



# Intelligent Transportation Systems: Operational Views

CITY OF SUGAR LAND

# Presentation Focus

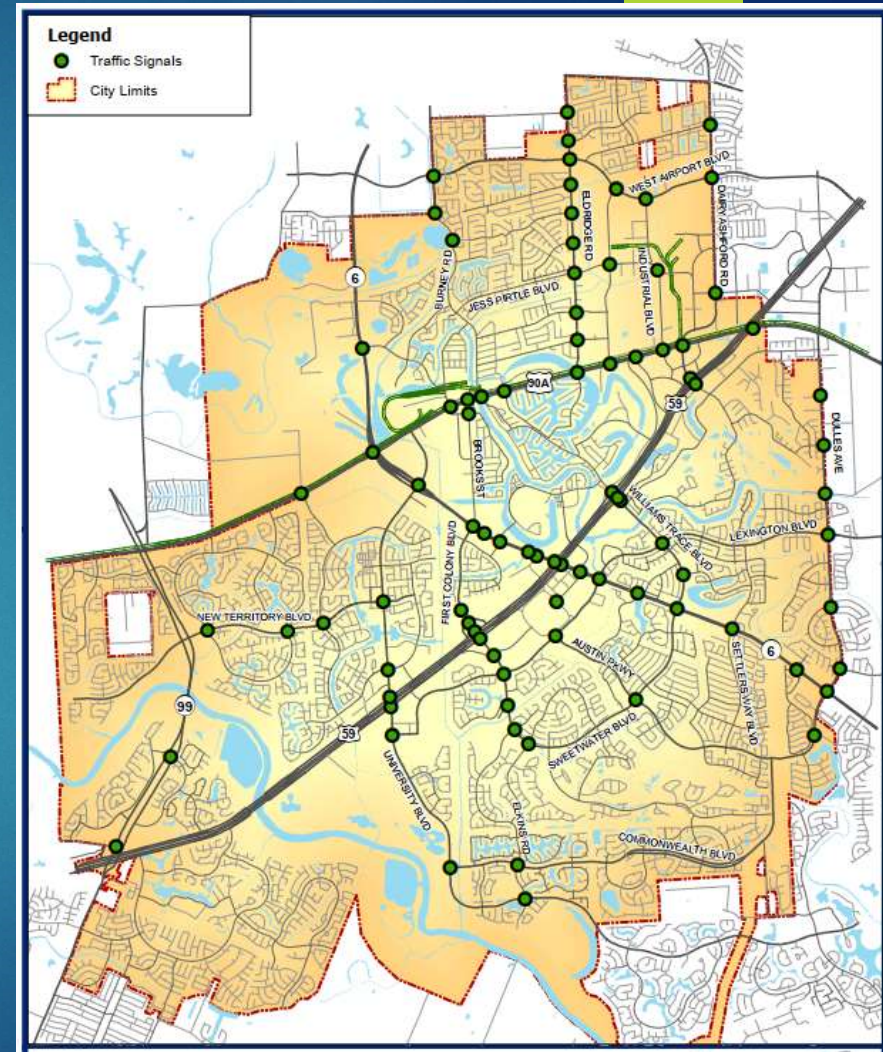
- City's ITS Infrastructure
- How it supports operations today?
- Challenges and Things to consider
- Future Improvements

ITS: 'set of technologies which aims to **provide innovative services** relating to traffic management. Enable users (and operators) **to be better informed** to enhance safety and make 'smarter' use of transport networks.'



# City of Sugar Land

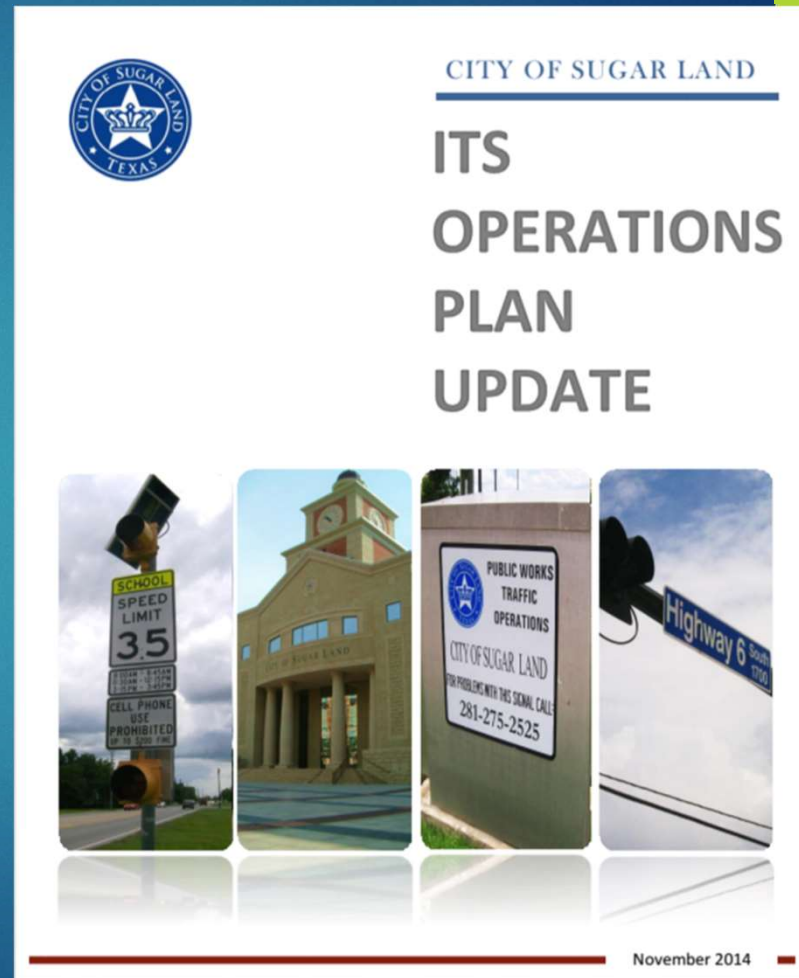
- Population approx.: 118,000
- I-69, SH 6, US 90a, SH 99 tollway
- Union Pacific RR Line: Dual Track
  - 32+ trains a day
- 92 Traffic Signals
- 15 staff: 5 signal techs, 4 signs techs, 2 engineers, 1 EIT, 2 TMC Operators, **1 ITS Manager (vacant)**
- Traffic Division Responsibilities:
  - Traffic Signal Operation & Maintenance
  - Sign Maintenance
  - Striping Contract
  - Roadway Lighting Contract
  - Engineering Studies
  - Development Review Committee
  - Capital Improvement Projects
  - ROW Permits





