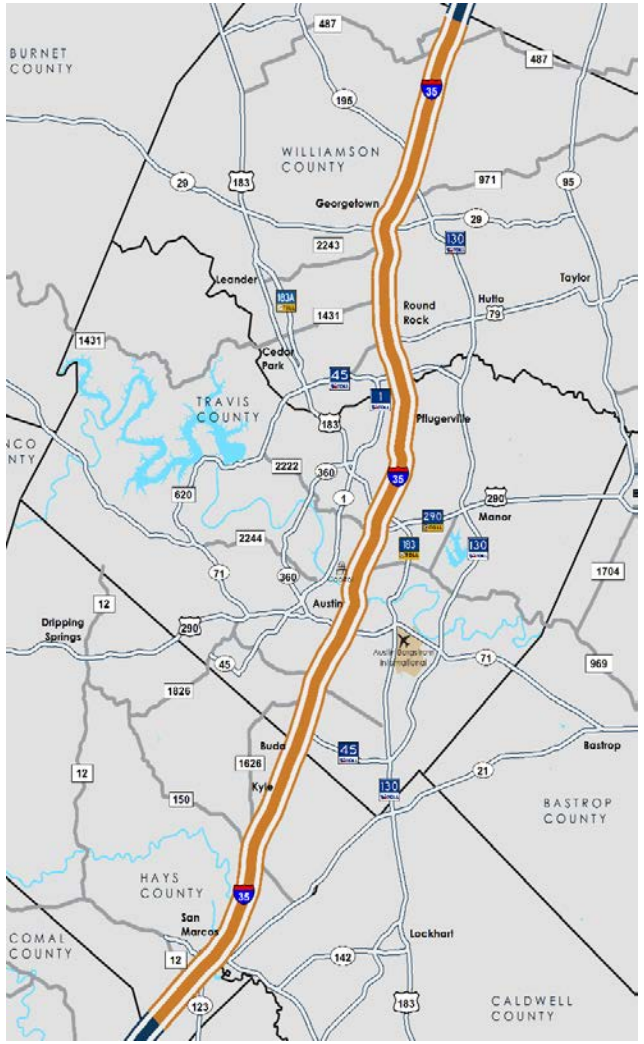
THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

Combining Sensor and Probe-Based Data to Quantify the Impacts of Freeway Lane Closures:

