II A.

FRESNO-CLOVIS

METROPOLITAN AREA CLASS IV BIKEWAY FEASIBILITY STUDY

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June 2017

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Chapter 1. Introduction

This feasibility study identifies and evaluates corridors in the Fresno-Clovis Metropolitan Area that are suitable for separated bikeways. Design recommendations in this study may also be used to support the planning of separated bikeways in other Fresno County communities.

This study is organized in eight chapters:

- **Introduction** to separated bikeways
- **Background** and evolution of separated bikeways
- **Design Overview** presents a review of current design guidance and typical implementation considerations
- **Existing Conditions** provides an overview of the existing bicycling environment in the Fresno-Clovis area
- **Outreach** describes the public engagement process
- **Evaluation** outlines analyses and selection criteria
- **Cost Estimates** for construction and maintenance of typical facilities
- **Conclusions** for the Fresno-Clovis region

In addition, detailed **Design Guidelines** for separated bikeways are provided in a companion volume to this study.

Purpose

The Fresno-Clovis Metropolitan Area is poised to further develop a high-quality bicycling environment, building on its existing network and natural assets. The flat terrain and temperate climate make it well-suited for bicycling year-round. A thriving metropolitan community with universities, commercial corridors, key employment corridors and high density housing can create the potential for higher demands for bicycling if the infrastructure supports a welcoming and inviting environment for bike riders of all ages and abilities.

By providing a higher level of separation and comfort, separated bikeways are likely to encourage people who are uncomfortable bicycling on busy collectors and arterials to feel confident bicycling more.

To that end, this feasibility study presents a review of design guidance and implementation needs, evaluates existing corridors in the Fresno-Clovis area, and identifies key locations where separated bikeways will likely provide the greatest benefit or return on investment.

Separated Bikeways

Separated bikeways are bicycle facilities that include a vertical physical barrier between the bikeway and moving traffic, such as flexible bollards, a curb, on-street parking, or planter boxes. They can be designed to allow for either one-way or two-way travel and can either be at street level or at sidewalk level.

Depending on the agency or jurisdiction, separated bikeways may also be referred to as "protected bikeways" or "cycle tracks," or "separated or protected bike lanes." In California, the preferred term is "separated bikeway" so as to not be treated or enforced as bike lanes within the California Vehicle Code.

They are not designated as bike lanes in California because of a statutory requirement that bicyclists must ride in a bike lane when one is present. As such, bicyclists are not obligated to use separated bikeways and may choose to ride with traffic instead.

A separated bikeway with concrete planters as a physical barrier

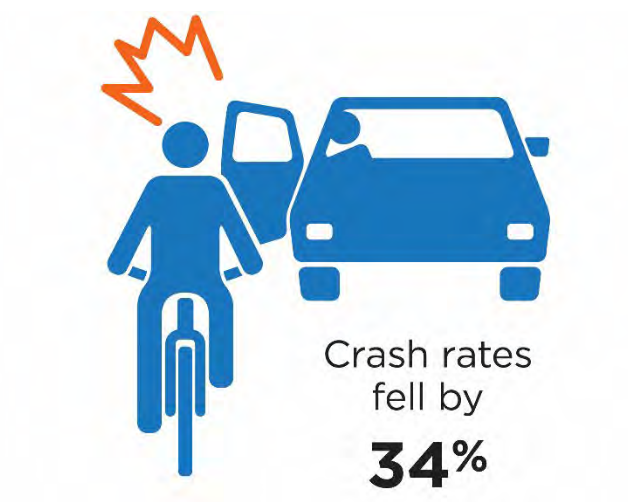
Benefits

Separated bikeways have the potential to improve the transportation network and the community in the Fresno-Clovis region. When well designed and integrated into an active transportation network, separated bikeways can also help the Fresno-Clovis Metropolitan Area meet goals and performance measures in adopted local and regional planning documents by promoting the use of bicycles for transportation.

The Fresno COG Regional Transportation Plan outlines a course of action for the region that prioritizes an efficient multimodal transportation network that meets the needs of residents in the region, with an emphasis on high-quality bicycle and pedestrian facilities, economic vitality, and improved air quality. For a complete review of local and regional plans and policies supported by separated bikeways, see Appendix A.

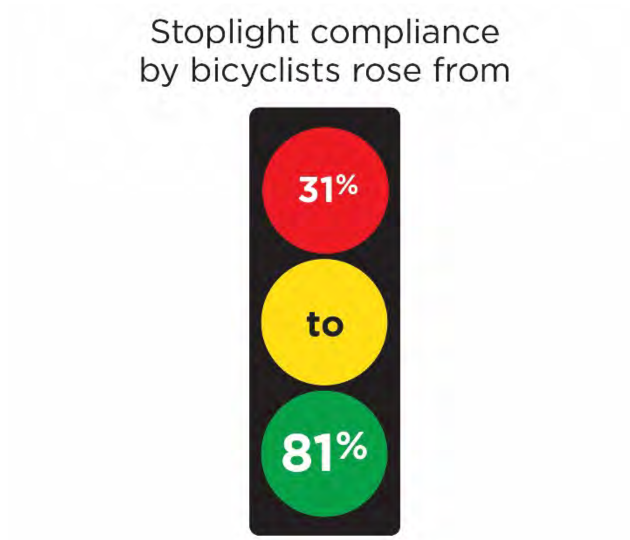
Improve Safety

Separated bikeways can improve safety by reducing conflicts between people biking and driving. When implemented as part of a road diet, a proven safety countermeasure identified by the FHWA, separated bikeways can improve safety for all road users by reducing vehicle speeds through physical and visual narrowing of the motor vehicle space. After implementing separated bike lanes in New York City, crashes involving bicyclists fell by 34 percent.[1]



Pedestrians benefit from the increased separation between the sidewalks and moving traffic. Pedestrian refuges can also be created if the physical barrier provided is wide enough, as in the case of an on-street parking protected bike lane.

Bicyclist compliance at traffic signals increased by as much as 50 percent in some places after separated bikeways were installed. In Chicago, stop light compliance rose from 31 percent to 81 percent among bicyclists.[2] This is likely due to the addition of bicycle signal heads and bicycle detection at traffic signals along corridors with separated bikeways, which make bicyclists more confident that the signal will recognize them and allow for enough time to cross the intersection.



[1] *"Columbus Avenue parking-protected bicycle path preliminary assessment." New York City Department of Transportation (2011).*

[2] *"City says Dearborn bike signals keeping cyclists in line." Chicago Department of Transportation (2013).*

Increase Bicycle Trips

Separated bikeways appeal to less confident or experienced bicyclists because of the protection they offer from moving vehicles. One national survey found 96 percent of bicyclists felt safer in separated bikeways. An FHWA survey found ten percent of bicyclists had switched from other modes after separated bikeways were installed. [3]

One survey found that

10%

of current riders switched from other modes after separated bikeways were installed

This can encourage bicycling among a new and diverse group, as people of all ages, genders, and abilities feel more comfortable bicycling for transportation. Separated bikeways can also provide important on-street connections to the area's sizeable and expanding shared-use path network and create more door-to-door routes to connect people from where they live to where they want to go. Over time, this can contribute to increased bicycle trips and decreased motor vehicle traffic as people choose bicycling instead of driving.

Improved Health and Quality of Life

Creating safer, more comfortable bicycle facilities can encourage more residents to incorporate active transportation into their daily lives.[4] This increased physical activity means Fresno-Clovis residents will be more likely to meet recommended physical activity levels and live healthy lifestyles.

As bicycle trips replace car trips, congestion and pollution are likely to decrease, improving air quality and reducing asthma and other respiratory health concerns. While the addition of dedicated bicycle facilities may spark concerns about increased congestion, studies have found separated bikeways have little or no effect on automobile travel times, and in many cases congestion may be reduced as more people choose to bicycle.[5]

Travel time studies find that separated bikeways have **little to no effect on automobile traffic**

Support the Local Economy

Creating bicycle-friendly streets can be a boon for local businesses. Research shows that although people on bicycles spend less on each trip, they visit shops more frequently than people who drive, resulting in an overall increase in business.[6]

Because separated bikeways are also likely to improve pedestrian comfort, increased foot traffic could result in additional visibility and patronage of local businesses along the corridor. One New York City corridor saw a 49% increase in retail sales after a separated bikeway was installed, compared to a 3% increase in the rest of Manhattan.[7]

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[3] *"Lessons from the Green Lanes: Evaluating protected bike lanes in the U.S." National Institute for Transportation and Communities (2014).*

[4] *"New Walking and Cycling Routes and Increased Physical Activity: One- and two-year findings from the UK iConnect study." American Journal of Public Health (2014).*

[5] *"Initial Findings: Kinzie Street Protected Bike Lane." Chicago Department of Transportation (2011)*

[6] *"Business Cycles: Catering to the bicycling market," and "Exploring the Relationship between Consumer Behavior and Mode Choice." TR News (2012).*

[7] *"Protected Bike Lanes Mean Business." Alliance for Bicycling and Walking (2016).*

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Chapter 2. Background

The California Department of Transportation (Caltrans) has four types or "classes" of bikeways:

- Bike paths or shared use paths, also referred to as "**Class I bikeways**," which provide a completely separated right-of-way designated for the exclusive use of bicycles and pedestrians with crossflows by motorists minimized.
- Bike lanes, also referred to as "**Class II bikeways**," which provide a restricted right-of-way designated for the exclusive or semiexclusive use of bicycles with through travel by motor vehicles or pedestrians prohibited, but with vehicle parking and crossflows by pedestrians and motorists permitted.
- Bike routes, also referred to as "**Class III bikeways**," which provide a right-of-way on-street or off-street, designated by signs or permanent markings and shared with pedestrians and motorists.
- Cycle tracks or separated bikeways, also referred to as "**Class IV bikeways**," which promote active transportation and provide a right-of-way designated exclusively for bicycle travel adjacent to a roadway and which are separated from vehicular traffic. Types of separation include, but are not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

Detailed design guidance for each bikeway type is described in the Caltrans Highway Design Manual and in Design Information Bulletin (DIB) 89, which established guidance for Class IV separated bikeways in December 2015.

History and Evolution

The first modern separated bikeway was implemented in the United States in 1967, in Davis, California. This experimental separated bikeway on Sycamore Drive was in fact, one of the first on-street bicycle facilities in the country, and separated riders from moving traffic with a row of parked cars. Construction of separated bikeways over the next 30 years were few in number; the vast majority of these advanced bike facilities have only been installed over the last decade.

This gap in development has been attributed to a number of factors including slow development of bicycle facility design standards, lack of funding for planning, design and implementation of bicycle facilities and decades of auto-centric design.[8]

The more recent wave of development can be attributed to increased popularity of utilitarian and recreational cycling across cities in North America over the last few decades, with particular focus on safe, comfortable facilities for the broadest range of ages and abilities. A survey by People for Bikes in 2016 estimated about 20 separated bikeways had been constructed in the U.S. in 2002. That doubled to roughly 40 by 2009. From 2010-2014 the survey estimated an approximate 400% increase in separated bikeways installed by the end of 2014. Cities like Portland, Oregon; Boulder, Colorado; Chicago, Illinois; Boston, Massachusetts; and New York, New York which had a fair share of standard Class II bike lanes began to design and build separated bikeways with increased frequency.

In 2016, the survey estimated separated bikeways had been constructed in around 34 states and 82 cities. One-way facilities account for 57% of separated bikeways, while 43% are two-way. Concrete curbs, fences, or planters are used on 45% of facilities, with 30% using on-street parking and 25% using posts or bollards.[9]

[8] *"Re-cycling Ideas: California's Earliest Bikeway Planning Rediscovered 50 Years Later." Caswell, Marc (2015).*

[9] *"Inventory of Protected Bike Lanes." People for Bikes – Green Lane Project (2016).*

Case Studies

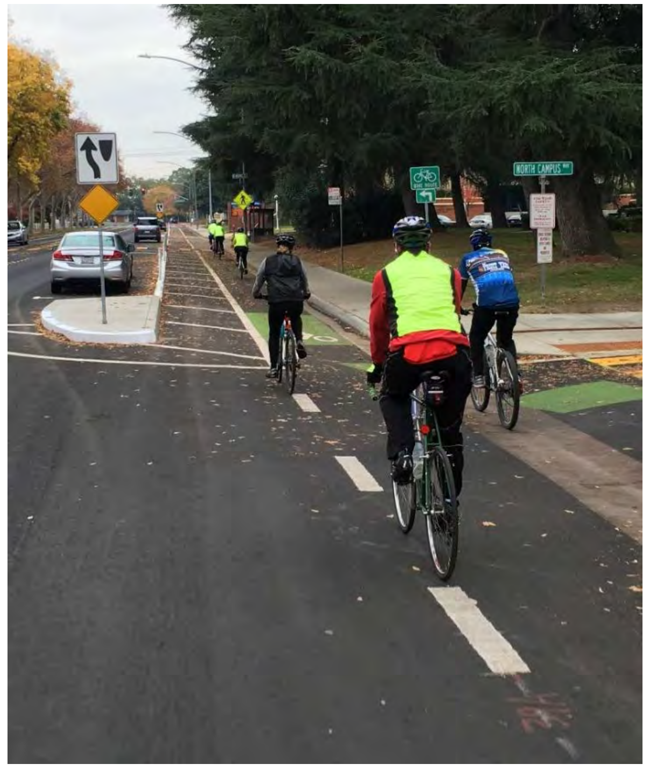
Several California communities have already implemented separated bikeways and experienced the benefits they offer. These case studies can offer important lessons for this feasibility study, demonstrating roadway types and community contexts where separated bikeways are likely to be successfully implemented.

California cities with separated bikeways

Modesto: College Avenue and 9th Street

The separated bikeway on College Avenue in Modesto, CA is protected by a raised curb and on-street parking. It provides access to several bus stops that can provide greater multi-modal connections, and includes pedestrian refuge areas between the bikeway and the travel lanes. The 9th Street separated bikeway was initially identified in the Stanislaus County Non-motorized Transportation Plan to provide a high quality bicycle connection between two campuses of Modesto Junior College.

The concept was developed as a part of a scheduled pavement overlay project to create a road diet on 9th Street, effectively repurposing an underutilized travel lane as a two-way separated bikeway.



Riders enter the new parking-protected separated bikeway along College Ave. Photo: Michael Sacuskie

As the first project of its kind in the city, it was very ambitious and not without some early skepticism. Bikeway maintenance was a significant concern of the Public Works Department, so the width of the bikeway was designed to accommodate street sweeping vehicles, and openings along the corridor were provided for better access/egress of street sweepers and emergency vehicles. With the support of the Mayor, City Council, the Modesto Junior College and local property owners, the project pushed forward.

Several Class II bikeways were completed prior to the 9th street bikeway, and helped to establish the need for citywide bicycle connections. City engineers also cite the success of the 10th St Plaza and Tactical Urbanism projects and events as helping to broaden community understanding and support for more innovative bike and pedestrian facilities and amenities.

Bicyclists in the two-way separated bikeway at 9th Street and Woodland/Coldwell Ave. Photo: Michael Sacuskie

Another key determinant of success for this project was the Transportation Engineering and Design (TED) office's recently granted authority to lead roadway design, construction and maintenance of new facilities. This allowed for design flexibility and led to creative new approaches to the connectivity and safety challenges identified around the city.

One year after completion, the facilities are being used regularly by residents for local trips, students, and recreational riders. Public and agency support for the projects have increased since implementation, and the City is looking to install more Class IV bikeways in the near future.

Murrieta: Nighthawk Way

Murrieta, CA had a one-way curb-separated bikeway installed on one side of Nighthawk Way. It was designed to provide access for Murrieta Valley High School students and help alleviate traffic congestion issues around the school. ROW was maintained on the other side of the roadway to install another separated bikeway, but there are no plans to install one at this time. Instead, the City made the bikeway two-way.

In 2014, right after installation, traffic congestion was a huge issue around the high school. Since the initial installation and conversion from a one-way facility to a two-way facility, reports of traffic congestion have been much less frequent.

Two-way separated bikeway installation on Nighthawk Way, Source: Google

Two-way separated bikeway on J Street

Davis: J Street

Davis, CA has a two-way separated bikeway installed on J Street separated from vehicle traffic with a barrier of flexible bollards that keep vehicles from crossing into the bikeway. J Street had existing Class II bike lanes on both sides of the street; the new facility replaced the southbound lane.

This short section of separated bikeway guides people riding bicycles to cross J Street at the intersection, rather than making a midblock crossing to access a shared use path to the north. This link provides a connection between a bicycle and pedestrian tunnel under a railroad and the Drexel Drive Bicycle Boulevard, which together form a key east-west bicycle corridor through the city.

Two years after implementation, the separated bikeway is working as intended. People of all ages are using it, including large numbers of elementary, junior high, and high school students traveling to schools along the corridor.

Chapter 3. Design Overview

Guidelines and Policies

California Statutes

There are multiple well-established guidance documents that describe the design of streets and bicycle facilities, including separated bikeways. Not all manuals include separated bikeways, however, because of their relatively recent popularity. These guidelines differ slightly on the dimensions they prescribe and how intersections are addressed.

The design of separated bikeways in the Fresno-Clovis region will draw on the best elements of each of these documents, while meeting or exceeding minimum Caltrans requirements.

Recommended dimensions and design details in this study are based on accepted guidelines and conceptual analysis, along with Alta's experience and knowledge of industry standards. Engineering judgment should always be used in street and intersection design.

Caltrans Design Information Bulletin 89 (2015)
Design Information Bulletin (DIB) 89 was issued by Caltrans in 2015 to officially endorse separated bikeways as Class IV in California, and provides dimensions and design requirements. The guidance outlined in DIB 89 will be integrated into the next update of the HDM.

California Manual on Uniform Traffic Control Devices (2014)
The California Manual on Uniform Traffic Control Devices (CA MUTCD) is the guide to all pavement markings and signs used for traffic control on California streets. It is a state-specific version of the national MUTCD updated every few years. This iteration of the CA MUTCD does not specifically address separated bikeways, but provides general guidance on signs, pavement markings, and other traffic control devices that may be used to create a separated bikeway.

California Highway Design Manual (2016)
The California Highway Design Manual (HDM) establishes uniform policies and procedures to carry out the design, implementation, and operation of highways for Caltrans, but its guidelines also apply to local streets. It is updated periodically, with the most recent revision released in 2016.

FHWA Separated Bike Lane Guide (2015)
The FHWA *Separated Bike Lane Planning and Design Guide* is commonly called the "Separated Bike Lane Guide," and was adopted in 2015. This document provides comprehensive guidelines on preferred and minimum dimensions of separated bikeways. It stresses the evolving understanding of this new bicycle facility, emphasizing the need for design flexibility as separated bikeways are implemented in widely varying contexts.

