CITY OF TUCSON

BICYCLE BOULEVARD MASTER PLAN

Photo credit: Stacey Halper

BICYCLE BOULEVARD MASTER PLAN

JULY 28, 2016

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BICYCLE & PEDESTRIAN PROGRAM
City of Tucson Department of Transportation

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EXECUTIVE SUMMARY

Tucson has a long history of supporting bicycling. With a network of over 1,000 miles of bikeways, above-average bicycle commuting rates, and a vibrant bicycling culture, Tucson has earned a gold-level Bicycle Friendly Community designation by the League of American Bicyclists. This Bicycle Boulevard Master Plan represents Tucson's continued commitment to prioritizing safe and convenient bicycle and pedestrian networks that appeal to people of all ages and abilities. This plan includes:

- **A summary of the history, current conditions, and benefits of bicycle boulevards in Tucson**
- **Design guidance for the construction of bicycle boulevards**
- **Conceptual plans and cost estimates for each bicycle boulevard corridor**
- **A prioritized list of bicycle boulevard projects**
- **A description of the implementation process**

There is strong policy support for bicycle boulevards in Tucson. Plan Tucson, the 2045 Regional Mobility and Accessibility Plan, the Tucson Regional Plan for Bicycling, the Pima Regional Trails Master Plan, and the Tucson Parks and Recreation Master Plan all support a growing role for bicycle transportation in the region. The bicycle boulevard network will serve as the backbone for active transportation throughout the city.

Bicycle boulevards are residential streets designed to prioritize bicycling and enhance conditions for walking. Bicycle boulevards are designed to:

- **Help people cross busy major streets:** Improved crossing treatments such as push button signals and median refuge islands make it easier for people walking and biking to cross busy streets.
- **Reduce the speed and volume of automobile traffic:** Traffic calming devices such as speed humps and traffic circles slow traffic speeds and discourage drivers from using bicycle boulevards as cut-through streets.
- **Guide people along the route and help them reach their destinations:** Pavement markings and signs help users follow the route, point out connections with other bike routes, and let them know what prominent destinations are nearby.
- **Enhance the biking and walking environment:** Native landscaping helps collect stormwater and provides shade for people walking and biking. Public art preserves and enhances unique community character.

Pilot projects along Third Street/University Boulevard and Fourth/Fontana Avenues have demonstrated positive results by attracting more bicyclists, reducing the speed and volume of cut-through vehicle traffic, and improving safety.

This plan identifies a network of 193 miles of future bicycle boulevards along 64 residential corridors. Thanks to funding from the Regional Transportation Authority and the Federal Highway Administration, eight corridors will see enhancements in coming years. When complete, these projects will add 36 miles to the bicycle boulevard network.

The estimated cost of completing the entire bicycle boulevard network in Tucson is $31.7 million or approximately $165,000 per mile. Included in this plan is a data-driven methodology for identifying areas of highest need and prioritizing remaining corridors for future improvements. When the entire network is complete, 44% of Tucsonans will have access to a bicycle boulevard within ¼ mile of their homes.

Biking and walking create healthy people and vibrant communities. These modes help to reduce air pollution and the causes of climate change, limit the costs and consequences of physical inactivity, and promote safer streets. Bicycle boulevards make biking and walking more accessible for all types of people, promote social equity, and support the local economy. Building the bicycle boulevard network is a sound investment for Tucson's future.

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1. INTRODUCTION

Tucson has long held a strong commitment to bicycling. The first bike routes date back to the 1960's, and the initial bike route network was identified in the 1970's. Over the past four decades, the regional bikeway network grew to over 1,000 miles. Today, Tucson is a gold-rated Bicycle Friendly Community designated by the national cycling advocacy group the League of American Bicyclists.

Tucson recently advanced efforts to improve walking conditions, as well. In 2014, Pima Association of Governments (PAG), the metropolitan planning organization for the greater Tucson region, developed a new Pedestrian Plan that highlights the current conditions and prioritizes pedestrian projects for implementation along major corridors.[1]

Walking and bicycling initiatives are supported by individuals, neighborhoods, and businesses throughout the city. Plan Tucson, the City's general plan adopted by voters in 2013, references the growing interest in Tucson and across the country for more walkable and bikeable communities. Through extensive public outreach, Plan Tucson includes 12 'shared values' that are of utmost importance to the community; one of them is 'access to multiple forms of transportation.' [2]

While efforts to-date serve as a great foundation for improving conditions for walking and bicycling, many Tucsonans have expressed an interest in safer and more comfortable multi-modal route options. As a result, City of Tucson staff identified a network of bicycle boulevards and have implemented pilot projects along Fourth/Fontana Avenues and Third Street/University Boulevard.

Bicycle boulevards are residential streets designed to prioritize bicycling and enhance conditions for walking. Bicycle boulevards vary in character to reflect the unique neighborhoods they travel through, but all include the defining features and engineering tools to:

- slow traffic,
- reduce cut-through traffic, and
- assist bicyclists and pedestrians in crossing busier roadways.

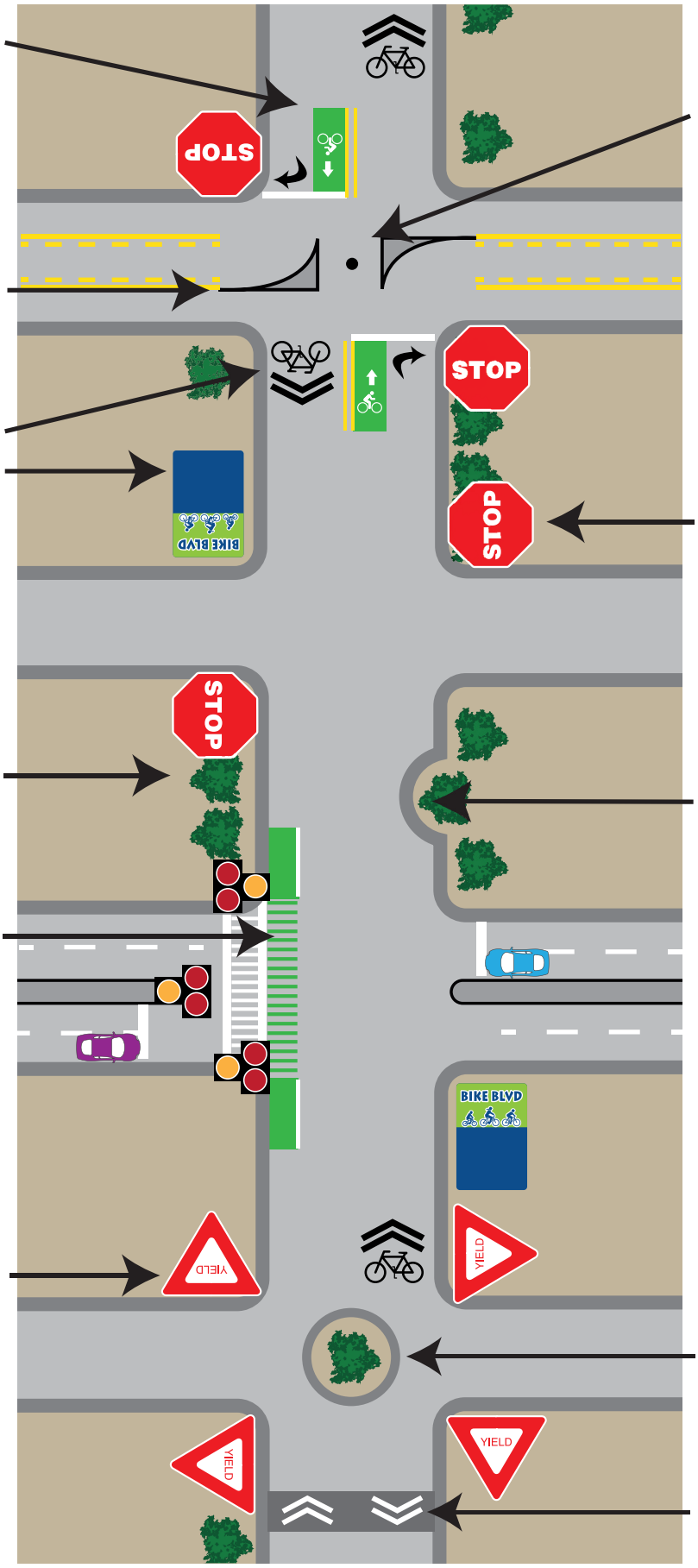
Bicycle boulevards encourage biking and walking as transportation options for individuals of all ages and abilities because they are safer and tend to be more comfortable than using major arterial roadways.

Bicycle boulevards support several community values by:

- reducing vehicular congestion
- improving air quality
- stimulating economic activity
- improving access to public transit
- increasing real estate values
- providing fitness opportunities
- enhancing native habitat and biodiversity
- promoting neighborhood vibrancy

Exhibit 1.1

Typical Bicycle Boulevard in Tucson



Green lane makes bicyclists more visible.

Raised median prevents motorists from cutting through.

Bicycle boulevard signs and pavement markings serve as wayfinding devices and reinforce that this is a bicycle priority street

Street trees for shade, cooling and aesthetics.

Push button crossing stops car traffic on busy major streets and allows bicyclists and pedestrians to cross.

Yield signs at traffic circles allow bicyclists to keep their momentum.

Median refuge helps bicyclists to cross roads of 3 lanes or more.

Stop signs on minor cross streets favor through bicycle movement.

Chicane serves as traffic calming treatment, and is an opportunity for green infrastructure.

Traffic circle serves as traffic calming treatment and is an opportunity for green infrastructure.

Speed table serves as traffic calming treatment.

1.1 Vision

The City of Tucson envisions an increasingly safe, comfortable, and convenient network of residential streets that support walking and biking as a form of transportation. The bicycle boulevard network will serve as the backbone for multi-modal travel throughout the city.

1.2 Plan Purpose

The purpose of the Bicycle Boulevard Master Plan is to create a planning document that is both an educational and implementation tool.

The plan provides an overview of bicycle boulevards, presents design elements for select residential streets, prioritizes Tucson's network of future bicycle boulevards and sets the framework and process for future implementation.

1.3 What is a Bicycle Boulevard

A bicycle boulevard is a shared roadway that has been modified with traffic calming, safer intersection crossings, signs, pavement markings and other amenities to prioritize the safety, comfort, and convenience of people biking and walking. A typical bike boulevard is routed along an existing residential street with low vehicle speeds and low volumes of motorized traffic, connects to other bikeways, and provides direct access to a variety of destinations. Bike boulevards, by design, discourage cut-through motor vehicle traffic, preserve the neighborhood aesthetic of residential streets, and provide an alternative travel route to busy streets for people walking and biking. In that way, they appeal to a broad spectrum of cyclists and encourage new bicycle ridership.

Tucson's grid street pattern, topography, and pleasant weather conditions for most of the year support a bike boulevard network. By utilizing the residential street system, investing in bike boulevards is a cost-effective way to connect people of all ages and abilities to popular destinations such as parks, schools, employment centers and shopping areas.

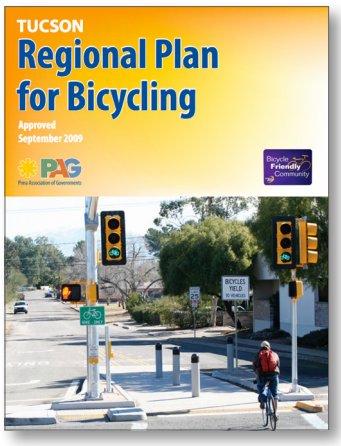
1.4 History of Bicycle Boulevards in Tucson

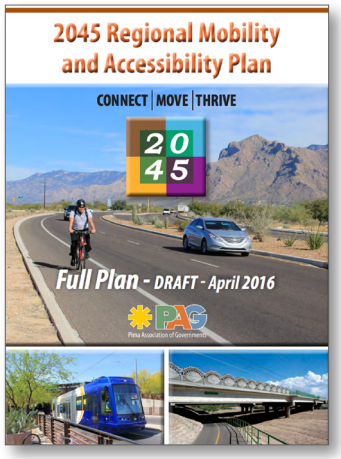
Tucson's first bicycle boulevard, Third Street, evolved long before the term 'bicycle boulevard' existed. The direct connection to the University of Arizona and picturesque orange trees that line the adjacent neighborhood to the east, Sam Hughes, make Third Street an ideal multi-modal corridor. In fact, Third Street is the oldest designated bike route in Tucson.

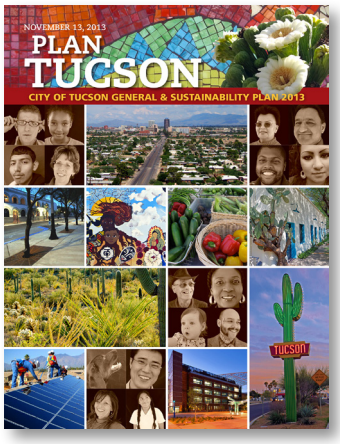
Traffic calming installed along Third Street improved the corridor for walking and bicycling. However, major road crossings presented a significant barrier that limited usage.

In the 1990's, City of Tucson staff members worked with the neighborhoods along the corridor to develop crossing solutions. Their efforts resulted in the installation of Tucson's first bicycle and pedestrian crossing at Third Street and Country Club Road in 1998. Since then, four additional enhanced crossings have been added along Third Street/ University Boulevard.

The Third Street/University Bicycle Boulevard is one of the most heavily used bike routes in Tucson







Tom Thivener, former Bicycle and Pedestrian Program Manager for the City of Tucson, developed a major bicycle boulevard initiative for Tucson in 2008. This was inspired by the success of the Third Street Bicycle Boulevard, growing national awareness of bicycle boulevards, and a strong interest in increasing bicycle ridership in Tucson.

During Thivener's time with the City of Tucson, he identified a proposed bicycle boulevard network, oversaw the design of multiple pilot corridors and worked diligently to promote bicycle boulevards within regional planning efforts.

In the 2009 Regional Plan for Bicycling, the bicycle boulevard network was included as a regional priority.[3] The plan identified over 40 streets and 166 miles of bicycle boulevards and recommended implementation by the year 2030. Today, those numbers have been adjusted to 64 corridors and 193 miles.

The 2045 Regional Mobility and Accessibility Plan, PAG's long-range transportation plan, also supports the extension and improvement of a bicycle boulevard network, calling for $35 million in investments.[4]

Bicycle boulevards are also referenced throughout Plan Tucson, and are included in the Land Use, Transportation, & Urban Design Policies:[5]

- **LT14:** Create pedestrian and bicycle networks that are continuous and provide safe and convenient alternatives within neighborhoods and for getting to school, work, parks, shopping, services, and other destinations on a regular basis.
- **LT13:** Continue to explore and monitor opportunities to increase the use of transit, walking, and bicycles as choices for transportation on a regular basis.
- **LT12:** Design and retrofit streets and other rights-of-way to include green infrastructure and water harvesting, complement the surrounding context, and offer multi-modal transportation choices that are convenient, attractive, safe and healthy.

1.5 Existing Conditions

The Tucson region has over 1,000 miles of bikeways, but many of them are located on busy arterial roads that discourage inexperienced cyclists – especially children and families – from using them. Pima County's Loop pathway system is a low-stress facility, separated from cars, that appeals to walkers and cyclists of varied abilities; however, much of The Loop is located on the outskirts of the city. Bicycle boulevards are needed to connect Tucsonans to key destinations throughout town.

As of 2015, there are two main residential corridors that have been enhanced and upgraded to reach the designation of a bicycle boulevard: Third Street/University Boulevard and Fourth Avenue/Fontana Avenue. Several other corridors are in-progress and have partial funding.

Exhibit 1.2
Current Conditions of Tucson's Bicycle Boulevard Network

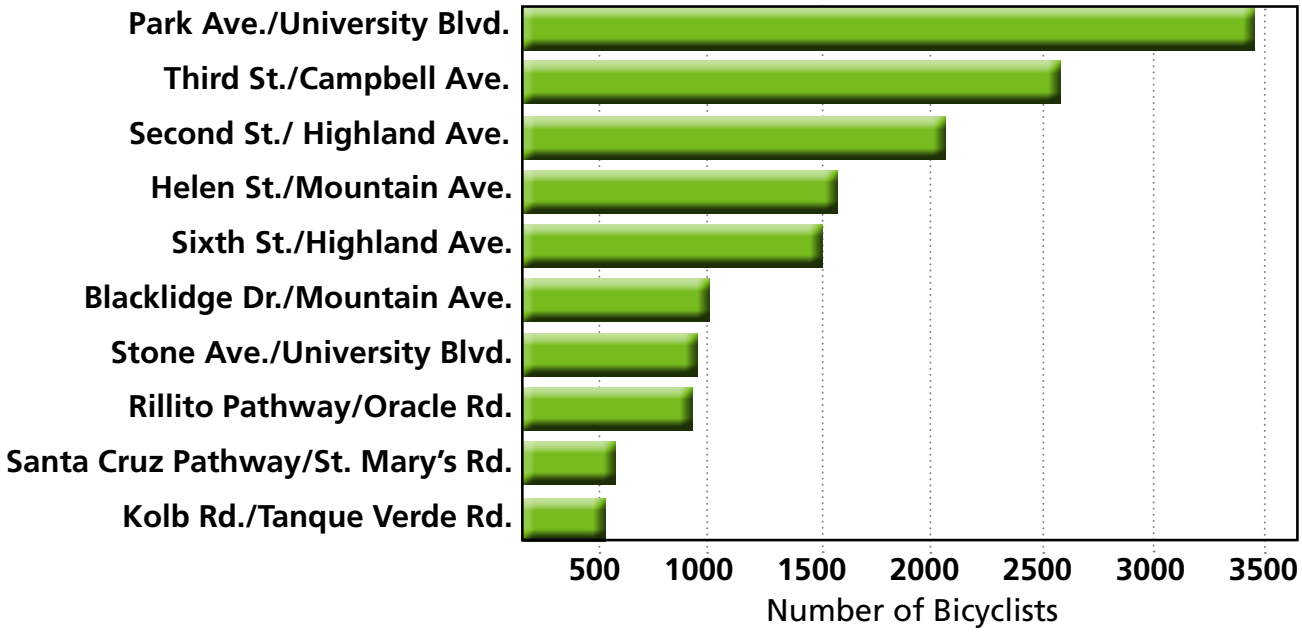
Enhanced Corridors
Third Street/
University Boulevard*
Fourth/Fontana Avenues

In-Progress
Liberty/San Fernando Avenues
Fifth Street
Treat Avenue
Copper/Flower Streets
Ninth/Eighth Streets
Ninth/Castro Avenues
Sahuara Avenue

**The Third Street/University Bicycle Boulevard from Main Avenue to Fourth Avenue and from Campbell Avenue to Craycroft Road is currently designated as an enhanced corridor, further improvements are proposed east of Craycroft Road, including new HAWKS at Craycroft Road and Wilmot Road.*

Exhibit 1.3

Top 10 Bicycle Count Locations 2015[6]



The two locations with the highest bicycle volumes in Tucson are both located along the Third Street/University Bicycle Boulevard. These are daily estimates based on peak-hour count data.

A bike box improves safety by positioning bicyclists in front of vehicles at the intersection of Park Avenue and University Boulevard. In 2015 approximately 3,410 bicyclists passed through this intersection each day.

Bicycle and Pedestrian signalized crossing (TOUCAN) on the Third Street/University Bicycle Boulevard at Stone Avenue.

The Third St./University Bicycle Boulevard links thousands of area residents with the University of Arizona's main campus.

Third Street/University Bicycle Boulevard

The Third Street/University Boulevard corridor has been functioning as a bike boulevard even before it was officially designated as one. It is the single busiest bikeway in Tucson, extending along 6.67 miles. Third Street/University Boulevard features various traffic calming elements, motor vehicle restrictions, crossing improvements at major roads for cyclists and pedestrians, and pavement markings.

The Third Street/University Bicycle Boulevard provides a direct and continuous connection for residents to shopping areas, jobs, schools and other bicycle friendly routes that easily reach the University of Arizona Main Campus, the downtown area, and the river pathways. The 2015 Regional Bicycle and Pedestrian Count shows that the two highest ranked locations are along the Third Street/University Bicycle Boulevard – one just west of the University of Arizona and the other just east. Approximately 3,410 bicyclists pass through the University Boulevard and Park Avenue intersection each day, while approximately 2,600 bicyclists pass through the Third Street and Campbell Avenue intersection daily.[7]

A notable increase in bike traffic along this corridor may be associated with the safety improvements implemented at intersections with busy major streets. The ridership during peak hours at Third Street and Campbell showed a significant increase in cyclists, from 678 bikes in 2000 to 2600 in 2015.[8, 9] In that time, four intersections were enhanced for the safety and convenience of bicyclists suggesting that improved crossing treatments can lead to increased ridership.

Exhibit 1.4

Third St./Broadway Blvd. Bicycle Crash Comparison

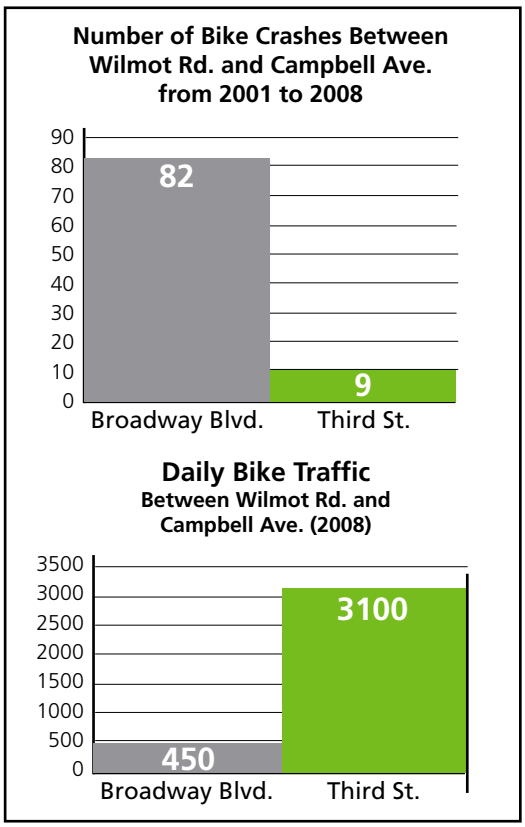


Exhibit 1.5

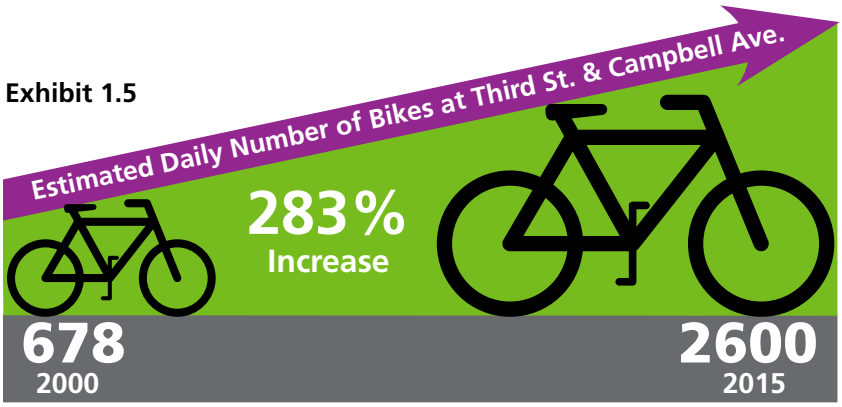
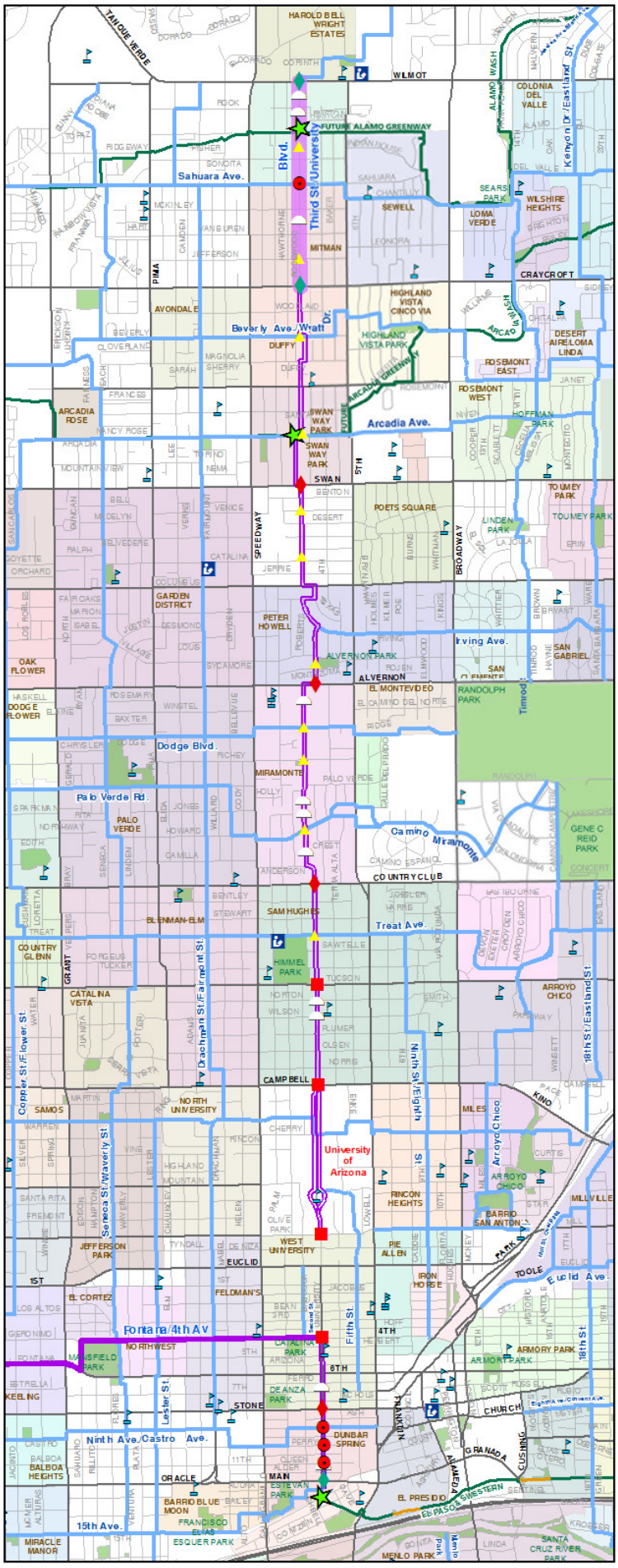


Exhibit 1.4 compares crash data for bicyclists on Third Street versus Broadway Boulevard between Wilmot Road and Campbell Avenue. Between 2001 and 2008 there were approximately 9 times fewer crashes on Third Street despite there being approximately 7 times more cyclists. These data suggest that residential bike routes like Third Street are a safer option for people biking compared to arterial bike lanes.

Exhibit 1.6
Third Street/University Bicycle Boulevard Map



Total Miles: 7.67

Estimated Total Cost: $603,805

0 0.25 0.5 1
Mile

Design Elements

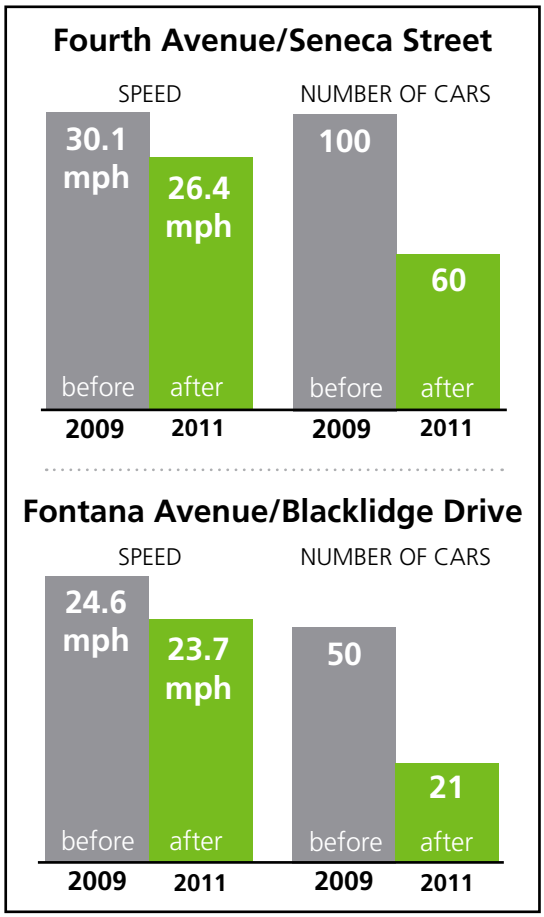
- Existing Third St. Bicycle Boulevard
- Future Third St. Bicycle Boulevard
- Existing Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

Right- and left-only turns restrict cut through traffic along Fourth Avenue at Speedway Boulevard.