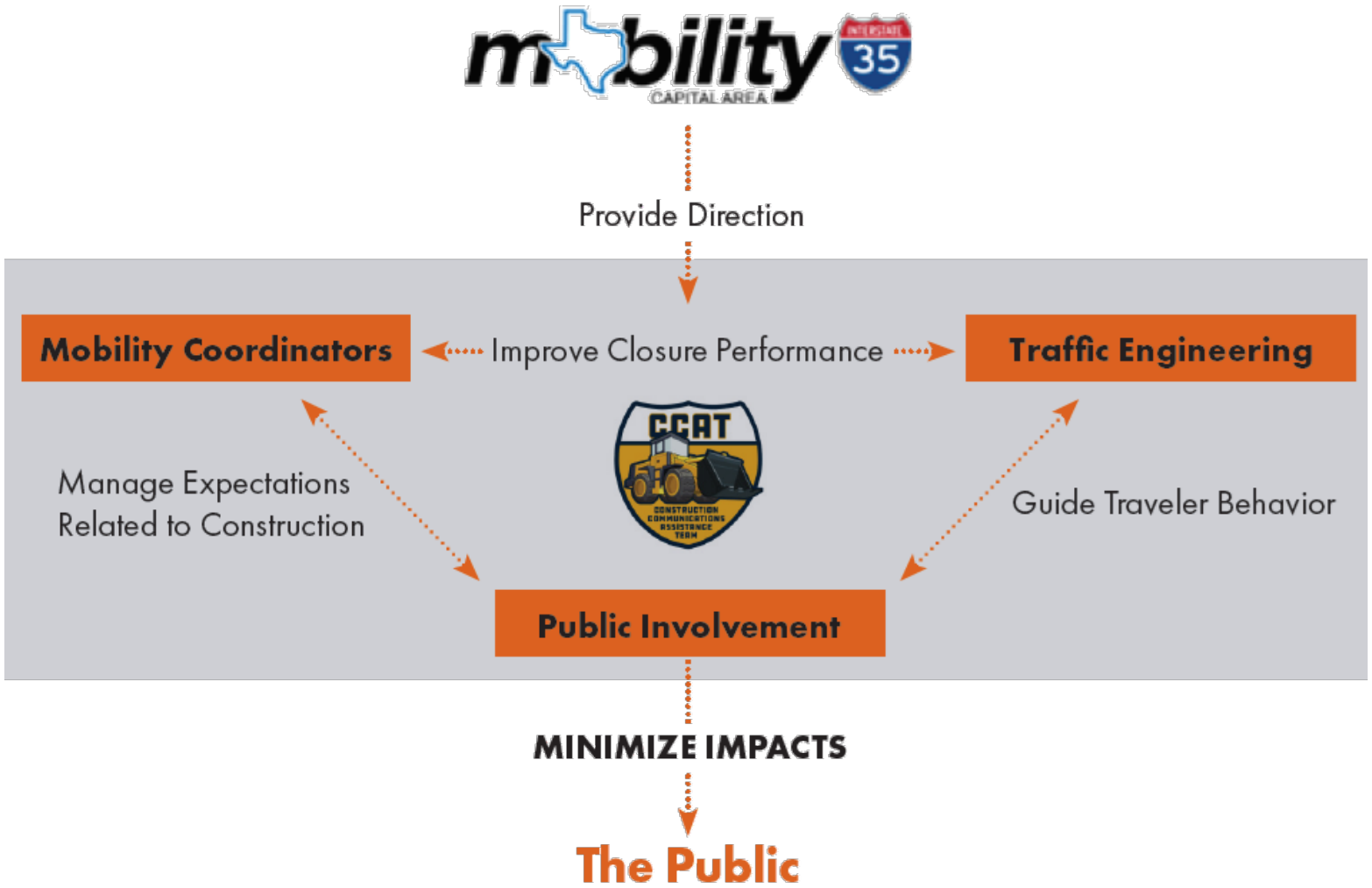
A Practical Application in Texas

Mobility35 Program



- A region-wide effort to improve safety and mobility on 79 miles of I-35 which includes **five** of the top 100 most congested roadways in Texas
- 10 to 15 year program
- **$11 Billion** total program cost
- Over 30 construction projects proposed as part of the region's on-going transportation system upgrade
  - 6 completed project
  - 7 projects under construction
  - 5 projects to begin construction soon
- Estimating over 12,000 lane closures for the program
  - 1,898 lane closures to date

Mobility35 Construction Communications Assistance Team (CCAT)



LANE CLOSURE GOALS

- Provide contractor with the best times for lane closures to minimize impacts to the traveling public
- Limit delays during construction to 20 minutes or less
- Provide up-to-date closure information utilizing our dynamic message signs and social media
- Coordinate with partner agencies to enhance operations through signal timing adjustments
- No major incidents in the construction work zone and approaches

Ultimately we wanted this TSMO tool to help us quickly plan, evaluate, and execute our lane closures in the safest manner possible and with the least impact to the traveling public and contractor

Features and Benefits

- Data-driven decision support tool
- Flexibility to incorporate a variety of data sources
- Evaluate best times for lane closures using data analytics and volumes which we refer to as “windows of opportunity”
- Determine delay and travel time impacts
- Predict length of queueing
- Calculate volume of vehicles impacted by lane closure
- Estimate travel time impacts
- Develop an after-action lane closure scorecard
- Calculate societal cost of the lane closures to the region
- Justify and refine begin and end times for lane closures
- User friendly, time efficient, automated and accurate

User Interface: Traffic impact 2/18/19

Measuring lane closure impacts: User Delay Cost

Conceptual approach

- Measure travel time increase
- Measure number of impacted vehicles

Data requirements

- Speed and/or travel time
- Traffic volumes

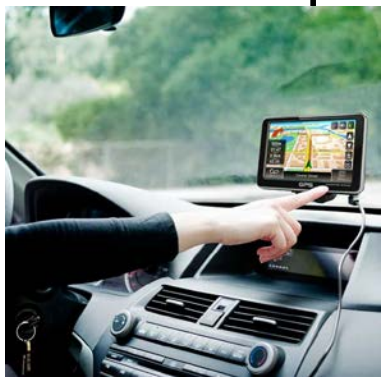
Limitation: not accounting for system-level impacts

