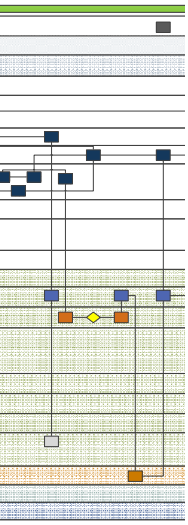
TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSMO)



YOAKUM DISTRICT ITS MASTER PLAN

OCTOBER 2021

Texas Department of Transportation

Document Control

Version	Date	Description of Change	Author
0.1	06/12/2020	Initial draft for Yoakum District Operations staff review	DKS Associates team
0.2	07/02/2020	Revised draft with initial comment incorporation based on 07/02/2020 review meeting	DKS Associates team
0.3	07/21/2020	Draft for review by broad cross-section of Yoakum District departments	DKS Associates team
1.0	09/25/2020	Final document	DKS Associates team

Disclaimer: ITS Master Plan represents recommended improvements. ITS will be deployed as funding is secured, project prioritization may change without notice.

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List of Acronyms

Acronym	Definition
AC	Alternating Current
ADA	Americans with Disabilities Act
ATMS	Advanced Traffic Management Systems
CCTV	Closed-Circuit Television
CRIS	Crash Records Information System
DE	District Engineer
DMS	Dynamic Message Sign
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTE	Full Time Equivalent (referring to full-time staff position)
FY	Fiscal Year
GIS	Geographic Information System
GPS	Global Positioning System
HSIP	Highway Safety Improvement Program
ITS	Intelligent Transportation Systems
O&M	Operations and Maintenance
PCMS	Portable Changeable Message Sign
PIO	Public Involvement Office
PTZ	Pan-Tilt-Zoom
TIM	Traffic Incident Management
TMA	Truck-Mounted Attenuator
TMC	Transportation Management Center
TMS	Traffic Management System
TP&D	Transportation Planning & Development
TRF	Traffic Division (Central Office)
TSMO	Transportation Systems Management & Operations
TTI	Texas A&M Transportation Institute
TxDOT	Texas Department of Transportation
UT	University of Texas
VIVDS	Video Imaging Vehicle Detection System
YKM	Yoakum District

Executive Summary

The Yoakum District ITS Master Plan provides a roadmap to help identify opportunities to implement technology to meet the transportation needs in the district.

In conjunction with the district's Transportation Systems Management and Operations (TSMO) Program Plan, this ITS Master Plan helps prioritize and coordinate recommended technology projects to maximize the use of funding sources and provide the most benefit to travelers in the district.

It also identifies district workforce strategies to ensure that newly deployed technologies can be operated and maintained effectively.

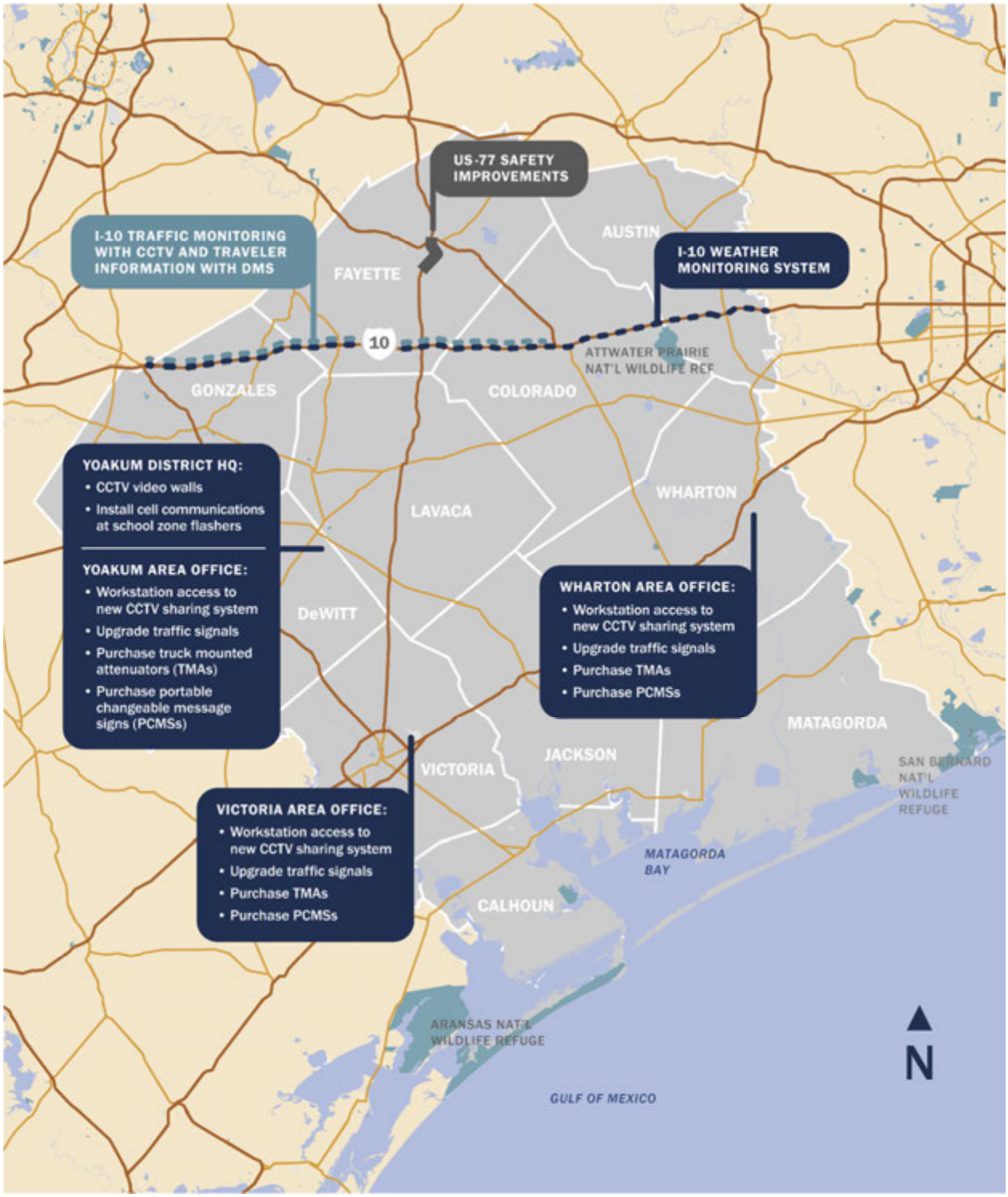
WHAT IS *ITS*?

Intelligent Transportation Systems (ITS) are the application of innovative technology to provide more efficient, safe, and convenient travel. They focus on enhancing the existing transportation system by providing improved traveler information, traffic management systems, incident response, and goods movement. They employ state of the art traffic management practices coordinated across multiple jurisdictions, agencies, and modes.

Proposed Early Action Projects

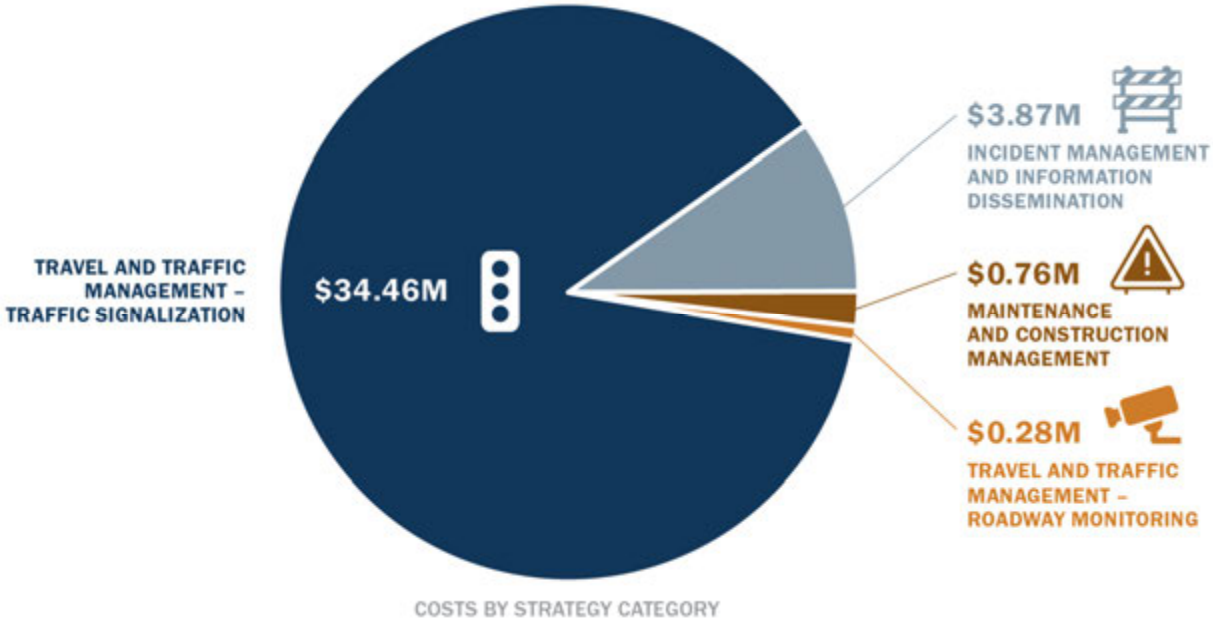
Project No.	Location	Description
Travel and Traffic Management		
4a		Signal upgrades: Replace outdated signals on major hurricane evacuation routes. Traffic Division (TRF) project will upgrade signal cabinets/controllers and install cellular modems in Fiscal Year 2021 (FY21) as a separate effort.
4c	Wharton Area Office (19 signals)	
Incident Management & Information Dissemination		
Maintenance and Construction Management		
9		Truck-Mounted Attenuators (TMAs): Purchase 12 TMAs (bringing the district total to 36) for use by TxDOT maintenance crews, so that each Maintenance Office has three TMAs and three on reserve at the District Office to enhance the safety of TxDOT personnel and the traveling public

ITS Deployment Plan Projects Map



Project Costs

Fully implemented, all the deployment projects come to a total planning level capital cost (2020 dollars) of $39,385,000 and an annual operations and maintenance cost of $590,500.



