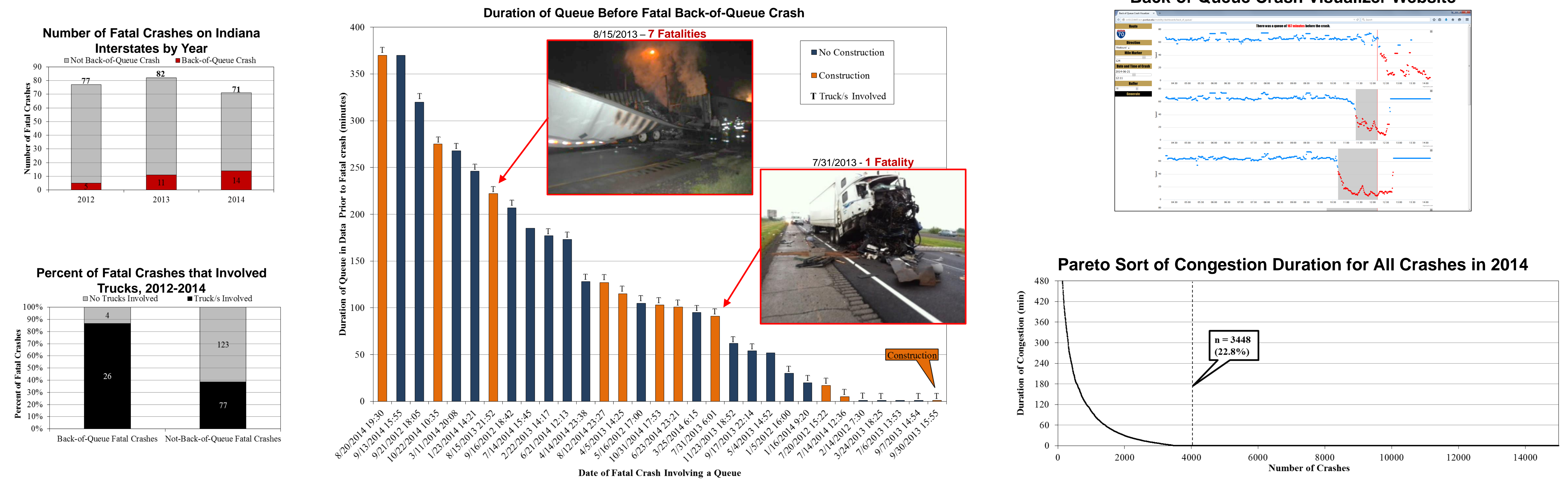


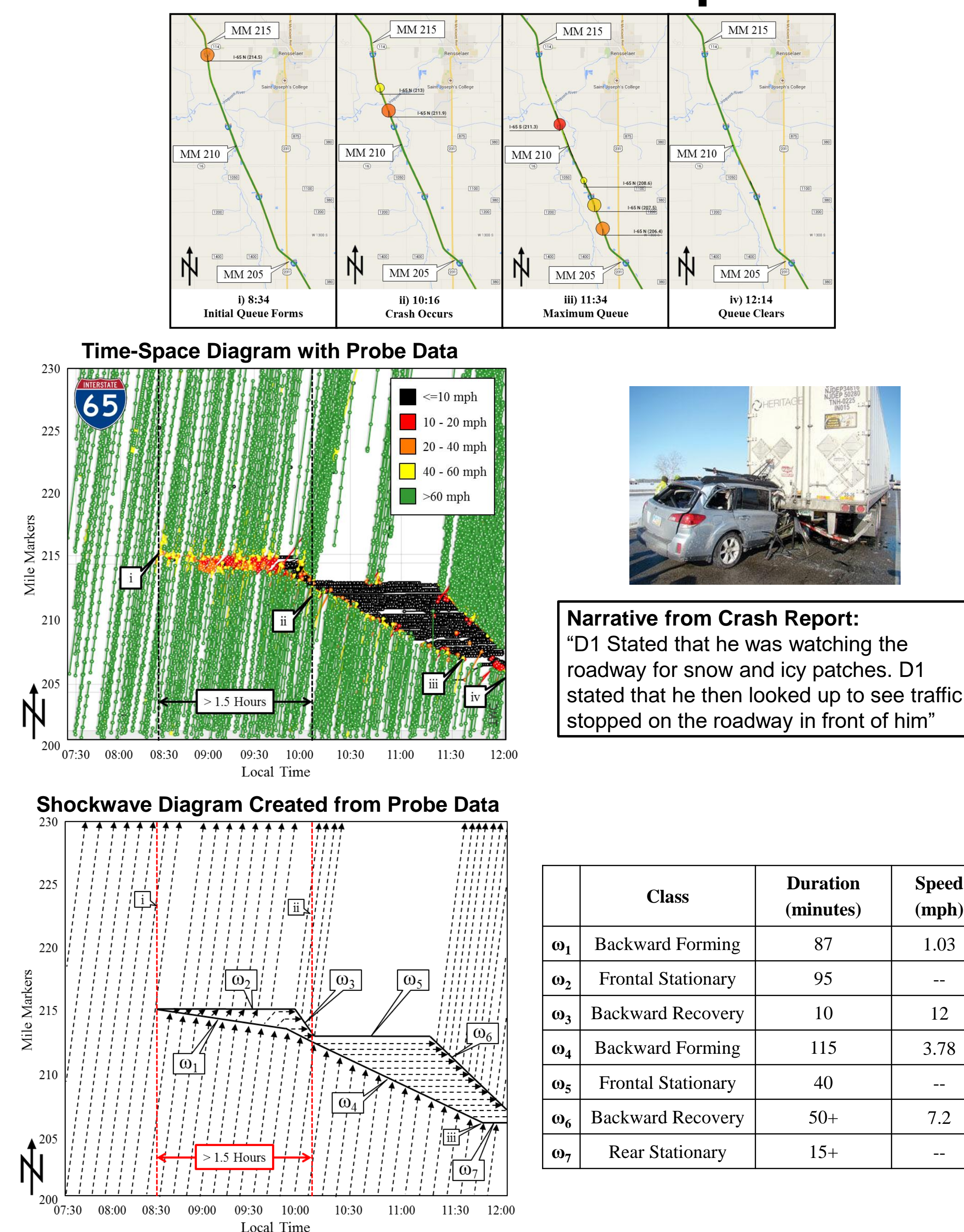
Abstract

Crash reduction factors are widely used by engineers for prioritizing safety investments. Work zones are routinely analyzed by the length and duration of queues. Queue detection warning technology has been growing in availability and reliability in recent years. However, there is sparse literature on the impact of freeway queueing on crash rates. This paper analyzes three years of crash data and crowd-sourced probe vehicle data to classify crashes as being associated with queueing conditions or free flow conditions. In 2014, only 1.2% of the distanced-weighted hours of operation of Indiana interstates operated at or under 45 MPH. A three-year study on Indiana interstates indicates that commercial vehicles were involved in over 87% of back-of-queue fatal crashes compared to 39% of all fatal crashes during free flow conditions. A new measure of crash rate was developed to account for the presence and duration of queues: crashes per mile-hour of congestion. The congested crash rate on all Indiana interstates in 2014 was found to be 24 times greater than the uncongested crash rate. These data were also separated into both rural and urban categories. In rural areas, the congested crash rate is 23 times the uncongested crash rate. In urban areas, the congested crash rate is 21 times the uncongested crash rate. Queues are found to be present for five minutes or longer prior to approximately 90% of congestion crashes in 2014. Longer term, this information shows the importance in the development of technology that can warn motorists of traffic queues.

