Fresno Council of Governments

EXISTING CONDITIONS REPORT

Regional Safety Plan

KITTELSON & ASSOCIATES

April 2021

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Fresno Council of Governments
California

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Executive Summary

EXECUTIVE SUMMARY

The existing conditions report provides an overview of existing roadway safety practices, policies and/or initiatives. It also documents the current multimodal roadway safety performance across both incorporated and unincorporated Fresno County (the region). The analysis and findings in this report point to the types of collisions and contributing factors that, if addressed, would lead to the greatest improvements in roadway safety for the region. As such, the findings from the existing conditions analysis will be used to inform the safety strategies (e.g., countermeasures, education program, enforcement strategies) identified for the region to make strides in improving roadway safety. The following presents a brief overview of key findings.

FINDINGS

Plans and Policy Review

The plans and policy review included state and regional planning documents to identify: (1) where there is commonality between state areas of focus for roadway safety improvement and the region's collision trends and patterns; (2) characteristics of the most pursued state grant funding for safety improvement projects (Highway Safety Improvement Program [HSIP]); and (3) the extent to which roadway safety is already being addressed as part of regional planning efforts.

(1) Commonality between State Focus and Region's Needs: There is a state-level Strategic Highway Safety Plan recently updated in 2020 that identifies challenge areas for the state to target programs, funding, and improvements to reduce collision risk on public roadways. The state challenge areas are types of collisions or contributing factors to collisions that are more most frequently part of severe or fatal collisions. The state's challenge areas overlap with the predominant collision trends and patterns in the Fresno COG region are: Intersection Safety, Pedestrian Safety, Aggressive Driving, Lane Departures.

(2) Characteristics of HSIP: The purpose of the HSIP is to significantly reduce traffic fatalities and severe injuries on all public roads, including non-state-owned roads and roads on tribal land. HSIP outlines a number of requirements that a jurisdiction must meet in order to qualify for the HSIP funds. An important recent requirement is that for local agencies to be eligible for HSIP funding, they must have a Local Road Safety Plan or an equivalent document.

(3) Roadway Safety in Regional Planning Efforts: Improving roadway safety and/or multimodal safety consistently in regional planning documents. The Regional Transportation Plan (RTP) provides the most specificity for forward looking performance measures or targets related to improving roadway safety performance. The Regional Safety Plan is an opportunity to provide guidance on roadway safety can be considered in other recurring planning processes across the region (e.g., active transportation plans, corridor plans, updates to the regional transportation plan) to create consistency.

Regional Collision Patterns and Trends

A regional collision database was created in coordination with Fresno COG and local jurisdictions within the County. The collision database used for the analysis in existing conditions report includes spatially referenced reported collisions from January 1, 2015 through December 31, 2019. The collision database was used to identify regional collision patterns and trends with respect to the type, severity, and contributing factors to collisions. The database was also used to identify high injury networks (HINs) for the region as well as local jurisdictions within the region. The high injury networks display the relative risk of injury in a collision at locations along road network; it is based on past reported collisions and their severities.

Based on the recurring collision patterns and trends, the region has the greatest opportunity to improve roadway safety by implementing strategies that are effective at: (i) improving pedestrian and bicycle safety; (ii) reducing the risk of broadside collisions; (iii) reducing the risk of hit object collisions; (iv) managing vehicle speeds; and (v) helping motorists accurately gauge appropriate gaps in traffic and expected behavior.

The following provides a more detailed breakdown of key findings.

- **Road Users and Severity**
    - Pedestrians are overrepresented in fatal and severe injury collisions. Pedestrians are involved in 3 percent of reported collisions but are involved in 17 percent of reported fatal or severe injury collisions.
    - Bicyclists are also overrepresented in fatal and severe injury collisions. Bicyclists are involved 2 percent of reported collisions but 5 percent and 6 percent of fatal and severe injury collisions, respectively.
    - Clovis, Fresno, Sanger, and Selma have higher shares of fatal/severe injury collisions involving pedestrians and bicyclists than the statewide average share reported in the 2020-2024 SHSP.
    - Other jurisdictions observe higher shares of fatal/severe injury pedestrian collisions which should be interpreted with caution given relatively low overall reported collision frequency: Coalinga, Firebaugh, Kerman, Parlier, and Reedley.
    - Other jurisdictions have higher shares of fatal/severe injury bicyclist collisions than the statewide average: which should be interpreted with caution given relatively low overall reported collision frequency: Fowler and Reedley.
- **Seasonality and Weather**
    - Collisions are relatively less frequent in January and February across the five years of data than the remaining months throughout each year. There is no other immediately available data to indicate why this has been a trend in that time period.

- At the same time, reported collisions in foggy conditions peak in the winter months (November through February).

- **Collision Types, Locations, and Primary Collision Factors:**
  - The top three collision types resulting in death or severe injury are broadside collisions (26 percent of reported fatal/severe injury collisions), hit object collisions (21 percent), and vehicle/pedestrian collisions (15 percent). These three collectively account for 62 percent of reported fatal/severe injury collisions in the region.
  - These trends generally prevail when comparing each jurisdiction's collision history.
  - Along roadway segments (i.e., non-intersection locations), vehicle/pedestrian collisions and head-on collisions result in notably more severe outcomes on average than other collision types—and comparatively more severe outcomes on freeways, arterials, and collectors than on local streets.
  - At intersections, vehicle/pedestrian collisions also have much higher average severity than other collisions types—especially at rural unsignalized locations. Head-on collisions at rural unsignalized intersections are also associated with higher average severity compared to other collisions types and compared to head-on collisions at other location types.
  - The three most frequently reported primary collision factors (PCFs) among fatal/severe injury collisions include improper turning and unsafe speed (each accounting for 23 percent) and automobile right of way (accounting for 14 percent) —collectively representing a total of 60 percent.

- **Pedestrian Collisions**
  - Pedestrian collisions are four times more likely to result in death or severe injury than collisions overall. Of the 1,123 pedestrian collisions in the County, 27 percent resulted in death or severe injury.
  - Among fatal or severe injury pedestrian collisions, 40 percent occurred while a pedestrian was crossing a roadway outside a crosswalk, which was disproportionately higher than the share of the same pedestrian action among the total reported pedestrian collisions (32 percent).
  - Collisions that occurred in the dark make up 45% of total reported collisions, but account for 71% of fatal and severe injury collisions.

- **Bicycle Collisions**
  - The most frequently cited PCF was wrong side of road driving/riding. Complete data are not available on whether these collisions indicate drivers or bicyclists were traveling on the wrong side of the road.
  - The other two most frequent PCFs among bicycle collisions include automobile right of way (indicating one road user failed to give way to another) and traffic signals and

signs (indicating that one road user failed to comply with a traffic signal indication or stop sign).

- Bicycle collisions occurring in the dark or in dusk/dawn conditions account for 29 percent of reported bicyclist collisions but 44 percent of fatal/severe injury collisions.

NEXT STEPS

The following work to develop the Regional Safety Plan (RSP) will focus on two efforts. One effort will identify strategies that address the recurring regional collision trends and patterns. Those strategies will include engineering countermeasures, enforcement strategies, as well as the development of an education program. The other effort will select 20 priority locations across the region that will be used as illustrative safety project opportunities for the COG to explore funding and implementation options with its partner agencies.

While the additional technical work above continues forward to inform the RSP's development, there will be ongoing public engagement to gather input from community members about their experiences and observations as it relates to roadway safety. This information will be integrated into the considerations and recommendations for the safety strategies. Ultimately, the technical work and input from the community will be integrated into a Regional Safety Plan the COG can use to guide policies, plans and projects in improving roadway safety.

Section 2
Introduction

INTRODUCTION

The Fresno Council of Governments (COG) and its member agencies are developing a Regional Safety Plan (RSP) to guide policies, plans, programs, and project investments to make consistent, sustained improvements in roadway safety across the region. This report documents the existing conditions in the region as it relates to roadway safety performance. The findings provide a basis for identifying areas of focus for the region and the types of recurring collision trends, patterns, and contributing factors that would be most beneficial for the COG to try to address.

BACKGROUND

The Fresno COG recognizes that roadway safety as a significant impact on the quality of life for all communities and community members across the region. They are committed to providing guidance, education, and resources to implement strategies that improve roadway safety and help their member agencies invest in and implement roadway safety improvements. Developing a RSP is the initial extension of explicitly considering roadway safety, expanding beyond the Regional Transportation Plan, and provide more targeted and coordinated guidance for the region.

On a similar timeline to the RSP's development, the COG is also leading the development of a Multijurisdictional Local Road Safety Plan (MLRSP) with the focus of creating LRSPs for the ten local agencies within the region who currently do not have one. The MLRSP will enable those ten local agencies to be eligible for future HSIP grant funding. This is one example of the type of coordinated guidance, resources, and support the COG can provide to its members agencies to help enhanced roadway safety.

SCOPE OF THE REPORT

This Existing Conditions Report includes a plan and policy review and data analysis of the five most recent years of collision data. The plan and policy review was conducted at the regional-level to document the state level focus areas for improvement as well as the extent to which regional planning activities address roadway safety. The collision data analysis focuses on regional collision patterns and trends. It does highlight some findings at a local level. It also includes high injury networks (HINs) for the region as well as local jurisdictions within the region. The high injury networks display the relative risk of injury in a collision at locations along road network; it is based on past reported collisions and their severities. Any additional detail at the local level, will be conducted as part of the MLRSP's development noted above.

Section 3
Plan and Policy Review

PLAN AND POLICY REVIEW

The purpose of performing plan and policy review is to establish the understanding of existing roadway safety practices, policies and/or initiatives that have been developed or implemented at the regional or state level.

DOCUMENTS AND POLICIES REVIEWED

The following planning documents have been reviewed as a part of this task and their summaries are provided in the section below.

- State Level
  - California Strategic Highway Safety Plan (2020)
  - Caltrans Highway Safety Improvement Program Guidance (2017)
- Regional Level
  - Fresno County Regional Bicycle & Recreational Trails Master Plan (2013)
  - Fresno County Regional Active Transportation Plan (2018)
  - 2000 Fresno County General Plan, materials on website (many from 2000)
  - Comprehensive General Plan Review and Revision (2017)
  - Eastside Transportation Corridor Improvement Study (2020)

Local planning and policies that may be related to roadway documents will be reviewed as a part of the multijurisdictional local road safety plan (MLRSP) development.

FINDINGS OF THE REVIEW

California Strategic Highway Safety Plan (2020)

The 2020-2024 Strategic Highway Safety Plan (SHSP) is a statewide, coordinated safety plan providing a comprehensive framework for reducing highway fatalities and severe injuries on public roads in California. It identifies key safety needs and guides investment decisions towards strategies and countermeasures with the most potential to save lives and prevent injuries.

The aspirational goal for the plan is to have zero fatalities and serious injuries on California public roads consistent with other Toward Zero Deaths (TZD) initiatives. The plan establishes steps for California to move closer to zero deaths. Figure 1 shows historical data on fatalities and severe injuries between 2000 and 2017. The reported collisions decreased from the years 2006 to 2010 but have been increasing since 2010. The increase may be influenced by different behavioral and economic factors such as increase total travel on the roadways within the state. Notably, the reported collisions are not normalized by the vehicle miles traveled and so an increase in vehicle miles traveled or the amount of travel across different modes

could impact the extent to which collisions increase or decrease. The dashed black like indicates when California's first SHSP was adopted, in 2006.

The challenge areas or emphasis areas presented in the SHSP are based on in-depth analysis of California collision data and the large number of safety stakeholders. The challenge areas in the updated plan are shown in Table 1:

Figure 1: Fatalities and Severe Injuries, 2000-2017

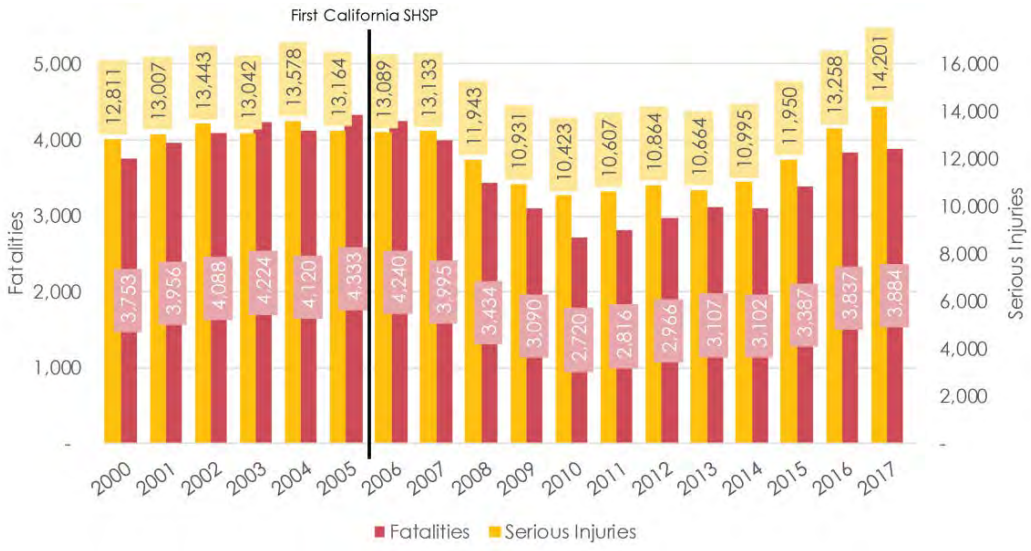


Table 1: SHSP Challenge Areas, 2020-2024

Challenge Areas for SHSP 2020-2024		
Aggressive Driving	Emergency Response	Occupant Protection
Aging Drivers (>=65)	Emerging Technologies	Pedestrians
Bicyclists	Impaired Driving	Work Zones
Commercial Vehicles	Intersections	Young Drivers (15-20)
Distracted Driving	Lane Departures	
Driver Licensing	Motorcyclists	

The key points about traffic-related deaths and severe injuries from the SHSP include:

- Fatalities and severe injuries increased 15 percent and 19 percent respectively, from 2008 to 2017
- Fatalities decreased for the years 2008 to 2010, before increasing again at approximately four percent per year from 2010 to 2017

The SHSP also includes the policy actions involved in the multi-year efforts led by the steering committee and/or technical expert members to develop the SHSP 2020-2024. The efforts included the following areas:

- Update of the SHSP (Began in 2018, and outreach activities completed in May 2019).

- Increase efforts to align SHSP with other Statewide Plans
    - Improving coordination and linkages among regional and statewide planning processes in California will facilitate a common approach to transportation safety planning. This will ultimately help in collectively working towards a common goal.
- Improve analysis of traffic safety data.
    - Improving the analysis on safety challenge areas, by quantitatively understanding fatalities and severe injuries and the contributing factors of traffic collisions.
- Increase federal, tribal, state, and local representatives' involvement.
    - Executive leadership directed that actions to increase communication between the SHSP and local agencies be strengthened. Increasing stakeholder engagement by conducting outreach events, webinar, and other events.

Caltrans Highway Safety Improvement Program Guidance (2017)

The Highway Safety Improvement Program (HSIP) is a core federal-aid program under the Fixing America's Surface Transportation (FAST) Act that went into effect in December 2015. The purpose of the HSIP is to significantly reduce traffic fatalities and severe injuries on all public roads, including non-state-owned roads and roads on tribal land.

The HSIP requires a data-driven, performance-based and strategic approach to improving highway safety on all public roads. The HSIP consists of three primary components:

- Strategic Highway Safety Plan (described above);
- Program of Highway Safety Improvement Projects; and
- Railroad-Highway Grade Crossing Program.

Federal HSIP funds are apportioned by formula to the State of California and split 50/50 between state and local programs. The goal is reducing collisions while providing a safe, sustainable, integrated, and efficient transportation system. Accomplishing this involves systematically investigating high collision concentration locations to determine if measures can be taken to improve highway safety.

To be eligible for HSIP funds, highway safety improvement projects must:

- Address a SHSP priority;
- Be identified through the data-driven process; and
- Contribute to a reduction in fatalities and severe injuries.

There are five steps in the process of Highway Safety Improvement Projects selection:

1. Issue identification.
    - This can be done through systemic approach, spot location approach, and/or comprehensive approach incorporating human/driver behavior.

2. Allocating HSIP funding is to the highest benefit/cost ratio projects. Generally, the maximum federal reimbursement ratio for a HSIP project is 90%; however, there are low-cost proven safety countermeasures that qualify for 100% federal funding eligibility. The project costs for federal HSIP include:
    - Preliminary Engineering, Right of way Capital and Support, and Construction Engineering and Support.
3. The HSIP typically calls for projects at one to two-year intervals. The timing and size of the call is determined by the program apportionments, HSIP Federal Transportation Improvement Program (FTIP) capacity, and the delivery of the existing HSIP projects.
4. Evaluate proposed projects based on the benefit/cost ratio. Other project selection criteria include:
    - Funding set-asides, High Risk Rural Roads (HR3) eligible projects, and maximum federal HSIP funding per agency per cycle. The projects must also address a SHSP priority.
5. Caltrans HQ-Division of transportation programming sends the list of approved projects to the Metropolitan Planning Organizations (MPOs) for consideration. The MPOs amend the FTIP to include their projects.

2018-2042 Fresno Regional Transportation Plan (2017)

The purpose of 2018 Regional Transportation Plan (RTP) is to assess all transportation modes available in incorporated and unincorporated Fresno County, as well as necessary movement of goods through the year of 2042. The first version of RTP was published in 1975 and is updated every four years per the federal requirements. The 2018-2042 RTP is the nineteenth version of the document.

Federal transportation bills Moving Ahead for Progress-21st Century (MAP-21) requires Metropolitan Planning Organizations (MPOs) to execute performance-based planning in order to achieve performance outcomes. One of the performance goals outlined by MAP-21 is related to transportation safety and requires MPO's to achieve significant reduction in traffic fatalities and serios injuries on all public roads. RTP sets specific targets for the following performance measures: number of fatalities; rate of fatalities; number of serious injuries; rate of serious injuries; number of non-motorized fatalities and no-motorized serious injuries.

Table 2 below represents 2018 safety targets set by the evidence-based method and two vision-based methods: state Strategic Highway Safety Plan (SHSP) and the State. The evidence-based method takes into account historical trends in order to predict future performance, while the vision-based methods sets targets regardless of the existing trends. As shown in the table, evidence-based safety targets would result in fewer collisions reduced than the vision-based methods. The vision-based methods set targets for greater collision reduction or greater strides in roadway safety improvement.

Table 2: Comparison of 2018 Numbers for All Target Options

Performance Measure	Evidence Based		State SHSP		State Target	
	2018	2014-2018 Avg.	2018	2014-2018 Avg.	2018	2014-2018 Avg.
Number of Fatalities	130	116	119	133.9	114	122.7
Rate of Fatalities	1.521	1.388	1.396	1.363	1.328	1.350
Number of Serious Injuries	320	315.4	310	313.5	310	313.5
Rate of Serious Injuries	3.743	3.779	3.629	3.756	3.629	3.756
Number of Non-Motorized Fatalities and Serious Injuries	69	67.7	61	65	57	64.1

Source: RTP (2017)

In order to achieve the set safety targets, Fresno COG outlined the following steps within the RTP:

- Provide assistance to member agencies in safety data analysis and other technical matters so that safety issues can be addressed both locally and regionally
- Develop regional implementation mechanism through COG's funding process to advance safety projects and achieve the safety targets
- Encourage and support member agencies to prioritize transportation projects that address safety issues
- Work with law enforcement and emergency medical service on developing strategies and programs to reduce accidents and casualties
- Support and work with responsible agencies in the public about safe driving practice; support the development of an education program/plan to increase awareness of the risky driving behaviors

Fresno County Regional Bicycle & Recreational Trails Master Plan (2013)

The primary focus of this plan is to create a comprehensive and safe network of trails and bikeways in the County. The goal of this network is to provide access for traveling to work, commercial and government centers, educational facilities, and recreational areas. Creating such system of bicycle facilities would enable more multimodal trips and increase bicycle ridership in the Fresno region. A special focus of the plan is to promote bicycle safety and to reduce the number of collisions involving bicyclists.

The Plan outlines that the overall bicycle commuter trips within the urban areas of the Fresno County are expected to double by the year 2035. The implementation of the Plan would result in more designated facilities for people to bike, well-maintained, and a more complete network of bicycle facilities to meet the demand and to maximize the benefits of the local commuters.

The Plan notes that improving the quality and convenience of bicycle facilities would enhance the safety of the users and increase ridership. The main ways for improving the quality of the facilities include elimination of parking next to the bicycle facilities, improving the quality of the roadway surface and removing obstacles, roadway cleaning and sweeping, installation of bicycle-detecting loops at signalized intersections. The Plan also outlines the importance of additional elements such as the availability of secure and convenient bicycle parking.

The Plan also discusses the advisory bodies, agencies, and advocacy groups that promote programs focusing on bicycle education and safety. The groups include but are not limited to the California Highway Patrol, the Fresno County Sheriff's Department, the Fresno County Fire Departments, city Police Departments, school districts, the Fresno Cycling Club, the Fresno County Bicycle Coalition, the local League of American Bicyclists League Certified Instructors, and Tree Fresno.

Fresno County Regional Active Transportation Plan (2018)

The goal of the Fresno County Regional Active Transportation Plan (ATP) is to help each jurisdiction (incorporated and unincorporated areas of the County) in the County to identify the need in bicycle and pedestrian projects, and to secure funds for implementing those projects. The Plan recognizes the need to be sensitive to the context of each jurisdiction and to work separately with local staff and community.

The goals that the ATP outlines for supporting bicycling, walking, and other human-powered transportation within each jurisdiction include increasing safety my improving the quality of bikeway, sidewalks, crosswalks, and trails; creating comprehensive and safe networks of trails, sidewalks, and bikeways; creating a network of bikeways between cities and other key regional destinations; increase walking and bicycling trips by creating more facilities that are friendly for a wider variety of users. To quantify its goals, the ATP outlines the length of each of type of the bikeways and the quantity of intersections and bicycle parking locations that would be improved through ATP.

The ATP expects that through implementing comprehensive measures throughout the state, the collisions involving bicyclists and pedestrians would be significantly reduced. The ATP states that a 50% or greater reduction in injuries and fatalities is reasonable.

Fresno County General Plan (2000)

The purpose of a general plan is to serve as a "blue print" for the County's land use and development. It provides long-term comprehensive vision for the County. It consists of seven elements, each of which focuses on a particular area of future development: land use, circulation, housing, conservation, open space, noise, safety.

The circulation element of the general plan focuses on the transportation facilities within the County. It recognizes roadway safety as one of the improvements and focus areas, however it does not specify detailed roadway safety goals or approaches to be taken. The safety element of the general plan establishes programs to protect the community from other hazards such as seismic, flood, and wildfire.

Comprehensive County General Plan Review and Revision (2017)

The purpose of this document is to provide update to the County general plan, summarized above. The same as the general plan itself, the review and revisions recognizes the importance of prioritizing roadway safety of all road users but does not specify specific goals or approaches.

Eastside Transportation Corridor Improvement Study (2020)

The purpose of the Eastside Transportation Corridor Improvement Study (ETCIS) was to determine the future transportation need of the eastern part of the Fresno County, with a focus on the major transportation corridors that serve the study area: Academy Avenue and Manning Avenue. The goal of the study was to address the issues of mobility, access, safety, and connectivity of all modes of transportation.

The draft ETCIS report presents safety improvements as one of the key outcomes of the project. As part of the projects, a detailed safety analysis was conducted along the Eastside Corridors, Academy Avenue, and Manning avenue which is discussed under “Collisions Analysis” section. As an outcome of the safety study, a set of improvements recommendations was proposed for multimodal modes. The safety related treatments included in those recommendations will be considered as part of the RSP work to identify safety strategies that could be applied across multiple locations within the region.

Section 4
Roadway Safety Performance

ROADWAY SAFETY PERFORMANCE

The following section presents countywide collision patterns and trends. The focus of this analysis is on behavioral and roadway patterns associated with injury and fatal outcomes that can be addressed systemically. Findings from this section help inform appropriate systemic countermeasures suitable for the County's context and align to help address collision trends in the County.

COLLISION DATA

Kittelson worked with Fresno COG and local jurisdictions within the County to assemble collision data for the County using collision data from the Statewide Integrated Traffic Records System (SWITRS) database, supplemented with location information from the Transportation Injury Mapping System (TIMS) database maintained by SafeTREC at the University of California, Berkeley. Kittelson also coordinated with local jurisdictions to provide any local collision data such that the data could be cross-referenced and deemed as complete as possible. The City of Fresno, which maintains a local collision database with the Crossroads Software, provided additional collisions for analysis that are not in the SWITRS or TIMS database.

A total of 39,054 collisions are present in the compiled database. The collisions are from the time period of January 1, 2015 through December 31, 2019. Collision severity is coded according to the highest degree of injury experienced, and the data used for this analysis includes the following coded severity levels (listed in descending order):

- Fatal: death as a result of injuries sustained in the collision
- Severe Injury: Injuries include, for example, broken bones, severe lacerations, or other injuries that go beyond the reporting officer's assessment of "other visible injuries."
- Other visible injury: An injury, other than those described above, that is evident to observers at the scene of the collision—for example, bruises or minor lacerations.
- Complaint of pain: Internal or other non-visible injuries—for example, a person limps or seems incoherent
- Property damage only (PDO): No injuries sustained

For simplicity in presentation, collisions "other visible injury" and "complaint of pain" collisions are frequently collapsed into a single "other injury" category.

REGIONAL COLLISION PATTERNS AND TRENDS

The findings in this section are organized as follows:

- All Road Users
  - Severity by Road User and Jurisdiction
  - Year, Month, and Weather
  - Collision Type
  - Location, Collision Type, and Severity
  - Reported Primary Collision Factor
  - Lighting
  - Time of Day
- Pedestrians
  - Year and Month
  - Pedestrian Action and Location
  - Lighting
- Bicyclists
  - Collision Type
  - Primary Collision Factor
  - Lighting

All Road Users

This section includes analysis and findings for all reported collisions. Subsequent sections focus exclusively on collisions involving pedestrians and bicyclists.

Severity by Road User and Jurisdiction

Table 3 presents reported collisions, organized by severity level and road user. Notable trends include:

- Pedestrians are overrepresented in fatal and severe injury collisions. Pedestrians are involved in 3 percent of reported collisions but are involved in 17 percent of report fatal or severe injury collisions.
- Bicyclists are also overrepresented in fatal and severe injury collisions. Bicyclists are involved 2 percent of reported collisions but 5 percent and 6 percent of fatal and severe injury collisions.

Table 3: Collision Severity by Road User Involved

Road Users Involved	Fatal (% of column)	Severe Injury (% of column)	Visible Injury (% of column)	Complaint of Pain (% of column)	Property Damage Only (% of column)	Total (% of column)
Pedestrian Involved	138 (23%)	195 (14%)	388 (9%)	350 (4%)	142 (1%)	1,213 (3%)
Bicycle Involved	31 (5%)	78 (6%)	290 (7%)	299 (4%)	148 (1%)	846 (2%)
Vehicle Only or Vehicle-Fixed Object	424 (72%)	1,150 (81%)	3,699(84%)	8,039 (93%)	23,748 (99%)	39,107 (95%)
Reported Collisions (% of total)	***592 (2%)***	***1,412 (4%)***	***4,358 (11%)***	***8,666 (22%)***	***24,026 (62%)***	***39,054 (100%)***

Source: City of Fresno, SWITRS, TIMS

Table 4 summarizes collision severity by road user involved by local jurisdiction and compares safety performance to state trends.[1] The SHSP described in the Plan and Policy Review section included 16 challenge areas to focus statewide resources and efforts. Three such challenge areas were collisions involving pedestrians, bicyclists, and motorcyclists. The SHSP analyzed the share of fatal and severe injury collisions involving each of these road users. Table 4 compares the trends within each jurisdiction to the statewide trends reported in the SHSP: red shaded cells indicate where jurisdictions have a higher share than the statewide average. Some jurisdictions include relatively low collision counts; although percentage shares are presented, results should be interpreted with caution.

- Several jurisdictions have higher shares of fatal/severe injury collisions involving pedestrians than the statewide average: Clovis, Fresno, Sanger, and Selma. Other jurisdictions observe higher shares which should be interpreted with caution given relatively low overall reported collision frequency: Coalinga, Firebaugh, Kerman, Parlier, and Reedley.
- Some other jurisdictions have higher shares of fatal/severe injury collisions involving bicyclists than the statewide average: Clovis, Fresno, Sanger, and Selma. Other jurisdictions observe higher shares which should be interpreted with caution given relatively low overall reported collision frequency: Fowler and Reedley.
- Clovis is the only jurisdiction in the County that exhibits a higher share of motorcyclists involved in fatal/severe injury collisions than the statewide average: 21 percent compared to 18 percent statewide.