Operations and Maintenance Workforce Plan

To ensure adequate operations and maintenance (O&M) support for the recommended ITS projects in this plan, the following actions are recommended:

- Use professional services contracts to support a 0.5–1 full time equivalent (FTE) traffic engineer
- Develop a leadership transition and succession plan for District Traffic Engineer
- Pursue operations and maintenance staffing agreements with adjacent districts as recommended in the Yoakum District TSMO Program Plan

ITS Plan Content

This plan provides an overview of current and future transportation conditions, an assessment of user needs, a link to the current ITS architecture, and includes a prioritized ITS deployment plan.

Current & Future Transportation Conditions

This section provides an overview of transportation conditions in the study area. The information was used to facilitate discussions with district staff regarding current and expected challenges with potential to be addressed by ITS strategies.

Traffic Conditions Summary

Congestion in the Yoakum District is primarily non-recurring and a result of work zones and roadway incidents (e.g., crashes, vehicles blocking roadway). Due to relatively few detour options on most major corridors, delay resulting from such incidents can be significant.

Crash Summary

From 2010 to 2019, the Yoakum District experienced more than 65,000 traffic crashes on all public roadways (TxDOT, 2019). These crash events resulted in 959 fatalities and 3,580 suspected serious injuries. Some of the most common attributes of these crashes include the following:

The Yoakum District 2020 Safety Plan shows that approximately 82 percent of fatal and suspected serious injury crashes occur on the State system (TxDOT Yoakum District, 2020). The plan identified the following additional common contributing factors to fatal and suspected serious injury crashes:

- Fatigued / Asleep
- Unsafe Speed / Failed to Control Speed
- Under Influence – Alcohol
- Wrong Side – Not Passing
- Driver Inattention
- Faulty Evasive Action
- Failed to Yield Right of Way – Stop Sign

Traffic Signals

This section describes the traffic signal equipment used at the 144 signalized intersections in the Yoakum District. This section provides an overview of jurisdictional responsibilities, traffic signal operations, detection, communications, and maintenance.

Jurisdictional Responsibilities

The Yoakum District owns, operates, and maintains the traffic signals on all state highways within the district except for within the City of Victoria. The City of Victoria owns, operates, and maintains the traffic signals on state highways within the City limits.

Traffic Signal Operations

The district operates a total of 144 signals. There are 68 older signals that are operated by Naztec or Eagle controllers and have a diagonal span-wire design. Newer controllers run Trafficware traffic signal software with Trafficware firmware installed, but there is currently no central signal system control. The Traffic Division is working on a statewide project to support central control.

The district has Highway Safety Improvement (HSIP) funds to update 10 traffic signals in the near term. The Traffic Division is also currently investigating software solutions that could provide remote traffic signal control for those signals with cellular communications capabilities.

The district is currently working with the Traffic Division to upgrade approximately half of the traffic signal controllers and install cellular modems. The project is expected to let in Fiscal Year 2021.

Note that the Signal Shop is planned to be remodeled this year as part of a Yoakum District Office re-model project. Although the budget does not include a video wall, accommodations are being made to support a future video wall, including networking infrastructure upgrades and physical space improvements.

Detection

The primary detection technologies used to actuate traffic signals in the district are Video Imaging Vehicle Detection System (VIVDS) and radar. Radar is preferred as it works better during foggy conditions.

Communications

Communications to traffic signals are exclusively via cellular modems. Currently, seven out of the 144 total signals have cellular communications capabilities. These are located in Gonzales, La Grange, and Schulenburg. The Traffic Division provided the cellular modems for the traffic signals on US-183 and US-90A in Gonzales to support hurricane evacuations. The district is in the process of adding cellular modems at 30 additional locations. The district has experienced some connection intermittency issues in the past; however, this is expected to improve as new 5G cellular towers are constructed throughout the district. Most of the traffic signals in the Yoakum District are at isolated locations. Traffic signal coordination is provided in the few locations where traffic signals are located close enough for coordination to provide a benefit.

Maintenance

Preventative maintenance for all traffic signals is done on an annual schedule. Other maintenance activities tend to be reactive and depend on staff availability and the priority level of the issue. In addition to being

responsible for day-to-day repairs, maintenance staff are also tasked with maintaining illumination and upgrading equipment.

Current traffic signal maintenance calls are relatively time intensive. 85% of the current signal calls cannot be addressed remotely and require staff to go on-site. The library of maintenance documents has logs for each cabinet and paper-based work orders but there is no manual for repairs.

Traffic signal replacement programming is done by the district's Transportation Planning and Development (TP&D) section. They typically identify a batch of signal upgrades every four-to-five years. In the past, some traffic signal replacement work was completed by contractors.

School Zone Flashers

There are over 200 school zones in the Yoakum District, equipped with flashers. Counties are typically responsible for setting the flasher timers.

ITS Infrastructure - Current and Programmed

Existing ITS infrastructure in the Yoakum District is primarily located along I-10 and includes closed-circuit television (CCTV) cameras, dynamic message signs (DMSs), and traffic data stations.

Planned ITS infrastructure is also primarily along I-10 as well as on the under-construction I-69, and includes CCTV, DMS, and traffic data stations. It is anticipated that current and planned projects on I-10 will be completed within the next five years and I-69 within the next 15 years. Project status is available on TxDOT's Project Tracker website (TxDOT, 2020).

Table 1 provides a summary of the existing ITS elements deployed in the Yoakum District. Existing cameras, DMSs, and travel speeds are shown on the HoustonTranStar.org website along with other traveler information. The DriveTexas.org website links to HoustonTranstar.org when you click on the camera in the Houston area.

TABLE 1. SUMMARY OF EXISTING ITS ELEMENTS DEPLOYED IN THE YOAKUM DISTRICT

Element Type	Operating Agency	Purpose
CCTV Camera	Yoakum District, Houston TranStar	Remote roadway monitoring, typically for incident and weather event response
Dynamic Message Sign (DMS)		
Portable Changeable Message Sign (PCMS)	Yoakum District	Traveler information messaging at variable locations, typically to provide safety messages around roadway construction or maintenance activities
Traffic Sensor System Radar	Houston TranStar	

Element Type	Operating Agency	Purpose
Traffic Sensor System Bluetooth	Yoakum District, Houston TranStar	Segment travel time data collection
Overheight Vehicle Warning		
High water Indicator	Yoakum District	Detect rising water levels indicating flood risk and generate alerts

ITS Infrastructure

The following subsections summarize the existing and programmed ITS in the Yoakum District and their primary functions. Programmed ITS are typically being installed with several major construction projects: I-10 upgrades in the eastern part of the district, on US-59/Future I-69 in Victoria and on US 59-/Future I-69 in Wharton.

Traffic Management Center (TMC)

The Yoakum District does not have plans for a formal traffic management center, but it does plan to expand its access to and use of statewide systems to support traffic management. The district is able to view pan-tilt-zoom (PTZ) cameras, primarily to support major incident or weather event response, in Houston TranStar's system. The Traffic Safety Division is working on a statewide video sharing system that will enable all districts easier access to cameras. The Yoakum District is planning for several future video walls as part of a remodel currently taking place at the district office.

Closed-Circuit Television (CCTV) Cameras

A total of 23 closed-circuit television (CCTV) cameras are operated in the Yoakum District to support traffic monitoring and incident and event management. An additional 22 cameras are programmed as shown in Table 2. Cameras are PTZ capable; however, the district has view-only access, and cannot reposition the cameras. The district also has access to Lonestar, the cloud-based statewide advanced traffic management system (ATMS) application, which provides additional camera access options. The district is still determining how best to utilize this resource.

TABLE 2. CURRENT AND PROGRAMMED CCTV CAMERA INSTALLATIONS

CCTV Location	Current	Programmed
I-10	23	10
US-59/Future I-69 (Wharton)		10

Dynamic Message Signs (DMSs)

Dynamic message signs (DMSs) provide motorists with information about traffic congestion, traffic crashes, maintenance operations, adverse weather conditions, roadway conditions, public safety announcements or other highway features. A total of six DMSs are operated in the Yoakum District and nine are programmed as described in Table 3. The district is able to remotely access the DMS via Lonestar.

TABLE 3. CURRENT AND PROGRAMMED DMS INSTALLATIONS

DMS Location	Current	Programmed
I-10	4	4
US-77 (Victoria)	1	
US-59/Future I-69 (Wharton)		3
Total:	**6**	**9**

Traffic Sensor Systems

A variety of data can be collected from sensor systems. The Yoakum District uses radar vehicle sensing devices to capture volumes and spot speed data and uses Bluetooth systems to capture travel times. Current data feeds go to Houston TranStar. The district has six current and 19 programmed traffic sensor systems as shown in Table 4.

TABLE 4. CURRENT AND PROGRAMMED TRAFFIC SENSOR SYSTEMS

Traffic Sensor Location	Current	Programmed
I-10	4	9
US-59/Future I-69 (Victoria)	1	10
US-77 (Victoria)	1	
Total:	**6**	**19**

Overheight Vehicle Warning

Currently, there is a single overheight vehicle warning installation on SH 71 in Columbus. The installation includes a static warning sign and overhead flexible markers that when hit physically let drivers know their vehicle height is taller than the approaching bridge height.

TABLE 5. CURRENT AND PROGRAMMED OVERHEIGHT VEHICLE WARNING

Overheight Vehicle Warning	Current	Programmed
SH 71 Business (Columbus)	1	
Total:	**1**	**0**

High-Water Indicators

High-water indicators are strategically located at flood-prone locations to detect rising water levels indicating flood risk and provide automated alerts. High-water indicators are currently being installed on I-10 at the Brazos River as shown in Table 6. The indicators will trigger alerts so that staff can mobilize a response plan and post traveler alerts to DMSs.

TABLE 6. CURRENT AND PROGRAMMED HIGH-WATER INDICATOR INSTALLATIONS

High Water Indicator Location	Current	Programmed
I-10 (Brazos River)		1
		1

Emergency Management

Being a coastal district, the Yoakum District responds to weather events, particularly hurricanes and flooding, that impact the safety and mobility of the traveling public and district personnel. The district's existing and planned ITS infrastructure plays a key role in supporting the management of the state highway system during emergencies through the dissemination of traveler information, remote monitoring of conditions, or adjustments to traffic signal operations to favor the progression of evacuation traffic.

