5 – RTTAP Opportunities

This chapter presents opportunities for transportation infrastructure improvements for the RTTAP Study Area. These improvements were developed in coordination and collaboration with the City of Fresno, Fresno County, Fresno COG, and Caltrans.

Context

Smart and equitable transportation planning within the Reverse Triangle area will set the stage for future growth opportunities for the Fresno region. With improved access to be provided by the Caltrans-initiated SR 99 interchange upgrades within the RTTAP Study Area, this plan serves as a crucial step to achieving a comprehensive and integrated circulation network within and to the city. Existing development is concentrated in the northern portion of the RTTAP Study Area (north of North Avenue), but recent additions to the area show a trend to continue industrial expansion southward.

Existing mobility plans identify multimodal improvements primarily along roadways in the northern portion of the RTTAP Study Area located within the city boundary, as well as along Orange Avenue and Cedar Avenue to American Avenue within the City Sphere of Influence. Other multimodal improvements include the “Rails to Trails” project, which is a proposed shared-use trail (City of Fresno ATP) along the existing railroad track alignment south of Annadale Avenue, providing an east-west connection from Cherry Avenue to Golden State Boulevard.

Although the RTTAP Study Area is predominately industrial in character, ensuring safe and accessible multimodal connections to existing residential communities and local schools is an essential component of this plan, especially considering the intensity of truck travel within the area. A significant portion of the RTTAP Study Area remains rural farmland with accompanying single-family homes, which are largely clustered into small subdivisions within the unincorporated County south of Central Avenue. In addition, residents from surrounding neighborhoods travel within the Study Area to reach destinations such as employment centers, schools, and retail. The RTTAP Study Area and the neighboring areas have populations that could be considered disadvantaged communities based on a multitude of statewide metrics including income and poverty status, minority status, exposure to pollutants, and vehicle access (Figure ES-2). California Senate Bill (SB) 535 and Assembly Bill (AB) 1550 aim to ensure that investments in transportation projects aim to improve public health, quality of life, and economic opportunity in California’s most burdened communities, while reducing criteria pollutants that can negatively contribute to climate change. The RTTAP aims to mitigate potential negative effects from planned industrial development to these communities within the Study Area.

Circulation Plan for Prosperity

The RTTAP identifies improvements to the major east-west and north-south corridors and their respective intersections necessary to accommodate planned development while balancing industrial and local community mobility needs. **The RTTAP therefore identifies transportation infrastructure improvements and mobility service programs and strategies to ensure that future anticipated growth within the Study Area will provide opportunities to improve connectivity, accessibility, and quality of life of the existing communities.**

Existing east-west roadways are spaced approximately 1-mile apart and include the following: Church Avenue, Jensen Avenue, North Avenue, Central Avenue, American Avenue, Lincoln Avenue, and Adams Avenue. Existing north-south

roadways are spaced approximately ½-mile apart and include the following: Cherry Avenue, East avenue, Orange Avenue, Cedar Avenue, and Chestnut Avenue. In an effort to develop a plan that improves connectivity to the broader Fresno community, improvement recommendations for major corridors providing direct access to the RTTAP Study Area were also evaluated, such as Elm Avenue.

RTTAP Major Transportation Corridors

The following is a list of the major transportation corridors within the RTTAP Study Area:

- Church Avenue
- Jensen Avenue
- North Avenue
- Central Avenue
- American Avenue
- Lincoln Avenue
- Adams Avenue
- Cherry Avenue
- East Avenue
- Orange Avenue
- Cedar Avenue
- Chestnut Avenue

Table 4 and Table 5 present the existing multimodal facilities for segments along RTTAP Study Area's east-west and north-south corridors, respectively. Segment lengths and approximate widths of currently developed roadway area (i.e., pavement with sidewalks if present) are also provided. As shown, sidewalks are present on the majority of Church Avenue and along portions of Jensen Avenue, North Avenue, and Central Avenue. Bike lanes are present along Church Avenue, and portions of North Avenue and Central Avenue. Within the RTTAP Study Area, roadways have been improved only as development occurs, creating a network of incomplete and disconnected multimodal facilities.

Due to the industrial character of the area's roadways, multimodal facilities should aim to improve the safety and comfort level of bicyclists and pedestrians in a manner where such mobility can coexist with movement of large trucks through the area. In addition, this plan presents opportunities to extend these multimodal improvements as the areas of development grow, primarily southerly along primary transportation corridors within the RTTAP Study Area. The RTTAP identifies transportation improvements, programs, and strategies with multi-jurisdictional support and community engagement that achieve the following objectives:

- Provide an circulation network that prioritizes the health and safety of the community by creating appropriate transitions between new development and existing uses, including residential communities and schools.
- Mitigate air quality and congestion impacts by encouraging mode shares away from single occupant vehicles to active modes via bicycle and pedestrian improvements and public transportation services (consistent with Caltrans Deputy Directive DD-64-R2 and the FCOG policies for implementation of "Complete Streets").
- Implement strategies to mitigate negative impacts to existing disadvantaged communities (per CalEnviroScreen metrics) related air quality, congestion, and safety due to the industrialization of the RTTAP Study Area.
- Improve connectivity and access for disadvantaged populations (per SB 535 and AB 1550 metrics) by ensuring that individuals can access basic amenities and key destinations related to employment, health, or personal trips.
- Identify roadway and intersection improvements that are consistent with local and regional plans to support continued growth and improve quality of life for residents, employees, and visitors of the RTTAP Study Area.

RTTAP Transportation Improvement Categories

The following categories of improvement opportunities have been identified for the RTTAP Study Area and represent projects that are either currently planned or newly identified within this plan.

- **Intersection operational improvements** to address existing and future deficiencies related to vehicular delay.

- **Multimodal and safety improvements** for roadways and intersections along major corridors to improve connectivity and safety for bicycle, pedestrian, vehicular, truck, and transit travel.
- **Transit and travel demand management (TDM) strategies** to provide efficient transportation choices that result in reducing traffic congestion, pollution, and commuting stress.

The improvement recommendations and strategies are described in further detail in Chapter 6 and are evaluated in Chapter 7.

Table 4 – Existing Multimodal Facilities (East-West Roadways)

Corridor / Segment	Segment Length (mi)	# Lanes (Planned)	Class II Bike Lanes (Existing)		Sidewalk (Existing)		Approximate Existing Width (feet)
East-West Roadways			**EB**	**WB**	**EB**	**WB**	
Church Ave							
Elm Ave to Cherry Ave	0.5	4	Yes	Yes	Yes	Gaps	80
Cherry Ave to GSB	0.3	4	Yes	Yes	Yes	Yes	80
Jensen Ave							
Elm Ave to Cherry Ave	0.5	4	No	No	Yes	Yes	109
Cherry Ave to East Ave	0.3	4	No	No	Yes	Yes	104
East Ave to GSB	0.4	4	No	No	Yes	Gaps	88
North Ave							
Elm Ave to SR 99	0.25	2	No	No	No	Yes	26
SR 99 to Cherry Ave	0.25	2	No	No	No	Yes	76
Cherry Ave to East Ave	0.5	4	Yes	Yes	Gaps	Yes	95
East Ave to Orange Ave	0.5	4	Yes	Yes	Gaps	Gaps	95
Orange Ave to Cedar Ave	0.5	2	No	No	No	No	40
Cedar Ave to GSB	0.25	2	No	No	No	No	50
Central Ave							
Elm Ave to Cherry Ave	0.5	2	No	No	No	No	40
Cherry Ave to Mary Ave	0.25	2	No	No	No	No	22
Mary Ave to East Ave	0.25	2	Yes	Yes	No	Yes	65
East Ave to Amazon Driveway	0.4	2	No	No	No	No	28
Amazon Driveway to Orange Ave	0.1	2	No	Yes	No	Yes	62
Orange Ave to GSB	1	2	No	No	No	No	28
American Ave							
Elm Ave to Orange Ave	1.5	2	No	No	No	No	24
Orange Ave to Maple Ave	1	2	No	No	No	No	24
Maple Ave to GSB	1.5	2	No	No	No	No	24
Lincoln Ave							
Elm Ave to Sarah St	0.7	2	No	No	No	No	22
Sarah Str to Chestnut Ave	2.3	2	No	No	No	No	22
Adams Ave							
Elm Ave to GSB	5.8	2	No	No	No	No	24

GSB = Golden State Blvd

Table 5 – Existing Multimodal Facilities (North-South Roadways)

Corridor / Segment	Segment Length (mi)	# Lanes (Planned)	Class II Bike Lanes (Existing)		Sidewalk (Existing)		Approximate Existing Width (feet)
North-South Roadways			**NB**	**SB**	**NB**	**SB**	
Cherry Ave							
Church Ave to Jensen Ave	0.5	2	No	No	Gaps	Gaps	75
Jensen Ave to Annadale Ave	0.5	2	Gaps	No	Gaps	Gaps	80
Annadale Ave to North Ave	0.5	2	Yes	Yes	Yes	Yes	76
North Ave to Valley Iron Inc.	0.25	2	Gaps	No	Gaps	No	55
Valley Iron Inc. to Central Ave	0.75	2	No	No	No	No	28
Central Ave to Adams Ave	3	2	No	No	No	No	24
East Ave							
Jensen Ave to North Ave	1.1	2	Gaps	Gaps	Gaps	Gaps	82
North Ave to Central Ave	1	2	Gaps	Gaps	Gaps	Gaps	60
Central Ave to Adams Ave	3	2	No	No	No	No	22
Orange Ave							
GSB to SR 99	0.4	2	No	No	No	No	85
SR 99 to North Ave	0.25	2	Yes	Yes	No	Gaps	62
North Ave to Fortune Ave	0.25	2	Yes	Gaps	No	Yes	72
Fortune Ave to Central Ave	0.75	2	Gaps	Yes	No	Yes	62
Central Ave to American Ave	1	2	No	No	No	No	22
American Ave to Adams Ave	2	2	No	No	No	No	22
Cedar Ave							
GSB to Central Ave	1.25	2	No	No	No	No	24
Central Ave to Adams Ave	3	2	No	No	No	No	24
Chestnut Ave							
Central Ave to Adams Ave	3	2	No	No	No	No	40

GSB = Golden State Blvd

Operational Improvements

Intersection operational improvements are identified to address existing and future deficiencies related to vehicular delay along RTTAP Study Area roadways.. These improvements were determined based on future operational analysis using Year 2042 volume forecasts from the Fresno COG ABM model consistent with the City of Fresno General Plan (2014). Additional planned/programmed improvements include Caltrans-initiated SR 99 interchange improvements. The list of operational improvements and their recommended locations within the RTTAP Study Area are presented in Chapter 6.

Multimodal & Safety Improvements

Roadway and intersection multimodal improvements include a variety of facility types that improve accessibility, comfort level, and safety for bicyclists and pedestrians by improving visibility, slowing vehicular traffic, and increasing separation between motorists and non-motorists.

The following sections describe some of the recommended multimodal and safety improvements within this plan. The provided images are not exact depictions of the recommended improvements, but rather provide examples of multimodal improvement types. Images are sourced from the *City of Fresno Active Transportation Plan* (2016), *Fresno-Clovis Class IV Bikeway Design Guide* (2017), National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide*, *Second Edition* (2014), or Google. Multimodal and safety improvement projects for the RTTAP Study Area are presented in Chapter 6.

Pedestrian Improvements

- Sidewalk gap closure, widening, or extension (10-foot sidewalks where feasible, including space for lighting) to provide continuous pedestrian facilities along major corridors.
- **Curb Ramps** are provided in line with the pedestrian path of travel as a transition area between crosswalks and sidewalk and should comply with ADA design standards.
- **Curb Extensions (Bulb-outs)** enhance pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing turning vehicles, and visually narrowing the roadway (source: sfbetterstreets.org). Blub-outs should be evaluated for use at key locations with consideration for truck turning design requirements and transit operations. The example image to the right shows the intersection of Amador Street at Broadway Street in Downtown Fresno.

Bulb-Out Example in Fresno

- **Rectangular Rapid Flashing Beacons (RRFB)** are pedestrian-actuated visibility enhancements that flash with high frequency when activated to alert drivers. RRFBs should be used in combination with pedestrian crossing warning signs.
- Leading Pedestrian Interval (LPI) phases at signalized intersections to allow time for the pedestrian to enter the crosswalk prior to vehicles receiving a green light.

Pedestrian Refuge Island with RRFB

Bicycle improvements

- Class II Bike Lanes: Class II facilities provide a striped and signed lane for one-way bicycle travel on each side of a street or highway within the paved area of a roadway. No physical separation is provided between cyclist and motorists.

Buffered Class II Bicycle Lanes

Image source: NACTO

- **Buffered Class II Bike Lanes** are conventional bike lanes with a designated buffer of at least 18 inches. Buffers are painted markings adjacent to bike lanes to provide additional separation between cyclists and motorists travel lanes.

- **Class IV Bikeways**, also known as protected bikeways, separated bikeways or cycle tracks, provide a separate travel way that is designated exclusively for bicycle travel adjacent to the roadway and are protected from vehicular traffic by physical separation. The separation may include, but is not limited to, grade separation, planters, flexible bollards, inflexible posts, physical barriers, or on-street parking. The City of Fresno has a Class IV Bikeway with flexible bollards along R Street between Ventura Street and Tulare Street, as shown in the following image.

Class IV Protected Bikeways with Flexible Bollards

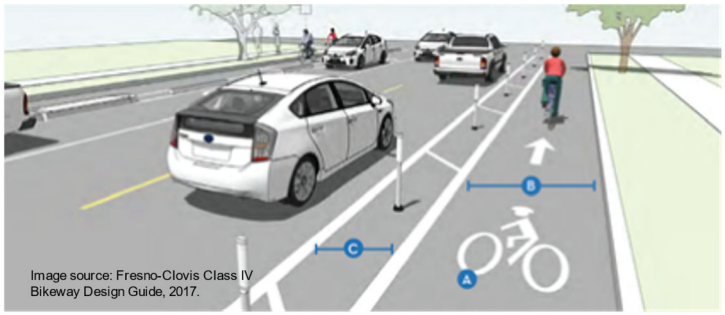


Image source: Fresno-Clovis Class IV Bikeway Design Guide, 2017.

- Class I Path (Shared Use Path): Class I Paths are paved, completely separated facilities for use by both bicyclist and pedestrians. The City of Fresno ATP identifies the “Rails to Trails” project that would provide an east-west Shared Use Path connection through the RTTAP Study Area via existing railroad track alignment adjacent to Annadale Avenue.

Additional bicycle facility types that aim to improve bicyclist safety through improved visibility and physical separation include the following:

Bicycle Box at Traffic Signal

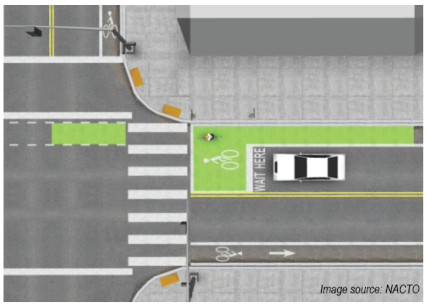
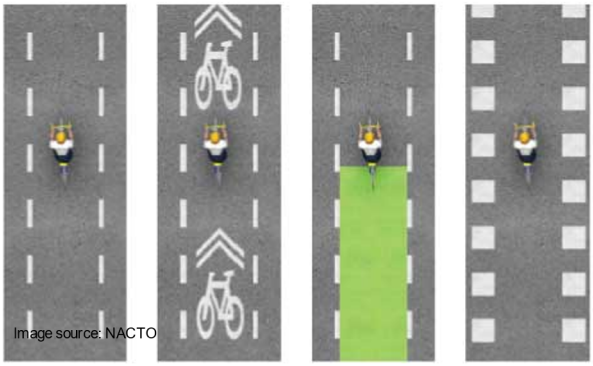


Image source: NACTO

- **Bicycle boxes** are designated marked areas to queue in front of automobiles at signalized intersections.
- **Green Paint/Conflict Markings** may be installed within bicycle lanes or the extension of the bicycle lane through an intersection or a conflict area as a supplement to bike lane markings. According to the City of Fresno Active Transportation Plan (December 2016), recommended best practices for green bike lanes include:
  - Prioritize locations that impact safety
  - Maximize effectiveness by prioritizing conflict areas
  - Consider green paint as a supplement to required markings
  - Use skipped green paint markings in weaving areas, such as at driveways or intersection approaches where vehicles are allowed to turn

Bicycle Crossing Markings



Bicycle Approach with Conflict Markings

The following image shows the southbound approach at the intersection of Central Avenue and Orange Avenue in the RTTAP Study Area, which was improved with a right turn lane and bicycle pocket. This intersection is located adjacent to the Amazon distribution site. This intersection could be improved with bicycle crossing markings to improve bicyclist visbility to right-turning vehicles.