AASHTO Green Book (2011)
The American Association of State Highway and Transportation Officials (AASHTO) released *A Policy on Geometric Design of Highways and Streets* in 2011, commonly referred to as the "Green Book." It contains current design research and practices for street and highway design, but does not include specific design guidance for separated bikeways.

AASHTO Bike Guide (2012)
The AASHTO *Guide for the Development of Bicycle Facilities*, or "Bike Guide," was adopted in 2012. It provides guidance on the dimensions, layout, and uses of specific bicycle facilities. This guide, published before the widespread popularity of separated bikeways, does not provide explicit guidance on their design. It does provide design guidance for on-street bike lanes (Class II) and sidepaths (Class I), which may inform separated bikeway designs.

NACTO Urban Bikeway Design Guide (2015)
The National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide*, released in 2012, was the first nationally recognized bicycle facility design guide to formally address separated bikeways. This guide refers to separated bikeways as "cycle tracks."

Design Flexibility

Caltrans encourages flexibility in the design of multimodal facilities, urging local communities to refer to both the NACTO *Urban Street Design Guide* and the *Urban Bikeway Design Guide* when making planning and design decisions.

Where new facility types or configurations are not covered in the CA MUTCD, however, communities must apply for permission to experiment and study the new design.[10]

FHWA Bicycle/Pedestrian Count Pilot

Because separated bikeways are an emerging facility type, monitoring and evaluation are an important part of implementation to improve future designs and respond to local contexts and needs.

The FHWA *Separated Bike Lane Design Guide* recommends performing a detailed post-implementation evaluation on all separated bikeways including bicyclist counts, travel characteristics, and collision history. Recommended evaluation data are summarized in Table 3-1.

Table 3-1: FHWA Recommended Post-Implementation Monitoring Criteria for Separated Bikeways

Category	Data	Minimum	Preferred	Notes
Number of bicyclists	Manual counts	4 hours each on 3 days	All daylight hours for 14 days	Ensure comparable conditions for before & after counts, including time periods, day of week, weather conditions, and count location If only 4 hours will be counted, count as one block (do not split morning and evening)
	Automatic counts	24 hours for 7 days	24 hours for 14 days	Ensure comparable conditions for before & after counts, including time periods, day of week, weather conditions, and count location
Travel characteristics	Direction of travel	All bicyclists in any direction	Document travel in each direction separately	
	Wrong way riding	Not counted	Count bicyclists riding the wrong way	If possible, data should include wrong-way counts for both sides of the street or facility, to identify which desired direction of travel is not being supported
	Facility being used	All lanes counted together	Each lane counted separately	Count each lane or roadway element separately, including sidewalks, bike lanes, and vehicle lanes
Collisions	Reported collisions	All bicycle-involved collisions within 5 years	All bicycle-involved collisions within 5 years	Collision reports should include location, date and time, injury severity of victims, and documentation on circumstances, behavior, or movements that contributed to the collision

[10] *This process is described in Section 1A.10 of the CA MUTCD*

Detailed Design Guidance

Design User

Planners, designers, and engineers should consider a typical bicyclist, called a "design user" of separated bikeways to determine not only the physical dimensions of the space occupied by the rider, but the human factors that influence the use of the facility, operations in traffic, and preference for levels of accommodation.

At the national level, the FHWA encourages transportation agencies to design bikeways that go beyond minimum requirements and foster development of a bikeway network that supports increased use by people of all ages, abilities, and skill levels. The AASHTO Bike Guide discusses bikeway users in terms of comfort and skill level, generally classifying most adult bicyclists into two categories:

- **Experienced and Confident** riders are comfortable riding on roads without dedicated bicycle facilities, and are confident navigating busy streets and riding in traffic. About 10% of adults are in this group.
- **Casual and Less Confident** riders are not comfortable riding in traffic on busy streets, and prefer to ride on separated paths or quiet neighborhood streets. About 60% of adults are in this group.

Children are considered to be a unique category of users, because their abilities are closely related to their age and cognitive development. In general, children tend to:

- Have slower reactions than adults
- Have a more narrow field of vision
- Have difficulty understanding risk
- Have difficulty concentrating on more than one thing at a time
- Have difficulty determining the direction of auditory input
- Have difficulty judging the speed and distance of oncoming vehicles

For the design of separated bikeways in this study, the design user is assumed to be in the "Casual and Less Confident" group. This means the bikeways will be designed to appeal to the majority of Fresno-Clovis area residents by providing additional separation and comfort. Table 3-2 describes these design considerations.

Table 3-2: Characteristics and Design Implications of Casual and Less Confident Bicyclists

AASHTO User Characteristic	Design Implications
Prefer shared-use paths, bicycle boulevards, or bike lanes along low volume, low speed streets	Facilities should emphasize low-volume and low-speed routes, either through route selection or engineered traffic calming Where routes are along higher-volume streets, physical separation from traffic is preferred
May have difficulty gauging traffic May be unfamiliar with the rules of the road as they apply to bicyclists May walk bicycle across intersections	Intersection treatments that reduce exposure to conflicts and minimize merge or weave maneuvers are preferred A small amount of increased delay for bicyclists is accepted if a safer, more comfortable maneuver is accommodated
May use less direct routes to avoid arterials with heavy traffic volumes May ride on sidewalks if no comfortable bicycle facility is available	On busy streets, bicycle facility selection should prioritize physical separation from traffic
May ride at speeds between 8 and 12 mph Downhill grades may significantly increase riding speed	Designers should accommodate speeds up to 20 mph to support a range of users, including both casual and more confident riders
Typical trip distances is 1 to 5 miles	Out of direction travel is a greater burden on short trips Route selection should emphasize directness
Will want to be able to travel with family and friends, including riding two abreast	Facilities should allow for side-by-side riding while permitting comfortable passing opportunities for other riders

Comparison of Design Guidelines

The space required to operate a bicycle can vary widely based on the type of bicycle—including conventional bicycles, recumbent or long-wheelbase bicycles, and tricycles—and the skill level of the rider.

Bicyclists require clear space to ride a bicycle within a facility, beyond the physical dimensions of the bicyclist themselves. Maintaining balance on a bicycle requires small steering corrections and lateral movement to stay upright. Bikeways six feet wide or greater are generally preferred, although five feet may be minimally acceptable.

Bikeway designs should consider reasonably expected bicycle types on the facility and use the appropriate dimensions. Figure 3-1 illustrates the operating space and dimensions for a typical adult riding a conventional bicycle.

The various documents that regulate the design of separated bikeways vary slightly in their detailed guidance, but are generally in agreement regarding preferred and minimum dimensions. Figure 3-1 and Table 3-3 show the components and recommended widths for separated bikeways in current design documents.

Table 3-3: Comparison of Preferred and Minimum Separated Bikeway Dimensions

Feature	Caltrans DIB 89 and HDM	FHWA Separated Bike Lane Guide	AASHTO Bike Guide[11]	NACTO Urban Bikeway Design Guide
Separation from roadway	1.5 ft to 3 ft minimum[12]	1.5 ft to 3 ft minimum	1.3 ft to 3 ft minimum	1.5 ft to 3 ft minimum
One-way bikeway	7 ft preferred 5 ft minimum	7 ft preferred 5 ft minimum	6 ft preferred 5 ft minimum	7 ft preferred 5 ft minimum
Two-way bikeway	14 feet preferred 12 ft minimum[13]	12 ft preferred	10 feet preferred 8 feet minimum	10 ft preferred 8 ft minimum
Pedestrian separation	Continuous detectable vertical element	Physical separation preferred. Visual separation minimum.		
Sidewalk	See HDM Topic 105	Varies. Must meet accessibility requirements.		

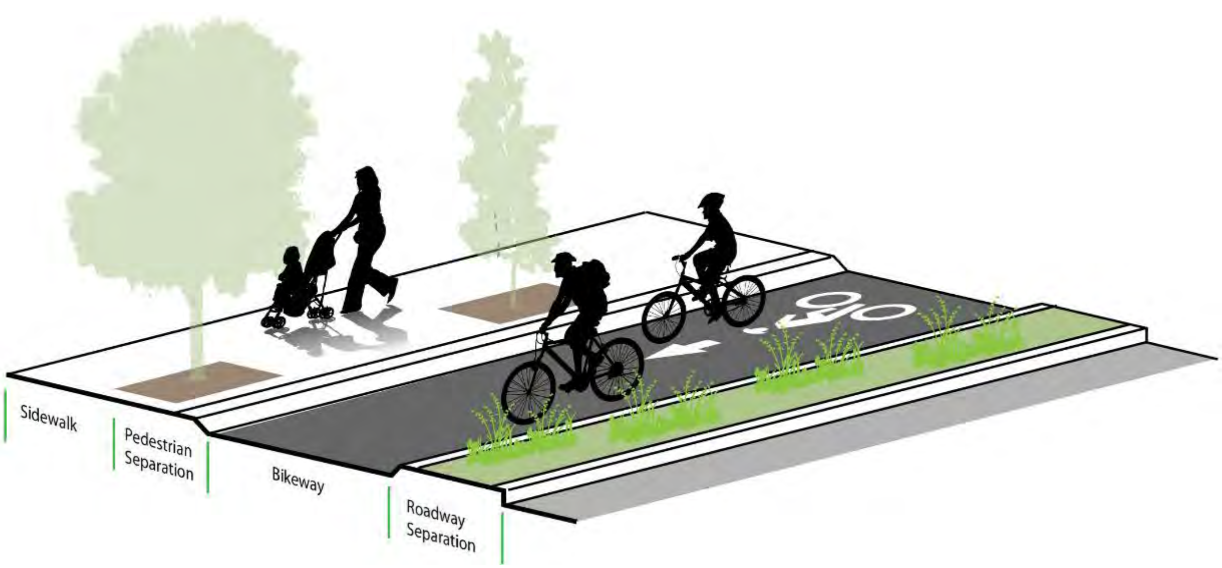


Figure 3-1: Separated Bikeway Components

[11] *The AASHTO Bike Guide was published prior to the widespread adoption of separated bikeways, and does not provide explicit guidance on their design. Values listed in this table are based on shared use path design dimensions, as the two facilities have similar operating width requirements.*

[12] *Refers to bikeway buffer separation only. If used adjacent to on-street parking, a 5 foot pedestrian route should be provided.*

[13] *Includes required 2 feet shoulders on each side of bikeway*

Implementation

Selecting a Facility

Selecting the best bikeway facility type to meet the needs of a given roadway can be challenging, due to the wide variety of factors that can impact comfort and safety for people riding bicycles. Figure 3-2 below offers a starting point to identify preferred bikeway types for particular vehicle speeds, traffic volumes, and roadway types based on guidance provided in the AASHTO Guide for the Development of Bicycle Facilities (4th Edition).

Other factors beyond speed and volume should also be taken into consideration when selecting a bikeway type, including:

- Presence and volume of heavy vehicles
- On-street parking
- Intersection or driveway density
- Surrounding land uses
- Sight distance

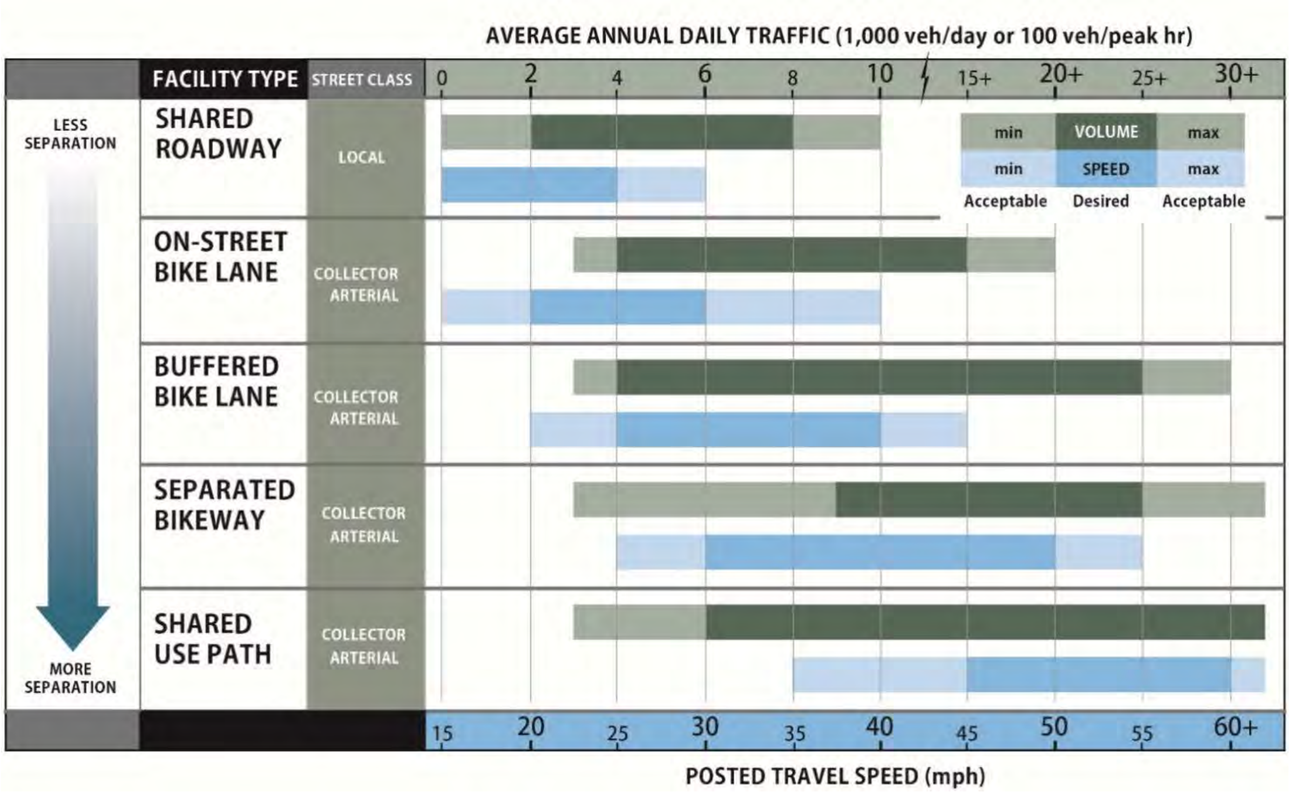


Figure 3-2: Bikeway Facility Selection by Speed and Volume (Source: Alta Planning + Design, Bikeway Selection Guidance, 2016)

Implementation Strategies

While some opportunities may exist to add separated bikeways during new construction, roadway widening, or reconstruction, many locations in the Fresno-Clovis area have physical and other constraints that would require street retrofit measures within the existing curbs. These strategies are discussed in detail in the FHWA guide *Incorporating On-road Bicycle Networks into Resurfacing Projects* and are summarized below.

Street Widening or Reconstruction

Separated bikeways can be accommodated on streets with excess right-of-way through roadway reconstruction, where existing curbs are relocated to create more space. Although this incurs higher expenses than re-striping projects, separated bikeways can be added to streets that currently lack curbs and gutters at a moderate cost.

Lane Narrowing

Lane narrowing redistributes roadway space by reducing the width of vehicle lanes that exceed minimum standards to create space for bicycle facilities. Many roadways have existing travel lanes that are wider than those prescribed in local or national design standards, or which are not clearly marked. Most standards allow for 10 foot travel lanes, especially where the posted speed limit is 45 mph or less.[14]

Special consideration should be given to the volume of heavy vehicle traffic and any curves in the corridor when evaluating the potential for narrowing lanes. Center turn lanes and parking lanes may also be narrowed in some situations.

Travel Lane Removal

Removing a single travel lane can provide valuable space for separated bikeways. Streets with excess vehicle capacity provide opportunities for this kind of bikeway retrofit project. A traffic analysis to identify potential impacts must be completed before a travel lane can be removed.

Depending on the existing configuration of the street, the needs of potential users, and documented safety concerns, different configurations can be used. For example, a common lane removal scenario involves converting a four-lane roadway with two travel lanes in each direction into a roadway with one travel lane in each direction, a shared center turn lane, and on-street bicycle facilities.

Parking Reconfiguration

Similar to removing a travel lane, removing or consolidating on-street parking can free up underused roadway width for bicycle facilities.

Electric Bicycles

Electric bicycles, or e-bikes, are bicycles equipped with an onboard motor to provide an electric assist to riders. This enables riders to go farther, faster, with less effort, and effectively makes bicycling more accessible to new bicycle riders who may not have otherwise ridden due to age, ability, convenience, and so forth. As a result, more communities across the country are seeing a rise in the popularity of e-bikes. One study reported an approximate 200% increase of e-bikes sold in North America from 2012 to 2014.[15] As a result of their growing popularity, State legislation was recently passed to clarify regulations around their use on public roads.

In California, e-bikes have been categorized into three classes, Type 1, Type 2, and Type 3 based on their maximum speeds. In general, all e-bikes (with the exception of Type 3 e-bikes on Class I bike paths) are treated by the law as standard bicycles, and no longer fall under the same regulatory category as mopeds. All e-bike classes are legally allowed to ride on Class IV bike facilities in the State of California.

In designing Class IV separated bikeways, wider lane dimensions are recommended to provide opportunities for faster e-bike riders to pass slower bike riders.

[14] *"A Policy on Geometric Design of Highways and Streets." AASHTO (2011).*

[15] *McMahon, Daniel. "Here's Why E-Bike Sales are Booming in Europe." Business Insider. August, 2014.*

Chapter 4. Existing Conditions

This chapter provides background information to support the identification and evaluation of potential corridors in the Fresno-Clovis Metropolitan Area for Class IV separated bikeways. This chapter describes current area demographics, the existing roadway network, bicycling destinations, crash data, and potential challenges in the study area as they relate to separated bikeways.

The following maps and descriptions of route conditions, opportunities, and constraints do not reflect any decisions about feasibility or preference. Rather, they summarize community and transportation factors to provide context for the potential separated bikeways, and describe specific challenges and opportunities for addressing them.

Area Demographics

The Fresno-Clovis Metropolitan Area is home to more than two-thirds of Fresno County residents, and grew by nearly 350 percent between 1970 and 2013.[16] The county is expected to grow by another 48 percent by 2040, and the metropolitan area will likely absorb more than half of this population increase.

Like many other communities around the country, there are growing health concerns related to low rates of walking and bicycling, and the growing health impacts associated with sedentary lifestyles. A network of safe and convenient Class IV bikeways represents a significant step toward providing these transportation and recreation options and addressing these increasing demands and challenges for a growing and aging population.

Figure 4-1 through Figure 4-4 illustrate general area demographics in the Fresno-Clovis Metropolitan area to provide a better understanding of where residents live, and identify locations where separated bikeways could serve the region's low-income and disadvantaged communities.

Figure 4-1 in particular, illustrates population growth patterns throughout the metropolitan area from 2010 to 2014. Class IV bikeway corridors should be planned with these current (and projected) growth areas in mind to accommodate anticipated demand for safe, convenient bike facilities.