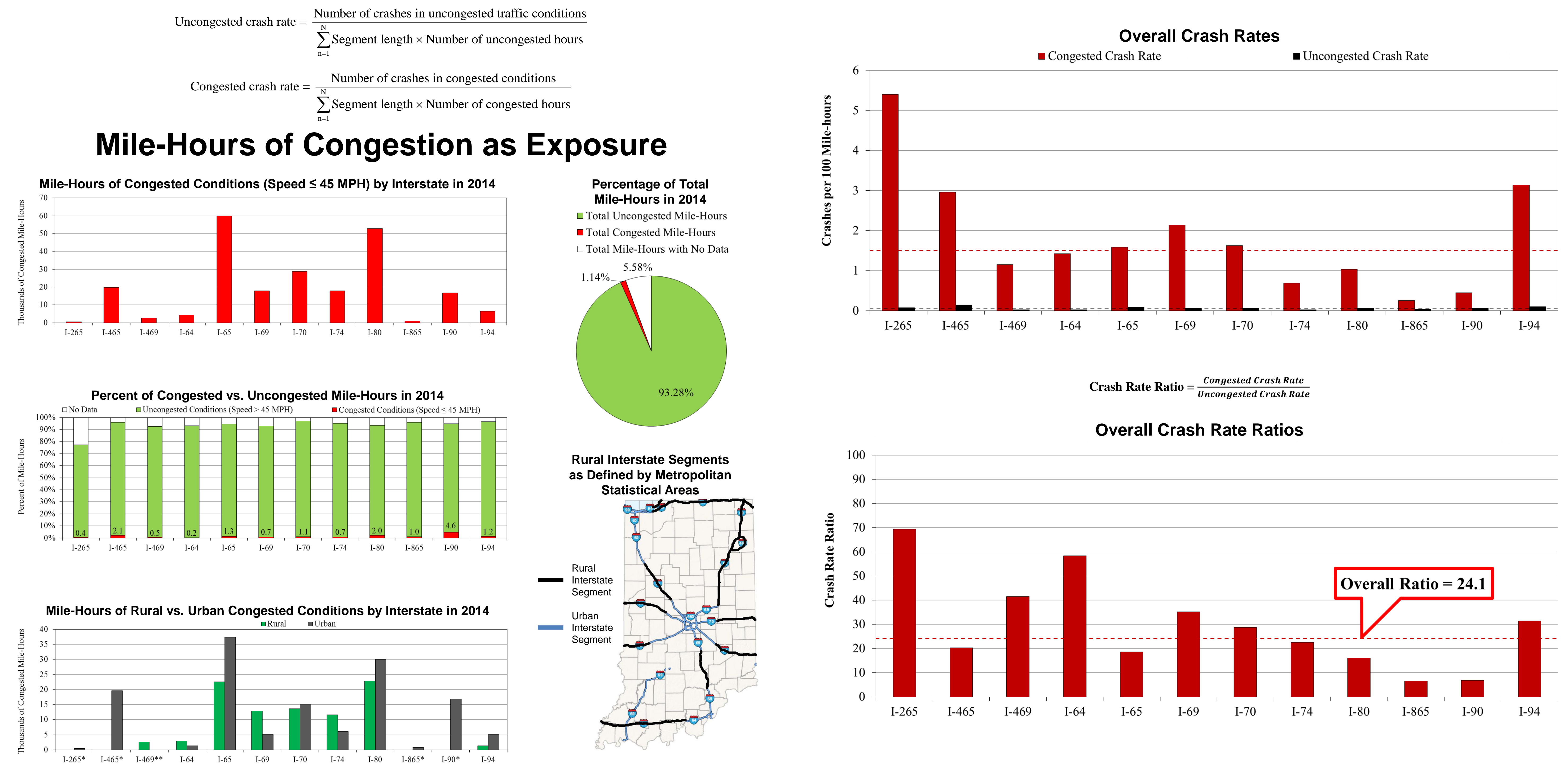
Queue Duration Prior to Crash



Back-of-Queue Crash: Probe Data Example

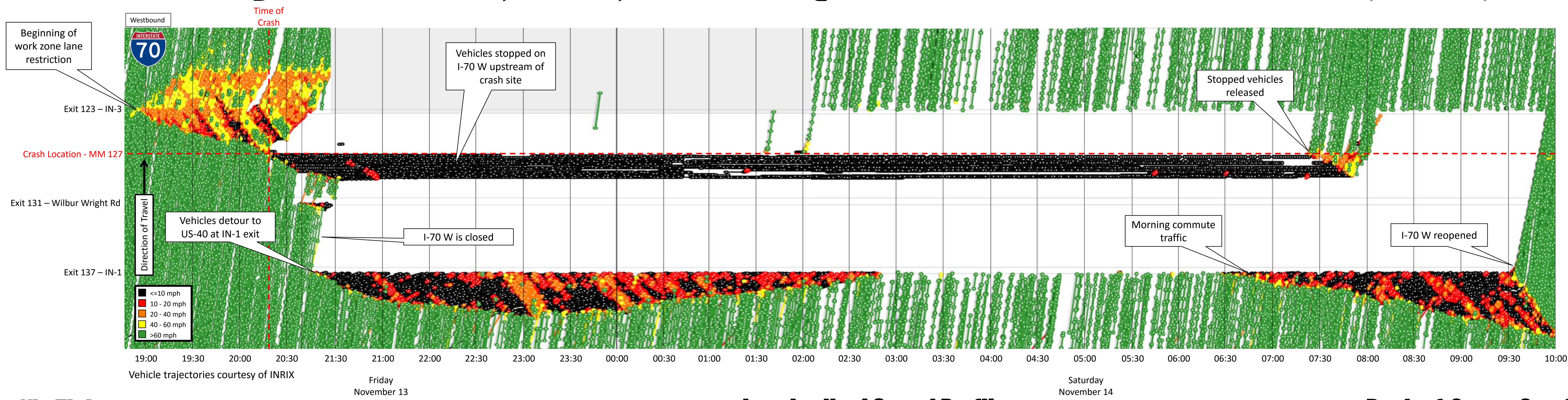