# ITS Master Plans

- TxDOT Signal Agreement: 2001
- City is service driven:
  - Continuous Investment to ITS
- Traffic Management Center:
  - First 2005
  - New 2016
- Master Plans:
  - 2008, 2011, 2014
- New ITS Master Plan: 2021



The image shows the cover of a report titled "ITS OPERATIONS PLAN UPDATE" for the City of Sugar Land. The cover features the City of Sugar Land logo in the top left corner. The title is prominently displayed in the upper right. Below the title, there are four small photographs: a traffic light with a speed limit sign, a clock tower building, a public works traffic operations sign, and a highway sign for Highway 6. The date "November 2014" is printed at the bottom right of the cover.

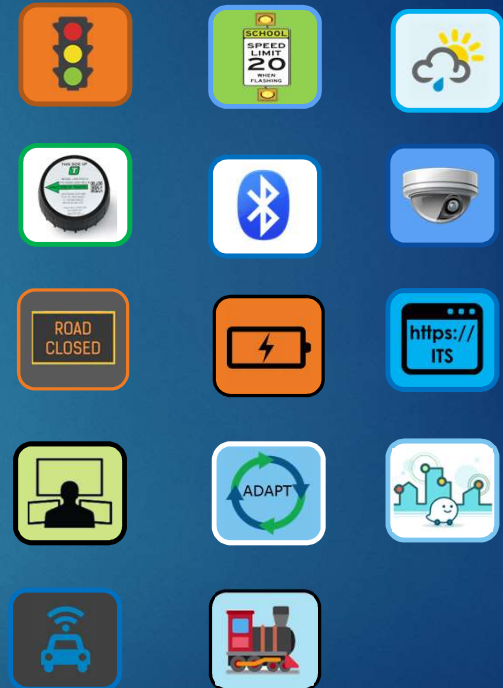
**CITY OF SUGAR LAND**

## ITS OPERATIONS PLAN UPDATE

November 2014

# City's Infrastructure

- Fiber and Wireless Communication Network
- Traffic Management Center (TMC) w/Operators
- Advanced Traffic Management System Software(ATMS)
- ATC Controllers
- Magnetometers (High Accuracy Counts)
- Adaptive Signal System
- Bluetooth Travel Time Readers
- Point Tilt Zoom Cameras
- Dynamic Message Signs (DMS)
- ITS Website ([its.sugarlandtx.gov](https://its.sugarlandtx.gov)) w/Waze Integration
- RR Monitoring System
- Connected vehicle module (Audi)
- Connected School Beacons
- \*Railroad Preemption System (RPS)
- \*Emergency GPS System



\* Ongoing Project

# Operational Views

- TMC:
  - Mon-Fri (6am – 7pm), Sat (11pm – 3pm), Events
- Targets:
  - Mobility Concerns (Cityworks)
  - Signal Performance
  - Safety
  - System Health
- Proactive:
  - Monitor system failures
  - Alerts to public
  - Goal Measures
  - Preventive Maintenance
  - Monitor Accident Data