Transit and Transportation Demand Management (TDM) Strategies

Chapter 6 presents a comprehensive list of transit and TDM strategies for the RTTAP Study Area. The following goals drive strategies for transit service and TDM programs to improve connectivity and access to the RTTAP Study Area and surrounding areas, with a specific focus on disadvantaged communities:

- **Mitigate Air Quality and Congestion Impacts:** Travel demand is better managed by increasing/encouraging mode shares away from single occupant vehicles to active modes. The RTTAP roadway and intersection multimodal improvements presented in this plan will link individuals to transit and/or TDM services.
- **Improve Connectivity and Access for Disadvantaged Populations:** Implementing the multimodal and safety improvements presented within the RTTAP will promote increased access and connectivity for priority populations. Priority populations are defined by the California Air Resources Board as disadvantaged communities, low-income communities, and low-income households, who are especially vulnerable to the impacts of climate change.

Safety Improvements

The abovementioned multimodal improvements play a role in improving corridor safety for bicyclists and pedestrians primarily by improving traveler visibility (i.e., via pavement conflict markings, bulb-outs, and high visibility pedestrian crossings) and increasing separation between motorists and non-motorists (i.e., separated bikeways, buffered bike lanes, and sidewalk improvements). Additional safety improvements address vehicular movements (such as turns) by providing two-way left-turn lanes on the majority of RTTAP Study Area corridors where turns into and out of industrial sites and employment centers are anticipated. On industrial streets within the County, roadway cross-sections should be improved with paved shoulders for the purposes of providing additional effective turning radii at intersections and emergency stopping space for vehicles.

Additional safety improvements were recommended for the safety priority intersections and roadway segments that were identified as safety priorities based on either the frequency of crashes, crash severity, or history of bicycle or pedestrian crashes. Table 6 presents the corridors that were considered safety priorities and their respective crash history, ranked by total number of crashes, ranked by total number of crashes. Along Cherry Avenue, there were two pedestrian injury crashes (including one severe injury crash) and one bicyclist fatality. Along American Avenue, there was one pedestrian injury crash. *Note: Crash severity 1 indicates a crash that results in a fatality; crash severity 2-4*

indicates an injury crash with varying severity, with 2 being the most severe. Night-time crashes refer to crashes that occurred outside of daylight hours, as defined by SWITRS.

Table 6 – Safety Priority Roadway Locations (Crashes by Severity)

	Total Segment Crashes					Night-time Crashes					Bicycle or Pedestrian Crashes				
Corridor	**1**	**2**	**3**	**4**	**Total**	**1**	**2**	**3**	**4**	**Total**	**1**	**2**	**3**	**4**	**Total**
Chestnut Ave			7	13	**20**			3	2	**5**			1		**1**
Cherry Ave	1	1	4	6	**12**	1	1	2		**4**	1	1	1		**3**
Central Ave			2	6	**8**			2	2	**4**					
American Ave			5	2	**7**				1	**1**			1		**1**
Cedar Ave			3	4	**7**				2	**2**					
Lincoln Ave			1	4	**5**				2	**2**					
Total	**1**	**1**	**22**	**35**	**59**	**1**	**1**	**7**	**9**	**18**	**1**	**1**	**3**		**5**

Table 7 presents the intersections that were considered safety priorities and their respective crash history, ranked by total number of crashes. Cherry Avenue at Central Avenue had one pedestrian injury crash, and Central Avenue at East Avenue had one bicycle injury crash. *Note: Crash severity 1 indicates a crash that results in a fatality; crash severity 2-4 indicates an injury crash with varying severity, with 2 being the most severe. Night-time crashes refer to crashes that occurred outside of daylight hours, as defined by SWITRS.*

Table 7 – Safety Priority Intersection Locations (Crashes by Severity)

Intersection		Total Intersection Crashes					Night-time Crashes					Pedestrian Crashes	Bike Crashes
Cross-street 1	**Cross-street 2**	**1**	**2**	**3**	**4**	**Total**	**1**	**2**	**3**	**4**	**Total**	**3**	**4**
American Ave	Chestnut Ave			3	8	11				2	2		
Cedar Ave	American Ave		1	2	6	9							
Central Ave	Chestnut Ave			2	6	8		1		1	2		
Cherry Ave	Adams Ave			2	5	7			1	2	3		
American Ave	Maple Ave		2	3	2	7				1	1		
American Ave	East Ave		1	1	4	6							
Central Ave	Elm Ave			2	4	6							
East Ave	Lincoln Ave		1	1	2	4							
Chestnut Ave	Lincoln Ave		1		2	3		1	1		2		
Chestnut Ave	Clayton Ave			2	1	3							
Cherry Ave*	Central Ave			1		1				1	1	1	
Central Ave*	East Ave				1	1				1	1		1
Total		**-**	**7**	**20**	**42**	**69**	**-**	**2**	**2**	**10**	**14**	**1**	**1**

*Included as a safety priority due to previous bicycle or pedestrian related crash.

Safety improvements are recommended at priority locations in Chapter 6 and are evaluated in terms of their relative crash reduction potential in Chapter 7 of this report. The following table provides a list of safety improvements (or "countermeasures") from Caltrans's *Local Roadway Safety Manual* (Version 1.5, April 2020) applicable to the RTTAP Study Area facilities, which are consistent with RTTAP roadway improvement standards and intersection improvement categories.

Table 8 – Appliable Safety Countermeasures

Type	Description
Applicable Roadway Countermeasures	
Lighting	Add segment lighting
Geometric Modification	Add two-way left-turn lane (without reducing travel lanes)
Geometric Modification	Widen shoulder (paved)
Operation/ Warning	Install no-passing line
Ped and Bike	Install bike lanes
Ped and Bike	Install sidewalk/pathway (to avoid walking along roadway)
Ped and Bike	Install pedestrian crossing (with enhanced safety features)
Applicable Intersection Countermeasures	
Lighting	Improve signal timing
Lighting	Install raised pavement markers and striping
Lighting	Install raised median on approaches
Lighting	Add intersection lighting
Control	Upgrade intersection pavement markings
Operation/ Warning	Install Flashing Beacons at Stop-Controlled Intersections
Operation/ Warning	Install left-turn lane (where no left-turn lane exists)
Ped and Bike	Install raised medians / refuge islands
Ped and Bike	Install Pedestrian Signal

RTTAP Roadway Improvement Standards

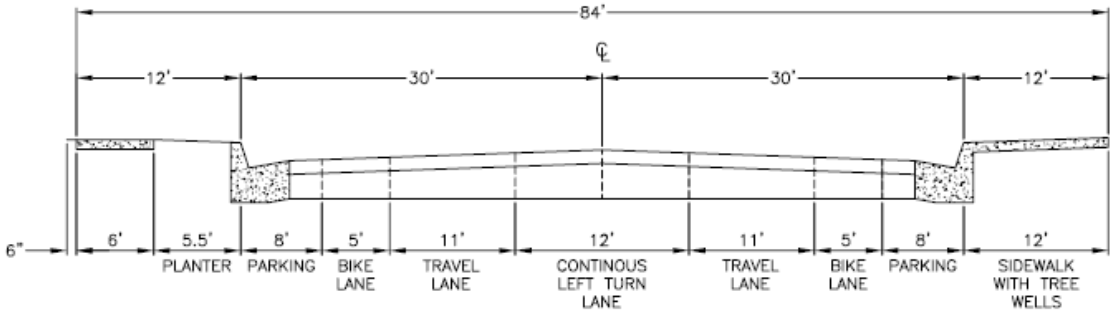
The following roadway improvement standards provide recommended cross-sections for major corridors within the RTTAP Study Area. Cross-sections refer to the basic elements or features of a roadway within the right-of-way width, such as width and number of travel lanes, bicycle lanes, sidewalk, landscaping, etc. RTTAP-specific roadway improvements standards were development in coordination with FCOG, the City, and County to identify opportunities for enhanced bicycle and pedestrian street features while balancing requirements for vehicular and truck travel lanes and turn lanes. Chapter 6 identifies the comprehensive list of roadway improvement projects and identifies locations where these cross-sections are recommended to be implemented within the RTTAP Study Area.

Table 9 presents the proposed improvement standards for the RTTAP Study Area. Right-of-way (ROW) ranges are provided to accommodate multimodal facilities within potential existing ROW constraints. However, wider bike lanes and bike lane buffers should be provided wherever feasible. *Note: The City of Fresno and Fresno County have preceding roadway improvement standards based on roadway classifications within their respective jurisdictions. These improvement standards are not intended to supersede current roadway classifications.*

Existing Standards

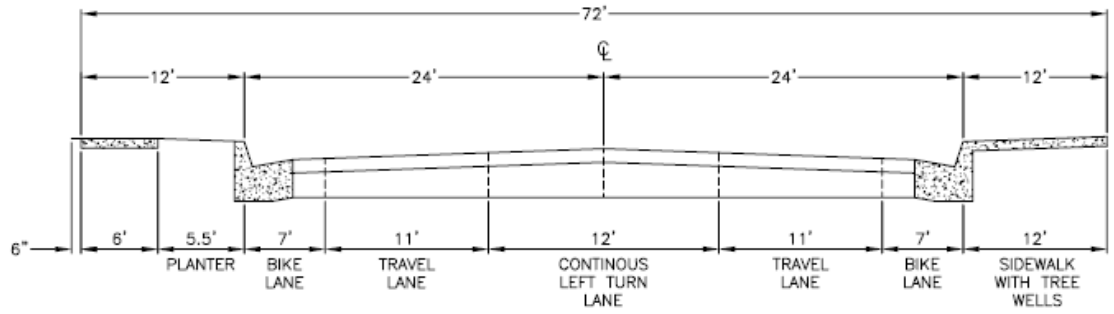
As shown in Table 9, cross-sections “A” and “B” reflect existing City of Fresno roadway improvement standards for 2-lane collector streets with and without parking. These standards include a 12-foot TWLTL, 11-foot travel lanes, 5- to 7-foot Class II bike lanes, and 12-foot landscaped sidewalks. It should be noted that current city and county standards for “Industrial Streets” recommend 12- to 13-foot travel lanes.

Cross-section “A”: 2-Lane Collector Street with Class II Bike Lanes, with Parking (84’ ROW)



COLLECTOR STREET WITH PARKING
(2 TRAVEL LANES) 84’ ROW

Cross-section “B”: 2-Lane Collector Street with Class II Bike Lanes, no Parking (72’ ROW)



COLLECTOR STREET – NO PARKING
(2 TRAVEL LANES) 72’ ROW

Existing Fresno County Improvement Standard (A-5): Local Road – Industrial (64’ ROW)

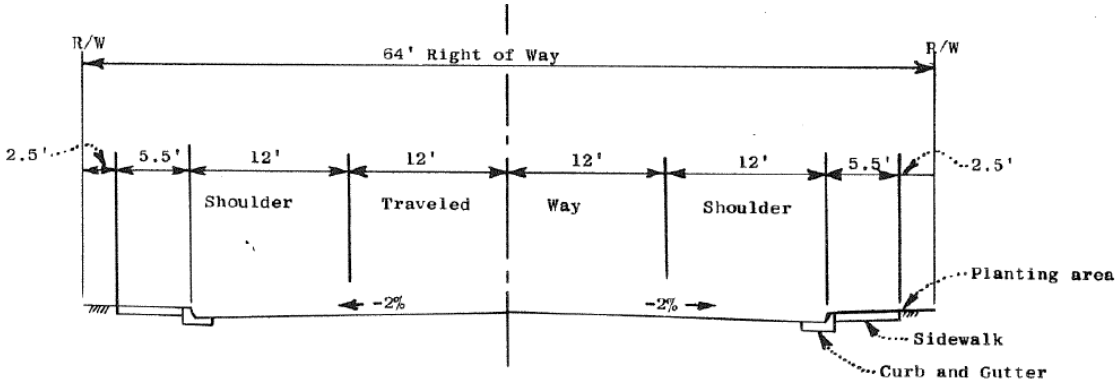


Table 9 – Proposed RTTAP Improvement Standards

ID	RTTAP Cross-section	ROW Range (feet)[1]	# Travel Lanes	Directional (feet)					
				Travel Lane[2]	TWLTL	Painted Bike Lane Buffer[3]	Bike Lane	Paved Shoulder[4]	Sidewalk[5]
A	Class II Bike Lanes, no Parking (2 Lanes) - Existing Standard	72	2	11	12		7		12
B	Class II Bike Lanes, no Parking (4 Lanes) - Existing Standard	92	4	11	10		7		12
C1	Buffered Bike Lanes, no Parking (2 Lanes)	72 - 78	2	11 - 12	12	2	7		10-12
C2	Buffered Bike Lanes, no Parking (4 Lanes)	94 - 102	4	11 - 12	12	2	7		10-12
D1	Class IV Bikeway, no Parking (2 Lanes)[6]	72 - 80	2	11 - 12	12	2 - 3	7		10-12
D2	Class IV Bikeway, no Parking (4 Lanes)[6]	94 - 104	4	11 - 12	12	2 - 3	7		10-12
E	Shared-Use Trail Option[7]	38 - 40	2	11 - 12	12			2	
F	Industrial Roadway with Buffered Bike Lanes	43 - 50	2	11 - 12		1.5 - 2	4 - 6	5	

ROW = Right-of-Way; TWLTL = Two-Way Left-Turn Lane

[1] The maximum footage is the City/County standard. The range is provided, should less ROW be available.
[2] 12-foot recommended for truck routes

[3] 3-foot recommended (2-foot minimum) for Class IV bikeways; 2-foot recommended (18-inches minimum) for buffered Class II bike lanes.

[4] Curb/gutter included in bike lane or parking lane if present.

[5] Includes designated space for light poles.

[6] Vertical separation provided via flexible post or inflexible physical barrier (i.e. concrete median or planter).

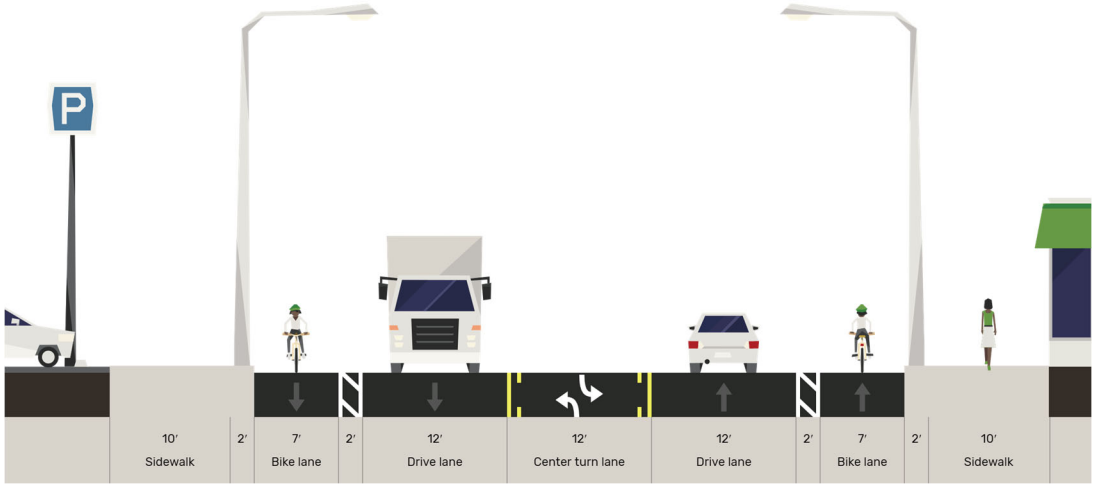
[7] Minimum 8-foot shared-use trail with 5-foot physical separation plus 2-foot shoulder distance from adjacent roadway.