Interstate Crash Rates in 2014



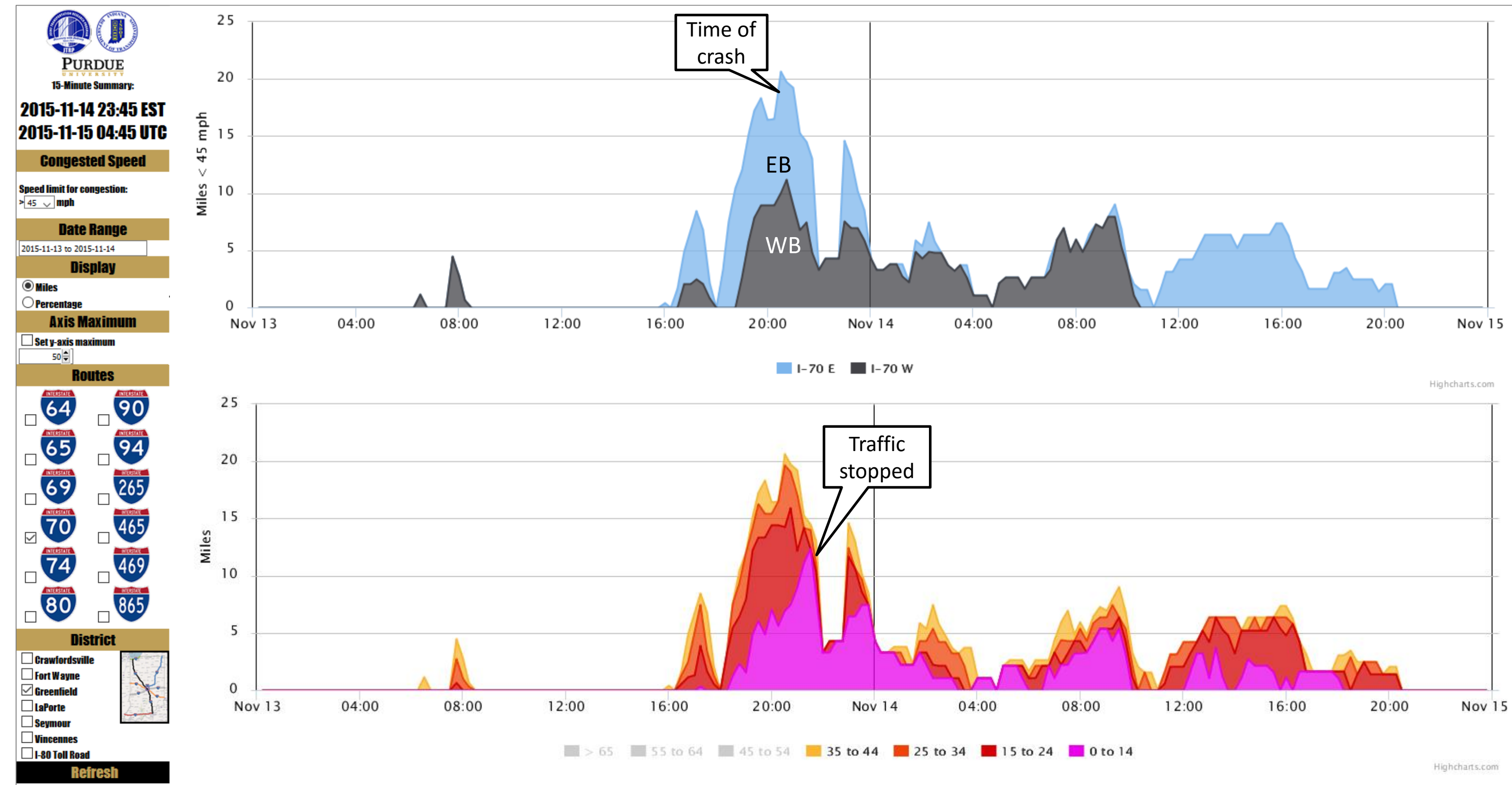
Case Study: 14-Vehicle, Fatal, Back-of-Queue Crash