Traffic circles with yield signs slow motor vehicles and limit delay for cyclists.

Exhibit 1.7

Fourth/Fontana Avenue Bicycle Boulevard Before/After Traffic Study



Fourth/Fontana Avenue Bicycle Boulevard

The City of Tucson installed similar improvements along Fourth and Fontana Avenues with the help of the Drachman Institute – the community-based research and outreach arm of the University of Arizona's College of Architecture, Planning and Landscape Architecture. The project was funded by the Regional Transportation Authority (RTA), the 2006 voter-approved plan.

The neighborhoods around the corridor – Amphi, Keeling, El Cortez Heights, Northwest, Feldman's, and West University – expressed their support from the beginning of the process and played a pivotal role in the bicycle boulevard design. The Drachman Institute worked closely with the neighborhoods to create a design concept that fulfills their vision for a bicycle boulevard that acts as a vital connector to key destinations.

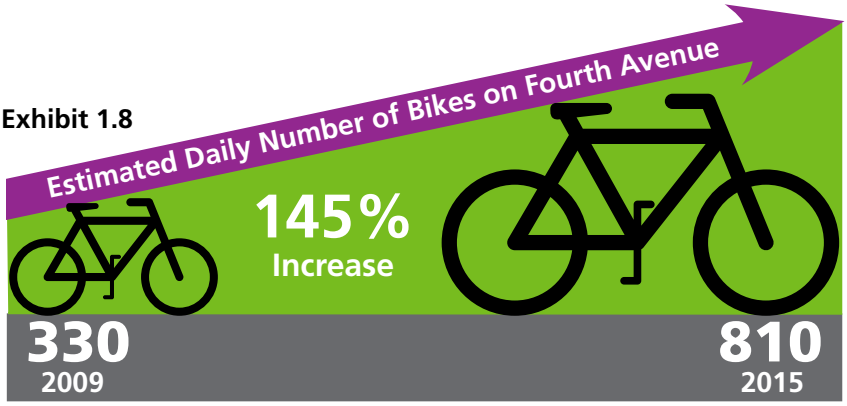
Traversing a dense residential part of Tucson, with areas of lower than average income, the Fourth/Fontana Avenue Bicycle Boulevard offers an economical transportation alternative for the residents of the area.[10] Easily reached major destinations include the University of Arizona, Pima Community College, the Fourth Avenue Shopping District, Main Gate Square, the Downtown area, and many schools and public parks. Furthermore, the Fourth/Fontana Avenue Bicycle Boulevard connects to the Third Street/University Bicycle Boulevard, making the first step towards creating an interconnected bicycle boulevard network.

Features incorporated in the corridor's design include traffic calming amendments, entrance restrictions for vehicles, intersection improvements, unique bicycle boulevard signage, and pavement markings. Bike movement is further prioritized by substituting stop signs with yield signs and installing bike boxes along the route.

Bicycle boulevard improvements along Fourth and Fontana Avenues are effective at limiting cut-through motor vehicle traffic, reducing the speed of cars using the route, and attracting bicyclists. Traffic studies were completed for two sections of the corridor before and after the addition of bicycle boulevard improvements in 2009 and 2011.

On Fourth Avenue at Seneca Street, peak-hour motor vehicle volumes declined 40%. Similarly, on Fontana Avenue at Blacklidge Drive, peak-hour motor vehicle volumes declined 58%. Traffic speeds were reduced in both locations as well (Exhibit 1.7).[11, 12] Between 2009 and 2015 there was a 145% increase in bicycle traffic on the bicycle boulevard (Exhibit 1.8).[13, 14]

Exhibit 1.8



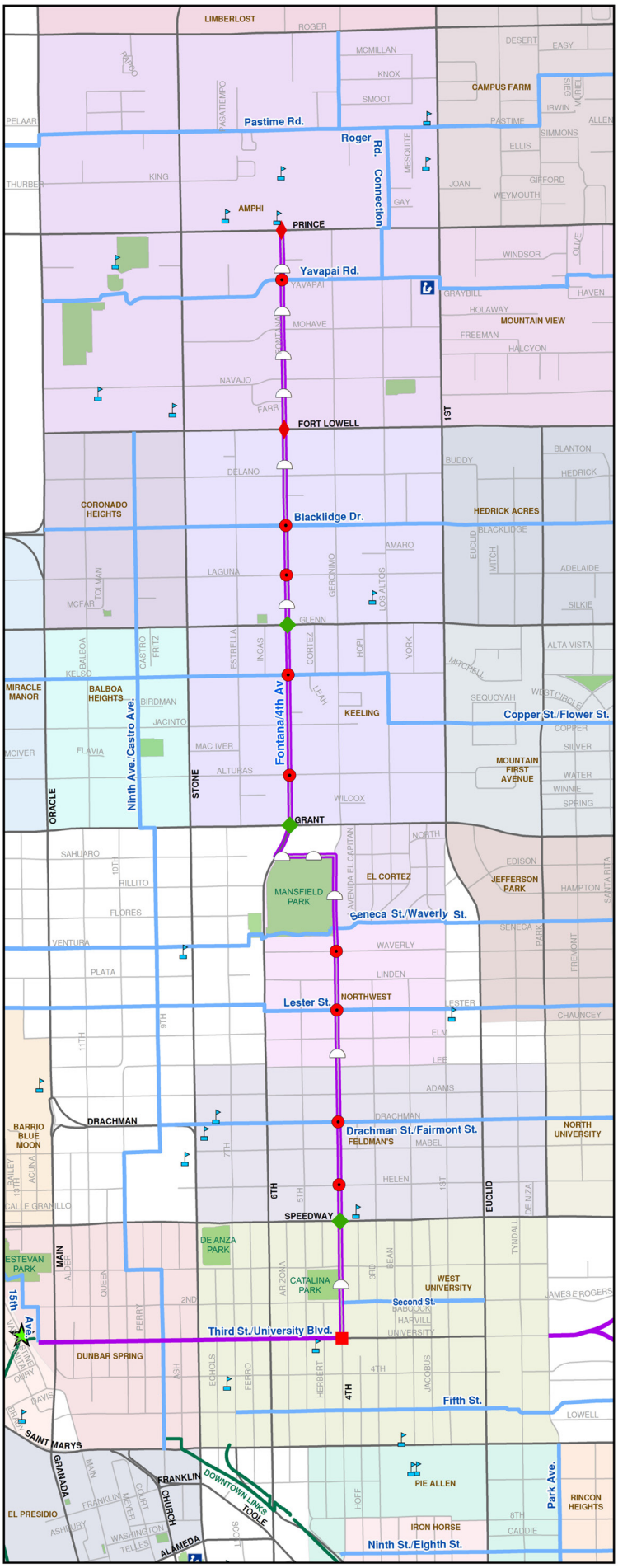


Exhibit 1.9
Fourth/Fontana Avenue Bicycle Boulevard Map

Total Miles: 2.94

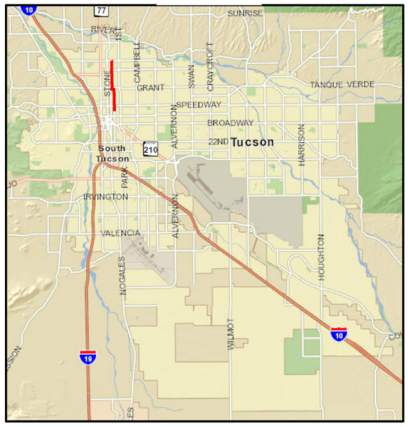
Estimated Total Cost: Completed

0 0.125 0.25 0.5
Mile

Design Elements

- 4th/Fontana Ave. Bicycle Boulevard
- Existing Bicycle Boulevard
- Future Bicycle Boulevards
- Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Future Shared-use-path
- Library
- School
- Park

N
W E
S



2. WHY BICYCLE BOULEVARDS

The City of Tucson initiated the bicycle boulevard network to provide a comfortable and convenient option for bicyclists and pedestrians to move through Tucson and to access key destinations including schools, parks, libraries, stores, and more. Bicycle boulevards benefit the community in many ways, as this section describes. Bicycle boulevards tend to:

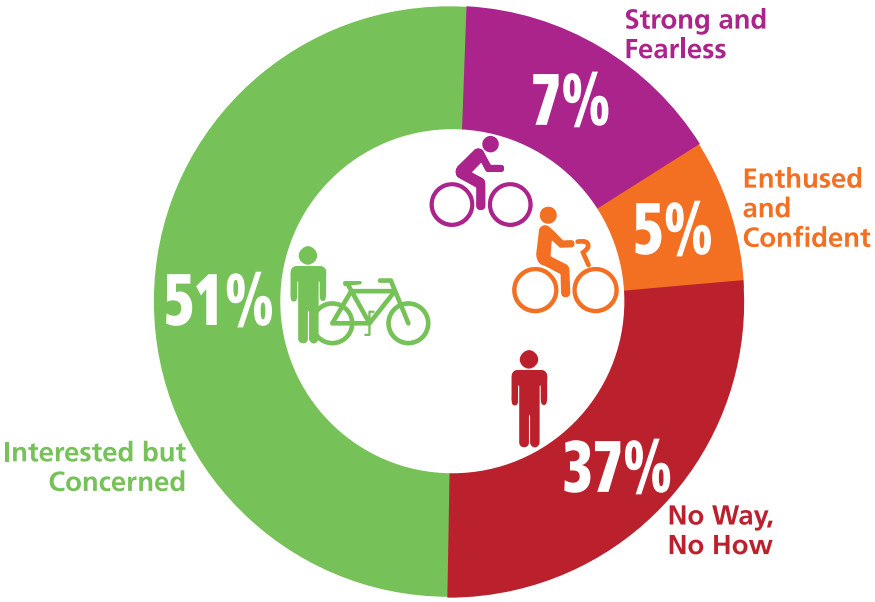
- Attract **new bicyclists**
- Enhance **safety** for everyone
- Improve **accessibility and mobility** options
- Improve the **environment**
- Promote **health**
- Stimulate **economic growth**
- Cultivate **community**

2.1 New Bicyclists

According to work by Portland Bicycle Coordinator Roger Geller and research by Dr. Jennifer Dill of Portland State University, there are four types of bicycle users. These types are defined by their relationship with bicycle infrastructure. The percentages of the population that make up each category are drawn from a May 2015 survey of 3000 individuals living in the 50 largest Metropolitan Statistical Areas in the United States.[1]

Exhibit 2.1

Four Types of Riders



Making up approximately 7% of the population, "Strong and fearless" bicyclists are undeterred by a lack of bike infrastructure, and they are confident riding alongside and among motor vehicles. "Enthused and confident" bicyclists – comprising roughly 5% of the population – will typically ride near motor vehicle traffic; however, they appreciate bicycle infrastructure, such as bike lanes. The largest group is made up of "interested but concerned" bicyclists, who represent approximately 51% of adults. They are interested in using a bicycle more often, but are concerned about their safety – especially around motor vehicles. Finally, the "no way, no how" group representing roughly 37% of adults are not going to ride a bike at all, either for reasons of inability or lack of interest.

Bicycle boulevards address the safety concerns of these "interested but concerned" bicyclists through a variety of design elements (see chapter 4 for more information). At the same time, bicycle boulevards benefit all road users and community members by improving safety, the environment, human health, economic vitality, and livability. Bicycle boulevards tend to have a higher percentage of women and families riding on them, an indication that these types of facilities appeal to the 'interested but concerned' category of cyclists. Data from the 2014 Pima Association of Governments Bicycle Count indicates that the top 10 locations with the highest number of female bicyclists are *all* located on low stress bike facilities – facilities that have less car traffic and/or slower speeds.[2]

2.2 Safety

Safety is a serious concern for many pedestrians and bicyclists – as well as "would-be" pedestrians and bicyclists. Bicycle boulevards address pedestrians' and bicyclists' safety concerns and increase safety for all road users primarily through reducing the speed of motor vehicle traffic and increasing the visibility of bicyclists and pedestrians. As such, bicycle boulevards are an important component of a safer, more comfortable, and more convenient bicycle and pedestrian network.

Lowering vehicle speed is essential to bicyclist and pedestrian safety. In the event of a crash, bicyclists and pedestrians are significantly more likely to survive if the motor vehicle is traveling at a slower speed. Exhibit 2.2 shows that a healthy adult has a 90% chance of survival when hit by a motor vehicle traveling at 20 mph. The healthy adult's chance of survival is dramatically reduced – to only 10% – when hit by a motor vehicle traveling at 40 mph.[3] Rates of survival are even lower for children and seniors.

Exhibit 2.2

Impact of Vehicle Speed on Pedestrian Survival Rates

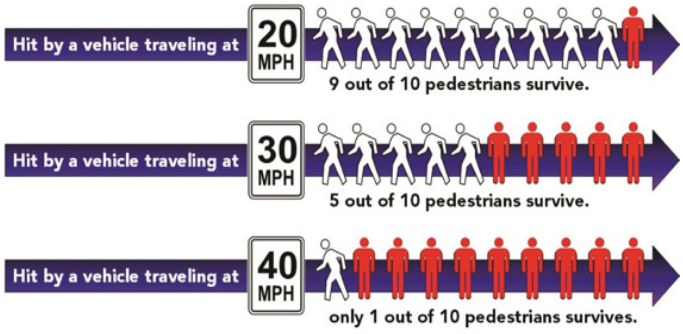
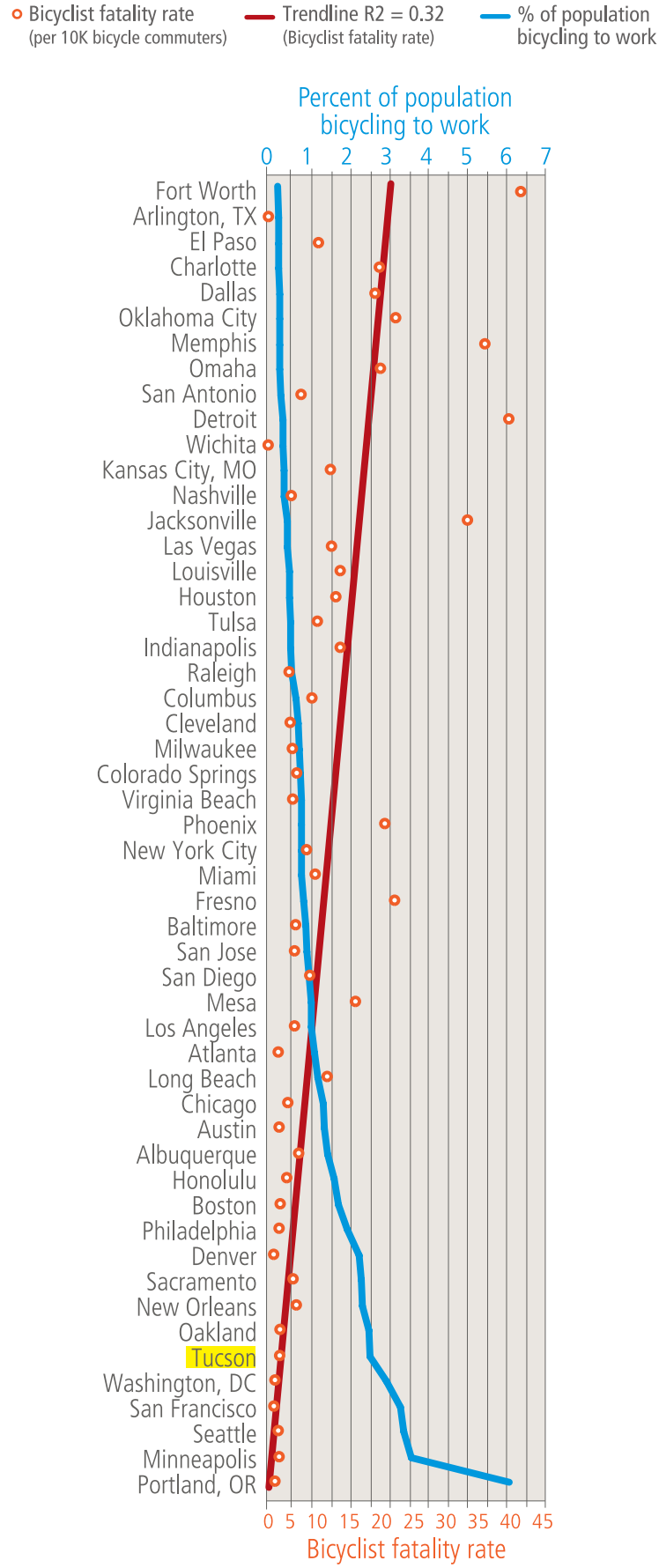


Exhibit 2.3

Comparing Bicycling to Work and Bicyclist Fatality Rates in Large Cities[4]

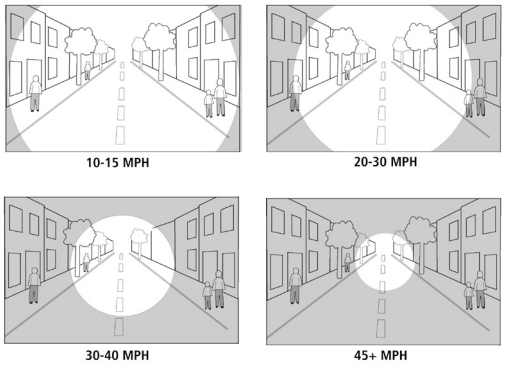


Higher motor vehicle speeds also limit motorists' field of view, consequently increasing the likelihood of a crash in which the motorist fails to notice pedestrians and/or bicyclists. The graphic below illustrates the significantly narrowed field of view of a motorist traveling at 45 mph; a motorist traveling at a slower speed has a much less limited field of view.

In Tucson, a bicyclist traveling on a bicycle boulevard is 15.7 times less likely to be in a crash with a motor vehicle than one traveling on an arterial bike lane.

Exhibit 2.4

Impact of Speed on Motorist's Field of View



Research suggests that bicycle and pedestrian crash rates are lower in areas with higher rates of biking and walking. Exhibit 2.3 compares bicycling to work rates and bicycle fatality rates in large U.S. cities.

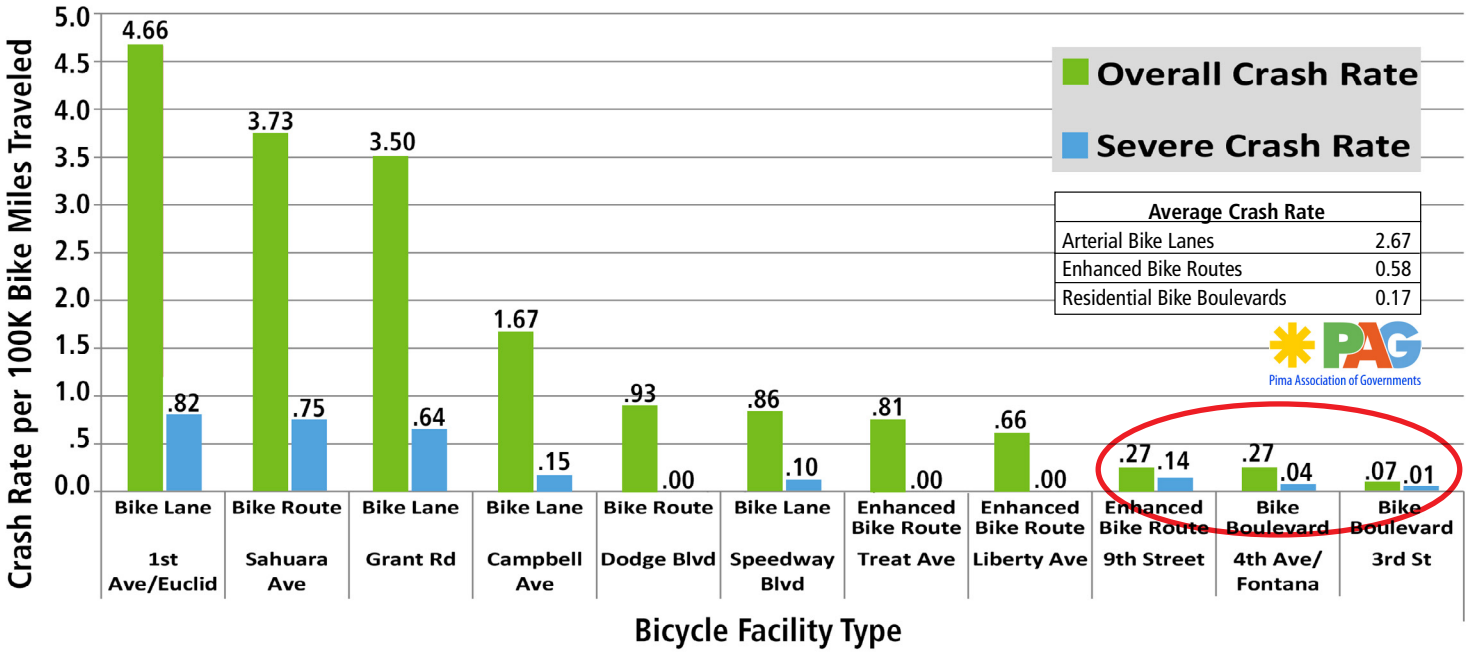
In general, bicyclist fatality rates decline as the portion of people who bike to work increases.

One of the reasons for these lower crash rates is thought to be increased 'visibility' of bicyclists and pedestrians. Higher numbers of people bicycling and walking make drivers more aware of their presence in the streets, thereby reducing the risk of crashes.

In Tucson, preliminary analyses reveal that bicycle boulevards and enhanced bike routes (routes that have some bicycle boulevard features but not enough to be upgraded to bicycle boulevard designation) have a significantly lower crash rate than other types of bicycle facilities. In the 2016 Regional Strategic Transportation Safety Plan, the Pima Association of Governments evaluated bicycle crash rates by facility type. Exhibit 2.5 indicates that a bicyclist traveling on a bicycle boulevard is 15.7 times less likely to be in a crash than one traveling on an arterial bike lane.[5] This analysis takes into account only on-street bicycle facilities and crashes involving a motor vehicle. Therefore, off-street trails and shared-use paths – like The Loop – could not be included in the analysis.

Exhibit 2.5

Bicycle Crash Rate by Facility Type, 2009-2013



2.3 Accessibility and Mobility

A relatively high percentage of Tucsonans lack access to a motor vehicle compared to the national average. 5.3% of Tucson adults who work do not have access to a motor vehicle (as compared to 4.5% of all Americans who work), according to the 2010-2014 American Community Survey 5-year estimate.[6] In multiple census tracts within Tucson, nearly 30% of working adults do not have a vehicle available. Similarly, many students and retired seniors do not own cars.

It is our most vulnerable population groups (children, seniors, low-income, and disabled individuals) who often lack access to a vehicle. However, these Tucsonans must still reach their destinations – work, school, doctor appointments, grocery stores, etc. – often by bike or on foot.

Bicycle boulevards improve mobility for all individuals without access to a motor vehicle, thereby reducing their dependency on family and friends for rides and offering them a greater sense of autonomy. They also function as an important first/last mile connector tool that facilitates walking and biking to other forms of public transportation like the bus and streetcar systems.

2.4 Environment

In Pima County, motor vehicle emissions are a major contributing source of air pollution. High levels of air pollution can result in difficulty breathing, as well as irreparable heart and lung damage. Treatment of respiratory disease costs the U.S. over $64 billion each year. Replacing motor vehicle trips with biking and walking trips result in significant environmental and personal health benefits.

In the United States, there is a great potential to replace a significant portion of motor vehicle trips with walking or biking. Sixty-nine percent of all motor vehicle trips in the U.S. are less than two miles, according to the most recent National Household Travel Survey. The average bicyclist can ride two miles in 15 to 20 minutes, making this distance accessible to most individuals.[7] It is often just as fast to walk or bicycle for many of those trips, especially when parking time is factored in.

In addition to reducing air pollution, replacing motor vehicle trips with biking and walking trips results in other environmental benefits, including reducing greenhouse gas emissions. In the eastern Pima County region, 28% of greenhouse gas emissions are due to 'transportation,' most of which is private or commercial vehicle travel. Reducing private vehicle trips could have a significant impact on overall greenhouse gas emissions.

Globally, 33% of the population cannot drive because they are too young, too old, or have a physical disability that prevents them from driving.[10]

Exhibit 2.6

Pima County Air Polution Sources [8]

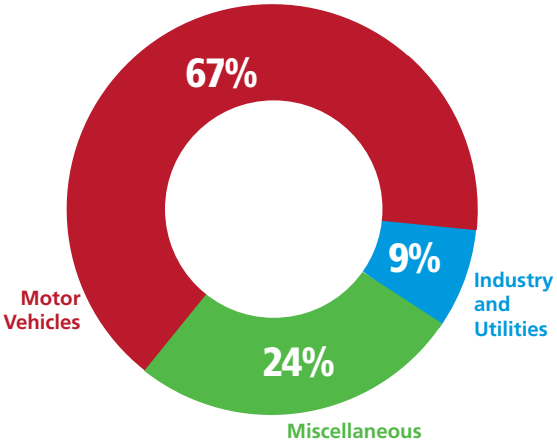
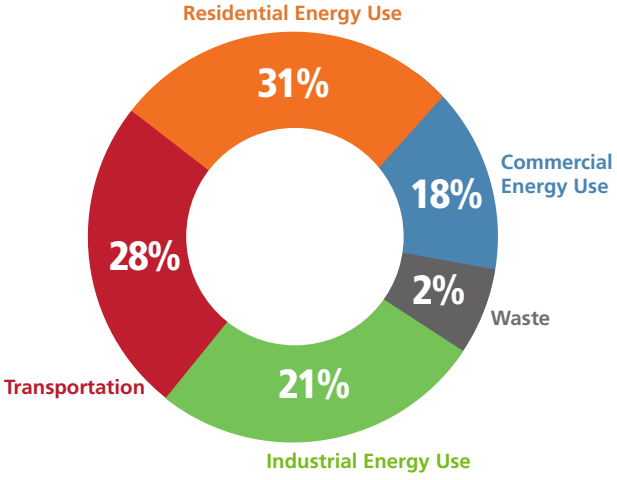


Exhibit 2.7

Pima County Greenhouse Gas Emissions by Sector[9]



Finally, one of the design elements of bicycle boulevards is green infrastructure (detailed on page 35). The Environmental Protection Agency has concluded that green infrastructure benefits the environment in many ways including:

- Reducing and delaying stormwater runoff volumes
- Enhancing groundwater recharge
- Reducing stormwater pollutants
- Helping to mitigate the urban heat island effect

2.5 Health

Bicycle boulevards reduce many of the barriers that often prevent people from walking and bicycling. They provide an option for individuals and families to use these active modes of transportation for many trips. Everyday walking and bicycling has proven to be one of the most effective ways of achieving recommended levels of physical activity and maintaining good health. Those who walk or bike regularly tend to have a healthy body weight, lower risk of chronic disease, and improved mental health.[11]

The Centers for Disease Control and Prevention (CDC) recommend that American adults engage in 150 minutes of moderate-intensity physical activity each week, while children should engage in at least 60 minutes each day.[13, 14] However, most Americans do not reach these recommended levels. In fact, over 20% of Tucsonans do not engage in any physical activity at all, according to the Behavioral Risk Factor Surveillance System operated by the CDC.[15]

The American Public Health Association estimates that lack of physical activity among Americans results in approximately $177 billion in medical costs each year and accounts for 16% of all deaths in the United States.[16] Research shows that exercise programs increase physical activity levels only temporarily. However, people who bike and walk – particularly for transportation – tend to increase their level of physical activity for the long-term.[17]

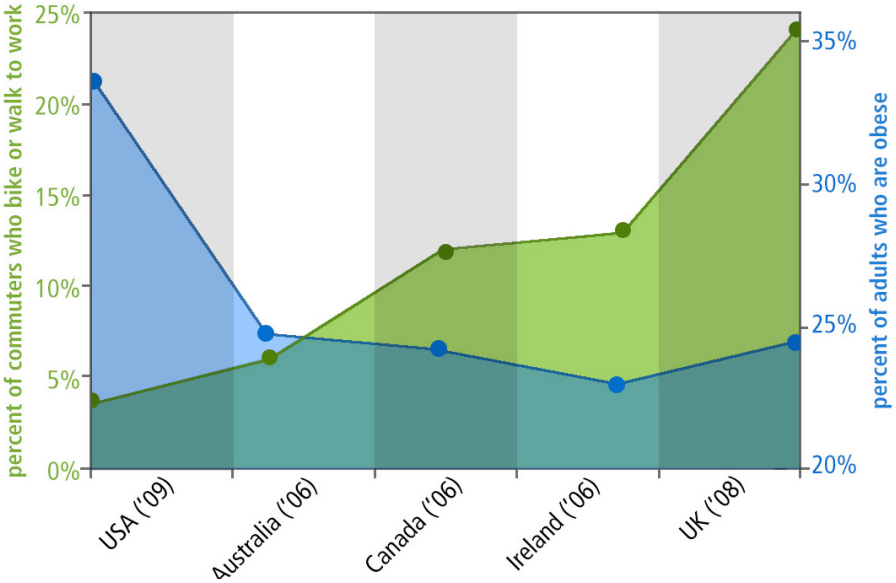
Nearly 37% of Tucsonans are overweight and 23% are considered obese, according to the Behavioral Risk Factor Surveillance System.[18] These numbers are a serious concern for our community. Walking and biking regularly, in combination with other healthy lifestyle choices, can help individuals of all ages achieve and maintain a healthy weight.