Proposed RTTAP Cross-sections

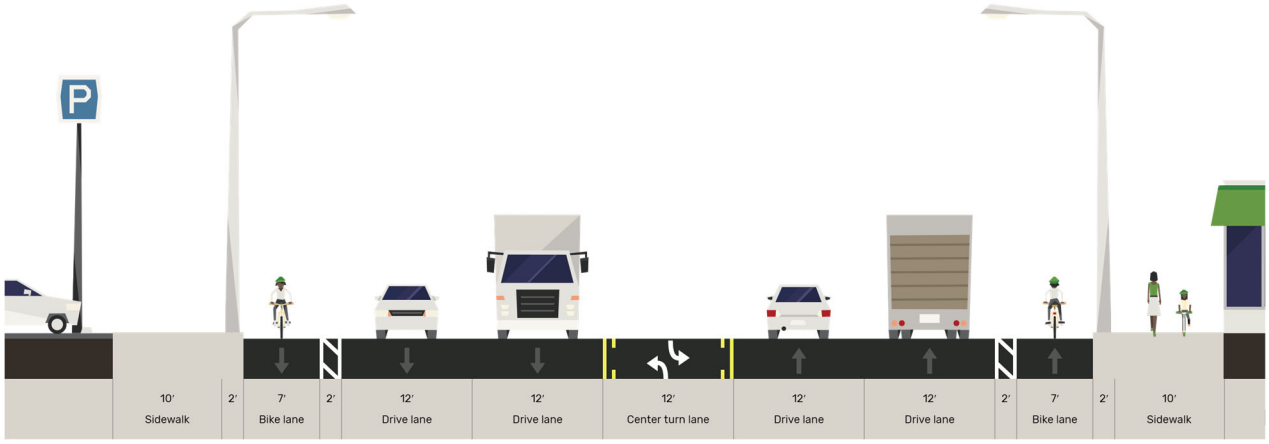
The following cross-sections are recommended for the major corridors within the RTTAP Study Area. These cross-sections aim to improve bicycle and pedestrian mobility while maintaining essential design elements to accommodate industrial travel. Streetmix was used to create cross-section illustrations. Each illustration presents the recommended widths for bicycle and pedestrian facilities (i.e., wider buffers and bicycle lanes).

Due to the existing and planned availability of on-site parking lots, on-street parking is not recommended along any major corridor. This allows for additional right-of-way (ROW) for wider sidewalks and bicycle lane buffers. Cross-section "C" options include Buffered Class II Bike Lanes, and cross-section "D" options include Class IV Bikeways. Cross-section "F" is recommended for areas where pedestrian activity is limited. An illustration is not provided for cross-section "E". Chapter 6 presents the preferred circulation plan for the RTTAP Study Area where specific recommendations for cross-section implementation are provided.

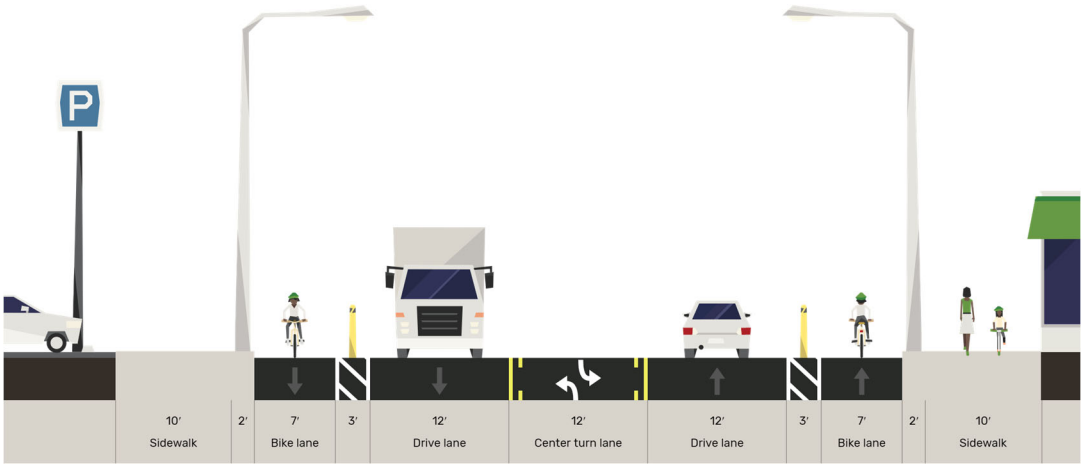
Cross-section "C1": Roadway with Buffered Bike Lanes (2 Travel Lanes) – 78' ROW



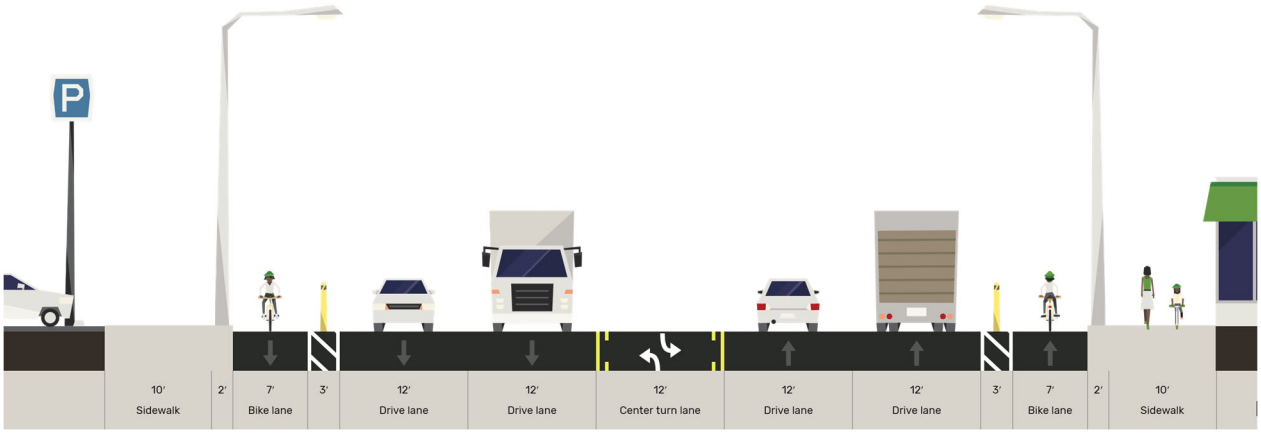
Cross-section "C2": Roadway with Buffered Bike Lanes (4 Travel Lanes) – 102' ROW



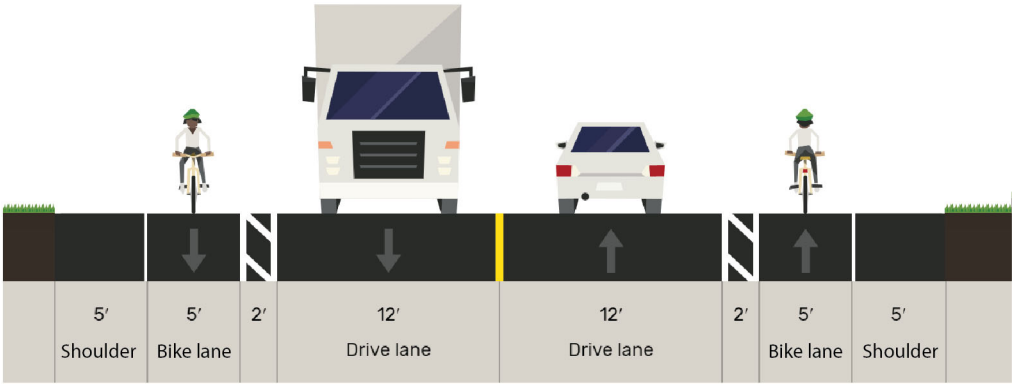
Cross-section “D1”: Roadway with Class IV Bikeway (2 Travel Lanes) – 80’ ROW



Cross-section “D2”: Roadway with Class IV Bikeway (4 Travel Lanes) – 104’ ROW



Cross-section “F”: Industrial Roadway with Buffered Bike Lanes (2 Travel Lanes) – 50’ ROW



RTTAP Intersection Improvement Categories

Multimodal intersection improvements include safety and visibility measures aimed at providing clear boundaries between motorists and bicyclists and pedestrians at these high-conflict areas, as well as alerting motorists of various traffic control types as they approach the intersection. Intersection improvements are grouped into categories for both signalized ("S") and unsignalized (or not signal, "NS") intersections based on the corresponding roadway improvement projects, anticipated multimodal activity, and crash history analysis. RTTAP intersection improvement categories are presented in Table 10.

Table 10 – RTTAP Intersection Improvement Categories

Intersection Improvement Category	
A - S	**Comprehensive Multimodal/Safety Improvements - Signalized Intersection** Locations along enhanced primary multimodal routes (with sidewalks and Class IV Bikeways) and/or near schools.
A - NS	**Comprehensive Multimodal/Safety Improvements - Unsignalized Intersection** Locations along enhanced primary multimodal routes (with sidewalks and Class IV Bikeways) and/or near schools.
B - S	**Multimodal/Safety Improvements - Signalized Intersection** Locations along multimodal routes (with sidewalks and Buffered Class II Bike Lanes).
B - NS	**Multimodal/Safety Improvements - Unsignalized Intersection** Locations along multimodal routes (with sidewalks and Buffered Class II Bike Lanes).
C	***Priority Industrial Street Bicycle/Safety Improvements - Unsignalized Intersection** Locations along Industrial Streets with bicycle lanes and considered a safety priority for vehicular travel.
D	**Industrial Street Safety Improvements - Unsignalized Intersection** Locations along Industrial Streets with bicycle lanes.

*Note: Priority locations determined based on evaluation of crash data (2012-2017) for both multimodal and vehicular crashes that occurred at or near intersections along the major RTTAP transportation corridors.

Improvement Types

Table 11 presents the types of improvements that are associated with each intersection improvement category. Intersection lighting improvements are recommended for all existing intersection locations. Improvement types were described in detail in preceding sections of this chapter.

As shown, each improvement category (specific to signalized or unsignalized intersections) differs slightly in the level of intensity of multimodal and safety transportation improvements. For example, category "A" for both signalized and unsignalized intersections includes additional bicycle and pedestrian facility improvements as compared to category "B". As such, recommendations for type "A" improvements correspond to locations where multimodal activity is anticipated to be slightly higher (i.e., near schools and/or along primarily multimodal corridors).

In addition, categories "C" and "D" for unsignalized intersections are recommended at locations without planned pedestrian facilities, including sidewalks, primarily within the County. As such, pedestrian intersection improvements are not applicable at these locations. Furthermore, category "C" includes additional safety measures such as advance

warning signs, turn lanes, and intersection conflict markings as compared to category "D". As such, recommendations for type "C" improvements correspond to locations that are considered a safety priority.

Table 11 – Intersection Improvement Types

Type	Improvement	Intersection Improvement Category					
		A - S	A - NS	B - S	B - NS	C	D
Bicycle	Bicycle Box (at Signal)	X	n/a		n/a	n/a	n/a
	Bicycle Detection/Actuation (at Signal)	X	n/a		n/a	n/a	n/a
	Conflict Area Markings (at Intersection Crossings/Approaches	X	X	X	X	X	
Pedestrian	Ped Countdown Signal Heads	X	n/a	X	n/a	n/a	n/a
	Leading Pedestrian Interval (LPI) at Signal	X	n/a	X	n/a	n/a	n/a
	Median Refuge Island at Stop-Controlled Intersection	n/a	X	n/a			
	Curb Extensions (Bulb-outs)	X	X	X	X		
	Curb Ramps	X	X	X	X		
	High Visibility Crosswalks	X	X	X	X		
Additional Safety Measures	Add/Improve Intersection Lighting	X	X	X	X	X	X
	Intersection Advance Warning Signs	X	X	X	X	X	
	Flashing Beacon at Stop-Controlled Intersection	n/a	X	n/a	X	X	
	Install Turn Lane (if currently a shared left/thru/right lane)	n/a	X	n/a	X	X	
	Conduct Traffic Signal Warrant Analysis	n/a	X	n/a	X	X	
	Conduct Multi-Way Stop Warrant Analysis	n/a	X	n/a	X	X	

Note 1: Improvements in this list do not preclude the need to meet warrants prior to installation of new traffic control devices. Analysis conducted as part of this study determined the need for vehicular operational improvements at specified locations (see Figure 3). Additional traffic control improvements to address vehicular, bicyclist, and pedestrian safety should be evaluated using methodology presented in the MUTCD.

Note 2: At existing built-out intersections, improvements should be evaluated for relative feasibility on a case-by-case basis.

Note 3: Additional modifications to existing traffic signals and stop-controlled intersections, including restriping projects, curb return modifications, and traffic signal modifications, are assumed at all intersections.

Additional Improvements

- Streetscape: Consider opportunities to provide landscaping (such as trees) along major corridors, consistent with the City of Fresno's current roadway improvement standards for collector streets (City of Fresno, 2010).
- Bike Share: Consider options to provide bike share stations to accommodate "last mile" travel.

  Bike share could be implemented in Fresno to complement the planned downtown high-speed rail station and the bus rapid transit system […]. By providing a network of bike share stations that includes these rail and transit stops, travelers will have a mode option complementing walking, taxis, and transportation networking companies such as Uber (Fresno ATP, 2016).

6 – RTTAP Circulation Plan

This chapter presents the comprehensive list of planned/programmed improvements and recommended improvements to accommodate continued growth in the RTTAP Study Area. As described in preceding chapters, recommended improvements aim to provide a comprehensive and integrated circulation system to promote the continued prosperity of the RTTAP Study Area. A robust and connected circulation system will not only serve to encourage future industrial development but is an opportunity to enhance mobility for the broader Fresno community of residents, employees, and visitors. As such, multimodal improvements are also considered in light of existing and planned facilities beyond the RTTAP Study Area boundary to improve the level of connectedness to surrounding areas.

Planned Improvements

Planned improvements include projects identified in existing planning documents, such as the local and regional active transportation plans, or currently planned or programmed separately from the adoption of the RTTAP. This plan builds upon these planned improvements and aims to identify recommendations to compliment and/or enhance projects within or connecting to RTTAP study facilities. Some of these planned improvements are already programmed with identified funding sources, while others are not currently programmed.

Active Transportation Plans

The *City of Fresno Active Transportation Plan* (December 2016) and the *Fresno County Regional Active Transportation Plan* (February 2018) provide a list of pedestrian and bicycle facility projects. Within the RTTAP Study Area, sidewalks and Class II bike lanes are recommended primarily along roadways in the northern portion of the RTTAP Study Area located within the city boundary, as well as along Orange Avenue and Cedar Avenue to American Avenue within the City Sphere of Influence. Class II bike lanes are also recommended along the full extent of Central Avenue. Figure 1 presents Future Baseline Pedestrian Facilities and Figure 2 presents Future Baseline Bicycle Facilities within and immediately adjacent to the RTTAP Study Area.

“Rails to Trails” (Class I Shared Use Path)

The “Rails to Trails” is a proposed Class I Shared Use Path planned along the existing railroad track alignment south of Annadale Avenue (City of Fresno ATP), providing an east-west connection from Cherry Avenue to Golden State Boulevard within the RTTAP Study Area. The proposed trail continues north via track alignments adjacent to Golden State Boulevard, and east via track alignments adjacent to Annadale Avenue east of SR 99. The “Rails to Trails” alignment is shown on Figure 2.

Caltrans SR 99 Interchange Improvements

Caltrans is working on several interchange studies along SR 99 within the Study Area limits that will identify recommended improvements at North Avenue interchange and American Avenue interchange.

Operational Improvements

Intersection operational improvements are identified to address existing and future deficiencies related to vehicular delay along RTTAP Study Area roadways.. These improvements were determined based on existing (2019) and future (2042) roadway and intersection operational analysis as presented earlier in this plan. Additional planned or programmed improvements include Caltrans-initiated SR 99 interchange improvements. Additional intersection and roadway improvements beyond those necessary to accommodate operational issues include multimodal and safety projects identified in subsequent sections of this chapter.

Intersection Operational Improvements

Improvements at the following intersections are recommended to address existing and future operational deficiencies within the RTTAP Study Area. These intersection locations are shown in Figure 13.

2. Jensen Avenue/SR 99 SB Off-Ramp (East Avenue): Addition of left-turn lane and re-striping

3. North Avenue/SR 99 SB Off-Ramp (Parkway Drive): Future Caltrans funded improvement

10. Central Avenue/Chestnut Avenue: Addition of right-turn lanes and re-striping

17. Clovis Avenue/SR 99 SB On-Ramp: Convert to traffic signal and addition of right-turn lane and restriping

23. North Avenue/Hwy 41 NB Off-Ramp: Addition of left-turn lane

24. North Avenue/Hwy 41 SB Off-Ramp: Addition of left-turn lane and re-striping

25. Central Avenue/Hwy 41 (SB): Optimize traffic signal cycle length

26. American Avenue/Hwy 41 (NB): Addition of left-turn lane

34. Central Avenue/Maple Avenue: Convert to traffic signal

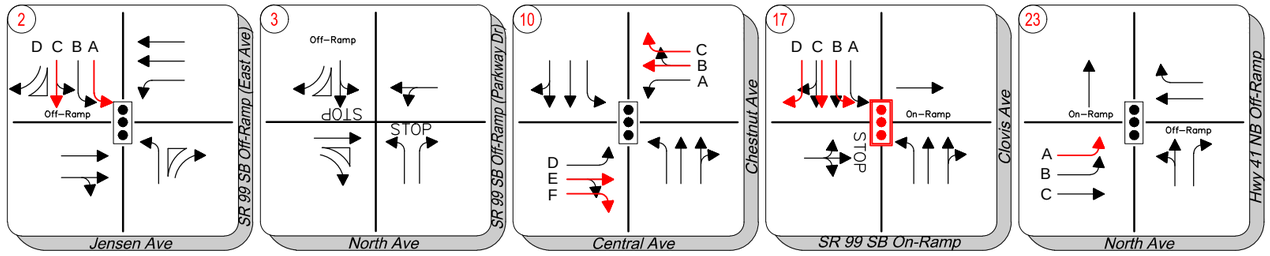
In general, cumulative traffic operating conditions indicate the study intersections generally meet current LOS thresholds within the RTTAP Study Area. Deficiencies noted were shown primarily along SR 99 interchange off/on ramps and along Hwy 41. Recommended improvements at these intersections include the addition of left or right-turn lanes which could be accommodated by re-striping or widening of intersection approaches, converting existing intersection control to a signalized control, and optimizing signalized intersections. No recommended improvements include the addition of thru travel lanes.