Agriculture accounts for 12.3 percent of jobs in Fresno County, compared to 2.5 percent of jobs statewide. It has been the top agricultural-producing county in in the United States since 1954 (with one exception in 2001, when Tulare County surpassed it by a small margin). The county has a relatively high unemployment rate compared to the state, fluctuating between eight and 17 percent.

By comparing the area demographics to the activity generators (Figure 4-5), existing bicycle network (Figure 4-6), and bicycle-related collisions (Figure 4-7) maps, we can provide a more complete picture of the region's existing bicycle facility supply and demand, better target infrastructure investments, and ultimately provide an equitable distribution of separated bikeways across the region. More specifically, these data provide the foundation for developing evaluation criteria to assess the feasibility and priority of separated bikeways in the Fresno-Clovis Metro area.

[16] *FresnoCOG Regional Transportation Plan 2014*

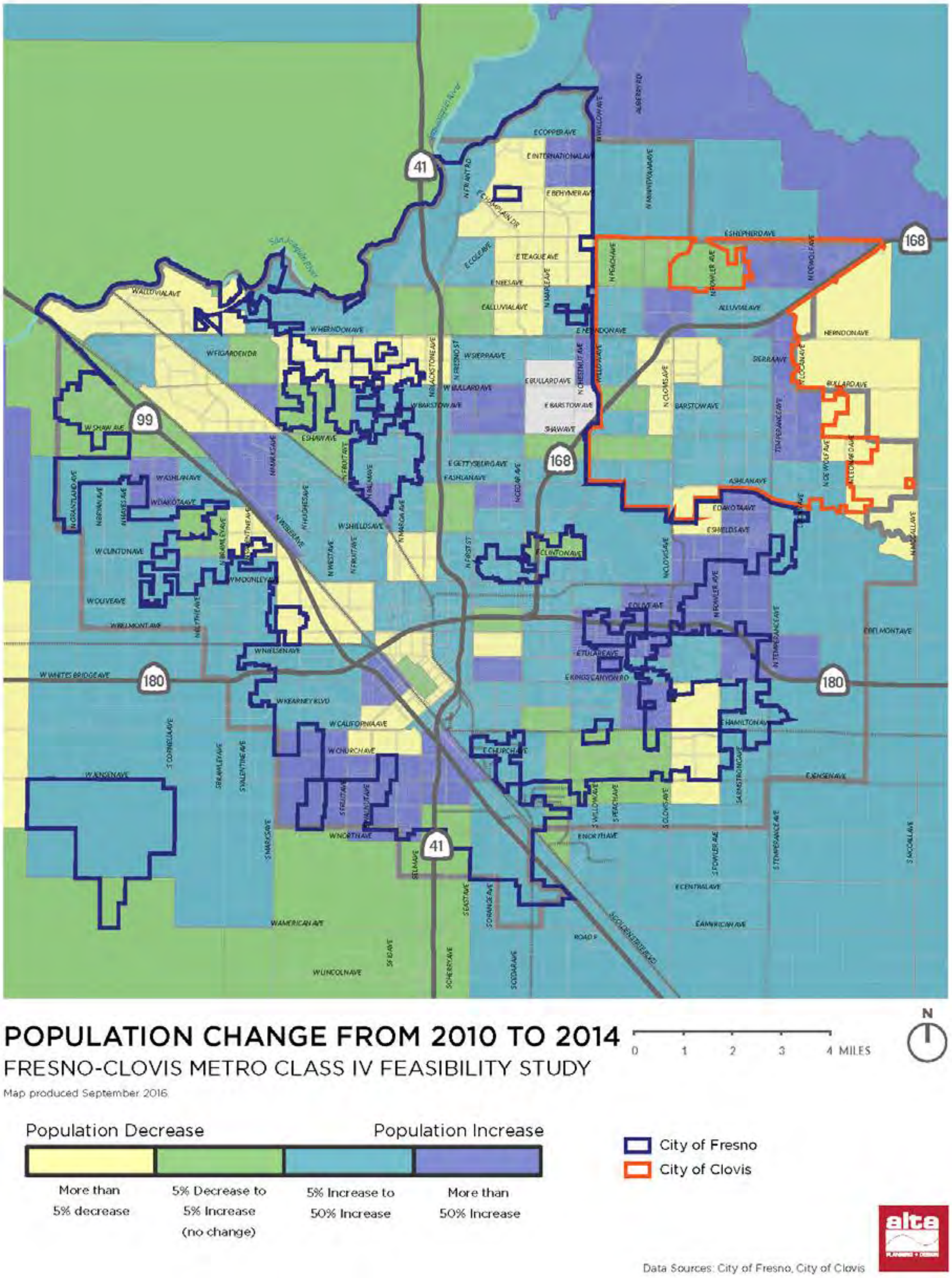
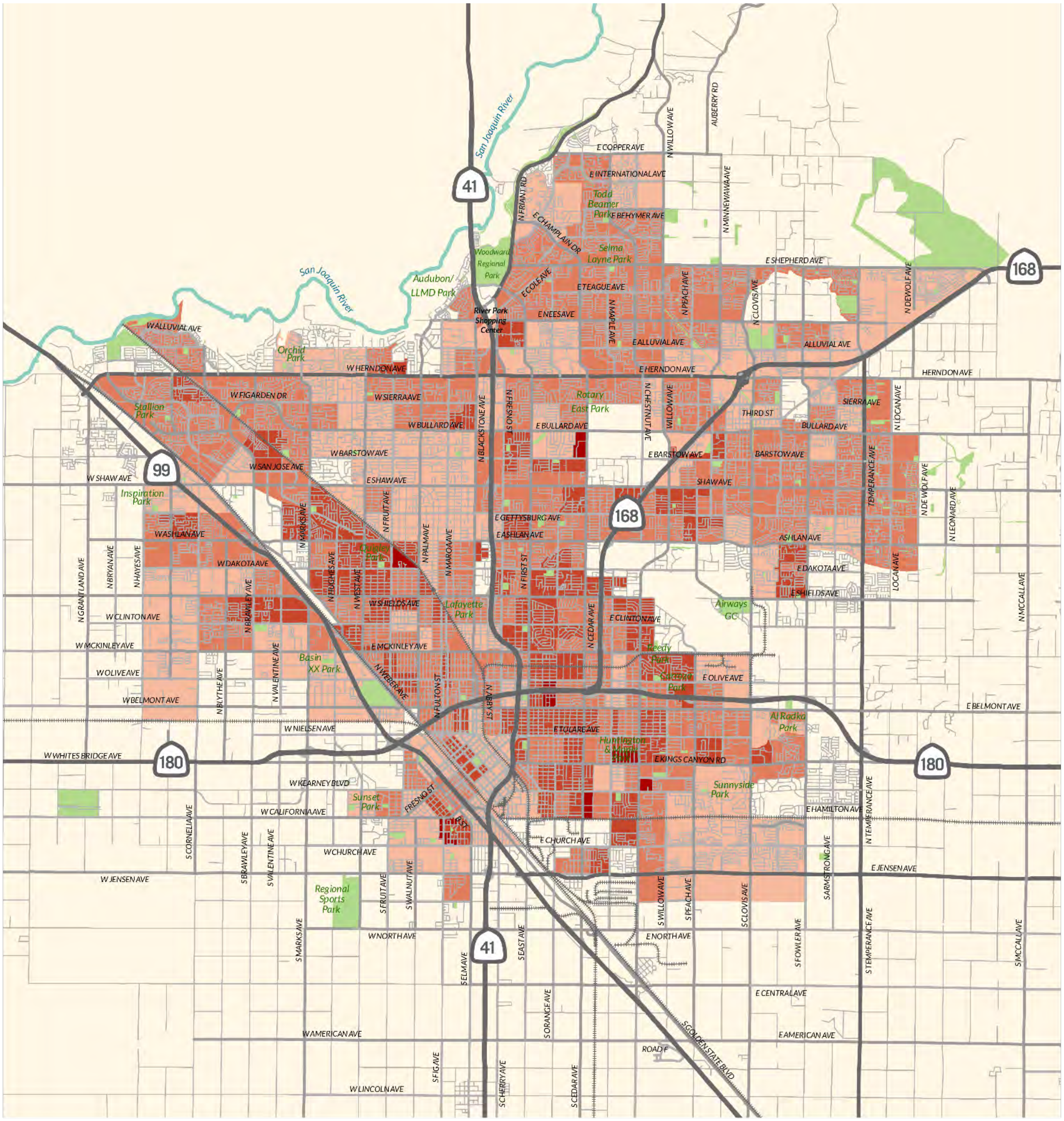


Figure 4-1: Population Change from 2010 to 2014



Population Density

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced July 2016.

0 1 2 3 4 MILES

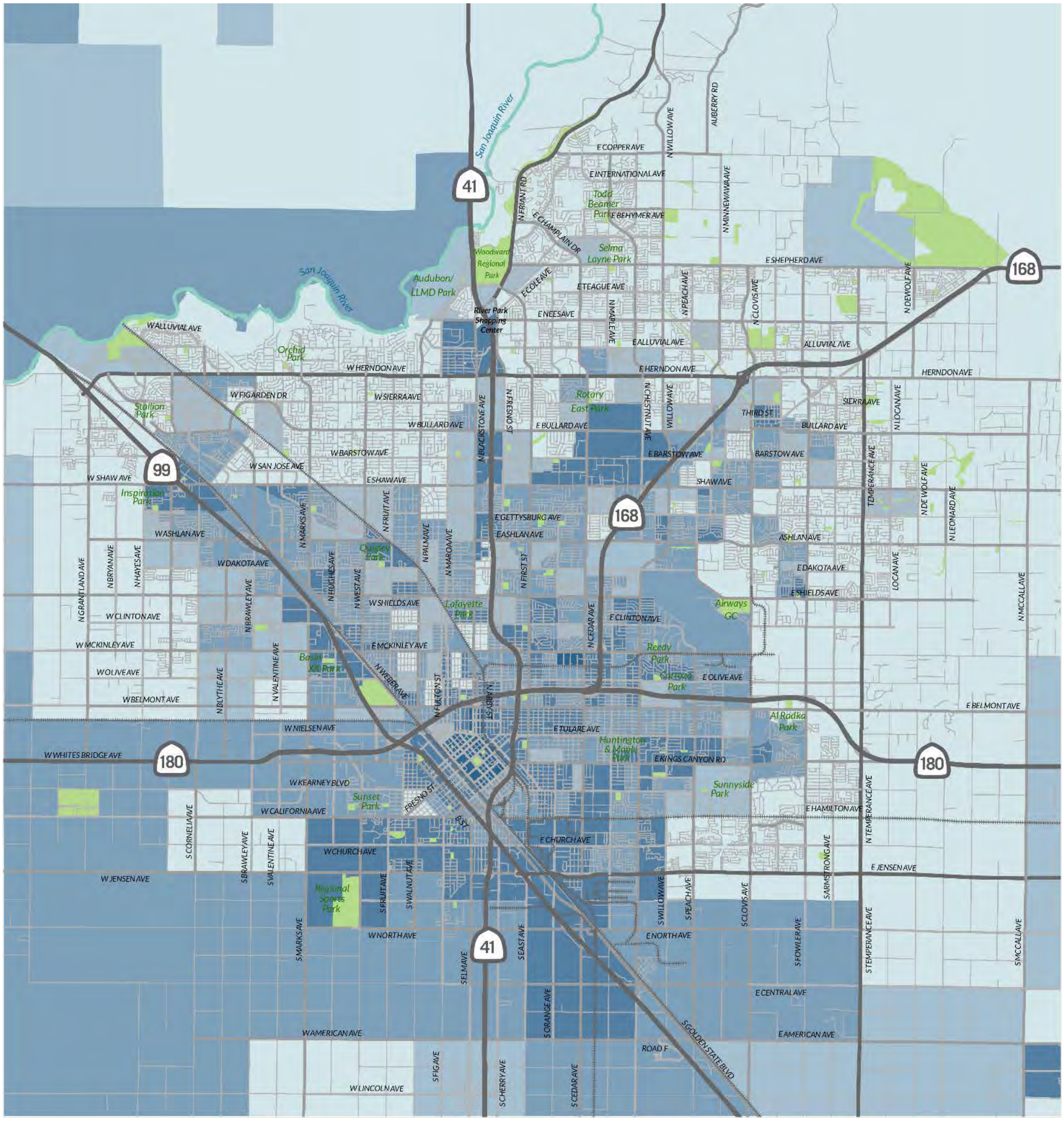
N

People per square mile

- 1 - 2,000
- 2,001 - 4,000
- 4,001 - 8,000
- 8,001 - 16,000
- 16,001 - 22,490

Data Source: City of Fresno, City of Clovis, U.S. Census Bureau 2014 ACS 5-year estimates

Figure 4-2: Population Density



Percent of Households in Poverty

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced July 2016.

0 1 2 3 4 MILES

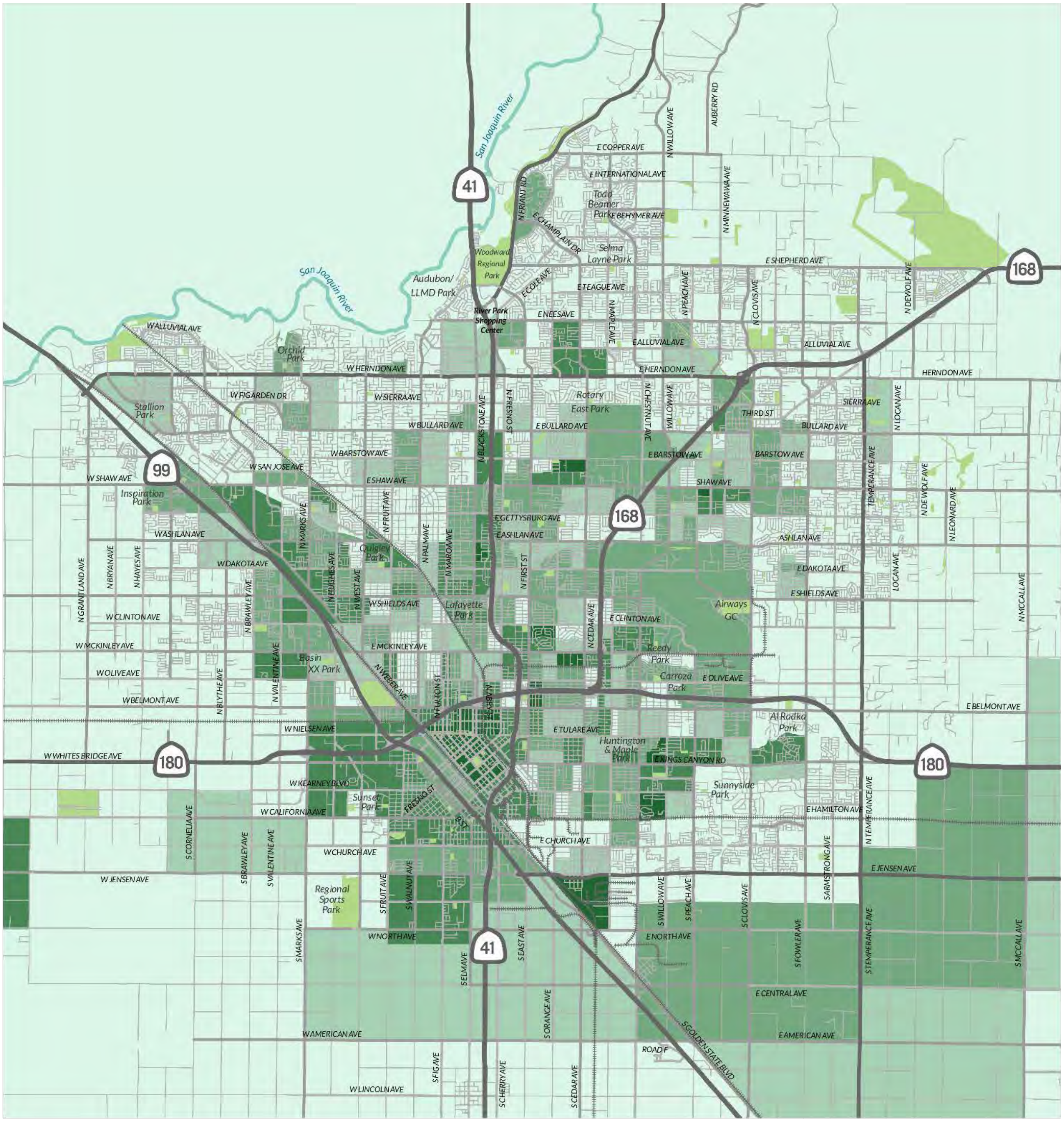
N

% of Households in Poverty

- 0% - 10%
- 11% - 20%
- 21% - 40%
- 40% - 80%
- 81% - 100%

Data Source: City of Fresno, City of Clovis, U.S. Census Bureau 2014 ACS 5-year estimates

Figure 4-3: Percent of Households in Poverty



Percent of Households Without a Vehicle

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced July 2016.

