of flow velocity, water depth, and flow contraction on the maximum local scour beneath the barge. Results indicate that flow contraction and velocity are the dominant controls on barge performance, while barge effectiveness becomes negligible under high-flow conditions associated with large water depths. These findings demonstrate that barges can serve as adaptable and environmentally low-impact infrastructure elements for localized sediment management.

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