Additionally, Caltrans is working on several interchange studies along SR 99 within the Study Area limits that will identify recommended improvements at North Avenue interchange and American Avenue interchange.

Roadway Operational Improvements

The following planned roadway improvements are identified in the City of Fresno General Plan – Mobility and Transportation (2014). The RTTAP does not make recommendations for roadway widening along the major corridors within the RTTAP Study Area.

- Widen Church Avenue to Four Lanes with Two-Way Left-Turn Lane (TWLTL)
- Widen Orange Avenue from Central Avenue to American Avenue to accommodate a TWLTL
- Widen American Avenue from Orange Avenue to Maple Avenue to accommodate a TWLTL



A = Addition of dedicated left-turn

B = Maintain dedicated left-turn movement

C = Alter thru-left movement to dedicated thru movement

D = Alter dedicated right-turn movement to include 350' of storage

Future Caltrans Funded Improvement

A = Maintain dedicated left-turn movement

B = Alter thru-right movement to dedicated thru movement

C = Addition of dedicated right-turn to include 120' of storage

D = Maintain dedicated left-turn movement

E = Alter thru-right movement to dedicated thru movement

F = Addition of dedicated right-turn to include 120' of storage

Convert from one-way stop control to signalized control (optimize cycle length).

A = Maintain dedicated left-turn

B = Alter thru-movement to dedicated left-turn movement (150' storage)

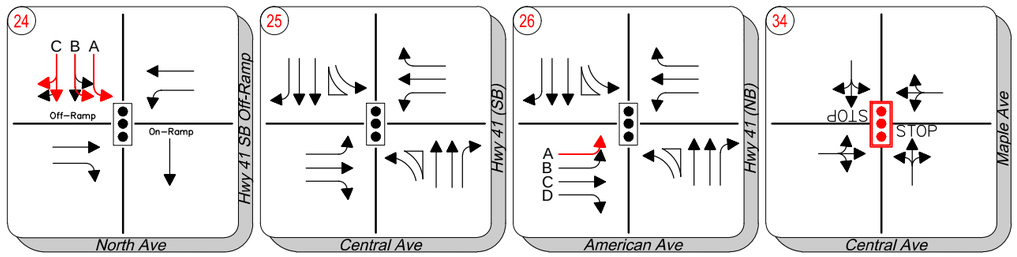
C = Alter thru-right movement to dedicated thru movement

D = Addition of right-turn movement (90' storage)

A = Addition of dedicated left-turn (250' storage)

B = Maintain left-turn movement

C = Maintain thru movement



A = Addition of dedicated left-turn

B = Alter thru-left movement to dedicated left-turn

C = Alter dedicated right-turn movement to thru-right movement (350' storage)

Optimized cycle length

Optimized cycle length

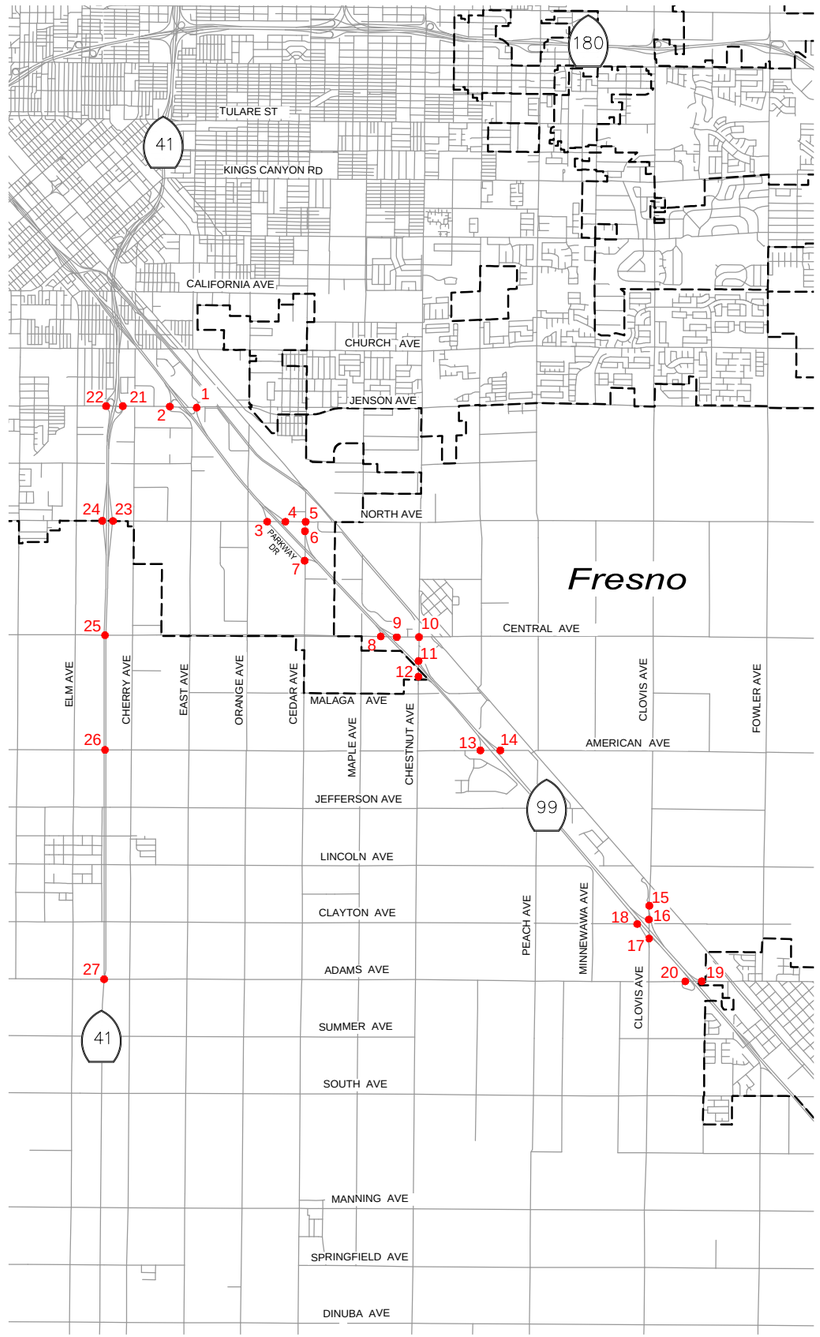
A = Addition of dedicated left-turn (300' storage)

B = Maintain left-turn movement

C = Maintain thru movement

D = Maintain right-turn movement

Convert from two-way stop control to signalized control (optimize cycle length).



LEGEND:

- CITY LIMIT
- EXISTING VEHICLE LANE
- IMPROVEMENT LANE
- EXISTING TRAFFIC SIGNAL
- IMPROVEMENT TRAFFIC SIGNAL

REVERSE TRIANGLE
TRANSPORTATION AREA PLAN

N

Fresno Council of Governments

GHD

Fresno COG
REVERSE TRIANGLE TRANSPORTATION AREA PLAN

Recommended Improvements

Project No. **11192258**
Report No. **001**
Date **01.31.2020**

FIGURE 13

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Multimodal & Safety Improvements

Roadway and intersection improvements are recommended for the RTTAP Study Area's major transportation corridors based on factors including planned number of travel lanes, planned two-way left-turn lanes, and anticipated bicycle and pedestrian activity associated with existing and future development.

Multimodal improvements are identified to improve connectivity and safety for bicycle/pedestrian, truck, and transit travel within the RTTAP Study Area, with a focus on residential and employee access to/from existing and future development sites. These improvements build upon and improve future baseline multimodal improvements identified in local and regional planning documents. Safety improvements are recommended for both roadways and intersections with a specific focus on areas with a history of fatal and/or severe injury crashes. In addition, improvements are recommended along corridors to accommodate future transit routes to ensure adequate access for all modes of travel.

This section summarizes the proposed multimodal and safety improvement projects for the RTTAP Study Area major transportation corridors and intersections.

Multimodal Cross-Sections on Major Corridors

Figure 14 presents the multimodal cross-section types that are recommended for the RTTAP major transportation corridors, which are listed by east-west and north-south segments in Table 12 and Table 13, respectively.

As shown, bicycle facilities are recommended on all Study Area corridors in the form of either buffered Class II bike lanes or Class IV bikeways. Class IV bikeways are recommended on both North Avenue and Cherry Avenue. Sidewalk is recommended on the majority of the Study Area corridors, with the exception of those roadways designated as "F: Industrial Roadway with Buffered Bike Lanes" within the County. Within the County, sidewalks are along both Cherry Avenue and Cedar Avenue, and a portion of Lincoln Avenue connecting to the community of Easton west of SR 41.

Class IV Protected Bikeways

Class IV protected bikeways are recommended along North Avenue and Cherry Avenue. A Class IV bikeway is also currently planned within the City of Fresno Active Transportation Plan (ATP) along Church Avenue west of the RTTAP Study Area.

North Avenue is anticipated to serve as a crucial east-west link for multimodal travel between existing residential communities to the west and Golden State Boulevard to the east of the RTTAP Study Area. North Avenue also provides a grade-separated path of travel under SR 41, providing a more comfortable connection to the west than alternative at-grade routes such as Central Avenue, or routes with high traffic volumes such as Jensen Avenue.

Cherry Avenue is anticipated to serve as a critical north-south link for multimodal travel between existing residential communities within the RTTAP Study Area, as well as west of the RTTAP Study Area along Lincoln Avenue. In addition, the existing Orange Center Elementary School is located on Cherry Avenue just north of Central Avenue.

*Roadway improvements shown are proposed within the Reverse Triangle Transportation Area Plan (RTTAP) and are not currently planned by the City of Fresno or Fresno County.

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REVERSE TRIANGLE TRANSPORTATION AREA PLAN

GHD

FRESNO COUNCIL OF GOVERNMENTS
REVERSE TRIANGLE TRANSPORTATION AREA PLAN

RTTAP MULTIMODAL ROADWAY IMPROVEMENTS

Project No. 11192258
Date JULY 2021

FIGURE 14

Data source: Light Gray Base: Fresno County Dept. PWP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA. Created by: pthornton

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Table 12 – Proposed Cross-sections (East-West Roadways)

Corridor / Segment	Segment Length (mi)	# Lanes (Planned)	Proposed Cross-section (ID / Description)	
East-West Roadways				
Church Ave				
Elm Ave to Cherry Ave	0.5	4	C2	Buffered Bike Lanes, no Parking (4 Lanes)
Cherry Ave to GSB	0.3	4	C2	Buffered Bike Lanes, no Parking (4 Lanes)
Jensen Ave				
Elm Ave to Cherry Ave	0.5	4	C2	Buffered Bike Lanes, no Parking (4 Lanes)
Cherry Ave to East Ave	0.3	4	C2	Buffered Bike Lanes, no Parking (4 Lanes)
East Ave to GSB	0.4	4	C2	Buffered Bike Lanes, no Parking (4 Lanes)
North Ave				
Elm Ave to SR 99	0.25	2	D1	Class IV Bikeway, no Parking (2 Lanes)
SR 99 to Cherry Ave	0.25	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Cherry Ave to East Ave	0.5	4	D2	Class IV Bikeway, no Parking (4 Lanes)
East Ave to Orange Ave	0.5	4	D2	Class IV Bikeway, no Parking (4 Lanes)
Orange Ave to Cedar Ave	0.5	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Cedar Ave to GSB	0.25	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Central Ave				
Elm Ave to Cherry Ave	0.5	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Cherry Ave to Mary Ave	0.25	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Mary Ave to East Ave	0.25	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
East Ave to Amazon Driveway	0.4	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Amazon Driveway to Orange Ave	0.1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Orange Ave to GSB	1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
American Ave				
Elm Ave to Orange Ave	1.5	2	F	Industrial Roadway with Buffered Bike Lanes
Orange Ave to Maple Ave	1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Maple Ave to GSB	1.5	2	F	Industrial Roadway with Buffered Bike Lanes
Lincoln Ave				
Elm Ave to Sarah St	0.7	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Sarah Str to Chestnut Ave	2.3	2	F	Industrial Roadway with Buffered Bike Lanes
Adams Ave				
Elm Ave to GSB	5.8	2	F	Industrial Roadway with Buffered Bike Lanes

GSB = Golden State Blvd

Table 13 – Proposed Cross-sections (North-South Roadways)

Corridor / Segment	Segment Length (mi)	# Lanes (Planned)	Proposed Cross-section (ID / Description)	
North-South Roadways				
Cherry Ave				
Church Ave to Jensen Ave	0.5	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Jensen Ave to Annadale Ave	0.5	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Annadale Ave to North Ave	0.5	2	D1	Class IV Bikeway, no Parking (2 Lanes)
North Ave to Valley Iron Inc.	0.25	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Valley Iron Inc. to Central Ave	0.75	2	D1	Class IV Bikeway, no Parking (2 Lanes)
Central Ave to Adams Ave	3	2	D1	Class IV Bikeway, no Parking (2 Lanes)
East Ave				
Jensen Ave to North Ave	1.1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
North Ave to Central Ave	1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Central Ave to Adams Ave	3	2	F	Industrial Roadway with Buffered Bike Lanes
Orange Ave				
GSB to SR 99	0.4	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
SR 99 to North Ave	0.25	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
North Ave to Fortune Ave	0.25	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Fortune Ave to Central Ave	0.75	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Central Ave to American Ave	1	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
American Ave to Adams Ave	2	2	F	Industrial Roadway with Buffered Bike Lanes
Cedar Ave				
GSB to Central Ave	1.25	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Central Ave to Adams Ave	3	2	C1	Buffered Bike Lanes, no Parking (2 Lanes)
Chestnut Ave				
Central Ave to Adams Ave	3	2	F	Industrial Roadway with Buffered Bike Lanes

GSB = Golden State Blvd

Multimodal Improvements at Intersections

Intersection improvements are identified for intersections within the RTTAP Study Area at locations where two major corridors intersect, and where major corridors intersect Maple Avenue, Jefferson Avenue, and Clayton Avenue. Intersection improvements were determined based on corresponding roadway improvement projects, anticipated multimodal activity, and crash history analysis. Figure 15 presents the recommended intersection improvement categories and corresponding improvement types for intersections along the RTTAP's major transportation corridors.

Multimodal intersection improvements include safety and visibility measures aimed at providing clear boundaries between motorists and bicyclists and pedestrians at these high-conflict areas, as well as alerting motorists of various traffic control types as they approach the intersection. Intersection improvements are grouped into categories for both signalized ("S") and unsignalized (or "not signal", "NS") intersections. Improvement recommendations are associated with categories based on corresponding roadway improvements and proximity to multimodal activity centers, such as schools, as well as those locations identified as RTTAP safety priority locations based on crash analysis for the RTTAP Study Area. Additional intersection operational improvements required to address existing and future deficiencies related to vehicular delay were described in a preceding section of this chapter, and they are also identified in Figure 15.

Improvement Category "A"

Improvement category "A" for both signalized and unsignalized intersections is recommended for locations primarily within the City of Fresno, as well as along Cherry Avenue at American Avenue, Lincoln Avenue, and Adams Avenue. These improvement recommendations correspond to the anticipated level of multimodal activity within the City versus the County, and the emphasis of Cherry Avenue as a primary multimodal corridor for the RTTAP Study Area. Cherry Avenue is proposed to have sidewalks and a Class IV Bikeway to serve north-south multimodal travel between existing residential neighborhoods, schools, and places of employment. Additional locations include Elm Avenue at Central Avenue (due to its crash history) and Elm Avenue at Lincoln Avenue (due to its proximity to both an elementary school and high school).

Improvement Category "B"

Improvement types included in category "B" are consistent with category "A" except for bicycle signal detection and actuation and the provision of a bicycle box. Improvement category "B" for both signalized and unsignalized intersections is recommended for locations where multimodal activity is still anticipated, but the level of activity is anticipated to be somewhat lesser than at locations with proposed "A" improvements.