Hurricane Response and Evacuation

More information about TxDOT's hurricane response procedures, including evacuation routes in the Yoakum District may be found online (TxDOT, 2020).

Essentially every state highway in the Yoakum District has the potential to be a hurricane evacuation route depending on where the weather impacts are. The I-10 corridor also has the potential to have evaculanes or contraflow operations if deemed necessary.

Communications Equipment

Communications in the Yoakum District consists primarily of commercial cellular wireless with some fiber optic on major corridors currently being constructed.

The current ITS communications on I-10 utilize 4G cellular modems but fiber optic communications is being added as part of the widening projects that are currently under construction. There is fiber installed and planned along US 59/Future I-69 connected to the ITS devices but there is no plan to get the communication to the Yoakum District office. The fiber optic communications on US 59/Future I-69 ties into the Houston District.

The City of Victoria maintains its own communications infrastructure, but at this time is not connected to district systems.

Incident Management

Traffic Incident Management (TIM) training for first responders has been a major recent TxDOT initiative. As of April 2020, all new police officers are now required to have TIM training, with courses being provided in all academies and local colleges will have academies.

Maintenance Crew TIM Response

First responders frequently reach out to TxDOT to provide support in response to traffic incidents. Each maintenance office works closely with the emergency responders in their area and provides maintenance crew assistance when requested. TxDOT maintenance vehicles have global position system (GPS) tracking, which can be useful for emergency events.

Traveler Information

The district's Public Information Office (PIO) notifies the public about conditions that impact travel (e.g. work zones, lane closures, crashes, events). The PIO coordinates with the media and uses Twitter (@TxDOTYoakum) to disseminate information. Traveler information is also provided through DriveTexas.org and HoustonTranStar.org. Dynamic message signs are also used to disseminate traveler information.

Work Zones

The Yoakum District currently deploys smart work zone strategies to provide en-route traveler information about roadway construction. This includes positioning Smart Work Zone Trailers, which provide queue detection, speed warnings, and PCMSs. The district is currently using smart work zone trailers on I-10, with mixed results. Although reliability has been improving, they cannot yet be relied upon to be operational every day.

Lane closures required for maintenance and construction activities are primarily done at night on I-10 from SH-71 to the Waller County line.

User Needs Assessment

This section provides a summary of transportation system user needs for the Yoakum District gathered from district staff through a stakeholder workshop and discussions with the district's Operations section. The assessment of current and future transportation user needs provides a basis for the development and evaluation of potential ITS projects.

The Stakeholders and System Users section identifies the stakeholder and key system users for this ITS plan. These users participated in the stakeholder workshop and individual interviews to identify and confirm key user needs. The Summary of User Needs section summarizes these user needs, organized by the following areas of interest:

Stakeholders and System Users

To ensure the success of this ITS Master Plan, a coalition of stakeholders and system users was created to gather input and build consensus on regional needs. A workshop was held in December 2019 to gather big-picture user needs and to facilitate discussion between the Plan's stakeholders. The workshop was followed by personal interviews with key stakeholders in the Operations section to discuss and verify the transportation needs that had been identified and to determine any additional needs.

Output from these meetings was used to refine the goals, objectives, and needs described in this section.

ITS Plan Stakeholders include district staff from all core departments, as shown in Figure 1.

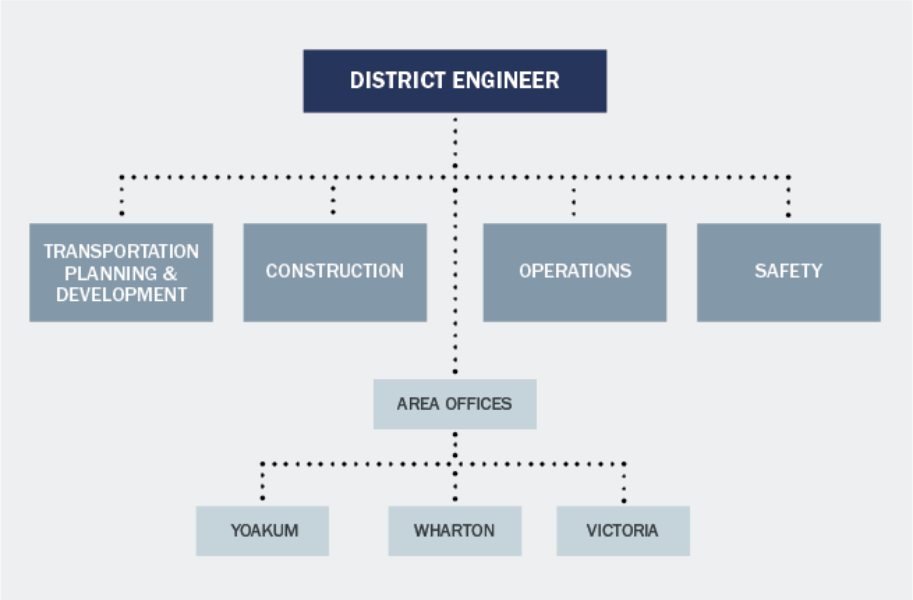


FIGURE 1. KEY YOAKUM DISTRICT STAKEHOLDERS

Vision, Mission, Goals and Objectives

The vision, mission, and goals and objectives described in this section were developed as part of the Yoakum District TSMO Program Plan (TxDOT Yoakum District, 2020). These served as the basis for identifying ITS strategies and projects described in the Deployment section of this plan.

STATEWIDE TSMO VISION

Improve safety and mobility for all modes of transportation by integrating planning, design, operations, construction, and maintenance activities and acknowledging all opportunities for innovation.

STATEWIDE TSMO MISSION

Through innovation, collaboration, and performance-based decision-making, transportation facilities are developed, constructed, maintained, and operated cost-effectively, with the end user in mind.

Goals and Objectives

The Yoakum District supports each of the six statewide TSMO goals (safety, reliability, efficiency, customer service, collaboration, and integration) and has developed measurable objectives for the district under each goal to support ongoing monitoring of the effectiveness of the TSMO Program Plan.

TABLE 7. STATEWIDE AND YOAKUM DISTRICT TSMO AND ITS GOALS AND OBJECTIVES

Goal	Strategic Statewide Objectives	Strategic Yoakum District Objectives
Safety	Reduce crashes and fatalities through continuous improvement of traffic management systems and procedures.	▪ Reduce 5-year average fatalities by half by 2035. ▪ Reduce fatalities to approach zero by 2050. ▪ Reduce severe injury crashes. ▪ Reduce work zone crashes. ▪ Increase the implementation of data-driven safety countermeasures on district highways and review status annually.
Reliability	Optimize travel times on transportation systems in critical corridors to ensure travelers are reaching their destinations in the amount of time they expected for the journey.	▪ Increase travel time reliability of person-miles travelled on I-10 and US 59/Future I-69. ▪ Increase ITS-related assets in use for incident and emergency detection/response on I-10 and US 59/Future I-69 to 100 percent coverage by 2030. ▪ Reduce average incident clearance time on state highways.
Efficiency	Implement projects that optimize existing transportation system capacity and vehicular throughput.	▪ Maintain a program of evaluating 100 percent of signals for retiming every three years.

Goal	Strategic Statewide Objectives	Strategic Yoakum District Objectives
Customer Service 	Provide timely and accurate travel information to customers so they can make informed mobility decisions.	▪ Reduce time between incident/emergency verification and posting an alert to traveler information outlets (e.g. dynamic message sign (DMS), website, social media). ▪ Reduce the time between recovery from incident/ emergency and removal of traveler alerts for that incident. ▪ Increase number of repeat visitors to Yoakum section of DriveTexas.org during major events (e.g. floods, hurricanes).
Collaboration 	Proactively manage and operate an integrated transportation system through multi-jurisdictional coordination, internal collaboration, and cooperation between various transportation disciplines and partner agencies.	▪ Meet twice each fiscal year with representatives from the four core departments (TP&D, Construction, Maintenance, and Operations) and the three Area Offices to review TSMO implementation status. ▪ Hold after-action review meetings with attendance from at least 90 percent of the agencies involved in the response to a major incident/emergency or adverse weather event.
Integration 	Prioritize TSMO as a core objective in the agency's planning, design, construction, operations, and maintenance activities.	▪ Maintain 90 percent TMS asset operational uptime annually. ▪ Expand network monitoring with automated failure alerts to 100% of traffic signals by 2023. ▪ Conduct joint training exercises in the district that support shared implementation of TSMO strategies.

Summary of User Needs

This section contains a summary of transportation system user needs for the Yoakum District based on input gathered from the user needs workshop and individual stakeholder interviews.