0 1 2 3 4 MILES

N

% of Households without a vehicle

- 0% - 5%
- 6% - 10%
- 11% - 20%
- 21% - 40%
- 41% - 100%

Data Source: City of Fresno, City of Clovis, U.S. Census Bureau 2014 ACS 5-year estimates

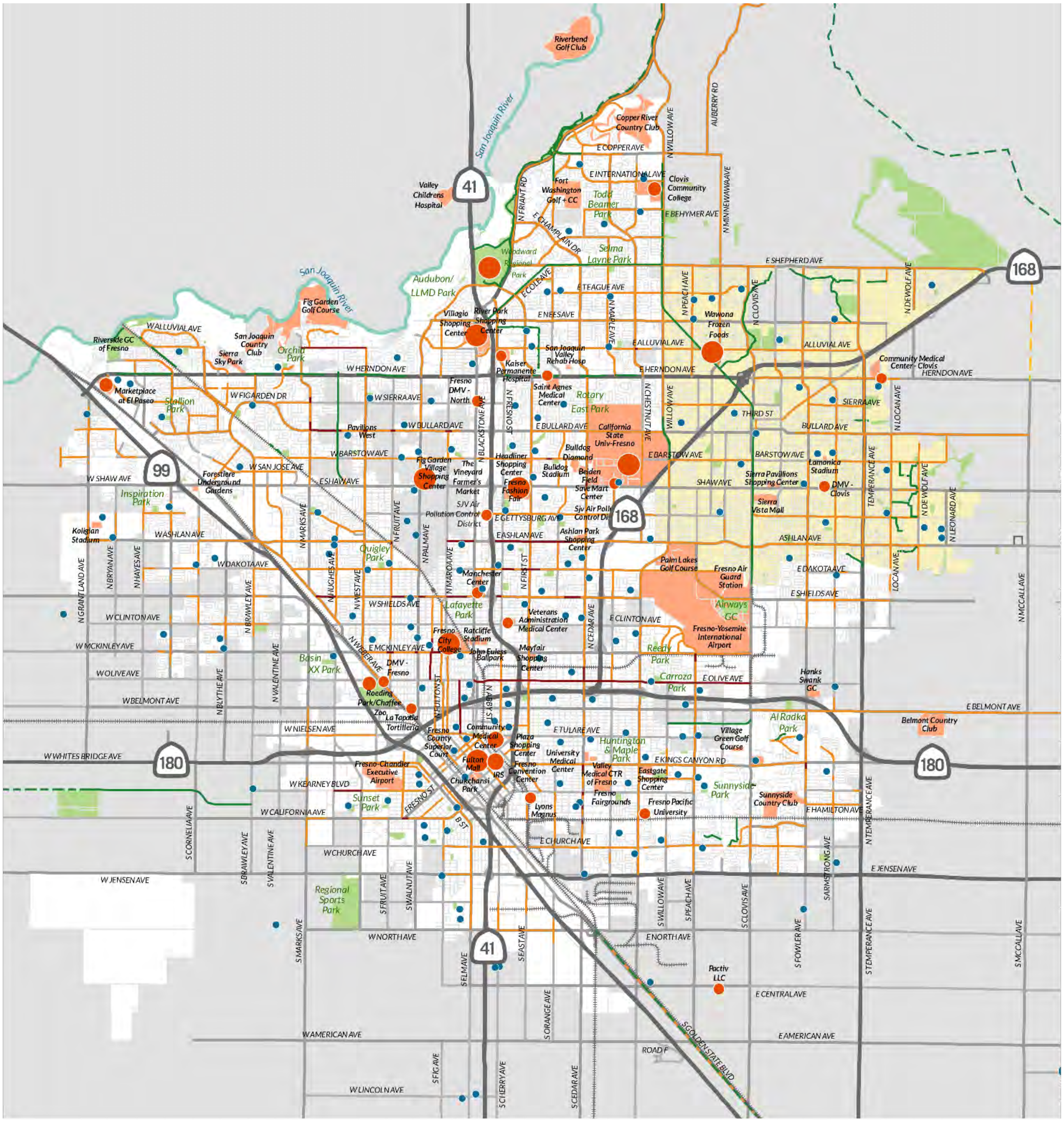
Figure 4-4: Percent of Households without a Vehicle

Activity Generators

An analysis of user demand was performed as a part of the Fresno COG Transportation Needs Assessment to identify specific locations in the region that represented "activity generators," or destinations that would attract larger shares of trips.

Activity Generators considered in this analysis included major shopping/retail centers, schools and colleges, transit stops, significant commercial and government destinations, parks and open space, and designated Urban Centers.

Figure 4-5 depicts the locations of activity generators considered in the demand analysis. The largest activity generators in the region are California State University – Fresno, Fresno City College, numerous shopping destinations and Downtown Fresno.



ACTIVITY GENERATORS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced August 2016.

0 1 2 3 4 MILES

N

Existing

Planned

Class I Off-Street Path

Class II Bike Lane

Class III Bike Route

Activity Generators

Primary Attractions

Secondary Attractions

Tertiary Attractions

Schools

Local Landmarks

City of Fresno

City of Clovis

Parks and Open Space

Data Source:
City of Fresno, City of Clovis

Figure 4-5: Activity Generators

Existing Bikeway Network

Although there are currently no Class IV separated bikeways in the Fresno-Clovis metropolitan area, there are already many miles of Class II bike lanes and Class I paths. See Figure 4-6.

The major Class I shared-use paths in the Fresno-Clovis area include the Clovis Old Town Trail, Fresno Sugar Pine Trail, Dry Creek Trail, Enterprise Trail, Van Ness Trail, McKenzie Trail, Thomas MacMichael Sr. Loop Trail and Lewis S. Eaton Trail in Woodward Park. These shared-use paths provide users of all ages and abilities access to local recreational opportunities and other neighborhood destinations via safer, more comfortable off-street connections.

These existing Class I shared-use path segments represent the early phase of development, and create an opportunity for a much larger future shared-use path system connecting all areas within and around the Fresno-Clovis metropolitan area. Connecting segments of these shared-use paths and filling the gaps between unserved areas will be a high priority. The proposed Midtown Trail represents a critical step toward these ends, providing a major connection between Central Fresno, Old Town Clovis and North Fresno. The majority of the existing shared-use paths are concentrated in the northern halves of the cities, and efforts to provide both east-west and north-south connections to the southern half of the city where a higher proportion of disadvantaged communities are located, is also a high priority.

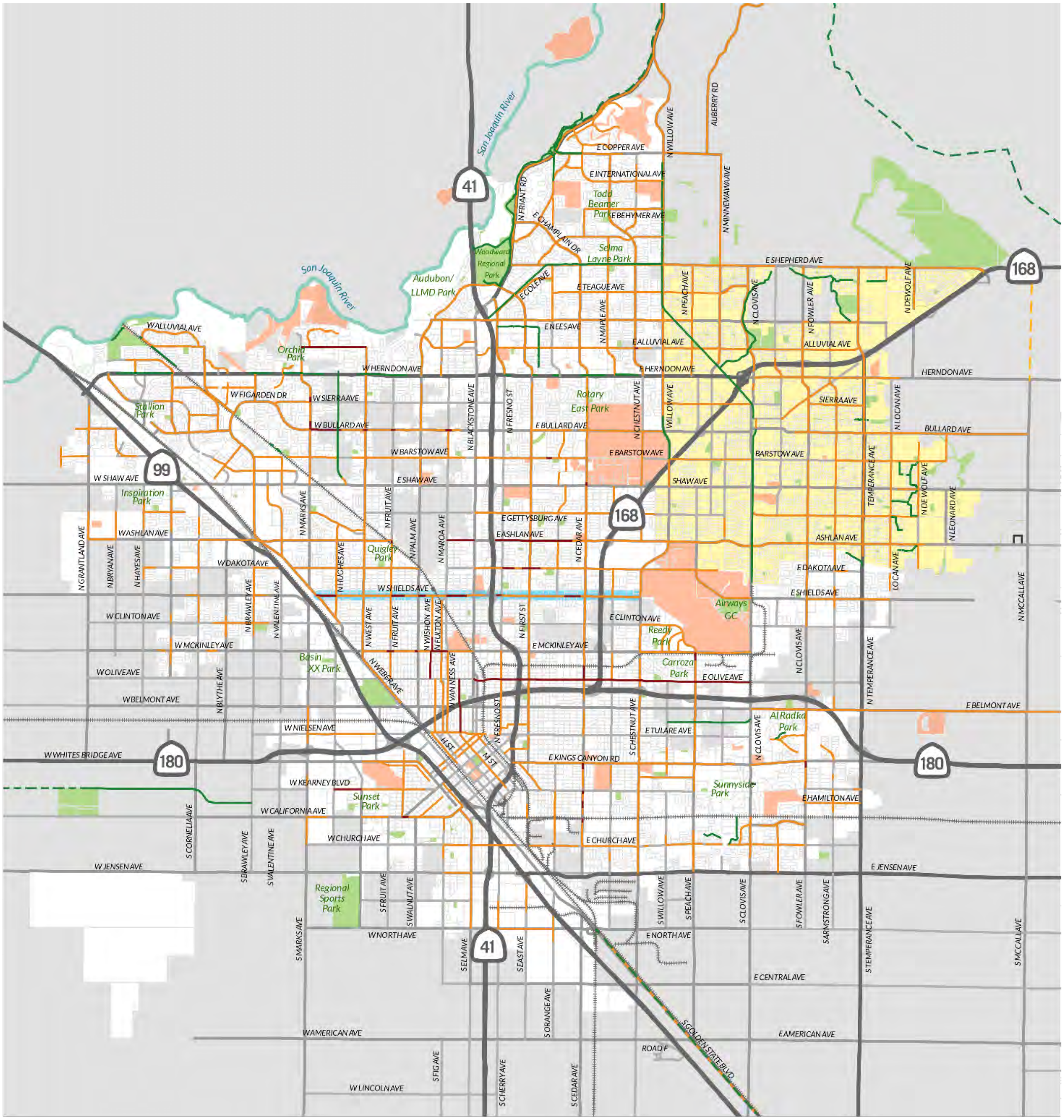
In Fresno, major corridors with continuous Class II bike lanes include First St, Cedar Ave, Nees Ave, West Ave, Alluvial Ave and segments of Dakota Ave and Shields Ave. In Clovis, bike lanes exist along Shepherd Avenue, Willow Ave, Temperance Ave, Ashlan Ave, and along portions of Shaw Ave and Fowler Ave.

There are fewer Class III bike routes in the Fresno-Clovis Metropolitan Area. With relatively minor improvement, such as wayfinding and traffic calming, many of the lower speed, lower volume residential streets in the region could be designated as Class III bike routes to provide comfortable local connections for people biking.

Future Demand

The Fresno COG Transportation Needs Assessment estimated bicycling demand and identified gaps in the network in unincorporated areas of Fresno County. As expected, the majority of the hotspots illustrated in the comprehensive demand score map were in or around the immediate Fresno-Clovis vicinity. Roadway segments were considered gaps if they existed between areas of high demand (as illustrated on a composite demand map). Of the top 15 projects selected, the two gap-connecting projects identified in this analysis nearest to Fresno and Clovis were:

- Clinton Ave from 1st Street to Chestnut Ave to provide a connection to destinations and existing facilities through the unincorporated community of Mayfair.
- Chestnut Ave from Jensen Ave to Golden State Boulevard connecting to destinations and existing facilities from Malaga to Fresno.



EXISTING BICYCLE FACILITIES

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced July 2016.

0 1 2 3 4 MILES

N

Existing

Planned

Class I Off-Street Path

Class II Bike Lane

Class III Bike Route

City of Fresno

City of Clovis

Parks and Open Space

Data Source: City of Fresno, City of Clovis

Figure 4-6: Existing Bicycle Facilities

Collision Analysis

One of the top reasons many people cite for not bicycling more often is a concern for their safety.[17] By analyzing collision data, locations are identified where there is clear demand for bicycle facilities that is not being met, and where safety improvements should be implemented.

A thorough assessment of collision reports can inform context-specific facility design by evaluating the built environment and human behavior factors that contribute to collisions at a location. For example, corridors with high numbers of collisions at intersections may need different design features than corridors with more collisions mid-block.

Figure 4-7 identifies the areas in the metro area with frequent bicycle-related collisions. Specific locations with high collision rates are symbolized as larger circles, and areas with larger concentrations of circles are considered "hotspots" or collision clusters. For example, N First Street from N Shields Ave to E Kings Canyon Rd, and E Shaw Ave between N Willow Ave and Sunnyside Ave could both be considered major crash corridors in the Fresno-Clovis Metro Area. Table 4-1 lists the locations where four or more collisions have occurred between 2005 and 2015, including a summary of injuries and information about the crashes. Figure 4-8 illustrates the locations listed in Table 4-1.

In order to improve bicyclist safety, communities will need to decide between major improvements along arterials, and smaller scale improvements along parallel corridors and connecting streets. For example, the intersection of Shaw Avenue and Minnewawa Avenue appears to be a major hotspot for bicycle collisions. While detailed exposure data is not available, it is presumed that these crashes are attributable to bicyclists accessing the many commercial destinations along the Shaw Avenue corridor. Many of these cyclists are likely to be riding from the nearby CSU Fresno Campus. In order to remedy this problem area, there are two primary options: 1) improve the bike lane along Barstow Avenue to Class IV standards and install similar facilities along all of the perpendicular streets (e.g. Villa, Minnewawa) to allow for access to the shopping district, or 2) perform a lane reduction and install a Class IV bikeway along Shaw Avenue. In either case, special care needs to be taken in design to reduce crash risks at the intersections and at driveways to the shopping centers.

[17] *"Selling Biking: Perceived Safety, the Barrier That Still Matters." People for Bikes. (2013)*

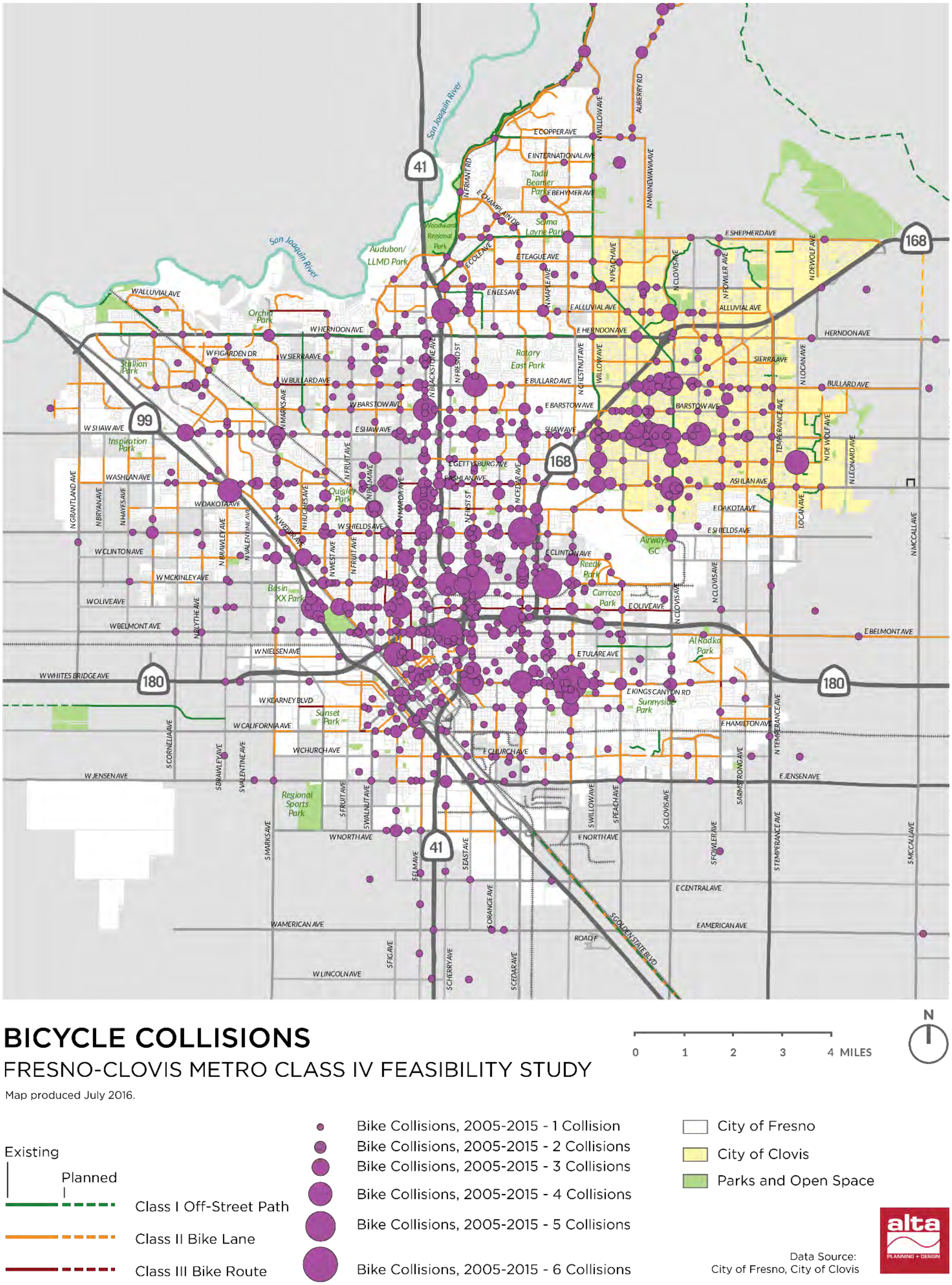
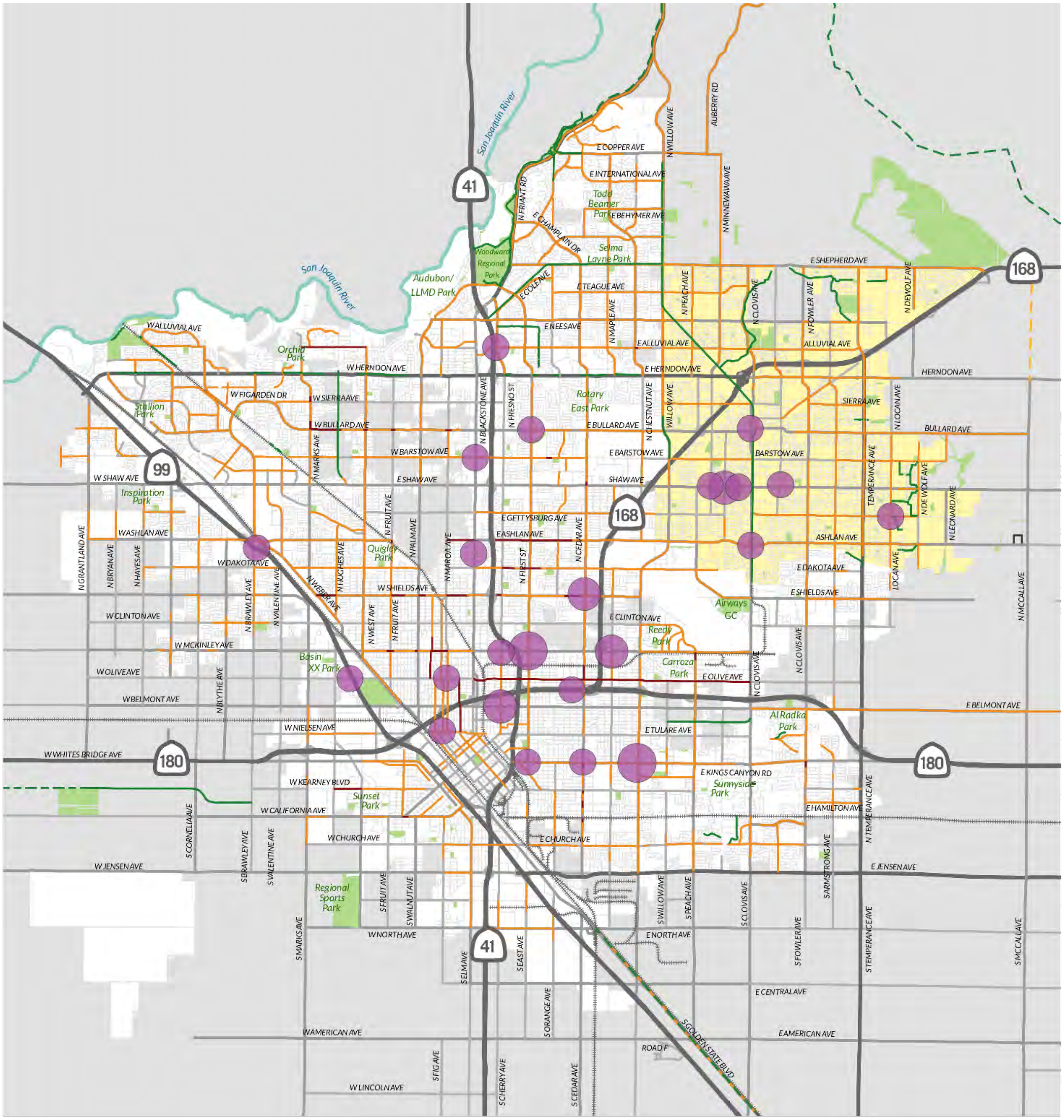


Figure 4-7: Bike Collision History

Table 4-1: Collision Clusters

Location	Cross Street	Collisions	Injuries	Fatalities
S Chestnut Ave	E Kings Canyon Rd	6	6	1
S Cedar Ave	E Ventura Ave	4	4	0
S 1st St	E Ventura Ave	4	3	1
N Fulton St	E Voorman Ave	4	4	0
Fresno	Belmont	5	5	0
N Cedar Ave	SR 180	4	4	0
N Parkway Dr	W Olive Ave	4	4	0
N Van Ness Ave	E Olive Ave	4	4	0
N Maple Ave	E Carmen	5	5	0
N Fresno St	McKinley Ave	4	4	0
McKinley Ave	1st St	6	6	0
N Cedar Ave	E Shields Ave	5	5	0
N Blackstone Ave	E Griffith Way	4	4	0
SR 99	W Ashlan Ave	4	4	1
Clovis Ave	Ashlan Ave	4	4	0
Gettysburg	Locan	4	4	0
Dewitt Ave	Shaw Ave	4	4	0
Shaw Ave	Minnewawa	5	5	0
Villa Ave	Shaw Ave	4	4	0
Shaw Ave	Sunnyside Ave	4	4	0
Blackstone Ave	W Barstow Ave	4	5	0
Bullard	1st St	4	4	0
5th St	Clovis Ave	4	3	1
N Abby	E Alluvial Ave	4	4	0



MAJOR BICYCLE COLLISION CLUSTERS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced July 2016.