Several chronic diseases affect significant proportions of the Tucson community, namely heart disease, cancer, diabetes, and respiratory disease. An individual's risk of developing any of these chronic diseases is greatly reduced through regular physical activity. For those individuals who have already developed one or more chronic diseases, symptoms of the diseases and negative outcomes – including early death – can be mitigated through regular physical activity.

Heart disease is the leading cause of death among Arizonans.[19] Regular physical activity has been shown to reduce an individual's risk of cardiovascular disease by up to 49%.[20]

Exhibit 2.8

Percent of Bicycling and Walking to Work vs. Measured Obesity Levels[12]



Cancer is the second most common cause of death among Arizonans.[21] Regular physical activity has been shown to significantly reduce an individual's risk of breast cancer (by 75%) and colorectal cancer (by 22%).[22]

Diabetes mellitus is a rapidly growing concern for Arizona. In 2013, 9.7% of Arizonans had received a diabetes diagnosis; this has increased from 6.1% only a decade earlier.[23] The CDC estimates that as many as 1 in 4 Americans suffering from diabetes has not been diagnosed.[24]

The number of Arizonans suffering from diabetes is, unfortunately, expected to rise significantly. For children born in this century, 1 out of 3 will develop diabetes during their lifetime.[25] Hispanic children face an even grimmer statistic: 1 in 2 will develop diabetes in their lifetime.[26] One of the best ways to prevent diabetes is regular physical activity.[27]

Additionally, active transportation can improve mental health. Multiple studies suggest that regular physical activity – such as biking and walking – reduces adults' risk of psychological distress and depressive symptoms.[28] Research also shows that bicycling and walking increases commuter well-being – which reduces stress – and leads to more satisfaction at the work place.

Other studies suggest that regular physical activity – particularly walking – mitigates natural cognitive decline in seniors.[29] Furthermore, studies show that children who bike or walk to school demonstrate more concentration/focus and achieve higher standardized test scores than peers who are driven or bussed to school.[30]

2.6 Economy

Throughout the U.S., more and more research shows that bicycling and bicycle facilities can stimulate the local economy. Facilities such as bicycle boulevards that break down the barriers to riding and attract new riders can be particularly impactful. There are many ways that bicycle boulevards can help benefit the Tucson economy. There is a significant monetary value associated with the benefits previously described in this chapter:

Safety - Bicycle boulevards improve safety for bicyclists; data shows that existing bicycle boulevards and corridors that have some of the bicycle boulevard elements have a significantly lower crash rate. Crashes can cause physical and emotional damage to the individual, but there is also an economic cost associated with crashes. Implementing a bicycle boulevard network in Tucson can result in fewer overall crashes and less severe crashes, saving Tucsonans money. The Federal Highway Administration estimates the cost of a crash ranges from $7,400 to $4 million depending on the injury severity involved.[31]

Accessibility - Increasing mobility for individuals of all ages and socioeconomic levels results in increased educational, economic and health options. A bicycle boulevard network can make it easier to access services without relying on a vehicle for every trip. The cost of owning and operating an average sedan is estimated to be $8,698. This averages out to approximately $725 per month or $0.58 per mile if the vehicle is driven for the US yearly average of 15,000 miles.[32]

Environment – By attracting new riders and facilitating a reduction in car trips, bicycle boulevards can support the health of the Sonoran Desert and save the region money. There is vast research on the cost of motor vehicles on the environment. For instance, vehicular emissions in California have contributed to air pollution which is estimated to cost the state $28 billion annually (up to $1,600 per person).[33]

Health – Bicycle boulevards help promote and encourage bicycle riding. Bicycle commuters can meet the recommended daily exercise quota as part of their transportation needs, without the cost or time associated with going to a gym. By increasing even modest amounts of riding, there could be a substantial health care cost savings. Research shows that if bicycling participation increased enough to reduce obesity by 3%, national medical expenditures could be reduced by $6 billion.[34]

Bicycle boulevards can also boost the local economy by improving real estate values, increasing spending at local businesses, attracting jobs to the region, and helping to create a healthier and more productive workforce.

Real Estate – Bicycle boulevard improvements such as traffic calming and green infrastructure can contribute to higher real estate values along the streets and in the neighborhoods they pass through. According to a study done by CEOs for Cities, a cross-sector organization that develops ideas to make U.S. cities more economically successful, "houses located in areas with above-average walkability or bikability are worth up to $34,000 more than similar houses in areas with average levels."[35]

Courtesy Mark Markovich

HOW'S BUSINESS?

Jobs and Workforce - As cities across the U.S. look to compete for corporations that bring high-paying jobs, bicycle-friendliness and quality bicycle infrastructure are essential. Executives of Tucson businesses such as Mister Car Wash, and most recently Caterpillar, have indicated that access to multi-modal transportation was a factor in locating their company in the urban core of Tucson. These types of employers not only bring new talent to a community, but they tend to improve the local economy and raise wages and quality of life for residents of all ages and socioeconomic levels. In Portland, OR, 62% of new arrivals in 2009 reported that the city's bike friendliness was a factor in their decision to move there.[36]

Businesses also see other general benefits when their community encourages active transportation through improved and expanded biking and walking infrastructure. Employees who commute with active transportation tend to take 15% fewer sick days and use fewer healthcare dollars than their driving colleagues.[37] They also have up to 55% lower health care costs and up to 52% increased productivity.[38]

Support Local Businesses - Bicyclists and pedestrians portend good things for the local business community. Studies show that while bicyclists spend less per visit, they visit local businesses more often and overall spend more money than motorists.[39]

Finally, building bicycle boulevards in Tucson is the most cost-effective approach to provide a low-stress bikeway network that can attract more riders and achieve the benefits described in this section. Bicycle boulevards utilize the existing roadway, thereby avoiding costly property acquisition that other types of facilities may require. The cost per mile to build a bicycle boulevard in Tucson is approximately $165,000. The entire bicycle boulevard network (193 miles) could be built for roughly $31.7 million.

2.7 Community

Bicycle boulevards do not simply transport people to their destinations; bicycle boulevards can help strengthen the communities they serve, as well.

A study of perceptions of residents who lived along a bicycle boulevard in Portland, OR showed that, "the majority of respondents felt that the bicycle boulevard had a positive impact on home values, quality of life, sense of community, noise, air quality, and convenience for bicyclists. Additionally, 47% of respondents said living on a bicycle boulevard makes them more likely to bike."[40]

Neighborhoods with a high rate of bicyclists and pedestrians also enjoy the benefit of additional "eyes on the street." A seminal research study by Angel (1968) found that the amount of crime in an area is inversely related to the level of activity in the area.[41] As such, we tend to see lower crime rates in areas with higher rates of biking and walking. That lower crime rate may encourage more bicycling and walking, especially by families – this is known as "The Positive Security Cycle."

Intersection painting event in Dunbar Spring Neighborhood, along the Third Street/ University Bike Boulevard, brings the community together.

Safer communities with more active street life create tighter bonds and show stronger social cohesion. Studies suggest that children who regularly bike and walk develop a stronger appreciation for and connection to their neighborhood as compared to children who are dependent on their parents to drive them.[42] A child's connection to their community may make them less likely to engage in vandalism and petty crime.

Adults, too, enjoy the social benefits of bicycle and pedestrian infrastructure and increased rates of biking and walking, which can strengthen neighborhood identity and encourage grassroots collaborations to improve a neighborhood and the surrounding area. There have already been several examples of Tucson neighborhood groups mobilizing in order to beautify a bicycle boulevard and contribute to their local environment:

1) Residents of the Dunbar Spring neighborhood have held an intersection painting party and have had several planting events centered around the Third Street/University Bicycle Boulevard.

2) Broadmoor-Broadway Village Neighborhood Association organized a fun social event to celebrate the installation of a bicycle and pedestrian crossing along the future Treat Bicycle Boulevard. The event was an opportunity for residents to get to know their neighbors and was also an opportunity to collaborate with an adjacent neighborhood association and local businesses.

3) Feldman's Neighborhood has coordinated several tree plantings along the Fourth/ Fontana Avenue Bicycle Boulevard with area residents and community volunteers.

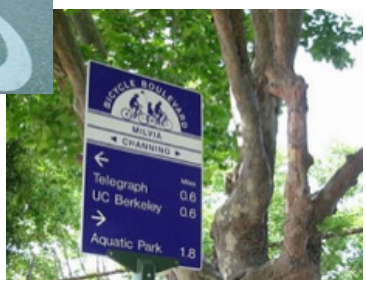
3. CASE STUDIES

Numerous American cities have implemented bicycle boulevards. This section highlights some lessons we can learn from our neighbors.

Berkeley, CA – Home of the First Bicycle Boulevard

- Berkeley is the birthplace of the term "bicycle boulevard." In 1999, city government developed a network of seven bicycle boulevards to provide continuous and comfortable bicycling routes to shopping districts, schools, and public transit stations.
- The success of the earliest bicycle boulevards is due, in part, to planners' careful selection of traffic calming treatments and traffic diverters that made the corridors attractive to bicyclists.
- Berkeley's bicycle boulevards are easily identifiable due to distinctive signage and pavement markings. Wayfinding signs help bicyclists and pedestrians navigate the network and find important destinations, such as schools, parks, and museums.

Large bike symbols inform the drivers of the street's nature



Wayfinding signs help brand the bike boulevards citywide

Portland, OR – From Bicycle Boulevards to Neighborhood Greenways

- Portland uses the term "neighborhood greenways" instead of bicycle boulevards to emphasize how the same design strategies that promote cycling provide safer, more comfortable, and more attractive routes for walking, as well.
- Portland's neighborhood greenways are active transportation corridors for people of all ages and abilities to enjoy.
- Rather than building separate facilities for different mode users, bicycle boulevards are a cost-effective way to meet the needs of nearly everyone. According to the Portland Bureau of Transportation, "The decision to prioritize the development of bicycle boulevards was driven by a desire to improve safety and to provide cost-effective facilities that work for the vast majority of Portlanders."[1]
- In 2015, Portland developed a Neighborhood Greenway Assessment Report that evaluated the existing 70 miles of greenways and provided operational performance recommendations for the network.[2]

Cyclists enjoy safe and comfortable riding conditions

Diverters deter cut-through traffic from entering the Greenway

Seattle, WA – An Open Planning Process

- Seattle – which also calls their bicycle boulevards "neighborhood greenways" – has an open planning process for their network.
- While the 2012 Neighborhood Greenways Design Toolkit lays out the basic design and implementation guidelines, a wide range of stakeholders – including residents, business owners, elected officials, and city staff – participate in the neighborhood greenways planning process.

Stakeholders at a neighborhood planning meeting (Photo: Seattle Neighborhood Greenways.org)

Streets become friendlier to pedestrians and cyclists of all ages and abilities

Albuquerque, NM – Slower Speeds for Safety

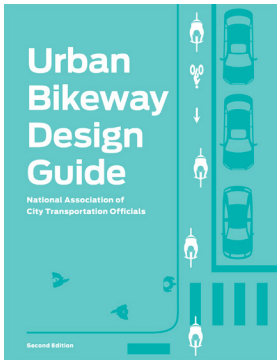
- No two bicycle boulevards are exactly the same. Planners choose from a toolbox of traffic-calming, traffic mitigation, and other safety elements to meet the needs of the street and surrounding neighborhood. These safety elements are published by National Association of City Transportation Officials (NACTO) and are summarized in the Design Elements section of this document.
- Albuquerque is an excellent example of how cities can create unique features that work well for a particular boulevard. One of Albuquerque's bicycle boulevards has a speed limit of 18 mph – the unique number is readily noticed by motorists.
- In addition to other traffic-calming features, lower speeds make the bicycle boulevard a safer place to bike and walk.

Columbia, MO – Evaluation Shows That Bicycle Boulevards Make Better Streets

- Average speeds were reduced by two miles per hour (from 26 mph to 24 mph) after traffic calming measures were introduced on Columbia's first bicycle boulevard.[3]
- Bicycle traffic more than doubled (from 33 to 71 riders) during peak travel time, and motor vehicle traffic declined by 45% (from 942 to 522 vehicles per day) on the bicycle boulevard due to traffic volume management elements, such as restricted turns onto the bicycle boulevard.[4]
- A city-wide survey found that a large majority of residents – not just bicyclists – liked the bicycle boulevard and agreed that it "improves the image of the neighborhood."[5]

4. DESIGN ELEMENTS

National Guidance



The following section outlines a series of design elements that may be used to enhance the biking and walking environment on residential corridors. It is meant to serve as a 'tool-box' of options for Tucson stakeholders to draw from when implementing bicycle boulevards.

In an effort to stay consistent with national standards and to utilize best practices, the City of Tucson follows the bicycle boulevard guidance provided by the National Association of City Transportation Officials (NACTO) when implementing projects. The NACTO Urban Bikeway Design Guide outlines eight design elements that serve as the backbone for creating bicycle boulevard corridors. The NACTO Urban Bikeway Design Guide is endorsed by the Federal Highway Administration and, therefore, is a nationally recognized manual that provides explicit design guidance for bicycle boulevards.

This section of Tucson's Bicycle Boulevard Master Plan summarizes the design elements described in the NACTO Urban Bikeway Design Guide. For more detailed guidance on these elements, including photos of each element from several U.S. cities, visit: **http://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/**

NACTO Urban Bikeway Design Guide-Bicycle Boulevards

The eight design elements of bicycle boulevards defined by NACTO and described in this chapter are:[1]

1. Route Planning: Direct access to destinations
2. Signs and Pavement Markings: Easy to find and to follow
3. Speed Management: Slow motor vehicle speeds
4. Volume Management: Low or reduced motor vehicle volumes
5. Minor Street Crossings: Minimal bicyclist delay
6. Major Street Crossings: Safe and convenient crossings
7. Offset Crossings: Clear and safe navigation
8. Green Infrastructure: Enhancing environments

4.1 Route Planning

Proper route planning is essential to achieving a successful bicycle boulevard network. Routes will be unappealing to cyclists if they are illogical, require frequent or unnecessary stopping, include unsafe major street crossings, or if they share roadways with high motor vehicle volumes and speeds.

- **CONNECTIVITY**

  Routes should be selected that follow relatively continuous lines with minimal deviations while maximizing connections with other bicycle infrastructure like bike lanes, urban greenways, and shared use paths. Bicycle boulevards complement existing infrastructure by providing alternative low-stress access to various destinations, like schools, grocery stores, business centers, shopping/entertaining districts, parks, and libraries.

  The typical north-south/east-west grid characteristic of Tucson's development pattern is ideally suited for the development of an integrated network of residential streets for bicycle boulevard improvements. To every extent possible, the proposed alignment of bicycle boulevards in Tucson has been made to maximize their directness, provide frequent connections with other bikeways, and access prominent destinations.

  The City of Tucson Department of Transportation has identified 64 corridors for future bike boulevard development. Totaling 193 miles, the corridors range from one half-mile to eight miles in length and are spaced approximately one half-mile apart. In total, there are 91 connections to existing or future shared use paths like The Loop and Tucson's urban greenways. Within one quarter-mile of the proposed corridors there are 188 schools, 154 parks, and 14 public libraries. When the entire network is complete, 44% of Tucsonans will have access to a bicycle boulevard within ¼ mile of their homes.

- **IDENTIFICATION**

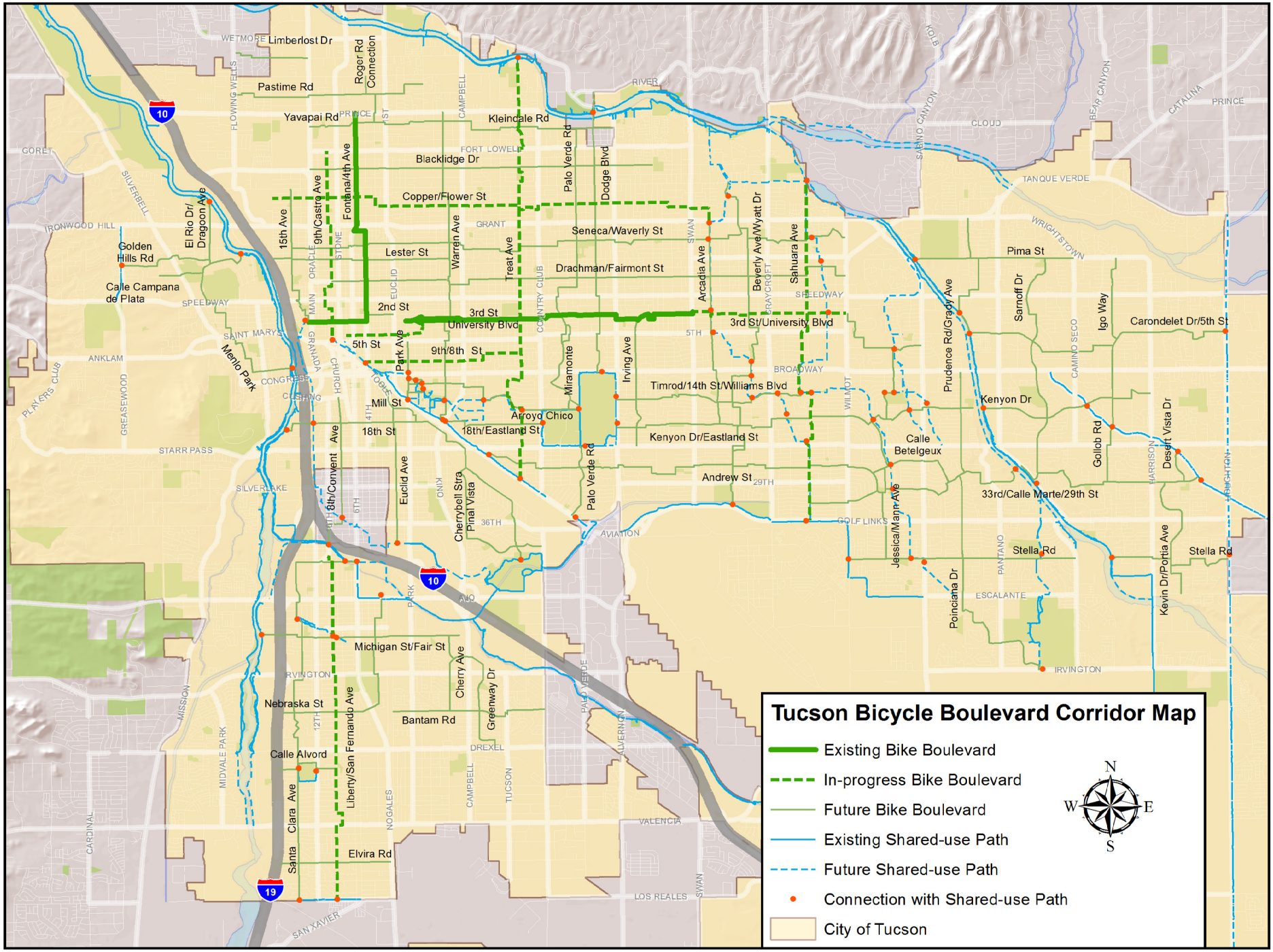
  Bicycle boulevards are attractive to most cyclists because they are located on quiet, residential roadways. This advantage also poses a challenge, as these routes may be less visible and challenging to follow. One goal of the bicycle boulevard network is to attract cyclists by making the routes clearly visible and identifiable as bicycle priority routes. A second goal is to alert drivers to the presence and prioritization of bicycles on the route. These dual goals may be accomplished through a combination of public outreach and education, as well as signage and pavement markings (described in the next section).

- **BICYCLE BOULEVARDS AND EMERGENCY VEHICLE ROUTES**

  Most emergency response routes are located on major roads that allow for automobile traffic to easily move out of the way of emergency vehicles. These streets rarely coincide with bicycle boulevards. However, destinations along a bicycle boulevard must also be accessible by emergency vehicles with as little delay as possible. Several treatments that lower general traffic speeds and volumes while minimizing constraints for emergency vehicles are outlined below. The Tucson Fire Department will be consulted during the design phase of bicycle boulevard implementation and acceptable emergency vehicle clearance distances and delays will be maintained.

Exhibit 4.1

Tucson Bicycle Boulevard Corridor Map



4.2 Signage and Pavement Markings

Visibility is a crucial element of a successful bicycle boulevard network. Appropriate signage and pavement markings alert all roadway users that they are on a street that prioritizes bicycle and pedestrian travel. They help unify the network with consistent branding and attract new riders by drawing attention to otherwise unknown bike routes. Signs and pavement markings should be used in combination with other traffic calming treatments to create a safe and effective bicycle boulevard network.

According to NACTO, there are three applications for signing and pavement markings on bicycle boulevards:

Modified street signs: A bicycle symbol or other unique identifier can be placed on a standard road sign to help increase visibility of the bicycle boulevard. Consistently applying a unique color scheme throughout the network helps increase visibility and familiarity with these bicycle priority streets. To date, Tucson has not modified existing street signs with bicycle boulevard branding. However, large signs have been added at major arterial roads to help market and educate motorists about the Bicycle Boulevard corridor.

Wayfinding signs: Wayfinding signs help brand the network, alert users to turns in the route, and may provide information about nearby destinations including distance and/or time. Tucson has developed its own bicycle boulevard sign program shown here.

Shared lane markings.

Dinner plate.

Pavement markings: Pavement markings help to identify the route as a bicycle boulevard and alert cyclists when there are direction changes along the route. Tucson uses shared lane markings (commonly referred to as sharrows or SLMs) and 'dinner plates' on the bicycle boulevard network.

- **SHARED LANE MARKINGS**

  Like many cities, Tucson has elected to use shared lane markings on the bicycle boulevard network. Shared lane markings (SLMs) are included in the Manual on Uniform Traffic Control Devices (MUTCD) and therefore are approved for use on the roadway. SLMs primarily help to:

  - Alert motor vehicle drivers to the potential presence of bicyclists
  - Position bicyclists more safely in the lane and outside of the "door zone" or the space where the car door swings into when drivers enter/exit their vehicles.

  According to the MUTCD, SLMs should be placed immediately following intersections and spaced at intervals not greater than 250 feet thereafter.

- **DINNER PLATES**

  Tucson also uses circular bike dots, or 'dinner plates' with directional arrows to help guide users through turns along the route.

4.3 Speed Management

Maintaining slow motor vehicle speeds is essential for creating a low-stress bicycle route that is attractive to all types of riders. A primary advantage of a bicycle boulevard over other types of bikeways is the inherent low-volume, low-speed nature of its roads. Additional speed management measures – also known as traffic calming – bring motor vehicle speeds closer to those of bicyclists to promote a safer and more comfortable cycling environment.

NACTO guidance suggests that streets developed as bicycle boulevards should have 85th percentile speeds of 25 mph or less (20 preferred). Bicycle boulevards should not have posted speed limits greater than 25 mph.[2]

Some cities such as Portland, Oregon and Albuquerque, New Mexico have the authority to lower the speed limit on residential streets to below 25 mph if certain conditions are met. The City of Tucson is currently in the process of determining whether cities have legal authority to lower speed limits on residential streets in the State of Arizona and evaluating the feasibility of doing so on the bicycle boulevard network.

Traffic calming measures fall into two main categories: vertical and horizontal deflection. Vertical deflection refers to elevated sections of pavement that require vehicles to slow down when crossing them. Horizontal speed control measures narrow the roadway requiring motorists to slow down in response to a curving path.

- **VERTICAL DEFLECTION**

  Speed hump: Speed humps of 3 to 4 inches high and 12 to 14 feet long reduce motor vehicle speeds to 15-20 mph. For maximum effectiveness, speed humps should be placed in a series with no two speed humps more than 300-500 feet apart. Longer separation may increase speeds as drivers attempt to make up for lost time.

  Speed table: Speed tables are 22-foot long speed humps with a height of 3 to 3.5 inches and a 10 foot flat section in the middle. Longer speed tables with more gradual curves are more comfortable for cyclists although may allow for increased motor vehicle speeds of 25-35 mph. Unlike speed humps, they may be used on collector streets, transit and emergency response routes.

  Raised crosswalk: A raised crosswalk has similar dimensions as a speed table with additional markings and signage for pedestrian crossing.

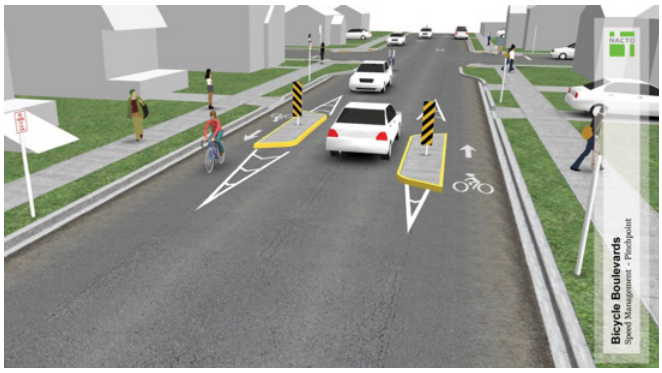
- **HORIZONTAL DEFLECTION**

  Curb extension: Also known as bulb-outs, curb extensions extend the sidewalk or curb face into the parking lane at an intersection. They visually constrict the roadway, thereby encouraging slower driving. They also narrow the crossing distance for pedestrians, and increase visibility among motorists, cyclists and pedestrians at intersections where parked cars would have created an obstruction. Curb extensions can act as stormwater management features and increase available space for street furniture, landscaping, and public art.

Edge island: Edge islands are curb extension that leave a gap along the curb to allow for improved stormwater drainage.

Chicane: Chicanes create an S-shaped path of travel by utilizing a series of edge islands or curb extensions on alternating sides of a street. Drivers are required to slow down to navigate a curving path.

Neighborhood traffic circle: Traffic circles placed at residential intersections are raised or delineated islands that reduce vehicle speeds by narrowing turning radii and narrowing the travel lane. Traffic circles can incorporate green infrastructure design principles that promote rainwater harvesting, storm water management, native plant habitat, public art, and contribute to neighborhood beautification.



Rendering Credit: NACTO

Pinchpoint: Pinchpoints use curb extensions or edge islands to narrow travel lanes such that two motor vehicles have difficulty passing at the same time. Pinchpoints should only be used where traffic speeds are already low. On a bicycle boulevard, cut-through passageways should be provided to the outside of the pinchpoint to accommodate bicyclists.

Neckdown: Neckdowns are pinchpoints located at low-volume residential intersections that narrow at least one side of the intersection using edge islands or curb extensions.

Center island: Center islands are short sections of raised median that effectively narrow travel lanes without blocking driveways. When placed in the center of a bicycle boulevard, they function as a speed management tool and pedestrian refuge for crossing the bicycle boulevard. Center islands may also be used on streets that intersect the bicycle boulevard to facilitate off-set crossings, assist with motor vehicle volume management, and provide refuge space for cyclists and pedestrians when crossing larger roads.

- **Combined Vertical and Horizontal Deflection**

  Vertical and horizontal deflection treatments can often be used together to enhance speed management goals along a bicycle boulevard. Common combinations include raised crosswalks with pinchpoints, raised intersections with pinchpoints, and speed humps with center islands, chicanes or pinchpoints.

Combined speed hump with curb extension

Combined speed hump with landscaped center median

Feasibility Survey of Lowering Speed Limits to 20 mph on Tucson's Bicycle Boulevards

Krista Hansen, a graduate student at the University of Arizona College of Public Health at the time, worked with the City of Tucson Bicycle and Pedestrian Program to evaluate the feasibility of lowering speed limits to 20 mph on Tucson's bicycle boulevards. Hansen conducted a public opinion survey and interviewed key decision makers in Portland and Tucson to assess the implementation process and gauge local support.