User needs are grouped into the following four categories:

1. Travel and Traffic Management
2. Information Management
3. Maintenance & Construction Management
4. Incident & Emergency Management

Travel and Traffic Management

Stakeholders identified the following travel and traffic management needs:

- Need for more monitoring capabilities (e.g., PTZ or fish-eye cameras)
- Need ability to verify high-water indications
- Need capability to verify status and performance of DMSs (e.g., via CCTV monitoring cameras)
- Need to ensure consistency with statewide standards with regard to systems and software
- Need to provide Area Engineers access to traffic cameras at key intersections and on corridors to verify conditions when there is a citizen complaint

Information Management

Stakeholders identified the following information management needs:

- Need high-speed communications on I-10 (e.g., fiber)
- Need to install communications at school zone flashers throughout the region to support remote access to change flasher operating parameters
- Need better capability to monitor uptime performance of traffic management system (TMS) assets (e.g. ITS devices, traffic signals)
- Need more corridor-focused operational and technology assessments that span multiple districts
- Need a more formal asset management system to replace the current spreadsheet-based approach
- Need access to the San Antonio TransGuide map for areas west of US-183

Maintenance & Construction Management

Stakeholders identified the following maintenance and construction management needs:

- Need about 12 more TMAs to enhance the safety of TxDOT maintenance staff
- Need approximately 20 additional PCMSs to support maintenance crew operations
- Need to use smart work zones on I-10 projects
- Need to operate and maintain future devices on US-77
- Need Americans with Disabilities Act (ADA) upgrades for many existing signals; this may also require right-of-way acquisition
- Need to (continue to) receive Maintenance training on traffic signal software, including getting support from vendors

Incident & Emergency Management

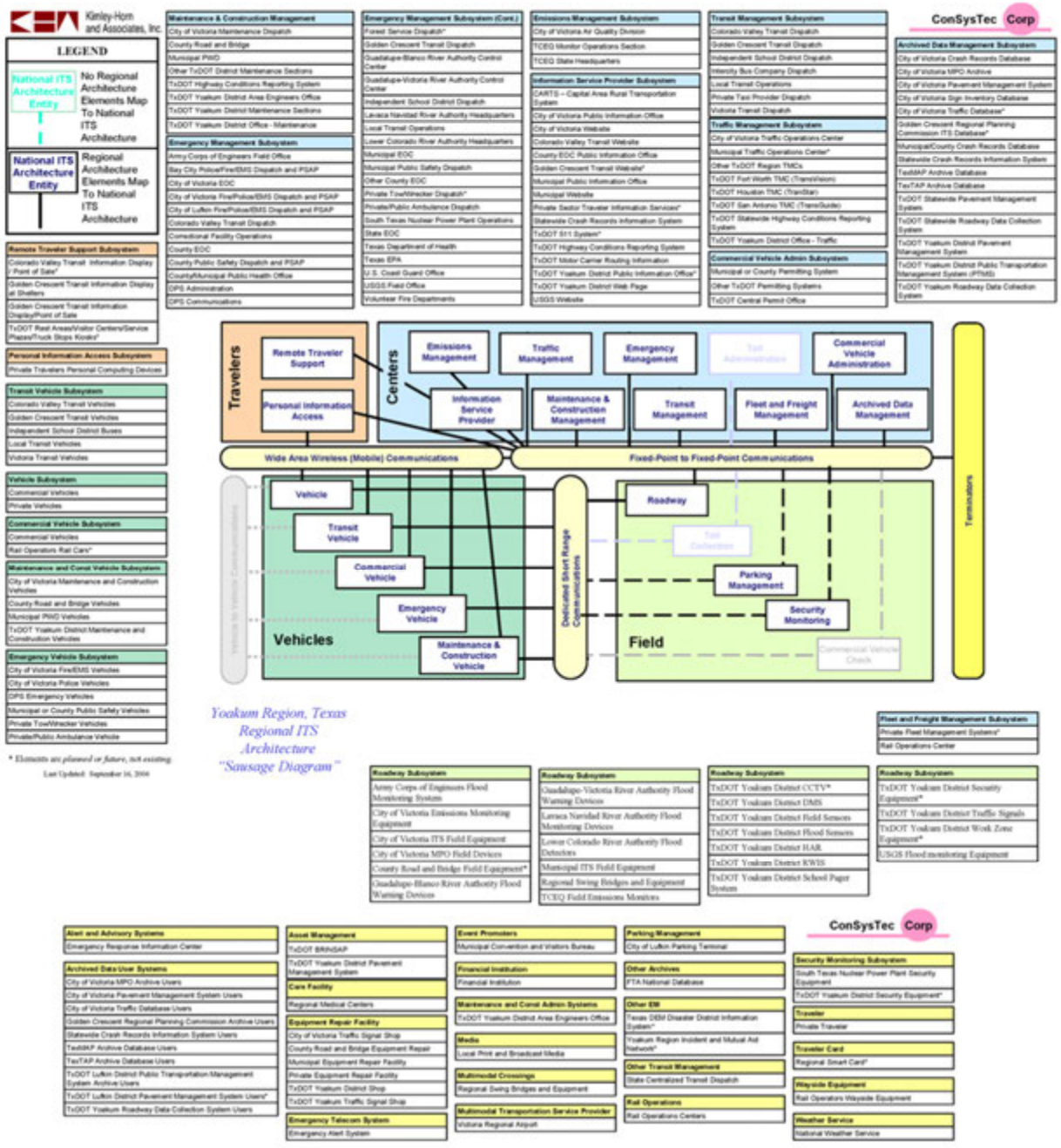
Stakeholders identified the following incident and emergency management needs:

- Need more automated incident detection capability (e.g., video-based warning system running on a central software platform)
- Need signal upgrades and communications to signals on evacuation routes (e.g., from SH 71 to US-183) to support hurricane evacuation response plans
- Need traveler information dissemination capability (e.g., DMSs) at key decision points to support alternate routing during incidents and emergencies
- Need greater density of detection (e.g., CCTV) and information dissemination (e.g., DMSs) to improve incident response capabilities
- Need to identify flooding and incident response strategies for areas subject to frequent floods and incidents (e.g., Jackson and Wharton counties)
- Need to reduce truck incidents in key locations (e.g., US-77 south of La Grange) and identify ITS and operational strategies to address (e.g., additional DMSs, detection)
- Need for queue detection and warning in key locations (e.g., on I-10 and US-59) and consider alternate data sources (e.g., crowd-sourced)

ITS Architecture

The Traffic Division is currently considering developing a statewide architecture or several multi-regional architectures, to include Yoakum and other Districts. The Yoakum District supports this approach and will roll its architecture into this statewide initiative.

The most current ITS architecture for the Yoakum District was developed in 2005 and can be reviewed online (TxDOT, 2005). An overview "sausage diagram" from the 2005 Regional ITS Architecture is shown below.

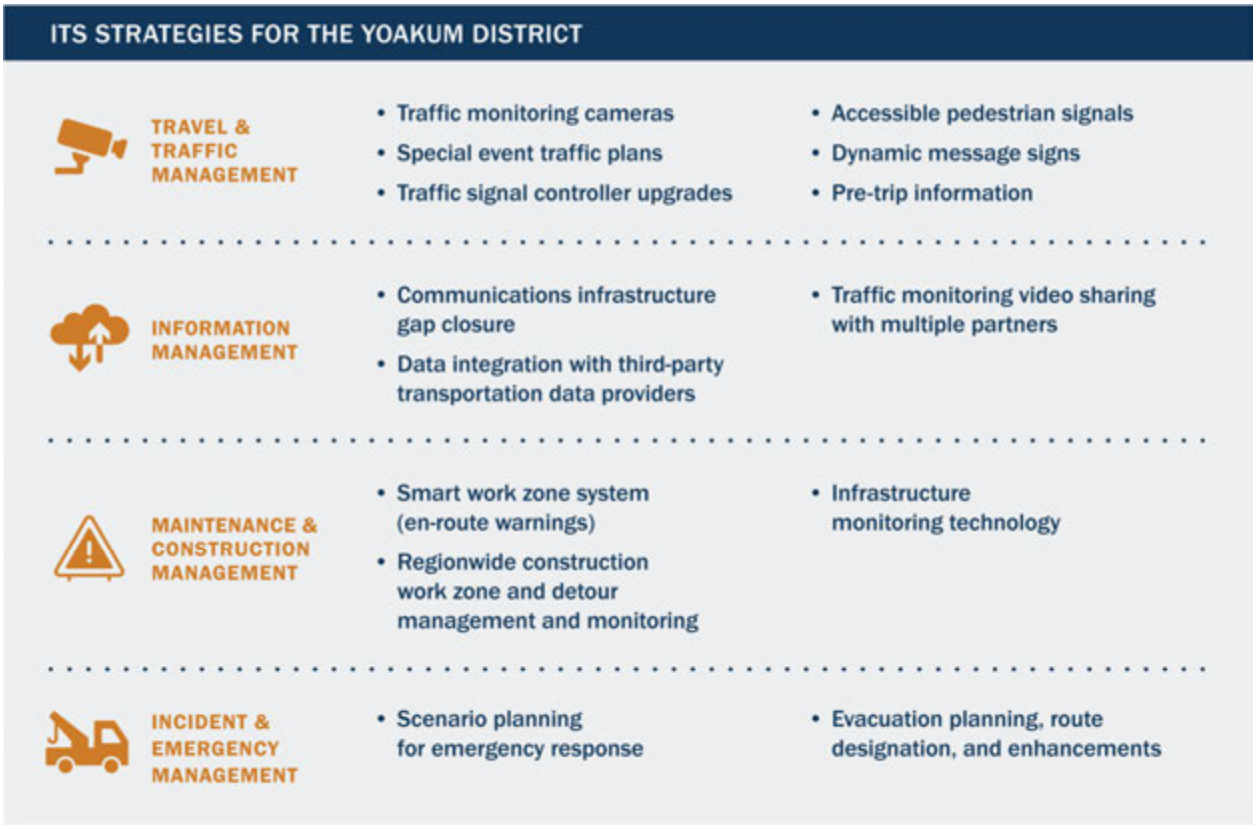


ITS Deployment Plan

This ITS Deployment Plan identifies ITS strategies and projects to address the user needs and goals and objectives of the Yoakum District described earlier in this document. The Deployment Plan includes project maps, descriptions, and costs.

ITS Strategies

Through the user needs workshop and interview process, stakeholders highlighted various strategies and areas of focus to address their needs. This section highlights the key focus areas and strategies of interest as identified by the Yoakum District ITS Plan stakeholders. These preliminary strategies, organized by functional areas, were refined and used as a basis to define specific projects for the Deployment Plan.



Communications Plan

The purpose of this communications plan is to identify general guidelines and specific actions to support transportation requirements for data and video transmission for the district. The communications network will support communications required for ITS deployment between key locations in the district, provide a backbone communications system, and a distribution network to reach individual devices and control locations.

Fiber Optic Communications

Fiber optic cable is proposed based on a best-fit basis for communication needs, reliability, growth, standards, and flexibility. It is anticipated that fiber optic communications will be practicable on key highway corridors with a significant distribution of ITS devices (e.g., I-10 and the future I-69).

It is recommended that in conjunction with any road widening or other significant roadway project that the district install conduit to accommodate future fiber installation.

Cellular Communications

Communications to remote ITS devices and traffic signals is currently done via cellular modems. The Yoakum District should continue to utilize commercial cellular networks to enable communications to remote devices, prioritizing those traffic signals and ITS devices supporting hurricane and other emergency evacuation routes.