- Congestion on detour routes
- Delays of users that divert away

Smart Work Zone Trailers

++ Precision

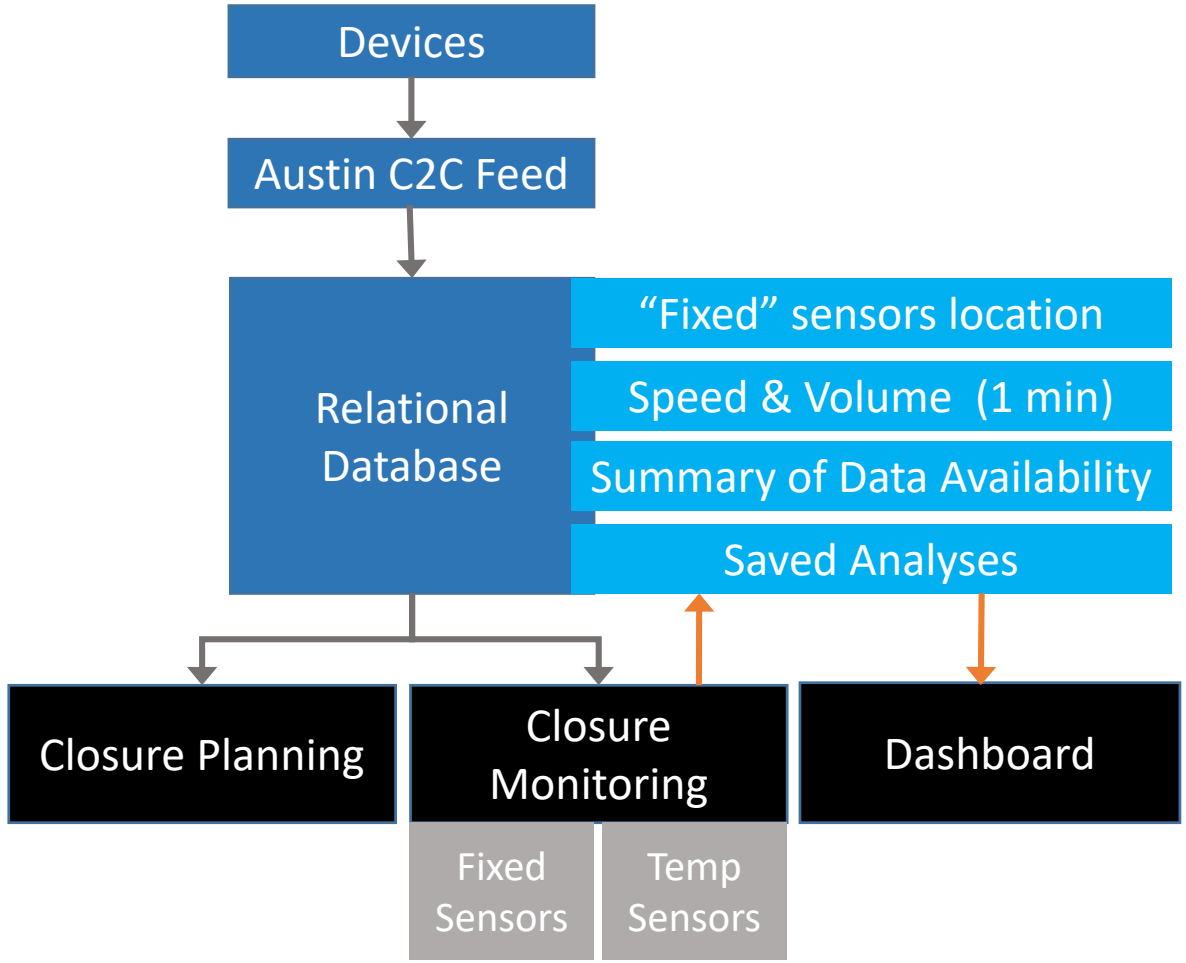
Probe Based Speeds



++ Coverage

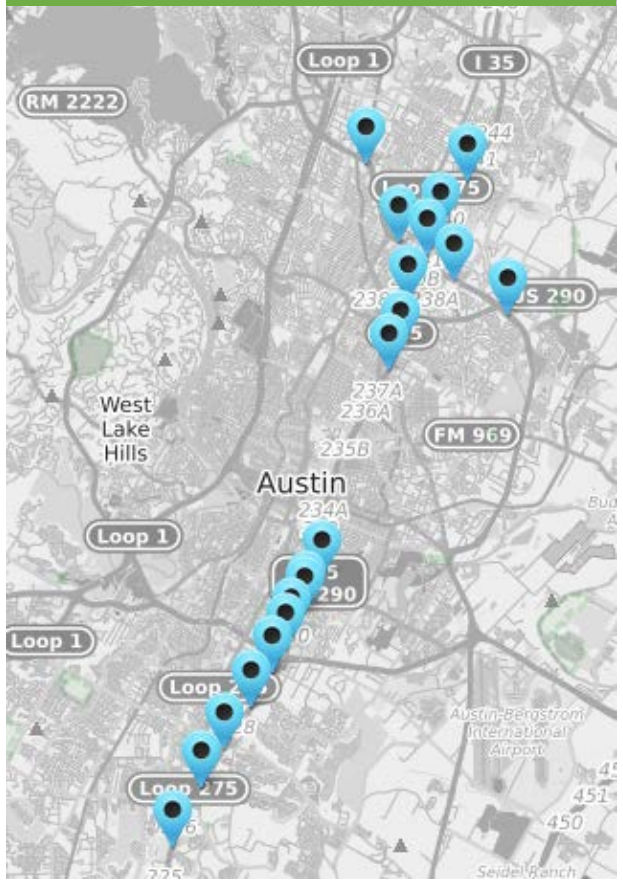
Data workflows for Smart Work Zone Trailers

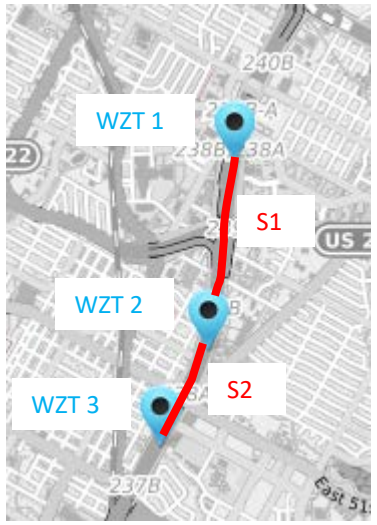
- Data from multiple providers streamed in real time through C2C feed.
- Data archival workflows are necessary to analyze historical data.
- Typical use of trailers:
  - Real-time monitoring
  - Manual processing of archived data for evaluation of specific events.