In Portland, 20 mph speed limits have been well received by the public and have contributed to reducing crashes among all modes of transportation. Interviews in Tucson revealed concerns about public opposition and compliance, however survey results told a different story. The majority (63%) of 1360 survey respondents would support a law that lowered speed limits to 20 mph on certain residential streets. 66% of respondents stated that they would feel safer walking or biking on these streets.[3, 4]

4.4 Volume Management

The number of vehicles on shared roadways, like bicycle boulevards, significantly impacts the comfort level of people on bikes. Higher motor vehicle volumes result in more incidents of cars overtaking bikes, and decrease the comfort and perceived safety of cyclists. In order to provide a low-stress bicycle facility that attracts cyclists of all ages and abilities, NACTO guidance recommends keeping motor vehicle volumes below 1500 vehicles per day (vpd) with up to 3000 vpd allowed on limited sections of a corridor.[5]

Volume management measures reduce cut-through motor vehicle traffic by prohibiting certain movements on select corridors and intersections along a route. Most volume management tools do not restrict residents from accessing their home or apartment, but rather are intended to reduce cut-through traffic. They may be used to maintain existing low motor vehicle volumes on roadways that already have fewer than 1500 vpd, or to reduce traffic volumes on roads with between 1500 - 3000 vpd. For short sections of a bicycle boulevard with traffic volumes over 3000 vpd, buffered or separated bike lanes should be considered to maintain the low-stress character of the route.

What follows is a selection of volume management measures that can be used to prohibit through or turning movements for motor vehicles while permitting passage for bicyclists and pedestrians.

Forced turn: Forced turns at intersections restrict through movements for motor vehicles while allowing bicycles to pass. Forced turns can be achieved with physical barriers or with the exclusive use of signs that allow for emergency vehicles to continue straight. Lack of physical barriers may achieve poor compliance by motorists.

Channelized right-in/right-out island: A type of forced turn, channelized right-in/right-out treatments use physical barriers to deny through movements for motor vehicles at intersections. Some treatments use cut-outs in the island allow passage for bikes and provide a refuge from cars turning onto the bike boulevard from the cross street.

Partial closure: Partial closures across one direction of travel at intersections allow through movements for bicyclists while restricting motor vehicle access to one side of the roadway. Motor vehicles traveling along the bicycle boulevard are forced to turn onto the cross street while those travelling on the cross street are denied entry onto the bicycle boulevard.

Source: NACTO

Median island/diverter: Median islands restrict through movements for vehicles and provide a refuge for cyclists crossing a larger cross street. This treatment is especially effective where bicycle boulevards cross streets with two-way center left turn lanes.

A median island/diverter on Glenn Street restricts through movements for cars while providing a refuge for cyclists traveling on the Fontana Bicycle Boulevard.

Snake diverter: A snake diverter is a raised curb along the centerline of the cross street that restricts through movements for motor vehicles with less impact to traffic on the cross street. A narrow channel allows people on bikes to pass through but does not provide a crossing refuge. This is a good option for median diverters on cross streets without two-way center left turn lanes.

Source: NACTO, Portland, OR

Diagonal diverter: Diagonal diverters at minor four-way intersections require motor vehicles approaching from all directions to turn while permitting cyclists and pedestrians to pass through. NACTO guidance suggests a 6- to 10-foot wide refuge area be provided to allow crossing cyclists and pedestrians to wait for a gap in traffic which is forced to turn across the feature.

Source: NACTO

Full closure/diverter: A full closure completely restricts through travel for motor vehicles by creating a "T" while allowing bicyclists to continue unrestricted. Full closures can be designed to allow for emergency vehicle passage when necessary.

Source: NACTO

4.5 Minor Street Crossings

Minor street crossings are intersections where a bicycle boulevard crosses a similar low-speed, low-volume residential street with a maximum posted speed limit of 25mph. In these circumstances, crossing treatments should primarily seek to prioritize bicycle travel and minimize delay for cyclists on the bicycle boulevard.

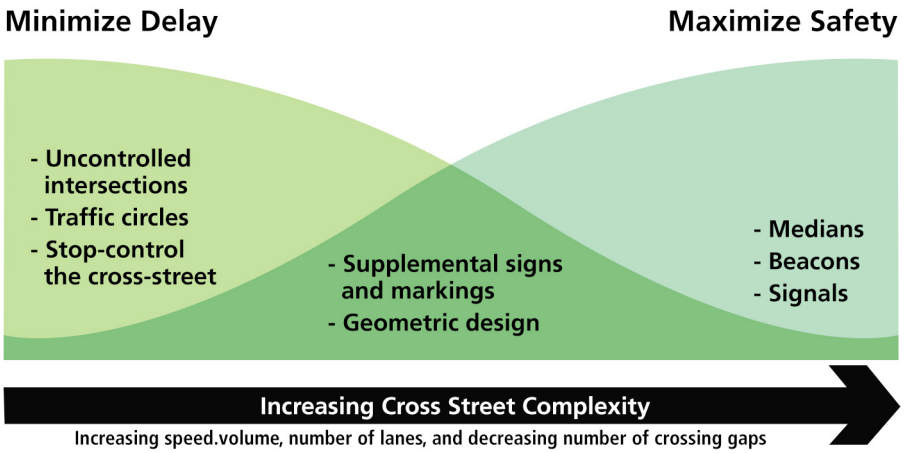
Frequent stop signs greatly increase travel times and energy expenditure for cyclists. They may be viewed as unnecessary by the cyclist, resulting in low compliance, selection of other routes, or not biking at all. Stop signs on bicycle boulevards should be reoriented to control traffic on cross streets, allowing for continuous bicycle travel. NACTO suggests that stretches of at least one half-mile or more without stop sign control are desirable. Speed and volume management measures should be implemented together with this approach to prevent these corridors from being overused as shortcuts by motorists.

Neighborhood traffic circles with four-way yield signs are an effective tool for minimizing bicyclist delay and slowing motor vehicle speeds. Where a bike boulevard intersects with another bike boulevard a traffic circle with a four-way yield is the preferred treatment for both safety and for delay. In some cases, traffic circles require additional deflection to slow motor vehicles, which could be posts in the ground, curb extensions or chicanes.

Pavement markings and warning signs may be used at or in advance of intersections to alert drivers to the likely presence of cyclists crossing their path.

Exhibit 4.2

Intersection Complexity and Bike Boulevard Crossing Treatments[6]



This graphic from the NACTO Urban Bikeway Design Guide presents the relationship between minimizing delay and maximizing safety for bicyclists at different types of intersections.

4.6 Major Street Crossings

Major street crossings can create serious obstacles to the comfort and safety of cyclists and pedestrians using a bicycle boulevard. In order to achieve an effective low-stress corridor that attracts people of all ages and abilities, there must be a safe way to cross busy roadways. Fortunately, Tucson has been leading the nation in innovative crossing treatments for pedestrians and bicyclists.

- **UNSIGNALIZED INTERSECTIONS (3 OR FEWER LANES)**
  For cross streets with three or fewer travel lanes and posted speed limits at or below 35 mph, advance warning signs, curb extensions, bicycle forward stop bars, and intersection crossing markings are potential treatments. Each intersection needs to be evaluated for the best treatment.

Modified Refuge Island/ Traffic Diverter: For a three-lane road, a modified refuge island that also serves as a traffic diverter improves safety along the bicycle boulevard. Cyclists can cross one lane of traffic and have a protected place to wait for a gap in traffic to cross the other lane. Motor vehicles can turn onto the bicycle boulevard from the major street but must turn right if they approach the intersection from the bicycle boulevard.

Median refuge island: Median refuge islands offer cyclists and pedestrians a protected place to wait while crossing streets that are too wide or have too many motor vehicles to cross all at once. Along the bicycle boulevard they may be used in combination with high visibility crosswalks or active warning beacons to further alert drivers that they are crossing a bicycle and pedestrian priority route.

Bicycle forward stop bar: Used in conjunction with a curb extension, bicycle forward stop bars encourage cyclists to stop in front of motor vehicle traffic offering a shorter crossing distance, an improved view of cross traffic, and better visibility of cyclists waiting to cross.

Source: NACTO, Portland, OR

Intersection crossing markings: Often used in conjunction with advance warning signs, intersection crossing markings bring better visibility to cyclists crossing the major street and alert drivers to their presence.

Source: NACTO, Chicago, IL

- **UNSIGNALIZED INTERSECTIONS (4 OR MORE LANES)**

  Crossing streets with four or more travel lanes and posted speed limits of or greater than 35 mph can be challenging for even experienced cyclists. Without a crossing treatment, these types of intersections can be too much of a barrier for some to consider bicycling at all.

  As mentioned, Tucson has been a pioneer in the development of safe crossings for bicycles and pedestrians. In particular, the work of former Tucson Traffic Engineer Dr. Richard Nassi has advanced the technical solutions available that save lives. Dr. Nassi developed several design treatments; the two most appropriate treatments for busy crossings along bicycle boulevards are BikeHAWKs and TOUCANs.

  Certain roadway, traffic, and bicycling factors lend themselves more to the use of a BikeHAWK or a TOUCAN. TDOT has done a study to determine the conditions for which each treatment is recommended. The bicycle boulevard implementation process will continue to use the results of the study to determine the best crossing solution for locations where bicycle boulevards intersect busy arterial roads.

Pedestrian and cyclists cross Speedway Boulevard at a BikeHAWK on 10th Avenue.

BikeHAWKs (enhanced Pedestrian Hybrid Beacons): Pedestrian Hybrid Beacons – better known in Tucson as HAWKs (High Intensity Activated Cross WalKs) – facilitate crossings of busy streets without resulting in additional traffic on the residential side street. They are demand-activated by cyclists or pedestrians trying to cross a major street and temporarily stop cross traffic to provide a protected gap for crossing. HAWKS are in the Manual of Uniform Traffic Control Devices (MUTCD) and are used throughout the U.S.

A BikeHAWK begins with the standard HAWK design, but includes features for the safety and convenience of cyclists. A BikeHAWK may include a short two-way protected bike lane as a lead-up to the crossing, a designated bike crossing area (usually dashed green) adjacent to the crosswalk, signs indicating that cyclists should use the pedestrian signal, illuminated signs indicating when cyclists should wait and when they may proceed, and a pushbutton within easy reach by bicyclists.

Cyclists wait to cross Stone Avenue at a TOUCAN on the University Bicycle Boulevard.

TOUCANs: TOUCANs, which stands for TwO groUps CAN cross, are used in areas of high cyclist and pedestrian activity, are demand-activated, and use a standard red-yellow-green signal head for motorists. Unlike HAWKs, TOUCANs also function as a volume control measure by restricting motor vehicle cut-through traffic.

- **SIGNALIZED INTERSECTIONS**

  Fully signalized intersections already provide gaps in traffic for crossing major streets. However, there are a variety of treatment options that can increase the comfort and safety of cyclists at these intersections. To prevent unwanted cut-through traffic, it may be necessary to include volume management treatments like: signs that prohibit through movements, right-in/right-out splitter islands, and partial closures.

  The following are features that can be added to signalized intersections to increase the comfort and safety of bicyclists; features can be used separately or in combination. Ultimately, the decision of which features to use is context sensitive.

Bicycle detection and actuation: Fully signalized intersections on a bike boulevard should provide bicycle detection and actuation. Almost all traffic signals in Tucson have cameras that detect cyclists. Additional pavement markings can assist cyclists in proper positioning to actuate the signal.

Bike button: Where automatic detection is not available, and there is no right turn lane, adding a push button at the curb accessible to a cyclist without dismounting is an option.

Bicycle signal head: Separate bicycle signal heads can provide a protected bicycle signal phase where there are no conflicts with motor vehicles, or a leading bicycle interval allowing cyclists to proceed in advance of other traffic.

Bike Boxes: Bike boxes provide a space for cyclists to queue at a traffic light ahead of cars improving their visibility and allowing them to take advantage of a short green signal phase. Other benefits include facilitating left turn positioning, helping prevent "right hook" conflicts with turning vehicles, grouping bicyclists together to clear an intersection quickly, and discouraging motor vehicles from encroaching on crosswalk space.

4.7 Offset Street Crossings

Bicycle boulevards periodically intersect cross streets asymmetrically, requiring users to make short detours along an intersecting roadway before continuing on the bicycle boulevard. These are known as "offset crossings." There are a variety of treatments that may be considered to facilitate comfortable, low-stress access for cyclists and pedestrians. Appropriate treatments vary depending on the characteristics of the cross street.

For minor cross streets, wayfinding signage and pavement markings, including shared lane markings and/or dinner plates, help guide users through jogs in the route. For major street crossings, treatments vary depending on the width of the street and whether the route jogs to the right or left.

Cyclists using the Third Street Bicycle Boulevard are directed along a two-way separated bike path adjacent to the sidewalk in order to make the offset crossing at Alvernon Way.

Two-way separated bike lane or bike path: A two-way separated bike lane or bike path along one side of the intersecting roadway channels users to a single crossing location. This can be especially effective when combined with a hybrid beacon at the major street crossing.

Source: NACTO, Billings, MT

Median island: A median island is similar to a center left turn lane but has the additional protection of a raised curb. This can be used for jogs to the right or the left and may be combined with a signal.

Source: NACTO, Portland, OR

Pair of one-way separated bike lanes: A buffered or separated bike lane along both sides of an intersecting roadway that connects offset segments of a bicycle boulevard may be necessary for a cross street where no bike infrastructure currently exists.

Source: NACTO, Portland, OR

Center left-turn lane: A bicycle only center left turn lane is appropriate on streets with only one travel lane in each direction and when the route jogs to the right. It provides an area for cyclists to wait after merging across one lane of intersecting traffic before completing the crossing and continuing on the bicycle boulevard.

Two-stage turn queue box: A two-stage turn queue box uses pavement markings to indicate where cyclists can wait to cross the intersecting street. This should be considered in situations where the intersecting street already has a separated or buffered bike lane and where space permits the queue box to be placed without blocking the bike lane.

Source: NACTO, Portland, OR

4.8 Green Infrastructure

In the context of bicycle boulevards, green infrastructure refers to strategies for utilizing stormwater runoff and native plantings in the urban environment to achieve a host of social and ecological benefits. Many bicycle boulevard design elements like curb extensions, chicanes, traffic circles, and median islands offer excellent opportunities to incorporate green infrastructure practices like bioswales, vegetated infiltration basins, permeable pavement, plantings, and street trees.

"Green Streets" practices help utilize stormwater runoff onsite by providing water for vegetation which, in turn, create shade and reduce urban heat island effects, improve water quality, and provide a more attractive bicycle and pedestrian environment. These practices serve mutual goals of providing more attractive street corridors, while providing traffic management, and sound ecological design.

Bioswales and vegetated infiltration basins: Also known as rain gardens, these are landscaped depressions in or along a roadway that slowly infiltrate storm-water and filter pollutants. They provide passive irrigation for trees and vegetation that reduce urban heat island effects, beautify the streetscape, and provide natural shade for cyclists and pedestrians.

A curb cut and bioswale captures stormwater while native trees provide shade for cyclists and pedestrians.

Landscaped curb extension on Elm Street collects stormwater after a rain

Curb cuts allow stormwater runoff to enter a landscaped basin in the public right of way (Photo credit: Watershed Management Group)

Stormwater infiltrates a catchment basin with native landscaping along Scott Avenue (Photo credit: Watershed Management Group)

A landscaped basin along Park Avenue captures water during a storm (Photo credit: Watershed Management Group)

4.9 Other Amenities

Certain design features can play an important role in improving the streetscape quality and inviting more people to populate and enjoy Tucson's bicycle boulevards. Such amenities include public art, street kiosks, lighting, bike parking, street furniture and shade structures.

Public art: The use of public art that express the unique character of the communities along each bicycle boulevard can make walking and biking a more pleasurable and interesting experience.

Street kiosks can be used to provide information such as a bike map or transit map. They can also be used by the neighborhood to post information for local events or meetings.

Street lighting can improve the safety and comfort of cyclists and pedestrians. Lighting makes bicyclists and pedestrians more visible to drivers, enhances security, and helps users identify obstacles in the roadway. Street lights should be in compliance with Tucson's Outdoor Dark Skies Lighting Code. There are many different types of street lights that meet the requirement of the Dark Skies code while improving safety.

Bike corrals are on-street bike parking facilities that can provide parking for up to 18 bikes in a space that would accommodate just one car. They preserve sidewalk space for pedestrians, increase the visibility of bicycling, and can provide traffic calming benefits.

Source: SFMTA

Technologies such as automated bicycle and pedestrian detection, mobile applications, and emerging sensor-based infrastructure that communicate with motor vehicles may offer new ways to enhance the convenience, safety, and "visibility" of bicyclists and pedestrians. GPS data gathered from sensors, mobile app users, and smart infrastructure can help planners track travel patterns, crashes, and near misses to identify areas that may be improved through design modifications.

Pavement Condition

Pavement condition has a significant effect on the comfort and safety of cyclists. As such, it is an important factor in the effectiveness of a bicycle boulevard to attract riders. Many cyclists are likely to go out of their way to enjoy a ride on a well-paved street. At best, damaged pavement may create a frustrating and uncomfortable ride. At worst, bumpy, cracked or severely pot-holed roads can pose a challenge to a rider's ability to control a bike.

TDOT recognizes the significance of pavement conditions on bicyclists comfort and safety. When possible, TDOT implements higher quality resurfacing treatments on designated bicycle boulevards during regularly scheduled resurfacing projects. For example, during the June 2015 resurfacing of the Sam Hughes neighborhood, and the June 2016 resurfacing of the Peter Howell neighborhood, the Third Street Bicycle Boulevard was milled and repaved – in order to provide a better riding surface and to get the most value by investing in segments that are used far more than most other residential streets. In 2017 the Third Street Bicycle Boulevard in Miramonte East and Speedway/Swan neighborhoods will receive the same treatment.

Resurfacing schedules in the City of Tucson are currently overseen by the Bond Oversight Commission, created to administer the 2012 voter-approved Road Recovery Bond program. Efforts are being made to further prioritize the bicycle boulevard network for future resurfacing investments.

Users of the bicycle boulevard network are encouraged to inform the City of Tucson Streets and Traffic Maintenance Department if they notice hazardous conditions such as: large pot-holes, severe pavement cracking, broken glass, excessive debris, loose gravel, or vegetation that needs trimming. Anyone can report these issues by calling the Department of Transportation at (520) 791-3154 or emailing a service request to tdotsr@tucsonaz.gov.

Exhibit 4.3

TUCSON CLEAN & BEAUTIFUL INC.

Tucson Clean & Beautiful administers two stewardship programs for volunteers to get involved in maintaining and improving public spaces in their neighborhoods. Tucson's expanding network of bicycle boulevards are important, heavily used, and highly visible sites. This makes the role volunteers can serve in helping to maintain and improve public spaces more critical than ever through one or both of these programs:

The Adopt-a-Park & Public Areas program welcomes interested volunteer groups – such as neighborhood associations, civic clubs, and many others – to be stewards of bicycle boulevards to remove litter as well as monitor for and report other maintenance needs along their adopted corridor. Bicycle boulevard segments of up to one mile in length are available for adoption. Volunteers may also assist with other light maintenance tasks where appropriate along bike boulevards, such as raking, sweeping, and weed removal. Cleanup supplies and other assistance are provided for registered volunteer groups. Groups that make an ongoing commitment as stewards of a site can also qualify for recognition including a sign and public volunteer recognition ceremony. Visit the Adopt-a-Park & Public Areas page online at **tucsoncleanandbeautiful.org**, email **adoptapark@tucsonaz.gov**, or call **(520) 837-6834** for more information or to adopt a portion of a bicycle boulevard.

The Trees for Tucson program provides a variety of affordable desert-adapted trees, including home delivery, for area residents to plant in their yard. Trees are also available for interested residents to plant in neighborhood streetscapes including along bikeways. Tools, and other technical assistance are available for community volunteer tree planting projects to create well-shaded landscapes in their neighborhoods, including along bicycle boulevards. The Trees for Tucson Tree Tenders training offers the opportunity for area residents to learn more and participate in hands-on activities about proper siting, planting, and pruning of desert-adapted shade trees. Visit the Trees for Tucson program online **treesfortucson.org**, email **tft@treesfortucson.org** or call **(520) 837-6835** for more information about obtaining affordable trees or to participate in an upcoming planting project or tree workshop.

5. PUBLIC OUTREACH

Over the course of Tucson's history with bicycle boulevards, the City conducted various public outreach efforts to educate neighborhood residents and stakeholders about the bicycle boulevard initiative and to get input into the planning process. Public outreach efforts included an online survey, open houses, and key stakeholder meetings. There was also a working group that met on an as-needed basis to provide feedback on components of this plan. These efforts all contributed to the plan development and are described below.

5.1 BICYCLE BOULEVARD SURVEY

Overview

From December 2013 through May 2014, TDOT conducted an online survey in both English and Spanish to learn more about Tucsonans' biking and walking habits and preferences. The survey was advertised on the City of Tucson website, on facebook, in the Bike/Ped program monthly e-newsletter, and through ward offices.

More than 600 individuals completed the survey, ranging in age from 18 to over 70 years old (see Exhibit 5.4). Respondents were 49% male, 48% female, and 3% preferred not to answer.

Respondents lived in all different areas of Tucson, although the zip codes with the highest number of respondents were in north-central Tucson – 85719, 85716, and 85705.

The survey included six sections and took approximately 10 minutes to complete. Questions related to walking and biking habits, preferred destinations, naming of the network, marketing of the network, and respondent demographics.

Survey Summary and Highlights

This section summarizes the responses for each section of the survey and concludes with a summary of general trends.

WALKING

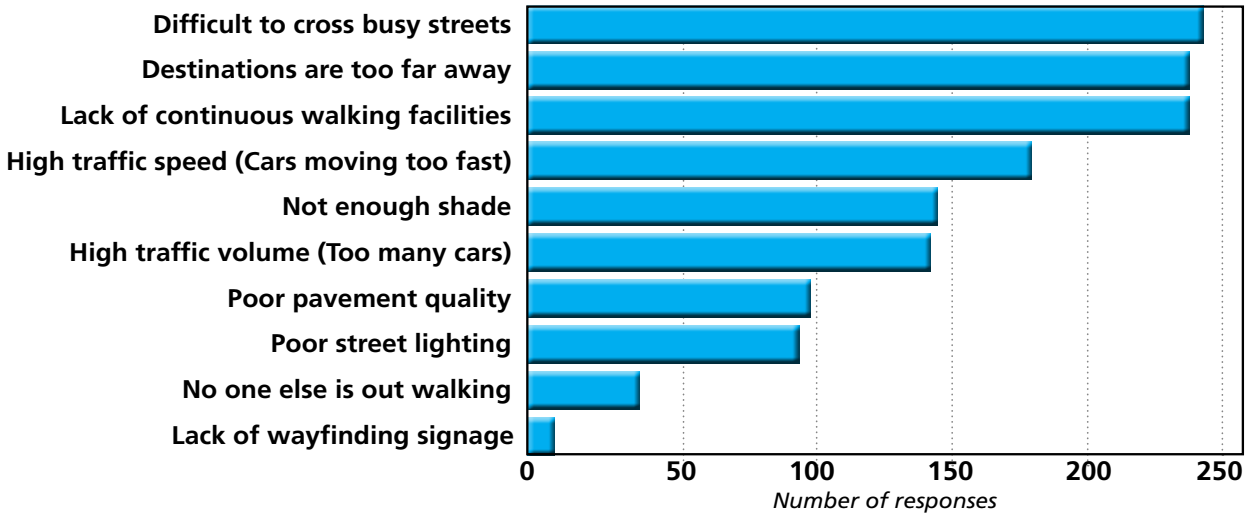
Respondents walk more than the Tucson average, with 46% of respondents walking every day. Most of the respondents walked for exercise or enjoyment, with only 20% of respondents reporting that most of their walking was for transportation (walking to a destination). Eighty-two percent of respondents said that they want to walk more often.

Given a short list of options, people most often say that they are prevented from walking by busy roadways that are difficult to cross, destinations that are too far away, and a lack of continuous walking facilities (sidewalks and paths). Respondents report that an area is a good place to walk if there are continuous sidewalks, push-button signals at intersections, and shade/landscaping.

Exhibit 5.1

Barriers to Walking

What prevents you from walking more often?



82%

of people say they want to walk more often than they do now

BIKING

Respondents bike more than the Tucson average, with most respondents riding at least two times a week. Respondents are evenly split on whether they biked mostly for recreation or transportation. Nearly all respondents (88%) say that they would like to bike more often. Given a short list of options, people most often say that they are prevented from biking by lack of continuous biking facilities, poor pavement quality, and high motor vehicle traffic speed. Write in responses frequently cite "safety" as a concern that prevents them from biking. Respondents say that an area is a good place to bike if there is quality pavement, low traffic speeds, and push-button signals to cross busy intersections (these items were all chosen from a short list).

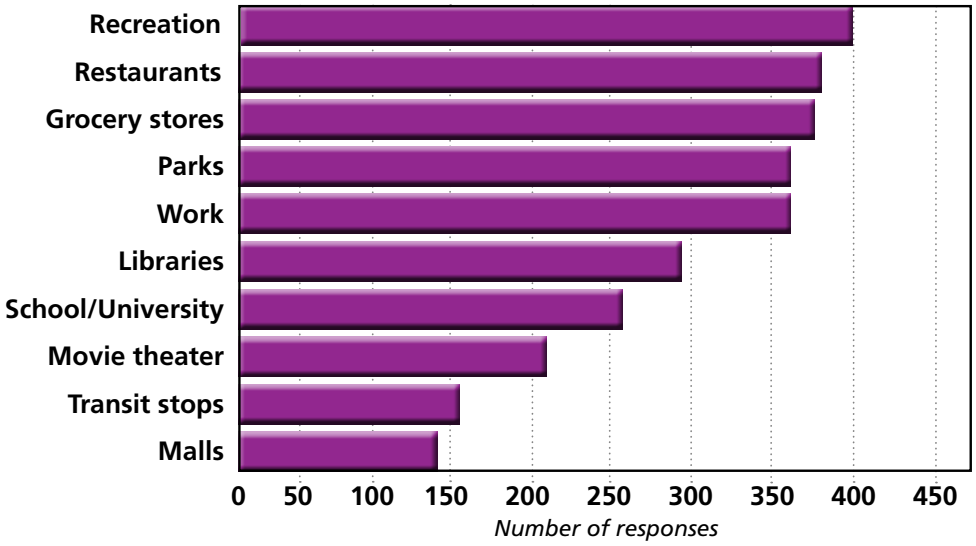
DESTINATIONS

When asked to choose from a short list of the destinations they would most like to walk or bike to, respondents most often say that they would like to bike to recreational destinations (such as The Loop and parks), work, and restaurants. Analysis of the write-in responses shows that respondents would also like to bike and walk to the homes of friends and family.

Exhibit 5.2

Popular Biking Destinations

What destinations would you like to walk or bike to?



NAMING

Given a short list of possible names for this residential network, most respondents prefer the name "Bicycle Boulevards" (the current name for streets in the network); "Urban Greenways" was a close second, and "Paseos" was a distant third. A follow-up question revealed that 76% of respondents had heard of the term "Bicycle Boulevards" before the survey, with 66% already knowing what the term meant.

MARKETING

All responses to the question "Where would you look for more information on walking and biking in Tucson?" confirm that respondents prefer to find their information online (e.g. the Bicycle and Pedestrian Program website); this response may be biased since the survey was conducted entirely online.

MOTIVATION

When given a short list of statements (below) that might convince someone to walk and bike more often, respondents overwhelmingly agreed that "personal health" was the most compelling reason.

Possible responses:

- Walking and biking are good for the local economy
- Walking and biking can save me and my family money
- Walking and biking are good for my health
- Walking and biking are good for the environment
- More walking and biking routes help me get to destinations more easily
- Lots of people in Tucson walk and bike
- None of these statements make me want to walk or bike

Exhibit 5.3

Motivation for Biking and Walking

Which of these statements make you want to walk or bike?