[1] Throughout this memo, collisions are associated with a jurisdiction based on the reporting officer's assessment of location. Some collisions may occur at or near jurisdiction boundaries, especially along state routes bordering unincorporated County.

Table 4: Collision Shares by Road User, Jurisdiction, and Severity Level Compared to Statewide Trends

Jurisdiction	Severity Level	Number of Reported collisions	Pedestrian Share of Collisions	Bicycle Share of Collisions	Motorcycle share	Vehicle Only or Vehicle-Fixed Object
Clovis	All Severities	3,507	3%	3%	3%	91%
	Fatal/Severe Injury	56	27%	9%	21%	45%
Coalinga	All Severities	378	4%	1%	2%	93%
	Fatal/Severe Injury	9	22%	0%	11%	67%
Firebaugh	All Severities	130	5%	1%	0%	94%
	Fatal/Severe Injury	6	50%	0%	0%	50%
Fowler	All Severities	368	1%	1%	1%	97%
	Fatal/Severe Injury	11	9%	9%	9%	73%
Fresno	All Severities	12,982	6%	4%	2%	88%
	Fatal/Severe Injury	599	36%	10%	8%	48%
Huron	All Severities	18	11%	0%	0%	89%
	Fatal/Severe Injury	1	0%	0%	0%	100%
Kerman	All Severities	200	6%	2%	1%	92%
	Fatal/Severe Injury	5	40%	0%	0%	60%
Kingsburg	All Severities	270	5%	1%	0%	94%
	Fatal/Severe Injury	7	14%	0%	0%	86%
Orange Cove	All Severities	3	0%	0%	0%	100%
	Fatal/Severe Injury	2	0%	0%	0%	100%
Parlier	All Severities	196	9%	1%	1%	90%
	Fatal/Severe Injury	6	50%	0%	0%	50%
Reedley	All Severities	921	3%	3%	1%	93%
	Fatal/Severe Injury	9	22%	33%	0%	44%
San Joaquin	All Severities	2	0%	0%	0%	100%
	Fatal/Severe Injury	-	-	-	-	-
Sanger	All Severities	787	3%	4%	2%	92%
	Fatal/Severe Injury	17	24%	12%	6%	59%
Selma	All Severities	629	5%	5%	1%	90%
	Fatal/Severe Injury	21	29%	19%	0%	52%
Unincorporated	All Severities	18,314	1%	1%	3%	96%
	Fatal/Severe Injury	1,249	6%	3%	15%	76%
Countywide	**All Severities**	**41,476**	**3%**	**2%**	**2%**	**92%**
	Fatal/Severe Injury	**2,096**	**18%**	**6%**	**12%**	**65%**
Statewide Average Share among Fatal/Severe Injury Collisions, 2008-2017			**17%**	**7%**	**18%**	**-**

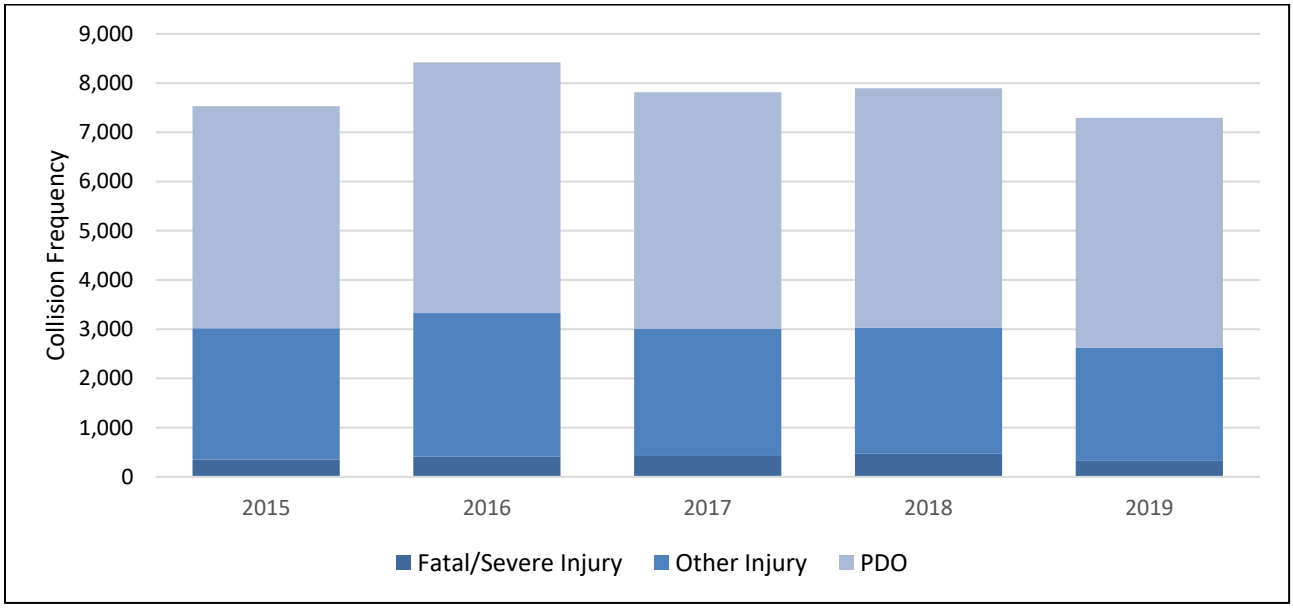
Source: City of Fresno, SWITRS, TIMS

Note: Red shaded cells indicate collision shares that exceed the relevant share from the 2020-2024 *Strategic Highway Safety Plan*.

Year, Month, and Weather

Figure 2 shows year-over-year trends in the data, by severity. The totals have been relatively steady, with an average of 7,810 annual collisions and 401 fatal/severe injury collisions countywide. The year 2019 reflects a decrease relative to prior years, but fluctuations from a single year to the next tend to represent the degree of randomness in collision occurrence and are not necessarily indicative of an overall trend.

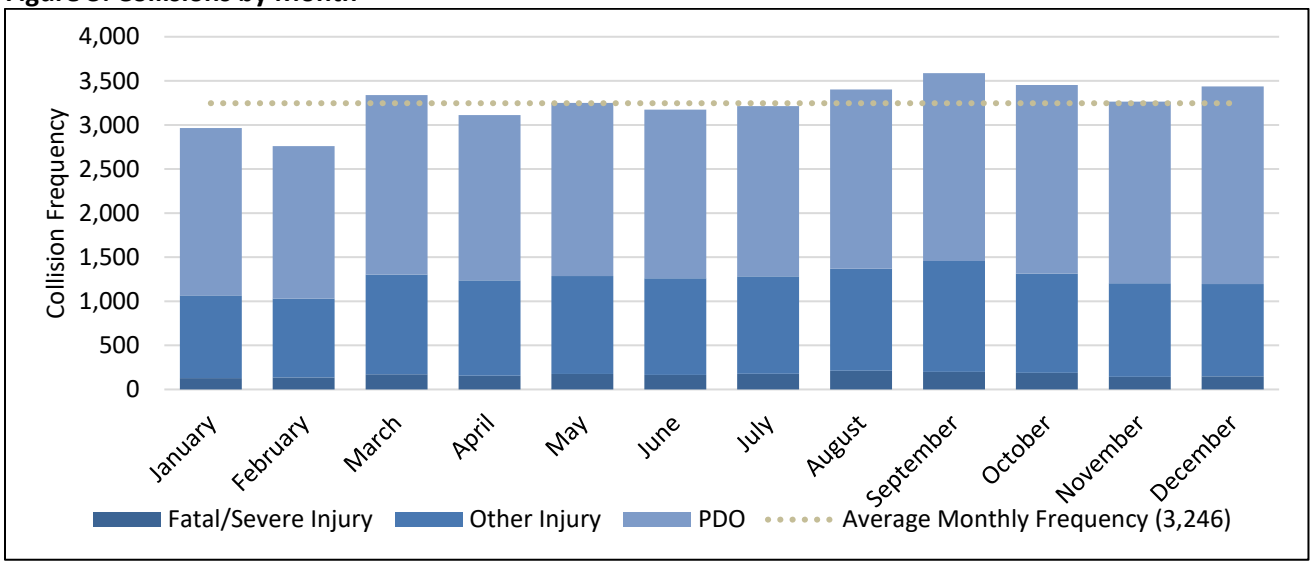
Figure 2: Year-over-Year Trends in Collision Data



Source: City of Fresno, SWITRS, TIMS
Note: "Other injury" includes "Other visible injury" and "Complaint of pain" collisions. "PDO" = property damage only.

Figure 3 presents monthly collision trends throughout the year countywide. The chart also includes the average number of monthly collisions. This line can be interpreted as the expected number of collisions per month if collisions were evenly distributed throughout the year. The largest deviation from average monthly collisions occurs in January and in February, respectively; those months are notably lower in collision frequency across the five years of data than the remaining months throughout each year.

Figure 3: Collisions by Month

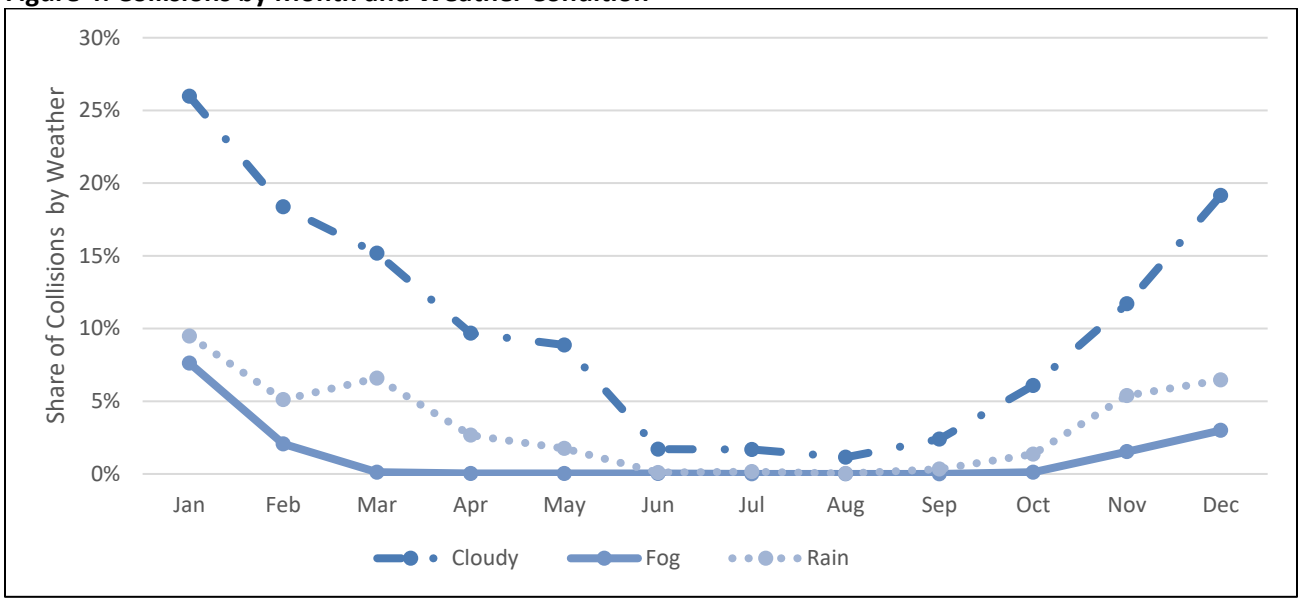


Source: City of Fresno, SWITRS, TIMS
Note: "Other injury" includes "Other visible injury" and "Complaint of pain" collisions. "PDO" = property damage only.

Figure 4 illustrates collisions by month and by weather condition.

- Collisions cited to have occurred under or during fog, cloudy, and/or rainy conditions show increases in the months of October to March.
- Based on available data, collisions occurring in foggy conditions peak in the winter months (November through February). This is the case in January and February as well even though other collision types and total reported collisions in January and February tend to decrease relative to other months in the year.

Figure 4: Collisions by Month and Weather Condition



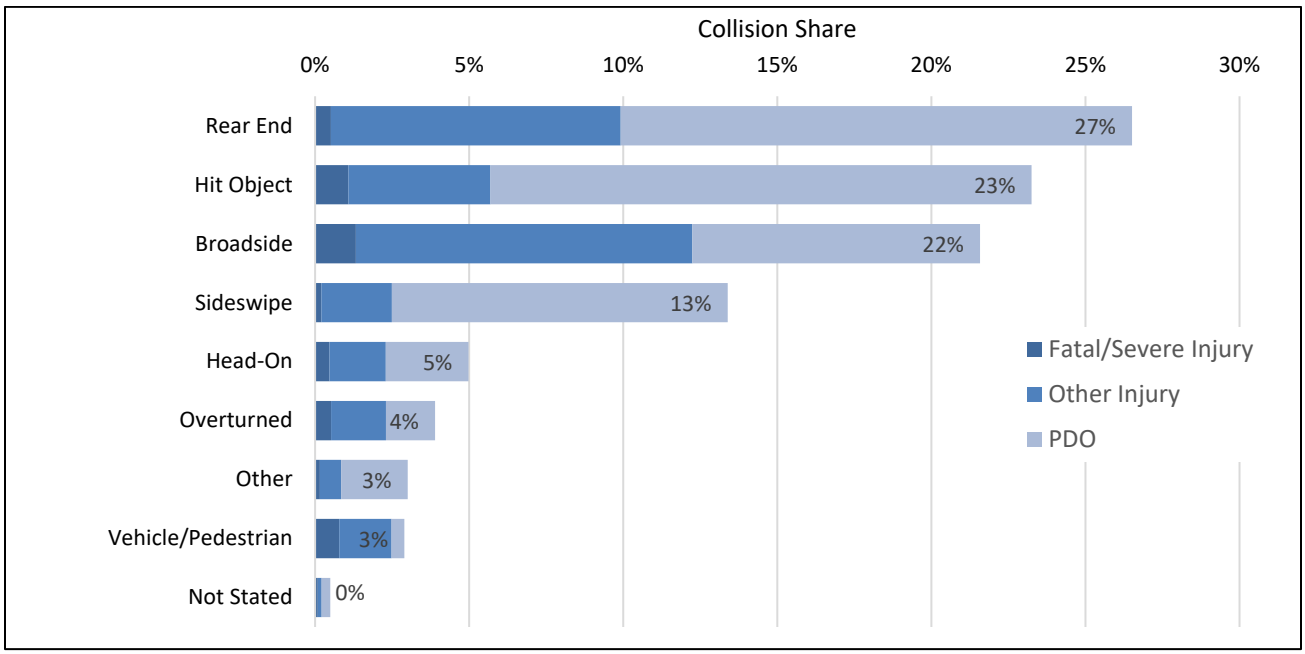
Source: City of Fresno, SWITRS, TIMS
Note: Only select conditions shown to improve legibility for less frequent weather conditions.

Collision Types

Reported collision type gives an indication of the movements most frequently resulting in collisions and in severe outcomes. Figure 5 reports the most frequent reported collision types by severity.

- The top three most frequent collision types are rear end collisions (27 percent of reported collisions), hit object collisions (23 percent), and broadside collisions (22 percent). These three collision types account for 72 percent of reported collisions in the region.
- Among collisions resulting in death or severe injury, the top three collision types are broadside collisions (26 percent of reported fatal/severe injury collisions), hit object collisions (21 percent), and vehicle/pedestrian collisions (15 percent). These three collectively account for 62 percent of reported fatal/severe injury collisions in the region.

Figure 5: Collision Types by Severity



Source: City of Fresno, SWITRS, TIMS
Note: "Other injury" includes "Other visible injury" and "Complaint of pain" collisions. "PDO" = property damage only.

Inspecting collision type by jurisdiction allows for comparison to the overall regional trends. Table 5 shows collision type and share organized by jurisdiction among all collisions, and Table 6 shows the same shares among fatal/severe collisions exclusively. In both tables, the red shaded cells indicate the top three most frequent collision types for each jurisdiction. For entries with fewer than 20 collisions, percentage shares are still shown but the shading is suppressed to emphasize caution in interpreting results.

Table 5: Overall Collision Share by Type and Jurisdiction

Jurisdiction (n = Collision Count)	Collision Type									
	Rear End	Hit Object	Broadside	Sideswipe	Head-On	Overturned	Other	Vehicle / Pedestrian	Not Stated	Total Reported
Unincorporated (n=18,314)	21%	30%	24%	10%	3%	7%	3%	1%	0%	100%
Fresno (n=12,982)	28%	18%	21%	15%	7%	1%	3%	6%	1%	100%
Clovis (n=3,507)	31%	17%	27%	16%	4%	1%	2%	3%	0%	100%
Reedley (n=921)	53%	13%	3%	18%	7%	1%	2%	4%	0%	100%
Sanger (n=787)	26%	11%	31%	17%	7%	1%	2%	4%	1%	100%
Selma (n=629)	38%	21%	6%	15%	7%	1%	4%	5%	1%	100%
Coalinga (n=378)	38%	9%	11%	26%	6%	0%	4%	4%	2%	100%
Fowler (n=368)	51%	17%	4%	17%	2%	1%	8%	1%	0%	100%
Mendota (n=348)	42%	7%	4%	30%	10%	1%	3%	3%	1%	100%
Kingsburg (n=270)	45%	23%	6%	14%	5%	0%	2%	5%	0%	100%
Kerman (n=200)	62%	9%	1%	16%	5%	1%	1%	6%	1%	100%
Parlier (n=196)	44%	13%	3%	21%	7%	1%	3%	9%	1%	100%
Firebaugh (n=130)	38%	8%	9%	22%	8%	3%	5%	4%	2%	100%
Huron (n=18)	17%	0%	22%	22%	0%	0%	11%	6%	22%	100%
Orange Cove (n=3)	33%	0%	67%	0%	0%	0%	0%	0%	0%	100%
San Joaquin (n=2)	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%

Source: Fresno, TIMS

Note: Cell shading not applied for rows with fewer than 20 collisions to avoid overstating trends.

Table 6: Fatal/Severe Injury Collision Share by Type and Jurisdiction

Jurisdiction (n = Collision Count)	Collision Type									
	Broadside	Hit Object	Vehicle / Pedestrian	Overturned	Rear End	Head-On	Sideswipe	Other	Not Stated	Total
Unincorporated (n=1,249)	30%	25%	6%	14%	9%	9%	4%	2%	0%	100%
Fresno (n=599)	21%	14%	34%	3%	9%	8%	4%	4%	6%	100%
Clovis (n=56)	23%	18%	23%	5%	9%	9%	5%	7%	0%	100%
Selma (n=21)	5%	19%	29%	0%	29%	10%	10%	0%	0%	100%
Sanger (n=17)	24%	12%	18%	6%	12%	12%	6%	6%	6%	100%
Fowler (n=11)	9%	9%	0%	0%	64%	9%	0%	9%	0%	100%
Coalinga (n=9)	11%	0%	22%	11%	44%	11%	0%	0%	0%	100%
Reedley (n=9)	11%	0%	33%	0%	11%	33%	0%	11%	0%	100%
Kingsburg (n=7)	14%	14%	0%	0%	43%	14%	0%	14%	0%	100%
Firebaugh (n=6)	0%	17%	17%	0%	0%	50%	0%	0%	17%	100%
Mendota (n=6)	0%	0%	50%	0%	33%	0%	17%	0%	0%	100%
Parlier (n=6)	0%	0%	50%	17%	17%	0%	17%	0%	0%	100%
Kerman (n=5)	0%	20%	40%	0%	20%	20%	0%	0%	0%	100%
Orange Cove (n=2)	50%	0%	0%	0%	50%	0%	0%	0%	0%	100%
Huron (n=1)	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Source: City of Fresno, SWITRS, TIMS

Note: Cell shading not applied for rows with fewer than 20 collisions to avoid overstating trends.

Collisions by Location and Type and Severity

The previous section focused on frequency of collision types. Throughout the County, collision types may exhibit different average severity levels depending on the location (i.e., intersection or segment) of the collision. Therefore, a useful complementary approach to understanding severe outcomes in Fresno County is through the use of a relative severity index (RSI). RSI allows for comparison of the average severity of collisions types and locations. In other words, it answers the question: *What combination of collision type and location has resulted in the most severe outcomes?* RSI values allow for focus on the types and locations that are most closely associated with risk and present the greatest opportunity for improvement.

To calculate RSI, every reported collision is assigned a cost based on its severity using average values provided by Caltrans.[2]. The values are then averaged for each collision type and location. The results are normalized as equivalent property damage only (PDO) collisions and can be compared on a relative basis.

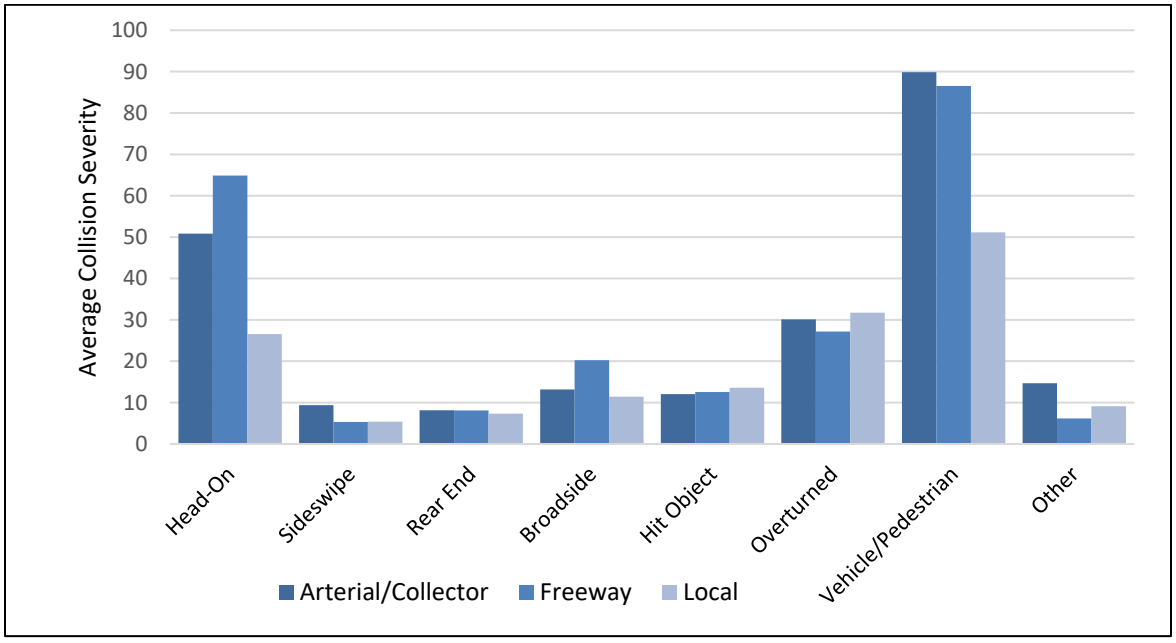
Figure 5 and Figure 6 present RSI values for segment and intersection collisions, respectively.

The discussion above established that broadside, hit object, and vehicle/pedestrian collisions are the most frequent fatal/severe injury collisions countywide and within many jurisdictions in the County. The results in Figure 5 reveal the following:

- Vehicle/pedestrian collisions result in notably higher severities than other collision types. Vehicle/pedestrian collisions on arterials and collectors are on average almost twice as severe as the next-highest collision type.
- Higher-order roadways are associated with higher severities: Average RSI for head-on collisions and vehicle/pedestrian collisions is notably higher on arterials and collectors and on freeways than it is on local roadways.

[2] This concept is discussed in more detail in the *Regional High Injury Network* section.

Figure 6: Segment Relative Severity Index

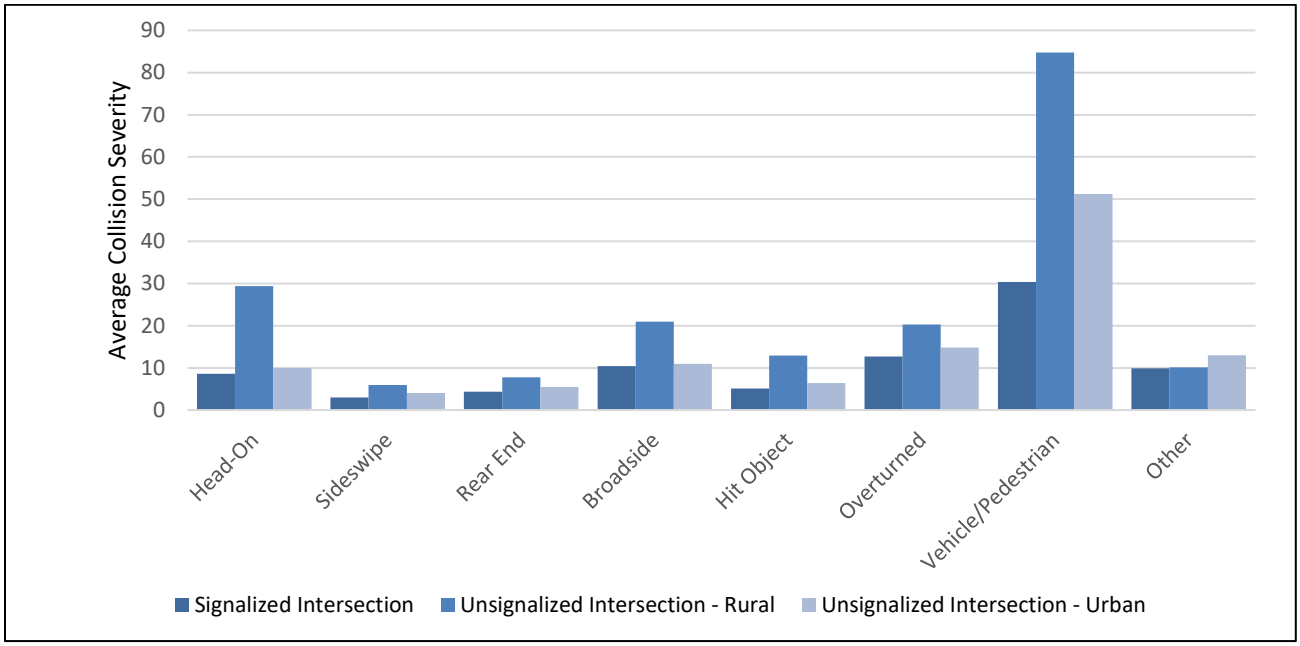


Source: City of Fresno, SWITRS, TIMS

Figure 7 shows that similar trends hold at intersections, which were classified by control type. Unsignalized intersections were further classified as urban if they were within a city's boundaries or rural if they were in unincorporated County.

- Vehicle/pedestrian collisions also result in the most severe outcomes across all locations, particularly at rural unsignalized intersections. Vehicle/pedestrian collisions at rural unsignalized intersections result in almost twice as severe outcomes compared to other locations.
- Other collision types that exhibit high relative average severities include head-on, broadside, and overturned collisions—all at unsignalized intersections. This finding coincides with the discussion of the top collision types in the prior section, which identified broadside, hit object, and vehicle/pedestrian collisions as the top three collision types among fatal/severe injury collisions.