Sensor Location and Travel Time Estimation

"Fixed" sensors location





Work Zone Trailer

Freeway Segment Geometry

$$TTime(t)_{S1}^{NB} = \frac{Length_{S1}}{\frac{Speed(t)_{WZT1}^{NB} + Speed(t)_{WZT1}^{NB}}{2}}$$

$$TotalTT(t)^{NB} = TTime(t)_{S1}^{NB} + TTime(t)_{S2}^{NB}$$

$$Delay(t)^{NB} = TotalTT(t)^{NB} - TypicalTT(t)^{NB}$$

Case Study: Unplanned vs. Planned Closure

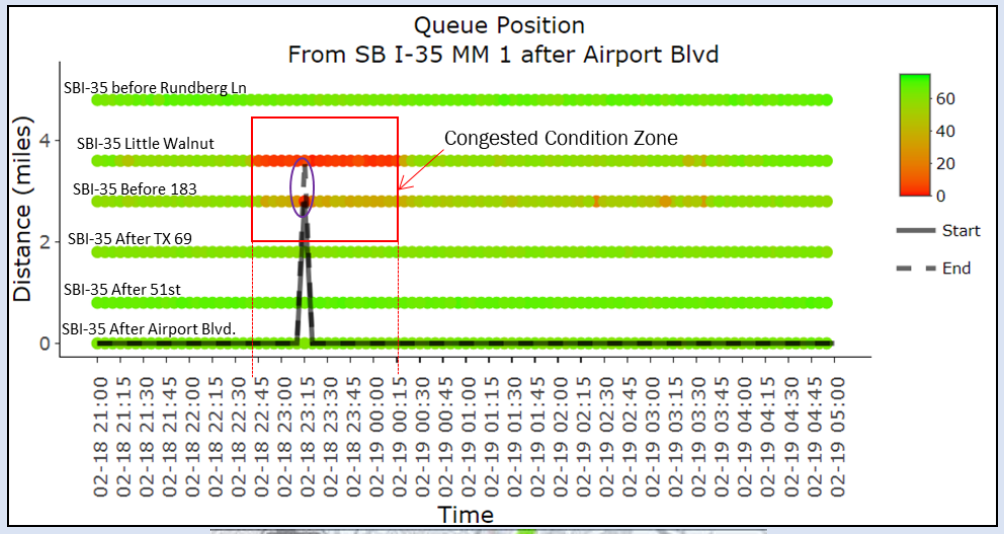
Unplanned Closure: Camera Looking South on I-35

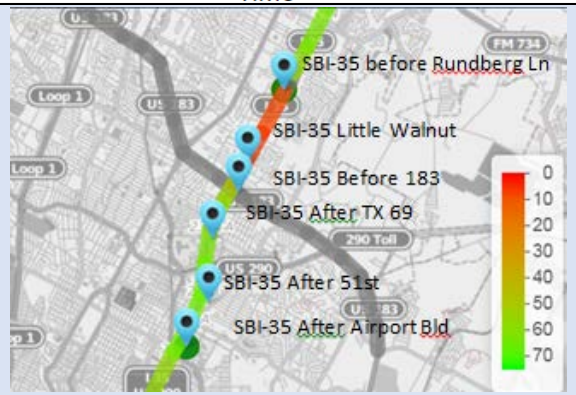
2/18/19	Southbound closure at 11 PM, traffic moved to one lane. No public information disseminated prior to the closure.
2/19/19	Southbound closure at 11 PM, traffic moved to one lane. **Public information provided.**

Analysis by Alberto Munguia, P.E.