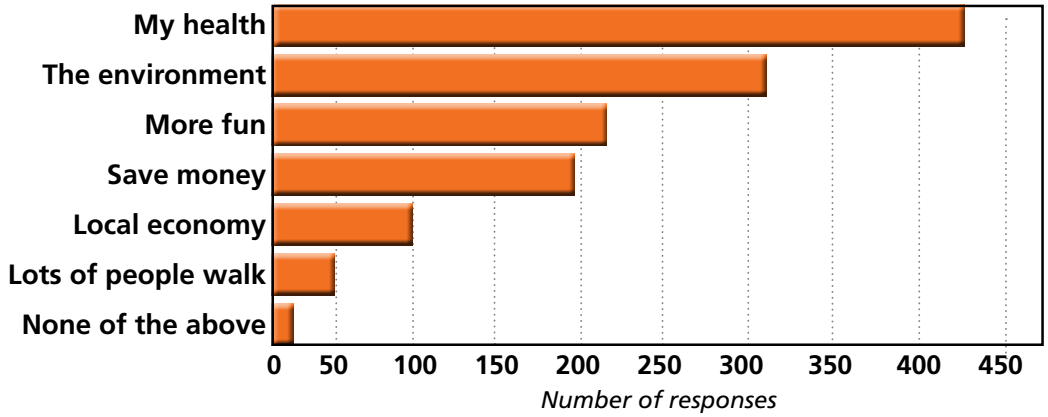
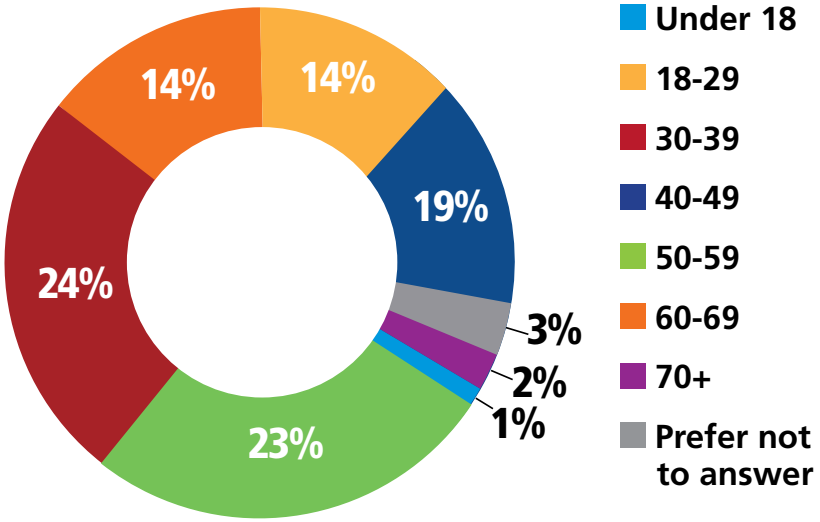


Exhibit 5.4

Age Distribution of Respondents



More than 600 individuals between the ages of 18 and 70 completed the survey.

SURVEY CONCLUSION

The survey was very helpful in developing the Bicycle Boulevard Master Plan and thinking through the most important design elements. The survey confirms that the general public is interested in a bicycle boulevard network. Tucsonans are interested in bicycling and walking more often, but are concerned for their safety. They feel that many bicycle boulevard features – such as safer crossings at major intersections, lower traffic speeds, and continuous facilities – will make their walking and biking trips more comfortable and convenient.

5.2 Open Houses

As the bicycle boulevard concept evolved, the Department of Transportation held public open houses and bicycle tours to provide Tucsonans with an opportunity to learn more about bicycle boulevards. These input sessions allowed residents and others to provide input into the design of specific corridors and provided staff with a better understanding of the concerns, needs, and neighborhood interests regarding walking and bicycling behavior. Mailers were sent to households near the specific corridors and the public input sessions were also advertised through neighborhood associations, ward offices, social media, etc. Below is a summary of the public input sessions that helped inform the development of the Bicycle Boulevard Master Plan.

Fifth Street Bicycle Boulevard Open House (47 attendees)

- Open House at Trinity Church, 400 E. University Boulevard, March 24, 2015

Liberty Bicycle Boulevard (12 attendees)

- Open House at Valencia Branch Public Library, 202 W. Valencia Road, August 29, 2012

Third Street / University Bicycle Boulevard Open House (71 attendees)

- Open house at Himmel Library, 1035 N. Treat Avenue
- Entire Corridor: July 25, 2011

Copper / Flower and Seneca Bicycle Boulevards (132 attendees)

- Open House at Tucson Association of Realtors, 2445 N. Tucson Boulevard, October 7, 2010
- Field Reviews (Presentation along with bike tour), McCormick Park (Columbus Blvd. just south of Fort Lowell Rd
  - Copper-Flower: May 15, 2010
  - Seneca: May 22, 2010

Fourth Avenue / Fontana Bicycle Boulevard Open Houses (51 attendees) Northwest Neighborhood Center, 2160 N. Sixth Avenue

- Northern Section, Prince to Grant: August 27, 2009
- Central Section, Grant to Speedway: August 18, 2009
- Southern Section, Speedway to University: August 25, 2009

NEIGHBORHOOD ASSOCIATION SUPPORT

In addition to public open houses, City of Tucson staff attended numerous neighborhood association meetings to discuss bicycle boulevards. The following neighborhood associations have expressed general support for bicycle boulevards:

- Amphi
- Arroyo Chico
- Barrio Centro
- Blenman Elm
- Broadmoor-Broadway Village
- Dunbar Spring
- El Cortez Heights
- Feldmans
- Keeling
- Miramonte
- Northwest
- Peter Howell
- Rincon Heights
- Sam Hughes
- Sunnyside
- West University

OTHER KEY STAKEHOLDERS

While bicycle boulevards bring neighborhood improvements such as traffic calming and green infrastructure, the corridors make up a regional bikeway network. Bike boulevards are "bikeway arterials" in that they are designed to carry a lot of cross-town bicycle traffic and connect to other bikeways. Therefore, TDOT staff met with regional stakeholders during the development of the plan including:

- Tucson-Pima County Bicycle Advisory Committee (TPCBAC)
- TPCBAC Urban Core Subcommittee
- City of Tucson Parks and Recreation
- Pedestrian Advisory Committee
- Pima County
- Regional Transportation Authority/ Pima Association of Governments
- City of Tucson Ward Offices

WORKING GROUP

At the onset of the bicycle boulevard planning process and at a couple critical decision-making points, TDOT convened a working group to provide valuable input and direction. Key contributions of this working group included assistance with the prioritization methodology, prioritization of bicycle boulevard design elements when limited funding is available for the corridor, and overall plan review. The working group members were experts in several topics that influence bicycle boulevards and included representatives from:

- Tucson-Pima County Bicycle Advisory Committee
- City of Tucson City Manager's Office
- City of Tucson Department of Transportation
- City of Tucson Parks and Recreation
- City of Tucson Planning and Development Services
- City of Tucson Sustainability Office
- Drachman Institute
- Living Streets Alliance
- City of Tucson Mayor's Office
- Pima Association of Governments
- Private Engineering Firms
- Trees for Tucson
- University of Arizona
- City of Tucson Ward Offices
- Watershed Management Group

6. NETWORK PRIORITIZATION

While the goal is to implement the whole bicycle boulevard network, the reality of the funding situation means that select corridors will be enhanced as funding becomes available. In order to strategically develop the network over time, a prioritization process was developed.

Priority was first given to the eight in-progress bicycle boulevards that have already received some funding. The remaining 55 corridors were then ranked based on a data-driven methodology involving an analysis of regional bicycle demand, corridor cost estimates, existing infrastructure, and overall network connectivity. What follows is a detailed description of the prioritization methodology that produced the final ranked list of bicycle boulevard corridors found on page 50.

6.1 IN-PROGRESS CORRIDORS

Priority was given to select bicycle boulevard corridors that have already received some funding through the Regional Transportation Authority (RTA). The RTA is a 2006 voter-approved transportation plan that is funded through a half-cent sales tax. Included in the RTA plan is the installation of 550 lane miles of bikeways.

The City of Tucson already received funding for improvements on bicycle boulevard corridors prior to the creation of this master plan. In order to complete these corridors and help the RTA fulfill the bikeway mileage promise to the voters, these corridors are the top priority. The in-progress corridors include:

- Liberty / San Fernando Avenue*
- Fifth Street
- Treat Avenue
- Third Street
- Copper / Flower Street
- Ninth / Eighth Street
- Ninth Avenue / Castro Avenue
- Sahuara Avenue

** While the rest of the in-progress corridors are RTA funded, the Liberty/ San Fernando Avenue BB is primarily funded by a federal Transportation Enhancement grant.*

6.2 BICYCLE DEMAND MODEL

The first step in prioritizing the remaining 55 corridors involved identifying areas of high bicycle demand in the City of Tucson. Prioritizing bicycle boulevards that facilitate access to areas of high demand has the greatest potential for attracting new riders and serving the bicycling community. The bicycle demand model was adapted from the PAG pedestrian demand model that was developed for the 2015 Regional Pedestrian Plan update. The pedestrian demand model was vetted by a regional technical advisory committee that spent months discussing the model before it was approved. Using a similar methodology but with adjustments to better include bicycling factors, the bicycle demand model identifies areas of Tucson that have a high demand for bicycling facilities.

BICYCLING ACTIVITY AREAS

In identifying high bicycling activity areas, the demand model takes into account four factors:

1) **Bicycle Generators and Attractors –** Those destinations to or from which bicyclists are known to frequent
2) **Current Biking/Walking Rates to Work –** Census block groups where people are biking and walking as their primary means of transportation to work
3) **The Urban Context –** Elements of the urban environment that research indicates support higher rates of bicycling and walking activity; these include population and employment density, and housing/employment mix
4) **Vulnerable Users –** Populations that are more likely to be dependent on alternate modes or are at greater risk of injury when using them.

Methodology

The demand model uses GIS computer-mapping software to identify bicycling and walking activity areas. First, a grid consisting of 75'X75' cells is overlaid on the base map of Tucson. Then each of the four bicycling factors is mapped and assigned a score based on a system described in this section. Finally, the four bicycle factor maps are combined so that each unique cell receives a score reflecting its relative likelihood of being within a high bicycle activity zone. This is based on current conditions and should be considered a snapshot in time.

6.2.1 Generators and Attractors

Bicycling attractors are the single destinations to or from which riders commonly bike or indicate a willingness to bike. The demand model uses 7 types of attractors:

- Schools
- Parks
- Community Facilities
- Transit Stops
- Commercial Destinations
- Multi-Family Housing
- Low-Stress Bikeways

Each of these types is further subdivided with a score applied based on an assumed level of bicycling attraction. After each individual attractor is scored, a multiplier is applied based on a buffered distance from the attractor. The multiplier ranges from 1/4 of a mile up to 1/2 of a mile, roughly encompassing the distance that most people are willing to bicycle out of their way to reach a preferred bicycle corridor.

Commercial destinations are classified into high demand retail and dining, and low-demand retail. The specific business types that comprise the commercial categories are derived from the North American Industry Classification System (NAICS), detailed on page 45.

Exhibit 6.1

Bicycle Demand Model – Bicycling and Walking Generators and Attracters

			Multipliers X2	X1
Generator	**Notes**	**Points**	**¼ mile**	**½ mile**
University		20	40	20
College		15	30	15
School		15	30	15
Park		10	20	10
Library, Community Center	Includes YMCA and Boys and Girls Clubs	10	20	10
Transit Centers		15	20	11
Transit Stops		5	10	5
Bicycle Shops		10	30	20
Supermarket/Grocery Store		7	14	7
Retail, Recreation, and Services – High-Demand	Bars, beer/ wine/ liquor, convenience stores, pharmacies/drug stores, Restaurants cafes, small markets, Convenience Stores ,etc.	7	14	7
Retail, Recreation, and Services – Medium-Demand		5	10	5
Retail, Recreation, and Services – Low-Demand	Miscellaneous retail	1	2	1
Multi-Family Housing		5	10	5
Health Care and Social Assistance		3	6	3
HAWK Locations		5	10	5
Shared-use path	The Loop, Aviation, etc.	10	10	5
Bike Boulevard	Third Street, Fourth Ave/ Fontana	10	10	5
Enhanced Bike Route	Mountain Ave, Treat Ave	5	10	5
Future Shared-use path	Arroyo Chico, El Paso Southwestern, etc.	3	5	2

Exhibit 6.2

Bicycle Demand Model – Retail and Service Categories

NAICS Categories	NAICS Code
Supermarket and Grocery Store	
Supermarket and Other Grocery Store	445120
Retail, Recreation and Services – High Demand	
Convenience Store	445120
Beer, Wine, Liquor Stores	445310
Pharmacies and Drug Store	446110
Gasoline Stations with Convenience Store	447110
Drinking Places (alcoholic beverages)	722410
Retail, Recreation and Services – Medium Demand	
Full Service Restaurants	722511
Limited Service Restaurants	722513
Snack and Nonalcoholic Beverage Bars	722515
Retail, Recreation and Services – Low Demand	
Men's Clothing Stores	448110
Women's Clothing Stores	448120
Children's and Infants' Clothing Stores	448130
Family Clothing Stores	448140
Clothing Accessories Stores	448150
Book Stores	451211
All Other General Merchandise Stores	452990
Gift, Novelty and Souvenir Stores	453220
Used Merchandise Stores	453310
Theater Companies and Dinner Theaters	711110
Motion Picture Theaters	512131
Urgent Care	
Community Food Services	624210
Temporary Shelters	624221
Coin-Operated Laundries and Drycleaners	821310
Health Care and Social Assistance	
Continuing Care Retirement Communities	623311
Assisted Living Facilities for the Elderly	623312

6.2.2 CURRENT WALKING AND BICYCLING RATES

The second factor considered in creating the bicycle demand model is locations where people are already known to be bicycling and walking. This information is available through the Census Bureau's American Community Survey (5-year) means of travel to work data table, where rates of bicycling or walking to work can be mapped at the Census block level for Pima County. While trips to work only account for a small percent of all trips, this information can serve as an indicator of areas that already accommodate bicycling/walking or where residents are more reliant on bicycling/walking as a means of transportation.

Exhibit 6.3 Bicycle Demand Model - Current Walking and Bicycling Rates

	% of People	Points
Bike to work	35.01%+	10
	20.01-35%	7
	10.01-20	5
	3.01-10%	3
Walk to work	35.01%+	5
	20.01-35%	3
	10.01-20%	2
	3.01-10%	1

6.2.3 URBAN ENVIRONMENT

As discussed earlier in the plan, research indicates that the urban context is an important determinant of bicycling/walking rates. In particular, bicycling/walking rates are usually highest in locations with high population and employment density and a mix of uses. Population and employment densities can be measured using readily available data sets. The mix-of-uses factor, on the other hand, must be approached through a more indirect method. The demand model uses the jobs-to-housing ratio, which looks at the relative number of jobs per house for each traffic analysis zone (TAZ) in eastern Pima County, giving a general sense of mix of uses in relation to each other.

Exhibit 6.4 Bicycle Demand Model - Urban Environment

Characteristic	Density	Points
Population Density (per sq. mile)	5,001+	20
	4,001-5,000	15
	2,001-4,000	10
	501-2,000	5
Employment Density (per sq. mile)	5,001+	20
	4,001-5,000	15
	2,001-4,000	10
	501-2,000	5
Jobs/housing Ratio	1.3-6	10
	1 std. dev.	5
	2 std. dev	1

6.2.4 VULNERABLE USERS

The final factor considered in developing the demand model is the location and concentration of the most vulnerable users of the transportation network. The relative concentrations of low-income individuals, seniors, households without access to a private automobile, and people under the age of 18 can all be mapped at the census block level using American Community Survey estimates. Each of these groups is either at higher risk of injury or death while bicycling or walking or more likely to bike/walk than the population as a whole and, therefore, needs to be considered specifically when improving the transportation environment.

Exhibit 6.5 Bicycle Demand Model - Vulnerable Users

Need	Description	Scoring	Points
Low-income Population	Density of households living in poverty by Census block group	51%+	10
		41-50%	8
		31-40%	6
		21-30%	4
		11-20%	2
Population w/o a car	Density of households w/o car by census block group	31% +	10
		16-30%	8
		11-15%	6
		6-10%	2
Elderly Population	Density of people 65+ by Census block group	5	5
		41-50%	4
		31-40%	3
		21-30%	2
		11-20%	1
Population under 18	Density of population under 18 by census block group	41%+	10
		31-40%	8
		21-30%	6
		11-20%	4

Exhibit 6.6

Bicycle Demand Map of Tucson

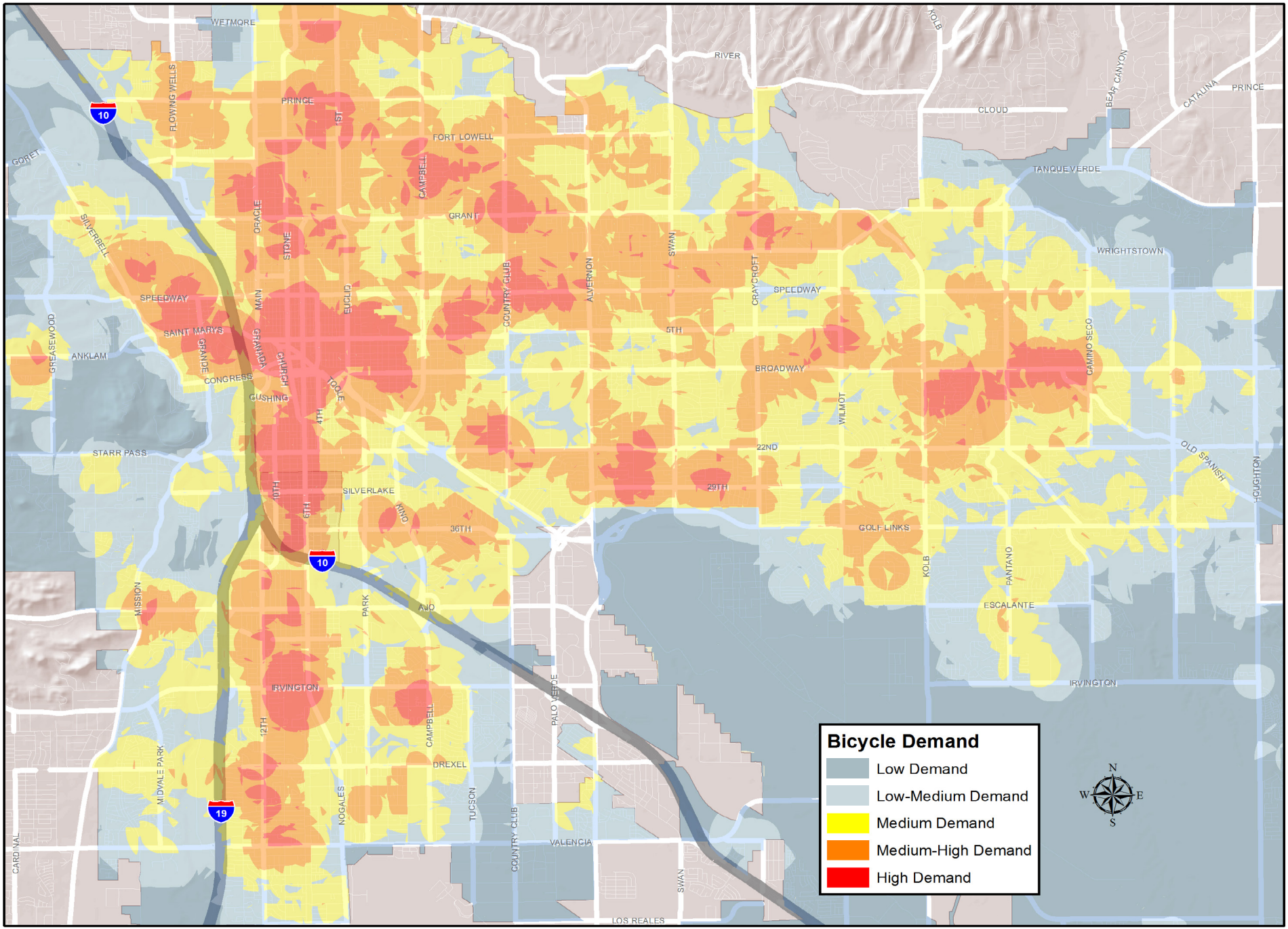
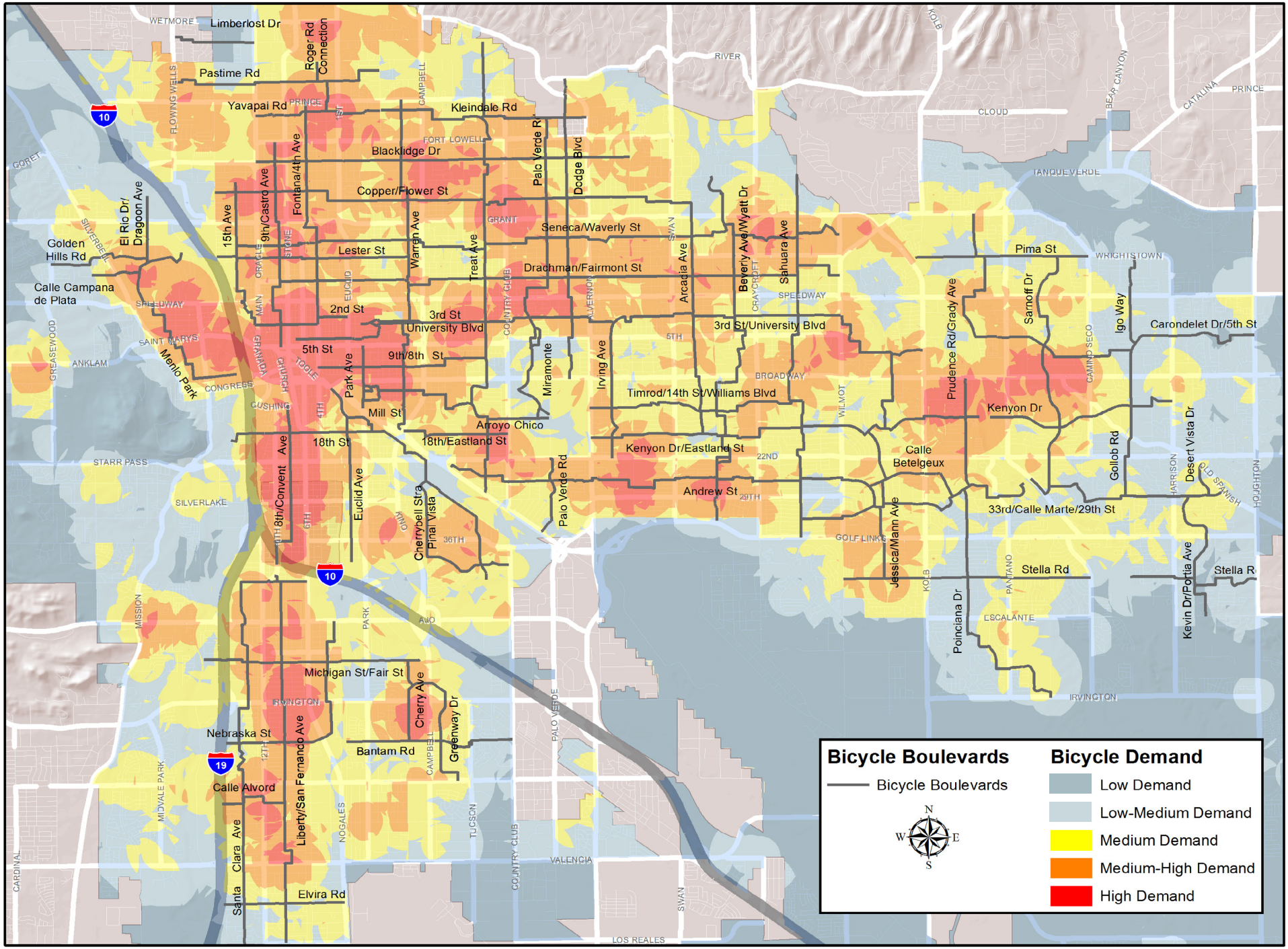


Exhibit 6.7
Bicycle Demand Map and Bicycle Boulevard Corridors



DEMAND RANK

Based on the demand model just described, an overall demand score was generated for each bicycle boulevard based on the average of the scores of each demand area intersecting a proposed route. All 55 corridors were then assigned a rank based on their overall demand score such that the corridor with the highest demand score received a rank of 1, and the lowest a rank of 55.

6.3 COST ESTIMATES

It is a priority of the Bicycle and Pedestrian Program to be as cost-effective as possible when requesting funds for the network. To this end, rather than rely exclusively on demand scores to inform the highest priority corridors for future investment, further analyses of cost estimates and existing infrastructure were integrated into the prioritization methodology.

Initial cost estimates were generated by developing maps for each corridor with proposals for traffic reduction, traffic calming, wayfinding, and major street crossing treatments (see corridor map appendices). Proposed treatments were tallied and total corridor cost estimates were created based on the current price of each treatment.

In order to prioritize corridors with the highest demand and lowest cost, a cost-demand ratio was created. Because not all corridors are the same length, costs estimates were first normalized by dividing the total cost of each corridor by the total length (miles), producing a cost per mile estimate for each corridor. The cost per mile estimate was then divided by the overall demand score producing a cost per mile-demand ratio (reflected in the formula below).

Cost-demand ratio = (corridor cost / corridor length) / demand score

Resulting low scores indicate corridors with high demand and low cost, whereas high scores indicate corridors with low demand and high cost. All 55 corridors were then assigned a rank based on this ratio such that the lowest cost per mile-demand score received a rank of 1, and the highest a rank of 55.

6.4 EXISTING INFRASTRUCTURE

In order to maximize the visibility and coverage of the bicycle boulevard network as quickly as possible, a "percent complete" score was developed for each corridor to prioritize those nearest to completion based on existing infrastructure. This score was calculated by dividing the number of existing bicycle boulevard treatments (HAWK lights, traffic circles, and speed humps) by the number of total treatments (existing + proposed).

Percent complete = existing bicycle boulevard amenities / (existing amenities + proposed amenities)

All 55 corridors were then assigned a rank based on their percent complete score such that the highest score (most complete) received a rank of 1, and the lowest (least complete) a rank of 55.

DEMAND-WEIGHTED COMBINED AVERAGE

The next step in the prioritization process took the average of the ranks for each bicycle boulevard based on all three factors described above. Because the overall demand scores represent the most comprehensive evaluation of bicycle boulevard need and potential use, the final combined average ranking process was demand-weighted using the following formula:

Prioritized list of corridors = [(Demand score rank * 2) + Cost-demand ratio rank + percent complete rank] / 4

All 55 corridors were then assigned a rank based on the resulting demand-weighted combined average scores such that the lowest score (lowest average rank) received a score of 1, and the highest a score of 55. In the event that the combined average scores for two bicycle boulevards were tied, the corridor with the highest overall demand score was prioritized.

6.5 NETWORK CONNECTIVITY AND GEOGRAPHIC DISTRIBUTION

Another step in the bicycle boulevard prioritization process involved a qualitative analysis of the top ranked corridors resulting from the methodology described above. The demand-weighted combined average model was used as a basis for identifying the most important bicycle boulevard corridors for future investments. Slight modifications increased overall network connectivity and provided more equitable regional distribution of bicycle boulevard infrastructure.