Figure 7: Intersection Relative Severity Index



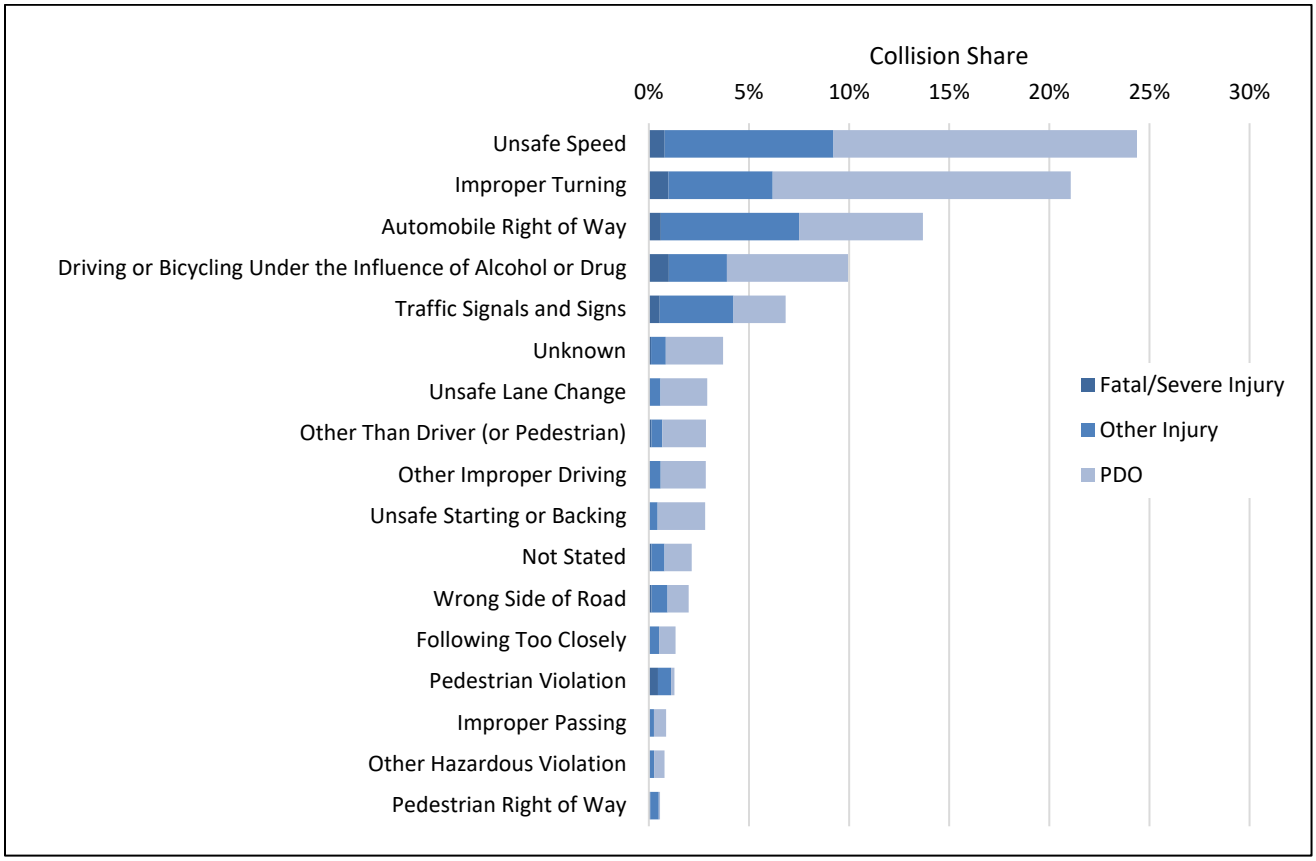
Source: City of Fresno, SWITRS, TIMS

Primary Collision Factor

Reporting officers identify a primary collision factor (PCF) for each collision. There are a number of different PCFs from which they can select. It is up to the officer's own judgement and information available at the scene for them to select the factor that is most relevant. Officers select one from among a list of PCFs based on violations and road user behavior. Figure 8 presents the most frequently cited PCFs in collisions Countywide.

- The three most frequently reported PCFs among reported collisions include unsafe speed (24 percent of reported collisions), improper turning (21 percent), and automobile right of way (14 percent). These three account for 59 percent of reported collisions.
- The three most frequently reported PCFs among fatal/severe injury are driving or bicycling under the influence of alcohol or drug, improper turning (both 19 percent of reported fatal and severe injury collisions), and unsafe speed (15 percent) – a total of 54 percent among all three.

Figure 8: Collisions by Reported PCF



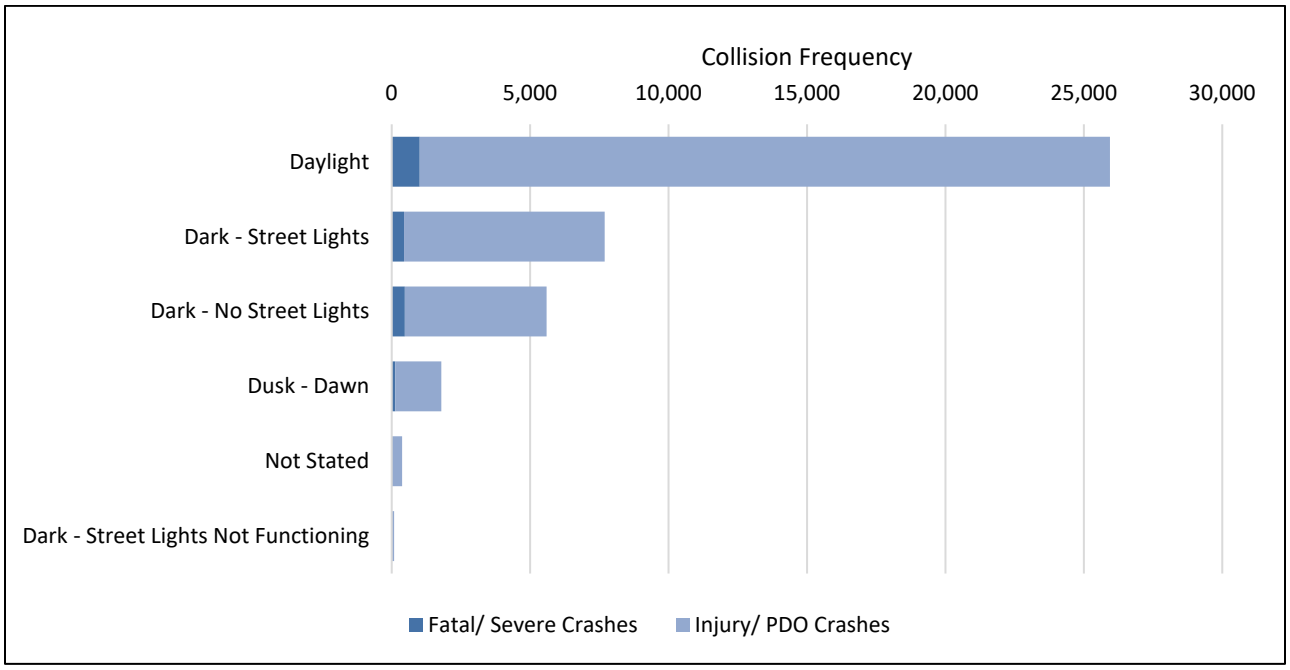
Source: City of Fresno, SWITRS, TIMS
Note: PCFs constituting <1% excluded from chart to enhance legibility. Those PCFs include other equipment, hazardous parking, impeding traffic, lights, and brakes.
Note: "Other injury" includes "Other visible injury" and "Complaint of pain" collisions. "PDO" = property damage only.

Lighting

Figure 9 shows countywide collisions by reported lighting condition and severity.

- Collisions that occurred in dark conditions make up 32 percent of total reported collisions, but account for 44 percent of fatal and severe injury collisions.
- 318 fatal collisions occurred in the dark, of which 168 occurred where there were either no streetlights or streetlights were reported not to be functioning.

Figure 9: Collisions by Lighting



Source: City of Fresno, SWITRS, TIMS
Note: "Other injury" includes "Other visible injury" and "Complaint of pain" collisions. "PDO" = property damage only.

Collisions by Time of Day

Table 7 shows collisions by time of day throughout the week, shaded by intensity to indicate the frequency of hours throughout the week. Collisions show a clear uptick during the weekday morning peak period and an extended afternoon/evening peak period (extending from approximately 2 PM to 6 PM). Collisions are distinctly lower and less temporally concentrated on Saturdays and Sundays.

Table 7: Collisions by Time of Day

Time of Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
12:00 AM - 12:59 AM	98	68	78	74	82	132	185
01:00 AM - 01:59 AM	109	71	79	93	105	191	232
02:00 AM - 02:59 AM	98	68	68	78	101	197	222
03:00 AM - 03:59 AM	66	70	56	48	76	157	155
04:00 AM - 04:59 AM	77	66	65	64	80	118	152
05:00 AM - 05:59 AM	142	145	121	148	145	181	128
06:00 AM - 06:59 AM	215	251	240	196	203	160	112
07:00 AM - 07:59 AM	389	434	379	420	358	147	92
08:00 AM - 08:59 AM	285	344	312	325	291	159	92
09:00 AM - 09:59 AM	194	240	227	220	193	174	143
10:00 AM - 10:59 AM	239	221	239	213	247	227	157
11:00 AM - 11:59 AM	266	250	254	260	296	243	226
12:00 PM - 10:59 PM	301	310	280	265	294	261	245
01:00 PM - 01:59 PM	285	284	347	286	318	286	230
02:00 PM - 02:59 PM	376	400	342	346	408	242	240
03:00 PM - 03:59 PM	437	437	397	452	467	292	247
04:00 PM - 04:59 PM	394	460	386	389	466	308	262
05:00 PM - 05:59 PM	440	454	457	458	498	292	269
06:00 PM - 06:59 PM	322	265	314	284	380	323	317
07:00 PM - 07:59 PM	202	204	218	235	286	268	267
08:00 PM - 08:59 PM	197	183	216	199	251	242	248
09:00 PM - 09:59 PM	187	177	167	221	272	278	214
10:00 PM - 10:59 PM	136	129	140	155	225	239	165
11:00 PM - 11:59 PM	110	107	118	124	170	217	163

Source: City of Fresno, SWITRS, TIMS
Note: 465 collisions did not have a time of day reported.

Pedestrians

This section focuses exclusively on collisions involving pedestrians. Table 8 presents pedestrian-involved collisions countywide organized by severity level. Of the 1,123 pedestrian collisions in the County, 27 percent resulted in death or severe injury. This share is more than four times higher than the same share of total reported collisions (6 percent). Pedestrian collisions are four times more likely to result in death or severe injury than collisions overall.

Table 8: Severity by Pedestrians Involved

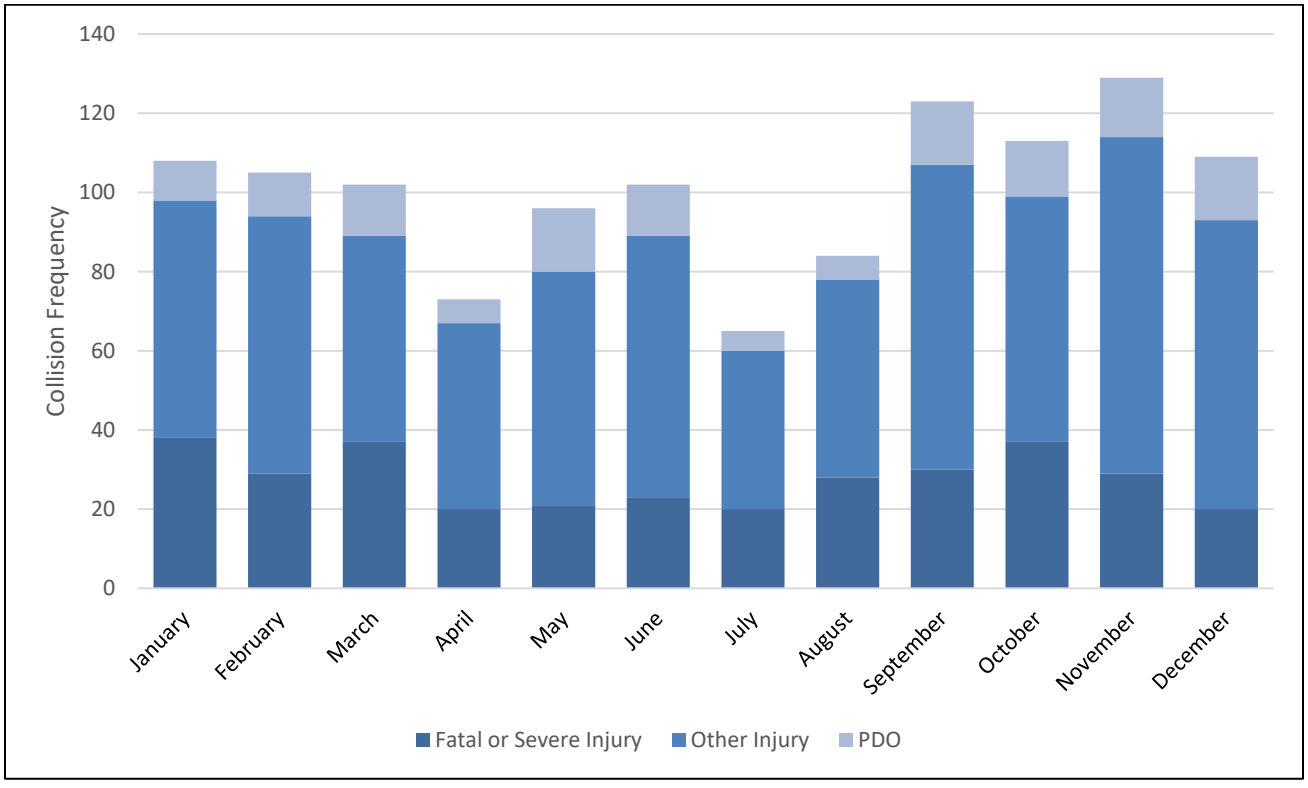
	Fatal (% of Total)	Severe Injury (% of Total)	Visible Injury (% of Total)	Complaint of Pain (% of Total)	Property Damage Only (% of Total)	Total
Pedestrian Involved	138 (11%)	195 (16%)	388 (32%)	350 (29%)	142 (12%)	1,213 (100%)

Source: City of Fresno, SWITRS, TIMS

Year and Month

Figure 11 presents pedestrian collisions organized by month and severity. Fall and winter months (in particular September through November) show an uptick in pedestrian collisions.

Figure 10: Pedestrian Collisions by Month



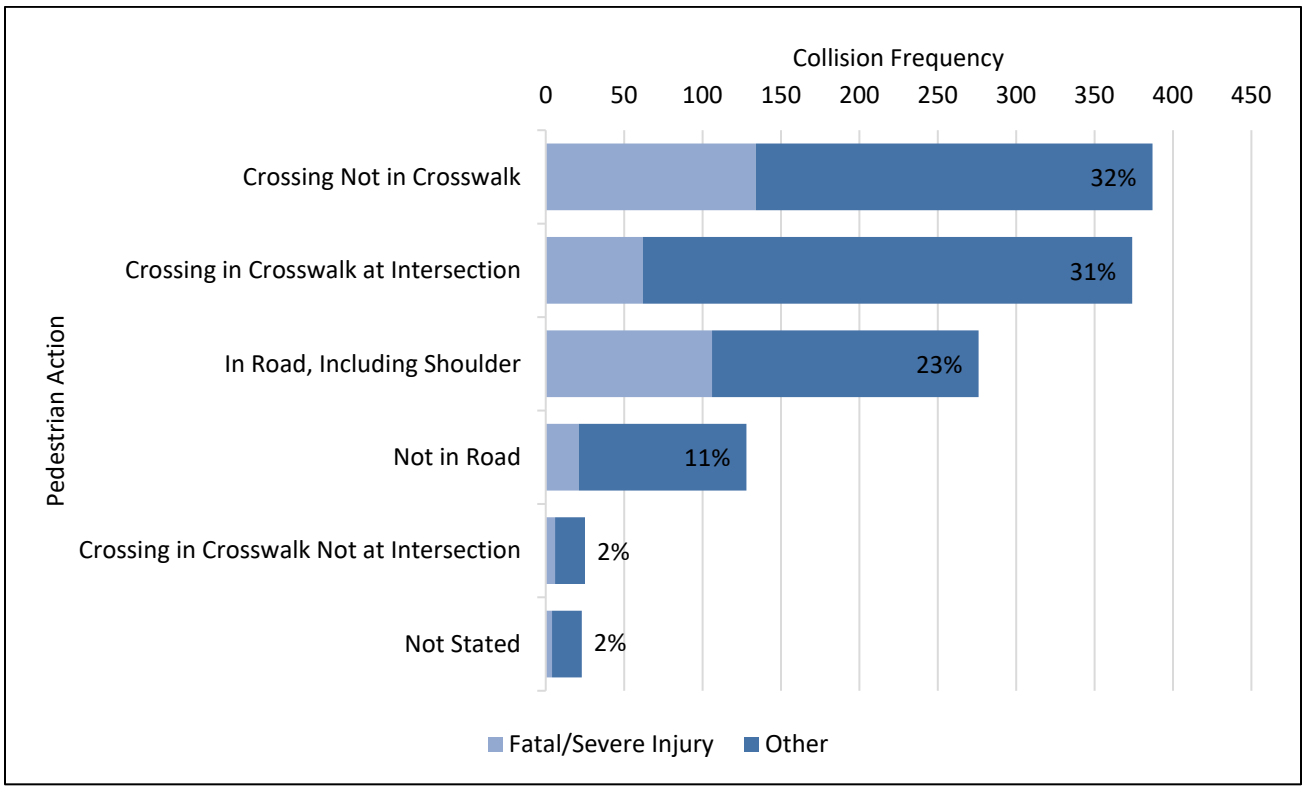
Source: City of Fresno, SWITRS, TIMS

Pedestrian Action and Location

For pedestrian collisions, data are recorded that indicate the reporting officer's best judgment about the person's location and action preceding the collision. Figure 11 reports these trends in the County.

- Among fatal or severe injury pedestrian collisions, 40 percent occurred while a pedestrian was crossing a roadway outside a crosswalk, which was disproportionately higher than the share of the same pedestrian action among the total reported pedestrian collisions (32 percent).
- The second and third most common pedestrian actions preceding a collision included crossing in a crosswalk at an intersection (31 percent) and walking in the road (along the roadway, including shoulder, at 21 percent).

Figure 11: Pedestrian Collisions by Reported Location and Action



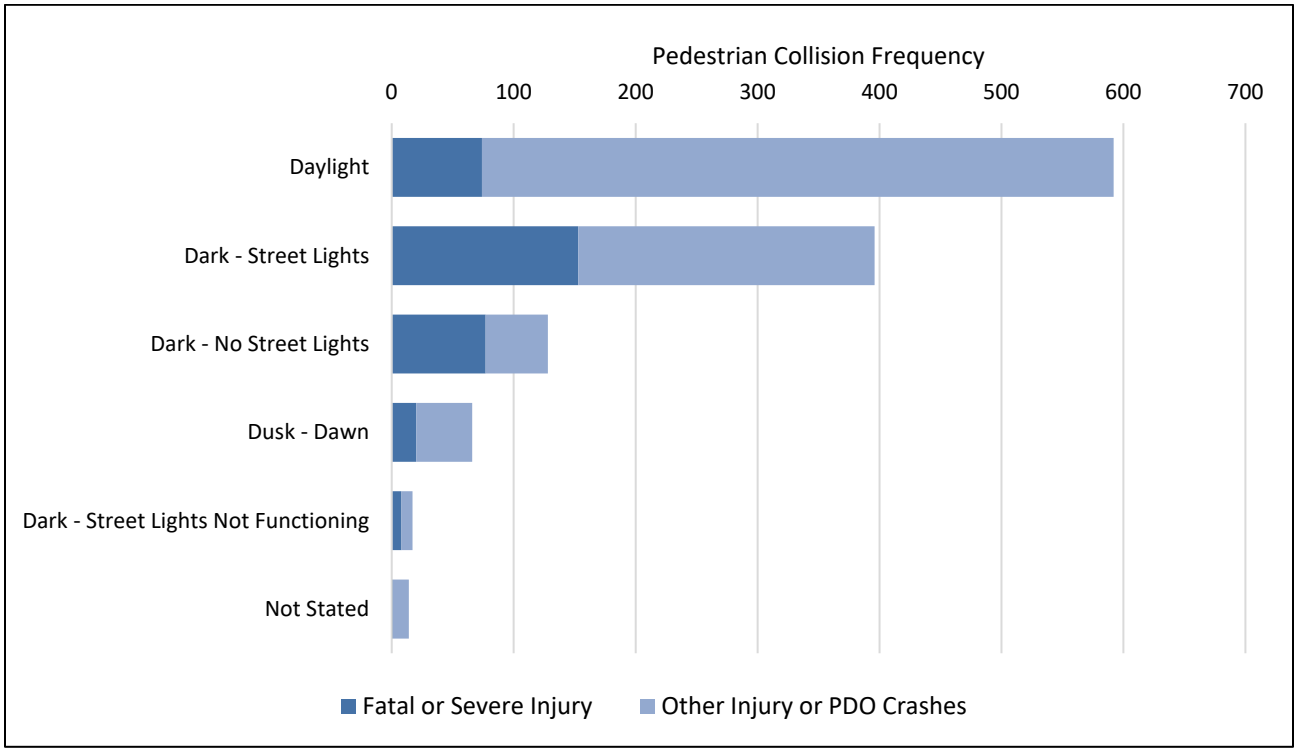
Source: City of Fresno, SWITRS, TIMS

Lighting

Figure 10 shows countywide pedestrian collisions by reported lighting condition and severity.

- Collisions that occurred in the dark or dusk/dawn conditions make up 50 percent of total reported collisions but account for 77 percent of fatal and severe injury collisions.
- 113 fatal collisions occurred in the dark, of which 45 (39 percent share) occurred where there were either no streetlights or streetlights were reported not to be functioning.

Figure 12: Pedestrian Collisions by Lighting



Source: City of Fresno, SWITRS, TIMS

Bicyclists

This section focuses exclusively on collisions involving bicyclists. Table 9 presents bicyclist-involved collisions countywide organized by severity level. Of the 846 bicyclist collisions in the County, 13 percent resulted in death or severe injury. This share is about twice the same share of total reported collisions (6 percent). Bicyclist collisions are four times more likely to result in death or severe injury than collisions overall.

Table 9: Severity with Bicycle User Involved

	Fatal (% of total)	Severe Injury (% of total)	Visible Injury (% of total)	Complaint of Pain (% of total)	Property Damage Only (% of total)	Total (% of total)
Bicycle Involved	31 (4%)	78 (9%)	290 (34%)	299 (35%)	148 (18%)	846 (100%)

Source: City of Fresno, SWITRS, TIMS

Collision Type

Table 10 presents reported bicycle collisions, organized by collision type.

- The top three collision types among bicyclist collisions include broadside collisions (36 percent), other (21 percent), and vehicle/pedestrian collisions (14 percent). While some

bicycle-involved collisions do include pedestrians, the relatively high share of collisions coded as other or vehicle/pedestrian could indicate a lack of precision in collision reporting for bicycle collisions.

Table 10: Collision Type with Bicycle User Involved

	Broadside (% of total)	Other (% of total)	Vehicle/ Pedestrian (% of total)	Rear End (% of total)	Sideswipe (% of total)	Head-On (% of total)	Total (% of total)
Bicycle Involved	305 (36%)	181 (21%)	115 (14%)	82 (10%)	80 (10%)	46 (5%)	846 (100%)

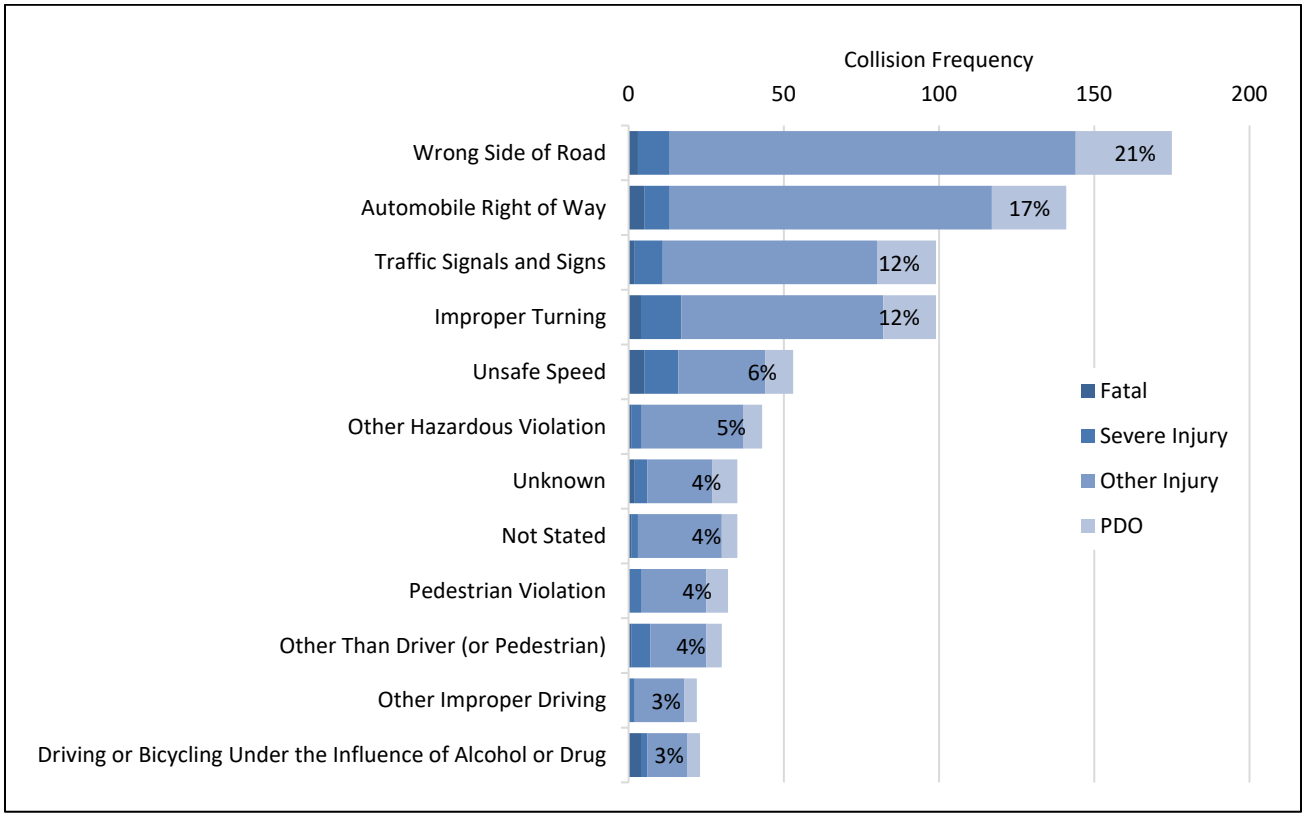
Source: City of Fresno, SWITRS, TIMS
Note: Low-percentage collision types excluded from table to enhance legibility. Those categories hit object, not stated, and overturned.

Primary Collision Factor

Figure 13 presents the reported PCF among bicycle collisions.

- The most frequently cited PCF was wrong side of road driving/riding. Complete data are not available on whether these collisions indicate drivers or bicyclists were traveling on the wrong side of the road.
- The other two most frequent PCFs among bicycle collisions include automobile right of way (indicating one road user failed to give way to another) and traffic signals and signs (indicating that one road user failed to comply with a traffic signal indication or stop sign).

Figure 13: Primary Collision Factor by Bicycle Collisions



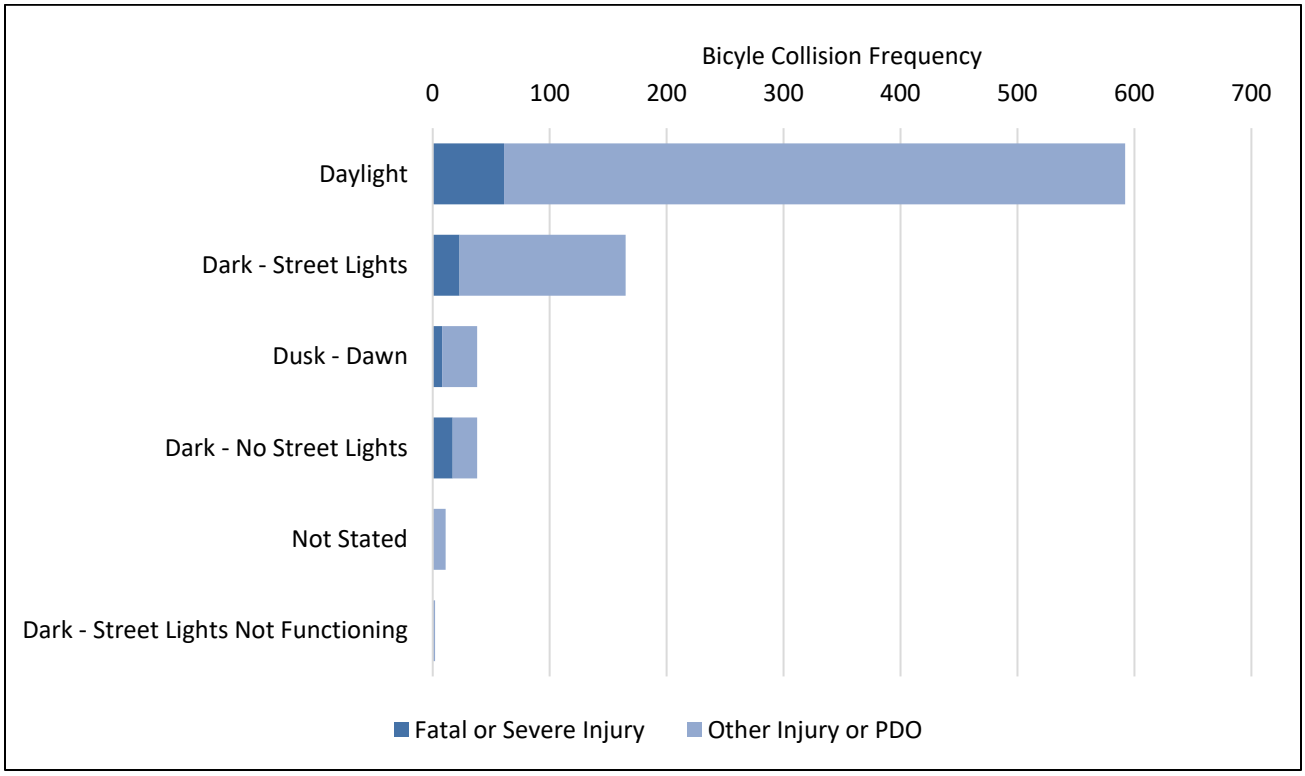
Source: City of Fresno, SWITRS, TIMS
Note: Low-frequency PCFs constituting excluded from chart to enhance legibility. Those categories include lights, pedestrian right of way, improper passing, unsafe lane change, unsafe starting or backing, brakes, and impeding traffic.