0 1 2 3 4 MILES

N

Bicycle Collision Clusters
2005-2015

- 4 Collisions
- 5 Collisions
- 6 Collisions

Existing Planned

- Class I Off-Street Path
- Class II Bike Lane
- Class III Bike Route

- City of Fresno
- City of Clovis
- Parks and Open Space

Data Sources: City of Fresno, City of Clovis

Figure 4-8: Locations of most frequent reported collisions

Summary

In general, these data demonstrate that existing Class I, II, and III bikeways do not currently meet the needs of all residents in the Fresno-Clovis region. Some areas of the region have better access and connectivity to local destinations than others, but these are not necessarily the same areas that exhibit the highest demand, or greatest need for safe, comfortable bikeways. Areas near the highways and larger arterials with high speed, high volume vehicle traffic tend to have greater, more severe collision rates, and relatively fewer bikeways. This is especially important because existing bikeways may not always provide the most convenient or direct route to and from local destinations, and few safe alternatives may exist. Many of the area's low-income households and households without a vehicle - that may rely more heavily on bicycling and walking for everyday trips - are located in areas that do not have great bicycle network connectivity. These areas also tend to have more frequent and severe collision rates, than more affluent areas of the region.

The maps in this chapter provide an effective way to visualize current conditions, and the opportunities and constraints for separated bikeways in the region. These data will be synthesized and further developed as inputs in a feasibility and prioritization analysis. In this analysis, individual roadway segments will be prioritized according to a set of evaluation factors related to the roadway characteristics, collision history, and equity measures considered here. Additional factors considering stakeholder input and local opportunities and constraints will also be utilized to provide a comprehensive, data-driven method for identifying and prioritizing specific roadway corridors for separated bikeways.

Chapter 5. Outreach

Stakeholder and community engagement informed the evaluation criteria, design recommendations, and route selections presented in this feasibility study.

A steering committee met several times throughout the course of the study to provide strategic guidance. The committee included representatives from the following organizations and agencies:

- Bicycle and Pedestrian Advisory Committee
- California State University, Fresno
- Caltrans
- City of Clovis
- City of Fresno
- Fresno Council of Governments
- Fresno County
- Fresno County Bicycle Coalition
- Fresno Cycling Club
- Granville Homes

Information about separated bikeways, this feasibility study, and public input opportunities was published on a project website: www.FresnoClovisSeparatedBikeways.com. The online resource was linked on the Fresno COG website, agency websites, and publicized through emails to stakeholders and on flyers distributed by the local advocacy community.

Online Survey

An online survey was created to collect information on preferences and priorities for various types of bikeways and important routes for bicycling. The survey received 313 total responses and represented every zip code in the area.

The views expressed in the survey largely reflect the opinions of bicyclists who have bicycled in the past 30 days for transportation or recreation (82.2%). The survey also includes views (16.2%) from those who do not bicycle regularly (within the last 30 days), but indicated an interest in riding more frequently.

Seventy-four percent of respondents feel strongly concerned about being hit by a motor vehicle while bicycling. Survey responses indicated that the most comfortable facility to ride a bicycle in the Fresno-Clovis area is a shared-use path, followed closely by a separated bikeway.

When asked about their comfort riding on a hypothetical roadway with two lanes of travel in each direction, traffic moving at 30-35 miles per hour, on-street car parking, and no bicycle lanes, not surprisingly, 184 respondents were very uncomfortable and only 12 people felt comfortable riding in this scenario. When a separated bikeway was introduced to the scenario, only 18 people felt the condition was still very uncomfortable and 231 reported this would be very comfortable.

When asked about the design of separated bikeways, responses were largely in favor of one-way separation (48%) over combining the bikeway for two-way travel (21%). The remainder indicated no preference.

The survey also presented the following four types of separation design options and asked respondents to pick the option that would make them feel most comfortable riding in that facility.

Option A) Paint and Flexible Posts

Sixteen percent (52 responses) indicated a preference for paint and flexible posts as the most comfortable Class IV Bikeway design.

Option B) Parked Vehicles

Four percent (12 responses) indicated a preference for using parked cars as a barrier as the most comfortable Class IV Bikeway design.

Option C) Inflexible plantings, posts, or raised curb

Fifty-six percent (174 responses) indicated a preference for inflexible plantings, posts, or raised curb as the most comfortable Class IV Bikeway design.

Option D) Grade separation

Twenty-four percent (75 responses) indicated a preference for grade separation as the most comfortable Class IV Bikeway design.

When asked about the location for installing Class IV facilities, over fifty percent of respondents agreed on three priorities:

- Streets with a high number of bicycle collisions (58.8%)
- Streets that connect to schools (54.3%)
- Streets that connect to trails (51.8%)

This information aligned with Steering Committee input and factored heavily in the selection of evaluation criteria.

Public Workshop

A public workshop was held on December 6, 2016 at Hoover High School to share information about the project and gather input from interested community members on a draft of the priority corridors. Thirty-two residents from 16 different zip codes in Fresno and Clovis attended the workshop.

Participants were invited to make comments on maps of existing conditions, indicating opportunities or challenges for separated bikeways in the region. Comment cards were also provided where attendees circled their highest priority corridor of the six presented at the workshop.

Eleven of the 32 comment cards favored First Street, and the remainder were split among the other five corridors. Residents also provided input on other corridors for consideration, preference for different separation designs, and priority destinations. Additional corridors were added to the analysis following input received from this workshop.

Workshop participants filled out comment cards and discussed potential corridors with the project team

Site Visit

Members of the Steering Committee met in early December 2016 to review the feasibility for certain priority corridors. The group traveled to several priority corridors to observe traffic and behavior along with the built environment to inform evaluation processes.

Steering Committee members visited priority corridors to observe conditions

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Chapter 6. Evaluation

Goals & Criteria

Separated bikeways are intended to integrate with existing and proposed bicycle networks in the region. Effective route selection requires understanding how these facilities support each city's active transportation goals and the criteria that will prioritize corridors that have the greatest impact in reaching those goals.

City of Clovis

On October 17, 2016 the City of Clovis adopted an Active Transportation Plan. The Plan is intended to help the City achieve the following three goals:

- Increase the share of residents who use walking and bicycling to get to work, school, shopping, and other activities.
- Reduce the number of collisions within the city involving pedestrians and bicyclists.
- Close gaps within the bicycle and pedestrian networks.

The Plan produced recommendations for new Class I shared-use paths, Class II bike lanes, and Class III bike routes in Clovis and suggested two locations where Class IV separated bikeways may be suitable (Alluvial Avenue west of Fowler Avenue and Barstow Avenue west of Clovis Avenue). In addition, the Active Transportation Plan listed several criteria that may be helpful in evaluating the applicability of installing Class IV bikeways:

- Traffic speed
- Traffic volume
- Large truck volume
- Number of traffic lanes
- Access control and intersection spacing
- Bicycle crash history
- Bicycle volume
- Pedestrian volume
- Bus stop
- Loading zone
- Parking
- Accessible parking

Based on the recommendations of this study, the City may choose to add Class IV separated bikeways to its proposed bikeway network map in future updates.

City of Fresno

Concurrent with development of this feasibility study, the City of Fresno adopted its Active Transportation Plan in March 2017. Similar to Clovis, the City of Fresno has established the following goals as part of the Plan:

- Equitably improve the safety and perceived safety of walking and bicycling in Fresno.
- Increase walking and bicycling trips in Fresno by creating user-friendly facilities.
- Improve the geographic equity of access to walking and bicycling facilities in Fresno.
- Fill key gaps in Fresno's walking and bicycling networks.

Fresno has evaluated and recommended 21 miles of Class IV separated bikeways on local streets through various planning efforts. Like Clovis, the City of Fresno leaves open the inclusion of additional Class IV separated bikeways to its proposed bikeway network map in future plan updates based on the recommendations in this study.

Regional Goals & Criteria

To facilitate a regional planning process, the Fresno Council of Governments convened a Project Development Team that included representatives from the following organizations and agencies:

- Bicycle and Pedestrian Advisory Committee
- California State University, Fresno
- Caltrans
- City of Clovis
- City of Fresno
- Fresno Council of Governments
- Fresno County
- Fresno County Bicycle Coalition
- Fresno Cycling Club
- Granville Homes

Over the course of several roundtable discussions, team members clearly expressed an interest in locating Class IV separated bikeways in areas that would help create a connected bicycling network and link people to logical destinations. Finding ways to build on the region's growing Class I shared-use path network to create safe and enjoyable facilities that appealed to all ages and abilities emerged as a consensus goal for the study.

The group also discussed the relative value of analyzing criteria such as corridors with excess roadway space, traffic volumes, proximity to major destinations, integration with transit or other trails, safety, street classification, parking/loading, ease of construction and maintenance, and cost to help prioritize locations.

Based on each City's active transportation goals, direction from the Project Development Team, and valuable public input, this study sets out to identify corridors that meet the following four (4) goals:

A) Mobility

Creating the type of facility that appeals to all ages and abilities so that bicycling is viewed as a viable mode of transportation by more people.

B) Connectivity

Providing logical and seamless connections in the bicycle network so that residents and visitors can directly reach major destinations.

C) Safety

Reducing the risk of serious injury by providing separated bikeways in historically high collision and high risk areas.

D) Feasibility

Identifying corridors and design solutions that can lead to swift implementation and low-cost maintenance.

The next section will detail the process for selecting and prioritizing routes that meet these goals.

Evaluation Process

This section outlines the process used to identify strategic corridors and prioritize route segments.

Step 1: Existing Conditions Analysis

Early phases of this feasibility study evaluated opportunities and constraints for separated bikeways by analyzing existing conditions with a particular focus on:

- Area Demographics
- Activity Generators (destinations)
- Existing Bikeway Network
- Collisions

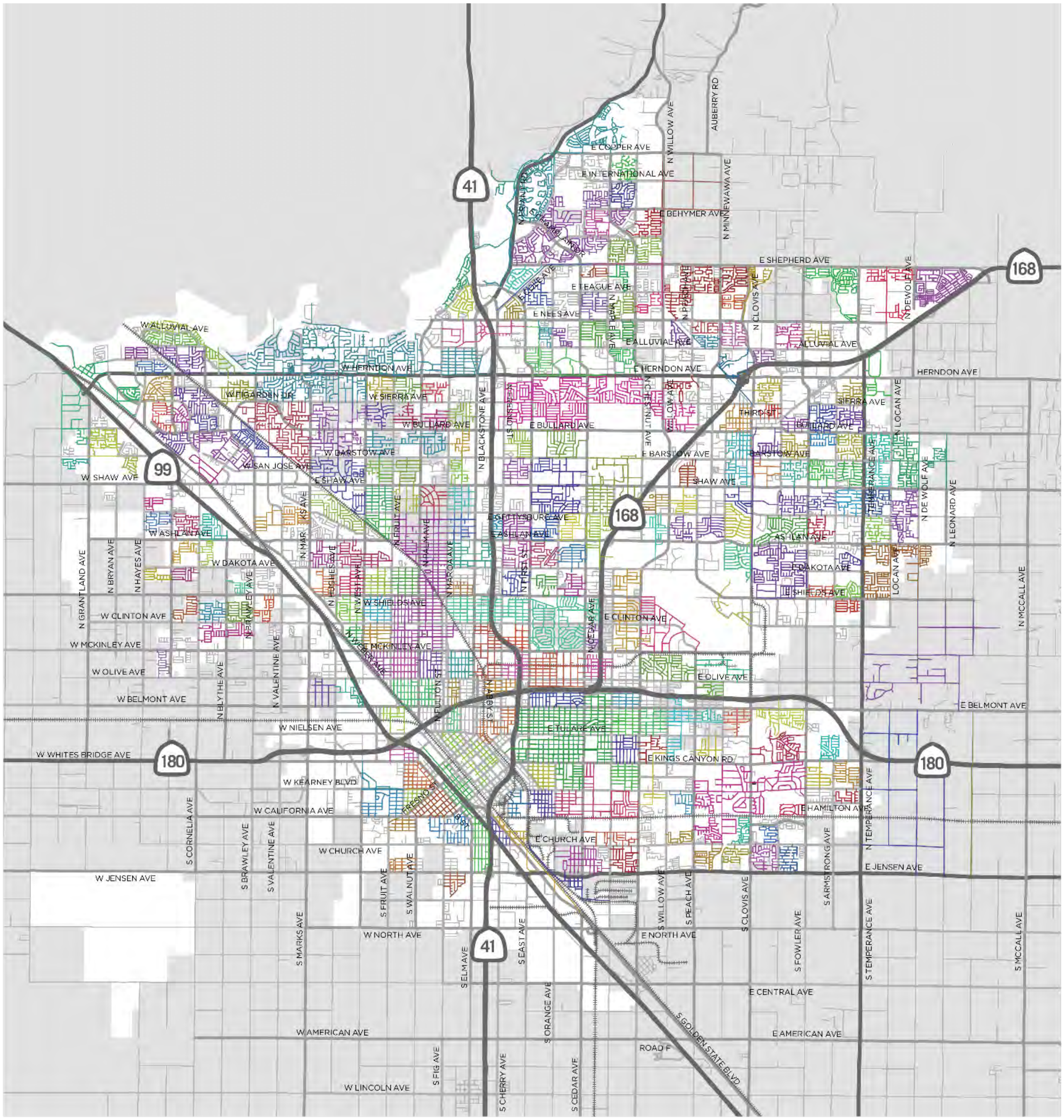
This research was coupled with additional analysis to better understand potential barriers to bicycling mobility.

Level of Traffic Stress Analysis

The Fresno-Clovis area already has many neighborhoods with small, low-stress streets where "casual and less confident" cyclists can ride safely and comfortably. These neighborhoods, however, are often separated by high-stress connector and arterial streets, making it difficult for cyclists to traverse from one neighborhood to the next. Class IV bikeways present an opportunity to reduce bicyclist stress along these larger roadways and provide connectivity between low-stress neighborhoods. The stress-based connectivity analysis classified all surface roadways along a three-point scale. Local streets were considered low-stress roadways. Collectors with bicycle lanes (Class II facilities) were considered medium-stress roadways. Arterials, even with standard bicycle lanes, were considered high-stress roadways. Intersections inherited the greatest stress of their adjoining roadways. However, intersections with traffic signals were always considered low stress because they would provide a window for crossing heavy traffic.

Based on connectivity between low-stress roadways and intersections we identified low-stress neighborhoods: areas that a bicyclist could access without ever traversing a medium- or high-stress area.

From this analysis, corridors were identified that could thread Class IV bikeways between disconnected low-stress neighborhoods. A map of low stress connectivity "islands" is shown in Figure 6-1.



LOW STRESS CONNECTIVITY

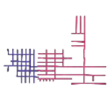
FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced August 2016.

0 1 2 3 4 MILES

N

Colored areas are internally-connected by low stress streets and intersections.



Areas with different colors are disconnected from one another.