Exhibit 6.8
Prioritized List of Bicycle Boulevard Corridors

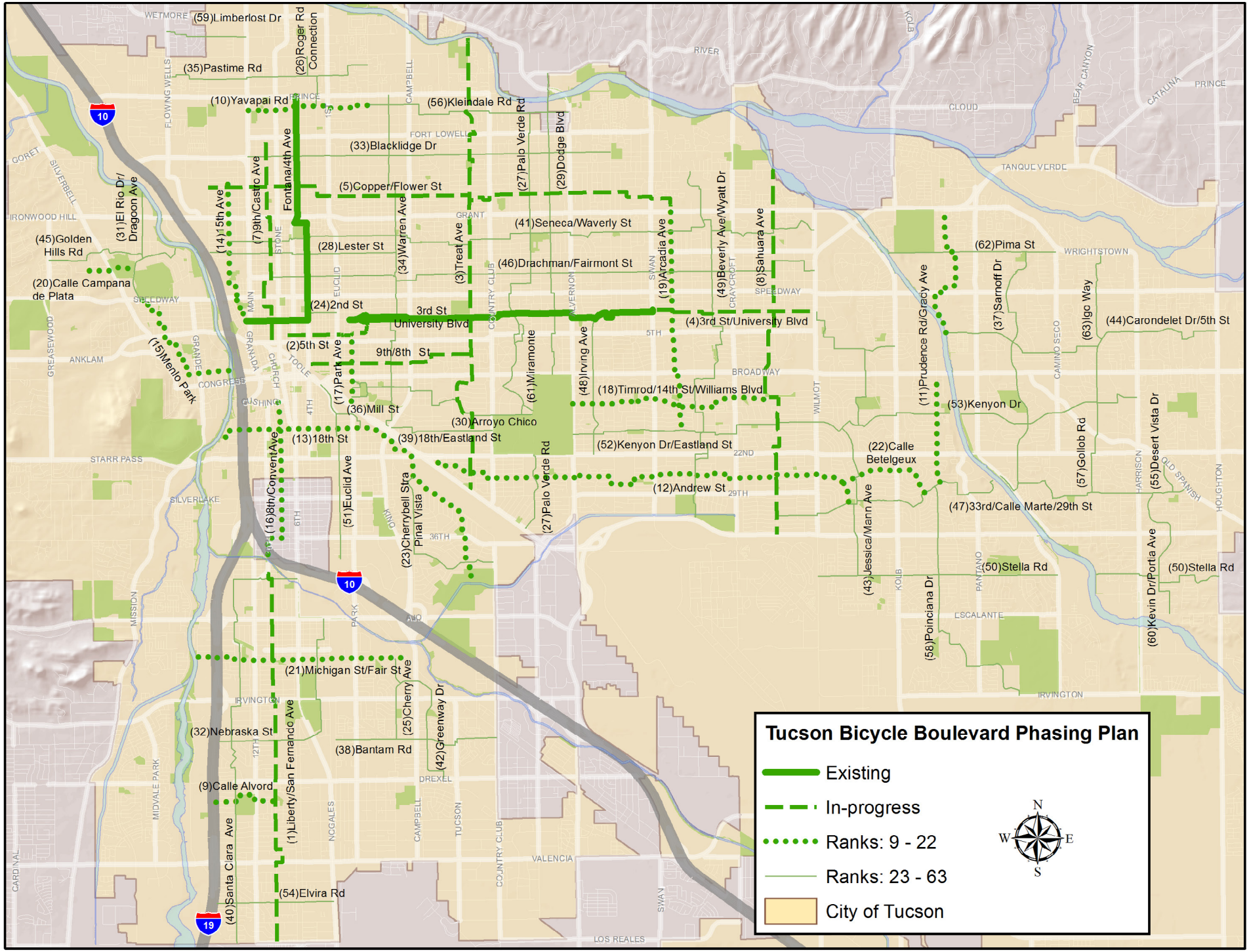
Rank	Bike Boulevard	Centerline Miles	Cost
Existing	Fontana Ave./Fourth Ave.	2.94	$0
1	Liberty Ave./San Fernando Ave.	4.84	$761,574
2	Fifth St.	1.84	$160,809
3	Treat Ave.	6.23	$1,112,286
4*	Third. St./University Blvd.	7.67	$603,805
5	Copper St./Flower St.	6.30	$1,201,976
6	Ninth St./Eigth St.	2.12	$303,607
7	Ninth Ave./Castro Ave.	2.77	$462,250
8	Sahuara Ave.	4.90	$1,194,024
9	Calle Alvord	0.90	$81,610
10	Yavapai Rd.	1.62	$162,581
11	Prudence Rd./Grady Ave.	3.30	$236,455
12	Andrew St.	5.66	$772,449
13	18th St.	4.45	$306,789
14	15th Ave.	2.05	$366,198
15	Menlo Park	2.02	$518,327
16	Eigth Ave./Convent Ave.	2.18	$441,382
17	Park Ave.	0.79	$158,520
18	Timrod St./14th St./Williams Blvd.	2.66	$699,724
19	Arcadia Ave.	2.77	$765,876
20	Calle Campana de Plata	0.59	$89,608
21	Michigan St./Fair St.	2.66	$324,080
22	Calle Betelgeux	1.47	$148,565
23	Cherrybell Stra./Pinal Vista	2.10	$256,986
24	Second St.	0.36	$187,091
25	Cherry Ave.	1.05	$252,296
26	Roger Rd. Connection	0.76	$215,912
27	Palo Verde Rd.	3.83	$812,314
28	Lester St.	2.35	$639,842
29	Dodge Blvd	3.87	$340,096
30	Arroyo Chico	3.15	$322,600
31	El Rio Dr./Dragoon Ave.	1.41	$414,742
32	Nebraska St.	2.84	$429,204
33	Blacklidge Dr	4.51	$1,161,770
34	Warren Ave.	4.56	$953,854
35	Pastime Rd.	2.73	$475,737
36	Mill St. overpass	0.45	$45,042
37	Sarnoff Dr.	3.20	$553,996
38	Bantam Rd.	2.16	$277,369
39	18th St./Eastland St.	1.33	$260,175
40	Santa Clara Ave.	5.66	$725,947
41	Seneca St./Waverly St.	8.19	$1,999,525
42	Greenway Dr.	1.74	$475,882
43	Jessica Ave./Mann Ave.	3.32	$362,910
44	Carondelet Dr./Fifth St.	5.29	$760,044
45	Golden Hills Rd.	1.88	$299,814
46	Drachman St./Fairmont St.	7.13	$1,769,477
47	33rd St./Calle Marte/29th St.	6.12	$834,154
48	Irving Ave.	1.73	$547,739
49	Beverly Ave./Wyatt Dr.	5.65	$1,081,661
50	Stella Rd.	4.82	$222,680
51	Euclid Ave.	2.26	$403,825
52	Kenyon Dr./Eastland St.	5.11	$1,219,789
53	Kenyon Dr.	2.43	$263,320
54	Elvira Rd.	1.46	$92,913
55	Desert Vista Dr.	0.43	$41,362
56	Kleindale Rd.	2.67	$570,472
57	Gollob Rd.	1.88	$410,528
58	Poinciana Dr.	3.53	$498,322
59	Limberlost Dr.	1.04	$63,473
60	Kevin Dr./Portia Ave.	1.89	$293,166
61	Camino Miramonte	2.07	$428,176
62	Pima St.	2.09	$541,051
63	Igo Way	1.17	$321,280

RTA Regional Transportation Authority

The Regional Transportation Authority has provided full or partial funding for improvements on these corridors. When complete they will contribute towards the RTA's promise of delivering 550 lane miles of new bikeways.

*While the section of the Third Street/University Bicycle Boulevard from Main Avenue to Fourth Avenue and from Campbell Avenue to Craycroft Road is currently designated as an "existing" corridor, further improvements are proposed east of Craycroft Road, including new HAWKS at Craycroft Road and Wilmot Road.

Exhibit 6.9 Tucson Bicycle Boulevard Phasing Plan



7. FUNDING AND IMPLEMENTATION

7.1 FUNDING

The City of Tucson Department of Transportation (TDOT) will seek funding to complete the bicycle boulevard network through federal, state, regional and local sources. Potential funding sources are listed in Exhibit 7.2 on page 54. When possible, TDOT will attempt to acquire funding to complete the entire corridor. However, if funding becomes available for a specific type of treatment along a bicycle boulevard (e.g. a traffic circle), TDOT will implement any funded improvements that will ultimately benefit the corridor. Priority will be given to improvements with the greatest impact on the safety of bicycle boulevard users, such as major roadway crossing treatments and traffic calming.

Similarly, when funding is available, projects will be completed in the order of prioritization as noted in Exhibit 6.8 on page 50. Exceptions to this may occur if projects of opportunity become available. For example, if funding is available that is restricted to improvements in one particular geographic area, the City of Tucson may elect to move forward on a lower ranked project. Ultimately, the goal is to complete all 193 miles.

7.2 BICYCLE BOULEVARD DELIVERY

Bicycle boulevards are characterized by the fact that they utilize residential streets to serve regional bicycling needs. They provide improved neighborhood walking routes – whether for students walking to the local elementary school or for residents walking their dog – while also facilitating cross-town bicycle travel. Therefore, the implementation process is tailored for this distinct type of infrastructure.

Once funding is secured for a particular corridor, TDOT will follow several steps to ensure a successful project delivery. TDOT will work with neighborhood associations and local residents, as well as the bicycle and pedestrian advisory committees and other key stakeholders to obtain meaningful input into the project design.

It is important to capture input from both regional bicyclists as well as local residents. However, safety is the most important consideration when implementing these projects.

Therefore, TDOT will prioritize bicycle boulevard design elements in the following order: major street crossings, speed and volume management, signs and pavement markings, green infrastructure, and public art.

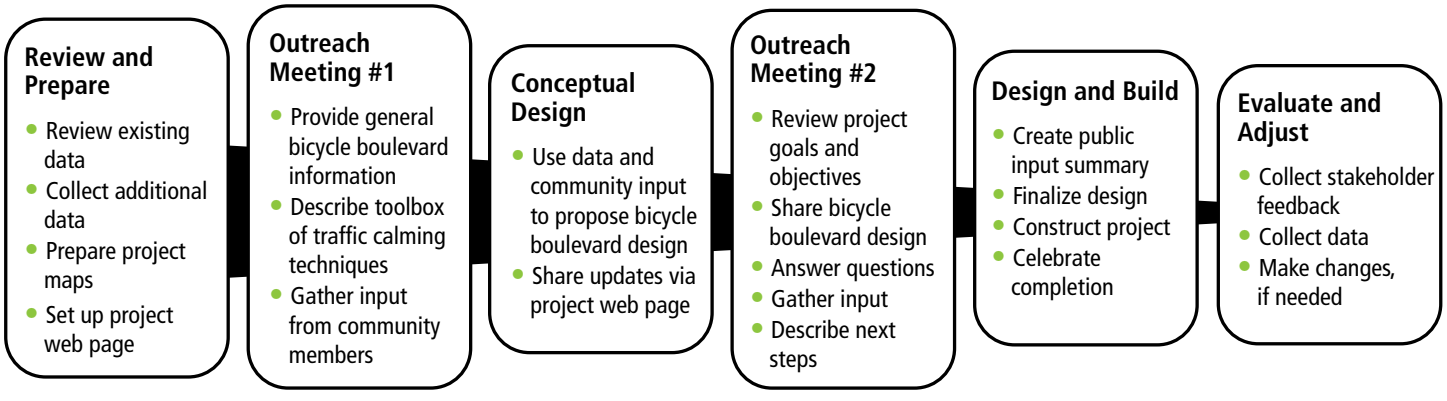
Note that the bicycle boulevard implementation process differs from the TDOT Neighborhood Traffic Management Program (NTMP). The NTMP involves a petition process initiated by residents for desired traffic calming improvements in a specific neighborhood. These improvements may be proposed on any residential street, including but not limited to future bicycle boulevard corridors. Proposed traffic calming included in this plan represents an effort to improve the safety, accessibility, and connectivity of bicycle and pedestrian infrastructure on select corridors throughout the region.

The steps in the bicycle boulevard project delivery include:

1) Review Existing Information and Prepare Project Materials
2) Outreach Meeting #1
3) Conceptual Design
4) Outreach Meeting #2
5) Finalize Design and Build
6) Evaluate and Adjust

Exhibit 7.1

Bicycle Boulevard Delivery



1. **Review Existing Information and Prepare Project Materials**
   The first step in project delivery is to review existing plans, crash data or any other information that is relevant to the bicycle boulevard corridor. Depending on the data available, TDOT may collect additional information, such as neighborhood traffic speeds, volumes or bicycle/pedestrian count information. TDOT will compile the data, prepare project maps and set up a project website.

2. **Outreach Meeting #1**
   Once information is compiled, TDOT will schedule an outreach meeting and send a notice regarding the meeting to homes within 1/8 mile of the corridor. TDOT will also work with neighborhood associations along the corridor, the Bicycle and Pedestrian Advisory Committees, the ward office(s) and other potential stakeholders to make sure they are informed about the project and to invite them to the outreach meeting.

   At the outreach meeting, TDOT will provide an overview on bicycle boulevards for Tucson. The presentation will focus on design elements with a special emphasis on the various types of traffic calming techniques. Attendees will be asked to provide input on the traffic calming tools for specific locations along the corridor.

   In addition, a large map of the project area will be available for attendees to describe any concerns they currently have for the corridor and/or to share ideas for improvements they would like to see for the bicycle boulevard.

   Comment cards will also be available at the outreach meeting and on the project website as an additional opportunity for public input.

3. **Conceptual Design**
   Based on the data and community input, TDOT will finalize the alignment of the corridor and will identify recommended treatments. This information will be uploaded to the project website.

4. **Outreach Meeting #2**
   Once a draft design is developed, TDOT will schedule a second outreach meeting and will follow the same process as Outreach Meeting #1 to inform and invite stakeholders.

   At the second meeting, TDOT will review the goals and objectives of the project. The preliminary design will be available, and there will be an opportunity to ask questions regarding the proposed improvements.

   Attendees will have an opportunity to provide feedback on the recommended treatments for the corridor.

   Comments cards will once again be available at the outreach meeting and on the project website.

5. **Finalize Design and Build**
   After the second outreach meeting, a public input summary will be created. TDOT will finalize the design of the project based on safety considerations and the public input. The final design and public input summary will be turned over to the TDOT director, who will approve the project for construction. Once the project is complete, there will be an opening event to celebrate the new facility.

6. **Evaluate and Adjust**
   Upon completion of the enhancements, TDOT will collect stakeholder feedback. "After" data will be collected to compare with the "before" data. If needed, changes will be made. For example, if it becomes apparent that vehicles are not slowing at a traffic circle, posts or a chicane can be added to slow traffic speeds.

Exhibit 7.2

List of Bicycle Boulevard Funding Sources

GRANT SOURCE	FUNDING AGENCY	FUNDING SOURCE DESCRIPTION
Surface Transportation Block Grant (STBG)	Federal Highway Administration (*Federal*)	Formally known as the Transportation Alternative Program, STBG funding can be used for bicycle and pedestrian facilities, as well as programs and planning.
Surface Transportation Program (STP)	Federal Highway Administration (*Federal*)	STP funds are a more general pot of federal funding; bicycle and pedestrian facilities are eligible.
Transportation Investment Generating Economic Recovery (TIGER)	United States Department of Transportation (*Federal*)	TIGER grants can be used for innovative, multi-modal projects that promise significant economic and environmental benefits to an entire metropolitan area.
Community Development Block Grant Program (CBDG)	U.S. Department of Housing and Urban Development (*Federal*)	The CBDG program allocates grants to develop viable communities principally for low-and moderate-income persons. CBDG funding can potentially fund walking/biking crossing treatments and other improvements that make these communities safer and improve accessibility.
State Forestry Grants	Arizona State Forestry (*State*)	Competitive grant programs through the state may be a source of funding for green infrastructure.
Regional Transportation Authority (RTA) Category 41: Greenways, Pathways, Bikeways and Sidewalks	Regional Transportation Authority (*Regional*)	Competitive regional funding through the voter approved RTA plan that funds miles of bikeways.
Neighborhood Reinvestment Program	Pima County Bond Funding (*Regional*)	Neighborhood improvements such as traffic calming and street lighting are eligible.
Local Funding	Varies	In the past, funding has been available through the Ward offices to implement neighborhood improvements. While this is not a viable funding source currently (due to the City of Tucson budget shortfall), in the future this could potentially return.
Conserve to Enhance (C2E)	University of Arizona Water Resources Research Center	Donations provided through Tucson Water bills help fund local habitat enhancement and restoration projects including green infrastructure projects.
Local Developers / Business Owners	Varies (*Private*)	Local developers and business owners can help enhance communities in their area by funding traffic calming and beautification projects.

8. CONCLUSION

Creating safe and convenient multi-modal transportation options that are accessible to people of all ages and abilities is a priority for our community. A robust network of low-stress bikeways offers countless social, environmental, and economic benefits that improve the overall quality of life in Tucson. Implementing the bicycle boulevard network outlined in this plan is an important step towards encouraging more people to choose biking and walking for their transportation needs while increasing the safety of all roadway users.

However, enhancing 193 miles of residential streets is a significant undertaking and we want your help. The Bicycle Boulevard Master Plan serves as a guiding document that can help different stakeholders make the network a reality. Below is a list of different stakeholder groups with suggestions for how each can use this plan as a resource for helping advance bicycle boulevards in Tucson.

Mayor's and Council Members' Offices

- By adopting this plan, Tucson's elected officials have demonstrated a policy commitment to prioritizing this residential roadway network for bicycling and walking. This plan can be used by elected officials and their staff to learn more about the benefits of developing bicycle boulevards in Tucson, the specific types of improvements needed along each corridor, and the costs associated with implementing them.

- The Mayor's and ward offices are closely connected with their constituents and neighborhood associations. Staff can help disseminate bicycle boulevard information and the contents of this plan. Similarly, elected officials can help communicate the priorities and preferences of their constituents with TDOT staff to assist in the design of bicycle boulevard facilities.

- Council members, along with their staff, can use this document as a resource that outlines future improvements on residential corridors within their ward.

Neighborhoods

- Neighborhood associations, homeowner's associations, and engaged citizens are important partners for implementing bicycle boulevards. TDOT will work closely with residents to determine the preferred traffic calming strategies to use in their neighborhoods.

- Residents and neighborhood associations may reference this plan in the development of grant applications for neighborhood traffic calming and beautification projects from any public or private funding source.

- Even if funding is not available today, neighborhoods are encouraged to develop conceptual plans for preferred design elements on bicycle boulevards in their area. TDOT may be able to leverage those plans when applying for funding.

Planners, Engineers, Landscape Architects

- The Bicycle Boulevard Master Plan is a resource for professionals who do work in the public right-of-way. The plan provides extensive information regarding bicycle boulevards for those seeking to understand the big picture.

- Chapter four describes the physical improvements that are required and/or desired along bicycle boulevard corridors.

- This plan identifies 64 corridors along 193 miles of residential streets for future roadway improvements. When working on any project on or near bicycle boulevard corridors, consider incorporating design elements and improvements into your project.

Developers

- Chapter two highlights many of the economic benefits of bicycling and walking in our community. Consider locating a new business or planning a new residential development near a bicycle boulevard corridor.

- When working on any project on or near any of the 193 miles of proposed bicycle boulevards, consider incorporating design elements and improvements into your project.

CONCLUSION continued

Foundations / Grantors

- Bicycle boulevards improve community health and safety, increase accessibility for those in poverty, benefit the local environment and economy, and enhance neighborhood quality (see chapter two). If your foundation addresses any of these issues, consider collaborating with TDOT to fund high-priority projects.

Non-profit organizations

- TDOT has collaborated with non-profits to improve and enhance bicycle boulevard projects. If your organization addresses health, safety, accessibility, economic justice, the environment, or neighborhood improvement, contact TDOT to develop a collaborative project.

Tucsonans (visiting or permanent)

- Share your support for bicycle boulevards and this planning document with your elected officials.
- Consider volunteering for the Adopt-a Park & Public Areas Program with Tucson Clean & Beautiful to help with maintenance on a bicycle boulevard near you (see page 37).
- Work with your neighborhood organization to fund traffic calming strategies in your neighborhood.
- Attend outreach meetings and visit TDOT's website to learn more about current and upcoming projects. Ask questions. Offer your input.
- Enjoy regular rides and walks along Tucson's bicycle boulevards!

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APPENDIX A – CONCEPTUAL CORRIDOR MAPS

FONTANA AVE.
4TH AVE.

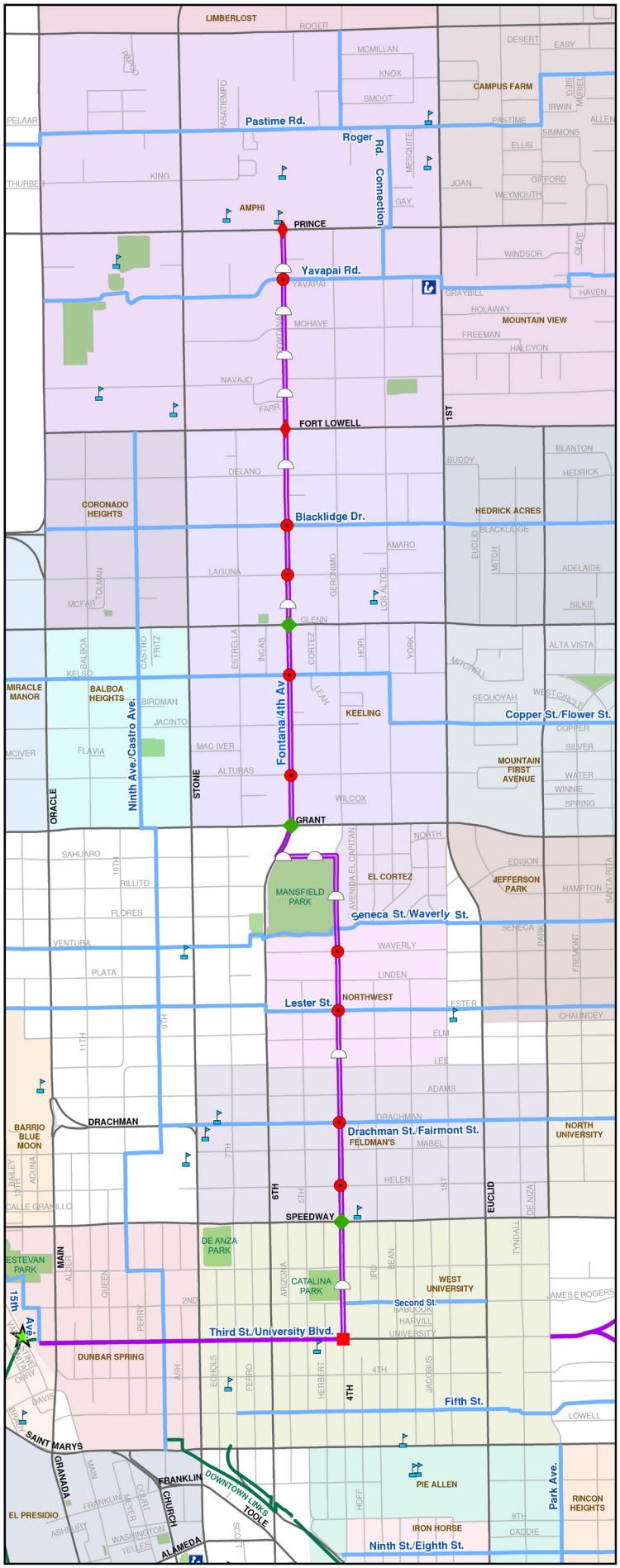
Bicycle Boulevard Master Plan

Rank: Existing

Total Miles: 2.94

Estimated Total Cost: Completed

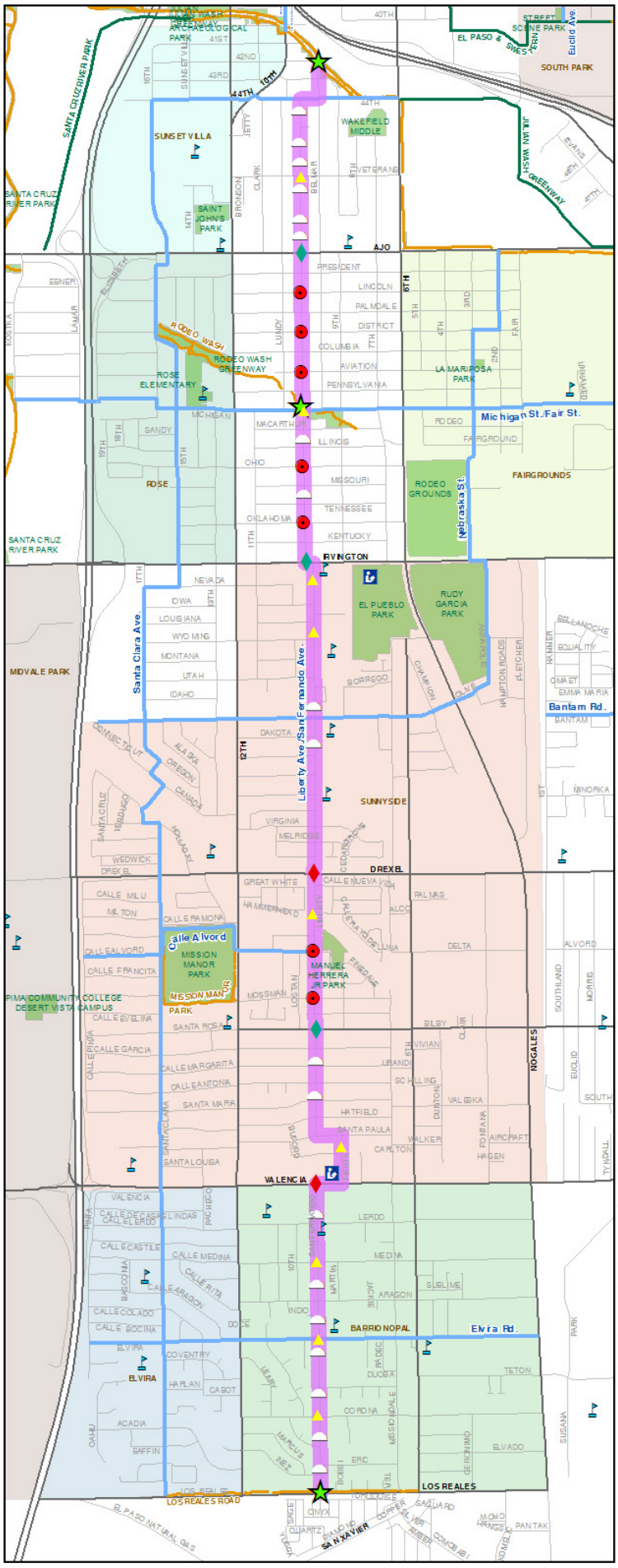
0 0.125 0.25 0.5
Mile



Design Elements

- Fontana Ave. 4th Ave. Bicycle Boulevard
- Existing Bicycle Boulevard
- Future Bicycle Boulevards
- Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Future Shared-use-path
- Library
- School
- Park

N
W E
S



LIBERTY AVE.
SAN FERNANDO AVE.

Bicycle Boulevard Master Plan

Rank: 1

Total Miles: 4.84

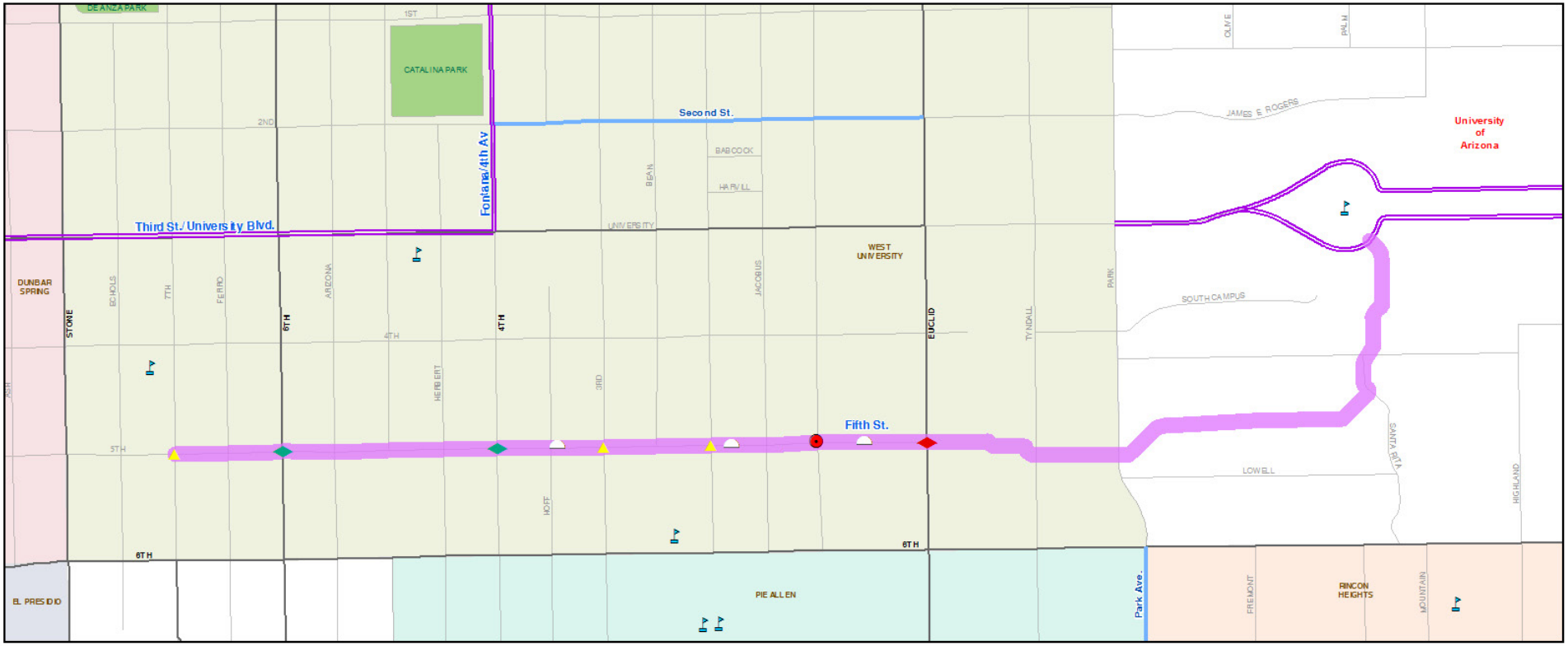
Estimated Total Cost: $761,574

0 0.5 1
Mile

Design Elements

- Liberty Ave./San Fernando Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S



Design Elements

- Fifth St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- School
- Park

N W E S

FIFTH ST.