ITS Deployment Plan Projects

Projects in this ITS Deployment Plan are documented in Table 8. Note that an editable Excel spreadsheet version of this table is also available to the district to use and update as needed between ITS Plan updates to help track status or adjust priorities as conditions change.

Figure 2 provides a map-based view of these projects, color-coded and labeled on a regional map. An interactive geographic information system (GIS)-based map with an online interface is provided as well.

The following information is provided for each project, which will be led by the Yoakum District and are listed in Table 8:

- Project number
- Project location
- Project description
- Partners/supporting agencies
- Priority (high/medium/low)
- Planning level cost estimate (capital cost and annual operations & maintenance cost)

Fully implemented, the plan comes to a total planning level cost estimate (2020 dollars):

- Capital costs: $39,385,000
- O&M costs: $590,500/year

TABLE 8. ITS DEPLOYMENT PLAN PROJECT LIST

Project No.	Location	Description	Partners	Priority	Planning Level Cost Estimate (Capital/O&M)
Travel and Traffic Management Roadway Monitoring					
2	Area Offices	Remote access to the new CCTV video sharing system from existing workstations	TRF	Medium	$23,000/ $3,600
Travel and Traffic Management Traffic Signalization					
4a		install cellular modems in FY21 as separate effort.			$3,133,000/ $48,000
4b	Victoria Area Office (2 signals)		TRF	High	$1,044,000/ $16,000
4c	Wharton Area Office (19 signals)		TRF	High	$9,922,000/ $153,000
		Signal Upgrades: Replace outdated signals. TRF project will upgrade signal cabinets/controllers and install cellular modems in FY21 as separate effort.			
5b	Victoria Area Office (7 signals)		TRF	Medium	$3,656,000/ $56,000
5c	Wharton Area Office (21 signals)		TRF	Medium	$10,967,000/ $169,000

Project No.	Location	Description	Partners	Priority	Planning Level Cost Estimate (Capital/O&M)
6	Districtwide	School Flasher Cellular Communications: Add cellular communications at all school flashers (200+)	School Districts	Low	$1,224,000/ $8,000
Travel and Traffic Management Incident Management & Information Dissemination					
8	I-10 between US-77 and FM 155	Install DMSs along I-10 to inform the public about road conditions. Install queue detection to detect incidents for display on DMSs. Install CCTV cameras at DMS locations.	Houston TranStar, Houston & San Antonio Districts	Low	$1,520,000/ $2,600
Maintenance and Construction Management					
10	Districtwide	PCMSs: Purchase 14 PCMSs, with remote access capability, so that each Maintenance Office has 1 PCMS and each Area Office has 1 PCMS to support maintenance, work zones, and incident/ emergency activities		Medium	$381,000/ $7,000

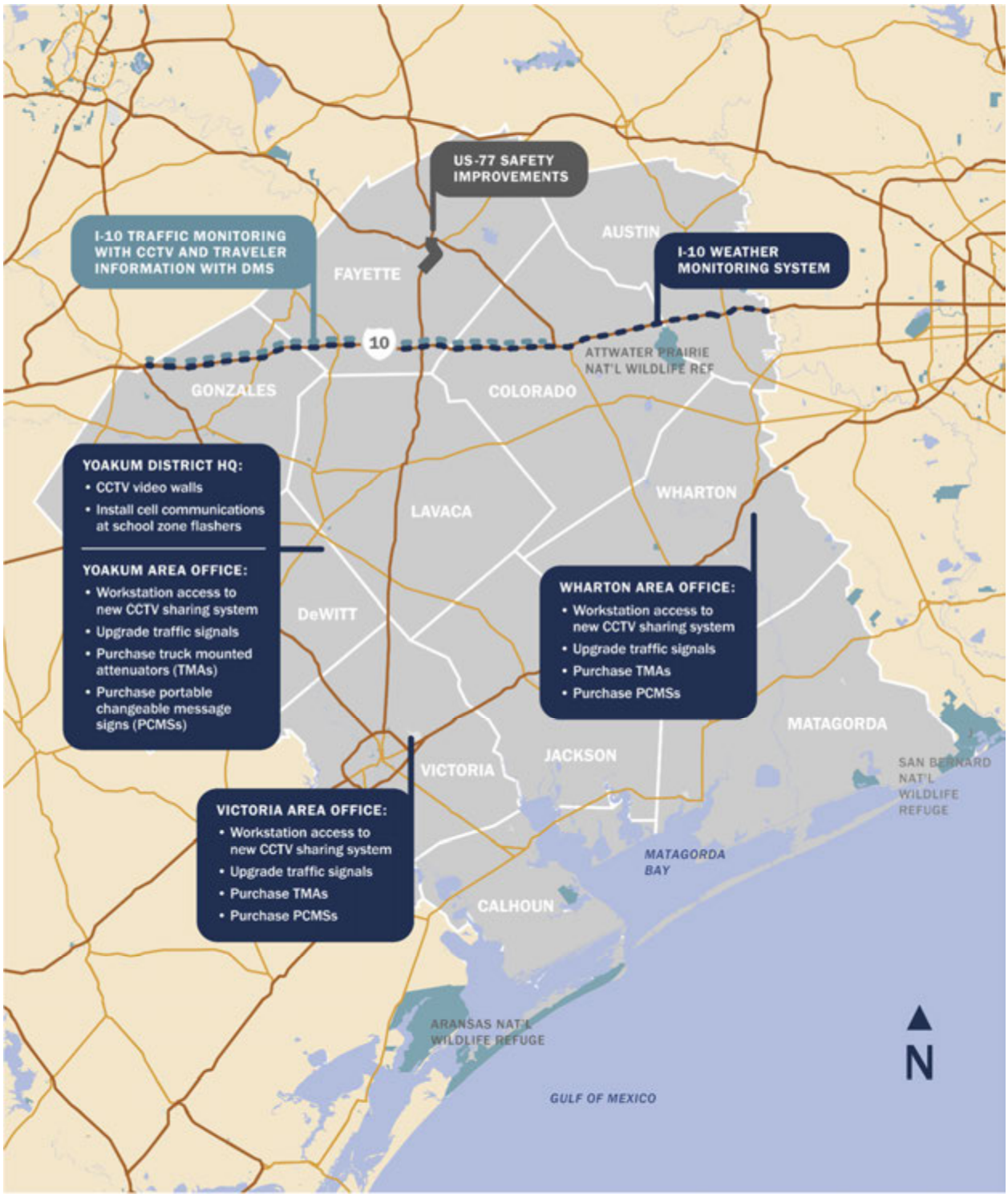


FIGURE 2. ITS DEPLOYMENT PLAN PROJECT MAP

Operations and Maintenance Workforce Plan and Equipment Upgrades

This section describes existing O&M requirements for Yoakum District resources, anticipated O&M needs, a proposed O&M staffing plan, and proposed equipment upgrades. In addition to the core departments located at the District Office, the Yoakum District has three Area Offices and 11 Maintenance Offices (one located in each county within the district) as listed in Table 9.

TABLE 9. OFFICES WITHIN THE YOAKUM DISTRICT

District Office	Area Offices	Maintenance Offices		
Yoakum		Bay City Bellville Columbus Cuero	Edna Gonzales Hallettsville La Grange	Port Lavaca Victoria Wharton

Existing Operations and Maintenance Responsibilities

This section describes existing O&M responsibilities. The district has a program that rotates junior staff into the TP&D, Operations, and Construction sections and Area Offices. This allows staff to cross-train and collaborate between sections, which is critical to successful TSMO practice. The district expresses difficulty in recruiting and retaining experienced staff including ITS/TSMO skills and experience. Retaining staff is difficult in the current competitive market especially after they have gained enough experience and training.

District FTE for Operations and Maintenance:

The Yoakum District staff are responsible for the operations of the TSMO/ITS strategies for the region:

- Providing traveler information via six DMSs and the district's PIO, which manages the media, district Twitter account (@TxDOTYoakum), and posts updates to DriveTexas.org and HoustonTranstar.org.
- Responding to weather-related traffic events (i.e., evacuations, flooding).
- Working with adjacent districts (e.g., Houston, San Antonio, Austin) and partner agencies to coordinate and integrate systems
- Managing traffic for construction and maintenance work zones
- Responding to traffic incidents
- Coordinating with other agencies located within the district boundaries.

Houston TranStar operates the existing ITS devices in the Yoakum District from their TMC that is operated around the clock. The Yoakum District has cloud-based access to the TranStar system.

Traffic management system maintenance activities performed by the Yoakum District are summarized in Table 10. The Yoakum District Maintenance section does not have a set budget. The maintenance services are funded on an ad hoc basis.

TABLE 10. TRAFFIC MANAGEMENT SYSTEM MAINTENANCE RESPONSIBILITIES

Equipment	Maintenance Activities and Notes
Traffic Signals (144)	▪ Perform annual preventative maintenance and as-needed corrective maintenance ▪ Troubleshoot remotely where cellular communications is available (may increase to half the signals in FY21)
School Zone Flashers (200+)	▪ School districts set and reset the timers ▪ District handles trouble calls and repairs, many of which are caused by the solar power systems
Illumination	▪ Perform preventative and corrective maintenance
ITS Devices (cameras, DMSs, sensors)	▪ Houston District performs most maintenance ▪ Yoakum District investigates power and communications outages and assists Houston District via phone support with repairs and troubleshooting when possible
Camera Detection	▪ Fog requires camera maintenance in coastal areas about every six weeks due to film that develops on the camera lens. For this reason, the district prefers radar detection over camera detection.

Anticipated Operations and Maintenance Needs

While TSMO relies upon technology investments, delivering a robust TSMO program is heavily dependent on having a workforce with the right background and capabilities. Transportation agencies are being called on to expand their activities beyond the more traditional design and construction functions most closely associated with civil engineering to the broader and more diverse tasks of TSMO. While many transportation agencies view TSMO as a priority, they are encountering a shortage of management, professional, and technical staff with appropriate skills and knowledge in their agencies. Specific skills and capabilities within TSMO are evolving to include emerging technologies, data management, data and statistical analysis, and emergency management. Consequently, staff position descriptions may need to be updated and new roles defined within the organization. Staffing and workforce development may require close coordination with human resources to identify and develop these new capabilities.