Lighting

Figure 14 presents bicycle collisions organized by lighting and severity.

- The majority of collisions (70 percent) occur in daylight conditions.
- Bicycle collisions occurring in the dark or in dusk/dawn conditions account for 29 percent of reported bicyclist collisions but 44 percent of fatal/severe injury collisions.

Figure 14: Bicycle Collisions by Lighting



Source: City of Fresno, SWITRS, TIMS

REGIONAL HIGH INJURY NETWORK

In combination with the descriptive statistics for the region, Kittelson conducted a network screening of the region's roadways and intersections to identify the locations with the highest frequency and severity of collisions as well as collision types of interest. The following sections describe the data and analysis used to evaluate countywide safety performance.

Roadway Network

The analysis evaluates collisions that occurred on public streets within unincorporated and incorporated areas of Fresno County including state highway facilities. A linear referencing system of all public roadways was developed using the Fresno County roadway centerline file. This dataset was updated to develop a measurement system based on the total road length (as determined by roadway name) to locate collisions to a specific mile point along the network to allow for the calculation of *Highway Safety Manual* network screening performance measures using spatial statistics. Following the creation of the roadway network, nodes were created for all intersections across the region. Quality control checks were performed to ensure grade-separated crossings were appropriately modeled and identify other inconsistencies or errors in the roadway and intersection network.

Analysis Approach

The following steps outline the basic analysis approach to assess countywide safety performance:

1. Establish the HIN database using the collision and roadway network data described above.
2. Evaluate the frequency and severity of reported collisions using Equivalent Property Damage Only (EPDO) and Excess Predicted Average Collision Frequency Using Method of Moments performance metrics and sliding window methodology from the Highway Safety Manual using weighting consistent with Caltrans Local Roadway Safety Manual collision costs guidance.
3. Map resulting performance metrics to display regional safety performance countywide.

Note, roadway segments and intersections in the resulting HIN maps are not weighted based on travel volumes or demand. While field-collected traffic volumes and travel demand model volumes can be useful tools in weighing and classifying roads differently based on their volume and demand, there are limits and challenges to this data which rendered it infeasible to apply to the countywide HIN in a consistent manner that would allow for comparisons across the region. For example, consistent traffic volumes are not available for all roads that are being analyzed. Additionally, Fresno COG's travel demand model network does not cover all roads analyzed and is not able to be directly linked to the roadway network. Therefore, all analyzed roadway segments are evaluated without adjusting for travel volumes.

Equivalent Property Damage Only (EPDO)

Kittelson used the equivalent property damage only (EPDO) score performance measure from the AASHTO *Highway Safety Manual*, which assigns weighting factors to collisions by severity relative to property damage only (PDO) collisions. The EPDO calculation was performed for all public intersections and roadway segments including state highway facilities. The EPDO performance measure is described below. Moving forward throughout this document, the EPDO performance measure is referred to as a collision severity score.

The collision severity score assigns weight to individual collisions based on the collision severity and location of the collision (Table 12). Weights, provided by the 2020 *Caltrans' Local Roadway Safety Manual*, are based on the cost of property-damage-only (PDO) collisions, assigning each collision with a score relative to a PDO collision.

Table 11: Collision Weights by Severity and Location Type

Location Type	Collisions Weighting by Severity				
	Fatal	Severe Injury	Other Visible Injury	Complaint of Pain	Property Damage Only
Signalized Intersection	119.55	119.55	10.70	6.08	1.00
Unsignalized Intersection	190.23	190.23	10.70	6.08	1.00
Roadway	164.66	164.66	10.70	6.08	1.00

Source: Caltrans, *Local Roadway Safety: A manual for California's Local Road Owners* (Version 1.5), 2020.

The weights prioritize fatal and severe injury collisions equally to recognize that a death versus a severe injury is often a function of the individual involved or of emergency response time. Therefore, both outcomes represent locations where the region may want to prioritize improvements. Collision weights vary by location due to the relative costs associated with the collision severity at the location types. Specifically, unsignalized intersections have a higher cost for fatal and severe collisions because fatal and severe collisions at these locations tend to result in more severely injured persons on average.

The EPDO score is calculated by multiplying each collision severity total by its associated weight and summing the results, using the following formula:

*EPDO Score = Fatal weight * # of fatal collisions + severe injury weight * # of severe injury collisions + other visible injury weight * # of other visible injury collisions + complaint of pain injury weight * # of complaint of pain injury weight collisions*

The EPDO score is annualized by dividing the score by the number of years (five) of collision data used in the analysis.

Excess Predicted Average Collision Frequency Using Method of Moments

Kittelson also used the Excess Predicted Average Collision Frequency Using Method of Moments performance metrics to calculate the predicted excess collision frequency for each analysis segment and intersection. This method identifies the extent to which a location is experiencing either more collisions or fewer collisions than one would expect based on how other locations like it are performing.

Mathematically, this method adjusts the observed collision frequency for a site based on the variance in the collision data and average collision frequencies for a site's reference population. Reference populations were established based on urban/rural designation, functional classification, and traffic control (for intersections only). The adjusted observed collision frequency is then compared to the average collision frequency for the reference population to calculate the excess predicted collisions for each location.

For this analysis, the following weights will be assigned, consistent with the methodology for the countywide bicycle and pedestrian HINs as part of the CATP.

Intersection Methodology

Kittelson first identified signalized and unsignalized intersections in the regional road network and defined collisions as intersection or segment collisions. An intersection collision is defined as a collision that occurs within 250 feet of the intersection based on Caltrans guidance. These collisions were spatially joined and summarized in ArcGIS to calculate the total number of collisions by severity at each intersection. Where intersections were less than 500 feet from each other, collisions were assigned to the nearest of the two intersections. Collisions occurring more than 250 feet from any intersection were separated to be used in the segment analysis discussed below. Collision severity and excess predicted collision scores were calculated were each location based on annualize collision frequencies.

Sliding Window Methodology

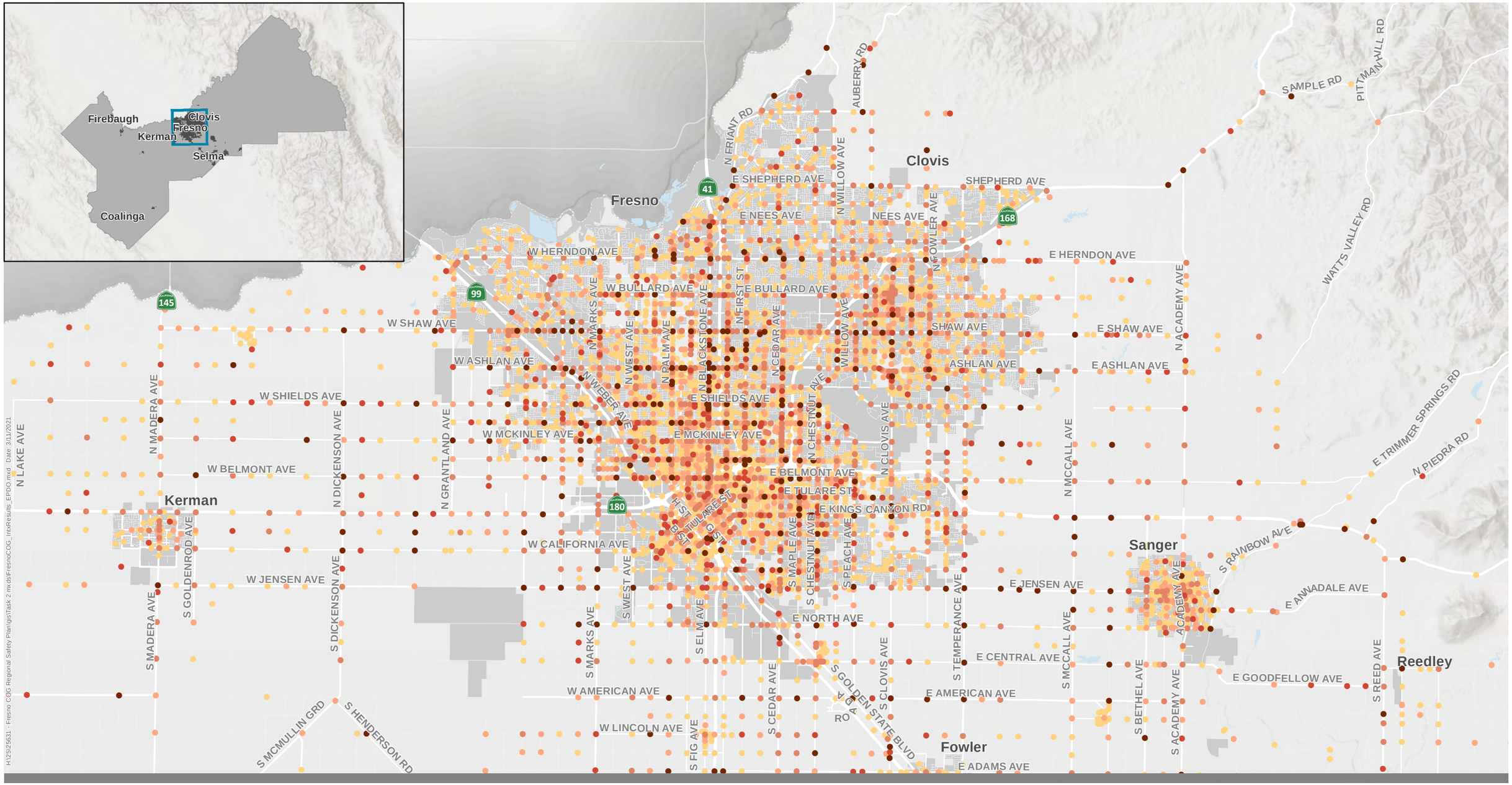
Kittelson used a Python-based script to segment the street network into one-half (1/2) of a mile segments, incrementing the segments by one-quarter (1/4) of a mile. The EPDO score will be calculated per increment of each segment as the script "slides" along each roadway in the network. Collisions associated with intersections (i.e., collisions within 250 feet of the intersection are ignored for the segment analysis and analyzed as part of the intersection methodology). This methodology helps to identify portions of roadways with the greatest potential for safety improvements. The scores were aggregated based on relative regional percentiles of the resulting collision severity and excess predicted collisions scores to map out regional safety performance and identify high injury locations.

High Injury Network Screening Findings

Kittelson identified priority intersections and segments using the annualized collision severity scores and excess predicted collisions; the results are presented below. For intersection locations, the collision severity scores ranged from zero (no reported collisions during the 5 years) to 201.09. For the half-mile roadway segments, the collision severity scores ranged from zero to 191.03. Figure 15.1 through Figure 15.7 show the results of the collision severity scoring. Figure 16.1 through Figure 16.7 show excess predicted collision scores by percentiles for intersection locations, respectively.

Collision severity score results for roadway segments are shown in Figure 17.1 through Figure 17.7. Excess predicted collision score results are shown in Figure 18.1 through Figure 18.7. Intersections or segments shown as not falling within one of the percentile breaks indicates that there were no reported collisions at that location.

In addition to these analyses, total collision frequencies for the three high-priority collision types identified in the regional collision patterns and trends – Broadside, Hit Object, and Vehicle-Pedestrian – to illustrate where these collision types are concentrated across the region. These results are shown in the compiled Figure 19, Figure 20, and Figure 21. For the top one percent of regional intersections and segments, and the top 20 locations for each jurisdiction (where applicable), see Appendix A.



Collision Severity Scores

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

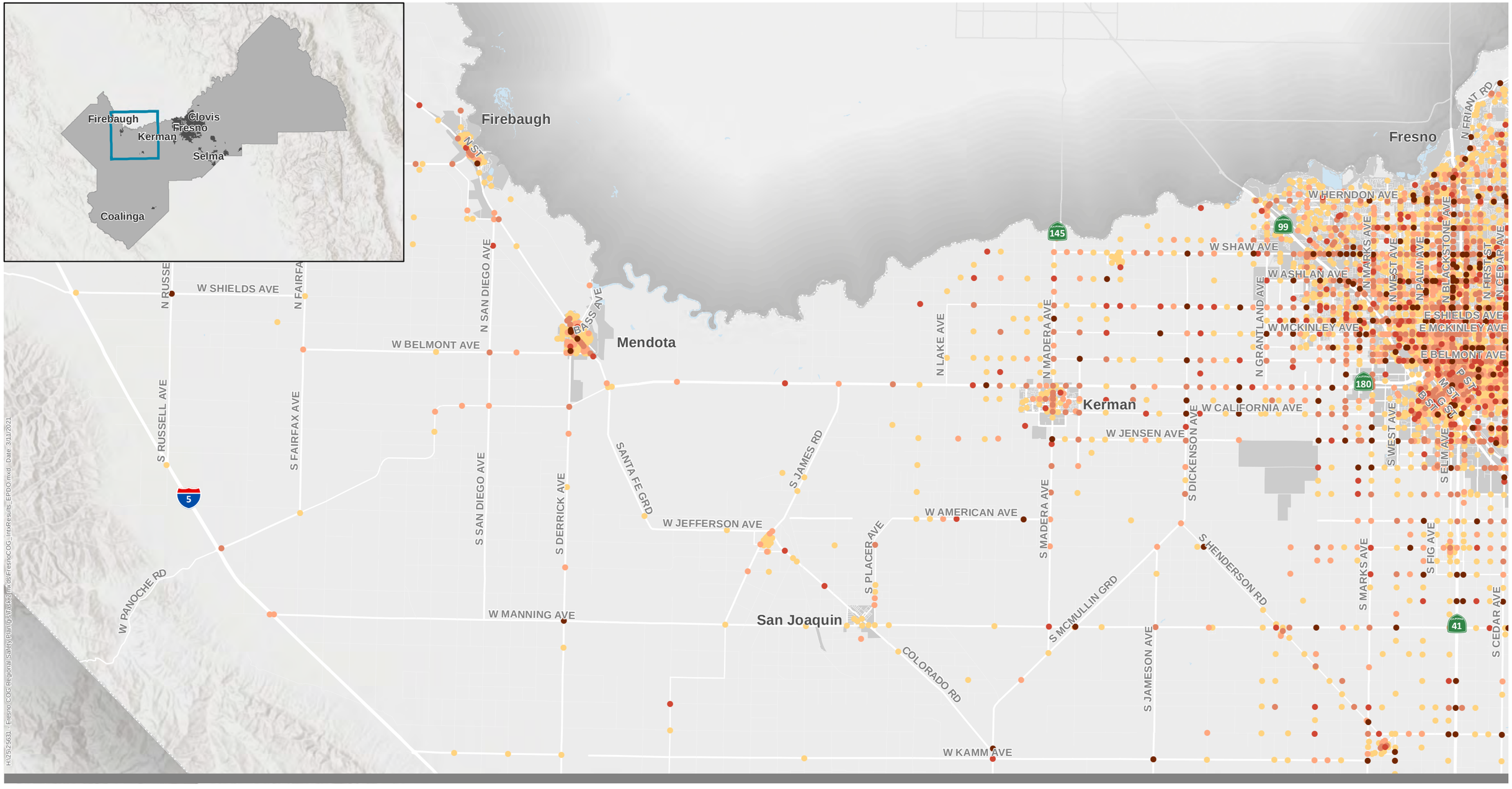
County Boundary

0 2.7 Miles

Figure 15.1

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

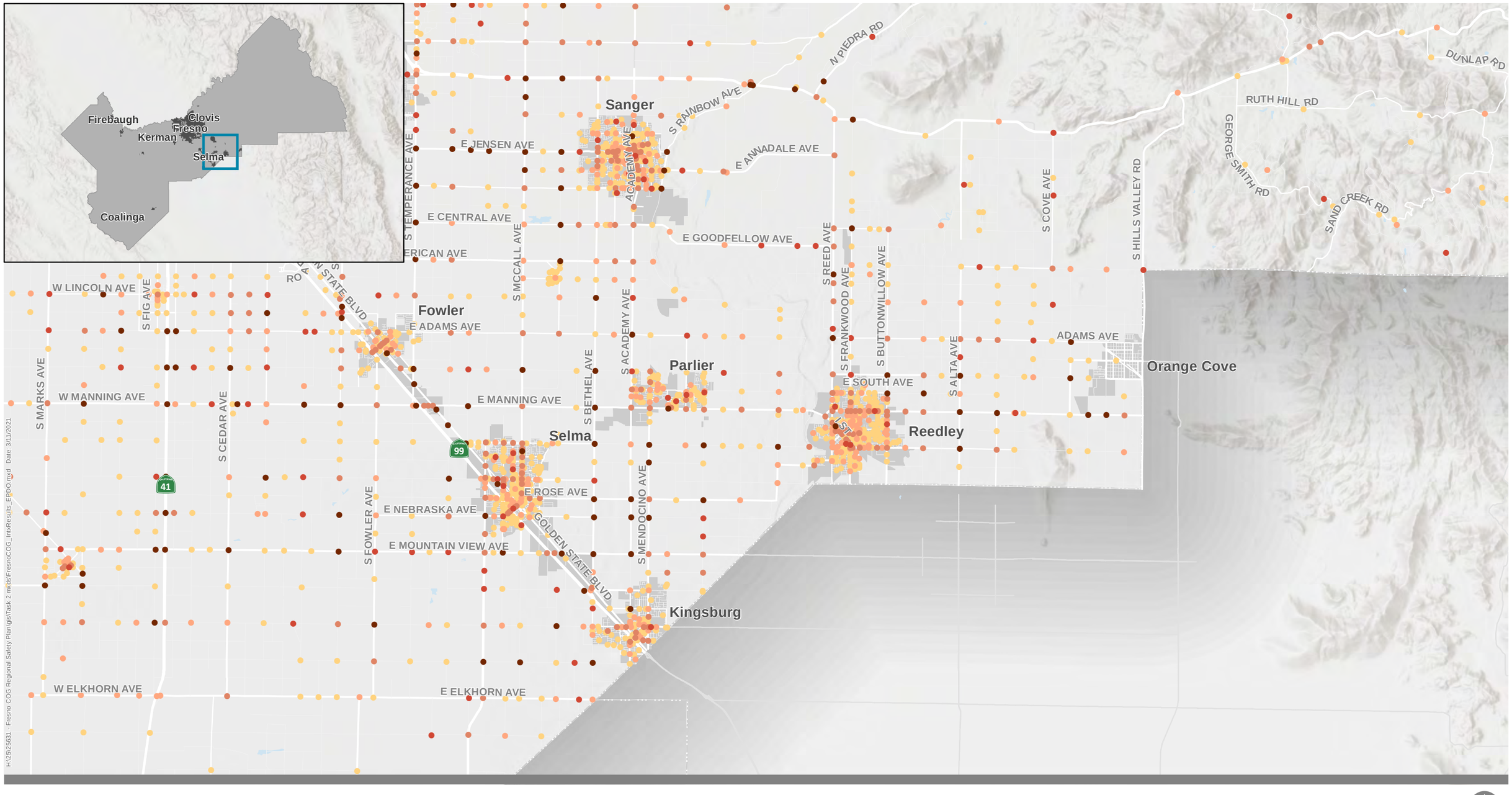
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 3 Miles

Figure 15.2

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

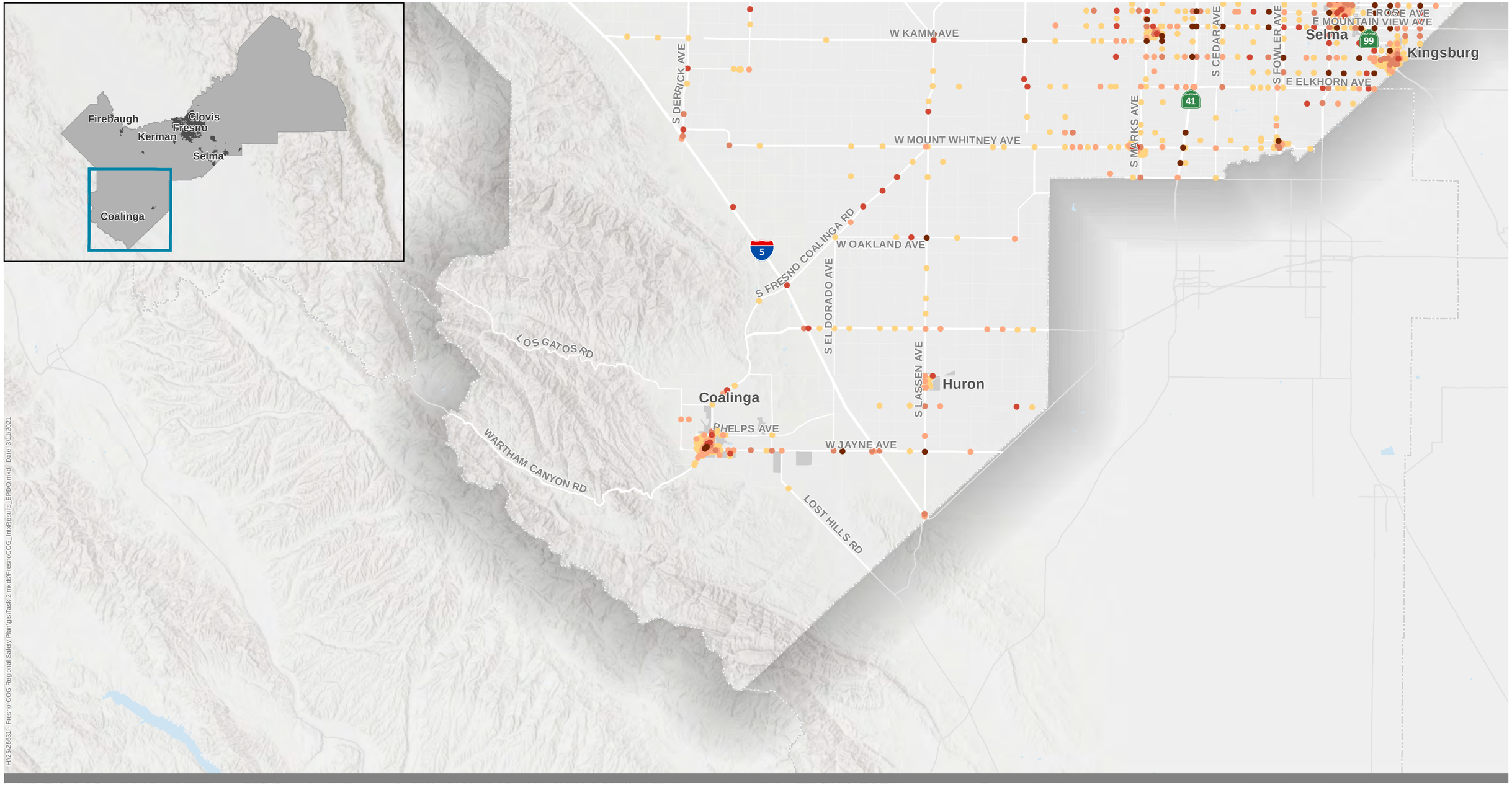
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 2.85 Miles

Figure 15.3

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

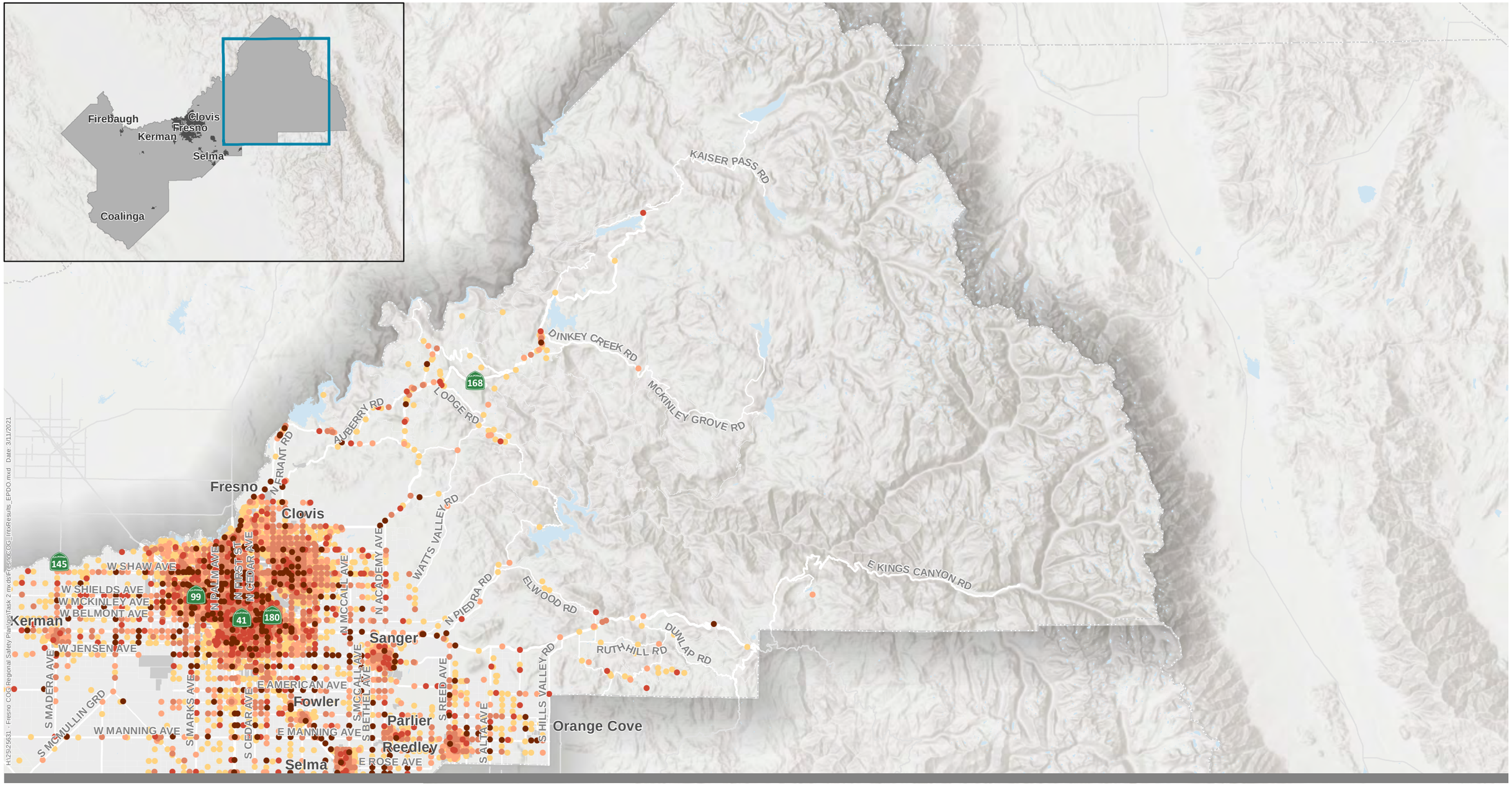
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 15.4