Speeds & queues

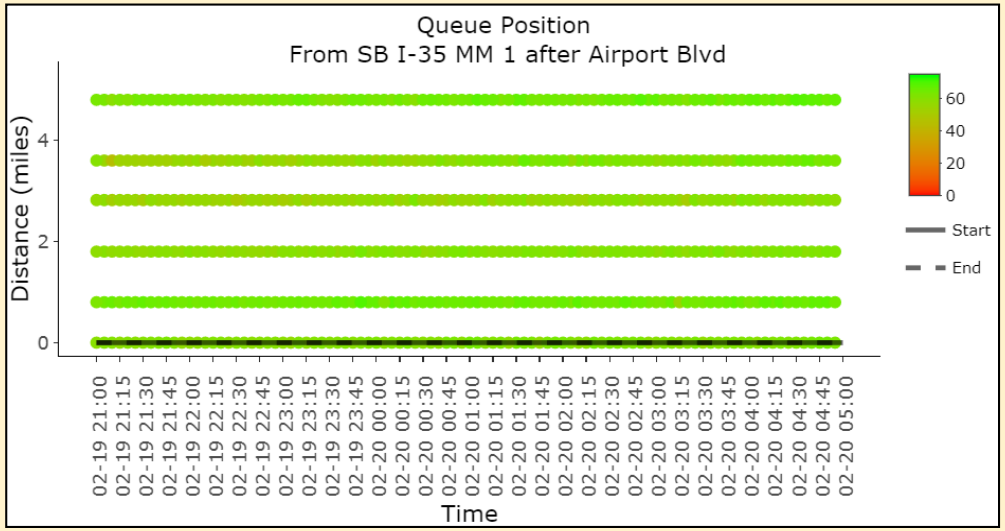
Unplanned





Probe-based speeds at 23:45

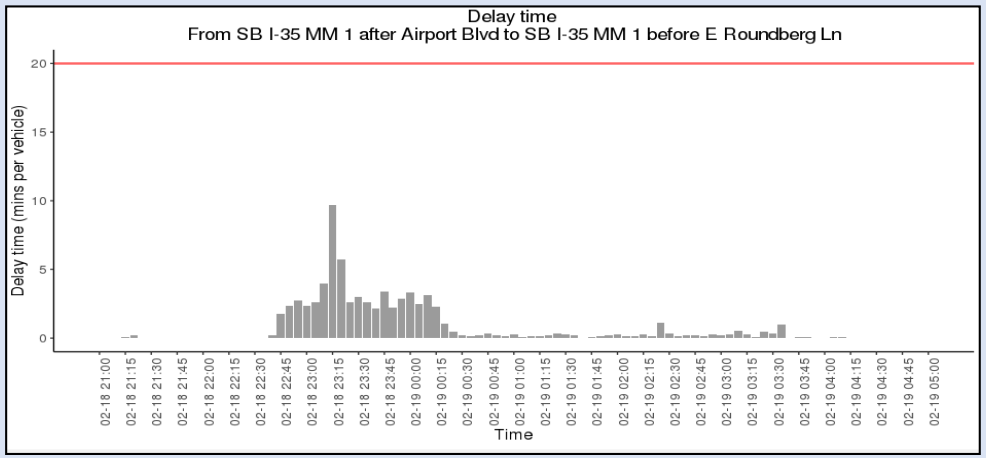
Planned

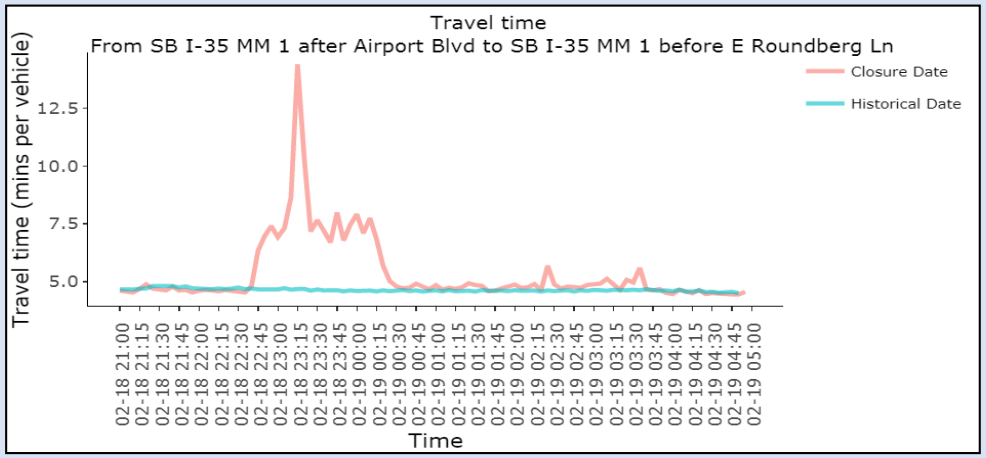


Probe-based speeds at 23:45

Delays & Travel Times

Unplanned





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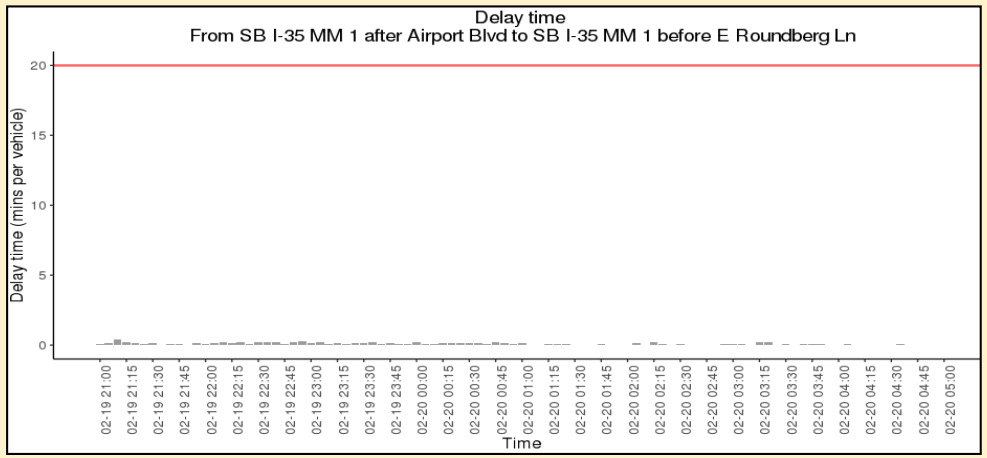