November 13, 2015; 8:17 PM; I-70 W @ MM 127

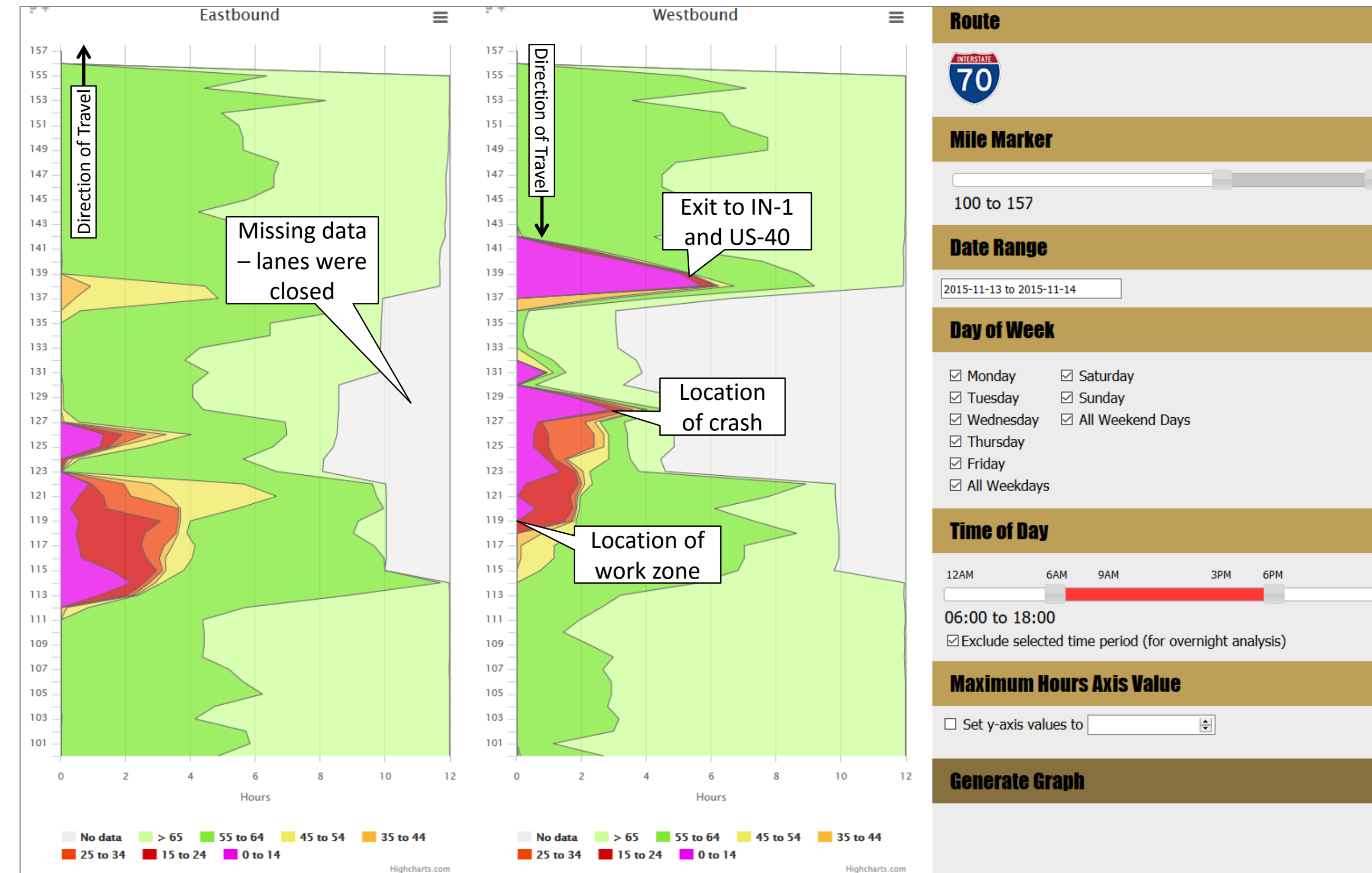