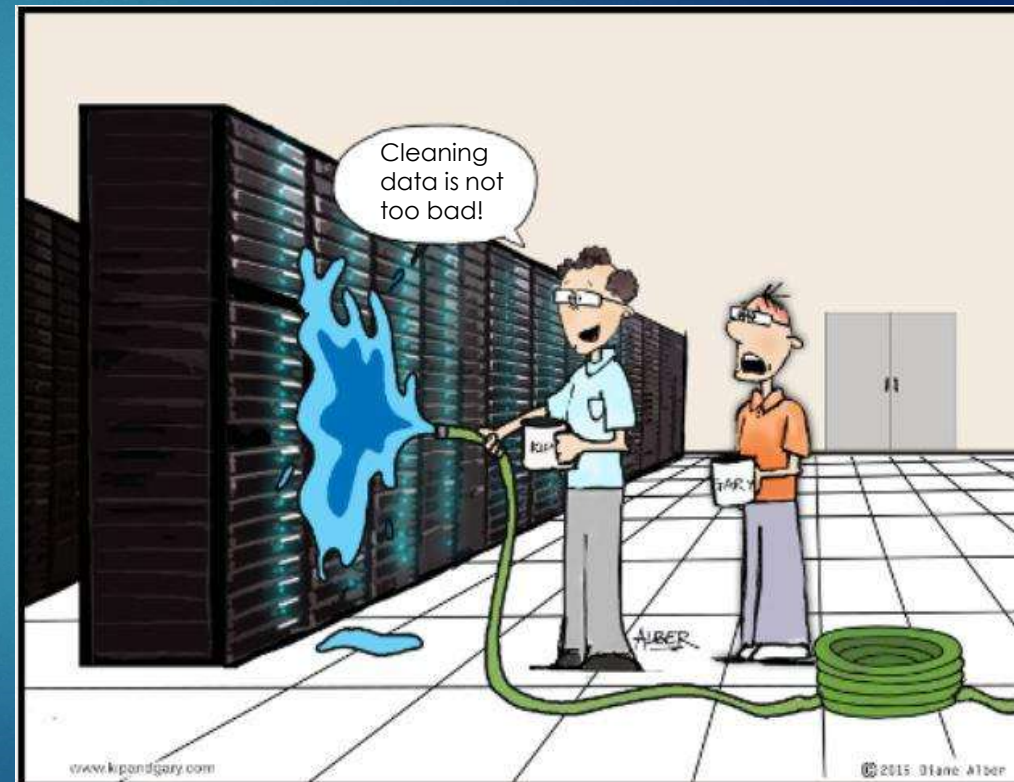






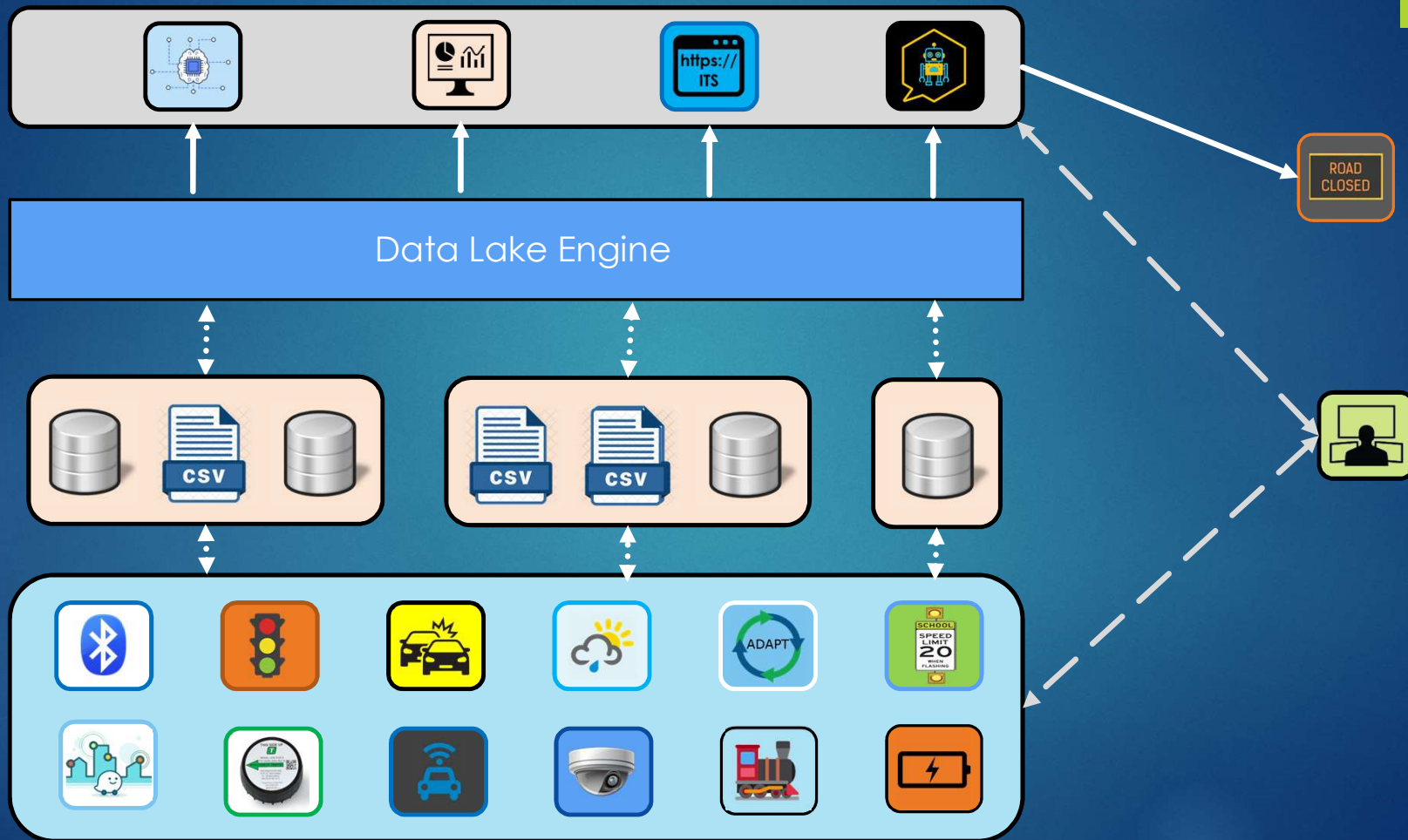
# In the Data Business

- All industries:
  - Justification
  - Data driven
  - Performance measures
- Data Capture
- Interoperability
  - How can we combine Data?
- Data Integrity
  - Will data stand test of time?
  - Accuracy?
- Tools:
  - Python (Build data pipelines)
  - Power BI
  - Sqlite DB