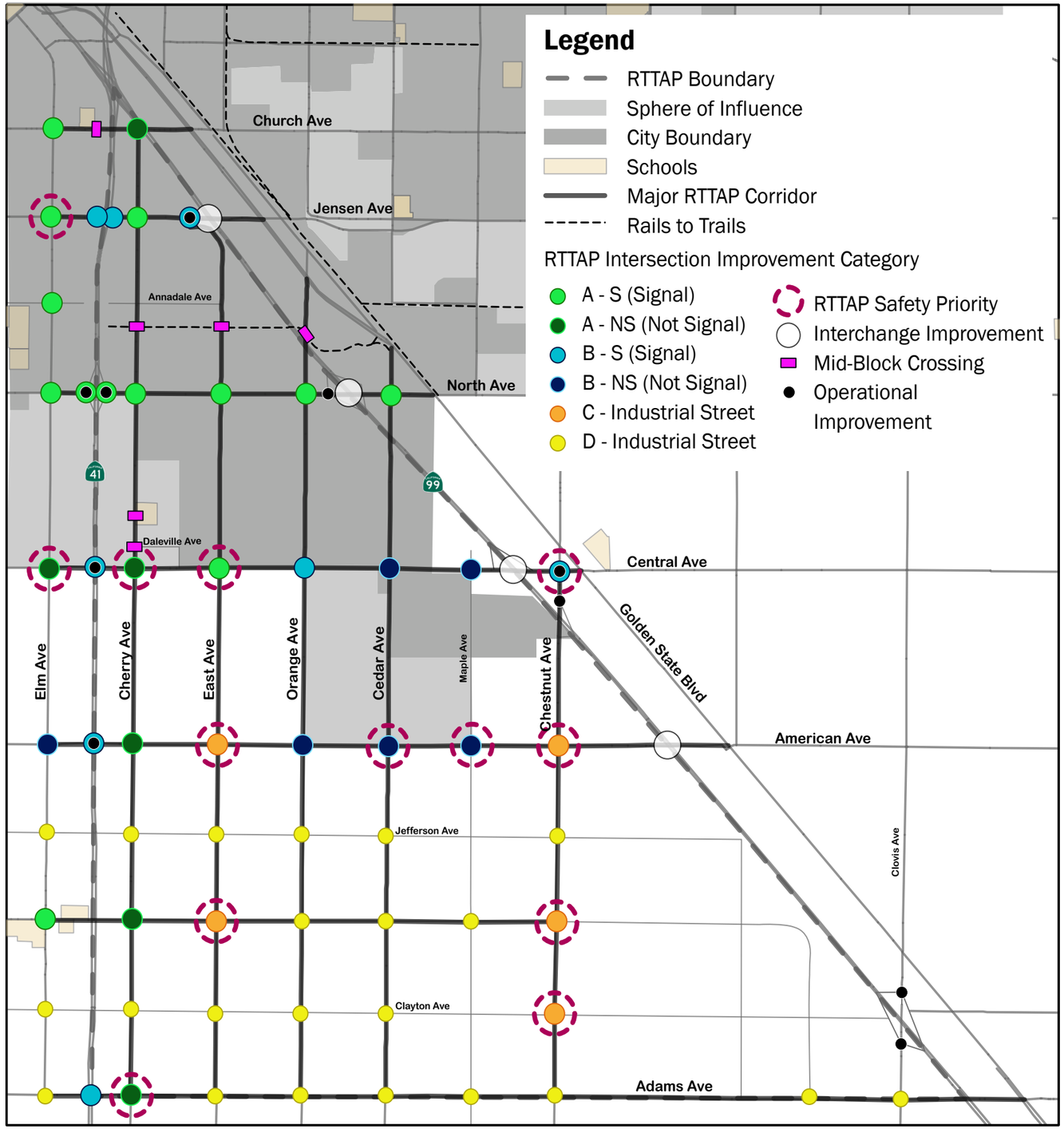
Improvement Categories "C" & "D"

Improvement category "C" for unsignalized intersections is recommended for locations primarily within the County of Fresno where the history of crashes necessitates additional safety measures that are not included in improvement category "D". Improvement category "D" for unsignalized intersections is recommended for locations where multimodal activity is anticipated to be minimal and no significant crash history was identified.

Mid-block Crossings

Mid-block crossings are also presented on Figure 15. Mid-block crossings should include high visibility features such as RRFBs, bulb-outs, warning signs, among others. Proposed locations for high-visibility mid-block crossings include:

- Church Avenue, near Lily Avenue: *Upgrade existing crossing with high-visibility features*
- Cherry Avenue, East Avenue, and Orange Avenue at future Rails-to-Trails crossings: *New crossings*
- Cherry Avenue, near Orange Center Elementary School: *Upgrade existing crossing with high-visibility features*
- Cherry Avenue, near Daleville Avenue: *Upgrade existing crossing with high-visibility features*



*Intersection improvements shown are proposed within the Reverse Triangle Transportation Area Plan (RTTAP) and are not currently planned by the City of Fresno or Fresno County. Intersection traffic control type (i.e., traffic signal or stop-control) are based on existing conditions. Additional "Operational Improvements" (shown on the map) are discussed in detail in the RTTAP document, and may involved changes to traffic control type. Caltrans-initiated interchange improvements are also shown.
Note: The intersection of Cherry Avenue at Central Avenue is currently planned to be signalized within the City of Fresno transportation fee program.

Intersection Improvement Category	
A - S	**Comprehensive Multimodal/Safety Improvements - Signalized Intersection** Along enhanced primary multimodal routes (with sidewalks and Class IV Bikeways) and/or near schools.
A - NS	**Comprehensive Multimodal/Safety Improvements - Unsignalized Intersection** Along enhanced primary multimodal routes (with sidewalks and Class IV Bikeways) and/or near schools.
B - S	**Multimodal/Safety Improvements - Signalized Intersection** Locations along multimodal routes (with sidewalks and Buffered Class II Bike Lanes).
B - NS	**Multimodal/Safety Improvements - Unsignalized Intersection** Locations along multimodal routes (with sidewalks and Buffered Class II Bike Lanes).
C	**Priority Industrial Street Bicycle/Safety Improvements - Unsignalized Intersection** Locations along Industrial Streets with bicycle lanes and considered a safety priority for vehicular travel.
D	**Industrial Street Safety Improvements - Unsignalized Intersection** Locations along Industrial Streets with bicycle lanes.

Note: Priority locations determined based on evaluation of crash data (2012-2017) for both multimodal and vehicular crashes that occurred at or near intersections along the major RTTAP transportation corridors.

Type	Improvement	Intersection Improvement Category					
		A - S	A - NS	B - S	B - NS	C	D
Bicycle	Bicycle Box (at Signal)	X	n/a		n/a	n/a	n/a
	Bicycle Detection/Actuation (at Signal)	X	n/a		n/a	n/a	n/a
	Conflict Area Markings (at Intersection Crossings/Approaches	X	X	X	X	X	
Pedestrian	Ped Countdown Signal Heads	X	n/a	X	n/a	n/a	n/a
	Leading Pedestrian Interval (LPI) at Signal	X	n/a	X	n/a	n/a	n/a
	Median Refuge Island at Stop-Controlled Intersection	n/a	X	n/a			
	Curb Extensions (Bulb-outs)	X	X	X	X		
	Curb Ramps	X	X	X	X		
	High Visibility Crosswalks	X	X	X	X		
Additional Safety Measures	Add/Improve Intersection Lighting	X	X	X	X	X	X
	Intersection Advance Warning Signs	X	X	X	X	X	
	Flashing Beacon at Stop-Controlled Intersection	n/a	X	n/a	X	X	
	Install Turn Lane	n/a	X	n/a	X	X	
	Conduct Traffic Signal Warrant Analysis	n/a	X	n/a	X	X	
	Conduct Multi-Way Stop Warrant Analysis	n/a	X	n/a	X	X	

Note 1: Improvements in this list do not preclude the need to meet warrants prior to installation of new traffic control devices. Analysis conducted as part of this study determined the need for vehicular operational improvements at specified locations (see Figure 3). Additional traffic control improvements to address vehicular, bicyclist, and pedestrian safety should be evaluated using methodology presented in the MUTCD.

Note 2: At existing built-out intersections, improvements should be evaluated for relative feasibility on a case-by-case basis.

Note 3: Additional modifications to existing traffic signals and stop-controlled intersections, including restriping projects, curb return modifications, and traffic signal modifications, are assumed at all intersections.

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REVERSE TRIANGLE TRANSPORTATION AREA PLAN

GHD

FRESNO COUNCIL OF GOVERNMENTS
REVERSE TRIANGLE TRANSPORTATION AREA PLAN

RTTAP MULTIMODAL INTERSECTION IMPROVEMENTS

Project No. **11192258**
Date **JULY 2021**

FIGURE 15

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Data source: Light Gray Base: Fresno County Dept. PWP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA. Created by: pthornton

Transit and Transportation Demand Management (TDM)

Transit and transportation demand management (TDM) strategies should aim to ensure that individuals can access basic amenities and key destinations related to employment, health, or personal trips. Due to the rural character of much of the RTTAP Study Area, ensuring adequate transportation services to these destinations is a critical component of this plan. In addition, large employment sites within the RTTAP Study Area, especially within the City of Fresno, create a need to address commute trips. Of total persons employed within the RTTAP Study Area, 99 percent commute from outside of the Study Area boundary. As such, transit service and TDM programs should aim to provide efficient transportation choices that result in reducing traffic congestion, pollution, and commuting stress.

Existing transit service is described in detail in Chapter 4 of this report.

RTTAP Transit and TDM Strategies

The following goals drive strategies for transit service and TDM programs to improve connectivity and access to the RTTAP Study Area and surrounding areas, with a specific focus on disadvantaged communities:

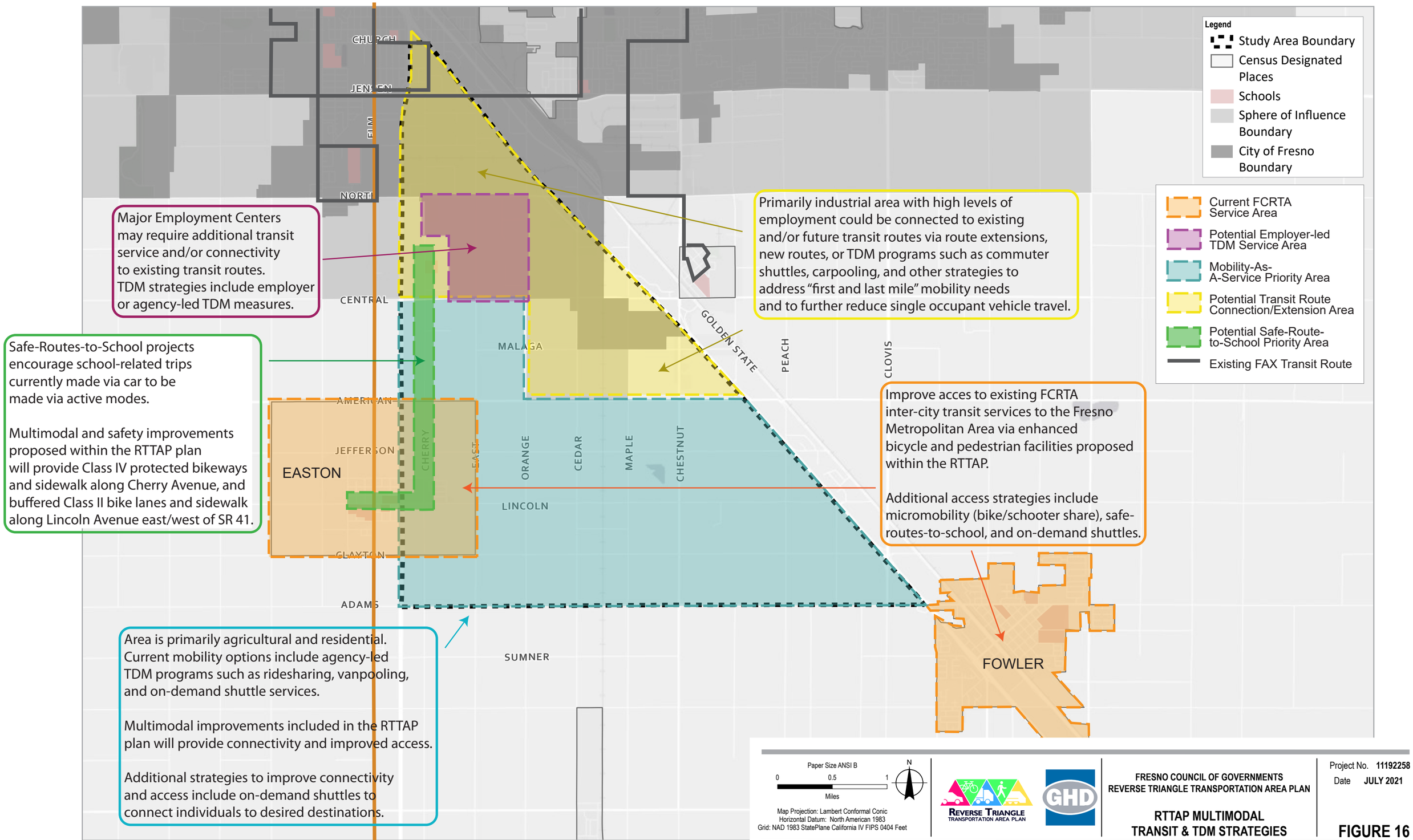
- **Mitigate Air Quality and Congestion Impacts:** Travel demand is better managed by increasing/encouraging mode shares away from single occupant vehicles to active modes. The RTTAP roadway and intersection multimodal improvements presented in this plan will link individuals to transit and/or TDM services.
- **Improve Connectivity and Access for Disadvantaged Populations:** Implementing the multimodal and safety improvements presented within the RTTAP will promote increased access and connectivity for priority populations. Priority populations are defined by the California Air Resources Board as disadvantaged communities, low-income communities, and low-income households, who are especially vulnerable to the impacts of climate change.

To address existing transit needs in the RTTAP Study Area, FAX is currently working on developing short and long-term transit options to serve the major job centers and industrial uses within the area. The following strategies should be considered in coordination with the current AB 617 and South Central Specific Plan planning efforts to improve connectivity and access to the RTTAP Study Area and surrounding areas. These strategies correspond to specific areas within the RTTAP Study Area, as shown on Figure 14.

- **Expand Transit Service:** Consider opportunities to expand FAX fixed route and shuttle-based transit service in the RTTAP Study Area with consideration to anticipated increases in commute trips.
    - *FAX Fixed Route*: Evaluate fixed route service to provide effective and efficient transit service to the major employment areas within the Study Area. Alternative alignments would need to consider: existing road conditions, stop placement and preferred stop locations, ADA accessibility of preferred stop locations, route length, service frequencies, hours of operation, opportunities for transfers to other FAX routes, ridership estimates, operating costs, and sustainable funding sources.
        - Based on the analysis, implement an initial fixed route transit service in calendar year 2022, consisting of either an entirely new FAX route or an extension of an existing FAX route.
        - Monitor land use intensification and road improvements along the initial route over time to determine whether the initial transit service can be refined.
        - Seek a sustainable funding source to continue service operations into the long term.

- FAX Commuter Shuttle: Explore a direct, non-stop, freeway-based commuter shuttle service from Courthouse Park in Downtown Fresno directly to employment areas in the North Pointe Business Park, with hours of operation based shift schedules of major employers three to four times per day, depending upon the season. The commuter shuttle service would travel along either SR-41 or SR-99 for the most direct access and fastest travel times possible. Identify a sustainable funding source to continue service operations into the long term. Shuttle service could start within the next several years, pending funding availability.

- **Public-facing TDM Programs:** Promote existing TDM programs led by Fresno COG and other public agencies including ridesharing programs, carpool and vanpool programs, and demand-response services, such as:
  - Fresno COG "Valleyrides" Ridesharing
  - Carpool Incentive Program
  - Commuter Vanpool Program
  - Agricultural Worker Vanpool Program
  - Senior Taxi Scrip Program
- **Employer-based TDM Programs:** Per San Joaquin Valley Air Pollution Control District, the employer-based trip reduction Rule 9410 (December 17, 2009) requires employers with at least 100 eligible employees at a worksite to implement programs to reduce vehicle miles traveled (VMT) from private vehicles used by employees to commute to and from their worksites. Employers should promote the education, information, and promotion of the above mentioned TDM programs, including the proposed FAX commuter shuttle service described above.
- **Mobility-As-A-Service:** Provide additional access and connectivity for underserved populations. Strategies to improve connectivity and access include on-demand shuttles to connect individuals to desired destinations. FCRTA recently initiated a community-based shared mobility program" "REV-UP" (rural electric vehicle utilization project) aimed at providing additional mobility services for residents in rural Fresno County.
- **Safe-Routes-To-School:** Encourage school-related trips currently made via car to be made via active modes. Multimodal and safety improvements proposed within the RTTAP plan will provide Class IV protected bikeways and sidewalk along Cherry Avenue, and buffered Class II bike lanes and sidewalk along Lincoln Avenue east/west of SR 41.
- **Connectivity Enhancement:** The bicycle and pedestrian facilities presented in the RTTAP plan should connect to transit route stops to accommodate "first mile" and "last mile" travel (travel between modes to a final destination). In addition, existing and future bus stops should be improved to comply with ADA design standards to ensure ADA-accessible bus stops and comfortable bus shelters.