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

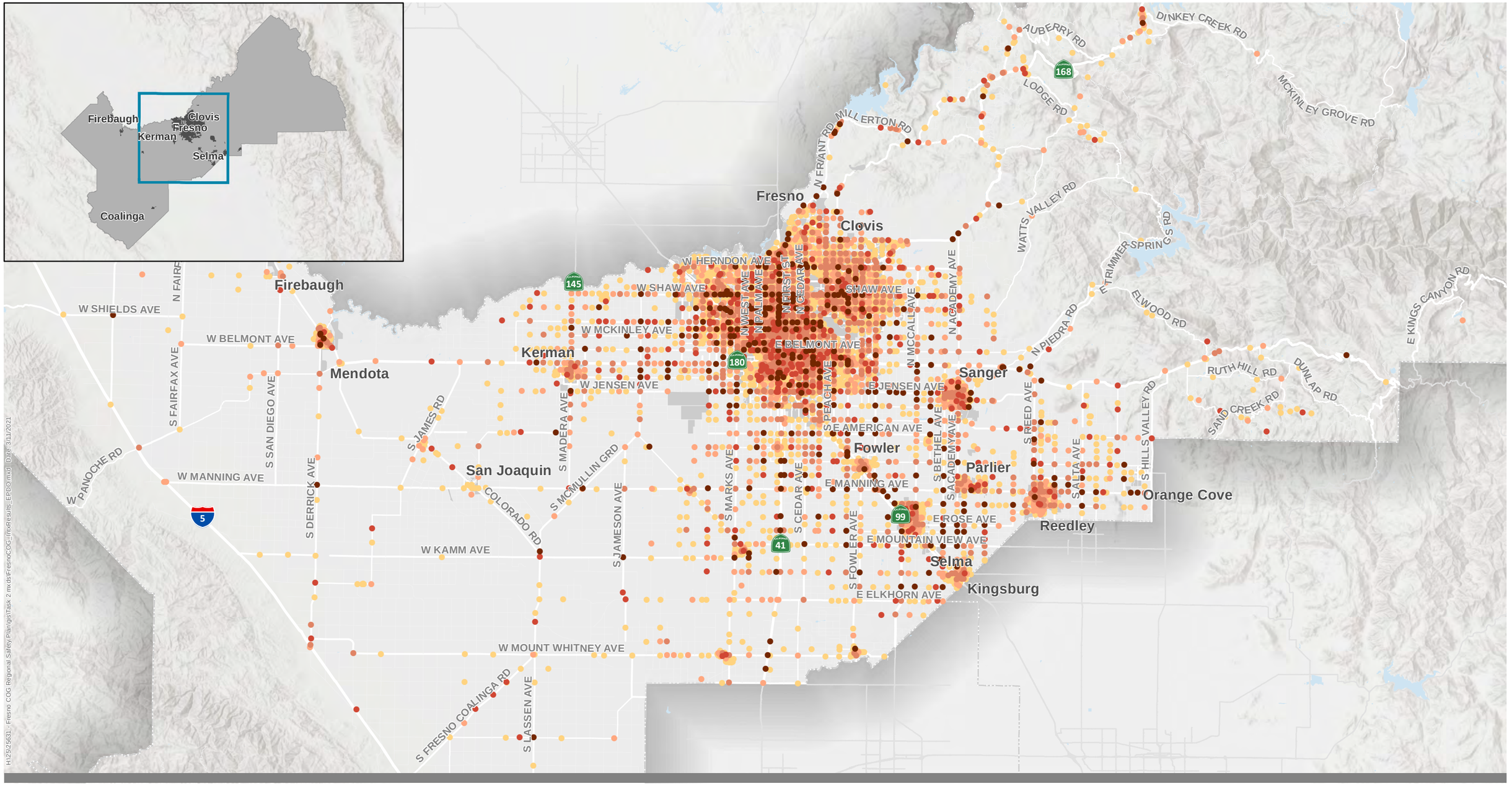
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 9 Miles

Figure 15.5

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

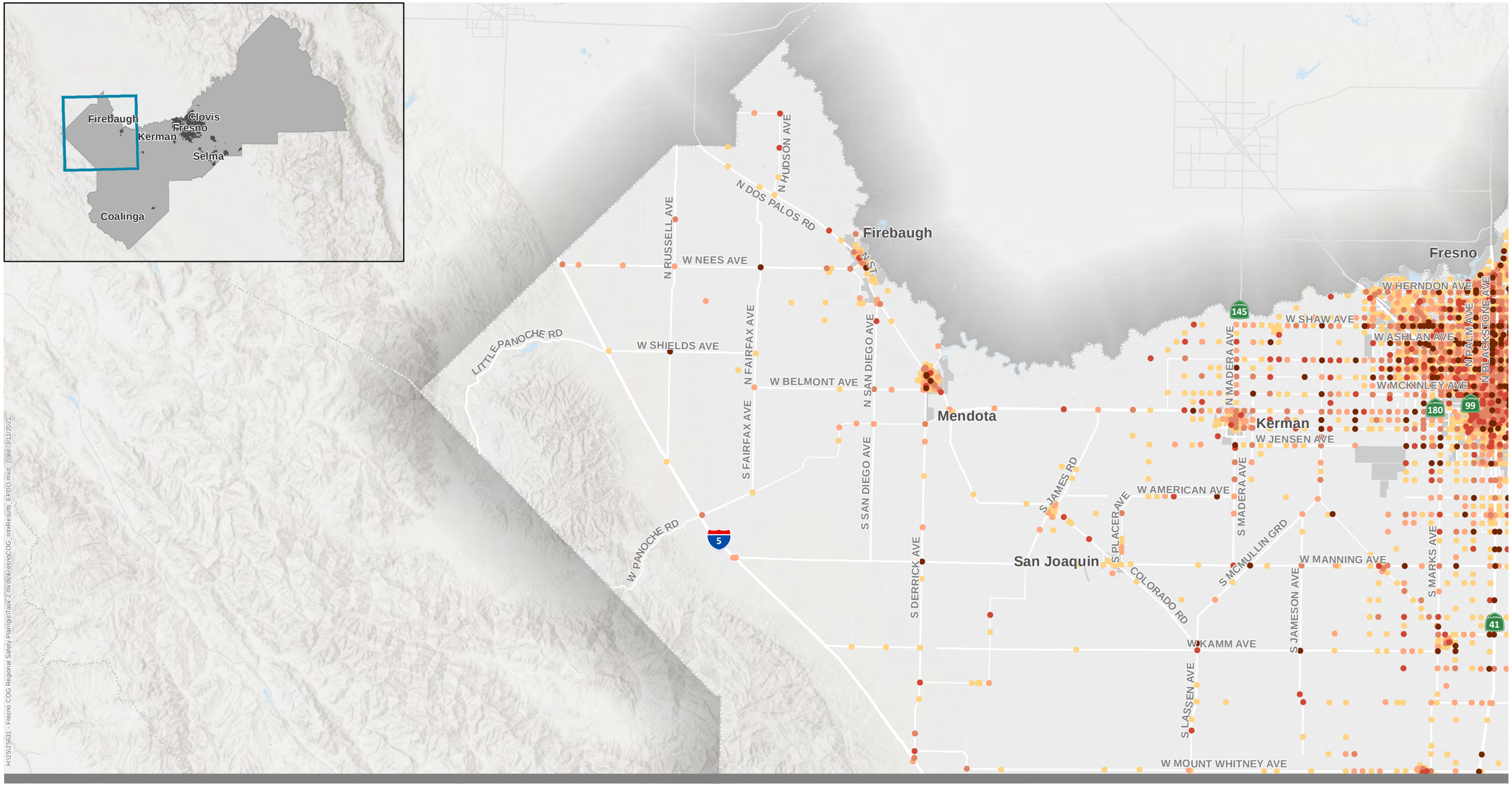
County Boundary

0 6 Miles

Figure 15.6

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Collision Severity Scores

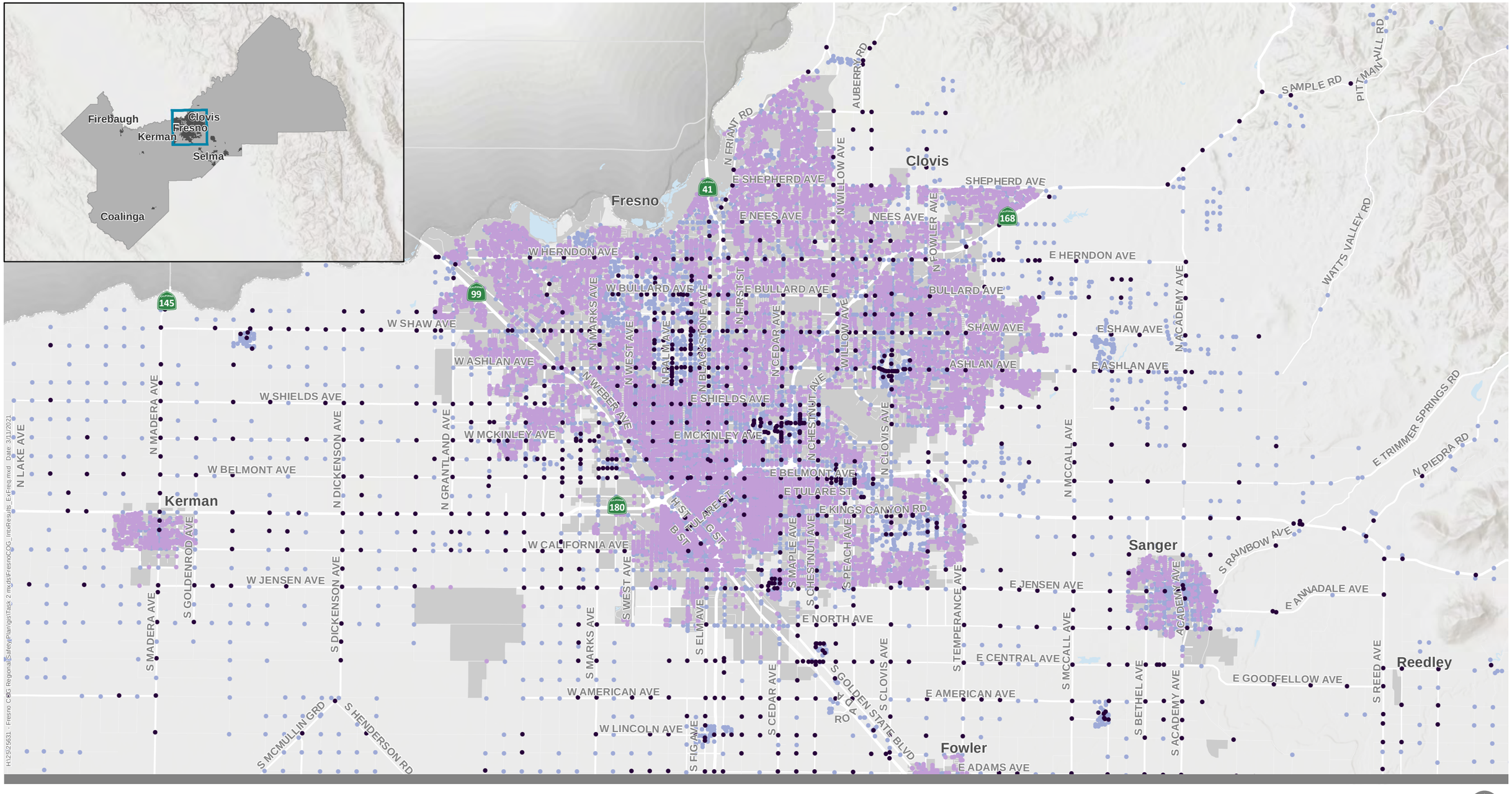
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 15.7

Intersection Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



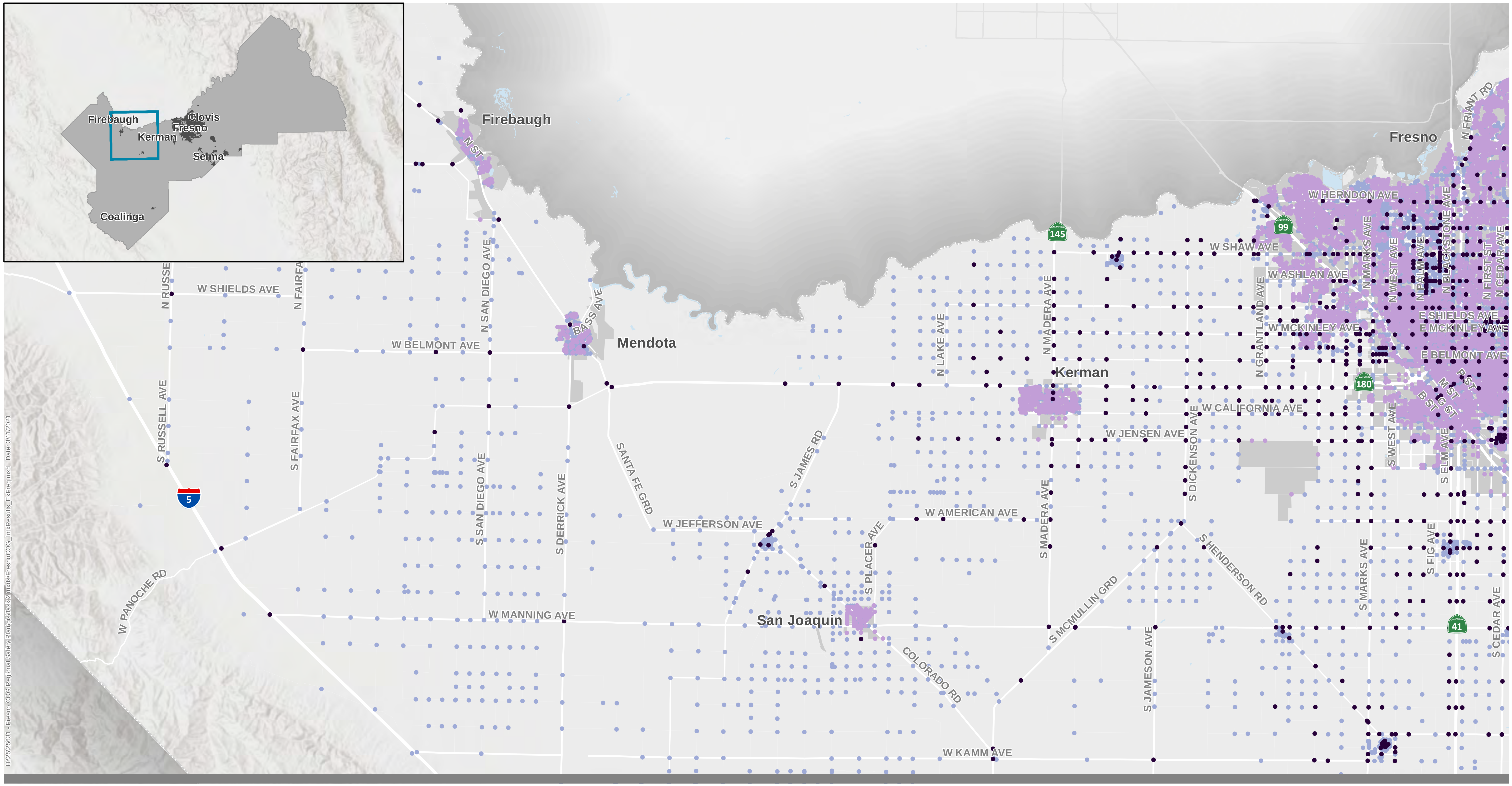
Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

Figure 16.1

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

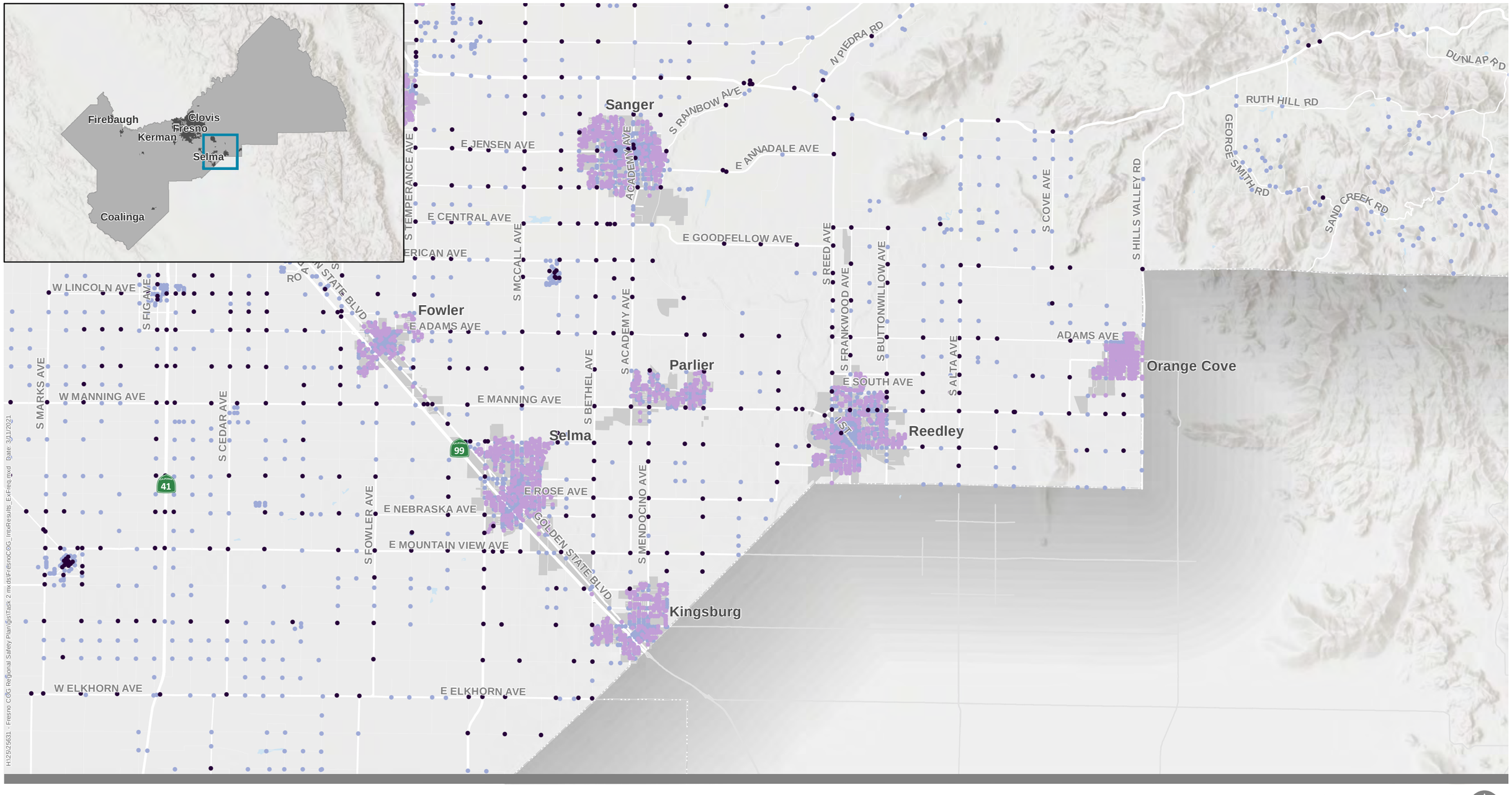
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 3 Miles