# Date Lake




# Volume Data Integrity

- ATMS maps volume reports by detector channels; modifications to this corrupts data
- Loss of Communication, loss of data
- Maintenance and performance
- Basestation:
  - \*Stores data locally (2+ months)
  - NTP Server (in testing)
  - Web Based GUI allows for data gathering via python
  - Naming of pods is key; sudo location reference, counter clockwise “NB\_1b#L”
  - Calculate accuracy with same lane pods




# Old Reports

- Very useful
  - Address concerns


Split History with Max(M),Gap(G), and Force-off(F)
Report Date: 8/28/2019

Controller: 151 UNIVERSITY @ ELKINS
Time: 08/28/2019 16:15:00 To 08/28/2019 23:59:59



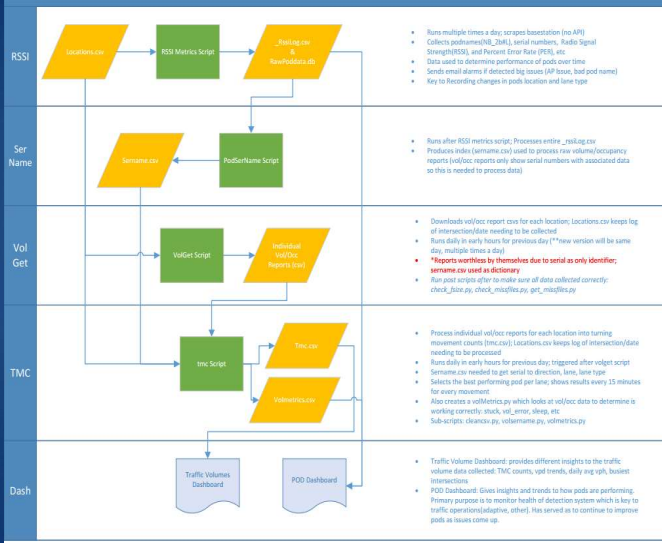
| Date/Time                         | Pattern | Cycle | SP1  | SP2  | SP3  | SP4  | SP5  | SP6  | SP7  | SP8  | SP9 | SP10 | SP11 | SP12 | SP13 | SP14 | SP15 | SP16 |
|-----------------------------------|---------|-------|------|------|------|------|------|------|------|------|-----|------|------|------|------|------|------|------|
| 08/28/2019 16:16:11 PM            | 254     | 42    | 18/G | 0    | 0    | 24/G | 0    | 18/G | 0    | 24/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:16:53 PM         | 254     | 91    | 16/G | 39/M | 0    | 36/M | 0    | 55/M | 0    | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:18:24 PM         | 254     | 110   | 22/G | 40/M | 0    | 48/M | 0    | 62/M | 12/G | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:20:14 PM         | 254     | 40    | 0    | 40/M | 0    | 0    | 11/G | 29   | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:20:54 PM            | 254     | 85    | 38/G | 0    | 0    | 47/G | 0    | 38/M | 11/G | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:22:19 PM            | 254     | 18    | 0    | 18/G | 0    | 0    | 13/G | 5    | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:22:37 PM            | 254     | 73    | 37/G | 0    | 0    | 36/M | 0    | 37/G | 0    | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2, P4 08/28/2019 16:23:50 PM     | 254     | 119   | 39/G | 40/M | 0    | 40/M | 0    | 79/M | 0    | 40/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:25:49 PM            | 254     | 86    | 31/G | 19/M | 0    | 36/M | 0    | 50/G | 0    | 36/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:27:15 PM         | 254     | 40    | 0    | 40/M | 0    | 0    | 21/G | 19   | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:27:55 PM            | 254     | 92    | 38/G | 0    | 18/G | 36/M | 0    | 38/M | 11/G | 43/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:29:27 PM         | 254     | 40    | 0    | 40/M | 0    | 0    | 17/G | 23   | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:30:07 PM            | 254     | 82    | 46/M | 0    | 0    | 36/M | 0    | 46/M | 0    | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2 08/28/2019 16:31:29 PM         | 254     | 39    | 0    | 39/M | 0    | 0    | 16/G | 23   | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:32:08 PM            | 254     | 78    | 42/G | 0    | 0    | 36/M | 0    | 42/G | 0    | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:33:26 PM            | 254     | 19    | 0    | 19/M | 0    | 0    | 13/G | 6    | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:33:45 PM            | 254     | 73    | 37/G | 0    | 0    | 36/M | 0    | 37/G | 0    | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:34:58 PM            | 254     | 87    | 29/G | 17/G | 0    | 41/M | 0    | 46/M | 12/G | 29/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| P2, P4, P4 08/28/2019 16:36:25 PM | 254     | 142   | 0    | 43/M | 0    | 99/G | 0    | 43/G | 25/G | 74/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:38:47 PM            | 254     | 101   | 41/G | 12/G | 0    | 48/M | 0    | 53/M | 12/G | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:40:28 PM            | 254     | 93    | 34/G | 16/G | 0    | 43/G | 0    | 50/M | 15/G | 28/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:42:01 PM            | 254     | 15    | 0    | 15/G | 0    | 0    | 15/G | 0    | 0    | 0    | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:42:16 PM            | 254     | 57    | 22/G | 0    | 0    | 35/G | 0    | 22/G | 0    | 35/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:43:13 PM            | 254     | 81    | 30/G | 0    | 0    | 51/G | 14/G | 16/G | 15/G | 36/M | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| 08/28/2019 16:44:34 PM            | 254     | 83    | 19/G | 12/G | 12/G | 40/G | 0    | 31/G | 0    | 52/G | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 0    |