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REVERSE TRIANGLE TRANSPORTATION AREA PLAN

GHD

FRESNO COUNCIL OF GOVERNMENTS
REVERSE TRIANGLE TRANSPORTATION AREA PLAN

RTTAP MULTIMODAL TRANSIT & TDM STRATEGIES

Project No. 11192258
Date JULY 2021

FIGURE 16

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Data source: Light Gray Base: Fresno County Dept. PWP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA. Created by: pthornton

Safety Improvements

As mentioned in preceding chapters, the multimodal improvements recommended for RTTAP Study Area roadways and intersections address safety issues as well as multimodal accessibility and comfort levels. Additional safety improvements (referred to as "countermeasures", or "CM") were recommended for the safety priority intersections (Table 14) and roadway segments (Table 15) that were identified as safety priorities based on either the frequency of crashes, crash severity, or history of bicycle or pedestrian crashes. As shown on Figure 11 (Chapter 4), most crashes occurred outside of the City of Fresno limits.

These countermeasures were identified for the purpose of calculating safety benefit utilizing the Highway Safety Improvement Program (HSIP) analyzer to compute anticipated crash reduction for crashes within a continuous 5-year period (2012-2016). The crash reduction potential and the monetized benefits associated with these safety countermeasures (CM) are presented in Chapters 7 and 8, respectively.

Table 14 – Safety Priority Intersection Countermeasures (CM)

Intersection Locations	CM 1	Description	CM 2	Description	CM 3	Description
American Avenue / Chestnut Avenue	NS6	Upgrade intersection pavement markings	NS1	Add intersection lighting	NS15	Install left-turn lane
Cedar Avenue / American Avenue	NS6	Upgrade intersection pavement markings	NS7	Install Flashing Beacons	NS15	Install left-turn lane
Central Avenue / Chestnut Avenue	S3	Improve signal timing	S8	Install raised pavement markers/striping	S12	Install raised median on approaches
Cherry Avenue / Adams Avenue	NS6	Upgrade intersection pavement markings	NS1	Add intersection lighting	NS15	Install left-turn lane
American Avenue / Maple Avenue	NS6	Upgrade intersection pavement markings	NS1	Add intersection lighting	NS15	Install left-turn lane
American Avenue / East Avenue	NS6	Upgrade intersection pavement markings	NS7	Install Flashing Beacons	NS15	Install left-turn lane
Central Avenue / Elm Avenue	NS6	Upgrade intersection pavement markings	NS7	Install Flashing Beacons	NS15	Install left-turn lane
East Avenue / Lincoln Avenue	NS6	Upgrade intersection pavement markings	NS7	Install Flashing Beacons	NS15	Install left-turn lane
Chestnut Avenue / Lincoln Avenue	NS6	Upgrade intersection pavement markings	NS1	Add intersection lighting	NS15	Install left-turn lane
Chestnut Avenue / Clayton Avenue	NS6	Upgrade intersection pavement markings	NS7	Install Flashing Beacons	NS15	Install left-turn lane
Cherry Avenue / Central Avenue	NS16	Install raised medians/refuge islands	NS19	Install Pedestrian Signal	NS1	Add intersection lighting

Table 15 – Safety Priority Roadway Segment Countermeasures (CM)

Roadway Segment Locations	CM 1	Description	CM 2	Description	CM 3	Description
Chestnut Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R33	Install no-passing line
Cherry Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R37	Install sidewalk/pathway
Central Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R1	Add segment lighting
American Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R33	Install no-passing line
Cedar Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R1	Add segment lighting
Lincoln Ave	R14	Add two-way left-turn lane	R16	Widen shoulder (paved)	R33	Install no-passing line

Truck Re-routing Options

During public workshops, discussion of truck route designations and possible truck re-routing were brought to the attention of the stakeholders. Benefits of potential truck re-routing, especially along primarily residential corridors and near schools, could play a role in reducing air pollution and improving quality of life for the community. Nearly the entire area identified in this study is also part of the Assembly Bill (AB) 617 Community Air Protection Program. AB 617 aims to direct programs to reduce exposure in communities most impacted by air pollution. The City of Fresno has initiated an AB 617 truck re-route study which includes the RTTAP Study Area to address this need.

The community was selected in the first round in 2017 recognizing the severe air quality problems they face affecting the community's health and overall quality of life. This process included developing a Community Air Monitoring Plan (CAMP) where monitors will be placed throughout the South Central Fresno area boundary to gain a real time understanding of sources and levels of hazardous pollution that residents are exposed to. Additionally, the community also developed a Community Emissions Reduction Plan ("CERP") that is currently awaiting final approval from the California Air Resources Board. This process represents a groundbreaking effort by residents, advocates, and businesses to establish quantifiable emission reduction targets and advance regulatory, enforcement and incentive strategies to reduce exposure to hazardous air emissions by sensitive receptors in several South Fresno neighborhoods.

Cherry Auction Improvement Considerations

Although the operations and collision analysis determined that the study intersection and roadways are operating within acceptable conditions, several residents voiced their concerns regarding congestion and access to Cherry Auction. This is a reasonable concern based upon review of Saturday data, i.e., it gets busy late Saturday morning. The RTTAP recommends that Cherry Avenue be improved to an urban standard to include sidewalks and Class IV bikeways along this segment that bisects the site (east) and adjacent parking area (west). This should assist with access and safety for bicyclists and pedestrians to/from Cherry Auction.

In addition to RTTAP recommended improvements, it is further recommended that the Traffic Management Plan (TMP) be reviewed by interested parties, i.e., Cherry Auction, Fresno County, CHP and Caltrans, to determine if existing TMP is being implemented. Since this TMP was implemented in 2011, changes in traffic patterns and population have occurred over the past decade. The TMP indicates that this document be reviewed and updated to reflect current

conditions. In discussions with Fresno County, a review should be conducted at the expense of the applicant, Cherry Auction. In addition, the County has indicated that should complaints be filed, the complainant should contact Fresno County Department of Public Works and Planning at (559) 600-3240, which is their direct line.

Based upon data collected, especially for Saturday conditions, it is recommended that a pedestrian warrant study (peak hour, 4-hour, etc.) be conducted at the existing cross walk on Cherry Avenue approximately 1,060’ north of American Avenue. If pedestrian warrants are met for this location, a high-intensity crosswalk beacon (HAWK) should be considered. The HAWK beacon is used on marked crosswalks and it stops only as needed, avoiding unnecessary or timed signals for traffic when Cherry Auction is not in operation. Due to limited peak pedestrian crossings needs during peak and off-peak hours, this solution should be studied.

Additional detail related to existing traffic conditions at the Cherry Auction site are provided in Appendix C.

7 – Plan Assessment

The performance metrics selected to evaluate components of the RTTAP preferred multimodal package are coordinated with the six objectives outlined in the Smart Mobility Framework to ensure the resulting improvement recommendations provide a balanced, sustainable, and multimodal assessment of current and future corridor conditions. Requisite metrics include bicycle level of traffic stress scores; bicycle mode shift; vehicular delay reduction; vehicular travel time; crash reduction; health cost savings; vehicle emissions reduction; network vulnerability and sustainability; equitable distribution of benefits/impacts; return on investment, and "value of time" metrics including recreational activity and mobility benefit, as shown in Table 16.

Table 16 – RTTAP Performance Metrics

Smart Mobility Objective	Analysis Purpose	RTTAP Performance Metric
Location Efficiency	Bicycle Connectivity	Bicycle Level of Traffic Stress
	Multimodal Facility Access	Bicycle Mode Share (# New Trips)
Reliable Mobility	Roadway Operations	Delay Reduction (Motorized/Non-Motorized)
	Roadway Service Quality	Vehicular Travel Time
Health and Safety	Safety	Crash Reduction (Roadways & Intersections)
	Health	Health Cost Savings (per Capita)
Environmental Stewardship	Air Quality	Vehicle Emissions Reduction
	Adaptation	Network Vulnerability & Sustainability
Social Equity	Social Equity	Equitable Distribution of Benefits/Impacts
Robust Economy	Economic Development	Return on Investment
All	Community Livability	Recreational Activity (Value of Time)
		Mobility Benefit (Value of Time)

The RTTAP performance metrics and the respective models and/or analysis tools utilized within this plan are mapped in matrix form in Table 17. Also shown is whether the metric can be monetized for inclusion in a benefit-cost assessment using societal cost and benefit monetization factors (per Caltrans 2018 Economic Parameters and the Local Roadway Safety manual (2020) cost for crashes). Results from these analyses are presented in the following sections of this chapter and were used to establish the quantifiable and qualitative benefits associated with the preferred RTTAP multimodal improvement package.

Models or analysis tools utilized include the regional travel demand model (Fresno COG Activity-Based Model, or ABM), traffic analysis software (Synchro 10), NPMRDS (National Performance Management Research Data Set), Bicycle Level of Traffic Stress (Mineta Transportation Institute, 2012), NCHRP Report 552 (Guidelines for Analysis of Investments in Bicycle Facilities), AASHTO HSM (Highway Safety Manual, Part C – Predictive Method), Cal-B/C Active Transportation (AT) Application (Version 7.1, 2019), Online Mapping Tools (such as CalEnviroScreen 3.0), GIS Analysis (ArcMap), and IMPLAN (data modeling application). The performance metric methodologies and respective model or analysis tools employed to evaluate existing and future conditions are described in Appendix A.

Table 17 – RTTAP Model or Analysis Tools

RTTAP Performance Metric	Model or Analysis Tool									Monetized?
	Travel Demand Model	Traffic Analysis Software	NPMRDS	Bicycle Level of Traffic Stress	NCHRP 552	HSM Part C CMFs	Online Mapping Tools	GIS Analysis	IMPLAN	
Bicycle Level of Traffic Stress				■	■			■		
Bicycle Mode Share (# New Trips)					■			■		■
Delay Reduction (Motorized/Non-Motorized)	■	■			■			■		■
Vehicular Travel Time			■							
Crash Reduction (Roadways & Intersections)						■		■		■
Health Cost Savings (per Capita)					■			■		■
Vehicle Emissions Reduction	■				■			■		■
Network Vulnerability & Sustainability							■			
Equitable Distribution of Benefits/Impacts				■			■	■		
Return on Investment									■	■
Recreational Activity (Value of Time)					■			■		■
Mobility Benefit (Value of Time)					■			■		■

Equal attention was given to documenting the beneficial outcomes of measures not directly reflected in the benefit-cost assessment. These include: Plan Consistency (with existing planning documents); Policy Consistency (City of Fresno, Fresno County, FCOG, and Caltrans); Environmental/Institutional Sensitivity; Adaptation; Economic Development and, Community Acceptance. Although some of the presented performance metrics cannot be monetized, assessment of the results of these analyses provide value to informing improvement recommendations.

Bicycle Mode Shift

To estimate the induced demand associated with the bicycle improvements proposed in the RTTAP, the project team utilized the National Cooperative Highway Research Program (NCHRP) 552 methodology provided in the *Guidelines for Analysis of Investment in Bicycle Facilities*. This performance metric methodology is described in detail in Appendix A. The facilities included in the benefit analysis presented herein include Buffered Class II Bicycle Lanes and Class IV Bikeways along RTTAP major transportation corridors as described in Chapter 6.

Induced Demand

Induced demand refers to the increase in trips made by bicycle due to improved or additional bicycle facilities. Induced demand takes into account percentage of child and adult population, bicycle commute mode share, percentage of children who bicycle, and the population within three buffer distances, 0.5 miles, 1.0 miles, and 1.5 miles, of the proposed facility. These variables are incorporated into the equations provided in the NCHRP methodology.

The result of the estimated induced demand analysis is reported below. Appendix A provides a detailed explanation of the analysis procedures and results. Table 18 presents the new adult, children commuter and total bicyclists estimated to induce with implementation of the proposed improvements. These results are used to calculate the measures of effectiveness associated with bicycle mode shift (reduction in trips and VMT), and the mobility, health, recreation, and decreased auto use benefits discussed in the following sections.

Table 18 – Study Area Induced Demand Results

New Commuters	New Cyclists (Total)	New Adult Cyclists	New Recreational Cyclists
456	5,346	3,648	3,192

Reduction in Trips and VMT

Induced demand/bicycle mode shift can be measured by the reduction in vehicle trips and vehicle miles traveled (VMT) associated with the proposed bicycle improvements using the methodology described above. The number of trips and VMT reduced was calculated using the number of new commuters estimated using the NCHRP methodology and the average roundtrip trip length per person (7.6 miles) reported by Commuting in America (AASHTO, 2013). Because the NCHRP 552 methodology uses new commuters to estimate decreased auto trips, trip reductions and VMT are annualized under the assumption that a working year is comprised of 47 weeks and 5 days per week to account for the typical work week and vacations. These measures are reported in Table 19.

Table 19 – Total Reduction in Trips and VMT Associated with Induced Demand

Reduced Daily VMT	Reduced Annual VMT
3,466	814,500

Bicycle Level of Traffic Stress

While the quantitative benefits associated with bicycle and pedestrian improvements are assessed using bicycle mode shift, qualitative benefits of these improvements can be analyzed by examining improvements to multimodal connectivity throughout the corridor. Connectivity benefits associated with the improvements recommended in this plan are analyzed through the lens of Level of Traffic Stress (LTS) as developed at the Mineta Transportation Institute. The LTS analysis presented herein incorporates Bicycle Level of Traffic Stress methodologies as a proxy for analyzing traffic stress for all active transportation network users. The recommended improvements provide low stress connectivity throughout the Study Area with off-street bicycle facilities and improved crossings along RTTAP Study Area facilities. This performance metric methodology is described in detail in Chapter 2.

The active transportation improvements in the RTTAP Study Area allow for low stress travel options for bicyclists and pedestrians and provide connectivity to other low-stress facilities proposed within the RTTAP Study Area. Collectively, the proposed active transportation, transit and operational improvements coalesce to provide a comprehensively connected, safe and multimodal corridor.

Safety

Based on contributing factors identified in the crash assessment, Part C of the Highway Safety Manual (HSM) was applied to estimate the potential safety performance of the RTTAP multimodal improvement package. Safety countermeasures were applied to estimate the reduction in crashes based on their respective potential to reduce

crashes at intersections (signalized and un-signalized) or along roadways, and for total crashes involving vehicles only, bicycle or pedestrian crashes, or crashes that occurred at night (i.e., in the dark). Safety countermeasures and crash reduction factors (CRFs) derived from Caltrans's *Local Roadway Safety Manual* (Version 1.5, April 2020) were then applied to estimate the reduction in crashes resulting from the implementation of safety-related countermeasures. This performance metric methodology is described in detail in Appendix A.

Vehicular and bicycle/pedestrian related crashes and countermeasures identified to improve safety were summarized for input into the Highway Safety Improvement Program (HSIP) analyzer to compute anticipated crash reduction and the monetized benefit. It is important to note that the analyzer tool limits the number of applied countermeasures to three per location for calculations purposes related to funding requirements. However, safety improvements should not be limited to three countermeasures, and each location should be further evaluated to fully assess safety needs. The following table presents the countermeasures that were assigned to priority roadways and intersections, as well as the associated crash reduction factors (CRF).

