

## Executive Summary, Research Readiness Level Assessment, and Technology Transfer

# An Investigation of Water Obstructions and Related Weather Conditions for Nebraska Roadways

### Research Objectives

The main objective of this investigation is to generate spatial maps of water obstructions on Federal and State highways across Nebraska (NDOT's responsibilities). The spatial maps will provide NDOT with a climatology of where water obstructions have occurred in the past. Composite spatial maps will be generated annually, and a climatology will then be produced for the period of record. In addition to the locations of the water obstructions, meteorological information will be investigated for the cause of the obstruction. Each obstruction needs to be identified and then similar weather situations will be combined. Once the obstructions are identified, then NDOT can determine what form of action might be taken to reduce water obstructions in the future.

### Research Benefits

One of the major benefits of the project is to generate spatial maps to understand the breath of water obstructions across the state. The regions of water obstructions are usually known locally within NDOT's Districts; however, that knowledge is being lost to retirements and departments within NDOT then do not have access to the knowledge of where and when water obstructions take place. This project will generate spatial information that can then be used by many departments within NDOT. Therefore, the main expected goal of this project is to be able to identify roadways that frequently have water obstructions associated with different water/flooding occurrences. Understanding where these obstructions are located is the main result; however, why the event took place in the first place also needs to be established and is a second expected result of this project. Therefore, for each water obstruction, weather conditions causing the obstruction will be investigated. After the cause of the obstruction is established then possible mitigation activities and infrastructure improvement prioritization within NDOT to lessen occurrences of these obstructions can take place.

### Principal Investigator

**Mark Anderson (P.I.)**

University of Nebraska

### NDOT Lead TAC Members

**Jesse Schulz**

NDOT Statistical Analyst

**Julie Ramirez**

NDOT Professional Engineer

### Background

Roadway resilience across the 10,000 miles of road and 3,500 bridges in Nebraska is critical to the economic success of production and logistics. In a state where historical flooding scenarios, such as the one in March 2019 that caused \$150 million in damage, could potentially be increasing, it has become essential to understand the spatial and temporal distribution of high-frequency water obstruction areas on roadways. Therefore, in order to further investigate these areas, the main objectives of this research were to perform statistical and spatial analyses to quantify the relationship between water obstructions and their associated meteorological conditions and identify the potential linkages between water obstructions and climate patterns.

### Conclusion

Nebraska Department of Transportation (NDOT) historical water obstruction data were obtained for June 2016 through August 2021 to formulate 298 total unique water obstructions, of which 174 came from March 2019, and 225 in total came from 2019 alone. While 2019 was an outlier year, on a median basis, the state experiences 13 water obstructions annually and these occur primarily in the summer season. A key finding in this analysis was that water obstructions over the study period were closely related with 30-year climatological data, which can then be used for water obstruction risk assessment on a seasonal and annual basis. Groundwater, ice jamming, and long- and short-duration precipitation obstructions occurred most frequently in the northern and eastern domains of Nebraska. There is a greater risk of water obstructions reoccurring given the exposure to weather-related hazards on average, and the higher density of roadways exposed to rivers such as the Elkhorn and Platte. In addition to identifying specific high-frequency water obstruction locations, there is a predictable relationship between weather, climate, and roadway water obstructions. A fundamental understanding of the water obstruction spatiotemporal climatology, knowledge of where water obstructions have occurred the most, and identifying the precursor and future meteorological conditions, a more proactive approach can be taken in the onset of potential water obstructions. Further, the identification of the high-frequency water obstruction locations can be considered for mitigation efforts to increase the resiliency of travel from water obstructions.

## Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Interested in finding out more?  
Final report is available at:  
[NDOT Research Website](#)

### NDOT Recommendations Based of Completed Research

This project used the Condition Acquisition Reporting System (CARS) data from 2016 to 2021 to identify the water obstructions. The CARS data is used to identify information incorporated into the 511 Nebraska travel information system. Also, this project used the archived weather conditions and radar returns from the National Center for Environmental Information (NCEI) to explain the weather conditions leading up to the water obstruction event. For other water obstructions, weather conditions were also determined and when available stream and river information were obtained from the United States Geological Survey (USGS) stream gauge measurement archive for water level heights. The study provided/developed a spreadsheet with all the data from CARS, NCEI and USGS. The spreadsheet is a starting point to turn the spreadsheet into a forecasting when overtopping will occur and calculations towards the hydraulic implications.

Further research is needed to collect more data to improve the spreadsheet's capabilities and to identify the high-frequency water obstruction locations is recommended for mitigation efforts to increase the resiliency of travel from water obstructions.

- *As provided by Jesse Schulz and Julie Ramirez, Lead TAC Members*

### Research Readiness Level (RRL) Assessment

#### Level 2: Applied Research/Proof Concept

- Integration of components needs more research

**RRL 2**

### Technology Transfer

Principal Investigator did not have any technology transfer for this research project

**This brief summarizes Project SPR-FY21(001)  
“An Investigation of Water Obstructions and Related Weather Conditions for Nebraska Roadways”  
Nebraska Department of Transportation Research Program**