# Data Visuals



## POD Data Collection Process

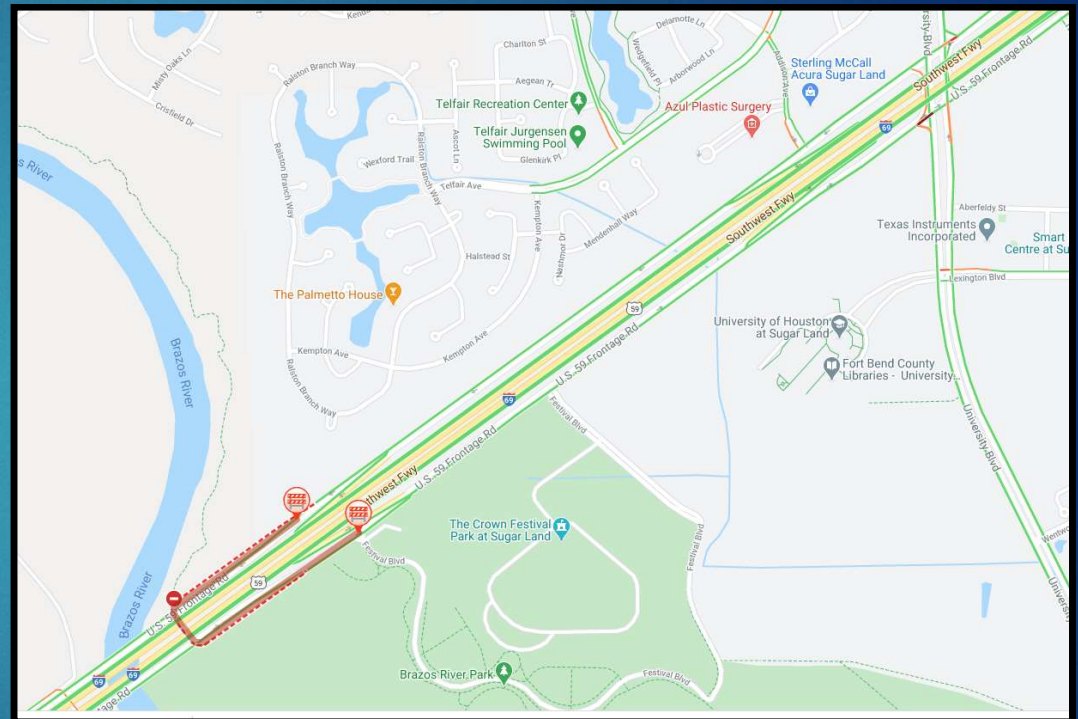


# SH 6 at Settlers Way



# Festival Site and Brazos U-Turn

- Brazos U-Turn Closed due to flooding
- Main Entrance to Festival Site
- Re-route to SH 99 U-turn
  - additional 3 miles
- Impact to 4<sup>th</sup> of July Event
  - Compare 2018 vs 2019
- No immediate plans to re-open
  - Looking at alternatives to re-route traffic