Figure 6-1: Level of Traffic Stress Analysis

Step 2: Selection of Corridors

After reviewing the region's opportunities and constraints based on existing conditions, the Project Development Team proposed the following list of corridors that had the highest potential for helping meet the goals of the study (see Figure 6-2):

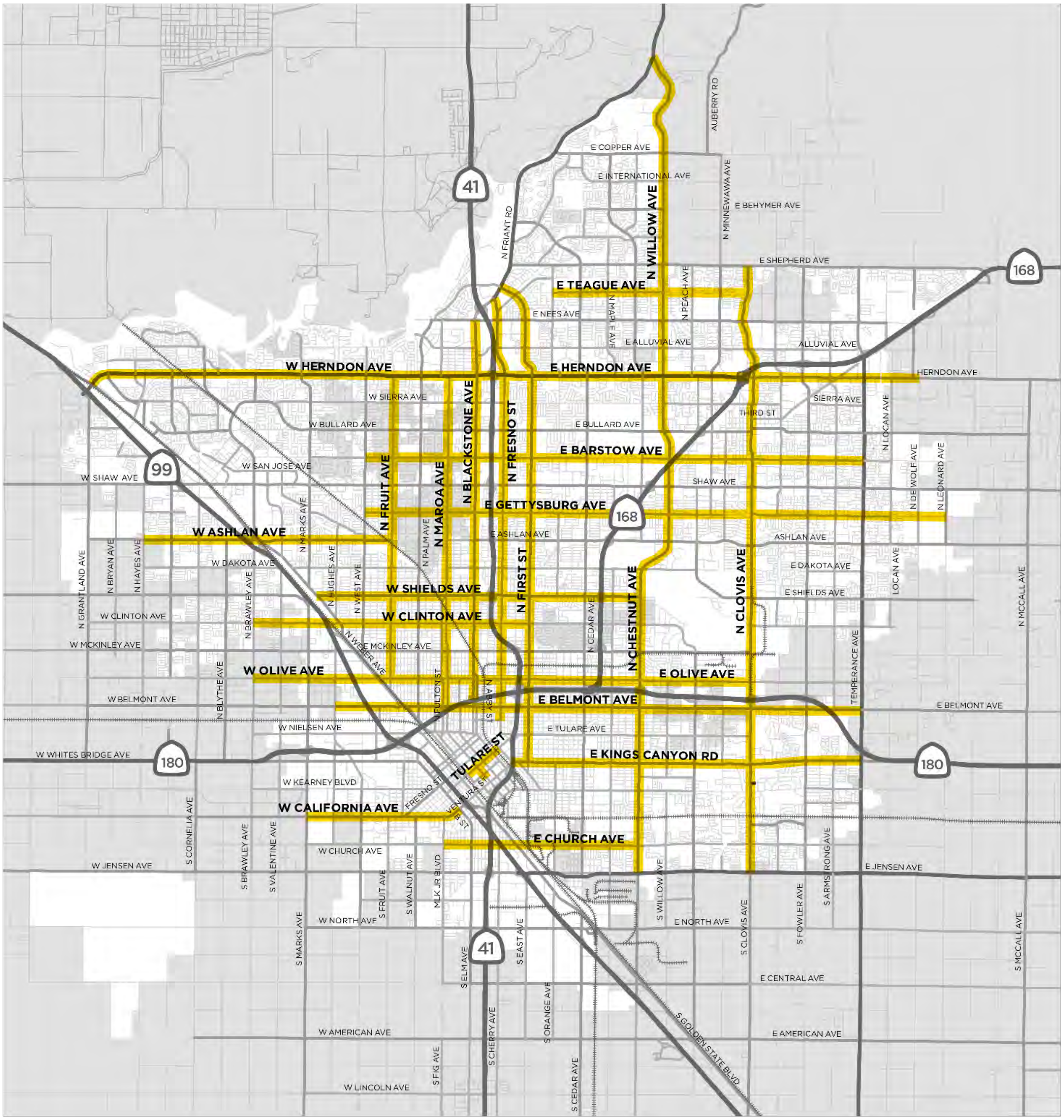
North-South Corridors

- Fruit Avenue (Herndon Avenue to Olive Avenue)
- Blackstone Avenue (Nees Avenue to State Route 180)
- Fresno Street (Friant Road to Divisidero Street)
- First Street (Friant Road to Kings Canyon Road-Ventura Avenue)
- Willow Avenue-Chestnut Avenue (Friant Road to Jensen Avenue)
- Clovis Avenue (Shepherd Avenue to Jensen Avenue)
- Maroa Avenue (Herndon Avenue to Shields Avenue)

East-West Corridors

- Teague Avenue (Millbrook Avenue to Clovis Avenue)
- Herndon Avenue (Golden State Boulevard to De Wolf Avenue)
- Barstow Avenue (West Avenue to Temperance Avenue)
- Gettysburg Avenue (West Avenue to De Wolf Avenue)
- Ashlan Avenue (Hayes Avenue to Fruit Avenue)
- Shields Avenue (Weber Avenue to Chestnut Avenue)
- Clinton Avenue (Brawley Avenue to First Street)
- Olive Avenue (Brawley Avenue to Clovis Avenue)
- Ventura Avenue-Kings Canyon Road (State Route 41 to Temperance Avenue)
- Church Avenue (MLK Jr Boulevard to Chestnut Avenue)
- California Avenue (Marks Avenue to B Street)
- Belmont Avenue (Hughes Avenue to Temperance Avenue)

A short section of Tulare between H and R Streets and Van Ness between Tulare and Mono Streets in downtown Fresno have been identified in previous planning efforts as proposed Class IV facilities in Downtown Fresno and were added to this analysis.



POTENTIAL CLASS IV CORRIDORS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced March 2017

0 1 2 3 4 MILES

N

Potential Corridor

alta

PLANNING + DESIGN

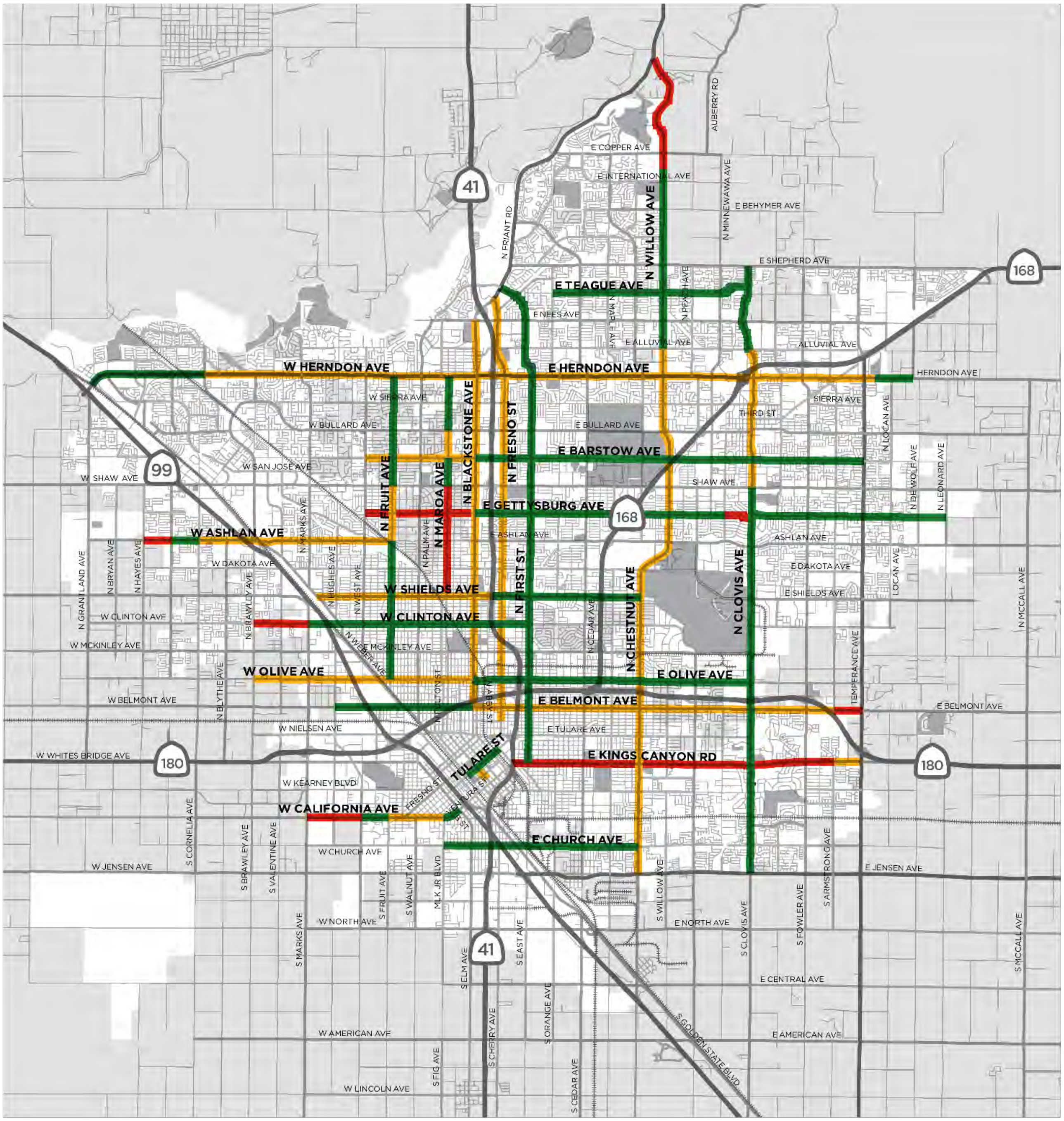
DRAFT

Figure 6-2: Potential Corridors

Step 3: Feasibility Analysis

While each corridor may serve a strategic purpose (e.g. closing a gap in the bicycle network, connecting dense residential areas to major destinations, or providing enhanced safety on a high-collision corridor), the actual feasibility of installing Class IV facilities requires a closer examination of roadway characteristics. The goal of this step is to discover the corridors that serve both a strategic purpose and are suitable for Class IV bikeways. Corridors that would require significant and costly reconstruction or require the elimination of travel lanes and contribute to significant congestion may be less suitable.

Each corridor was evaluated based on street width, lane configuration, traffic volume, parking, and vehicle capacity needs. Lengthy corridors were broken into route segments based on feasibility scoring of low, medium, or high potential for Class IV separated bikeways (see Figure 6-3 and Table 6-1).



FEASIBILITY OF POTENTIAL CLASS IV SEGMENTS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced March 2017

0 1 MILE

N

Feasibility Ranking

- Most Feasible
- Moderatly Feasible
- Least Feasible

DRAFT

Figure 6-3: Corridor Feasibility Analysis

Table 6-1: Feasibility Analysis

Corridor	Segment	Cross Section (ft)	Lanes	Average Daily Traffic	Feasibility	Notes
Fruit Avenue	Herndon to Shaw	55-65	4 (with turn lanes at intersections)	8,000-11,000	High	Convert to 3 lanes and prohibit parking when necessary
	Shaw to Ashlan	35-50	2	7,000-8,000	Medium	Includes some unimproved frontages
	Ashlan to Olive	58-62	3 (with bike lanes)	8,000-9,000	High	Convert to 3 lanes and prohibit parking
Blackstone Avenue	Nees to Hedges	90-95	6 (with raised median, turn pockets)	33,000-42,000	Medium	May require removal of on-street parking or turn lanes
	Hedges to SR 180	50	3 (one way SB)	10,000	Medium	Remove parking on one side
Fresno Street	Friant to Santa Ana	60-85	4-5 (medians/ turn pockets)	26,400	Medium	Eliminate parking and/or narrow lanes
	Santa Ana to McKinley	50-60	4	13,200	Medium	Eliminate parking and/or road diet
	McKinley to Floradora	75	5 (center turn lane)	16,000	Medium	May require road diet
	Floradora to McKenzie	45-60	4	10,800	Medium	Convert to 3 lanes
First Street	Friant to Tulare	70-80	4 (with raised median, turn pockets, frontage roads, bike lanes)	13,000-18,000	High	Narrow lanes or remove 1 lane each way
	Tulare to Ventura	60-64	5	13,000-18,000	High	Narrow lanes or remove 1 lane each way
Willow and Chestnut Avenues	Friant to Sports Fields (N of Clovis High)	35	2	10,000	Low	Would require widening
	Sports Fields to Shepherd	75	4-6 (unbalanced)	7,000-11,000	High	Would require significant work given unbalanced corridor
	Shepherd to Alluvial	105	4 (with raised median, turn pockets, unbalanced in some areas)	18,000-20,000	High	Would require work given unbalanced segments, but has wide shoulders
	Alluvial to Belmont	85-100	4-6 (with raised medians, turn pockets)	18,000-23,000	Medium	Would require work, but has wide shoulders in some areas
	Belmont to Jensen	75	4	23,000-25,000	Medium	Narrow lanes and remove parking

Corridor	Segment	Cross Section (ft)	Lanes	Average Daily Traffic	Feasibility	Notes
Clovis Avenue	Shepherd to Alluvial	78	4 (with raised median, turn pockets)	3,000	High	May be able to maintain 5-lane configuration
	Alluvial to Sierra	62	5	9,000	Medium	West side undeveloped, east side has wide lane
	Sierra to 8th Street	64	4	19,300	High/Med	Road diet to 3 lanes
	8th Street to Shaw	60-62	5 (with center turn lane and rail trail)	22,900	Moderate	
	Shaw to Dakota	85	6 (with raised median, turn pockets, and rail trail)	20,000-30,000	High	Remove 1 lane in each direction
	Dakota to Kings Canyon	85	6 (with raised median, turn pockets)	20,000-30,000	High	Remove 1 lane in each direction
	Kings Canyon to California	85	5 (no bike lanes, some unimproved segments)	20,000-30,000	High	Narrow lanes and make some frontage improvements
	California to Jensen	85	5 (with raised median, turn pockets, bike lanes)	20,000-30,000	High	Narrow lanes
Teague Avenue	Millbrook to Chestnut	60	3 (with center turn lane, or 4 lanes)	8,000	High	Remove on-street parking and/or narrow lanes
	Chestnut to Willow	60-70	5 (with center turn lane)	9,000	High	Remove 1 lane each direction
	Willow to Clovis	55	3 (with center turn lane)	7,000	High	Remove on-street parking and/or narrow lanes
Herndon Avenue	Golden State to Milburn	85	4-6 (with raised median, turn pockets)	10,000-16,000	High	Remove 1 lane in each direction, however this capacity may be needed with future development
	Milburn to Conventry	95	6 (with raised median, turn pockets)	35,000-52,000	Medium	Narrow existing lanes and/or use unpaved right of way
	Coventry to DeWolf	47	3 (with center turn lane)	9,000-11,000	High	Wide shoulders

Corridor	Segment	Cross Section (ft)	Lanes	Average Daily Traffic	Feasibility	Notes
Barstow Avenue	West to Blackstone	40-58	2-3 (with and without center turn lane)	6,000-11,000	Medium	Eliminate center turn lane or remove on-street parking
	Blackstone to Jackson	75	5 (with center turn lane)	21,800	High/Med	Narrow lanes and eliminate on-street parking
	Jackson to Willow	35-50	2	6,000-7,000	High	Wide shoulders
	Willow to Sunnyside	50-60	3 (with center turn lane, or 4 lanes)	13,000	High	
	Sunnyside to Temperance	50-60	4	13,000	High	Road diet to 3 lanes
Gettysburg Avenue	West to Blackstone	30-38	2	3,000-4,000	Low	Not feasible within current cross section
	Blackstone to Winery	60-64	3-4	5,100	High	Convert to 3 lanes
	Winery to Minnewawa	60-64	4	5,100	High	Convert to 3 lanes
	Minnewawa to Clovis	50-60 (34 paved)	2	Not available	Low	Canal creates connectivity barrier to east
	Clovis to Leonard	50-60	3 (with center turn lane)	7,600	High	
Ashlan Avenue	Hayes to Polk	22	2	2,000-3,000	Low	Not feasible within current cross section
	Polk to Cornelia	48	3 (with center turn lane)	6,000-7,000	High	
	Cornelia to Fruit	75	4 (with raised median, turn pockets)	26,000-31,000	Medium	Narrow lanes and eliminate on-street parking
Shields Avenue	Weber to SR 41	60-75	4 (some with raised median, turn pockets)	25,000	Medium	
	SR 41 to Chestnut Ave	60-75	4 (some with raised median, turn pockets)	14,000	High	Road diet to 3 lanes
Clinton Avenue	Brawley to Marks	65	2, 3, and 5 (with center turn lane)	15,000-16,000	Low	Several unimproved sections make conversion difficult
	Marks to First	60	5 (divided and undivided)	25,000	High/Med	Feasible if road diet to 3 lanes is possible
Olive Avenue	Brawley to Blackstone	35-60	2-3	5,000-8,000	Medium	Tower business district may be challenging
	Blackstone to Clovis	60	4 (with center turn lane or raised median with turn pockets)	11,000-14,000	High	Road diet to 3 lanes

Corridor	Segment	Cross Section (ft)	Lanes	Average Daily Traffic	Feasibility	Notes
Ventura Avenue-Kings Canyon Road	SR 41 to Armstrong	80	5 (with center turn lane)	20,000-21,000	TBD	Fresno BRT currently under construction
	Armstrong to Temperance	40	2	10,300	Medium	Undeveloped area presents uncertainty
Church Avenue	MLK Jr. to Railroad	60	3 (with center turn lane) or 2 (with raised median, turn pockets)	5,000-6,000	High	Use wide shoulders, or remove on-street parking
	Railroad to Chestnut	55-65	2-4	9,000-10,000	High	Use wide shoulders, or remove on-street parking
Tulare Street	R Street to H Street	50-75	4 (with raised median, turn pockets)	6-10,000	High	Remove 1 lane, or remove on-street parking
Van Ness Avenue	Tulare to Mono	50-60	3-4	6,000	Medium	Eliminate center turn lane or remove on-street parking
Maroa Avenue	Herndon to Bullard	64	4	4,000	High	Road diet to 3 lanes
	Bullard to Barstow	64	3 (with bike lanes)	4,000	Medium	Remove on-street parking on one side
	Barstow to Shaw	64	4	4,000-5,000	High	Road diet to 3 lanes
	Shaw to Shields	24-30	2	5,000-6,000	Low	
California Avenue	Marks to West	32	2	1,000	Low	
	West to Fruit	85	5 (with bike lanes)	1,000	High	May require removing some on-street parking
	Fruit to MLK Jr	48-54	3 (with bike lanes)	1,000	High/Med	Narrow lanes
	MLK Jr to B	85	5 (with bike lanes)	1,000	High	May require removing some on-street parking
Belmont Avenue	Hughes to Weber	50	4	4,000-5,000	High	Road diet to 3 lanes
	Weber to Blackstone	64	4	5,000-6,000	High	Road diet to 3 lanes
	Blackstone to Clovis	78	5	6,000-8,000	High/Med	Remove on-street parking
	Clovis to Armstrong	64	4 (unbalanced 1-1-2)	3,000	High/Med	Road diet to 3 lanes
	Armstrong to Temperance	30	2	2,000-3,000	Low	

Step 4: Prioritization Process

Following the feasibility screening in step 3, each segment was evaluated on its ability to address safety, connections, and mobility.

Safety

Each route was evaluated based on the number of bicycle collisions that occurred within 100 feet of the route over the past 10 years. Routes were scored low if they had two or fewer collisions, medium if they had three to 10 collisions, and high if they had 11 or more collisions.

Connections

Each route was evaluated based on its ability to *directly* connect to activity generators (major retail areas, employment centers, or institutional destinations), schools, and existing/proposed Class I shared-use paths.

Destinations/Activity Generators

Routes that do not connect to major destinations/activity generators scored low. Routes that connect to one or two activity centers scored medium. Routes that connect three or more scored high.

Schools

Routes that do not connect to schools scored low. Routes that connect to at least one school scored medium. Routes that connect to two or more schools scored high.

Shared-Use Paths

Routes that connect to one or fewer existing or proposed Class I shared-use paths scored low. Routes that connect two shared-use paths scored medium. Routes that connect three or more shared-use paths scored high.

Mobility

Each route was evaluated on its ability to expand low stress bicycle networks. Separated bikeways are low stress facilities that invite all ages and abilities. For interested but concerned potential bicyclists, separated bikeways provide the opportunity to go beyond low-volume, low-speed residential areas and cross or travel along busy arterials or other barriers. This criterion was scored based on the number of connections each route could make between isolated low stress bicycle networks. Routes that connect five or fewer networks scored low. Routes that connect 6 to 14 networks scored medium. Routes that connect 15 or more scored high.

Step 5: Prioritization Assessment

Based on these scores, segments were prioritized in the following five categories:

High Priority

These projects present few barriers to implementation and will help the region address at least two strategic goals. Furthermore, these segments do not duplicate an existing or proposed Class I facility and provide geographic balance for users across the region.