KITTELSON & ASSOCIATES

Figure 16.2

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments



Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

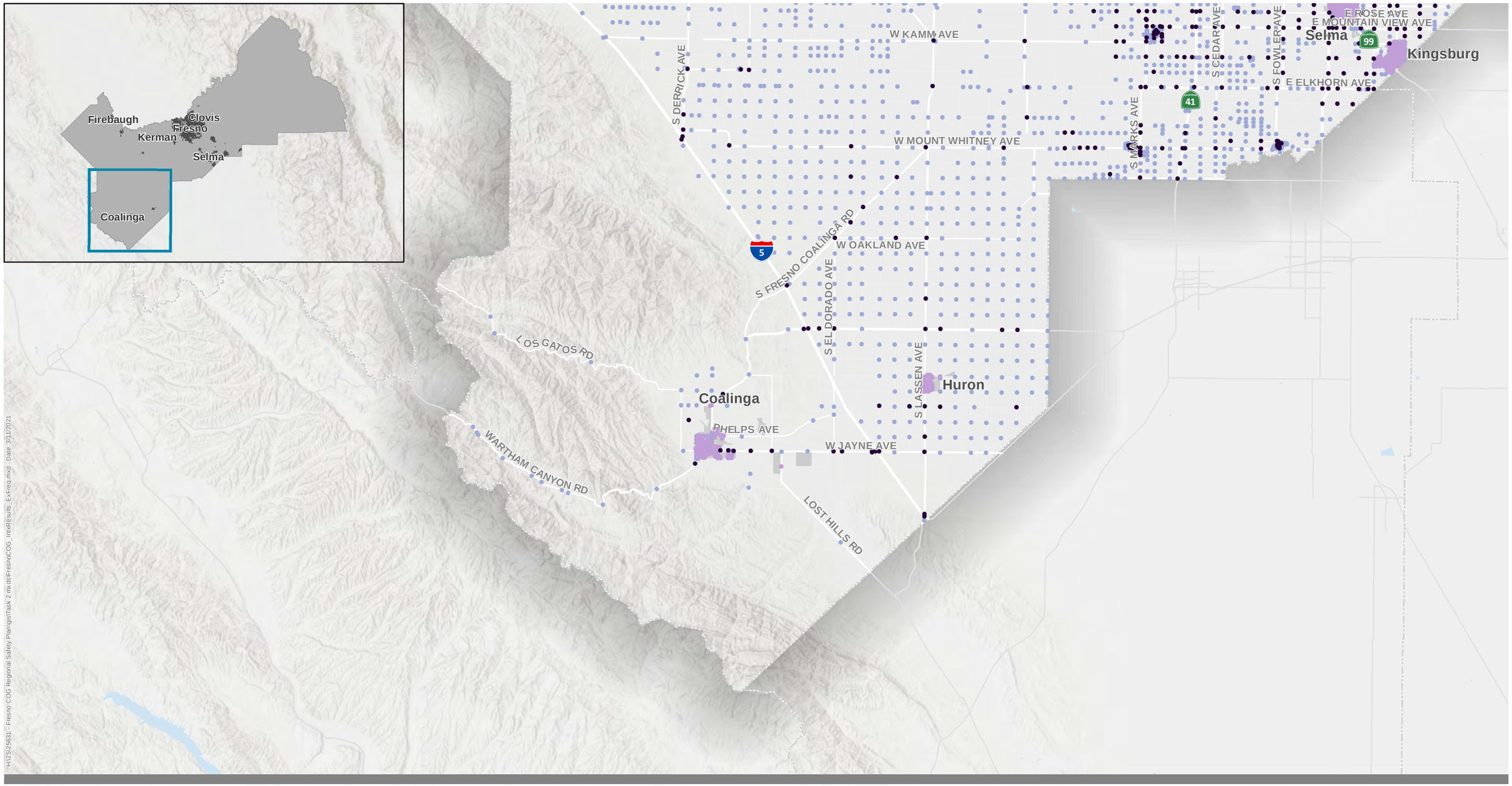
County Boundary

0 2.85 Miles

Figure 16.3

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

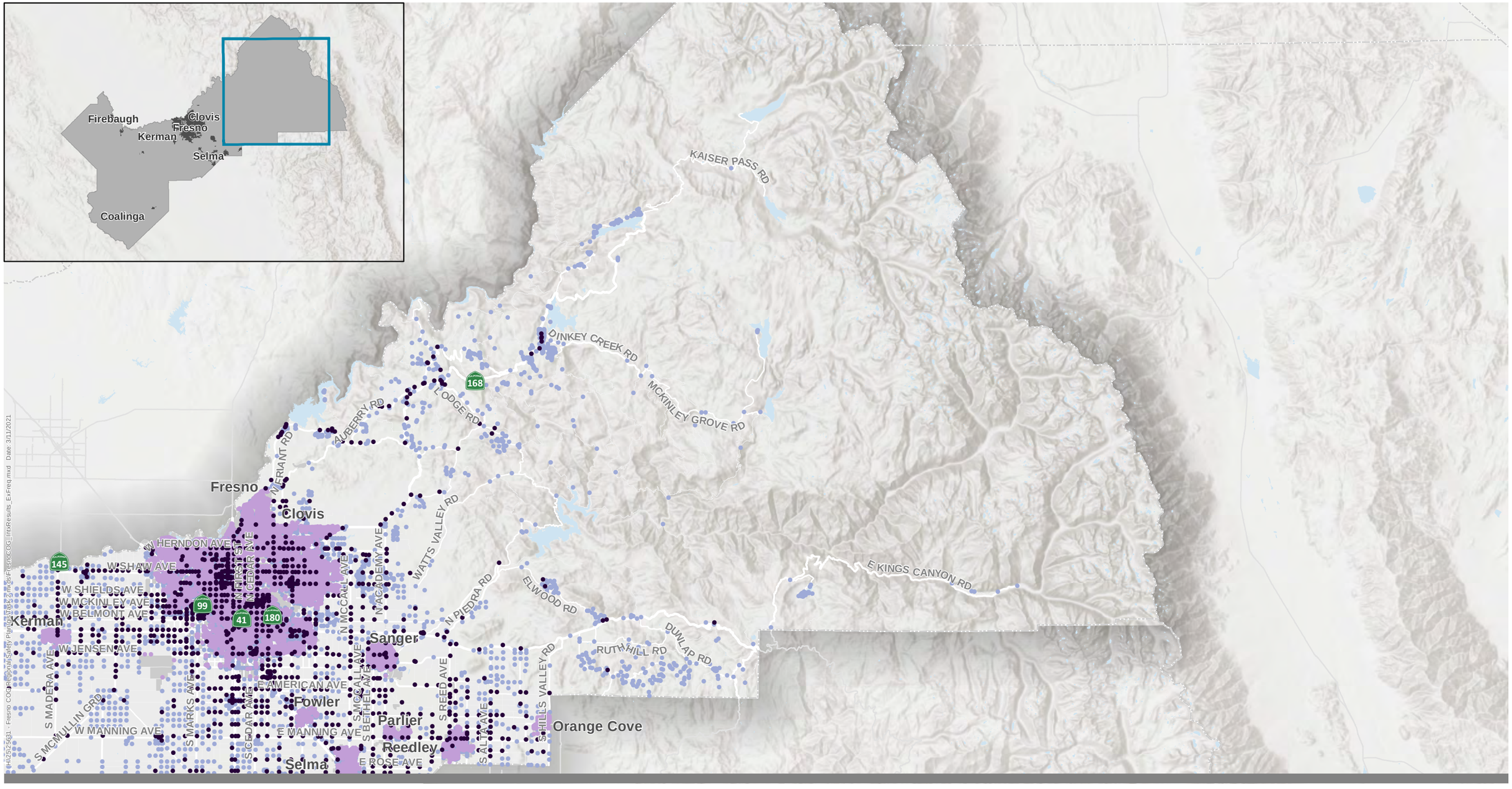
County Boundary

0 6 Miles

Figure 16.4

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

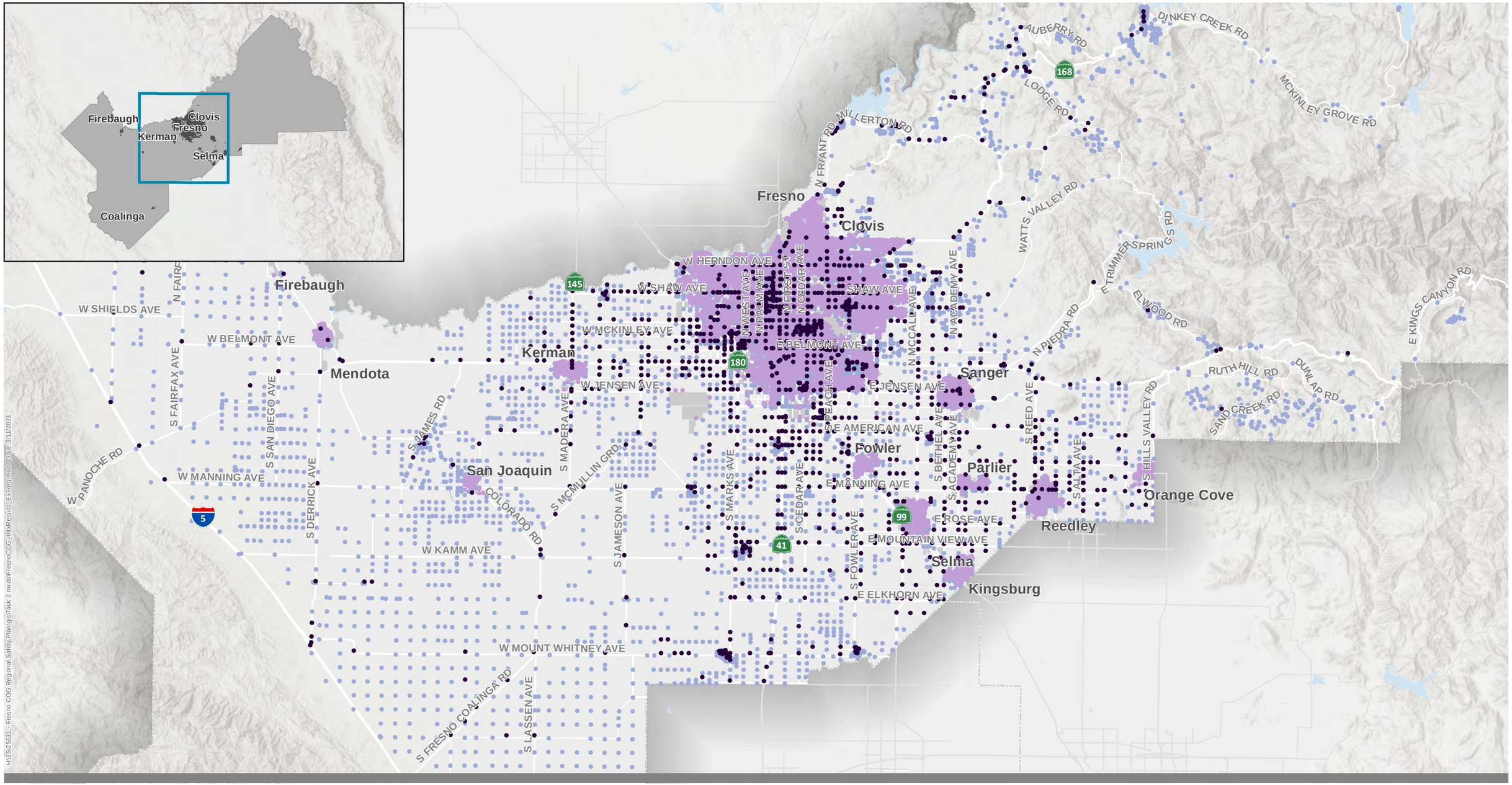
County Boundary

0 9 Miles

Figure 16.5

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

City Limits

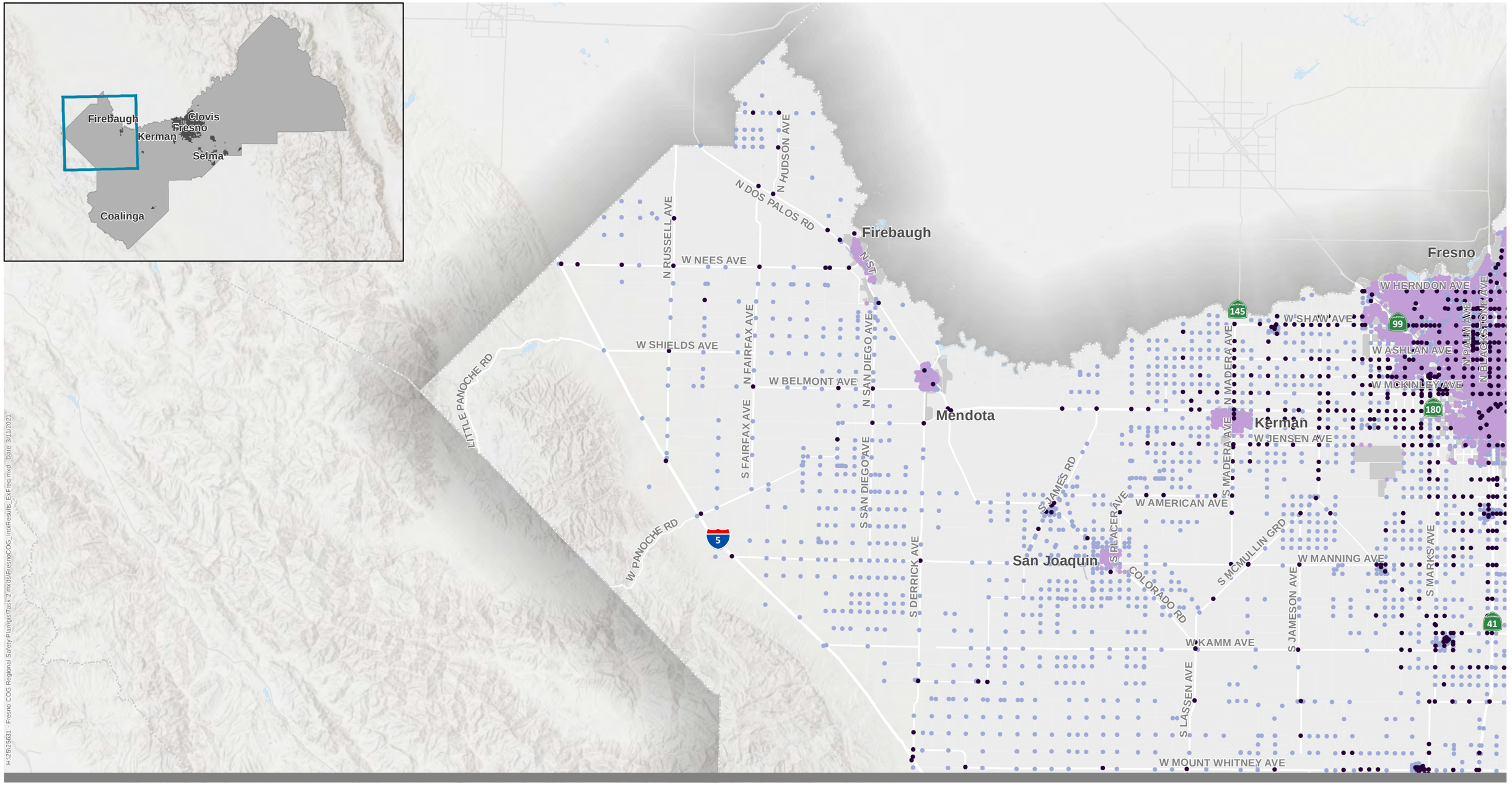
County Boundary

0 6 Miles

Figure 16.6

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Excess Expected Frequency

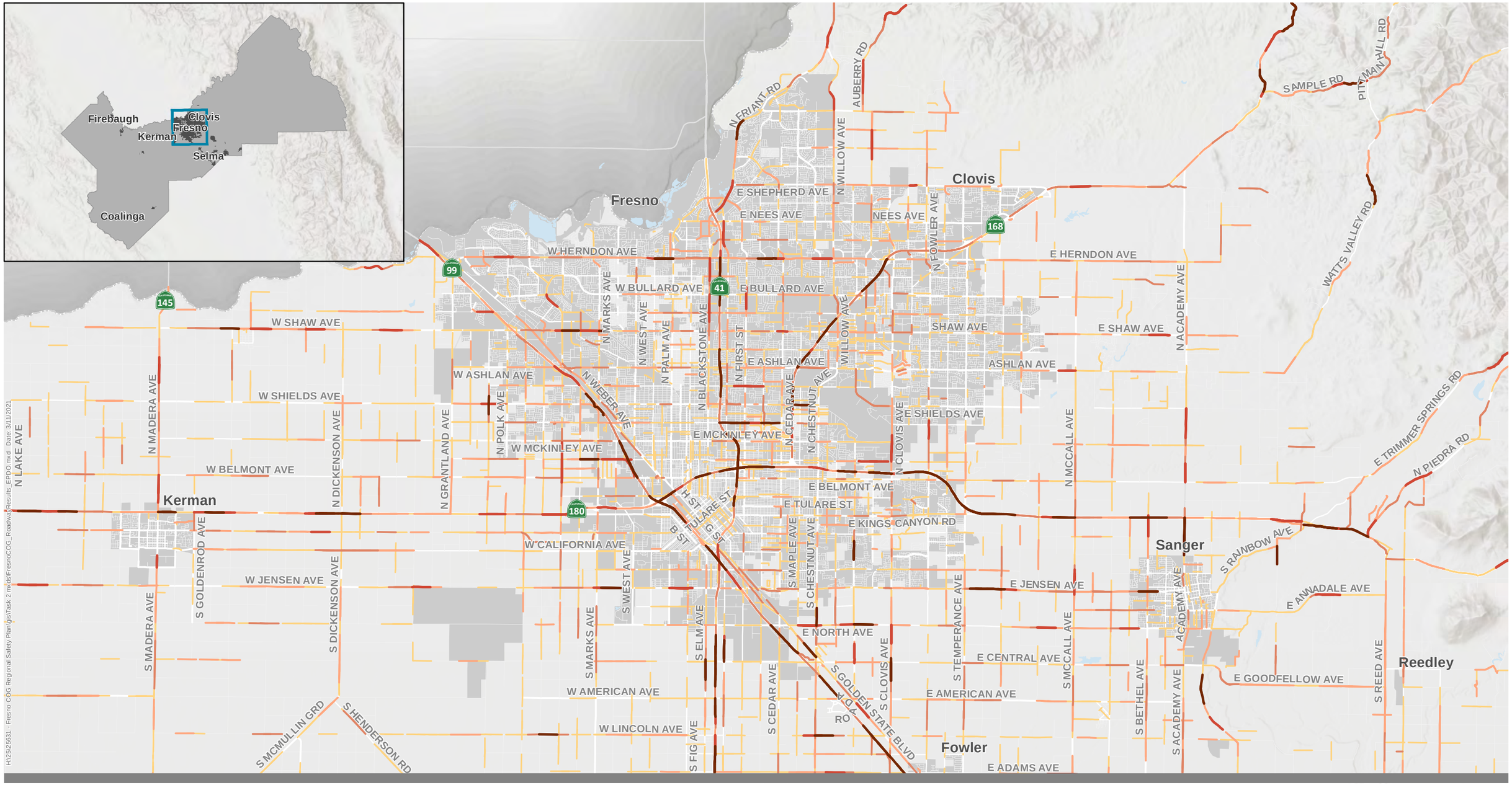
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 16.7

Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Collision Severity Scores

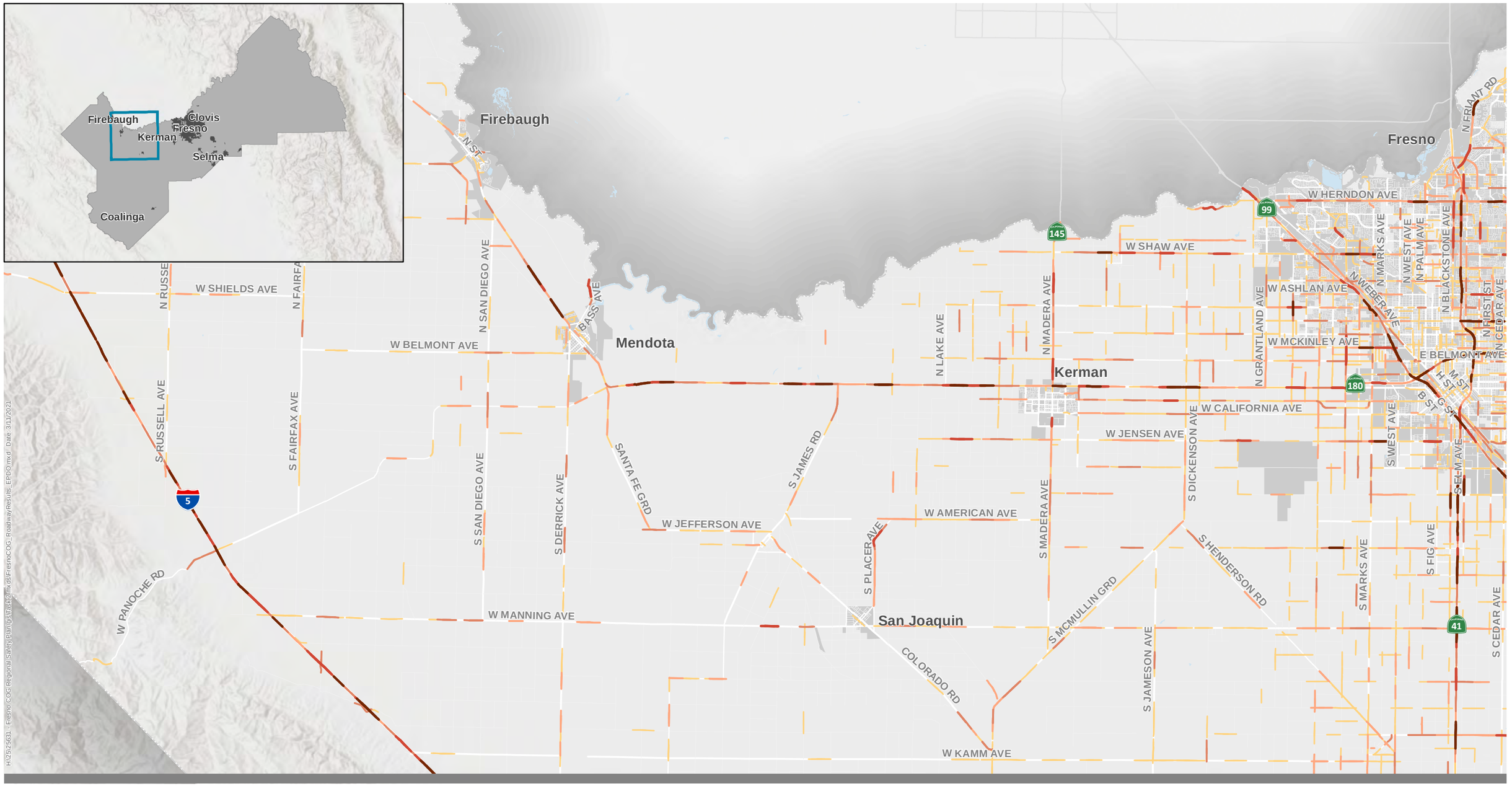
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 2.7 Miles

Figure 17.1

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Collision Severity Scores

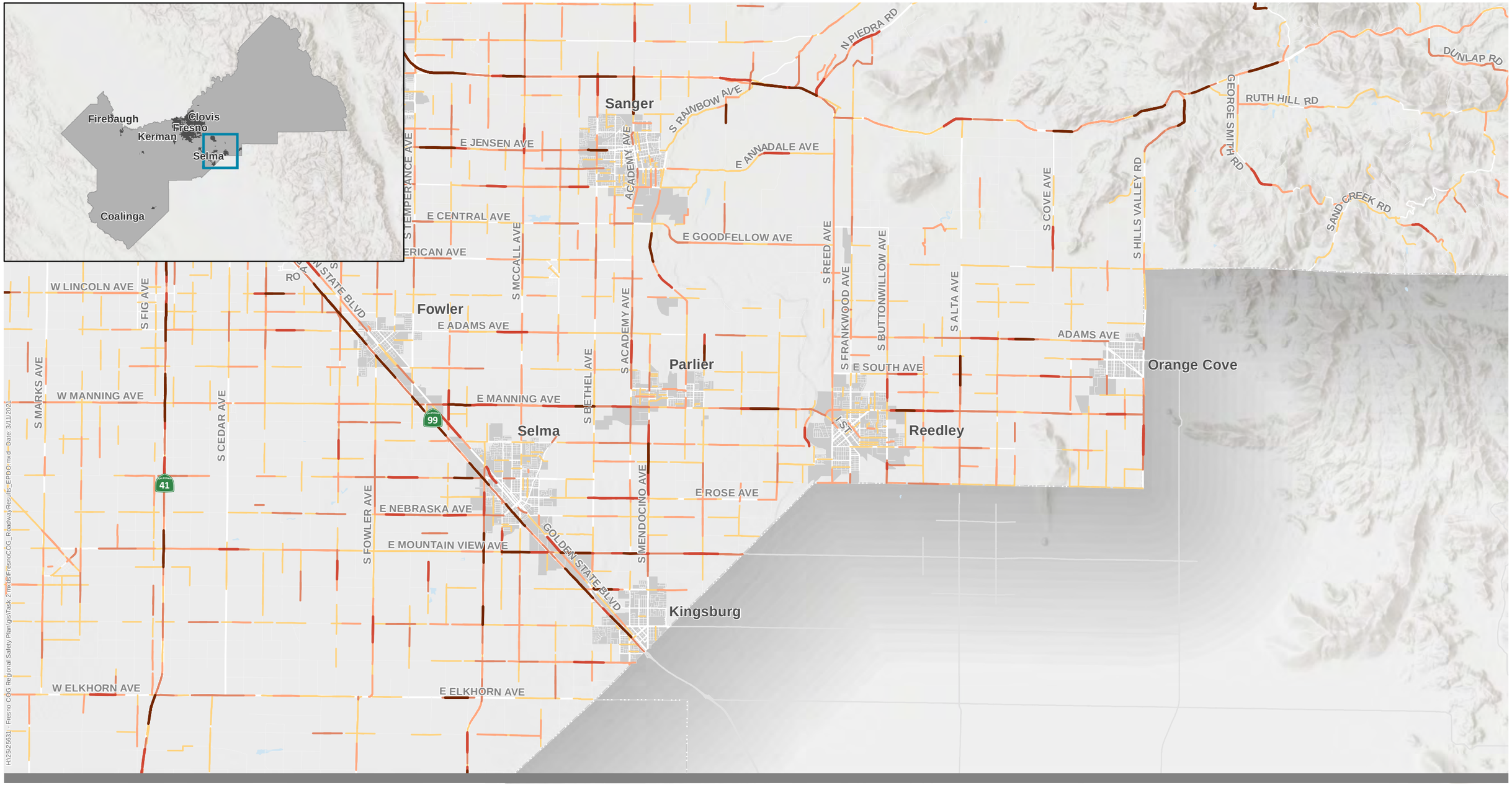
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 3 Miles

Figure 17.2

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Collision Severity Scores

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 2.85 Miles

Figure 17.3

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES

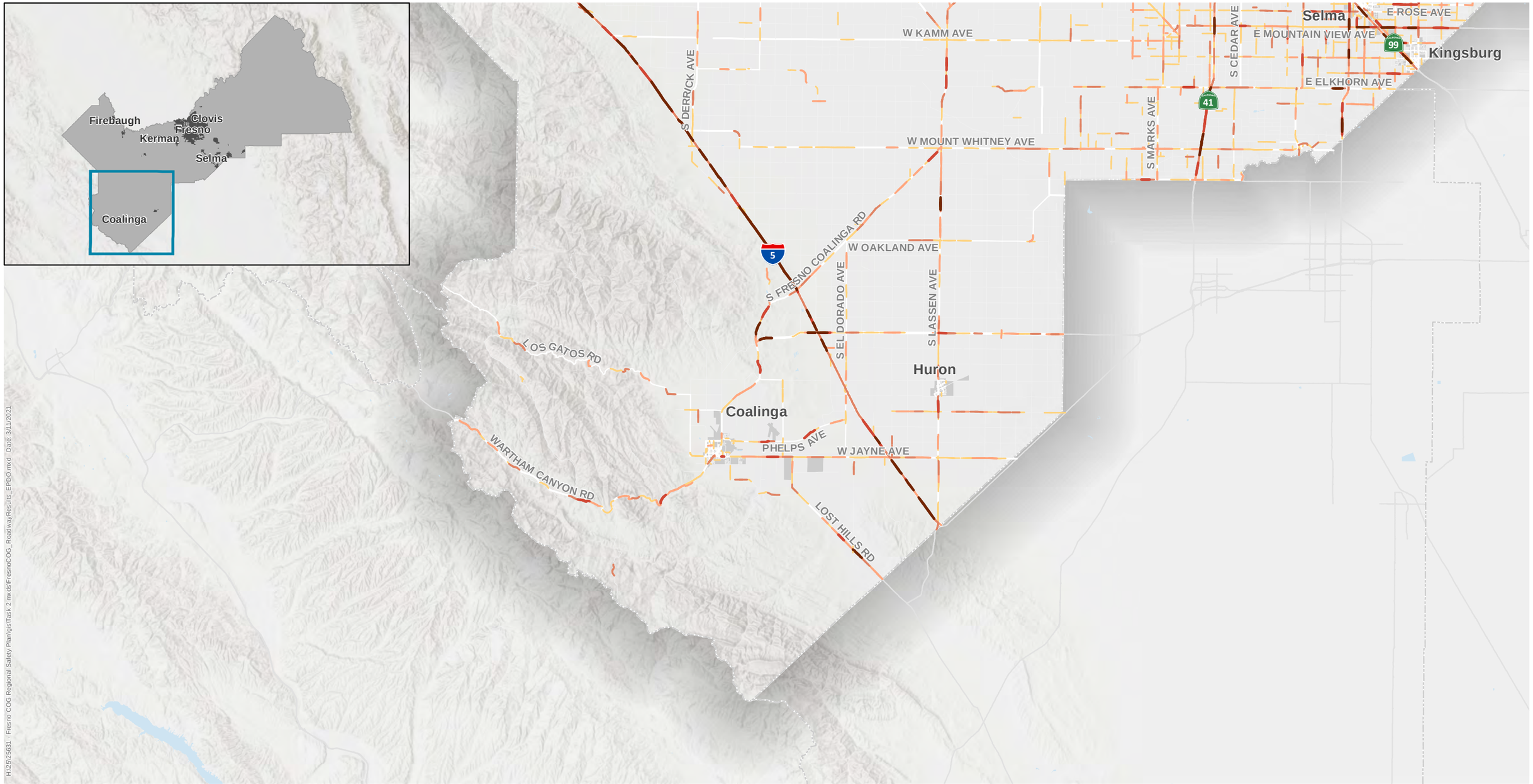
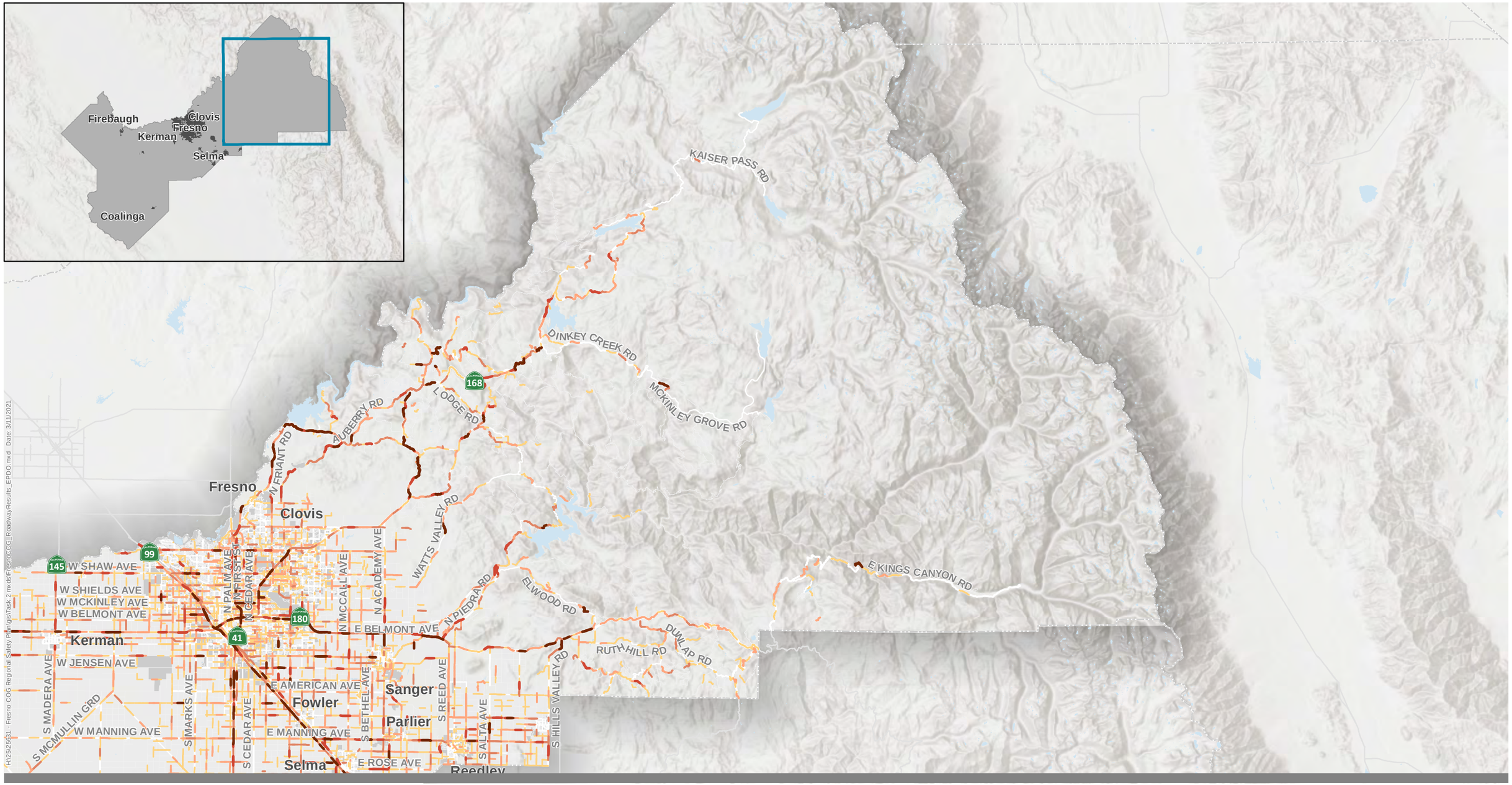


Figure 17.4

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



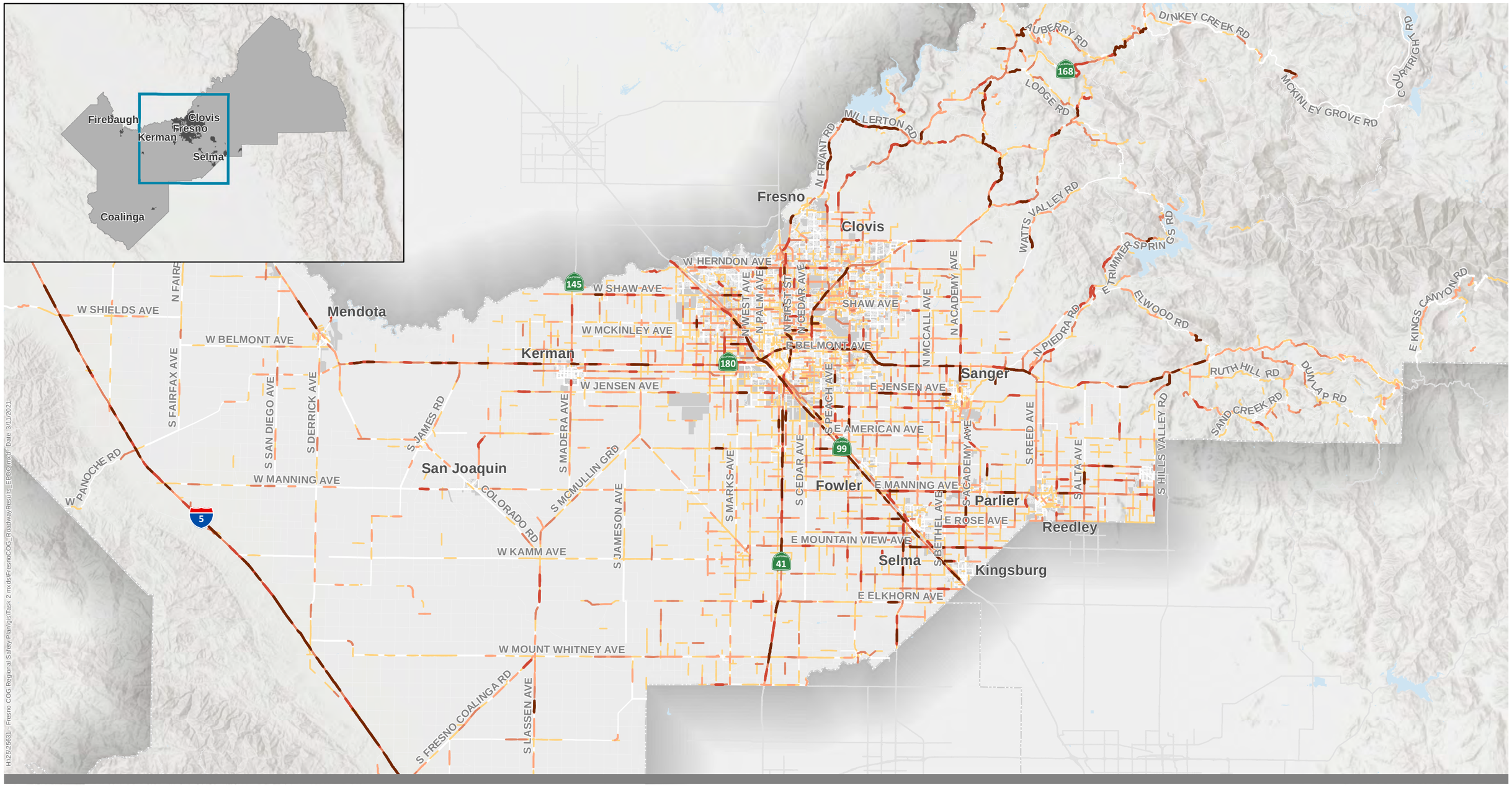
Collision Severity Scores

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

Figure 17.5

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Collision Severity Scores

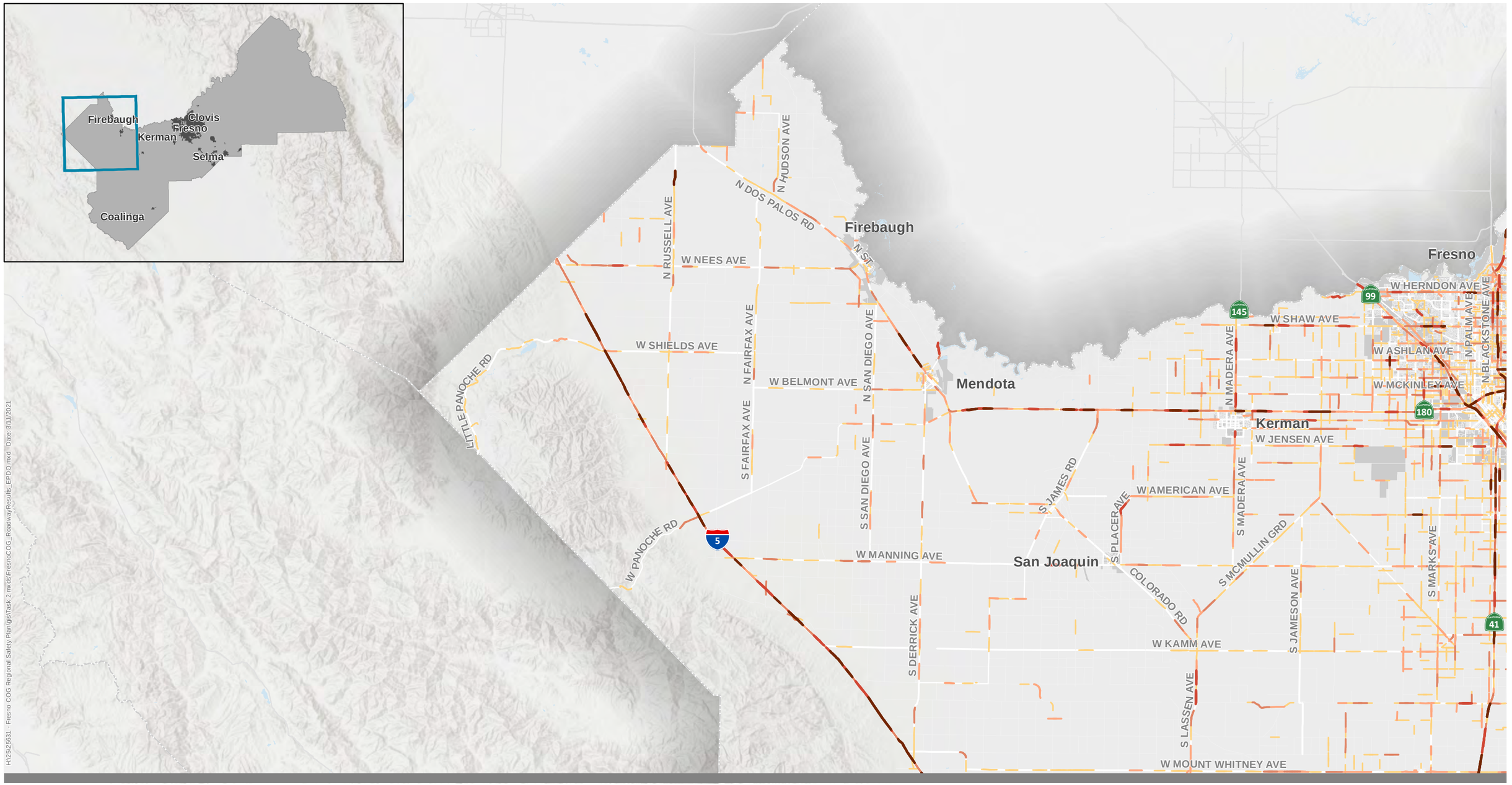
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 17.6