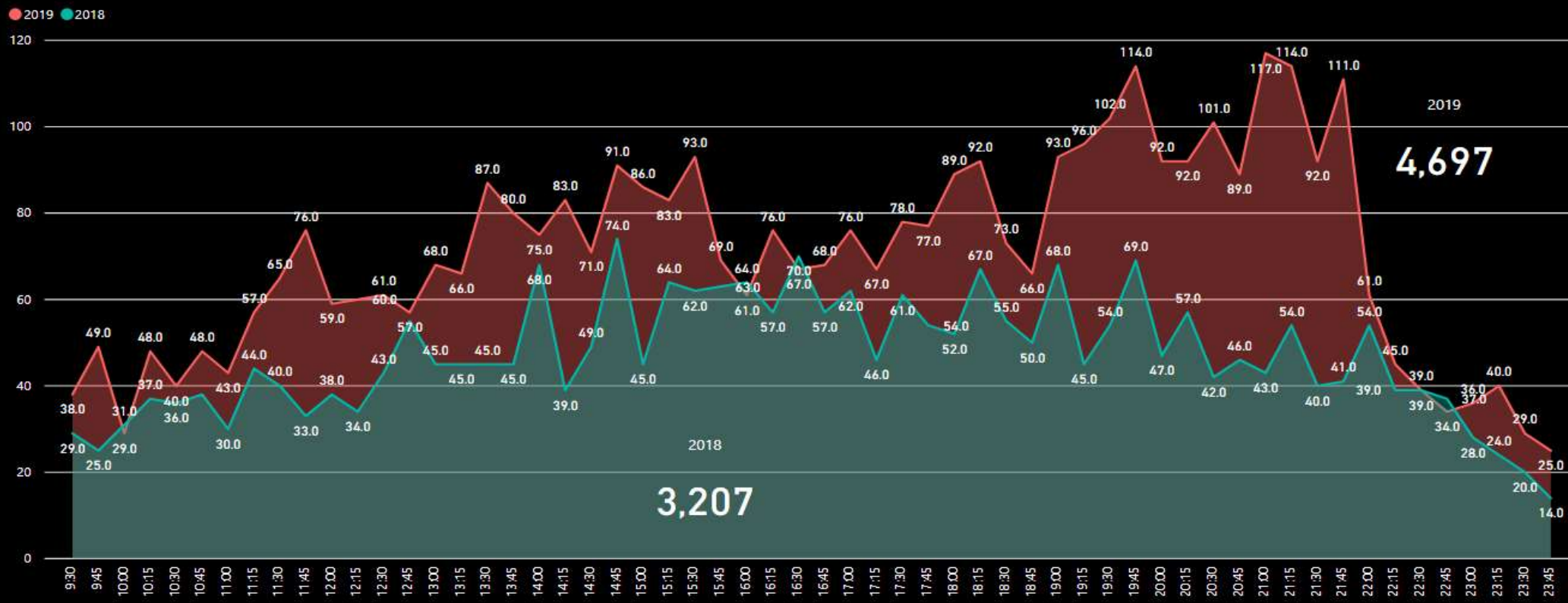




# I-69 at University Impacts

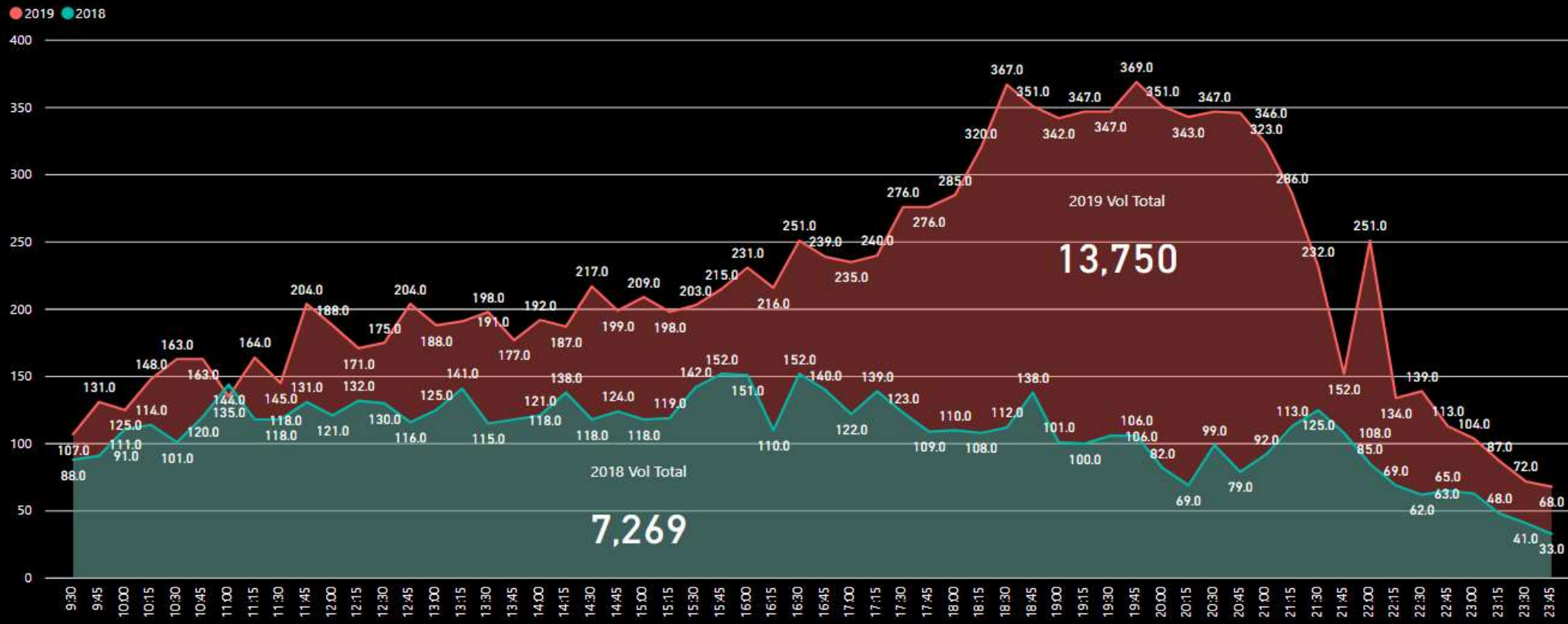


59/University Left Turn Volumes



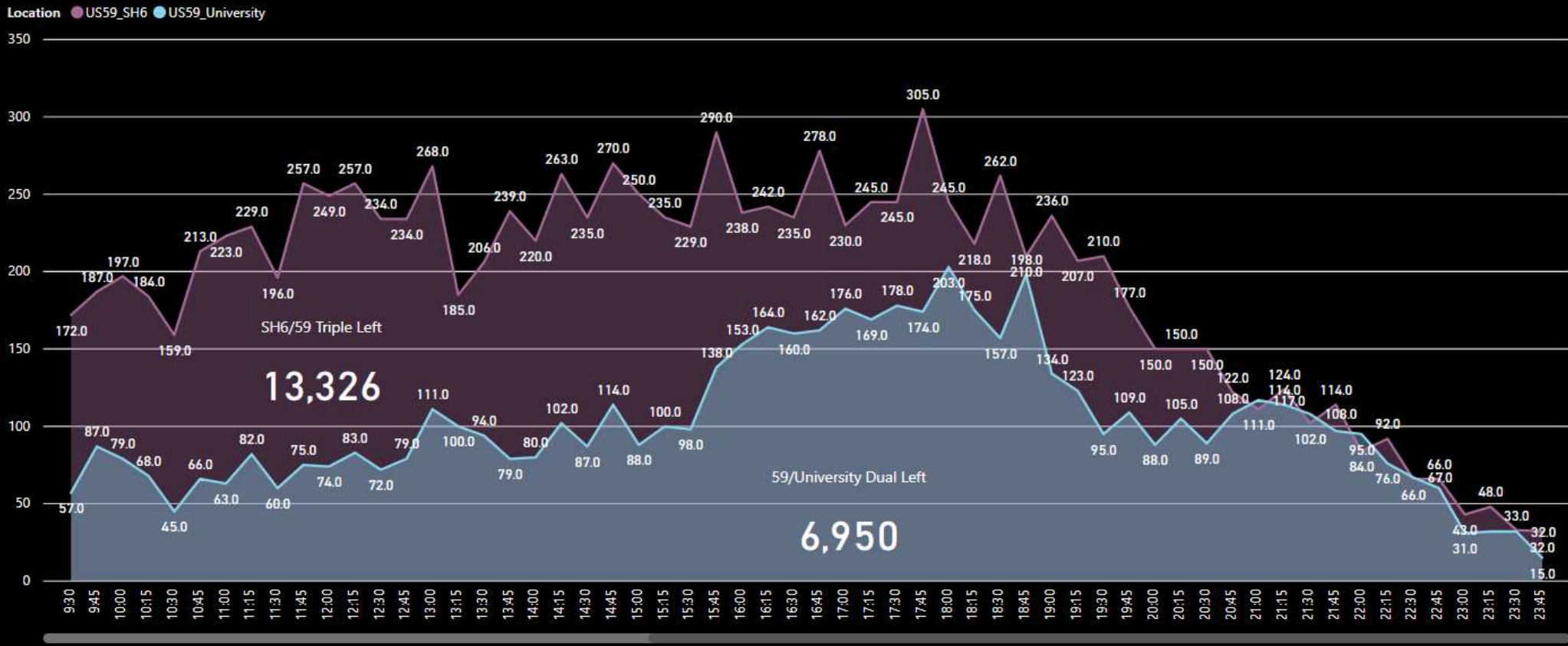
# I-69 U-turn at SH99 Impact

SH 99 at US 59 U-Turn



