



# Weather Responsive Traffic Signal Timing in Utah Department of Transportation

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## BACKGROUND

The Utah Department of Transportation (UDOT) implemented and evaluated an advanced traffic signal timing strategy just outside Salt Lake City on the Riverdale Road corridor in Ogden, UT. The objective of the project was to make UDOT's traffic signal system more responsive to changes in traffic demands and travel speeds during severe weather conditions.

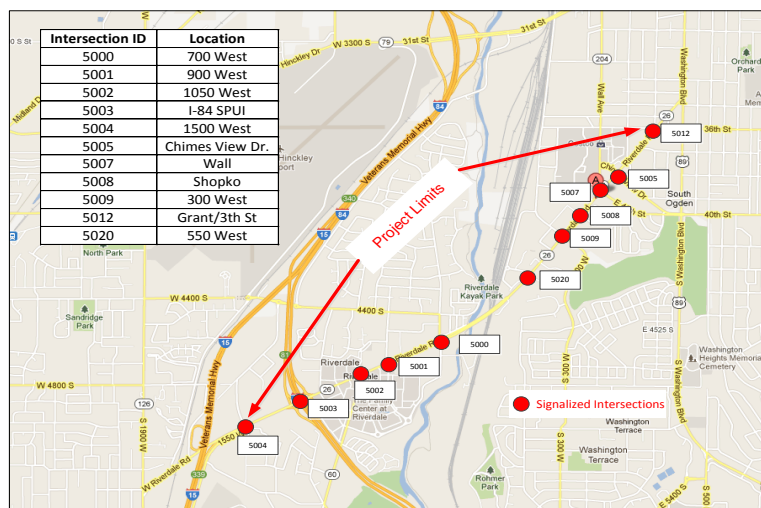
## WHY RIVERDALE CORRIDOR?

Riverdale Road is a congested non-freeway corridor in Ogden, Utah (see photo below) that carries about 47,000 vehicles a day. Commercial activity in the corridor is significant with shopping areas on both sides of the road for large portions of the corridor, especially on the western side, gradually reducing in density west to east. This segment is primarily a 6-lane road with 11 traffic signals.



*Riverdale Road in Ogden Utah. Photo taken from the Deseret Morning News.*

Signal spacing ranges from 700 feet to over 3,000 feet. The map on the right shows the locations of the traffic signals on the corridor. The corridor is highly instrumented with video and radar traffic data collection devices. UDOT's goal for implementing weather responsive traffic signal operations along the Riverdale Road corridor is to allow traffic signal operators to anticipate when weather conditions deteriorate to the point of impacting travel speeds in the corridor. Once aware of the impending deterioration, the system allows the operators to deploy traffic signal timing plans that best match the prevailing travel conditions in the corridor.



*Locations of Traffic Signals on Riverdale Corridor Project.*

## SYSTEM IMPLEMENTATION

UDOT procured, installed and integrated an RWIS station directly in the corridor. This station provided UDOT meteorologists and TMC operators with information on road temperature, road surface condition, precipitation type and rate, snow accumulation on the road, wind speed, and air temperature. The RWIS station served as an additional data point for UDOT meteorologists to customize forecasts for the Riverdale corridor, and allowed UDOT signal engineers to view current weather and road weather conditions in the corridor before implementing signal plans. UDOT also installed additional advanced traffic sensors to provide detection at critical locations in the corridor. Because the sensors monitor individual vehicles as they approach the intersection, they are able to provide increased dilemma zone protection as well as increase intersection efficiency. Also as part of this effort, UDOT developed and deployed a Signal Performance Metrics System. The system uses high-resolution detector and controller timing data to automatically generate performance metrics that operators at the Traffic Signal Operations Desk can use to assess, both in real-time and post-event,

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the effectiveness of different traffic signal timing plans, and to identify necessary changes or future events. Through a web interface, operators are able to access the following tools and data to assist them in making their evaluations:

- *Purdue Coordination Diagrams*
- *Approach Volumes Profiles*
- *Corridor Travel Speeds*

### WEATHER RESPONSIVE SIGNAL TIMING

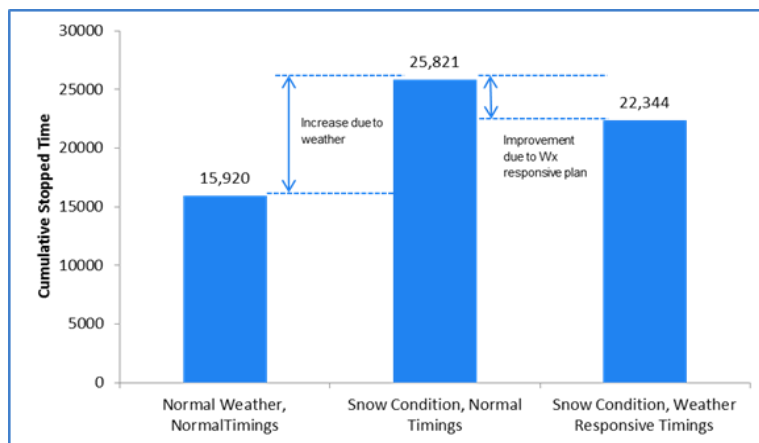
UDOT created three special traffic signal timing plans that were implemented during significant weather events:

(1) using no recalls, (2) using minimum recalls on all phases, and (3) using maximum recalls on all phases. The timing plans were patterned after the time-of-day (TOD) plans, deployed in UDOT's Traffic Signal Management System as special timing plans, and downloaded to each of the 11 signalized intersections in the corridor. The timing plans were deployed only when weather events were expected to have a significant impact on traffic operations for an extended period or duration.

### EVALUATION RESULTS

Operator assessments, field performance measures, and modeling were all used to examine the impacts of deploying weather responsive traffic signal timing plans on the corridor. The analysis showed that UDOT was able to better manage traffic signal operations on the Riverdale corridor during inclement weather. Weather responsive timing plans were deployed a total of 13 times during different winter weather events in early 2013. A particular event was one of the worst winter storms experienced in the Salt Lake City/Ogden area in the past decade. In over half of these events, including this major storm, operators assessment indicated either an average or above average improvement in traffic operations as a result of the weather responsive timing plans. In the majority of those cases where the timing plans were not judged to be effective, the weather conditions were judged not to have a significant impact on travel speeds in the corridor. The analyses also showed that UDOT was able to maintain a high level of progression on the corridor by implementing weather responsive traffic signal timings. The high resolution signal performance metrics system showed that the arrivals on green and platoon ratios are at least the same (or higher) with weather responsive timing plans as they were during normal, time-of-day conditions. A performance evaluation using dynamic simulation model, the Traffic Estimation and Prediction System (TrEPS), was also used to compare the effectiveness of the traffic signal timing plans during weather events. The model was able to

generate and compare a variety of performance measures for the corridor including travel times, delays, stopped times and reliability. Like the field performance measures, the results showed that UDOT was able to improve the performance of the system during weather events by implementing the weather-responsive signal timing plans. For example, as shown in the chart below, the weather responsive signal timing plans reduced total stop time by 11 percent compared to using normal, time-of-day timing plans during inclement weather.



**Cumulative Stopped Times Under Different Weather and Traffic Signal Timing Plans for the Riverdale Road**

### NEXT STEPS

UDOT expects to continue utilizing the system to fine-tune their signal operations on the Riverdale corridor during weather events and expand its use to other corridors where sufficient technology exists. Updates to the weather responsive signal timing plans are also to be developed to correspond to the time-of-day plans. The TrEPS model will be implemented to support the evaluation and updates of the signal timing plans.

All photos unless otherwise attributed are courtesy of the Federal Highway Administration Road Weather Management Program.

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