Courtesy of Indiana State Police

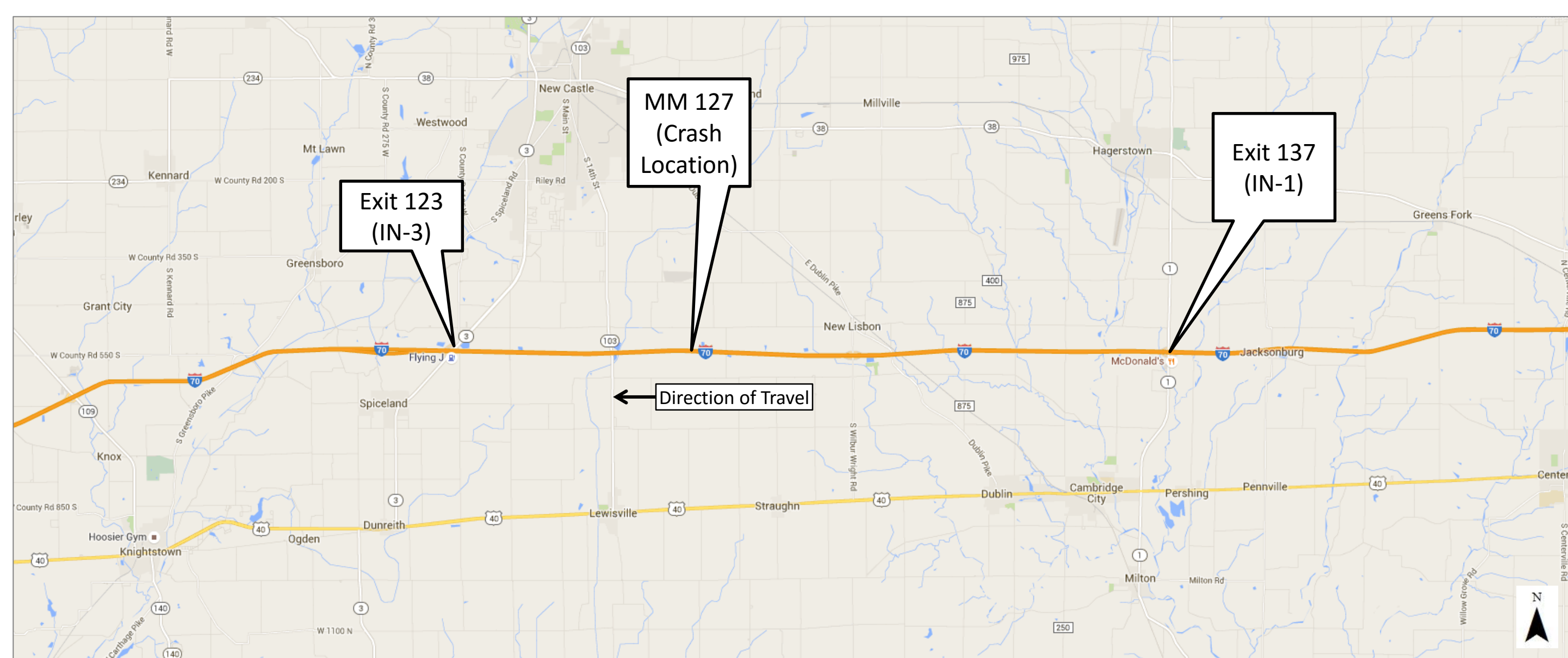