# I-69 at University Triple Left?

59/SH6 Triple Left vs 59/University Dual Left

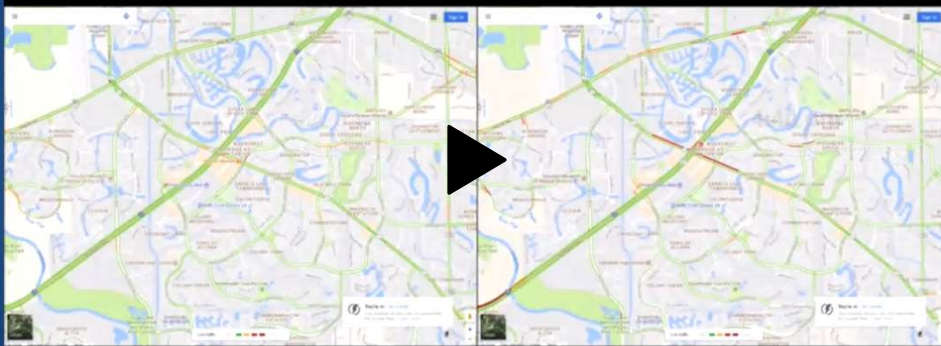




# Google Screen Shots

- Google maps
  - Compare or Evaluation Hot Spots
  - Stakeholders
  - Visually corroborating the measured improvements

