Integrating riverine and infrastructure information, such as field notes and images from past flooding events, helps engineers make timely decisions about detours or other actions when roads flood.

RESEARCH SOLUTIONS

Riverine Infrastructure Database assesses infrastructure flood risk, enhances safety

Determining road and bridge flood risk during rain events is dependent on multiple factors. Iowa DOT engineers must understand stream behavior, including when water rises to levels of concern, and characteristics of roads and other infrastructure in flood-prone areas. A new interactive database integrates data from riverine and infrastructure sources to enable timely decisions on road detours that will enhance public safety and reduce travel delays.

THE NEED

Flooding events present real-time risks to roads and bridges, property, and the traveling public. Assessing the vulnerability of Iowa's approximately 2,100 bridges and associated roads over streams and rivers during heavy rains requires analyzing multiple factors that contribute to flooding. But it can be difficult and time-consuming to acquire the substantial data describing stream hydrology and the hydraulic relationship between water flow and infrastructure that is needed for this assessment.

Iowa DOT maintains records and physical surveys about as-built infrastructure, but this information can change over time and may not be easily accessible. While agency engineers work to analyze the hydrology and hydraulics related to riverine infrastructure, current and complete information for proactive protection — before water rises to the level of flooding — may be incomplete.

An interest in creating a geographic information system (GIS) based database that integrates riverine and infrastructure data began

(continued)

"This tool provides timely, easily accessible data before or during heavy rain events, which we can use to arrange detours around high water."

– JIMMY ELLIS,

Iowa DOT Preliminary Bridge Design Unit Leader

after extensive flooding on the Cedar River in 2008. That year, a bridge replacement project included the collection of detailed hydraulic information that enabled Iowa DOT to estimate when rising water may require road detours or other action. This data-driven approach to road closures in the area minimized the impacts of flooding and road delays.

Iowa DOT created the Riverine Infrastructure Database (RIDB) to quickly assess infrastructure risk during potential flooding events and provide a common data structure.

RESEARCH APPROACH

Numerous data sources maintained by Iowa DOT provided inputs for a relational database incorporating stream flow and flood elevations with infrastructure and other site characteristics where roads and riverine environments intersect. Data the agency collected during the 2008 bridge project and various efforts afterward was used to create stream flow rating curves, which plot the relationship between water level and stream flow. As bridges and related structures were replaced or maintained, Iowa DOT continued to collect hydraulic and physical site characteristic data, producing flow frequency and rating curves for over 270 sites.

Summaries of these sites, GPS surveys of all bridge and roadway locations, and historic flood information were used to create the RIDB. The database comprises several spatial layers and tables representing Iowa's entire stream network and adjacent roadway infrastructure, including roadways, bridges, culverts, dikes and levees.

WHAT IOWA LEARNED

The RIDB enables continuous monitoring of flooding potential across the state's road network, allowing Iowa DOT to quickly identify areas where high water levels may impact roads, bridges, and other infrastructure. The RIDB allows for daily data updates, data quality checks and archiving, and hourly hydraulic analyses. Flood frequency and rating curves, past impacts, and high and low stream velocities are also available. A field notes layer provides data and images from flood events to be saved for later analysis.

The database is visualized through a web-based, interactive series of map tools:

- RIDB Map displays hydraulic and infrastructure data.
- RIDB Flooding Impact shows near real-time events (updated hourly) and infrastructure impacts using stream flow data from the Iowa Flood Center.
- RIDB Flood Frequency identifies flood frequencies and areas where roads or bridges were overtopped.

PUTTING IT TO WORK

The RIDB is currently operational. Iowa DOT will maintain and expand the system to include hydraulic and infrastructure information for every site on the state's primary highway system with a drainage area of over 10 square miles. The agency is currently working to develop rating curves and site summaries to populate the database.

ABOUT THIS PROJECT

PROJECT NAME: Iowa DOT Riverine Infrastructure Data Base (RIDB) for Rapid Assessment of Vulnerable Infrastructure

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