Long Term

These projects may present a challenge for implementing Class IV facilities, such as the removal of parking or travel lanes, however the project would help the region address two or more strategic goals.

Opportunity Projects

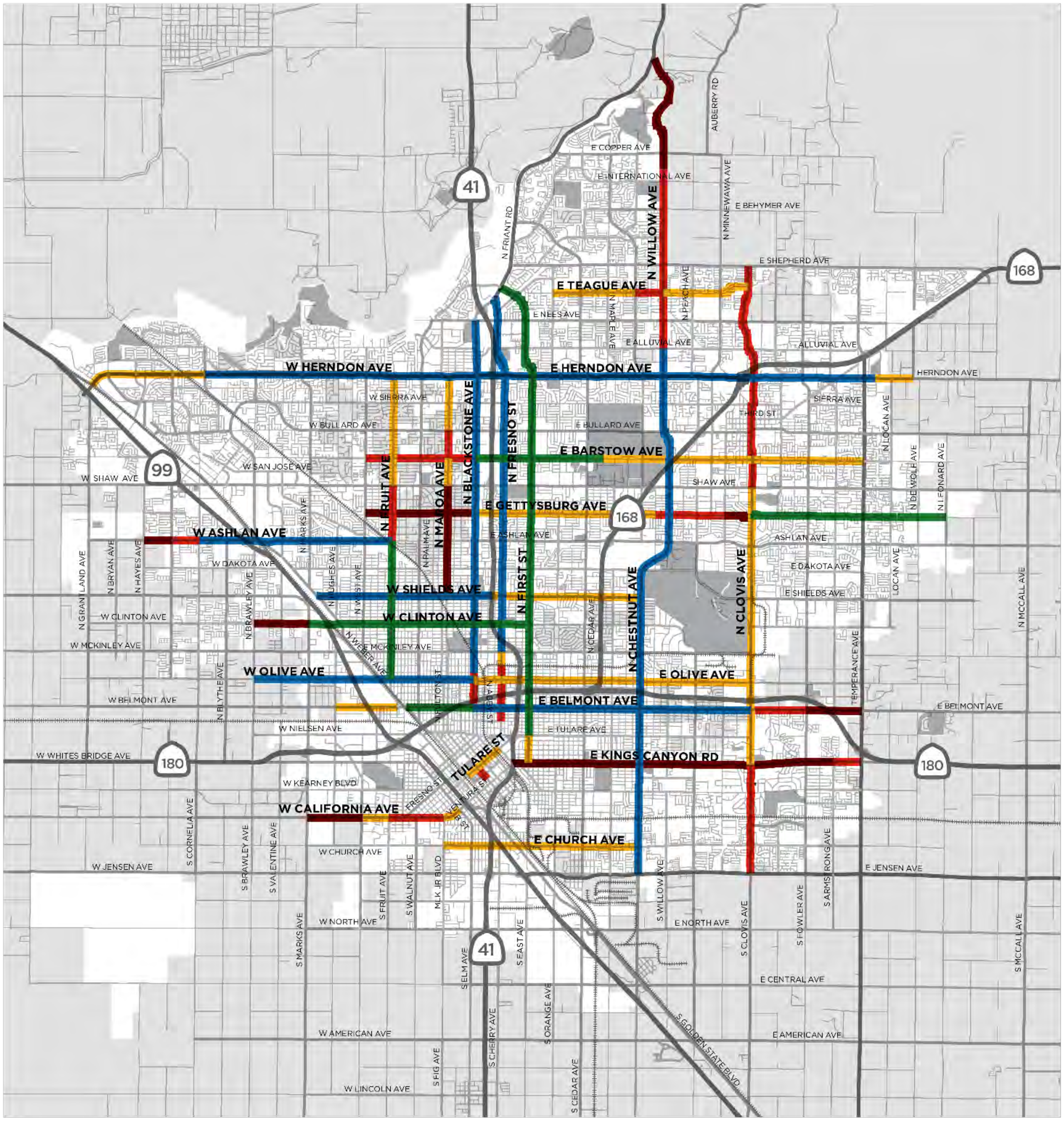
These projects present few barriers to implementation, however only address one or two strategic goals. They also may be adjacent to redundant existing or proposed Class I facilities.

Low Priority

These projects may be easy to implement but will not help the region meet any strategic goals or may be challenging to implement and only address one or fewer strategic goals.

Infeasible

These projects have major barriers to implementation and are not recommended for consideration for Class IV facilities.



PRIORITY OF POTENTIAL CLASS IV SEGMENTS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced March 2017

Priority Levels

- High Priority
- Long Term
- Opportunity Projects
- Low Priority
- Infeasible

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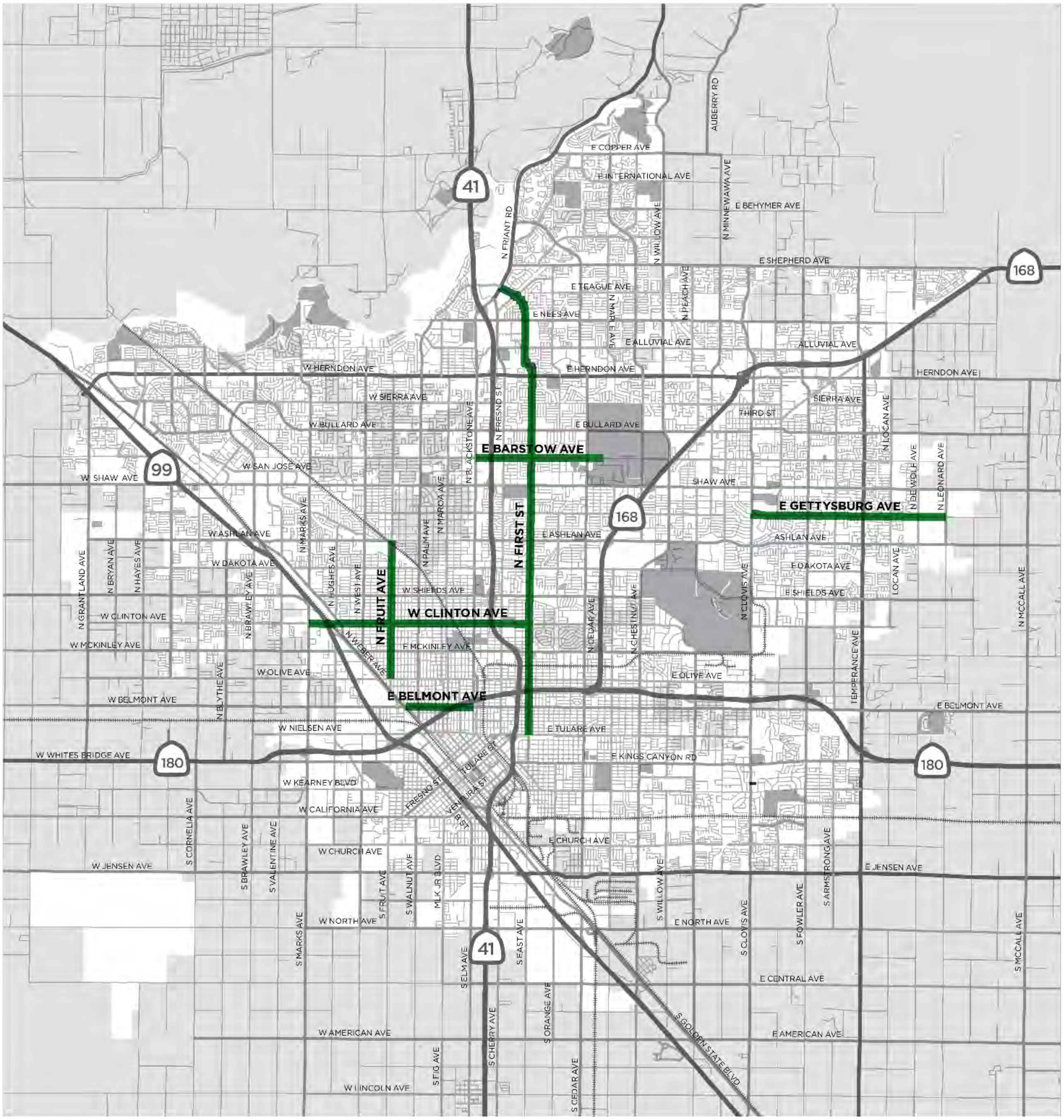
Figure 6-4: Assessment Map

The following six high priority routes are listed below for further consideration as early implementation projects for Fresno County, and the Cities of Fresno and Clovis:

- **First Street** (Audobon Drive and Friant Road to Tulare Avenue)
- **Belmont Avenue** (Weber Avenue to Blackstone Avenue)
- **Barstow Avenue** (Blackstone Avenue to Jackson Avenue)
- **Gettysburg Avenue** (Clovis Avenue to Leonard Avenue)
- **Fruit Avenue** (Ashlan Avenue to Olive Avenue)
- **Clinton Avenue** (Marks Avenue to First Street)

The raw scores for each route can be found in Table 6-2, and high priority segments are shown in Figure 6-5.



HIGH PRIORITY CLASS IV SEGMENTS

FRESNO-CLOVIS METRO CLASS IV FEASIBILITY STUDY

Map produced March 2017

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High Priority Segments

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Figure 6-5: High Priority Corridors

Table 6-2: Separated Bikeway Route Prioritization Matrix

Corridor	Segment	Safety	Desti-nations	Schools	Trails	Mobility	Feasibility
Fruit Avenue	Herndon to Shaw	Medium	Low	Medium	Low	High	High
	Shaw to Ashlan	Low	Low	Medium	Low	Medium	Medium
	Ashlan to Olive	Medium	Low	High	Medium	High	High
Blackstone Avenue	Nees to Hedges	High	High	Medium	High	High	Medium
	Hedges to SR 180	Medium	Low	Medium	Low	High	Medium
Fresno Street	Friant to Santa Ana	High	High	Low	High	High	Medium
	Santa Ana to McKinley	High	High	High	Medium	High	Medium
	McKinley to Floradora	Medium	Low	Medium	Low	Low	Medium
	Floradora to McKenzie	High	Low	Medium	Low	Medium	Medium
First Street	Friant to Tulare	High	High	High	High	High	High
	Tulare to Ventura	High	Low	Low	Low	Low	High
Willow Avenue-Chestnut Avenue	Friant to Sports Fields	Medium	Low	Low	Medium	Low	Low
	Sports Fields to Shepherd	Low	Low	Low	Low	Medium	High
	Shepherd to Alluvial	Medium	Low	Low	Medium	Medium	High
	Alluvial to Belmont	High	High	High	High	High	Medium
	Belmont to Jensen	High	Medium	High	Medium	High	Medium
Clovis Avenue	Shepherd to Alluvial	Medium	Low	Low	Medium	Medium	High
	Alluvial to Sierra	Medium	Low	Low	Medium	Medium	Medium
	Sierra to 8th Street	Medium	Low	Medium	Medium	Medium	Medium
	8th Street to Shaw	Medium	Low	Low	Low	Low	Medium
	Shaw to Dakota	High	Medium	Low	Low	Low	High
	Dakota to Kings Canyon	High	High	Medium	High	Medium	High
	Kings Canyon to California	Medium	Medium	Low	Medium	Low	High
	California to Jensen	Low	Low	Low	Medium	Low	High
Teague Avenue	Millbrook to Chestnut	Low	Low	High	Low	High	High

Corridor	Segment	Safety	Desti-nations	Schools	Trails	Mobility	Feasibility
	Chestnut to Willow	Low	Low	Low	Low	Medium	High
	Willow to Clovis	Medium	Low	High	Medium	Low	High
Herndon Avenue	Golden State to Milburn	Medium	Low	Low	High	Low	High
	Milburn to Conventry	High	High	High	High	High	Medium
	Coventry to DeWolf	Low	High	Low	Low	Low	High
Barstow Avenue	West to Blackstone	Medium	Low	Medium	Low	Medium	Medium
	Blackstone to Jackson	High	High	Low	Medium	Medium	High
	Jackson to Willow	Low	Medium	Low	High	Low	High
	Willow to Sunnyside	High	Medium	Medium	Medium	Medium	High
	Sunnyside to Temperance	Medium	Medium	Low	Medium	High	High
Gettysburg Avenue	West to Blackstone	Medium	Low	Low	Medium	Medium	Low
	Blackstone to Winery	Medium	Low	High	Low	High	High
	Winery to Minnewawa	Medium	Low	Medium	Low	Medium	High
	Minnewawa to Clovis	Low	Low	Low	Low	Low	Low
	Clovis to Leonard	High	Low	High	Medium	High	High
Ashlan Avenue	Hayes to Polk	Low	Low	Low	Low	Low	Low
	Polk to Cornelia	Medium	Low	Low	Low	Low	High
	Cornelia to Fruit	High	Low	High	High	High	Medium
Shields Avenue	Weber to SR 41	High	Medium	High	Medium	High	Medium
	SR 41 to Chestnut Ave	High	Medium	Medium	Medium	Medium	High
Clinton Avenue	Brawley to Marks	Low	Low	Low	Low	Low	Low
	Marks to First	High	Medium	Medium	Low	High	High
Olive Avenue	Brawley to Blackstone	High	Low	Medium	Low	High	Medium
	Blackstone to Clovis	High	Low	Medium	High	High	High

Corridor	Segment	Safety	Desti-nations	Schools	Trails	Mobility	Feasibility
Ventura Avenue-Kings Canyon Road	SR 41 to Armstrong	High	High	Medium	High	High	Low
	Armstrong to Temperance	Low	Low	Low	Medium	Low	Medium
Church Avenue	MLK Jr. to Railroad	Medium	Low	Medium	Low	Medium	High
	Railroad to Chestnut	Medium	Low	Low	Low	High	High
Tulare Street	R Street to H Street	Medium	High	Medium	Medium	Low	High
Van Ness Avenue	Tulare to Mono	Low	Medium	Low	Low	Low	Medium
Maroa Avenue	Herndon to Bullard	Low	Low	Low	Low	Medium	High
	Bullard to Barstow	Medium	Low	High	Low	Low	Medium
	Barstow to Shaw	Medium	Low	Low	Low	Medium	High
	Shaw to Shields	Medium	Low	Low	Medium	Medium	Low
California Avenue	Marks to West	Low	Low	Low	Low	Low	Low
	West to Fruit	Low	Low	Low	Low	Low	High
	Fruit to MLK Jr	Medium	Low	Low	Low	Low	Medium
	MLK Jr to B	Low	Low	Medium	Low	Low	High
Belmont Avenue	Hughes to Weber	Medium	Low	Low	Low	Low	High
	Weber to Blackstone	High	Low	Low	Medium	High	High
	Blackstone to Clovis	High	Low	High	Medium	High	Medium
	Clovis to Armstrong	Low	Low	Low	Medium	Low	Medium
	Armstrong to Temperance	Low	Low	Low	Low	Low	Low

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Chapter 7. Cost Estimates

Construction

Construction cost estimates are provided in Table 7-1 for three types of separated bikeways on four different roadway configurations. Cost estimates are per linear mile.

The different types of separation include:

- Bollards: Painted buffer with flexible posts
- Curb Stops: Painted buffer with bolt-down concrete bars
- Raised Curb: Narrow median

Estimates include signs and intersection treatments, in addition to construction overhead costs and contingencies.

The four roadway configurations include:

- 3 lanes, where separated bikeways are accommodated by removing on-street parking. These are typically 50 feet wide.
- 4-to-3 road diet, where one vehicle lane in each direction is reallocated to create a two-way turn lane and separated bikeways. These are typically 60 feet wide.
- 5 lanes, where separated bikeways are accommodated by removing on-street parking. These are typically 64 feet wide.
- 7-to-5 road diet, where one vehicle lane in each direction is reallocated to create separated bikeways. These are typically 74 to 85 feet wide.

More detailed cost estimates for these roadway types and design configurations are provided in Appendix B.

While this feasibility study is focused on evaluating opportunities for Class IV separated bikeways, in some locations it may not be feasible to provide this separation. Buffered Class II bike lanes may be an alternative to preserve connectivity, and are estimated to cost between $180,000 and $345,000 per mile depending on the need to remove and restripe bicycle and/or vehicle travel lanes. The most cost effective time to install on-street bikeways is when the roadway is being resurfaced.

Table 7-1: Class IV Construction Cost Estimates

Roadway Type	Estimated Cost per Mile		
	Bollards	Curb Stops	Raised Curb
3 lanes with parking removal	$308,405	$421,301	$685,901
4-to-3 lane road diet	$301,349	$414,245	$678,845
5 lanes with parking removal	$386,885	$499,781	$764,381
7-to-5 lane road diet	$400,997	$513,893	$778,493

Maintenance

Maintaining separated bikeways shares many similarities with maintenance of on-street bicycle lanes.

All separated bikeways must be swept regularly to keep them free of debris, and the pavement surface must be repaired or refreshed to ensure a smooth surface for bicyclists. Separated bikeways should be incorporated into the city's routine street sweeping schedule, and swept no less than once per month. More frequent sweeping may be needed on priority or high-volume streets, or where street trees or yard waste piles create more debris.

If the bikeway is wide enough, it can be swept using the City's existing standard street sweeper. Narrower bikeways may require new sweeping equipment. A wide range of options and models are available, and can also be used to sweep off-street paths or sidewalks if necessary. These specialized sweepers cost between $80,000 and $200,000 depending on the model.

Maintenance of the physical features of separated bikeways will include filling potholes and making other minor pavement repairs, replacing signs, refreshing pavement markings, and conducting periodic pavement overlays. Some of these actions should be performed on a routine schedule, while others may require action on an as-needed basis if bikeway features are damaged or obscured.

Typical annual cost ranges for these activities are listed in Table 7-2.

Table 7-2: Average Annual Maintenance Costs

Activity	Annual Cost/Mile
Sweeping (existing equipment)	$1,900 - $4,000
Fill potholes	$500
Replace signs	$50-$100
Refresh pavement markings	$100-$150
Replace flexible bollards (assuming 25% of bollards replaced annually)	$6,500
Pavement repairs and overlay (distributes cost of overlay annually)	$5,500 - $8,000
TOTAL	$14,500 - $19,200

Chapter 8. Conclusions

This study evaluated potential Class IV separated bikeway routes on corridors strategic to developing a comfortable and connected active transportation network. The region has made a significant commitment to developing shared-use paths as the primary connections for people looking to comfortably bicycle to meet their recreation, transportation, and health needs. Companion on-road facilities in the form of Class IV separated bikeways are necessary to help existing and prospective bicyclists connect from other bikeways to access their destinations.

The Fresno-Clovis metropolitan area benefits from a largely gridded arterial and connector street system, which provides multiple travel options for dispersing traffic and keeping congestion minimized. Moderate traffic volumes and wide lanes provide excellent opportunities for making cost-effective modifications to existing streets in order to implement Class IV separated bikeway facilities. The purpose of this study is to help decision-makers understand where these types of facilities could make the greatest impact.