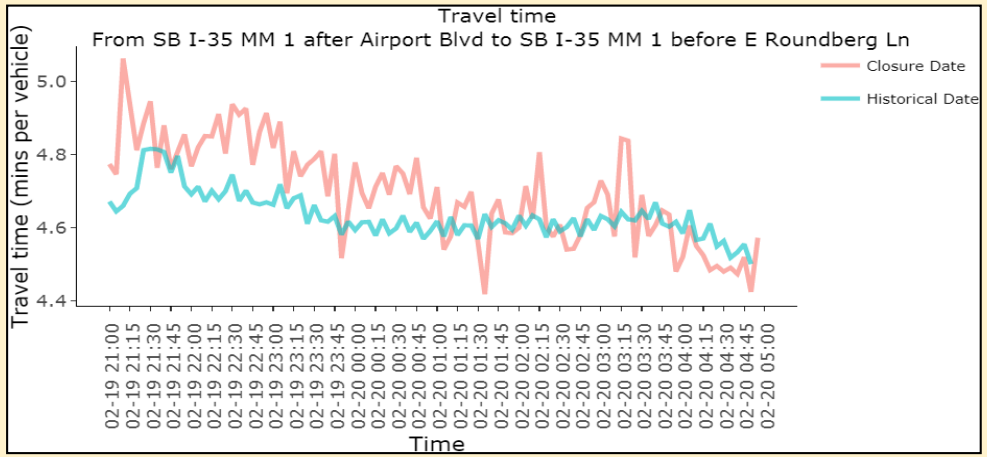

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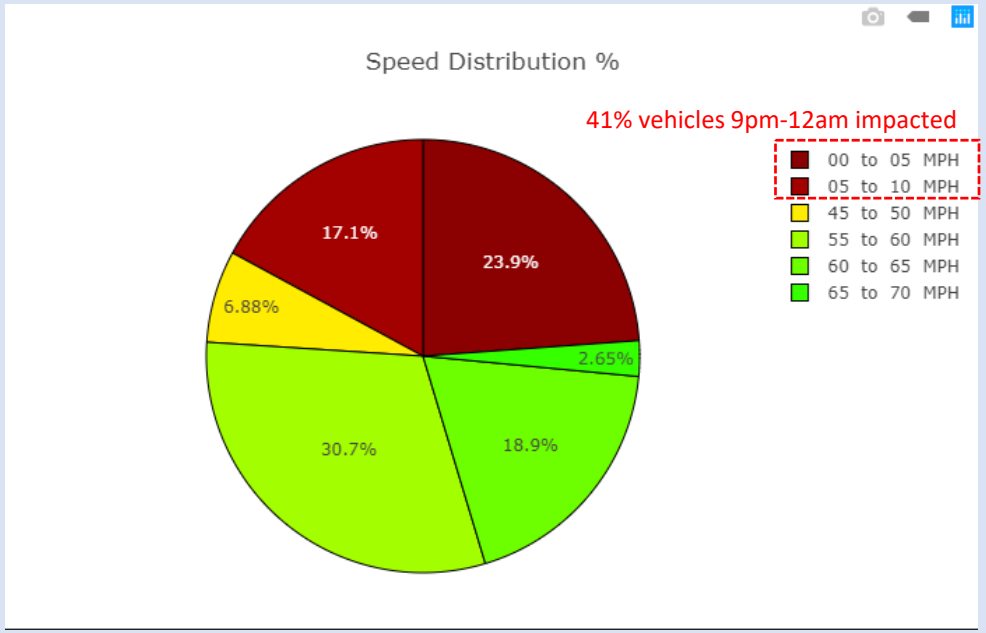
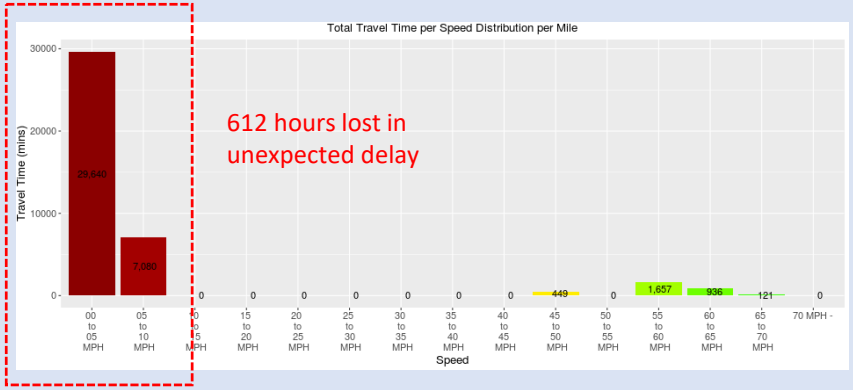
Impacted vehicles & user cost

Unplanned





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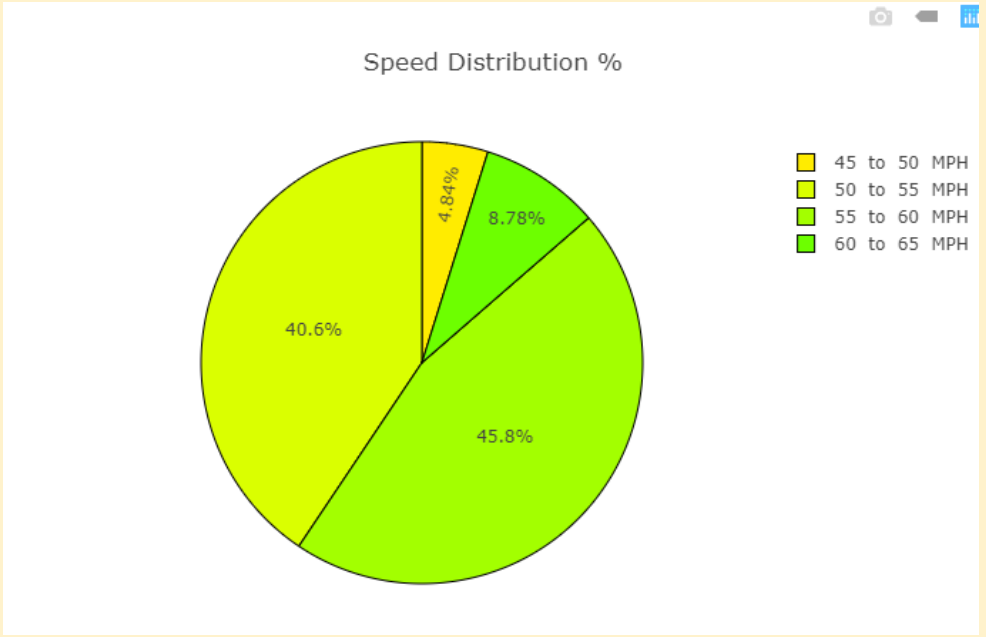