Table 20 – Countermeasures and Crash Reduction Factors

CM ID	Type	Description	Crash Type	CRF
	Applicable Roadway Countermeasures			
R1	Lighting	Add segment lighting	Night	0.35
R14	Geometric Modification	Add two-way left-turn lane	All	0.3
R16	Geometric Modification	Widen shoulder (paved)	All	0.3
R33	Operation/ Warning	Install no-passing line	All	0.45
R36	Ped and Bike	Install bike lanes	P & B	0.35
R37	Ped and Bike	Install sidewalk/pathway	P & B	0.8
R38	Ped and Bike	Install pedestrian crossing	P & B	0.3
	Applicable Intersection Countermeasures			
S3	Lighting	Improve signal timing	All	0.15
S8	Lighting	Install raised pavement markers and striping	All	0.1
S12	Lighting	Install raised median on approaches	All	0.25
NS1	Lighting	Add intersection lighting	Night	0.4
NS6	Control	Upgrade intersection pavement markings	All	0.25
NS7	Operation/ Warning	Install Flashing Beacons at Stop-Controlled Intersections	All	0.15
NS15	Operation/ Warning	Install left-turn lane (where no left-turn lane exists)	All	0.35
NS16	Ped and Bike	Install raised medians / refuge islands	P & B	0.45
NS19	Ped and Bike	Install Pedestrian Signal	P & B	0.55

CM = Countermeasure

CRF = Crash Reduction Factor

P & B = Pedestrian or Bicycle Crash
Night = Crash Occurred at outside of daylight hours

All = All crash types

The safety countermeasures and their associated crash reduction potential are presented in the following tables for the priority roadway segments and intersection locations. *Note: Crash reduction is reported as the anticipated number of crashes that the respective countermeasures have the potential to reduce based on the total number of crashes that occurred within a 5-year period at the study location, as presented in Chapter 6. Crash reduction values are shown with decimal points due to reflect the result of the raw calculation without rounding. These values should not be used to project future safety conditions without further evaluation, such as systemic safety analysis.*

Table 21 – Roadway Segment Countermeasures Crash Reduction Potential

Corridor	Cross-section Category	Countermeasure			Crash Reduction (#)		
		CM1	CM2	CM3	CM1	CM2	CM3
Chestnut Ave	F	R14	R16	R33	6	6	9
Cherry Ave	D1	R14	R16	R37	3.6	3.6	2.4
Central Ave	C1	R14	R16	R1	2.4	2.4	1.4
American Ave	C1 and F	R14	R16	R33	2.1	2.1	3.15
Cedar Ave	C1	R14	R16	R1	2.1	2.1	0.7
Lincoln Ave	C1 and F	R14	R16	R33	1.5	1.5	2.25

Table 22 – Intersection Countermeasure Crash Reduction Potential

Intersection		Intersection Improvement Category	Countermeasure			Crash Reduction (#)		
Cross-street 1	Cross-street 2		CM1	CM2	CM3	CM1	CM2	CM3
American Ave	Chestnut Ave	C	NS6	NS1	NS15	3	1	4
Cedar Ave	American Ave	B - NS	NS6	NS7	NS15	2.25	1.35	3.15
Central Ave	Chestnut Ave	B - S	S3	S8	S12	1.2	0.8	2
Cherry Ave	Adams Ave	A - NS	NS6	NS1	NS15	1.75	1.2	2.45
American Ave	Maple Ave	B - NS	NS6	NS1	NS15	1.75	0.4	2.45
American Ave	East Ave	C	NS6	NS7	NS15	1.5	0.9	2.1
Central Ave	Elm Ave	A - NS	NS6	NS7	NS15	1.5	0.9	2.1
East Ave	Lincoln Ave	C	NS6	NS7	NS15	1	0.6	1.4
Chestnut Ave	Lincoln Ave	C	NS6	NS1	NS15	0.75	0.8	1.05
Chestnut Ave	Clayton Ave	C	NS6	NS7	NS15	0.75	0.45	1.05
Cherry Ave	Central Ave	A - NS	NS16	NS19	NS1	0.45	0.55	0.4
Central Ave	East Ave	A - NS	NS16	NS19	NS1	0.45	0.55	0.4

Vehicular Delay Reduction

Operational improvements are identified to address existing and future deficiencies and to upgrade intersections and roadways to support continued growth in the RTTAP Study Area. These improvements were determined based on future operational analysis using Year 2042 volume forecasts from the Fresno COG ABM model and are consistent with the City of Fresno General Plan (2014) planned roadway improvements. Deficiencies noted were shown primarily along SR 99 interchange off/on ramps and along Hwy 41. Recommended improvements at these intersections include the addition of lanes which could be accommodated by re-striping or widening of intersection approaches to accommodate additional left/right turn lanes, converting existing intersection control to a signalized control, and optimizing signalized intersections. Table 23 presents the vehicular delay reduction associated with the 2042 RTTAP operational intersection improvements.

Table 23 – Vehicular Delay Reduction

Intersection	Improvement Description	AM Peak Hour - Vehicular Delay Reduction (seconds)	PM Peak Hour - Vehicular Delay Reduction (seconds)
Jensen Avenue/SR 99 SB Off-Ramp (East Avenue)	Addition of left-turn lane and re-striping	44.1	41.5
Central Avenue/Chestnut Avenue	Re-striping improvement	54	25.1
Clovis Avenue/SR 99 SB On-Ramp	Convert to traffic signal	520	1098.2
North Avenue/Hwy 41 NB Off-Ramp	Re-striping improvement	0.9	42.5
North Avenue/Hwy 41 SB Off-Ramp	Addition of left-turn lane and re-striping	248.1	19.1
Central Avenue/Hwy 41 (SB)	Optimize traffic signal cycle length	24.1	32

Environmental Justice and Social Equity

Impacts of construction and benefit of use should be shared across the community regardless of ethnicity, economic situation, or physical ability because improvements developed with public funds are for everyone[4]. Disadvantaged communities suffer disproportionate air quality, environmental and health burdens, which are compounded by economic challenges, underscore the need to prioritize these populations when recommending and implementing infrastructure investments. Projects that could potentially affect low-income communities and communities of color, or that will provide benefits that favor wealthier communities, need to be offset by mitigating activities, or another less impactful solution should be pursued.

Community Health & Wellbeing

On behalf of the California Environmental Protection Agency (CEPA), the Office of Environmental Health Hazard Assessment (OEHHA) developed an analysis tool known as CalEnviroScreen 3.0 (updated June 2018). This tool is used to designate disadvantaged communities in accordance with Senate Bill 535 of 2017, and assists the State of California and communities to determine core areas in need of immediate reinvestment to mitigate pollution and advance environmental improvements.

The CalEnviroScreen 3.0 model is based on CalEPA's definition of cumulative impacts. This model is based on geography, specifically census tracts in California. The model is made up of four components, including two pollution burden components and two population characteristics components. Each component is made up of a set of indicators comprising of 12 pollution burden indicators and eight population characteristics indicators.

Disadvantaged communities may receive up to 25% of the proceeds from the Greenhouse Gas Reduction Fund to go toward projects that provide a benefit to disadvantaged communities. The entire RRTAP Study Area falls within the disadvantaged community status. Actually, CalEnviroScreen 3.0 exhibits high pollution, low population areas of the

[4] The consideration of environmental justice is consistent with Title VI of the Civil Rights Act of 1964 and subsequent Executive Orders 12898 and 13166, that prohibit discriminatory based on a variety of factors.

state as being a disadvantage community in accordance with SB 535. CalEnviroScreen 3.0 scores communities on a 10-tiered percentile for air pollution.

The Pollution Burden score is the average of Environmental Effects and Exposures components, where the Environmental Effects component is weighted one-half because we consider Environmental Effects to make a smaller contribution to Pollution Burden than Exposures do.

FCOG's 2018 Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS) includes an Environmental Justice Analysis, demonstrating FCOG's compliance as a Metropolitan Planning Organization (MPO) with the federal and state requirements of the RTP development process related to Title VI and Environmental Justice (EJ). EJ population groups defined by FCOG's analysis include minority and/or low-income populations compared against the County region as a whole. Additional detail on Fresno COG's Environmental Justice methodology can be found in Appendix H of the 2018 RTP and SCS.

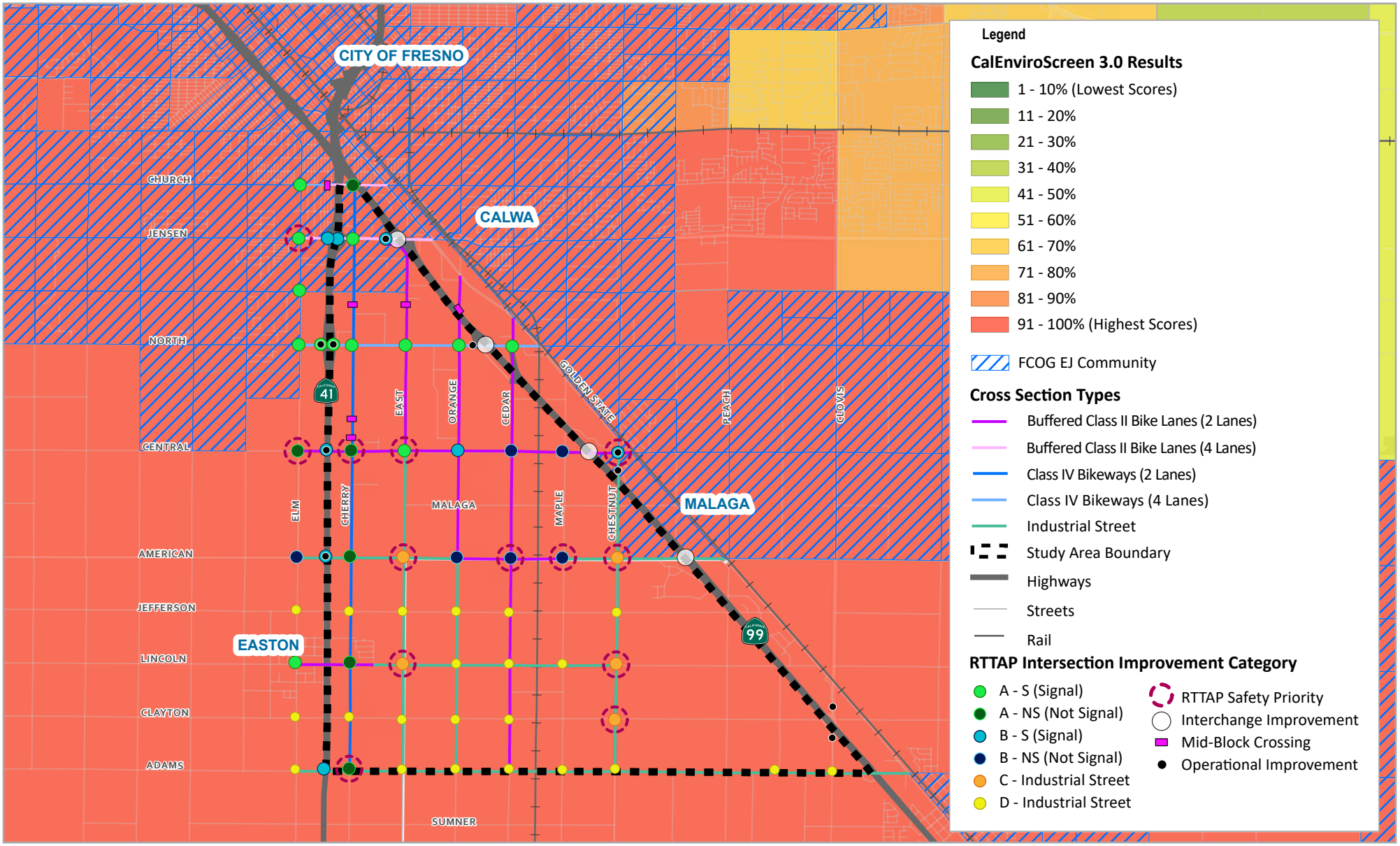
Community Health & Wellbeing Assessment

Figure 17 presents the CalEnviroScreen 3.0 results in relation to the multimodal roadway and infrastructure improvements recommended as part of this Plan. As stated previously, the CalEnviroScreen results show that Study Area and its nearby communities are among the Census Tracts that are the most environmentally burdened in the entire State. The entirety of the Study Area and much of the surrounding communities are within the 95th to 100th percentile range.

The recommended multimodal improvements can improve air quality by contributing to a reduction in mobile source emissions polluting the area. Vehicular operations improvements will result in reduced vehicle delay, which could contribute to a reduction in the emissions and pollutants contributing to poor air quality. Less vehicle delay means a reduction in the emissions and pollutants that are associated with congestion.

By providing a well-connected, safe and attractive multimodal transportation network, the number of vehicles on the road can be reduced as a result of the mode shift from vehicle to active modes anticipated to be associated with the proposed facilities. Areas that are walkable and bikeable can reduce the number of vehicle trips that would have otherwise been taken by car in the absence of improvements, resulting in less vehicle emissions. Moreover, in conjunction with bicycle and pedestrian improvements, recommendations to extend transit service to new areas within the Study Area, as well as supporting the development of transportation demand management programs throughout the area could further reduce the number of vehicle trips and the mobile source emissions that result.

In addition to potential air quality benefits, the recommended improvements will support a more livable, safe and healthy environment for the disadvantaged populations who use the transportation system every day. As described under the Active Transportation Accessibility and Mode Shift Analysis, qualitative LTS connectivity assessments were also conducted to identify the degree of access to active transportation and transit improvements by disadvantaged communities versus non-disadvantaged communities. Low stress facilities will increase the comfort and connectivity of the active transportation system to encourage walking and bicycling.



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REVERSE TRIANGLE
TRANSPORTATION AREA PLAN

FRESNO COUNCIL OF GOVERNMENTS

REVERSE TRIANGLE TRANSPORTATION AREA PLAN

CALENVIROSCREEN RESULTS & FCOG EJ COMMUNITIES

Project No. **11192258**
Revision No. **-**
Date **MAY 2021**

FIGURE 17

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Data source: Light Gray Base: Fresno County Dept. PWP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA; Environmental Justice Data: Fresno COG; CalEnviroScreen Results: . Created by: pthornton

Social Equity

Some populations are particularly vulnerable to environmental impacts of climate change and pollution. These populations are designated as priority populations by the California Air Resources Board (ARB). Priority populations include SB 535 disadvantaged communities and Assembly Bill (AB) 1550 Low-Income Communities. At least 35 percent of California's climate investments must benefit these priority populations to ensure social equity and environmental justice for the populations that have historically been the most impacted.

As stated previously, CalEnviroScreen is used to designate disadvantaged communities in accordance with SB 535 of 2017. Per SB 535, disadvantaged communities are defined as the Census Tracts scoring within the top 25 percent of CalEnviroScreen. In addition to the Tracts scoring in the top 25 percent overall, Census Tracts that score in the highest 5 percent of CalEnviroScreen's Pollution Burden Indicator, but do not have an overall score due to undependable socioeconomic or health data, are also designated as SB 535 disadvantaged communities.

Priority populations also include low-income communities and households as defined by AB 1550. Per AB 1550, low-income communities are designated by the Census Tracts that are at or below 80 percent of the statewide median income. Low-income households are defined by households whose median income is at or below the threshold designated as low-income by California Department of Housing and Community Development (HCD) State Income Limits.

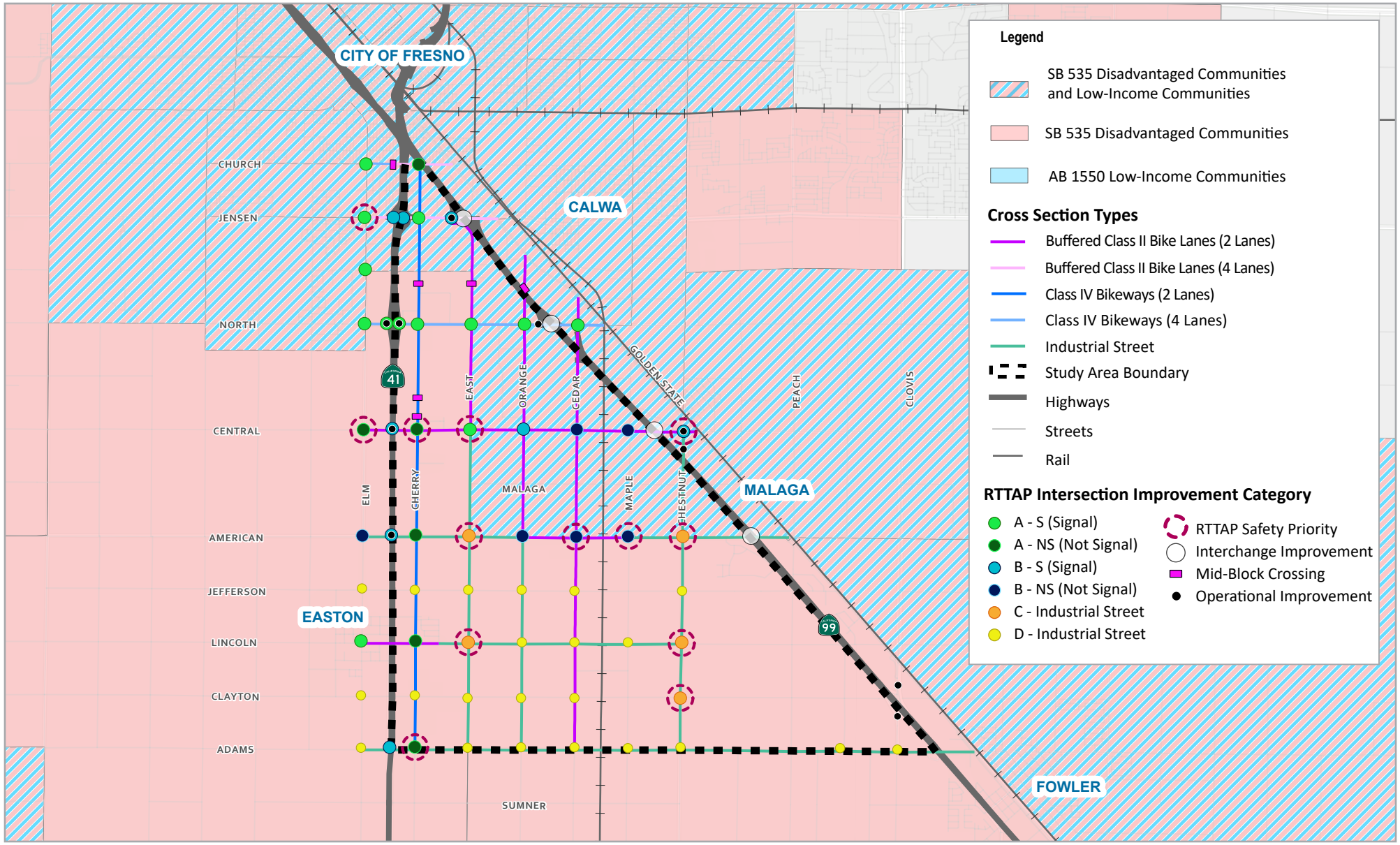
The entirety of the Study Area and the surrounding areas are designated as disadvantaged communities, consistent with the CalEnviroScreen results discussed in the previous section. A portion of the Study Area to the north and east are designated as both disadvantaged and low-income, per SB 535 and AB 1550 definitions. All of these areas are considered priority populations for infrastructure investments.

