

ENV Report 37 - *Entrainment and Transport of Sediments by Towboats in the Upper Mississippi River and Illinois Waterway, Numerical Model Study* by Ron Copeland

ABSTRACT

A numerical model study was conducted to determine the magnitude and duration of increased sediment concentration due to towboat passage. The quantity of bed material transport into backwater areas was also predicted. This was accomplished using two 2-dimensional numerical models for hydrodynamics (RMA2 and HIVEL), and a sediment transport model (SED2D). Ambient hydrodynamic bed shear stresses were calculated using RMA2. Bed shear stresses created by drawdown and return currents were calculated using HIVEL. Bed shear stresses induced by the bow pressure wave and the tow's propeller jet as a function of depth and ambient velocity were determined external to the numerical models using an algorithm developed from experimental techniques. The combined bed shear stresses from these three sources were imported into the SED2D sediment model to calculate entrainment and transport. The currently available SED2D model was modified to simulate towboat passage and to entrain bed sediments from rapidly changing bed shear stresses. The two-dimensional depth-averaged unsteady-flow sediment transport model was then used to simulate the advection and diffusion of suspended sediment. Portions of Pools 8 and 26 on the Mississippi River and the LaGrange Pool on the Illinois River were modeled. The study included collection of bed-material and suspended sediment data. Model results showed very little impact on ambient sediment concentrations on the Mississippi River where the predominate bed sediment was medium sand. Likewise the on the Illinois River where the predominant bed material in the center of the navigation channel was fine sand, sediment entrained by towboats was quickly re-deposited. However, cohesive sediment, which is located in patches on the bed and all along the edge of the navigation channel, remained in suspension much longer than the sand.