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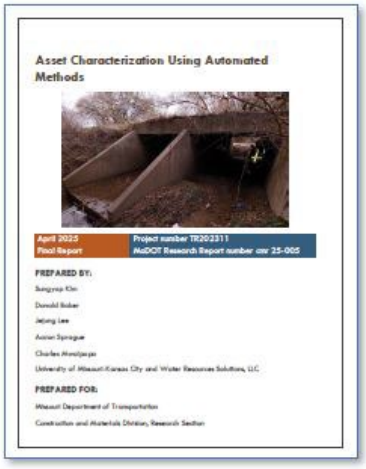
Research Summary

Asset Characterization Using Automated Methods



Floods are frequent and costly natural disasters that pose significant societal impacts, including damaging effects on highway safety, infrastructure, and traffic flows. As the number and intensity of extreme flood events are expected to increase in the coming decades, highway agencies face increasing challenges in maintaining and monitoring water crossing assets and assessing flood hazard risks of the assets.

This project aimed to develop an automated flood risk assessment tool using existing Light Detection and Ranging (LiDAR) data for small water crossing assets with less than a 20-foot span on Missouri's highways not listed in the 2023 National Bridge Inventory (NBI) database. LiDAR is a remote sensing technology emitting laser pulses at object surfaces to create 3D point cloud representations of the objects. Thus, it can generate high-resolution 3D models or Geographic Information System (GIS) mappings such as Digital Elevation Models (DEM) and Digital Surface Models (DSM). Many state highway agencies have used LiDAR data for various purposes, including highway, infrastructure, natural, topographic, and terrain data collection and asset management.

The information on small water crossing assets is often limited and not readily available. Thus, the project used GIS to identify potential non-NBI water crossing sites and conducted field surveys to collect the asset information. Upon the surveys, the project focused on box culverts, the most typical type of small water crossing assets.

> *"To protect the integrity of the nation's transportation system and the people it serves, it is essential to manage and reduce flood risk when taking actions to plan, design, maintain, and repair our transportation system." –Excerpt from the Federal Flood Risk Management Standard by the U.S. Department of Transportation.*

The project developed a GIS-based flood risk assessment tool or the Missouri Automated Culvert Analysis Tool (MoACAT), using the readily available high-resolution (6.56-foot or 2-meter) topographic LiDAR data from the Missouri Spatial Data Information Service (MSDIS). The tool was developed as a plugin with Python scripts that process four sequential steps on the Quantum Geographic Information System (QGIS), the most popular non-proprietary open-source GIS software program, for simple and no-cost testing and implementation.

The project conducted a pilot study using surveyed culverts collected from Cass County,

Missouri. The MoACAT hydraulic results were compared against HEC-RAS 2D modeling results. The results indicate that the tool has the potential to identify small water crossing assets and predict flood overtopping efficiently. The project also developed a step-by-step manual of the flood risk assessment tool.

The MoACAT program should be able to help MoDOT identify and manage small assets on Missouri's highways. It can facilitate MoDOT in assessing small flood-prone assets that can be used for highway and emergency management, prioritizing highway infrastructure investment to safeguard road users, providing efficient, reliable, and safe transportation networks, and ensuring efficient water crossing asset management.

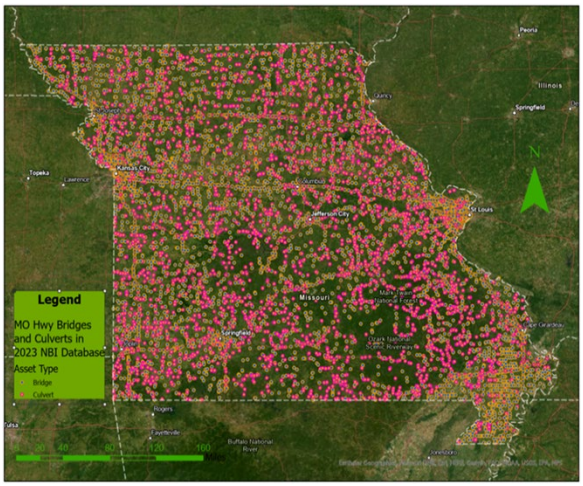


Figure 1: Bridge and Culvert Locations of the 2023 National Bridge Inventory (NBI) Data

Project Information

PROJECT NAME: Asset Characterization Using Automated Methods

PROJECT START/END DATE: June 2023-March 2025

PROJECT COST: $200,000

LEAD CONTRACTOR: University of Missouri-Kansas City and Water Resources Solutions, Inc.

PRINCIPAL INVESTIGATOR: Sungyop Kim and Don Baker, PE

REPORT NAME: Asset Characterization Using Automated Methods

REPORT NUMBER: cmr 25-005

REPORT DATE: April 2025

Project Manager

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