As this ITS plan is deployed and equipment is replaced at the end of its lifecycle, specific Operations and Maintenance needs for signals includes:

- Upgrade cameras and install new cameras at signalized intersections and critical locations. Replace outdated signals and add connectivity. Provide alternating current (AC) power to signals and cameras. Review signal mounting for proper height and pole safety.
- Add PTZ/fish-eye cameras at critical traffic signal locations (e.g. major hurricane evacuation routes).

- Provide means to monitor and configure signal operation from central location (e.g. central traffic signal system software).
- Provide additional radar detection instead of camera detection (preferred due to fog).
- Incorporate school zone flasher connectivity and prefer hardwired AC power for each flasher, instead of solar power systems (low priority).

Specific Operations and Maintenance needs for ITS devices includes:

- Install and configure video walls to view cameras at the District Office (Signal Shop, EOC, key offices, etc). Provide video access to Area Offices through computer workstations.
- Upgrade existing DMSs, install additional DMSs and provide remote capability.
- Review ITS needs on corridors across multiple districts (e.g., I-10, US-59/Future I-69).
- Prioritize operations on hurricane evacuation routes.
- Provide additional radar detection instead of camera detection (preferred due to fog).
- Monitor roadway surface temperatures along I-10 at the freeze line.

Proposed Operations and Maintenance Staffing Plan

This section describes proposed operations and maintenance staffing changes. Based on national FTE guidelines (Federal Highway Administration (FHWA), 2009), an engineer can optimally operate an average of 75 to 100 traffic signals, which includes timing plans and day-to-day response to real-time conditions and citizen calls. A technician optimally operates an average of 40 to 50 traffic signals. Given that the Yoakum District operates approximately 144 signals, at least two engineers and three technicians are necessary for optimum traffic signal operations and maintenance. To support an additional 0.5 to 1.0 FTE traffic engineer, the Yoakum District plans to use professional services contracts to augment current staffing.

As responsibilities of operations staff increase, additional full-time engineering staff will be needed to focus exclusively on ITS operations. In addition to signal operations, engineers may be responsible for the design and operation of other traffic elements including:

- Monitor cameras and post incident updates
- Monitor road weather conditions
- Coordinate traveler information with the district's PIO
- Post messages on permanent DMSs and PCMSs
- Apprise other stakeholders (cities, counties, first responders) of current travel conditions including hurricane and storm evacuation and coordinate as appropriate.

Technicians are responsible for traffic signal maintenance, which is typically done with two-person crews and one bucket truck. In addition to signals, these technicians will be needed to focus on maintenance issues including:

- Configure cameras and real-time signs
- Perform regularly scheduled maintenance including annual maintenance and preventative maintenance

- Troubleshoot configuration and operational issues
- Replace equipment as needed.

All maintenance staff should be provided with technical training on ITS/TSMO devices.

Currently Houston TranStar operates the ITS devices/systems in the Yoakum District and the Houston District maintains them. The Yoakum District prefers to continue this arrangement. The Houston District is open to an agreement to continue ITS device operations and maintenance with funding support. The Yoakum District TSMO Program Plan includes a high-priority action item to formalize an agreement between the two districts. A similar agreement is also needed with the San Antonio District as the Yoakum District deploys ITS devices in the western parts of the district, particularly along I-10.

Proposed Equipment Upgrades

This section includes lifecycle equipment estimates and district needs associated with equipment, TMAs, PCMSs, video walls, and smart work zones.

Lifecycle estimates for equipment:

Traffic signals – Some of the district's 144 signals are 45 to 50 years old. A limited number of the locations have cellular modems. There is limited interconnect within the signal system. The district needs wireless or wired communications to the signals, especially the locations along major hurricane evacuation routes, so they can put the signals into flash remotely during evacuations.

DMS – the District has six fixed messaging signs that are mapped for the ITS plan. The District should upgrade the existing DMS signs and provide remote capability.

Traffic Cameras – At present, many of the existing traffic cameras on I-10 are solar powered. Solar panels and batteries have a life expectancy of approximately five years, but some are beginning to degrade prematurely. These cameras need to be upgraded to hardwired AC power connection. The district would like to have more PTZ and/or fish-eye cameras at high priority intersections.

Vehicle Detection – Many older traffic signals have VIVDS but when a signal is upgraded or a new signal is added, radar detection will be included. Radar detection is preferred over video due to fog.

Communications Equipment – the District has approximately 144 signals connected by cellular modems at limited locations with more modems to come in FY21. There is presently limited interconnect. The district is currently expanding ITS infrastructure and communications network with ongoing and upcoming construction projects that include fiber optic communications along I-10 and US-59/Future I-69.

The district currently has 24 attenuators (mix of trailer and truck-mounted) used by maintenance crews. The district should add 12 truck-mounted attenuators (TMAs), to bring the total to 36 attenuators, to service the entire district with three TMAs at each Maintenance Office and three TMAs on reserve at the District Office. Standard traffic control plans require the use of three TMAs when performing maintenance activities.

The district owns five and rents five PCMSs for incident response and maintenance activities. None of the signs have remote access and the average age is 12 years old. The district should upgrade to 14 PCMSs with remote access. Ideally there will be one PCMS available at each Maintenance Office and one at each Area Office.

Currently, the Yoakum District does not have any video walls. It will be beneficial for staff to view camera feeds, particularly during major emergency events or when responding to major traffic incidents. Seven locations at the Yoakum District Office have been identified as places to install video walls as listed in Table 8.

The district should coordinate with the Traffic Division to improve reliability in Smart Work Zones – troubleshoot and upgrade equipment where necessary:

- There is a lack of connectivity among Smart Work Zones in adjacent work zones on I-10, the equipment is not compatible with other jurisdictions.
- The existing equipment is not reliable (asset uptime is approximately 35%).
- There are issues with data transmission to Texas A&M Transportation Institute (TTI) from the Smart Work Zone equipment.

ITS Plan Update Process

This ITS Master Plan is a part of the overall Yoakum District TSMO program. This plan will be maintained by performing a bi-annual check-in of ITS deployment project status. As shown in Figure 3, the TSMO Plan will receive minor updates every three years as needed, and this ITS Master Plan will receive an update every six years.

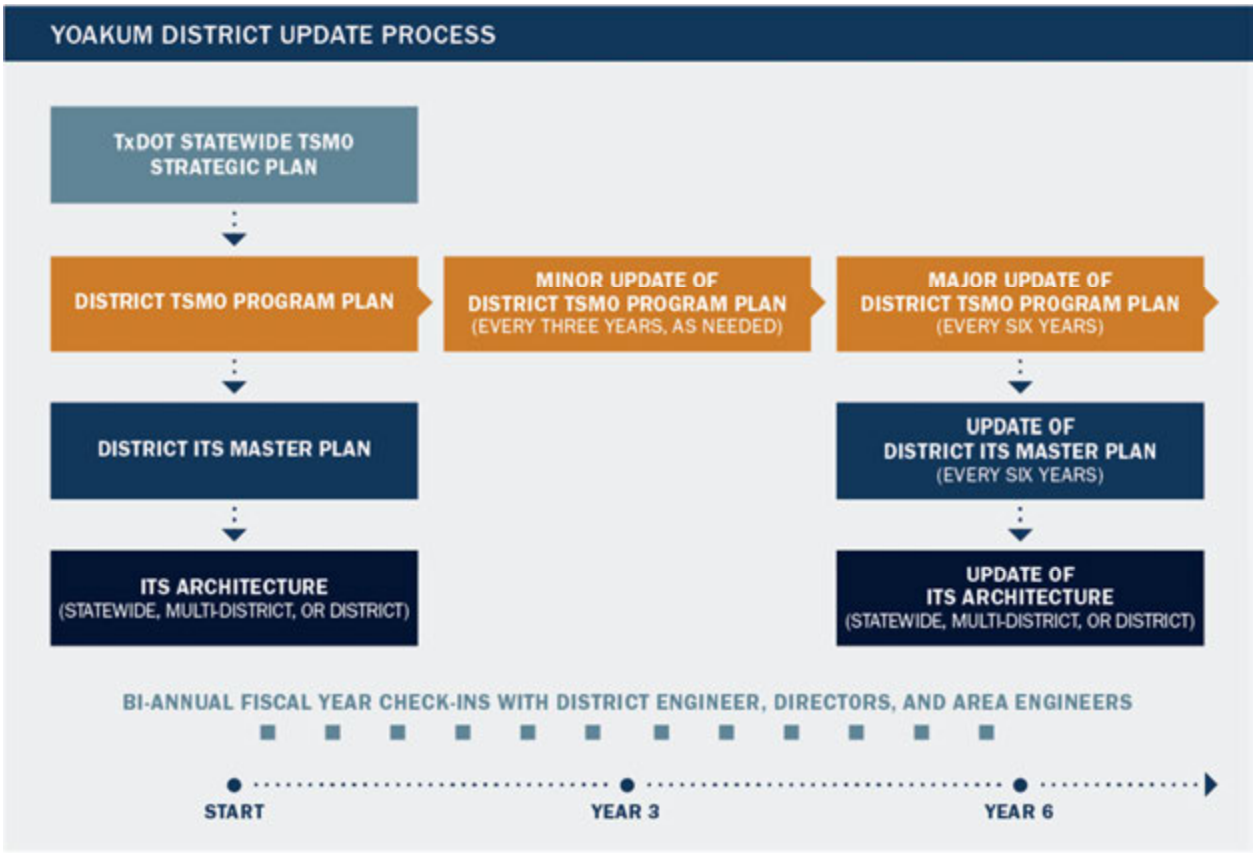


FIGURE 3. YOAKUM DISTRICT TSMO AND ITS MASTER PLAN UPDATE PROCESS

References

- TxDOT (2019) *Crash Records Information System (CRIS)*
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- TxDOT (2020) *Project Tracker*
- Houston TranStar (2020) *HoustonTranStar.org*
- TxDOT (2020) *DriveTexas.org*
- TxDOT (2020) *Hurricane Information*
- TxDOT Yoakum District (2020) *@TxDOTYoakum Twitter Feed*
- TxDOT Yoakum District (2020) *Yoakum District TSMO Program Plan*
- TxDOT (2005) *Yoakum Regional ITS Architecture*
- United States Department of Transportation (2020) *Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)*
- FHWA (2009) *Traffic Signal Operations and Maintenance Staffing Guidelines*