Bicycle Boulevard Master Plan

Rank: 2

Total Miles: 1.84

Estimated Total Cost: $160,809

0 0.125 0.25

Mile

TREAT AVE.

Bicycle Boulevard Master Plan

Rank: 3

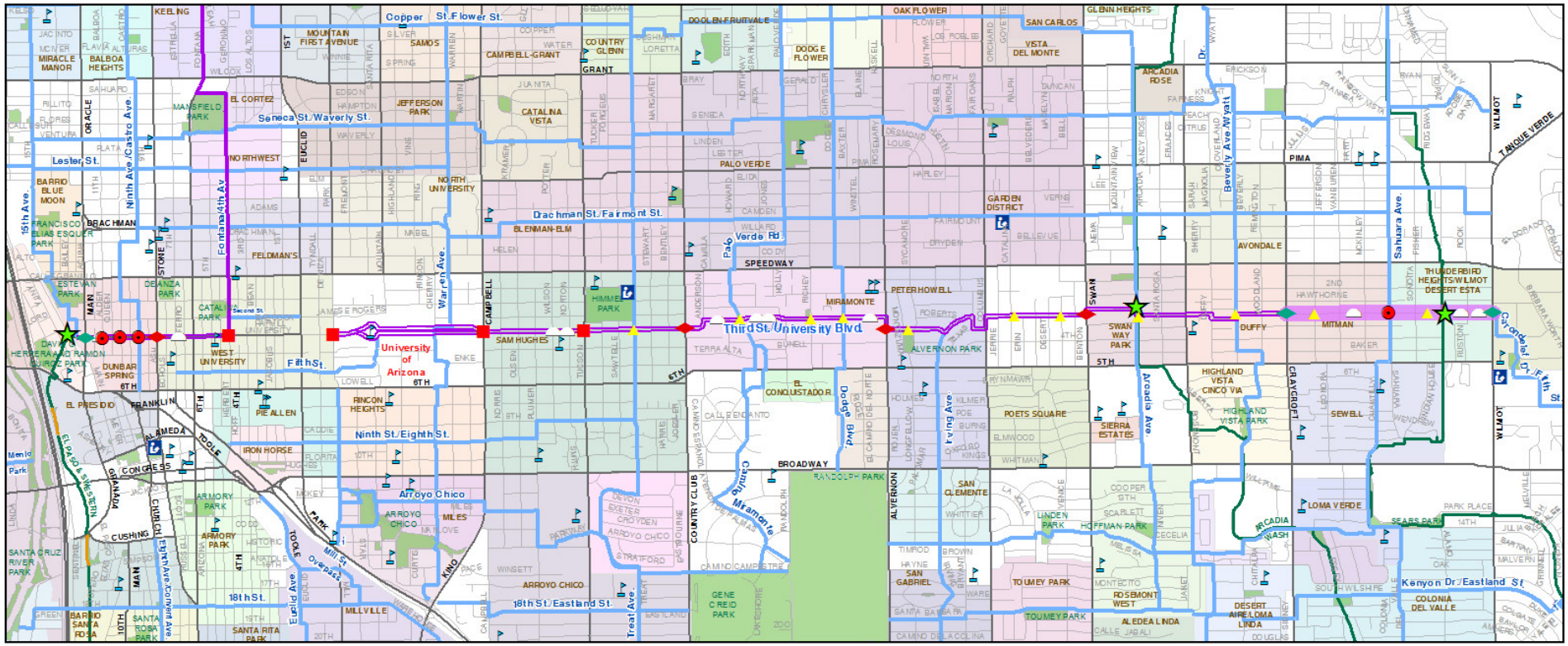
Total Miles: 6.23

Estimated Total Cost: $1,112,286

0 0.5 1
Mile

Design Elements

- Treat Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park



Design Elements

- Existing Third St. Bicycle Boulevard
- Future Third St. Bicycle Boulevard
- Existing Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

THIRD ST. UNIVERSITY BLVD.

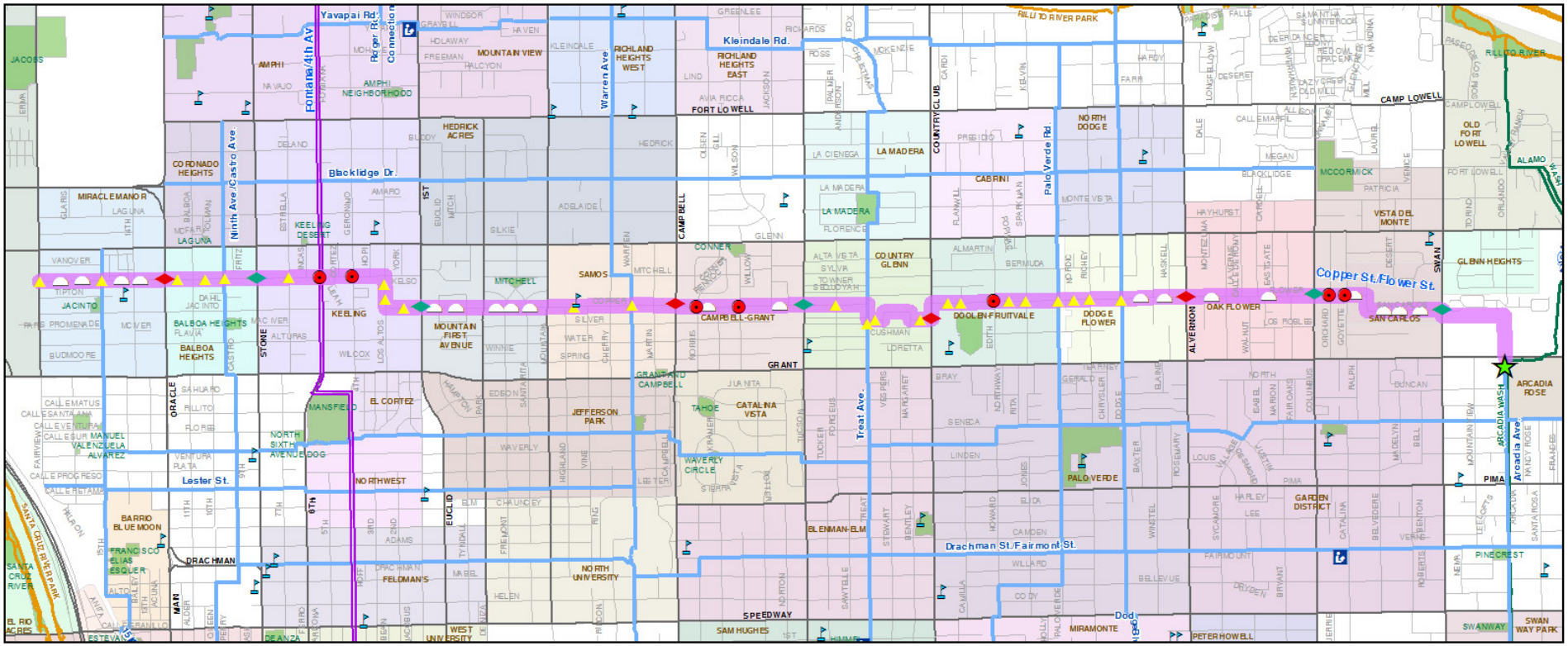
Bicycle Boulevard Master Plan

Rank: 4

Total Miles: 7.67

Estimated Total Cost: $603,805

0 0.25 0.5 1
Mile



Design Elements

- Copper St./Flower St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

COPPER ST. FLOWER ST.

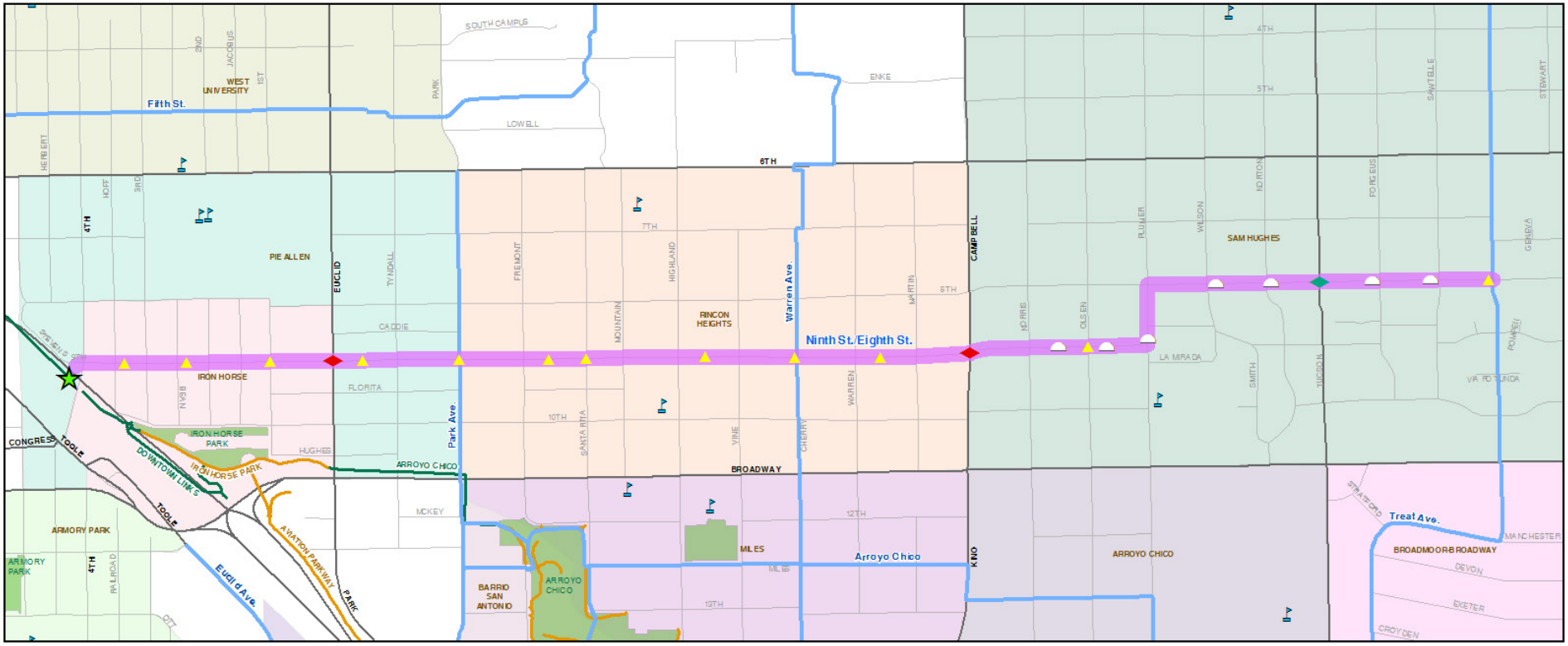
Bicycle Boulevard Master Plan

Rank: 5

Total Miles: 6.30

Estimated Total Cost: $1,201,976

0 0.5 1
Mile



Design Elements

- Ninth St./Eighth St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

NINTH ST. EIGHTH ST.

Bicycle Boulevard Master Plan

Rank: 6

Total Miles: 2.12

Estimated Total Cost: $303,607

0 0.25 0.5
Mile

NINTH AVE. CASTRO AVE.

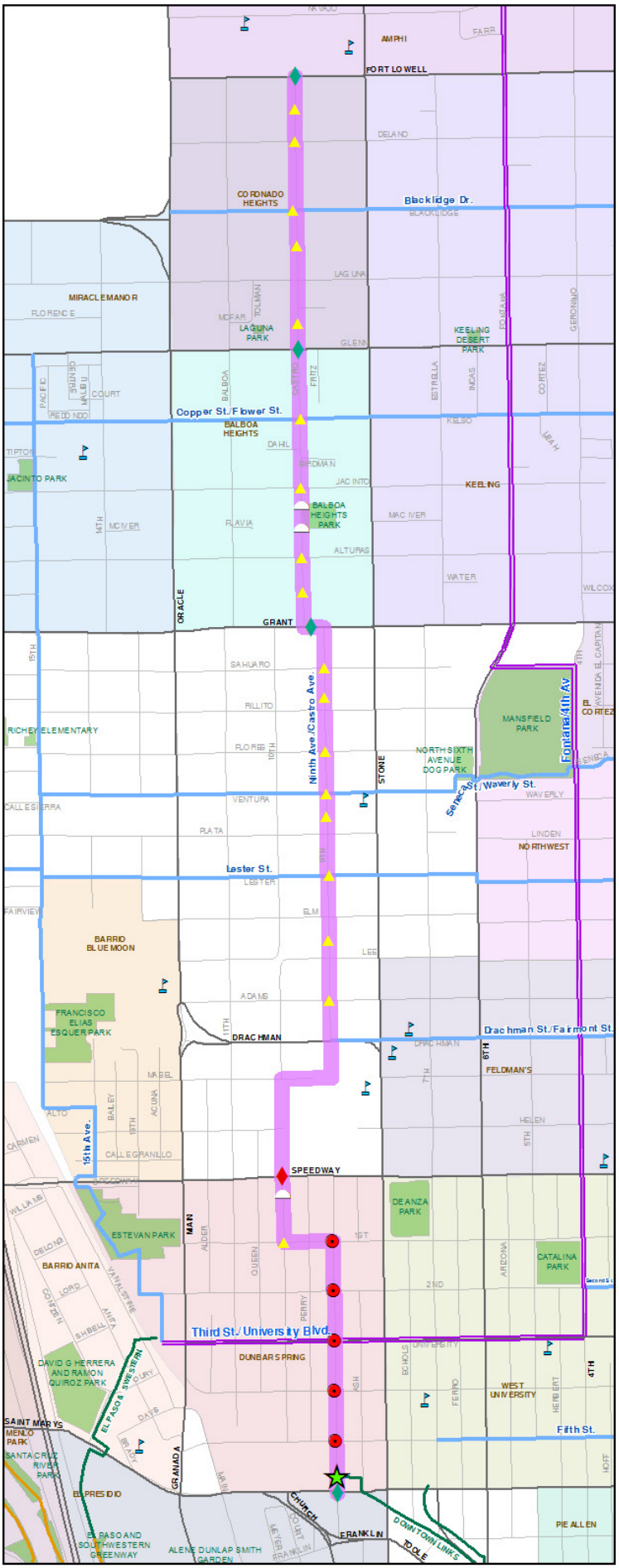
Bicycle Boulevard Master Plan

Rank: 7

Total Miles: 2.77

Estimated Total Cost: $462,250

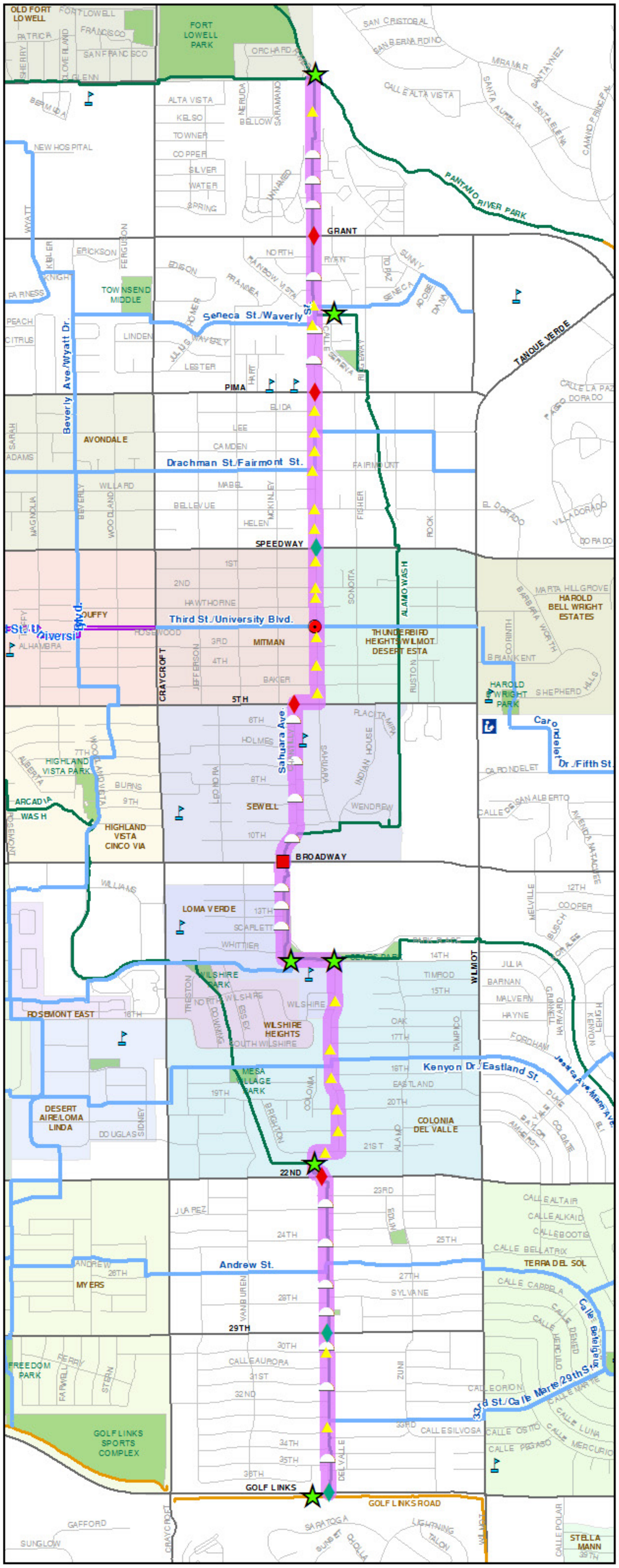
0 0.25 0.5
Mile



Design Elements

- Ninth Ave. Castro Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S



SAHUARA AVE.

Bicycle Boulevard Master Plan

Rank: 8

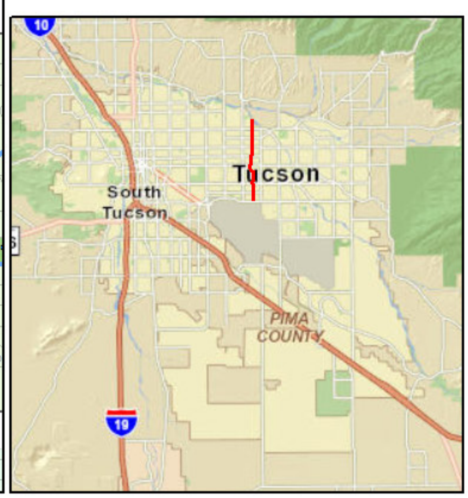
Total Miles: 4.90

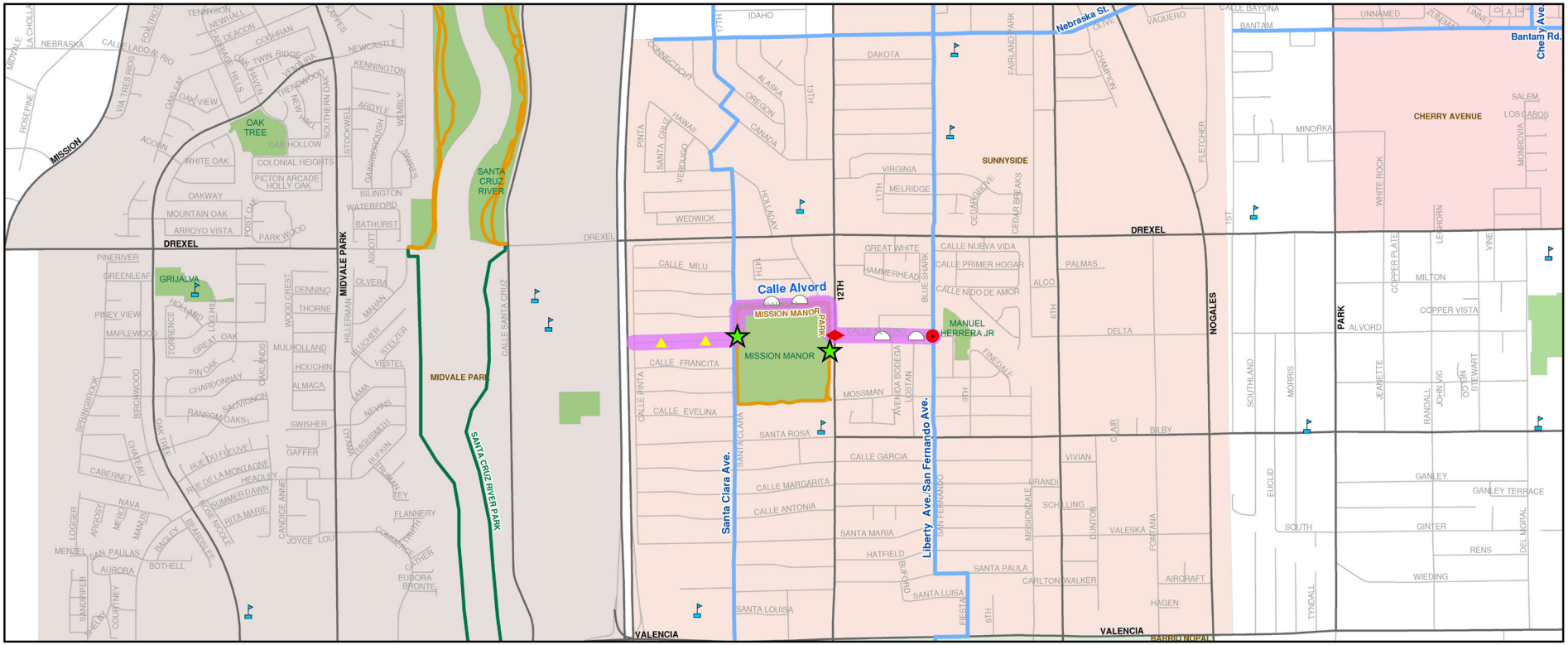
Estimated Total Cost: $1,194,024

0 0.5 1
Mile

Design Elements

- Sahuara Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park





Design Elements

- Calle Alvord Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

CALLE ALVORD

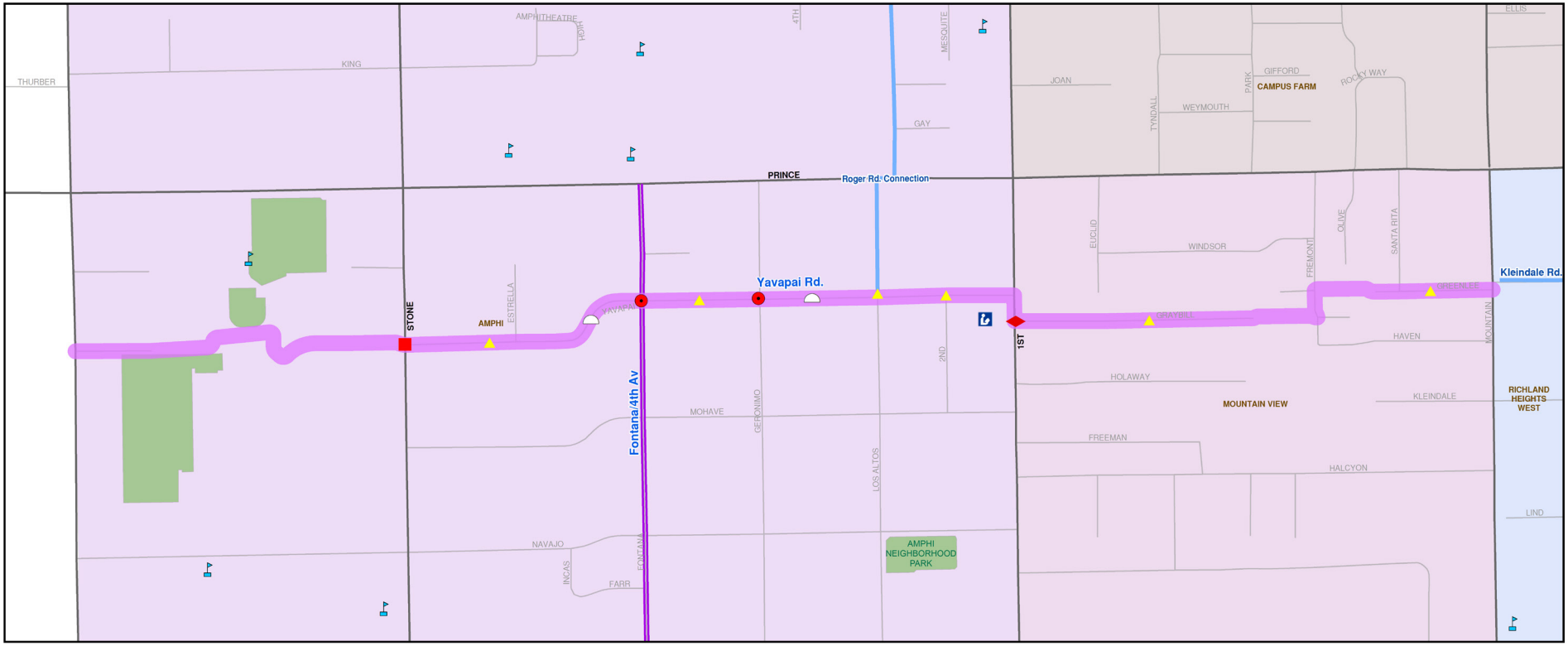
Bicycle Boulevard Master Plan

Rank: 9

Total Miles: 0.90

Estimated Total Cost: $81,610

0 0.25 0.5
Mile



Design Elements

- Yavapai Rd. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Library
- School
- Park

N W E S

YAVAPAI RD.

Bicycle Boulevard Master Plan

Rank: 10

Total Miles: 1.62

Estimated Total Cost: $162,581

0 0.125 0.25

Mile

PRUDENCE RD. GRADY AVE.