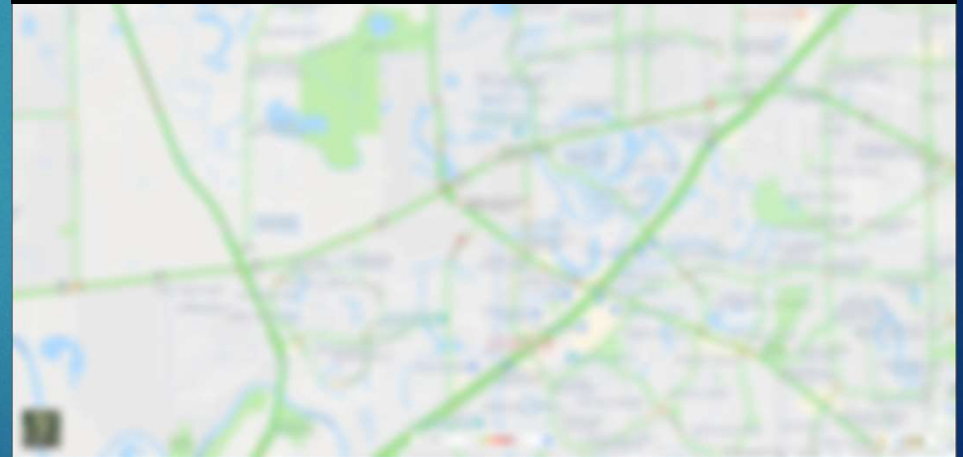
## Adaptive System Evaluation



Synchro On

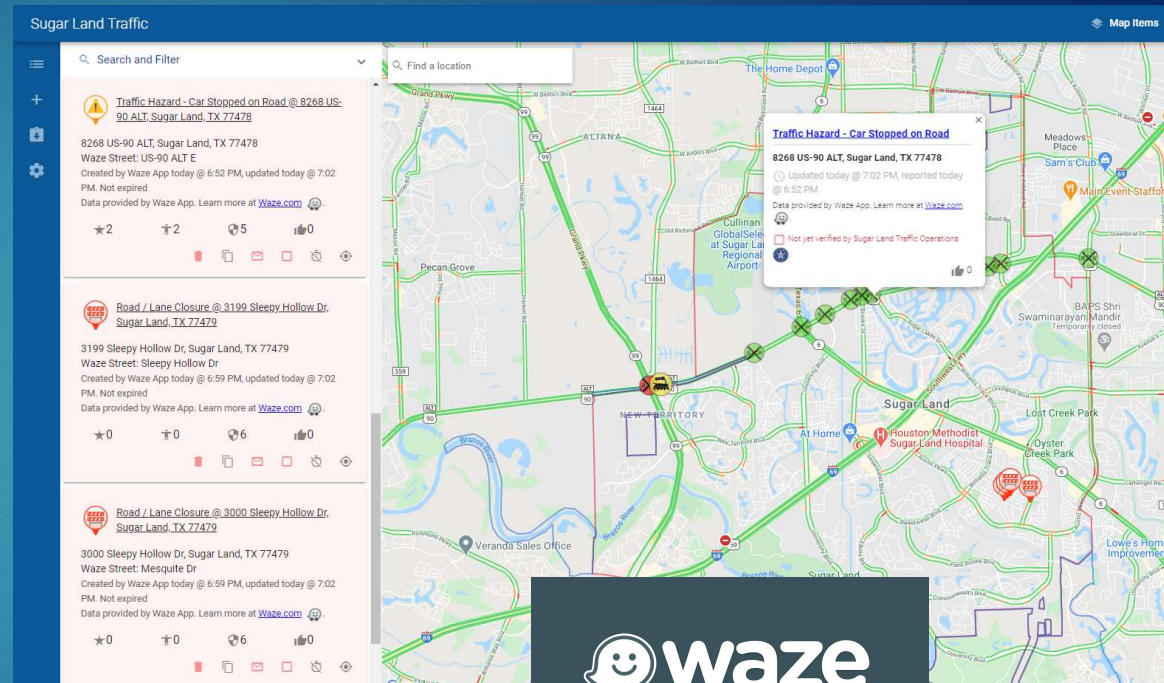
Synchro Off

## 4<sup>th</sup> of July Event (2019)



# ITS Website (its.sugarlandtx.gov)

- Share data with Wazers
  - Extra useful during weather events
  - Construction Projects
- Waze crowd source data
  - TMC receives accident alerts via email to address or report as necessary
- Future:
  - Automate posting on traffic signal out
  - Automate posting to social media for major events: construction, major closures, major accidents
  - Push notifications



# Improvements to Consider

- Data access
  - API or Direct access to database (not manual reports)
  - Is data free?
  - Data Integrity checks?
- Controller Logging for 30+ Days
  - Account for Network Issues; Protect Data
  - Automated upload of data after network restoration
- Remote Reset of Intersection
  - Reponses times and impacts
  - Checks on components before reset
  - Use PTZ from TMC
- [Accident Data Quick Insights](#)



# ITS Master Plan Exploration

Targeted approach to specific gaps or challenges.

- Improve on Communication Systems
- RR Monitoring Improvements
- **Data Warehouse**
- ITS Mobile App (CV project, feed more ITS data)
- Automated Traffic Signal Performance Measures (ATSPMs)
- RPS integration into Traffic Controller
- Hardware Upgrades (UPS Technology, PTZ, Cabinet Locks, Connected PDU, Comm. Switch Upgrades, etc)
- Improve detection for Bike lanes
- Smart Parking Technology
- **Machine Learning Possibilities**

# Conclusion: Perspective



How the customer explained it



How the project leader understood it



How the analyst designed it



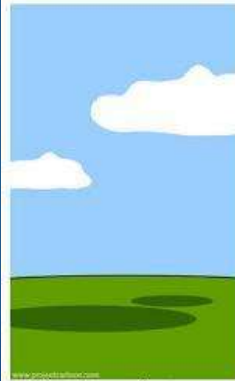
How the programmer wrote it



What the beta testers received



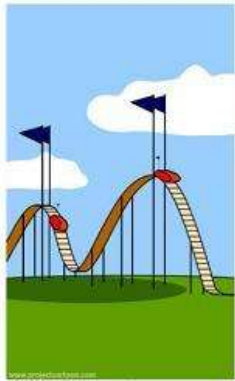
How the business consultant described it



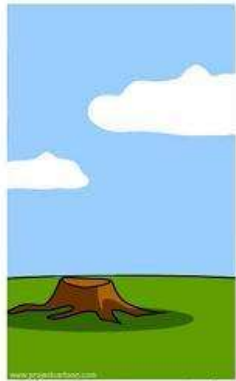
How the project was documented



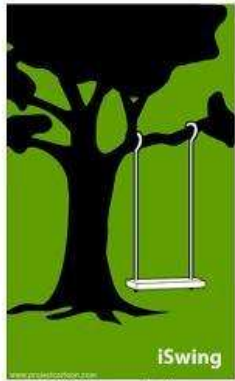
What operations installed



How the customer was billed



How it was supported



What marketing advertised



What the customer really needed