Yoakum District TSMO Program

ITS Master Plan

APPENDIX

Appendix A: Acknowledgments

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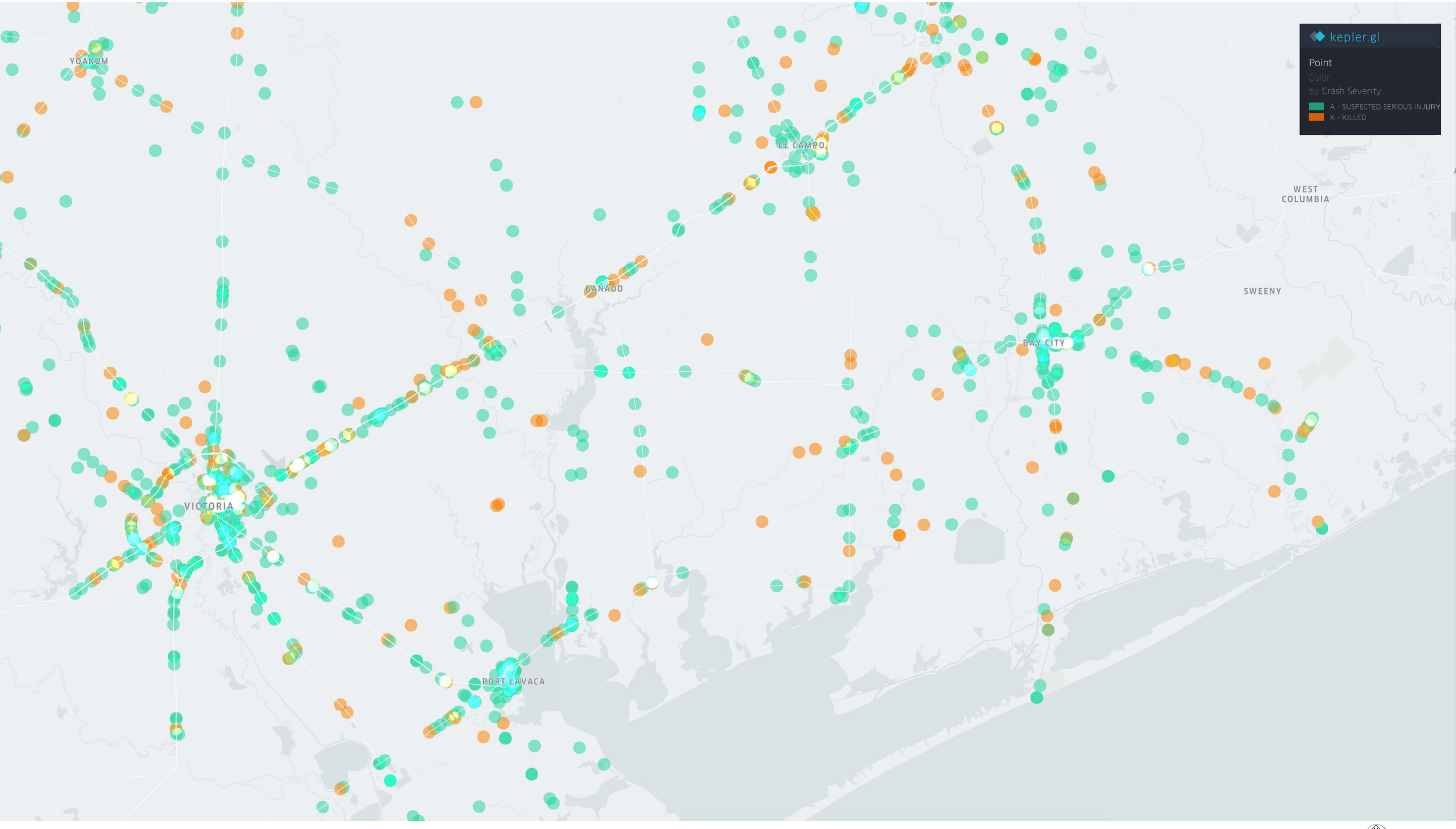
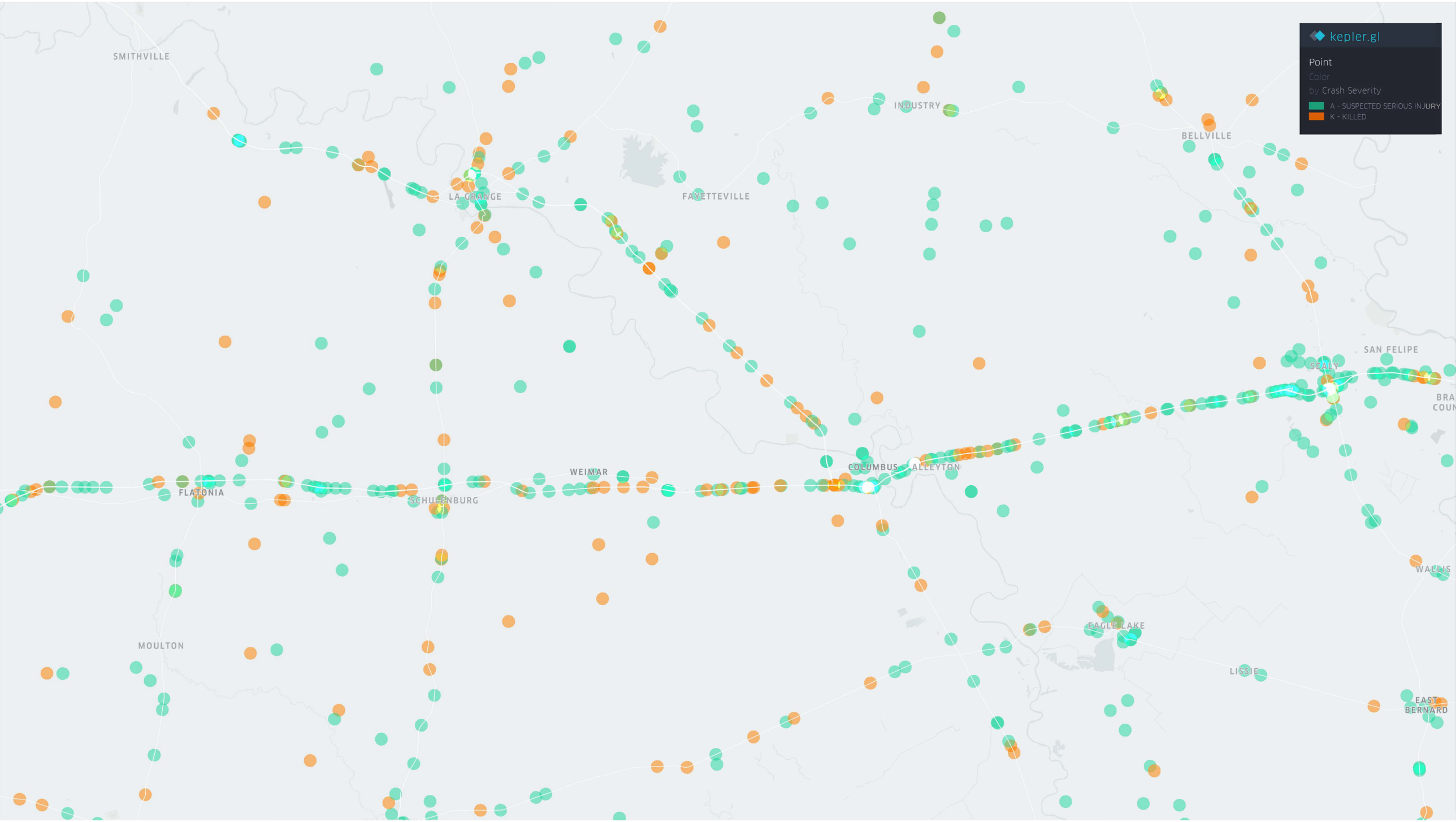
Appendix B: Crash Maps

Fatal and Serious Injury Crashes (2013 - 2018)- Coast



No Scale

Fatal and Serious Injury Crashes (2013 - 2018)- I-10 Corridor and Surrounding Area