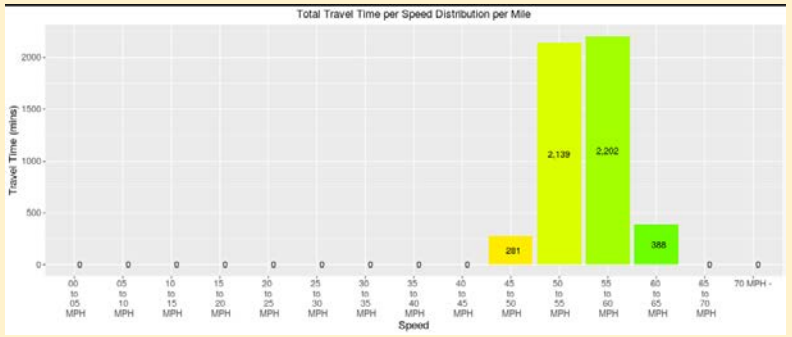

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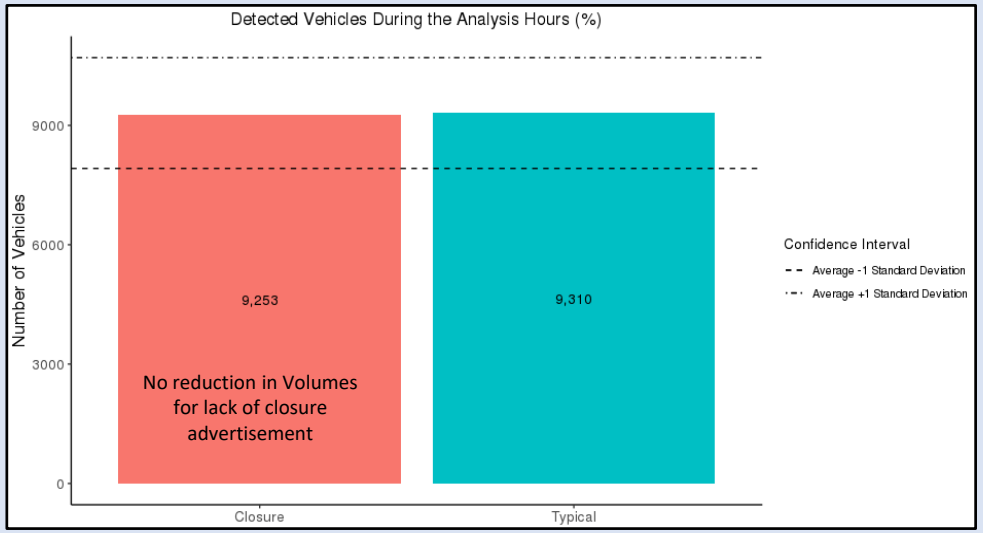
Changes in Travel Demand

Unplanned



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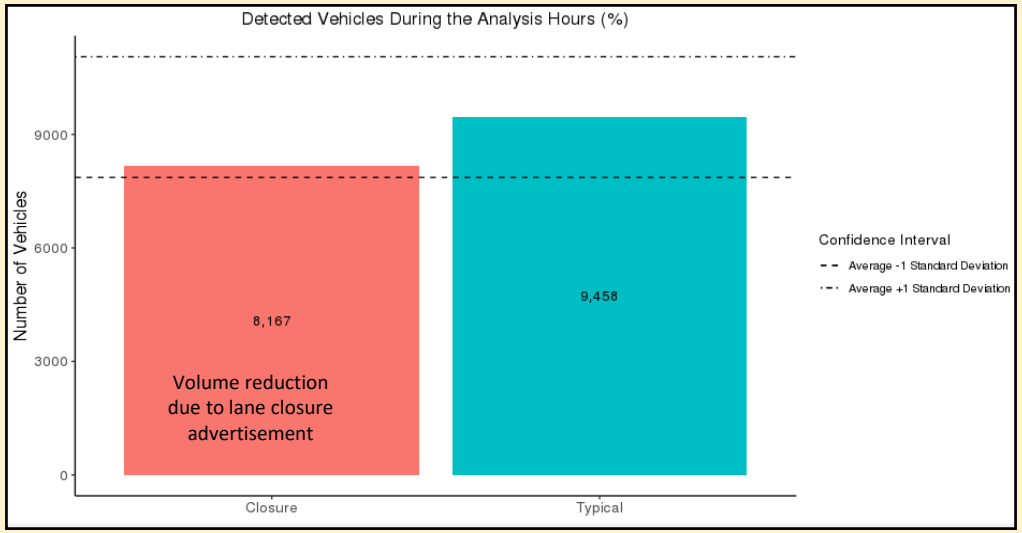