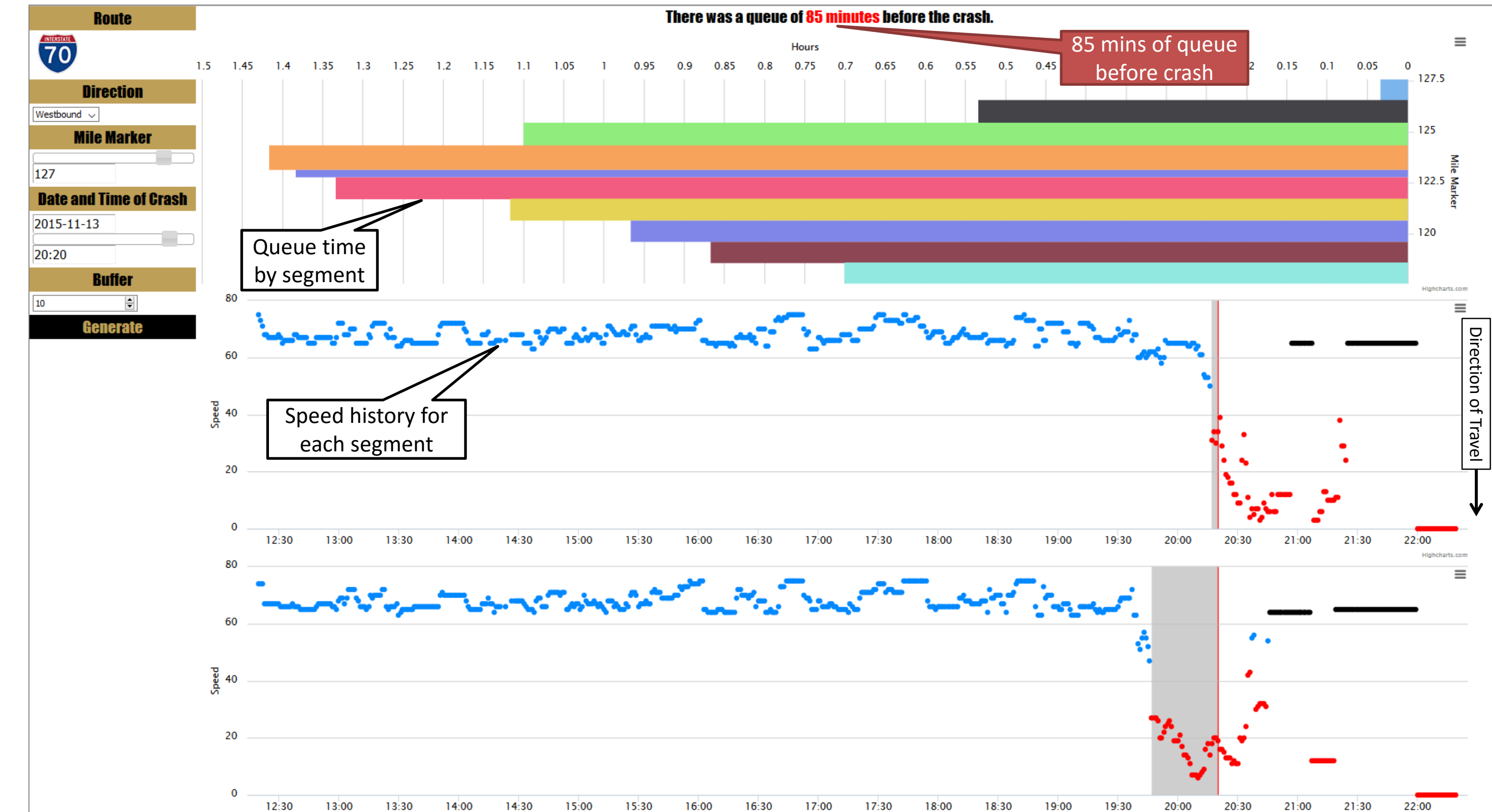
Traffic Ticker



