

Large-Eddy Simulation of the Piscataqua River: Hydrodynamic Insights for Tidal Turbine Deployment Under Ebb and Flood Conditions

Mustafa Meriç Aksen^a, Ali Khosronejad^a

^a*Department of Civil Engineering, Stony Brook University, Stony Brook, NY 11794, USA*

Abstract

We present a series of high-fidelity numerical simulations to investigate the turbulent flow in a 6 km-long reach of the Piscataqua River and Portsmouth Harbor at the borderline between New Hampshire and Maine states under both the ebb and flood-tidal conditions. The objective of this study is to (1) find an adequate location for a tidal farm within the river and (2) optimize the placement of individual turbines within the selected site. The digital map of the study area was reconstructed from remote sensing data (i.e., above water topography of the riverbanks via LiDAR) and field measurements (i.e., bathymetry of the river via multi-beam sonar). To prescribe the inflow conditions of the flood and ebb flows in the river, three inlet boundary conditions were imposed: (1) a synthetic inlet profile obtained from the log-law, (2) instantaneous turbulent flow generated from a precursor straight-channel simulation, and (3) instantaneous turbulent flow from a precursor river simulation in a 500 m upstream reach. By evaluating the hydrodynamic conditions from preliminary numerical studies, we explored optimizing a proposed tidal turbine farm along the Piscataqua River and Portsmouth Harbor.

Keywords: Large-eddy simulation, Piscataqua River, Tidal farm, Marine hydrokinetic turbine.