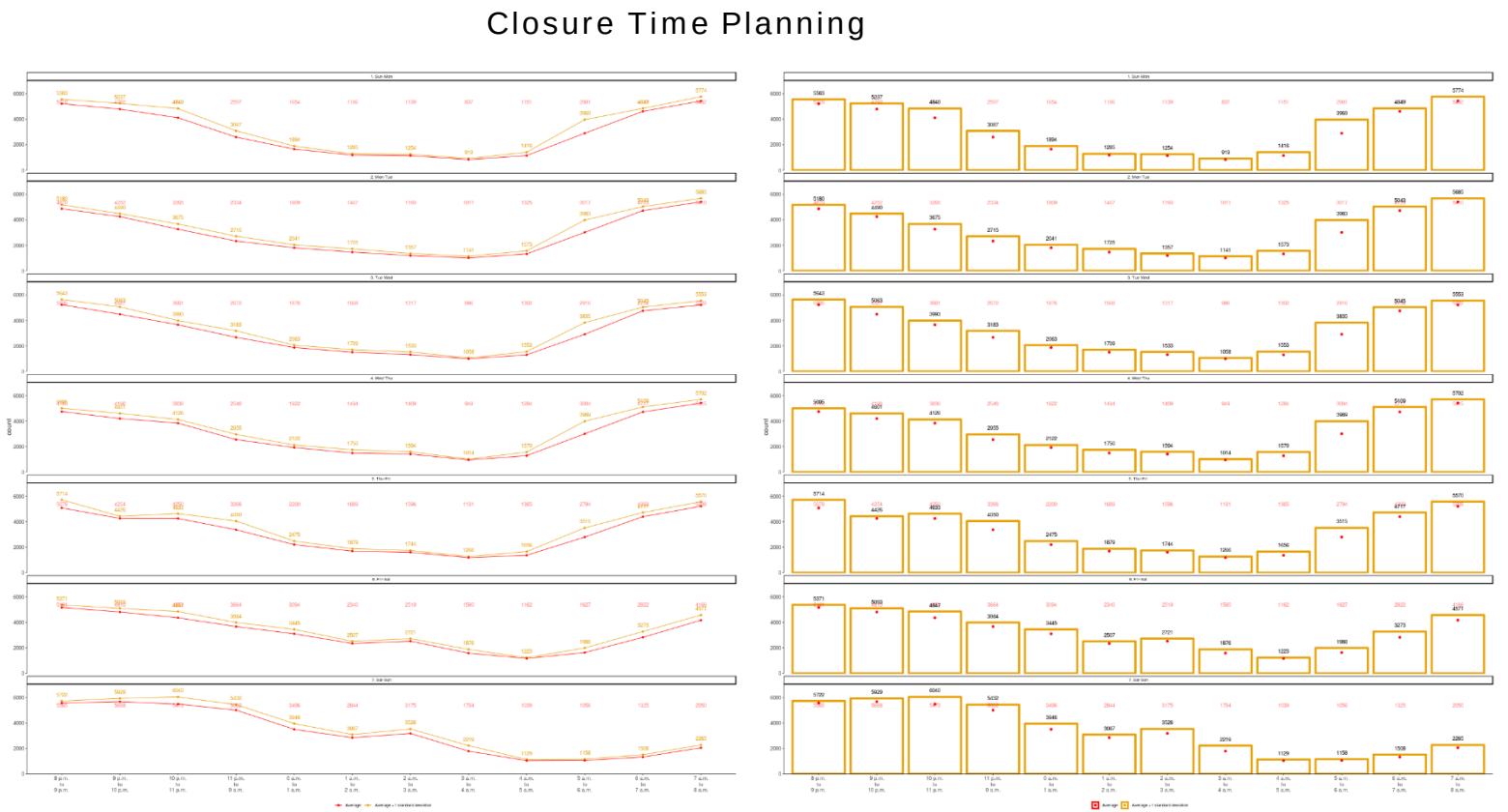
Web Application: Closure Time Planning

Interactive inputs:

- Analysis start & end time
- Time window size
- Sensor(s)
- Time range for “Typical” conditions (5+ months available)

Metrics by direction & day of week

- Average traffic volumes in time window by time window start time.
- Corresponding standard deviation within the selected time range



Successful Applications of the Lane User Cost Tool

- Example use of Tool: A 4-evening closure to reconstruct overpass
  - CCAT's actions:
    - Reduced the number of vehicles through the closure by 23% (a total reduction of 5,465 vehicles)
    - Saved a total savings of 4,351 vehicle-hours of traffic delay
    - Resulted in a societal savings of $136,506 in delay cost
- Used to evaluate more than 50 closure events
- Several major unplanned closures (incidents) captured by data analytics; queue length, travel delay, and societal cost calculated
- Have been able to identify optimal days, times, and scenarios for closures
- Increased efficiencies in closure planning, analysis, and reporting

Our Team - Thank you!

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