Longitudinal Speed Profiles



Back-of-Queue Crash Visualizer

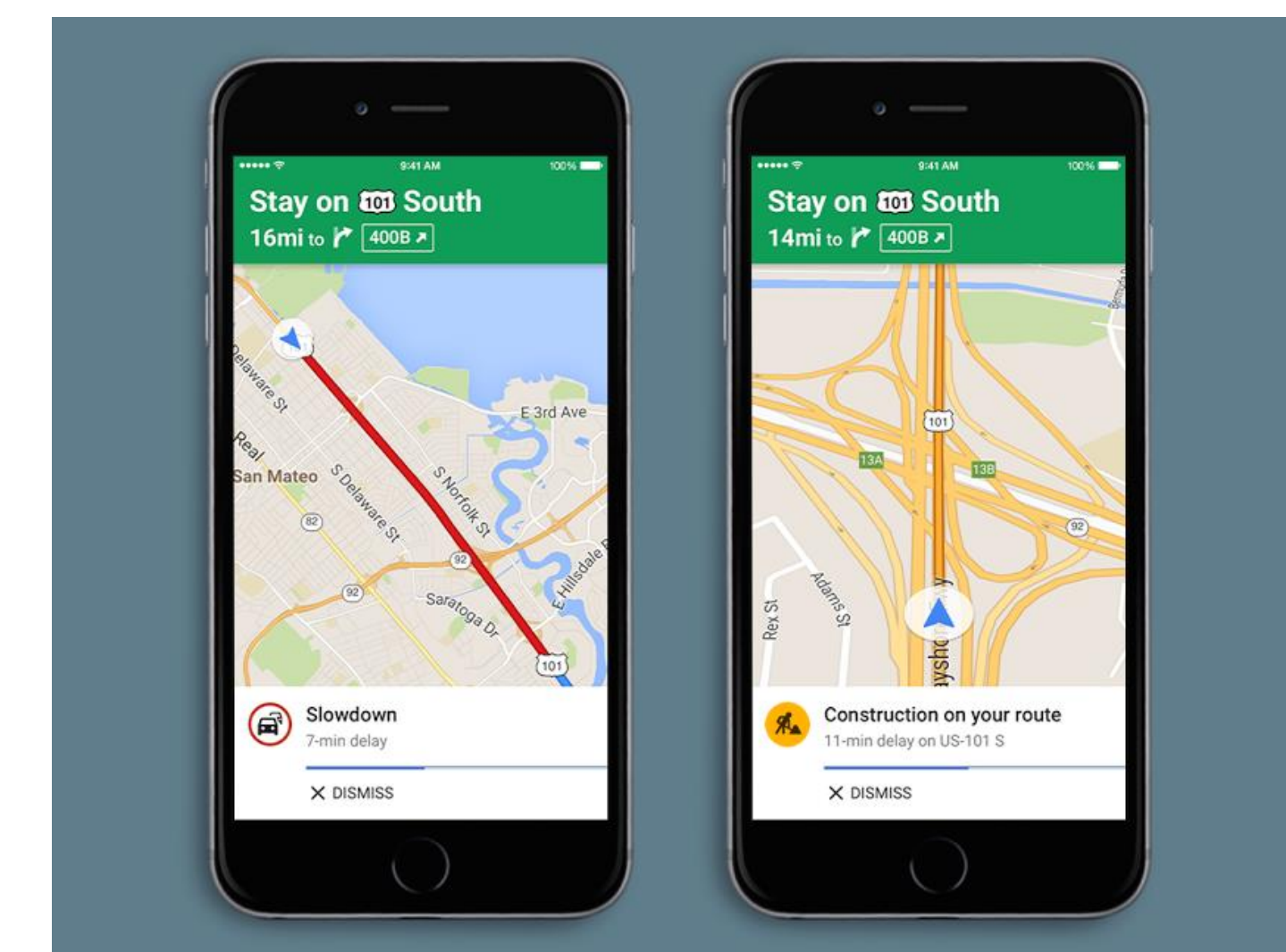


Characterizing Interstate Crash Rates Based on Traffic Congestion Using Probe Vehicle Data

Possible Mitigation Strategies



Courtesy of Livetrucking.com



Courtesy of Google



Michelle M. Mekker, Stephen M. Remias, Margaret L. McNamara, Darcy M. Bullock