Enhancing Waterway Management and Decision-Making through System-Wide Hydrologic and Hydraulic Modeling of the Erie Canal

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The Erie Canal is a historic waterway extending approximately 360 miles across upstate New York, connecting the Great Lakes to the Hudson River and ultimately the Atlantic Ocean. There are over 150 miles of earthen embankments impounding the Canal, which present a potential hazard to public safety in the event of failure. To date, no comprehensive breach modeling or consequences evaluation has been completed to help the Canal Corporation understand their risks associated with failure of these embankments. To address this gap, system-wide hydrologic and hydraulic (H&H) modeling, including breach analysis, is being performed.

Comprehensive hydrologic and hydraulic models are in development for the Erie Canal system in western New York, focusing on the 17- and 60 Mile Pool reaches between Lockport and Macedon. These areas were selected due to their likely highest consequences in case of structure failures. HEC-RAS 2D rain-on-grid models were developed to simulate rainfall, infiltration, and runoff directly on the 2D mesh, providing a fully coupled representation of overland flow, channel routing, and spatially variable rainfall. This approach eliminates the need for separate hydrologic inputs from external models and allows rainfall to be applied directly across the terrain. As a result, it more accurately captures localized runoff generation, flow connectivity, and dynamic interactions between surface water and hydraulic structures than traditional deterministic models. Extensive data was collected to inform and develop the model, including high-resolution terrain and bathymetric surveys, aerial imagery, and detailed structure inventories. The models capture the complex interdependencies among the system's major components such as locks, gate systems, waste weirs, dive culverts, and water impounding embankments across a range of flood and operational scenarios. The resulting simulations provide quantitative insights into canal storage dynamics, water-surface levels, asset performance, and downstream consequences associated with potential embankment breaches.

This presentation will provide participants with valuable insights into the fascinating Erie Canal system and show how the integration of modern engineering, data solutions, and advanced technologies enables the Canal Corporation to better understand, assess, and manage the risks associated with its Canal embankments and other assets. The outcomes of this work enhance canal operations, strengthen emergency preparedness, and support long-term capital planning across the Canal system.