Social Equity Assessment

SB 535 and AB 1550 provide clear direction for the way in which proceeds from California's Cap-and-Trade program should be used to fund infrastructure investments, with the goal being to reduce the impacts resulting in climate change, as well as improve quality of life, public health outcomes and economic opportunity among the State's most impacted communities. These laws require that at least 25 percent of the proceeds from the fund be spent on projects that are located within and will benefit disadvantaged communities.

Figure 18 presents the location of the recommended improvements in relation to the areas designated as disadvantaged or low-income, per SB 535 and AB 1550. As shown, all of the Study Area is considered disadvantaged based on environmental burden or income. Additionally, much of the population the Study Area serves lives in a household with no access to a vehicle, which provides challenges for individuals accessing employment, education, or basic services. As discussed previously, the percent of the population living within the Study Area that do not have access to a vehicle is roughly 15 percent in the Study Area's northernmost Census Tract. However, this figure is even higher in the Census Tracts north of the Study Area – as high as 50 percent for some of the Census Tracts. Moreover, between 23 and 38 percent of the adult population in the Census Tracts covering the Study Area have limited English ability, providing further challenges for these populations.

Due to this lack of equitable access and disadvantaged status, the need for both economic revitalization and the prioritization of improvements that reduce environmental burdens disproportionately impacting disadvantaged communities is fundamental to future prosperity, environmental justice and social equity in the RTTAP Study Area. Given that the RTTAP Study Area facilities serve and are expected to benefit a significant number of disadvantaged populations, particularly those who work in service and agriculture-based industries, all improvements recommended in this Study promote a social equity perspective.



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REVERSE TRIANGLE
TRANSPORTATION AREA PLAN

FRESNO COUNCIL OF GOVERNMENTS

REVERSE TRIANGLE TRANSPORTATION AREA PLAN

DISADVANTAGED & LOW-INCOME COMMUNITIES

Project No. **11192258**
Revision No. **-**
Date **MAY 2021**

FIGURE 18

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Data source: Light Gray Base: Fresno County Dept. PWP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA; Priority Population Data: CA ARB. Created by: pthornton

COVID-19 Effects

During development of this RTTAP, a worldwide spread of COVID-19 (coronavirus) began in late 2019/early 2020. COVID-19 symptoms include potential damage to lungs, heart and brain, which increases the risk of long-term health problems. This virus is highly contagious and can spread not only with touch, but with airborne droplets.

As a result of health concerns, the national Centers for Disease Control (CDC) implemented recommendations regarding hand washing, social distancing (6-feet minimum), wearing of facemasks, and routine cleaning and disinfecting frequently touched surfaces. Additionally, the State of California [and other geographic regions in the country] issued stay-at-home orders for non-essential workers and students, thus shutting down many aspects of the economy, including many jobs in the service industry and schools of all grades (pre-school through college).

Fortunately, the RTTAP team was able to collect all existing traffic data and two (2) public outreach workshop prior to the mandatory state shut-down orders.

Plan/Policy Consistency

In sorting and selecting a preferred corridor concepts for the RTTAP, both a quantitative and qualitative measures were considered and used. The Benefit/Cost Analysis quantified and compared metrics associated with traffic operations, safety, emissions, and cost characteristics to help narrow and focus the selection to the most beneficial improvements to RTTAP circulation and safety. In addition to these quantitative metrics, qualitative measures, although often less objective, can provide further insights into the desirability and functionality of proposed improvements. Per the Smart Mobility Framework process, the following qualitative factors were also considered when evaluating and selecting the preferred alternative. These factors included:

- **Plan Consistency** (Regional Transportation Plan and local agencies' General Plan Circulation Elements)
- **Policy Consistency** (Fresno COG, City, County, Caltrans and local agencies)
- **Environmental/Institutional Sensitivity** (per the environmental screen analysis)
- **Community Acceptance** (based on the community engagement process)
- **Social Equity** (consideration of low income and minority population concentrations relative to the location of anticipated improvement impacts and benefits)

Plan Consistency

An assessment was performed as to the general consistency of the corridor alternatives relative to the following plan documents emanating from the involved agencies. A section of the existing conditions background report identified published goals and policies for planning studies that affect the RTTAP Study Area. The RTTAP, not having any goals or policies by itself, strived to be consistent with current and future planning efforts ongoing within the Study Area. Specifically, Caltrans SR 41 & 99 Route Concept Reports, Fresno COG Regional Transportation Plan, local Active Transportation Plans and City of Fresno/ Fresno County General Plan Circulation Elements are found to be consistent with the plan documents from the involved agencies.

Policy Consistency

Recognizing the importance the RTTAP to both regional and local circulation, the involved agencies have been and are aligned in establishing policies that further the improvement of the corridor to enhance traffic operations, safety and multimodal opportunities and reduce environmental impacts. Similar to the assessment made regarding Plan Consistency, the RTTAP was found consistent with all policies established by the involved agencies.

8 – Benefit Monetization

The benefits associated with the performance assessment analyses were monetized based on the societal and economic cost information from the Caltrans 2018 Economic Parameters and the Local Roadway Safety manual (2020) cost for crashes. These monetized benefits were then combined with currently available planning level improvement cost opinions (described below) to yield a holistic benefit-cost estimate for each project alternative.

Monetized Benefits

Monetized benefit categories include the following:

- **Multimodal Induced Demand Monetized Benefit**: Includes dollar cost savings associated with reduced vehicle miles travelled, health costs, and value of time savings.
- **Safety Monetized Benefit:** Includes dollar cost savings associated with reduction in fatal and injury crashes at priority roadway and intersections based on crash history.
- **Vehicular Delay Reduction Monetized Benefit:** Includes dollar cost savings associated with vehicle hours of delay reduction from intersection operational improvements.
- **Economic Impacts from Plan Investments:** Includes economic benefits from spending associated with the RTTAP improvement investments, and includes direct, indirect, and induced benefits.

The Caltrans 2018 Economic Parameters societal cost of time per vehicle is provided below.

- Automobile: $16.33 per hour /person
- Truck: $32.30 per hour /vehicle

The Local Roadway Safety manual (2020) cost for crashes by severity is as follows:

- Fatal and Severe Injury Accident:
  - Roadway: $2,190,000 per accident
  - Signalized Intersection: $1,590,000 per accident
  - Unsignalized Intersection: $2,530,000 per accident
- Other Visible Injury Accident: $142,300 per accident
- Complaint of Pain Accident: $13,300 per accident

All quantified benefits were annualized and projected to reflect a 20-year design year condition (i.e., life-cycle costs). The total estimated monetized benefits are $309 million; however, other monetized benefits could be estimated.

Multimodal Induced Demand Monetized Benefit

The total lifecycle monetized benefit associated with multimodal induced demand (i.e., mode shift) is estimated at $197.2 million, as shown in Table 24. Monetized benefits per roadway segment are presented in Table 25.

Table 24 – Multimodal Induced Demand Monetized Benefit

	Mobility Benefits	Health Benefits	Recreation Benefits	Decreased Auto Use Benefits	Total Annual Benefits	Life-Cycle (20 Years) Benefits
Total	$ 1,607,344	$684,319	$ 11,652,002	$ 8,145.00	$ **13,951,810**	**$ 197,194,034**

Table 25 – Roadway Segment Multimodal Induced Demand Monetized Benefits

Roadway Segment	Segment Extents	Induced Demand Benefits				
		Mobility Benfits	Health Benefits	Recreation Benefits	Decreased Auto Use Benefits	Total Induced Demand Lifecyle (20 year) Benefit
Church Ave	Elm to Golden State	$259,732	$114,485	$1,949,361	$1,363	**$32,860,582**
Jensen Ave	Elm to Golden State	$118,019	$51,901	$883,719	$618	**$14,900,793**
North Ave	Elm to Golden State	$99,441	$38,398	$653,807	$457	**$11,195,545**
Central Ave	Elm to Maple	$70,641	$30,950	$526,990	$368	**$8,889,519**
Central Ave	Maple to Golden State	$65,444	$28,566	$486,392	$340	**$8,208,166**
American Ave	Elm to Orange	$67,444	$29,538	$502,941	$352	**$8,484,236**
American Ave	Orange to Maple	$75,053	$32,714	$557,032	$389	**$9,401,735**
American Ave	Maple to Golden State	$56,227	$24,616	$419,142	$293	**$7,070,895**
Lincoln Ave	Elm to Sarah Street	$65,941	$28,703	$488,738	$342	**$8,250,331**
Lincoln Ave	Sarah Street to Chestnut	$52,952	$23,175	$394,601	$276	**$6,657,123**
Adams Ave	Elm to Golden State	$70,979	$31,175	$530,817	$371	**$8,951,607**
Cherry Ave	Church to Central	$178,044	$68,799	$1,171,449	$819	**$20,057,639**
Cherry Ave	Central to Adams	$104,710	$40,409	$688,055	$481	**$11,782,834**
East Ave	Jensen to Central	$60,493	$26,366	$448,934	$314	**$7,577,306**
East Ave	Central to Adams	$36,566	$15,958	$271,713	$190	**$4,585,425**
Orange Ave	Golden State to American	$45,673	$19,952	$339,730	$237	**$5,732,627**
Orange Ave	American to Adams	$35,555	$15,493	$263,803	$184	**$4,452,688**
Cedar Ave	Golden State to American	$40,610	$17,723	$301,769	$211	**$5,092,647**
Cedar Ave	American to Adams	$41,126	$17,949	$305,612	$214	**$5,157,474**
Chestnut Ave	Central to Adams	$62,694	$27,450	$467,396	$327	**$7,884,862**

Safety Monetized Benefit

The total lifecycle monetized benefit associated with safety countermeasures for the six priority roadway segments and twelve priority intersections is estimated at $64.3 million, as shown in Table 26. Monetized benefits per roadway segment are presented in Table 27, and monetized benefits per intersection are presented in Table 28.

Table 26 – Safety Monetized Benefit

	Benefit
Lifecycle (20 Year) Total	**$ 64,256,928**
Annual Total	**$ 3,212,846**

Table 27 – Roadway Segment Safety Monetized Benefits

Roadway Segment Locations	Total Lifecycle (20 year) Benefit
Chestnut Ave	$ 3,093,960
Cherry Ave	$ 1,532,006
Central Ave	$ 1,532,006
American Ave	$ 1,868,368
Cedar Ave	$ 1,926,000
Lincoln Ave	$ 1,027,382
Total	**$ 10,979,722**

Table 28 – Intersection Safety Monetized Benefits

Intersection Locations	Total Lifecycle (20 year) Benefit
American Avenue / Chestnut Avenue	$ 3,729,374
Cedar Avenue / American Avenue	$ 5,603,271
Central Avenue / Chestnut Avenue	$ 2,084,401
Cherry Avenue / Adams Avenue	$ 1,457,508
American Avenue / Maple Avenue	$ 16,849,177
American Avenue / East Avenue	$ 5,097,472
Central Avenue / Elm Avenue	$ 1,850,879
East Avenue / Lincoln Avenue	$ 4,828,386
Chestnut Avenue / Lincoln Avenue	$ 5,097,472
Chestnut Avenue / Clayton Avenue	$ 1,850,879
Cherry Avenue / Central Avenue	$ 4,828,386
Total	**$ 53,277,206**

Vehicular Delay Reduction Monetized Benefit

The total lifecycle monetized benefit associated with vehicular delay reduction at intersections with identified operational improvements is estimated at $48 million, as shown in Table 29. Monetized benefits per improved intersection are presented in Table 30.

Table 29 – Vehicular Delay Reduction Monetized Benefit

	Benefit
Lifecycle (20 Year) Total	$48,009,350
Annual Total	$3,290,492

Table 30 – Intersection Vehicular Delay Reduction Monetized Benefits

Intersection	Improvement Description	Total Lifecycle (20 year) Benefit
Jensen Avenue/SR 99 SB Off-Ramp (East Avenue)	Addition of left-turn lane and re-striping	$3,659,746
Central Avenue/Chestnut Avenue	Re-striping improvement	$3,085,421
Clovis Avenue/SR 99 SB On-Ramp	Convert to traffic signal (potential roundabout opportunity)	$30,600,152
North Avenue/Hwy 41 NB Off-Ramp	Re-striping improvement	$1,108,045
North Avenue/Hwy 41 SB Off-Ramp	Addition of left-turn lane and re-striping	$6,834,581
Central Avenue/Hwy 41 (SB)	Optimize traffic signal cycle length	$2,721,403

Preliminary Cost Estimates

Preliminary cost estimates were sourced from previous planning documents and reviewed and adjusted to be consistent with existing costs, where possible. Where not available, preliminary planning-level costs were developed by project team planning and engineering staff. The individual corridor improvement cost estimates are presented in the report. The total preliminary costs for the proposed roadway improvements are $348.1 million and intersection improvements are $27.3 million. These cost estimates include 50 percent contingency costs and 45 percent support costs, including PA&ED, PS&E, and construction support costs. Cost estimates are provided per project in Appendix F. Preliminary cost estimates were note estimated for other programs or strategies recommended within this plan.

Economic Impacts from Plan Investments

An economic impact analysis of the corridors' improvements was conducted and is presented in terms of regional impacts for gross regional product (GRP), jobs, and personal income. To analyze these impacts the economic impacts a model of the economy, called "impact analysis for planning" or IMPLAN was deployed. This model enables one to examine the impact structure of each investment. In the case of construction projects, project expenditures are tracked through the supply chain, from the construction contractor and its employees (direct impacts), to its suppliers and to their employees and onward to further levels of suppliers, employees, and their suppliers (indirect impacts). It also

enables the examination of the effects from all the associated income to employees and their household purchases (induced impacts). The methodology for the economic impact analysis is presented in Appendix E.

The economic impact analysis analyzes the economic impacts associated with the recommended investments (proposed projects recommended within the RTTAP) identified across the plan timeline; however, since project implementation is within the purview of the local agencies, and the timeline for implementation is uncertain, we talk about total impacts over the life of plan implementation instead of a year-by-year impact analysis. The estimated project investments total $368.22 million.

The direct economic impact on the Fresno County economy of the $368.22 million initial investment in projects (based on preliminary cost estimates for proposed projects within the RTTAP) are estimated to generate about 1,668 direct jobs and $115.5 million in direct labor income over the planning horizon. When considering indirect and induced impacts, the initial investment supports 2,760 job years for full-time equivalent jobs, over $173 million in labor income and close nearly $308 million of value added gross regional product, **for a total economic effect of over half a billion dollars** (total multiplier effect of 1.57).

Funding Opportunities

Funding opportunities for infrastructure projects are generally categorized into grants and loans available from the federal, State, or local agency (county or city) level of government, from fees or assessments in a particular district or jurisdiction, and private funding organizations. Government funding is often competitive and recurring on a regular basis, while fees and assessments are continuous over a period of time, and private funding is usually narrowly focused and highly selective based on the focus of the granting organization. A comprehensive assessment of funding opportunities for the RTTAP improvement recommendations is provided in Appendix G.