This study started broadly by evaluating which arterial corridors have the highest numbers of bicycle-related collisions and provide direct access to schools, major retail and employment destinations, trails and other neighborhoods. With candidate corridors identified, this study used roadway dimensions, traffic volumes, posted speed, and field assessments to evaluate the ease of retrofitting existing roadways to accommodate Class IV separated bikeway facilities.

With the input of the public and engaged Steering Committee, the following six routes were prioritized as both highly feasible and strategically important. Additional study is recommended to further advance each segment.

High Priority Routes

First Street

This segment starts at Audobon Drive and Friant Road and extends south to First Street and Kings Canyon Road. This corridor would create the central North-South spine in the region's all ages and abilities bikeway network (where people from ages 8 to 80 feel comfortable bicycling). By reducing travel lane widths and expanding current bicycle lanes, Class IV facilities with intermittent buffered Class II facilities can be implemented with minimal disruption to the roadway and without high cost. First Street also scored high in every prioritization category, demonstrating its impact to meet important strategic goals.

Belmont Avenue

This segment starts at Weber Avenue and extends to Blackstone Avenue. This segment helps create a connection in the Southwest part of the region and crosses under SR 180. A reduction from two travel lanes in each direction to one in each direction with a center turn lane creates the opportunity to accommodate Class IV separated bikeways.

Barstow Avenue

This segment starts at Blackstone Avenue and extends to Jackson Avenue. This segment helps connect into the heart of California State University, Fresno and would address a high-collision corridor in the region. Narrowing the travel lanes and eliminating on-street parking would provide space necessary to accommodate a Class IV separated bikeway.

Gettysburg Avenue

This segment extends from Leonard Avenue to Clovis Avenue and would help extend access from residential areas to elementary schools, the Clovis Old Town Trail and Sierra Vista Mall. A parking occupancy study will help determine if unused capacity can be reapportioned to expand existing Class II bike lanes into a Class IV separated bikeway.

Fruit Avenue

This segment extends from Ashlan Avenue to Olive Avenue. This corridor could serve as a companion north-south route to the First Street connection. The segment scored high in its ability to connect to schools as well as link disconnected neighborhoods. A parking occupancy study will help determine if unused capacity can be reapportioned to expand existing Class II bike lanes into Class IV separated bikeways.

Clinton Avenue

This segment extends from Marks Avenue to First Street. A reduction from two travel lanes in each direction to one in each direction with a center turn lane creates the opportunity to accommodate a Class IV separated bikeway.

For further concept ideas and considerations, refer to the Fresno-Clovis Class IV Design Guide.

Appendix A. Plan & Policy Review

This appendix contains a review of adopted local and regional planning and policy documents relevant to this feasibility study.

Goals, policies, and other items that are most relevant to this study have been reproduced in this review in italic text. Items that are less relevant have been omitted for clarity. As a result, pages referenced and policy numbering may be nonconsecutive.

Policy documents included in this review are organized as follows:

Appendix A. Plan & Policy Review A-1

Regional Documents

FresnoCOG Regional Transportation Plan

From a broad perspective, the FresnoCOG Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS) discusses several themes that support investment in bicycling as a mode of transportation: sustainability, health and economic benefits of active transportation, and social equity.

The RTP also notes an extension of the Fresno County Measure C sales tax that was approved by voters in 2006 will allocate nearly $55 million for bicycle improvements in the county.

Chapter 4: Sustainable Communities Strategy

The 2014 RTP/SCS also includes a notable increase in the regional active transportation network for walking and bicycling. Active transportation is an essential part of the Fresno COG transportation system, is low cost, does not emit greenhouse gases, can help reduce roadway congestion, and increases health and the quality of life of residents. This emphasis signifies an important opportunity to advance the goals of SB 375 by increasing non-motorized modes of transportation, thereby expanding access to a variety of land uses and transit, and improving public health and air quality. A total of $94 million is proposed in the 2014 RTP/SCS to fund bike and pedestrian projects. It is estimated that more than 500 (lane) miles of bike lanes and 120 miles of sidewalks will be added by the end of 2040, the horizon year of this 2014 RTP. (page 4-25)

In an effort to improve the health of residents, cities are promoting physical activity, particularly walking and biking, through their general plans, zoning codes, and transportation planning. (page 4-29)

Cities throughout the region are using their planning processes to address the obesity epidemic. Many are including a focus on smart growth principles—developing healthy, vibrant communities where homes, jobs, schools, and places for play are nearby each other and linked *by walking, biking, and transit. The smart growth approach is gaining ground as GHG emission reduction mandates shape transportation and housing planning. Examples of smart growth incorporated into the 2014 RTP/SCS include:*

- *Promote compact, mixed-use and transit-oriented development*
- *Increase walking and biking through street design*
- *Target infrastructure investments on walking, biking, and transit*
- *The selected SCS land use scenario moves the region towards a healthier future by improving the connection between land use and transportation. The result is more walkable communities, increased bicycling, more people using transit, and better access to healthy food. (page 4-29)*

Chapter 5: Actions: Assessing Our Transportation Needs

"Achievement of some ultimate state of multimodal transportation service would be a system in which a traveler could make a "seamless" journey with connections between modes, taking minimum effort and involving little delay…. It will require even stronger commitment to the goals of air quality and the quality of life in this County to make the changes needed to implement the "seamless" multimodal system. It involves people making conscious choices to use alternative transportation modes, and the provision of those alternate systems in a manner which encourages their use. To succeed, those efforts would have to focus on long-term changes:

[…]

- *Facilitating the development of mixed land use districts which promote living, working, shopping and recreation accessible by foot or bicycle, and which are served by centrally located transit routes (the Tower District in Fresno, Clovis' Old Town, and many of the County's small cities serve as examples built more than 40 years ago);*
- *Developing connecting bikeway systems and facilitating and encouraging their use (page 5-6)*

Chapter 6: Policies: Foundations of the Plan

Goals, objectives, and policies are established to direct the courses of action that will provide efficient, integrated multimodal transportation systems to serve the mobility needs of people, including accessible pedestrian and bicycle facilities, and freight, while fostering economic prosperity and development, and minimizing mobile sources of air pollution. (page 6-2)

Non-Motorized goals identified in this chapter include:

- *Maximize bicycling and walking through their recognition and integration as valid and healthy transportation modes in transportation planning activities*
- *Safe, convenient, and continuous routes for bicyclists and pedestrians of all types which interface with and complement a multimodal transportation system*
- *Increased development of the regional bikeways system, related facilities, and pedestrian facilities by maximizing funding opportunities (page 6-6)*

Go Green Fresno County

This initiative is a package of environmental policies and practices that was adopted by the Fresno County Board of Supervisors in 2008.

Commute Green Fresno County is a travel demand management (TDM) program intended to reduce congestion on Fresno County's roads. The goal is to convince participating employees and prospective participants that driving alone is perhaps the least desirable way to get to work, and encourage bicycle commuting, flexible schedules, and telecommuting.

Commute Green Fresno County also encourages employees who are able to do so to ride their bikes to work. According to the County's facilities manager, the County currently has three bike racks for the sum of its facilities. Commute Green Fresno County will strategically place an additional 20 bike racks across the County's facilities. (page 3)

City of Fresno Documents

City of Fresno General Plan

The following goals and policies are most relevant to the implementation of separated bikeways.

Mobility and Transportation Element

- *14: Provide a network of well-maintained parks, open spaces, athletic facilities, and walking and biking trails connecting the city's districts and neighborhoods to attract and retain a broad range of individuals, benefit the health of residents, and provide the level of public amenities required to encourage and support development of higher density urban living and transit use.*
- *16: Protect and improve public health and safety*

Benefits of complete streets acknowledged in the plan include:

- Fewer traffic jams
- Reduced air pollution
- Reduced energy consumption
- Decreased GHG emissions
- Increased transit usage (pages 4-3 to 4-4)

The plan also recognizes bicycle facilities with more separation from motor vehicles, like Class I shared use paths and Class IV separated bikeways, as more desirable for users than Class II bike lanes or Class III shared roadways.

- *Objective MT-1: Create and maintain a transportation system that is safe, efficient, provides access in an equitable manner, and optimized travel by all modes.*
    - *MT-1-g: Complete Streets concept implementation. Provide transportation facilities based upon a Complete Streets concept that facilitates the balanced use of all viable travel modes (pedestrians, bicyclists, motor vehicle and transit users), meeting the transportation needs of all ages, income groups, and abilities and providing mobility for a variety of trip purposes, while also supporting other city goals.*
- *Objective MT-4: Establish and maintain a continuous, safe, and easily accessible bikeways system throughout the metropolitan area to reduce vehicle use, improve air quality and the quality of life, and provide public health benefits.*
    - *MT-4-b: Bikeway Improvements. Establish and implement property development standards to assure that projects adjacent to designated bikeways provide adequate right-of-way and that necessary improvements are constructed to implement the planned bikeway system […] to provide for bikeways, to the extent feasible, when existing roadways are reconstructed; and alternative bikeway alignments or routes where inadequate right-of-way is available.*
    - *MT-4-c: Bikeway Linkages. Provide linkages between bikeways, trails, and paths, and other regional networks such as the San Joaquin River Trail and adjacent jurisdiction bicycle systems wherever possible.*
    - *MT-4-d: Prioritization of Bikeway Improvements. Prioritize bikeway components that link existing separated sections of the system, or that are likely to serve the highest concentration of existing or potential cyclists, particularly in those neighborhoods with low vehicle ownership rates, or that are likely to serve destination areas with the highest demand such as schools, shopping areas, recreational and park areas, and employment centers.*
    - *MT-4-i: Bicycling and Public Transportation. Promote the integration of bicycling with other forms of transportation, including public transit. Continue to provide bike racks or space for bicycles on FAX buses.*

- *MT-4-k: Bicycle Safety, Awareness, and Education. Promote bicycle ridership by providing secure bicycle facilities, promoting traffic safety awareness for both bicyclists and motorists, promoting the air quality benefits, promoting non-renewable energy savings, and promoting the public health benefits of physical activity.*

- Objective MT-6: Establish a network of multi-purpose pedestrian and bicycle paths, as well as limited access trails, to link residential areas to local and regional open spaces and recreation areas and urban Activity Centers in order to enhance Fresno's recreational amenities and alternative transportation options.

City of Fresno Active Transportation Plan

The Fresno Active Transportation Plan establishes four goals to guide the development of walking and bicycling networks in the city:

- *Equitably improve the safety and perceived safety of walking and bicycling in Fresno*
- *Increase walking and bicycling trips in Fresno by creating user-friendly facilities*
- *Improve the geographic equity of access to walking and bicycling facilities in Fresno*
- *Fill key gaps in Fresno's walking and bicycling networks*

More than 20 miles of Class IV Separated Bikeways are recommended in the Plan, which also notes this concurrent feasibility study to identify additional locations for Class IV bikeways.

Fresno Green Plan

The Fresno Green Plan identifies five Fresno "Green Visions," two of which relate to bicycle and pedestrian planning.

New City Beautiful

Fresno will be nationally recognized for the innovative integration of buildings within their neighborhood context, good urban design, and for giving priority to public health, open spaces, public art, historic preservation, urban forests, and the protection of natural habitats. (page 7)

- *Strategy 1: Support new urbanist principles that advance higher density, mixed use, and accessible neighborhoods which coordinate land use and transportation with open space systems for recreation and ecological restoration by 2011.*
  - *Update street design standards to provide increased quality of life for residential neighborhoods, a more attractive bike and pedestrian environment, and conservation of natural resources by 2012. (page 9)*

Sierra View 2025

The Sierra Nevada Mountain Range will be clearly visible to all Valley Residents by 2025. Public Health will be improved by having cleaner air, enhanced public transportation, and additional opportunities for walking and cycling (page 7)

- *Strategy 9: Reduce by 20% the number of commute trips by single occupancy vehicles from 2000 baseline by 2015*
- *Strategy 10: By 2024 meet the federal clean air standards through coordination with the California Air Resources Board, the San Joaquin Valley Air Pollution Control District, and Operation Clean Air. (page 12)*

City of Clovis Documents

City of Clovis General Plan

The following goals are most relevant to the implementation of separated bikeways.

Circulation Element

- *Goal 4: A bicycle and transit system that serves as a functional alternative to commuting by car.*
- *Goal 5: A complete system of trails and pathways accessible to all residents.*

Air Quality Element

- *Goal 1: A local environment that is protected from air pollution and emissions.*
    - *Policy 1.1: Land use and transportation. Reduce GHGs and other local pollutant emissions through mixed-use and transit-oriented development and well designed transit, pedestrian, and bicycle systems.*
- *Goal 2: A region with healthy air quality and lower GHGs.*

City of Clovis Active Transportation Plan

The City of Clovis Active Transportation Plan highlights and supports many benefits of bicycling, including:

- Improving health and reducing health care costs
- Reducing air pollution
- Connecting families with fun transportation and recreation choices
- Reducing transportation costs
- Reducing congestion, especially for short trips

It also includes the following goals and policies relevant to separated bikeways.

- *Increase the share of residents who use walking and bicycling to get to work, school, shopping, and other activities.*
- *Reduce the number of collisions within the city involving pedestrians and bicyclists.*
- *Close gaps within the bicycle and pedestrian networks.*

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Appendix B. Cost Estimates

This appendix contains detailed cost estimates for various roadway types and separation treatments.

Fresno-Clovis Class IV Construction Cost Estimates: 3 Lane Roadway 3/23/2017

Engineer's Estimate

	Units	Quantity	Unit Price	Totals
ITEM				
A1 - 3 lanes, remove parking, (Flexible Bollards)				
Remove Existing Striping	LF	4,900	$4.00	$19,600
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Flexible bollards with Striping	LF	9,800	$7.00	$68,600
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$214,170*
Design		*20*	*percent*	*$42,834*
Contingency		*20*	*percent*	*$51,401*
Total (Per Mile)				**$308,405**
A2 - 3 lanes, remove parking, (Curb Stops)				
Remove Existing Striping	LF	4,900	$4.00	$19,600
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Curb Stops with Striping	LF	9,800	$15.00	$147,000
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$292,570*
Design		*20*	*percent*	*$58,514*
Contingency		*20*	*percent*	*$70,217*
Total (Per Mile)				**$421,301**
A3 - 3 lanes, remove parking, (Raised Curbs)				
Remove Existing Striping	LF	4,900	$4.00	$19,600
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Raised Buffer	LF	7,350	$45.00	$330,750
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$476,320*
Design		*20*	*percent*	*$95,264*
Contingency		*20*	*percent*	*$114,317*
Total (Per Mile)				**$685,901**

Fresno-Clovis Class IV Construction Cost Estimates: 4-to-3 Road Diet 3/23/2017

Engineer's Estimate

	Units	Quantity	Unit Price	Totals
ITEM				
B1 - 4 to 3 lane road diet (Flexible bollards)				
Remove Existing Striping	LF	4,900	$3.00	$14,700
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Bollards with striping	LF	9,800	$7.00	$68,600
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$209,270*
Design		*20*	*percent*	*$41,854*
Contingency		*20*	*percent*	*$50,225*
Total (Per Mile)				**$301,349**
B2 - 4 to 3 lane road diet, (Curb Stops)				
Remove Existing Striping	LF	4,900	$3.00	$14,700
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Curb stops with striping	LF	9,800	$15.00	$147,000
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$287,670*
Design		*20*	*percent*	*$57,534*
Contingency		*20*	*percent*	*$69,041*
Total (Per Mile)				**$414,245**
B3 - 4 to 3 lane road diet, (Raised curbs)				
Remove Existing Striping	LF	4,900	$3.00	$14,700
Restripe 3 lanes	LF	4,900	$3.00	$14,700
Raised Buffer	LF	7,350	$45.00	$330,750
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$15,000.00	$90,000
Traffic Control	LS	1	$15,000.00	$15,000
Subtotal				*$471,420*
Design		*20*	*percent*	*$94,284*
Contingency		*20*	*percent*	*$113,141*
Total (Per Mile)				**$678,845**

Fresno-Clovis Class IV Construction Cost Estimates: 5 Lane Roadway 3/23/2017

Engineer's Estimate

	Units	Quantity	Unit Price	Totals
ITEM				
C1 - 5 lanes, remove parking (Flexible bollards)				
Remove Existing Striping	LF	4,900	$6.00	$29,400
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Bollards with striping	LF	9,800	$7.00	$68,600
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$268,670*
Design		*20*	*percent*	*$53,734*
Contingency		*20*	*percent*	*$64,481*
Total (Per Mile)				**$386,885**
C2 - 5 lanes, remove parking, (Curb Stops)				
Remove Existing Striping	LF	4,900	$6.00	$29,400
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Curb Stops with Striping	LF	9,800	$15.00	$147,000
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$347,070*
Design		*20*	*percent*	*$69,414*
Contingency		*20*	*percent*	*$83,297*
Total (Per Mile)				**$499,781**
C3 - 5 lanes, remove parking, (Raised curbs)				
Remove Existing Striping	LF	4,900	$6.00	$29,400
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Raised Buffer	LF	7,350	$45.00	$330,750
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$530,820*
Design		*20*	*percent*	*$106,164*
Contingency		*20*	*percent*	*$127,397*
Total (Per Mile)				**$764,381**

Fresno-Clovis Class IV Construction Cost Estimates: 5 Lane Roadway with Road Diet 3/23/2017
Engineer's Estimate

	Units	Quantity	Unit Price	Totals
ITEM				
D1 - 7 to 5 lane Road Diet (Flexible bollards)				
Remove Existing Striping	LF	4,900	$8.00	$39,200
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Bollards with striping	LF	9,800	$7.00	$68,600
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$278,470*
Design		*20*	*percent*	*$55,694*
Contingency		*20*	*percent*	*$66,833*
Total (Per Mile)				**$400,997**
D2 - 7 to 5 lane Road Diet (Curb Stops)				
Remove Existing Striping	LF	4,900	$8.00	$39,200
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Curb Stops with striping	LF	9,800	$15.00	$147,000
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$356,870*
Design		*20*	*percent*	*$71,374*
Contingency		*20*	*percent*	*$85,649*
Total (Per Mile)				**$513,893**
D3 - 7 to 5 lane Road Diet (Raised curbs)				
Remove Existing Striping	LF	4,900	$8.00	$39,200
Restripe 5 lanes	LF	4,900	$6.00	$29,400
Raised Buffer	LF	7,350	$45.00	$330,750
Bike Lane Markings	SF	294	$5.00	$1,470
Signs	EA	32	$150.00	$4,800
Intersection Treatments	EA	6	$20,000.00	$120,000
Traffic Controls	LS	1	$15,000.00	$15,000
Subtotal				*$540,620*
Design		*20*	*percent*	*$108,124*
Contingency		*20*	*percent*	*$129,749*
Total (Per Mile)				**$778,493**