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Collision Severity Scores

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile

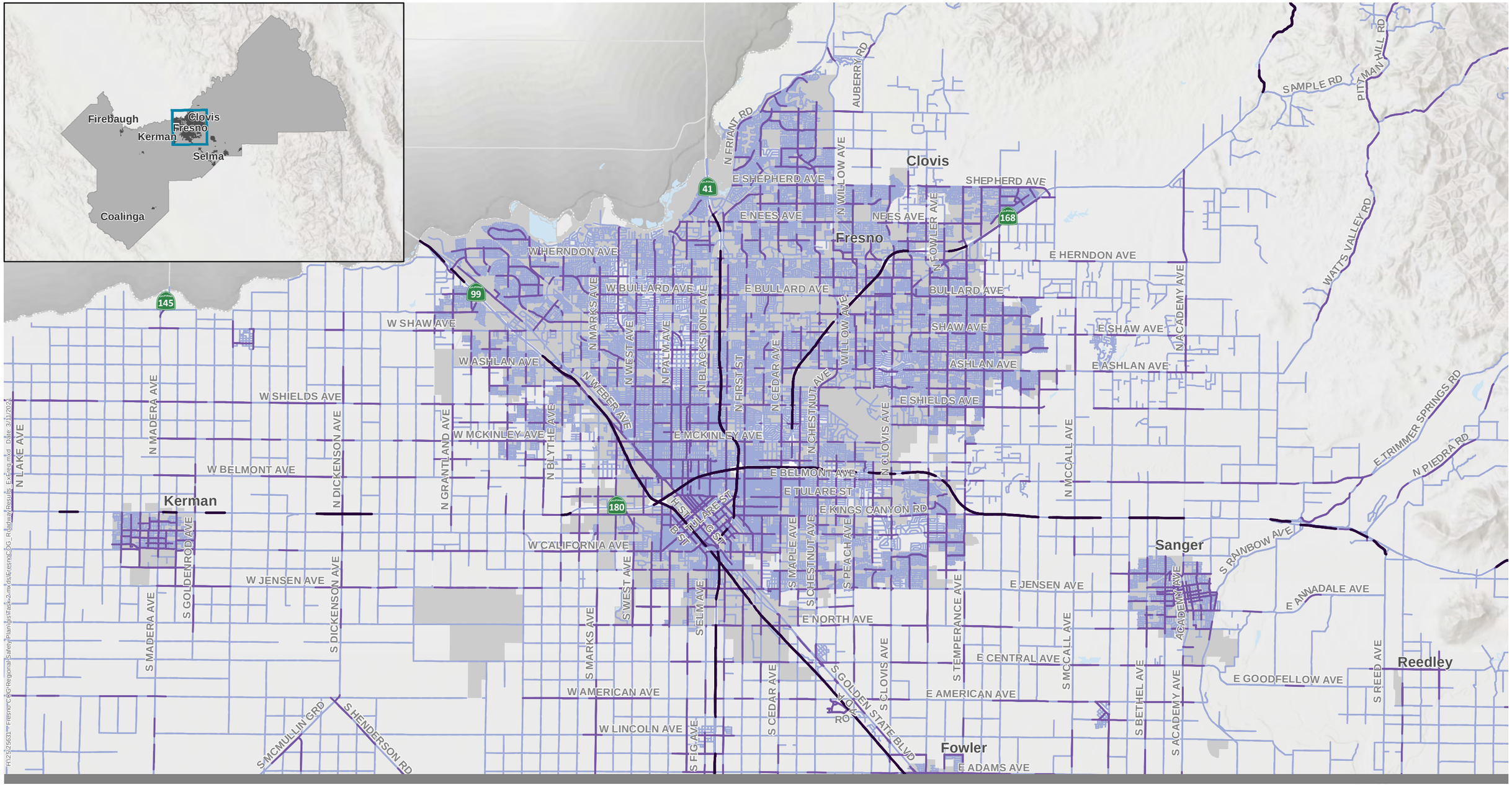
- City Limits
- County Boundary

0 6 Miles

Figure 17.7

Roadway Collision Severity Scores
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

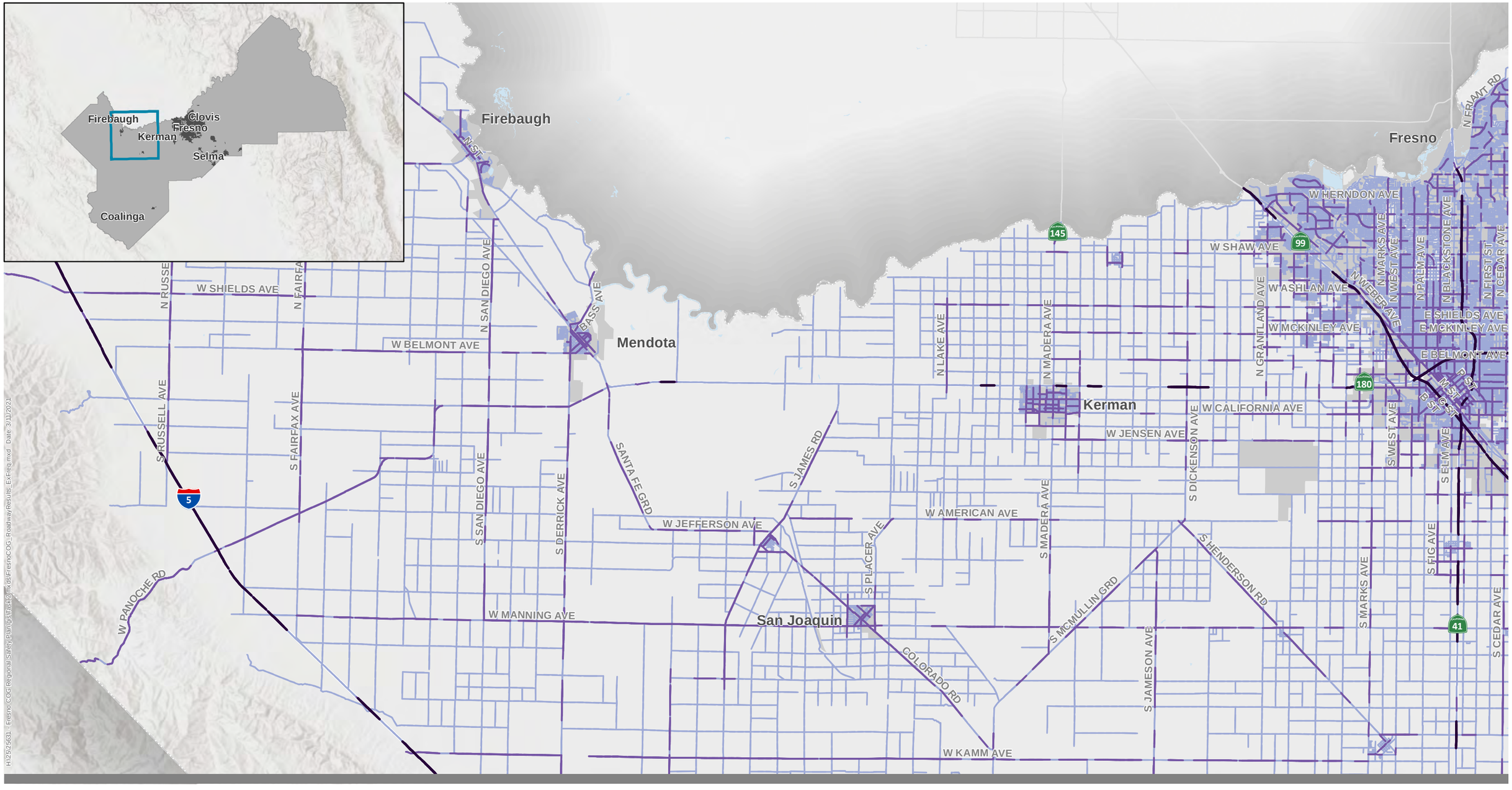
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 2.7 Miles

Figure 18.1

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Excess Expected Frequency

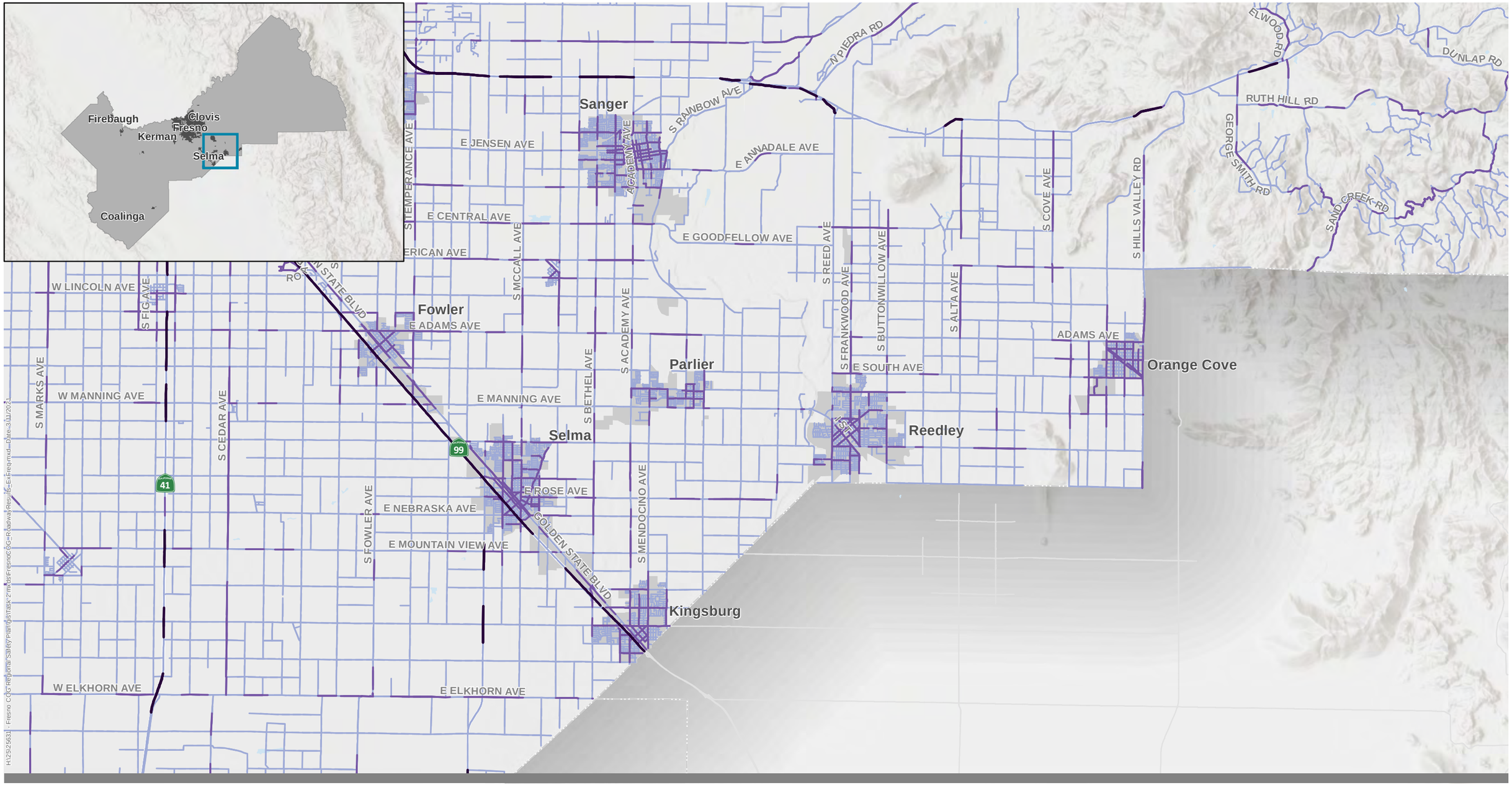
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 3 Miles

Figure 18.2

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 2.85 Miles

Figure 18.3

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES

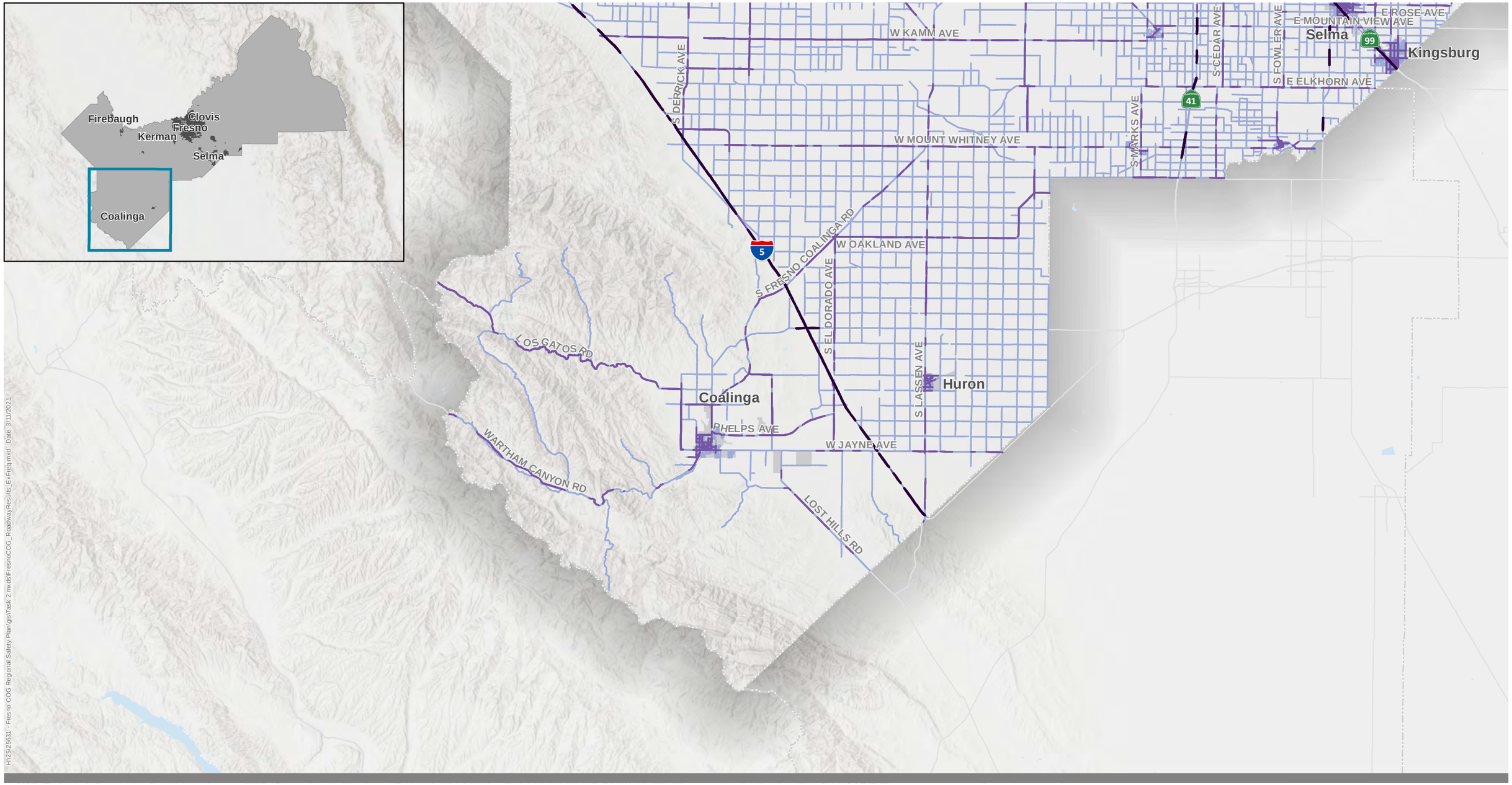
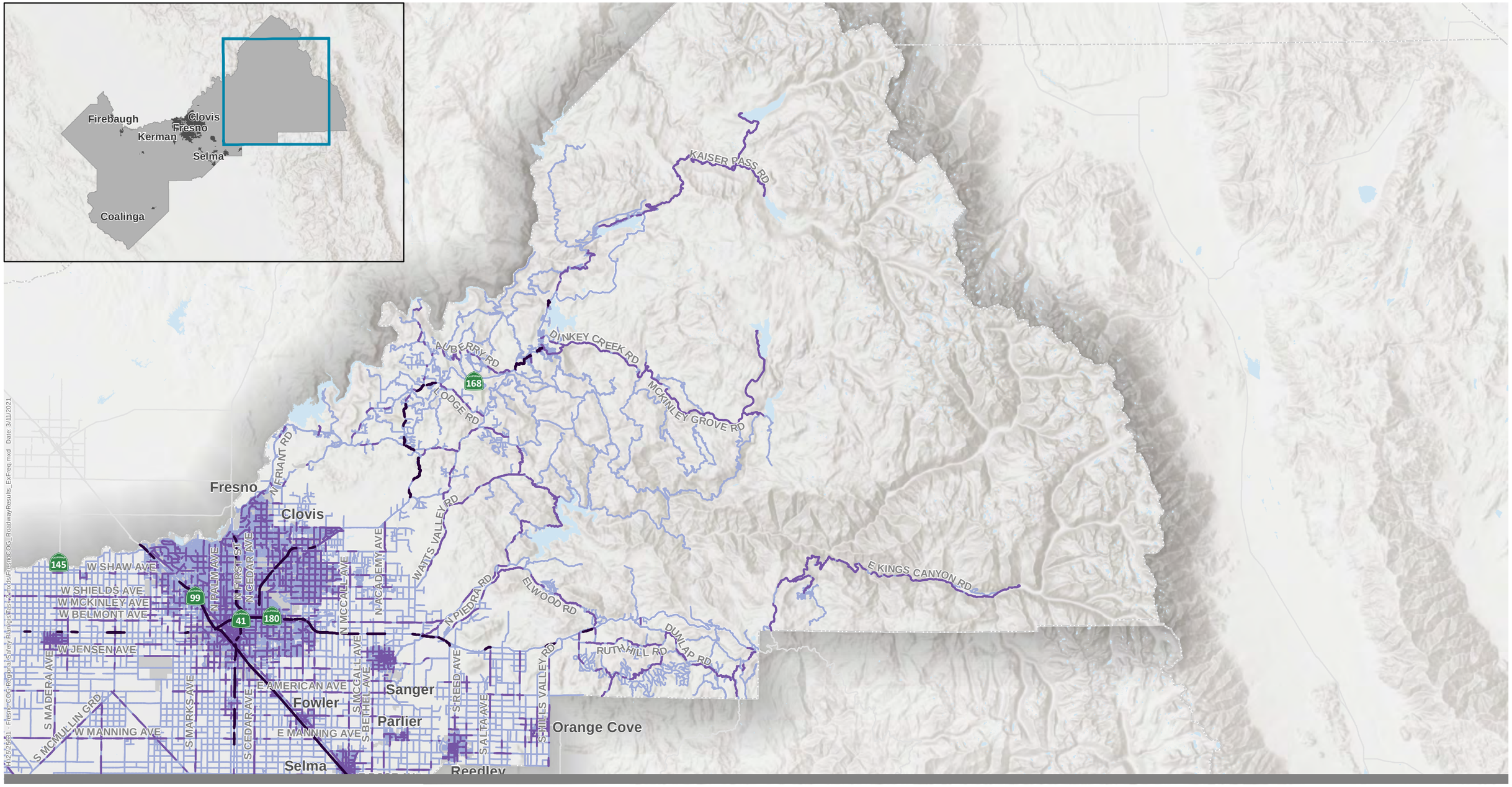


Figure 18.4

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Excess Expected Frequency

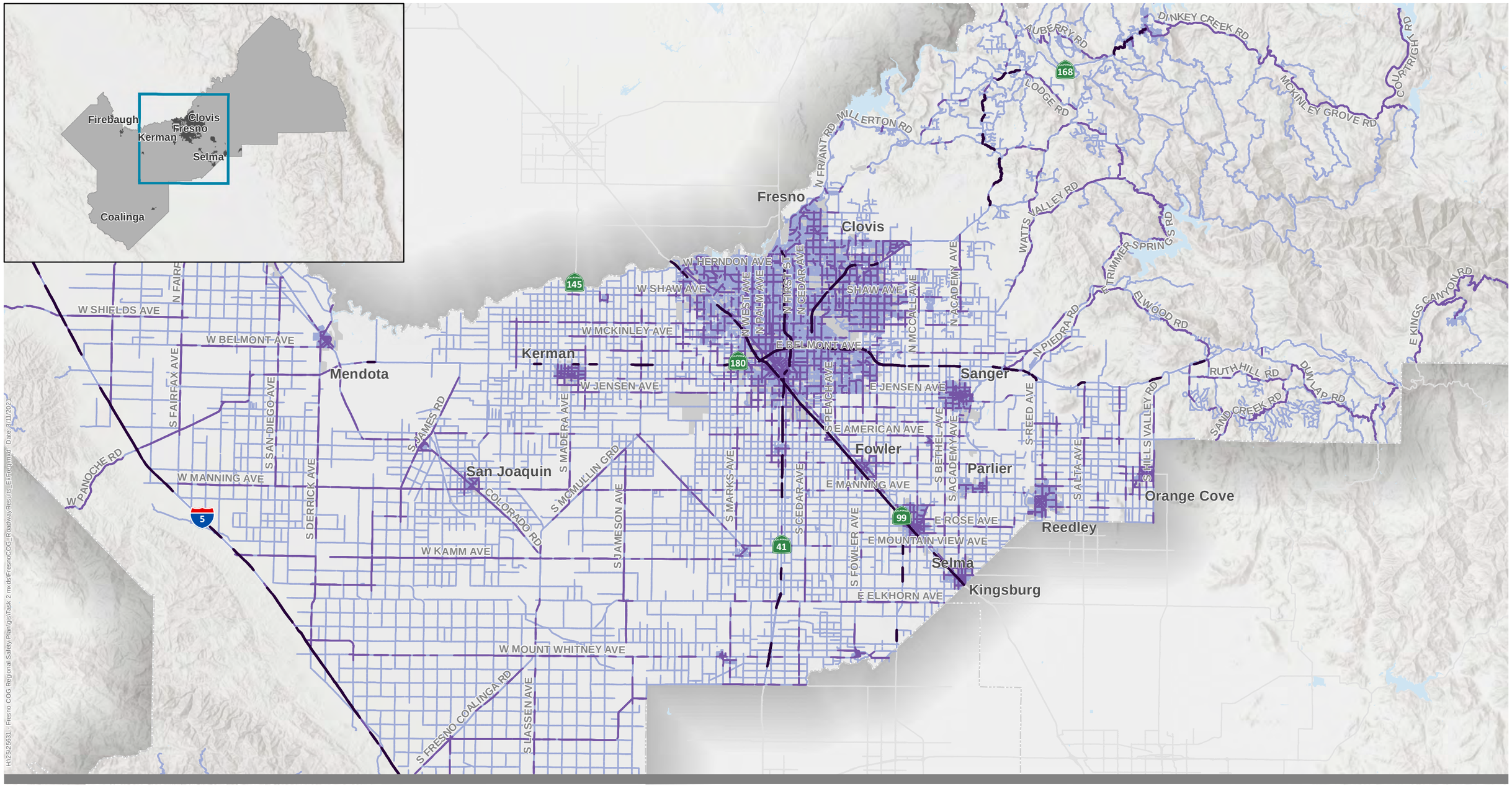
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 7.5 Miles

Figure 18.5

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Excess Expected Frequency

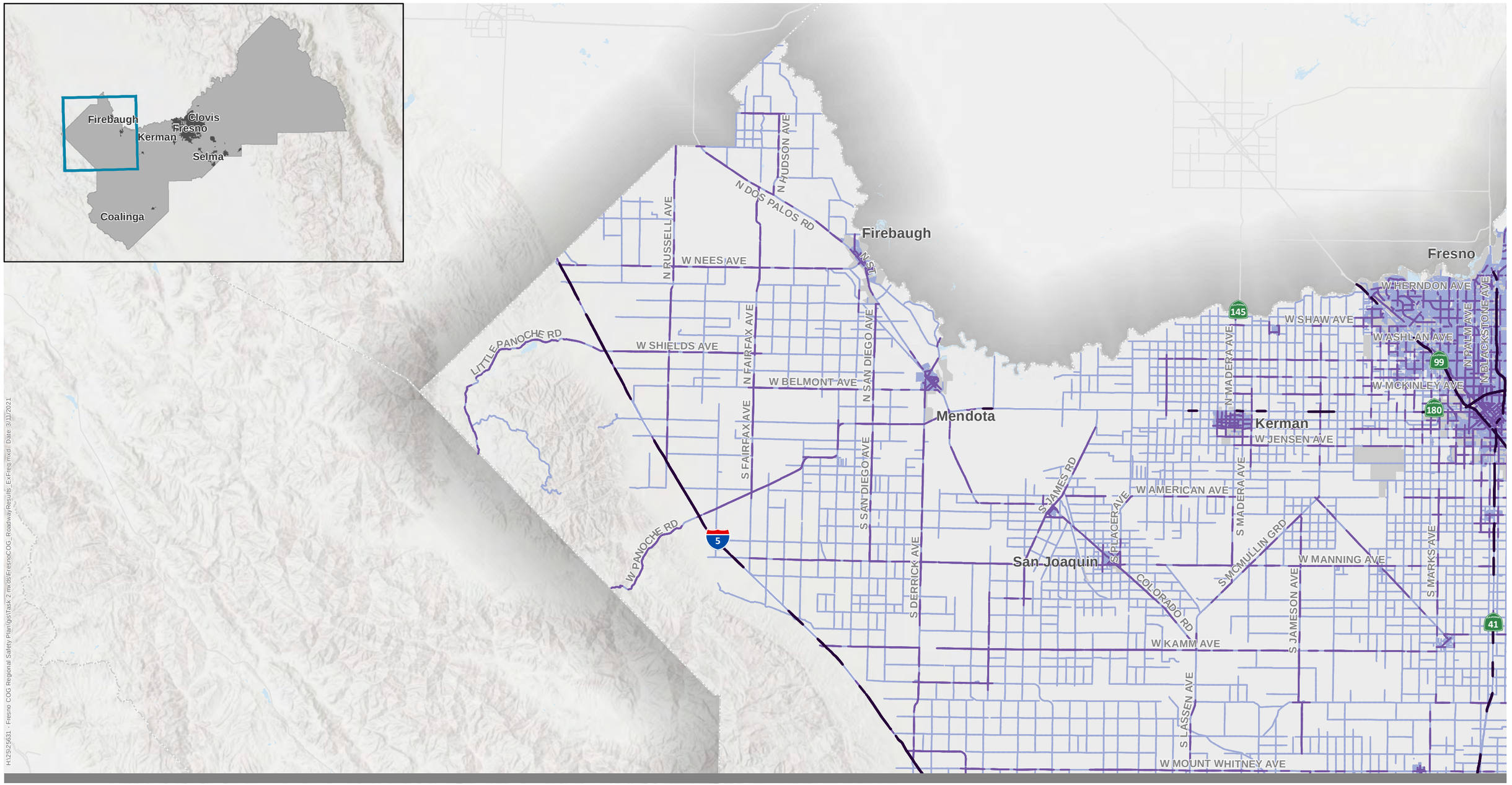
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 18.6