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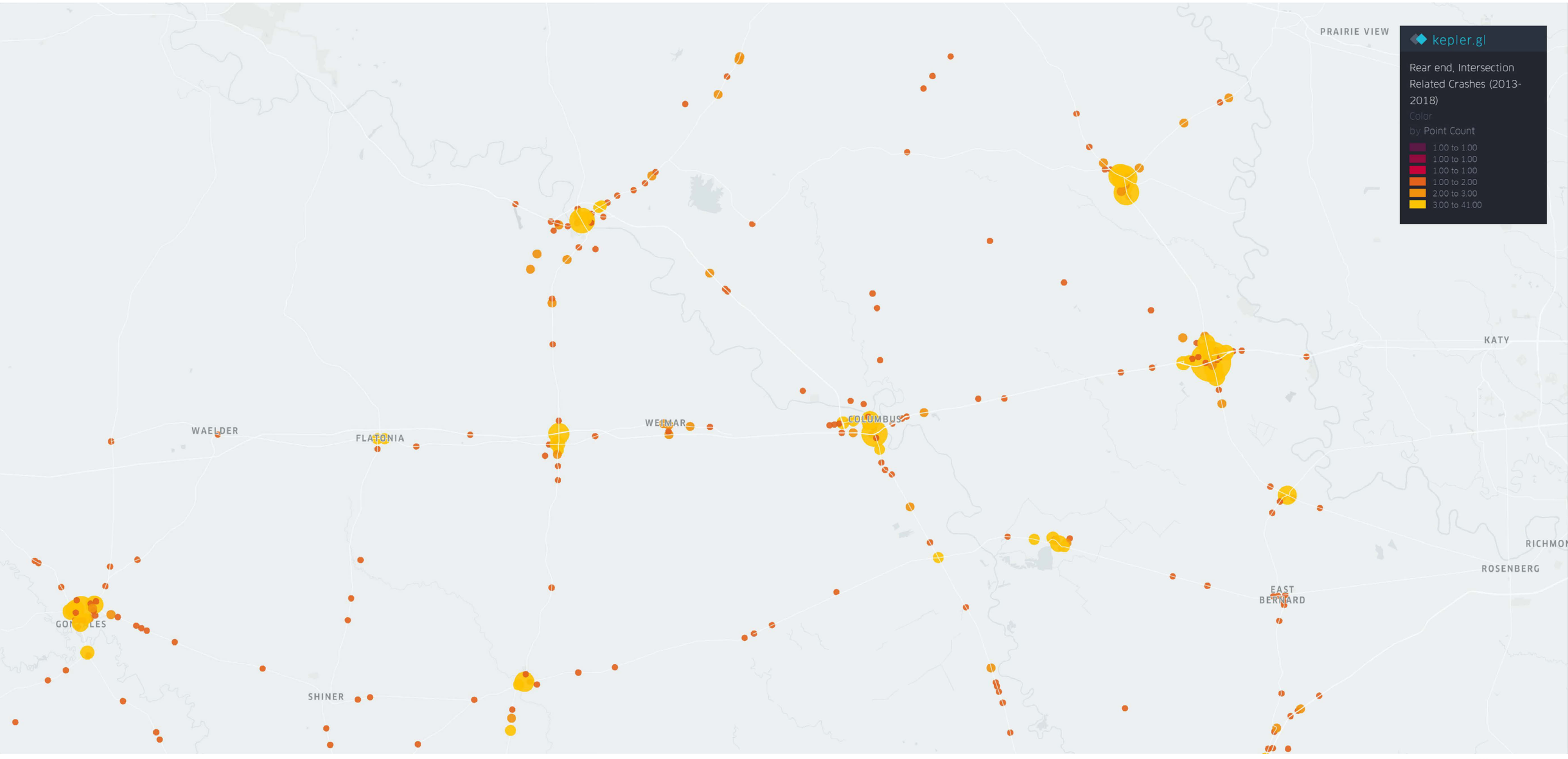
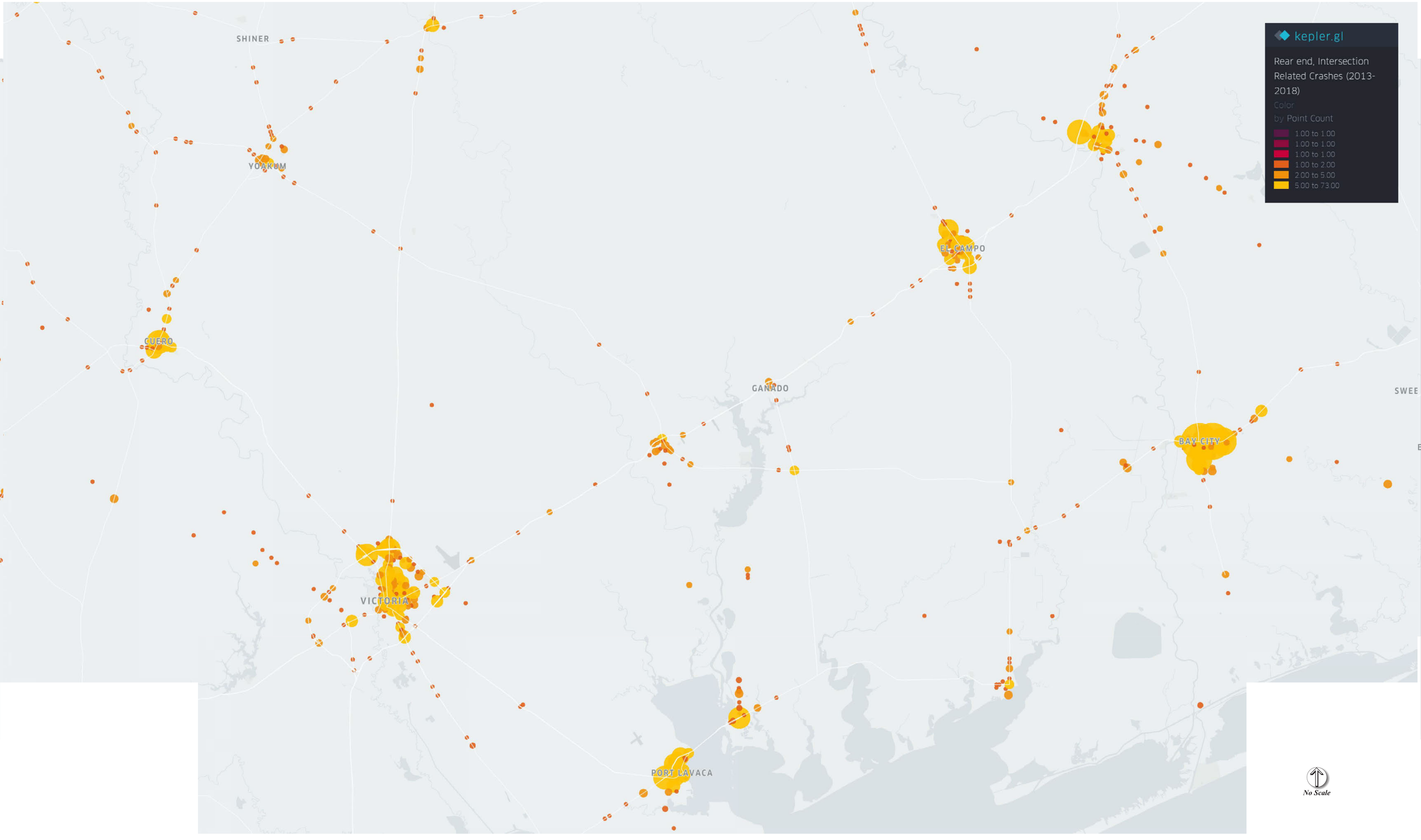
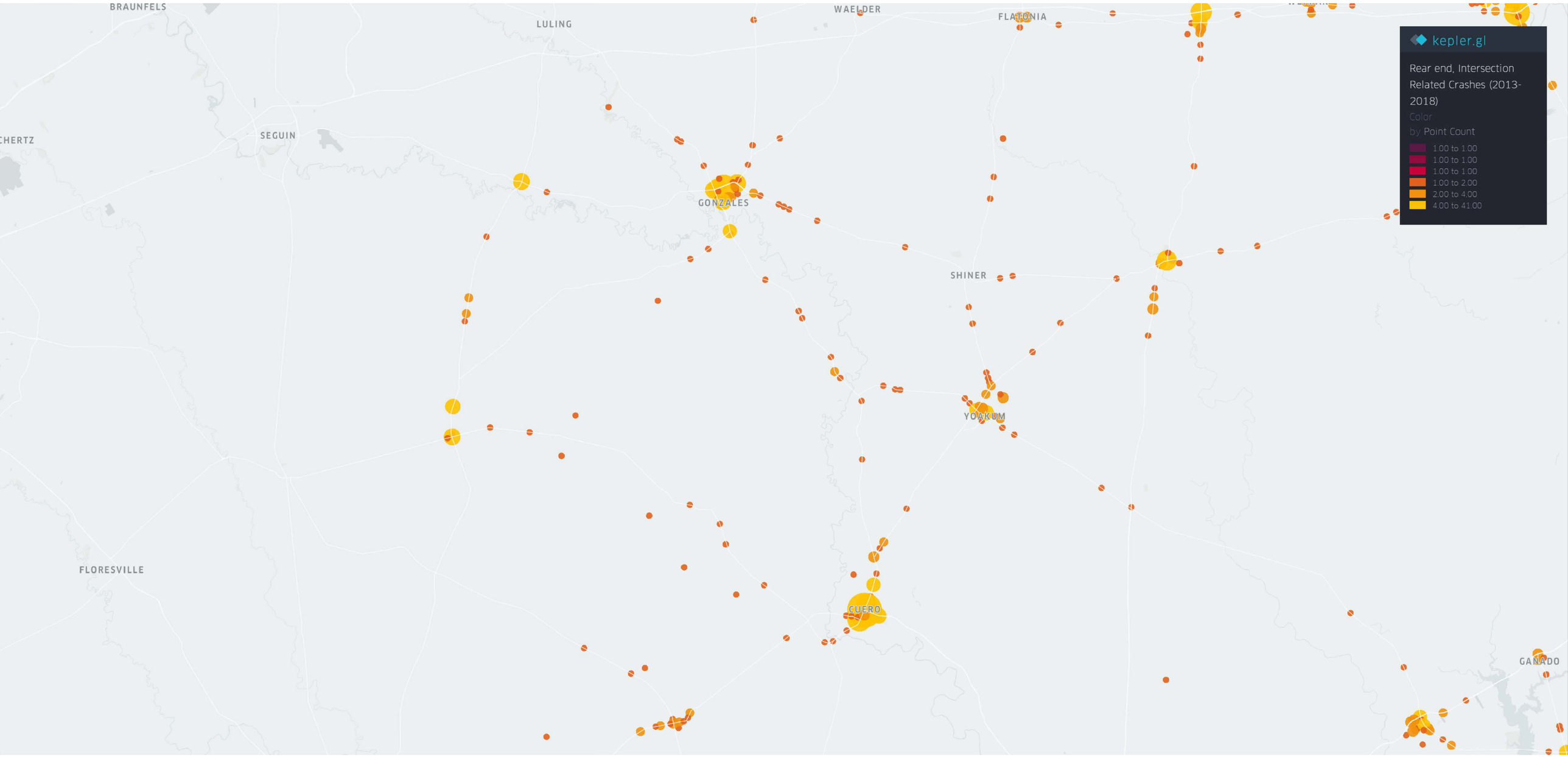
Rear-End Crashes (2013 - 2018)- I-10 Corridor



Rear-End Crashes (2013 - 2018)- Coast and Cities to North



Rear-End Crashes (2013 - 2018)- Gonzales-Yoakum-Cuero



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