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Excess Expected Frequency

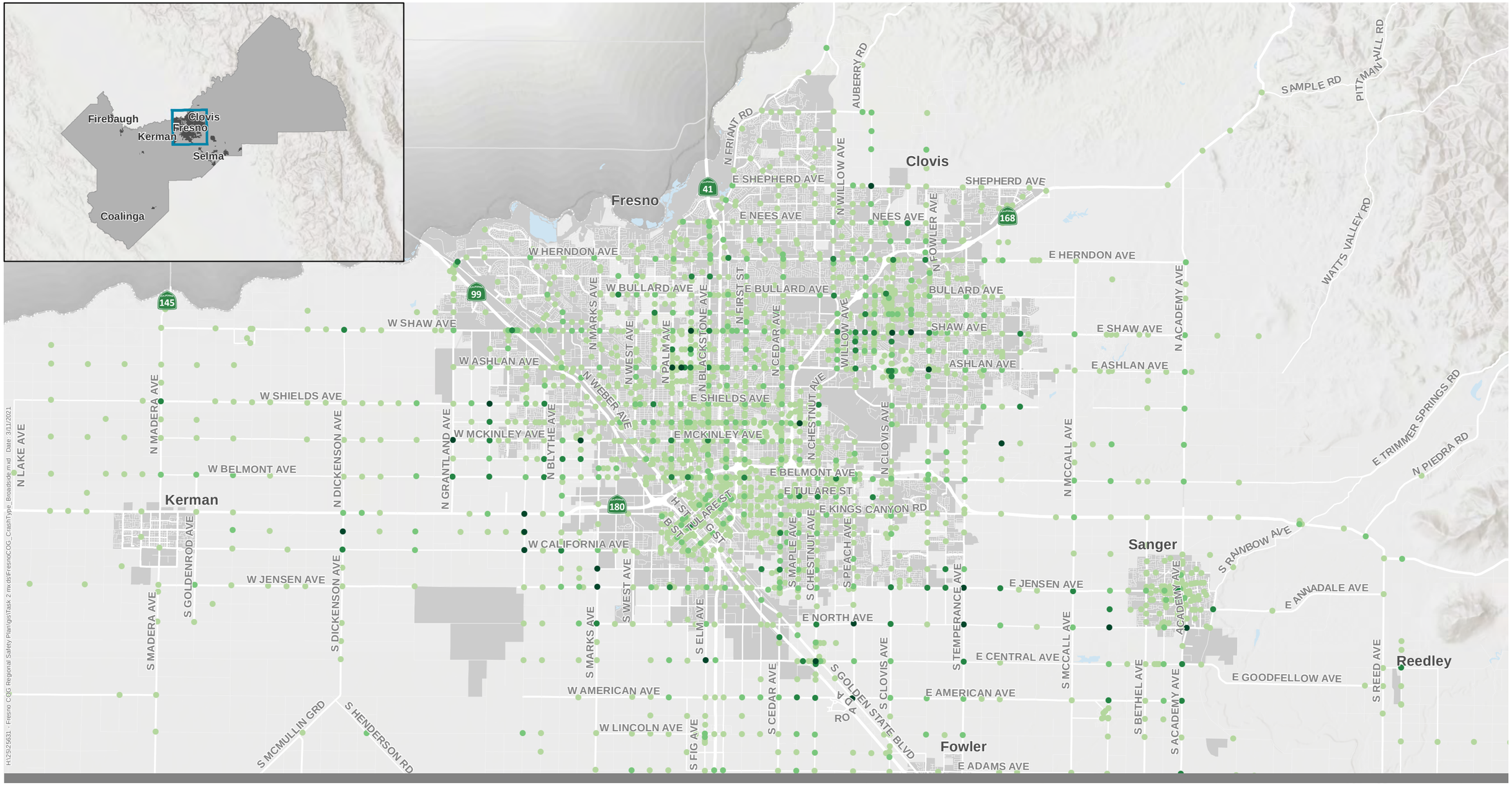
- 95-100th Percentile
- 90-95th Percentile
- 75-90th Percentile
- 50-75th Percentile
- 0-50th Percentile
- City Limits
- County Boundary

0 6 Miles

Figure 18.7

Roadway Excess Predicted Average Collision Frequency Using Method of Moments
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



H:\25\25631 - Fresno COG Regional Safety Plan\gis\Task 2.mxds\FresnoCOG_CrashType_Broadside.mxd Date: 3/11/2021

Total Broadside Collisions

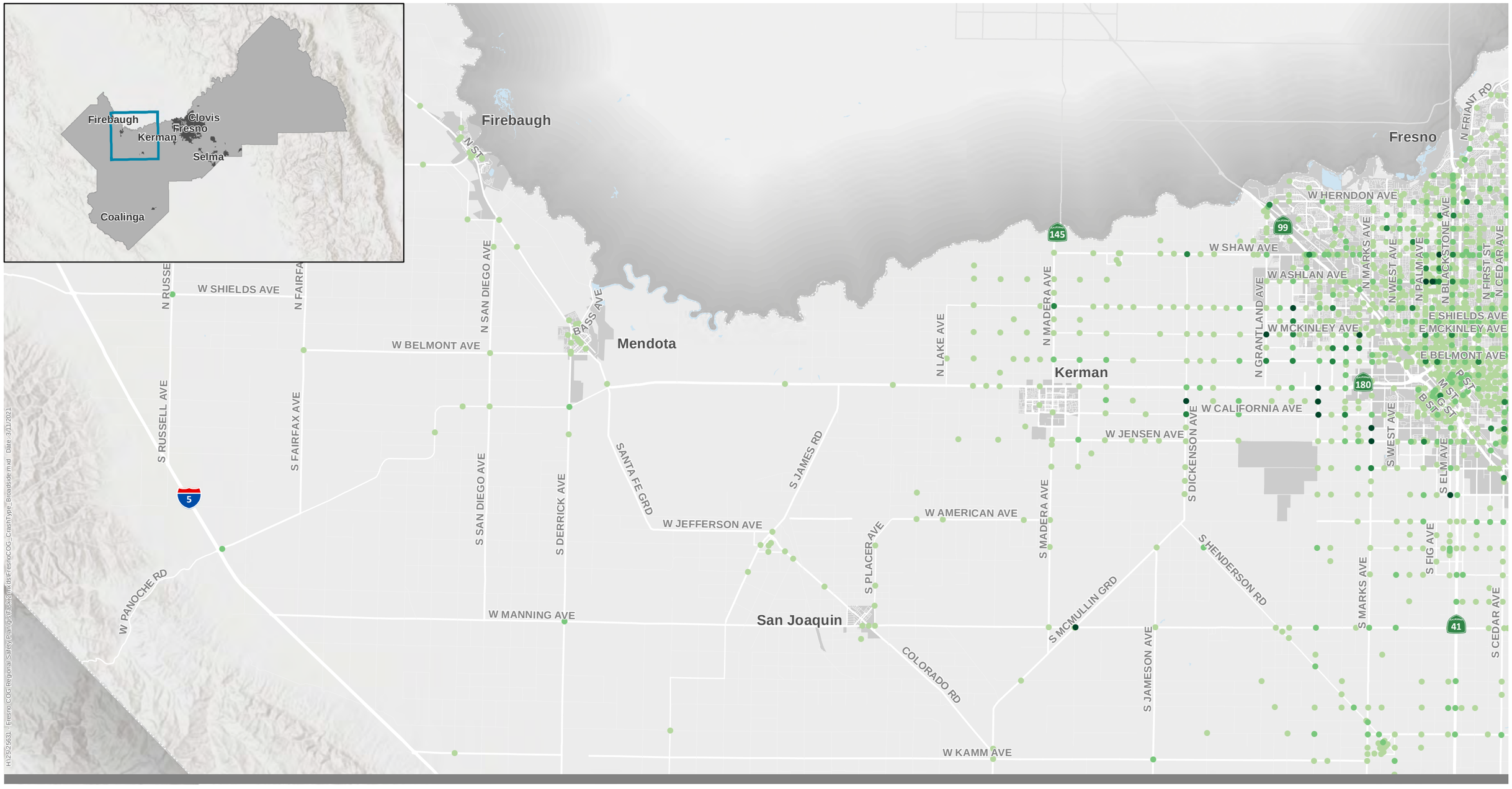
- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

0 2.85 Miles

Figure 19.1

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Total Broadside Collisions

- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

0 3 Miles

Figure 19.2

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES

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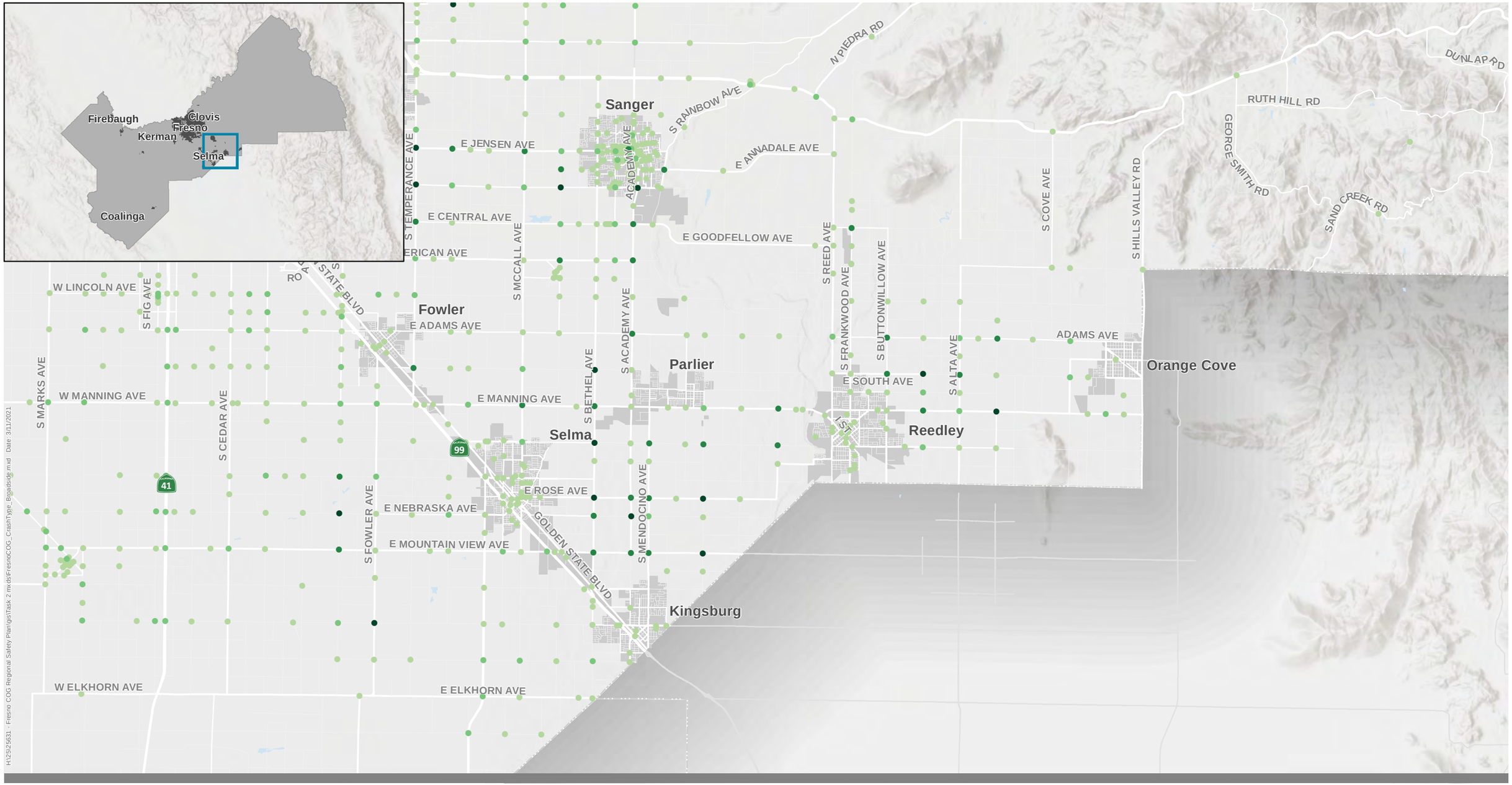

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Total Broadside Collisions

- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions

City Limits

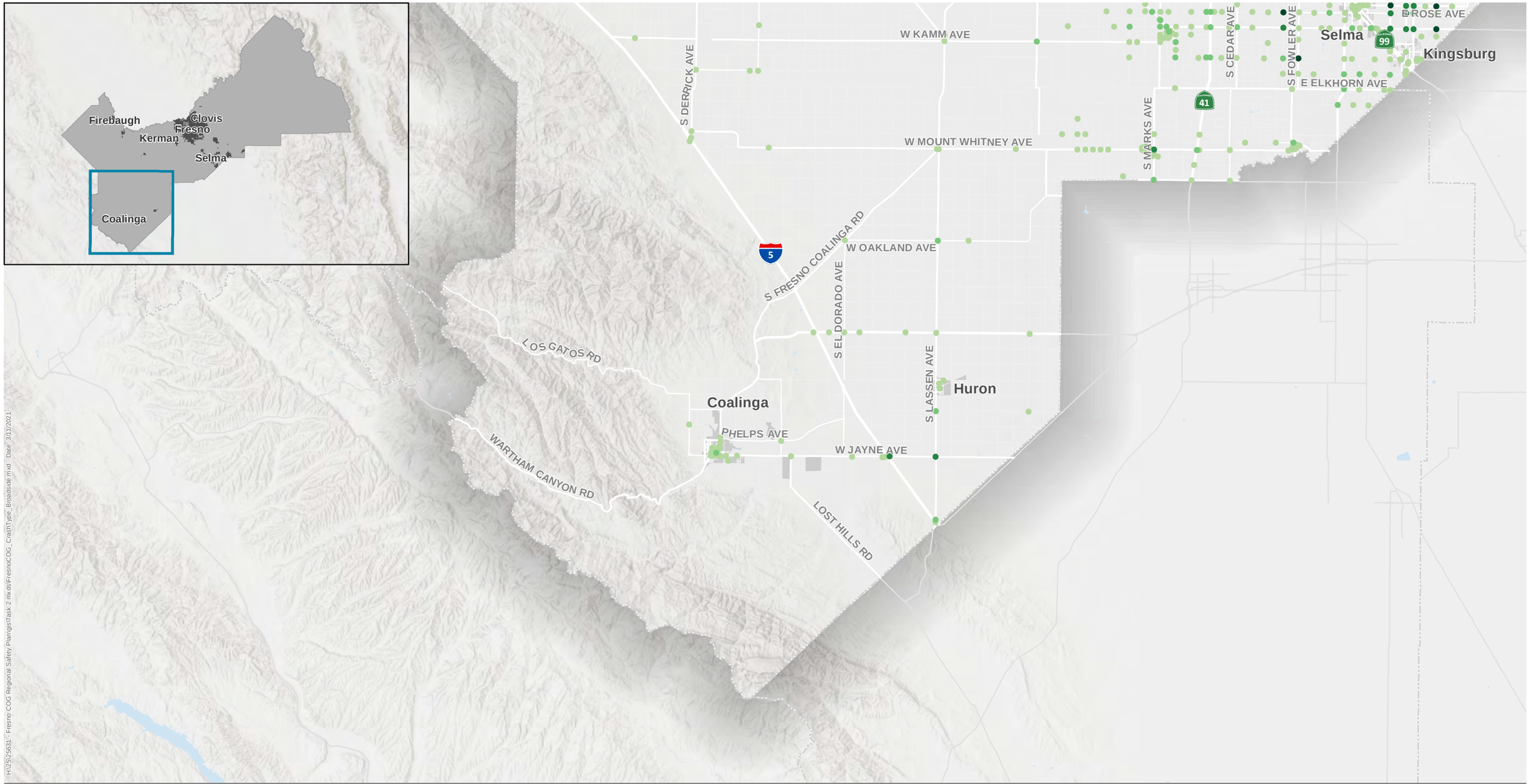
County Boundary

0 2.85 Miles

Figure 19.3

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Total Broadside Collisions

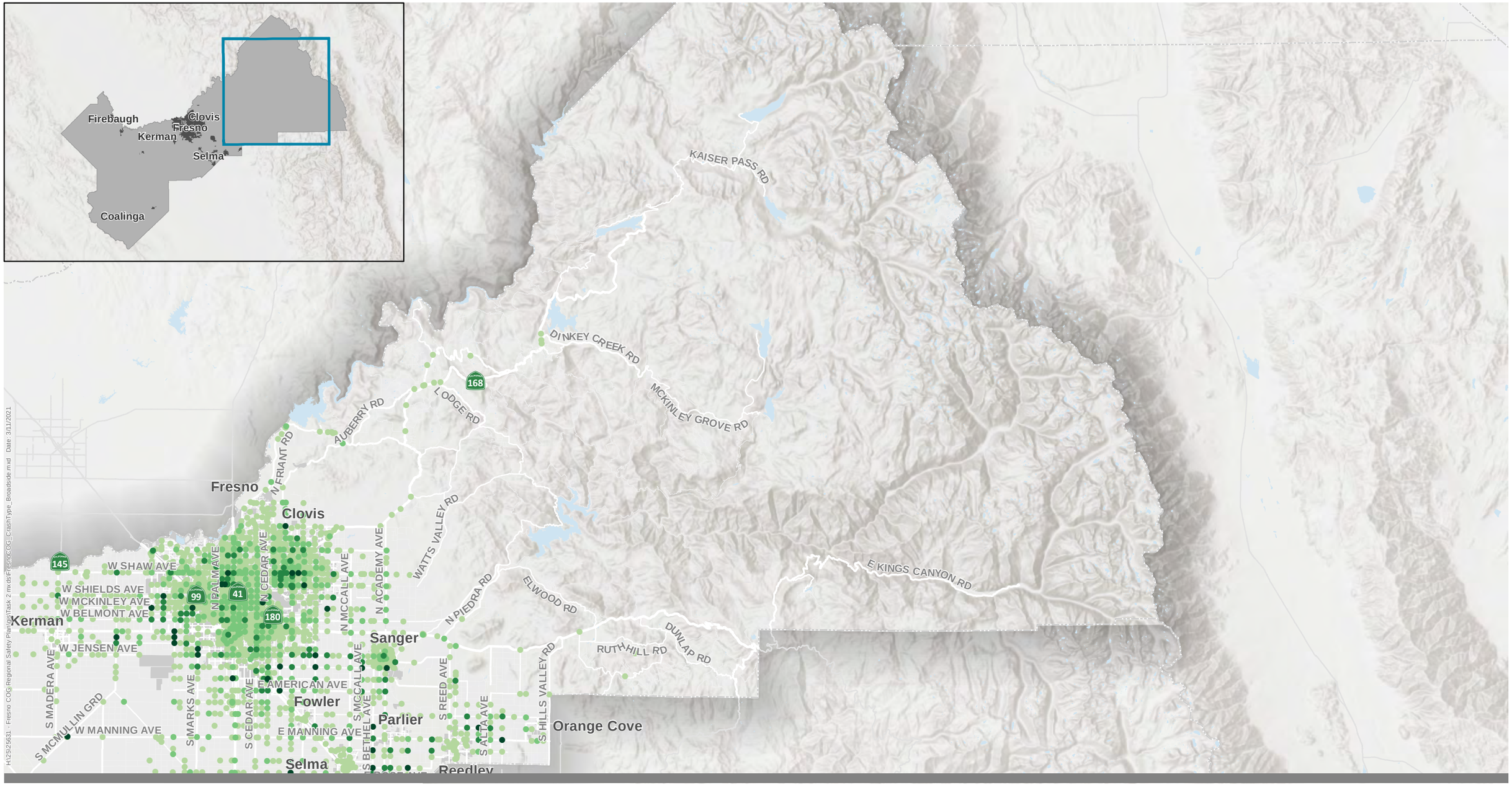
- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

0 6 Miles

Figure 19.4

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



Total Broadside Collisions

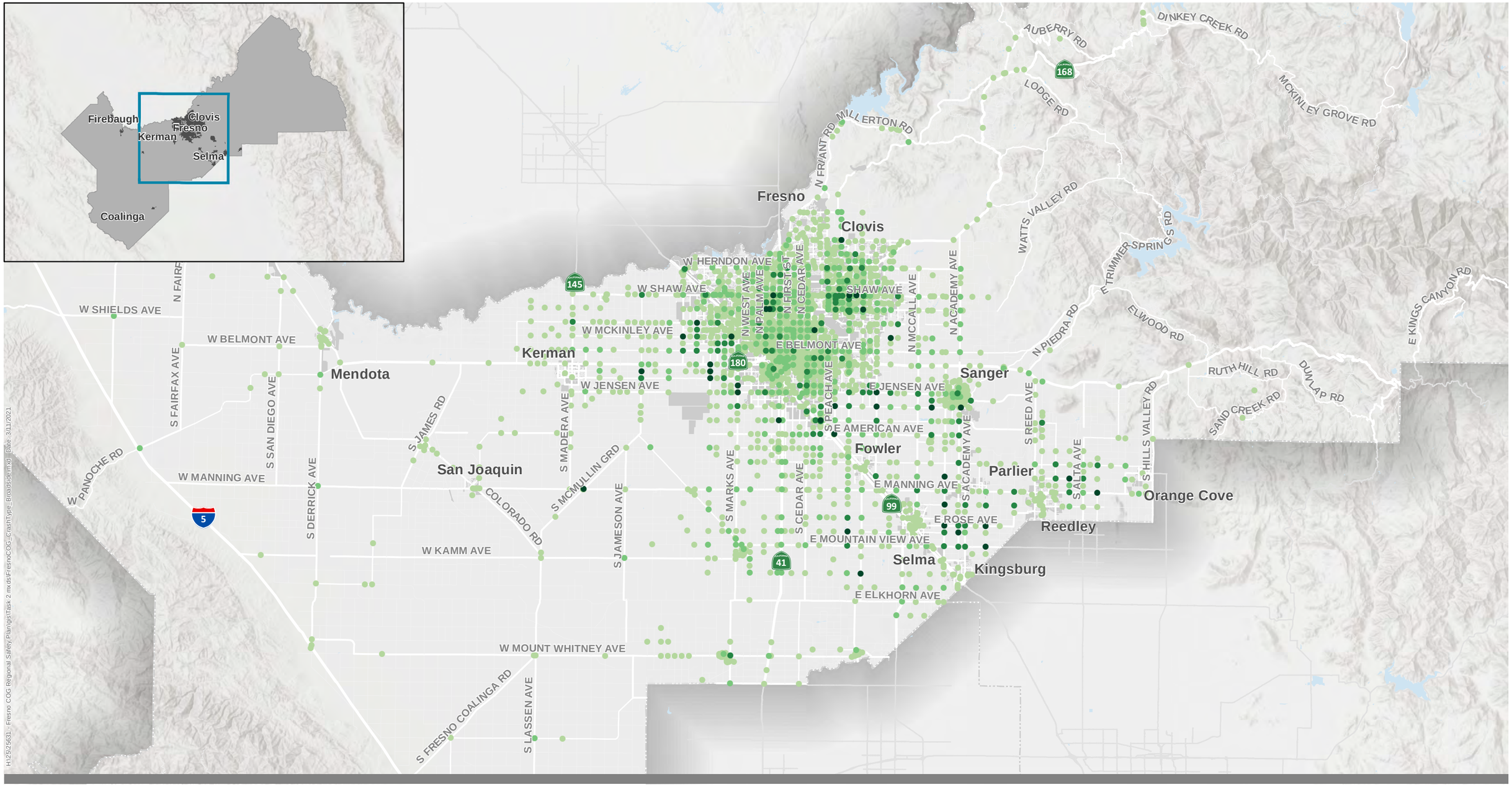
- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

0 9 Miles

Figure 19.5

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



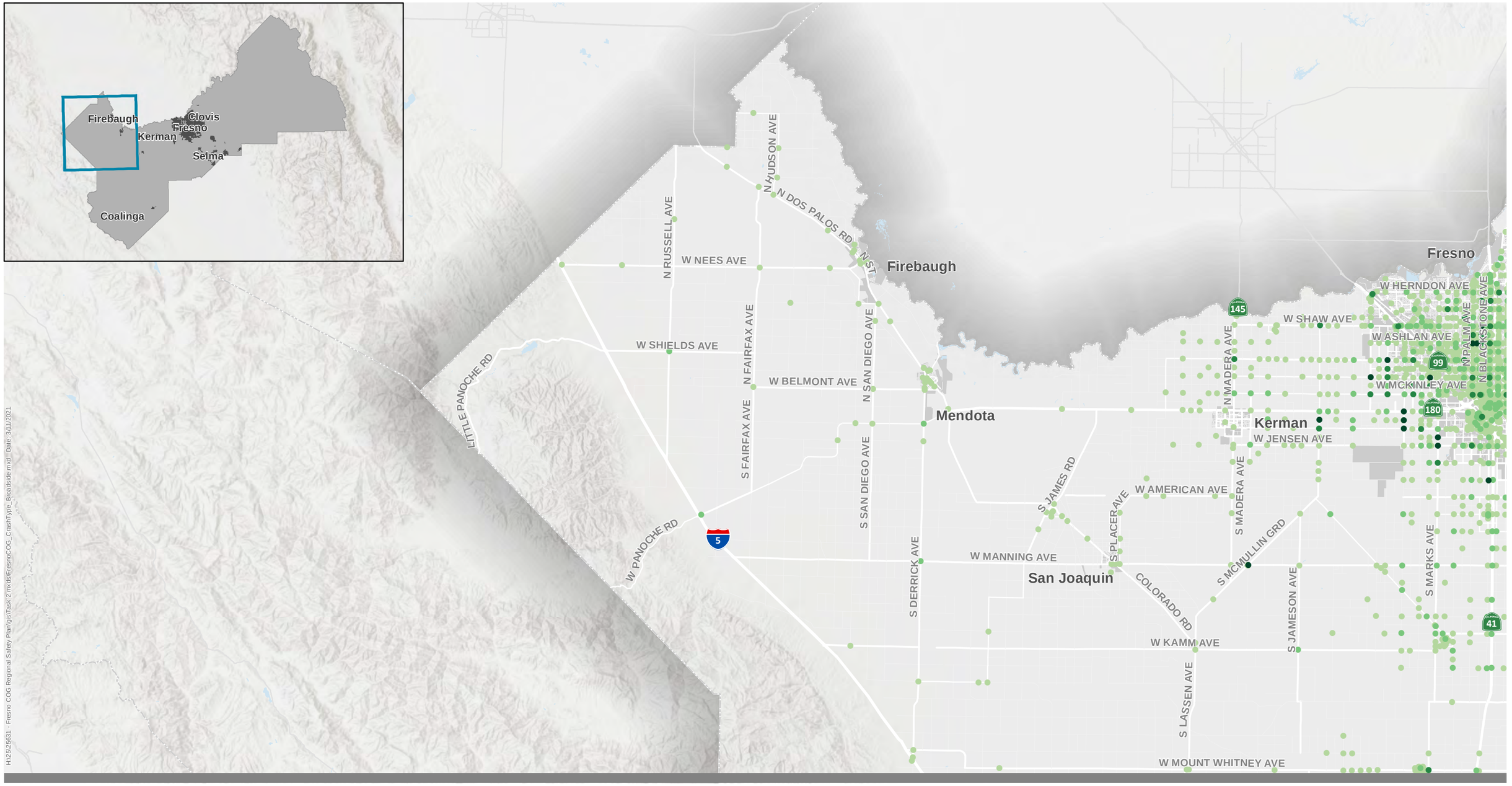
Total Broadside Collisions

- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

Figure 19.6

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES



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Total Broadside Collisions

- 1-3 Collisions
- 4-8 Collisions
- 9-16 Collisions
- 17-44 Collisions
- City Limits
- County Boundary

0 6 Miles

Figure 19.7

Top Collision Types: Broadside Collisions
Regional Results
Fresno Council of Governments

KITTELSON & ASSOCIATES