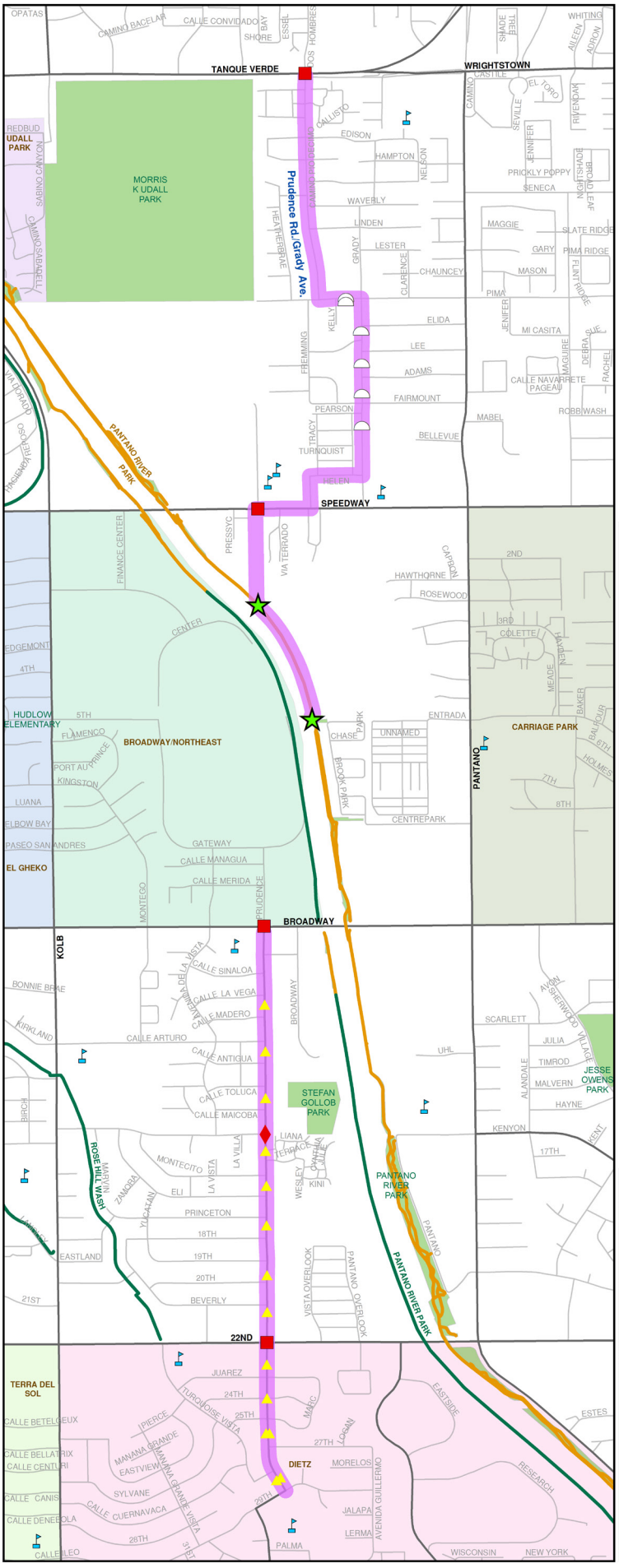
Bicycle Boulevard Master Plan

Rank: 11

Total Miles: 3.30

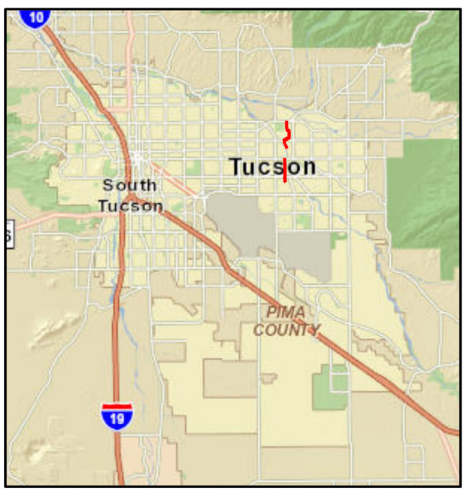
Estimated Total Cost: $236,455

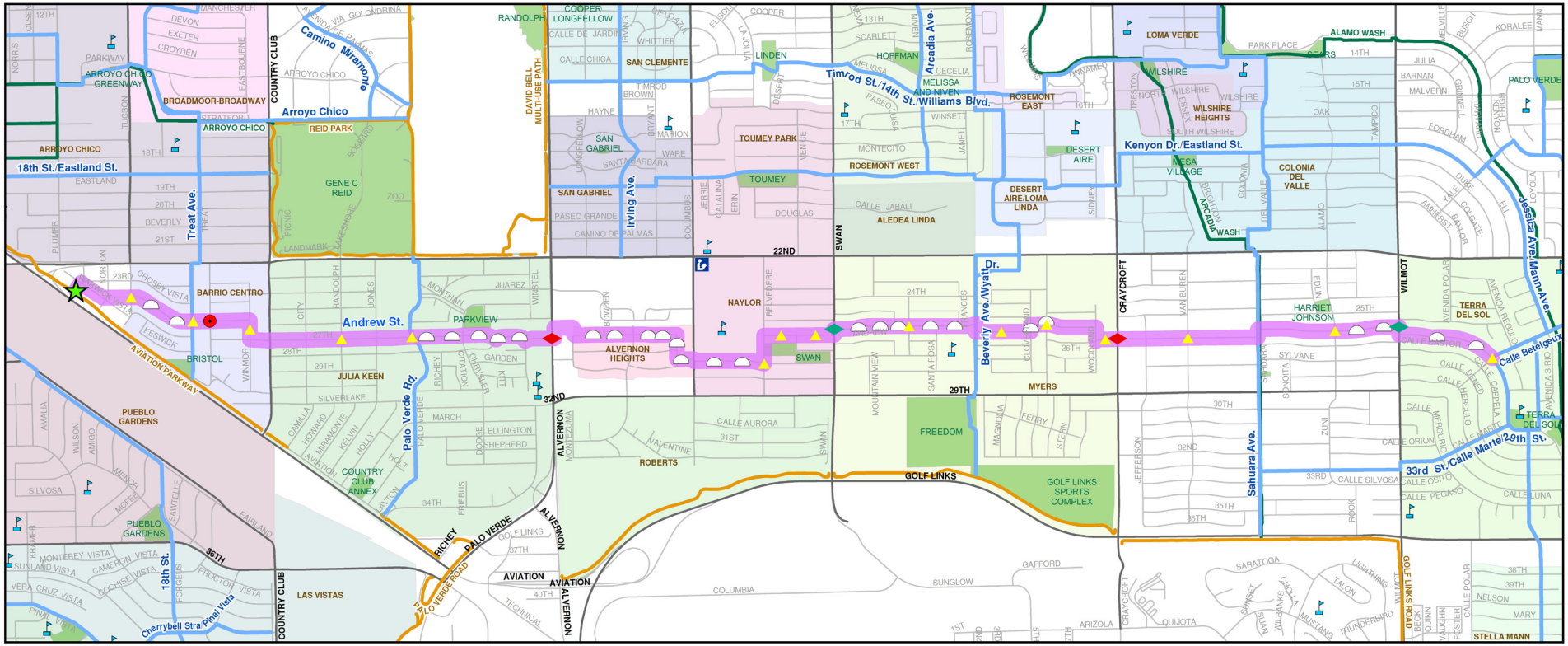
0 0.375 0.75
Mile



Design Elements

- Prudence Rd./Grady Ave. Bicycle Boulevard
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park





Design Elements

- Andrew St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

ANDREW ST.

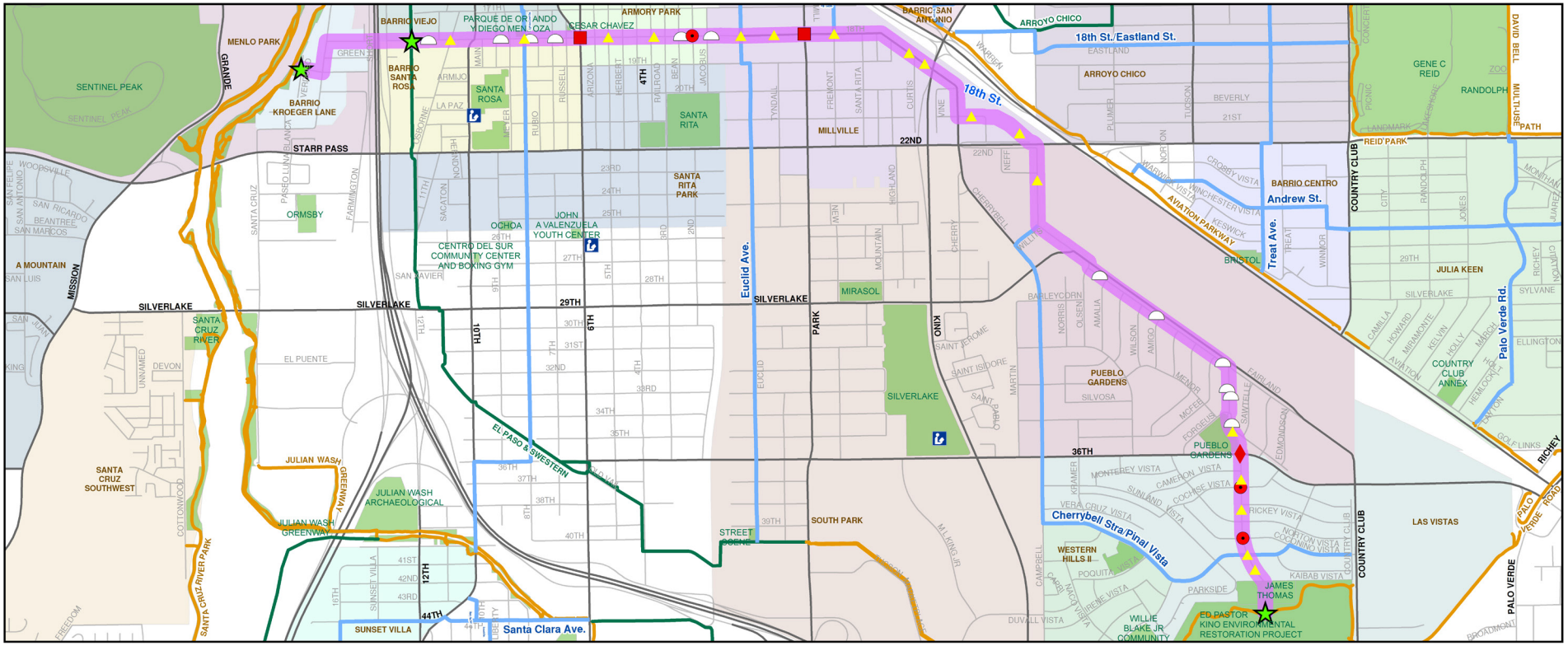
Bicycle Boulevard Master Plan

Rank: 12

Total Miles: 5.66

Estimated Total Cost: $772,449

0 0.5 1
Mile



Design Elements

- 18th St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

18TH ST.

Bicycle Boulevard Master Plan

Rank: 13

Total Miles: 4.45

Estimated Total Cost: $306,789

0 0.5 1
Mile

15TH AVE.

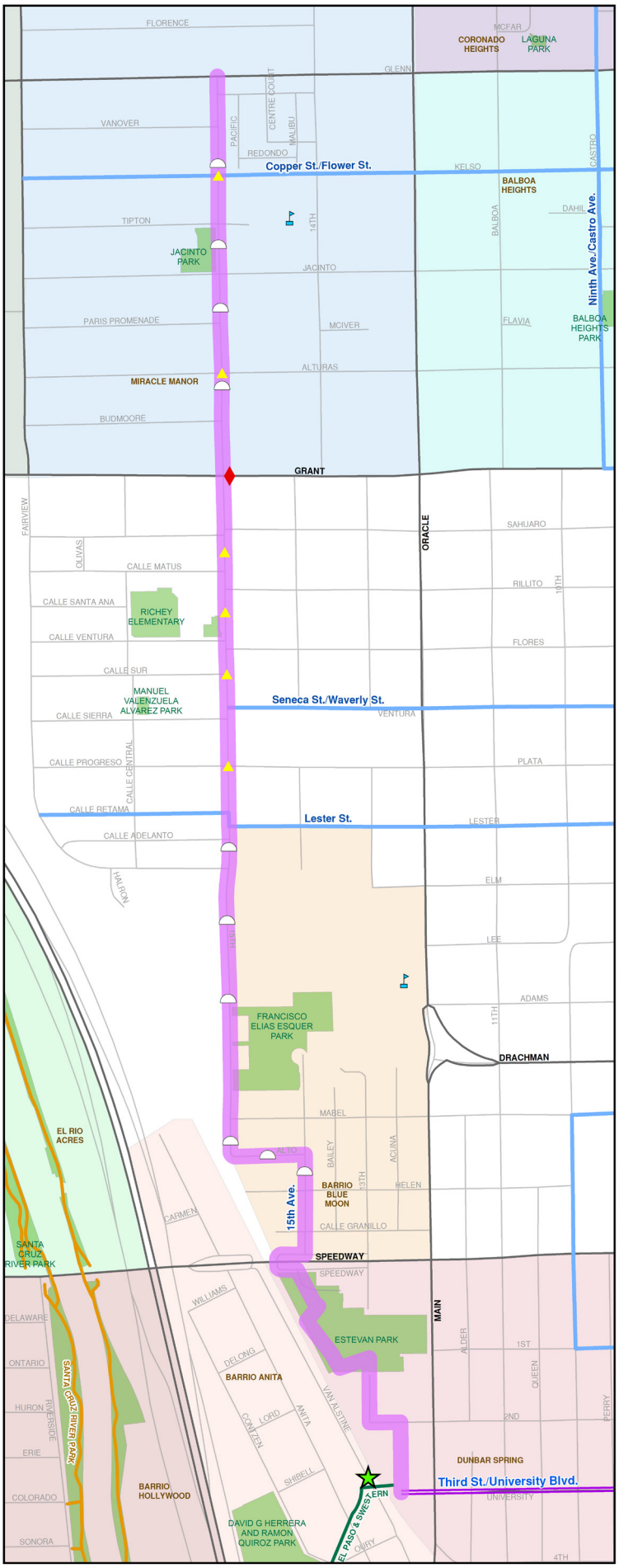
Bicycle Boulevard Master Plan

Rank: 14

Total Miles: 2.05

Estimated Total Cost: $366,198

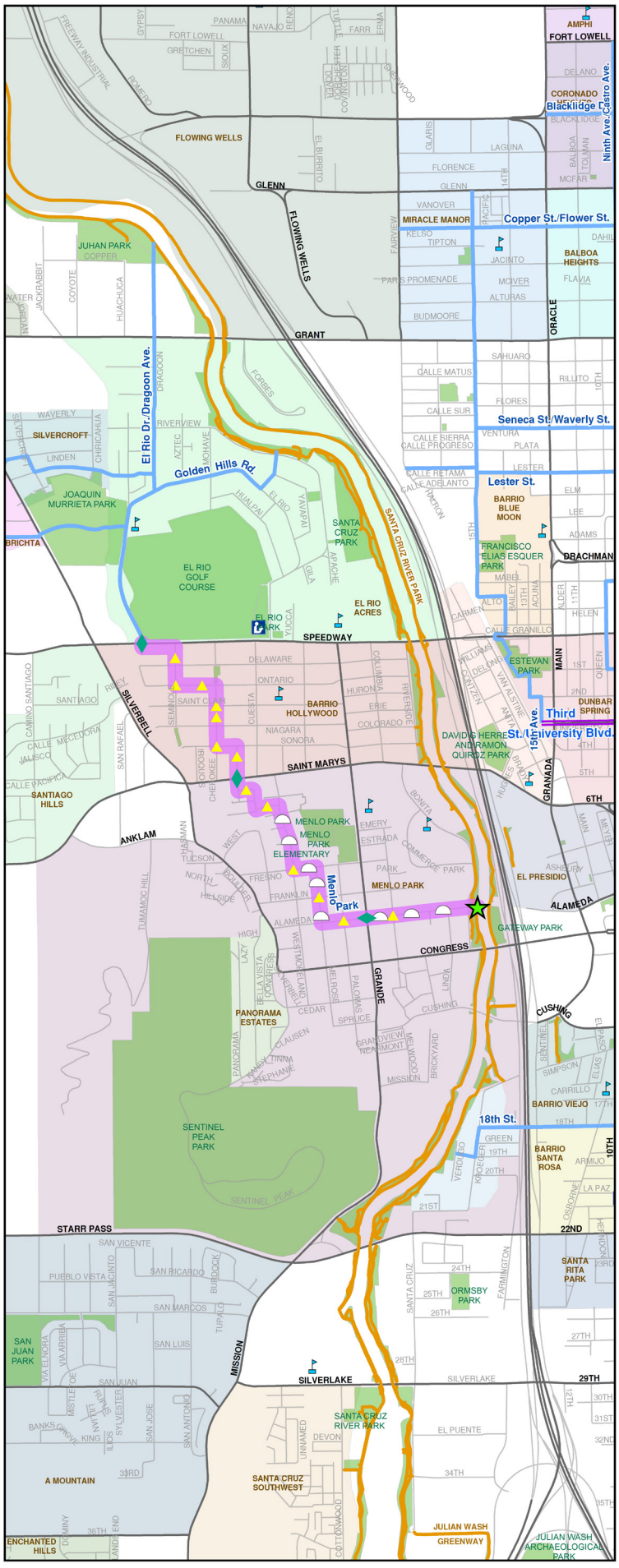
0 0.125 0.25
Mile



Design Elements

- 15th Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N
W E
S



MENLO PARK

Bicycle Boulevard Master Plan

Rank: 15

Total Miles: 2.02

Estimated Total Cost: $518,327

0 0.5 1
Mile

Design Elements

- Menlo Park Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Library
- School
- Park

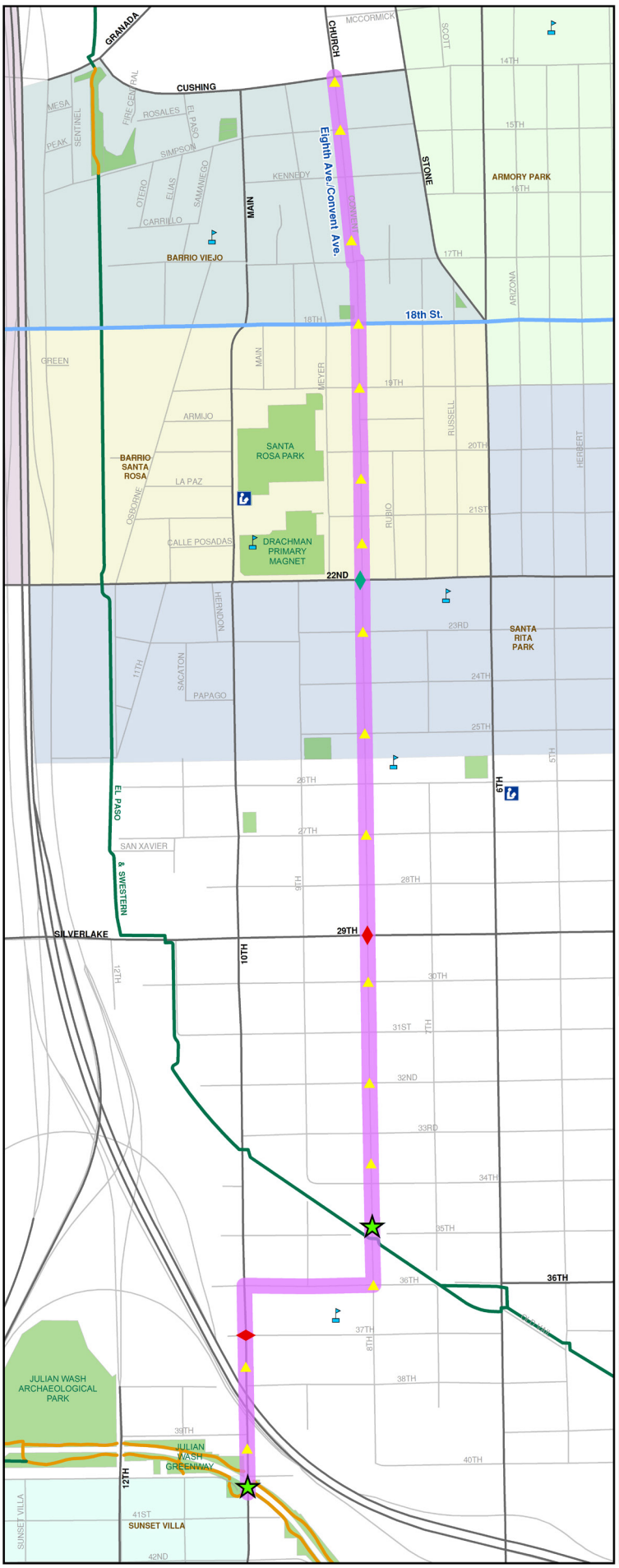
EIGHTH AVE. CONVENT AVE.

Bicycle Boulevard Master Plan

Rank: 16

Total Miles: 2.18

Estimated Total Cost: $441,382



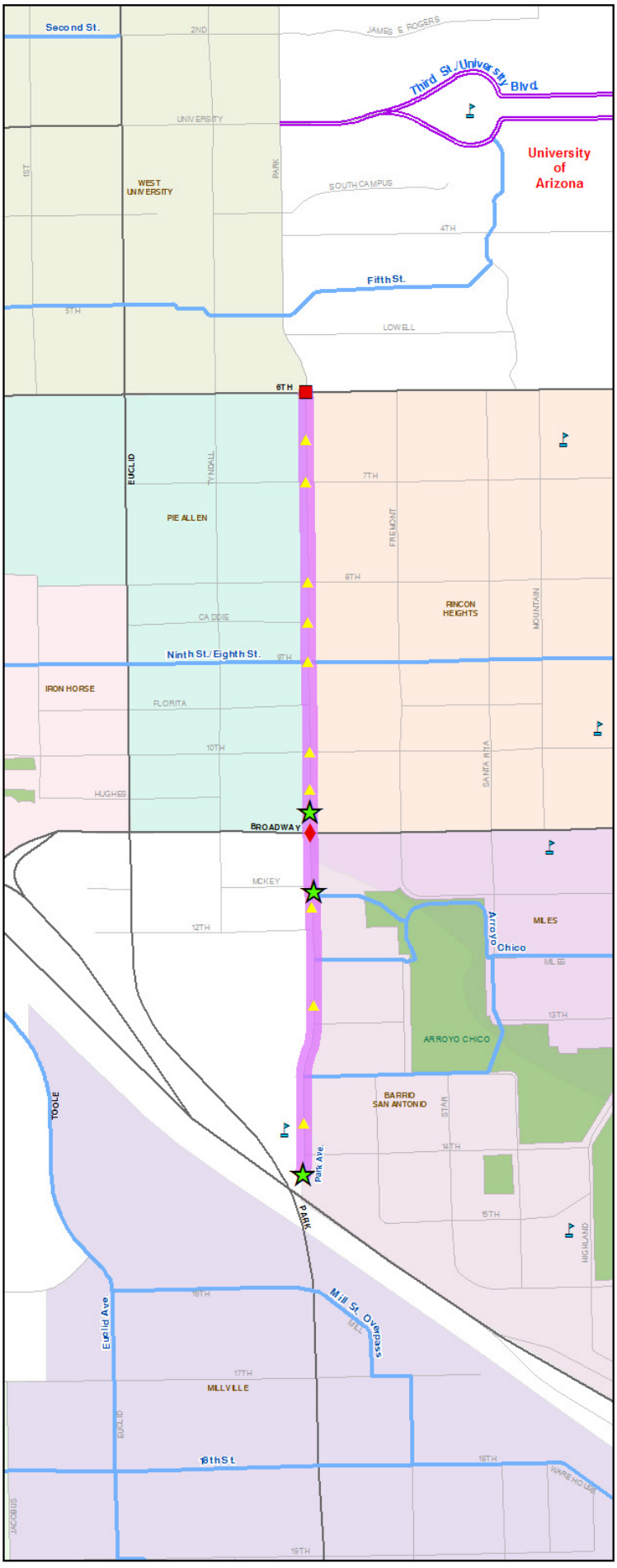
0 0.25 0.5

Mile

Design Elements

- Eighth Ave./Convent Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S



PARK AVE.

Bicycle Boulevard Master Plan

Rank: 17

Total Miles: 0.79

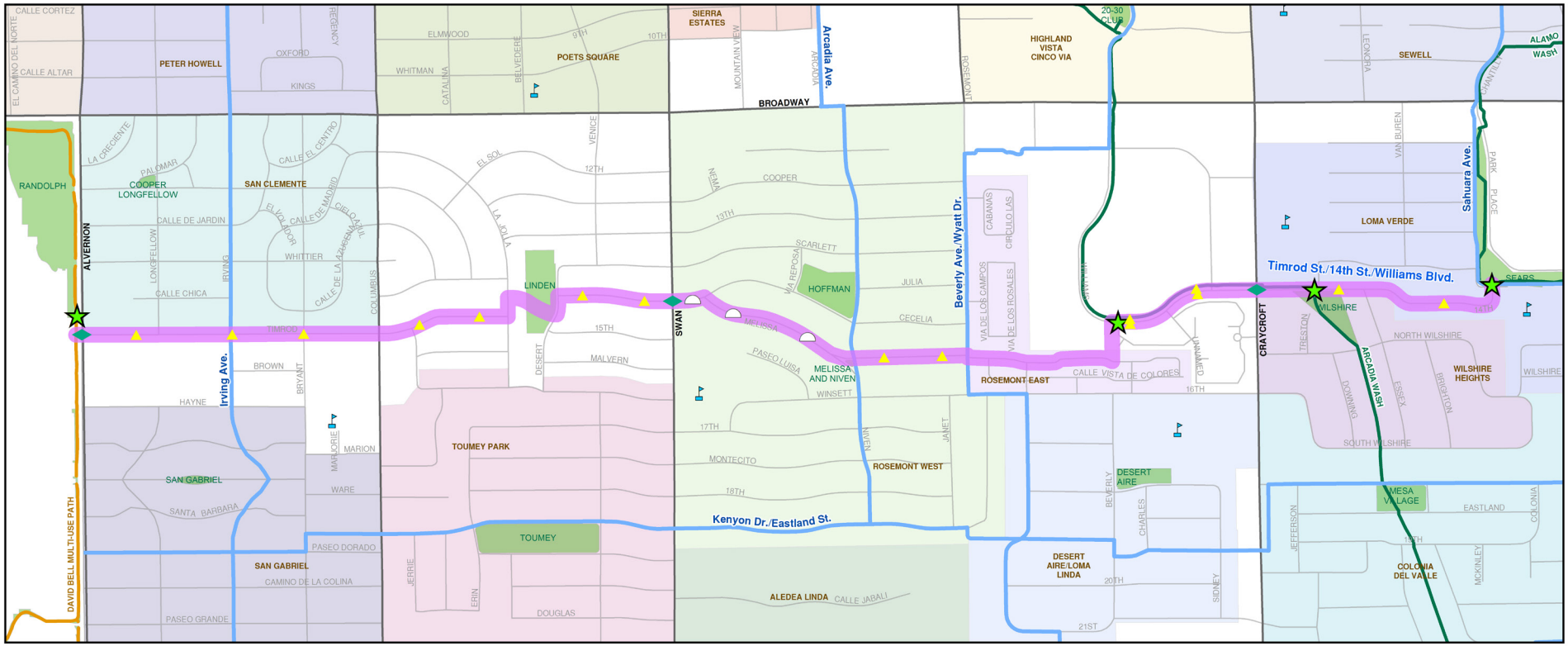
Estimated Total Cost: $158,520

0 0.125 0.25
Mile

Design Elements

- Park Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S



Design Elements

- Timrod St./14th St./Williams Blvd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

TIMROD ST./14TH ST. WILLIAMS BLVD.

Bicycle Boulevard Master Plan

Rank: 18

Total Miles: 2.66

Estimated Total Cost: $699,724

0 0.25 0.5
Mile

ARCADIA AVE.

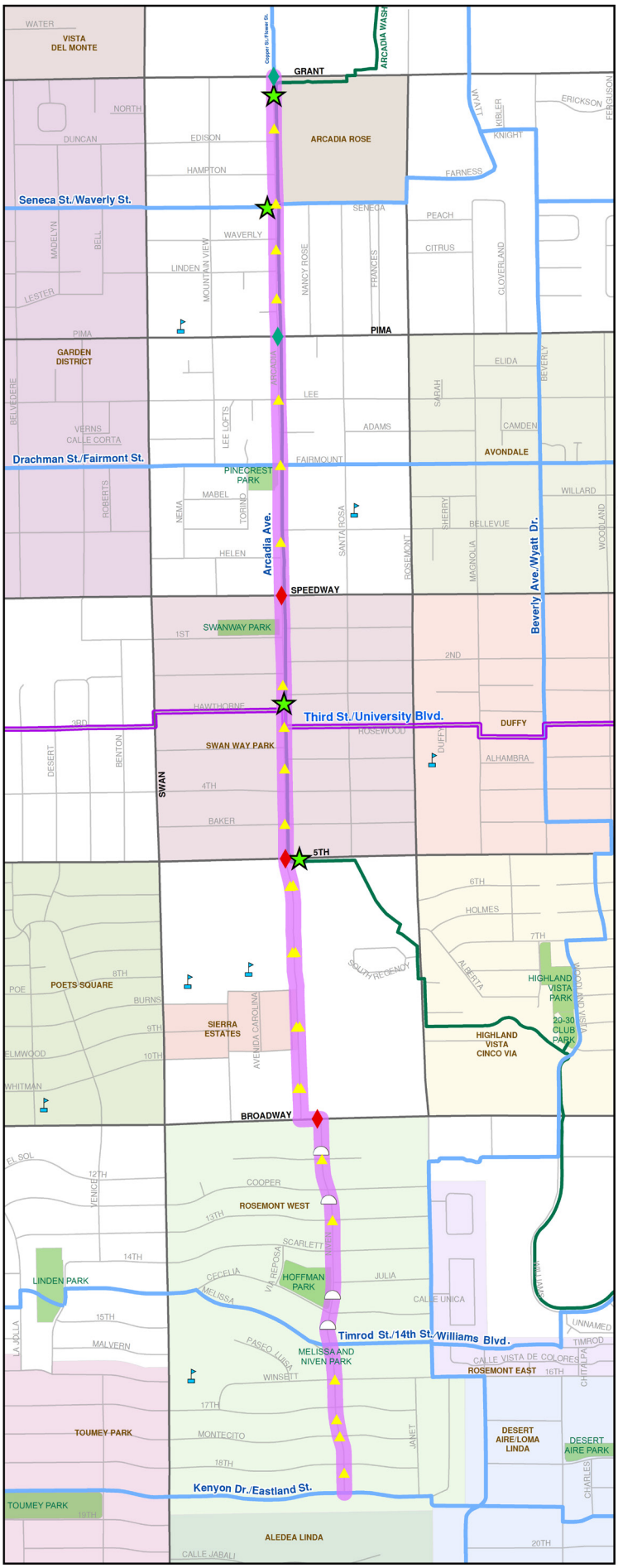
Bicycle Boulevard Master Plan

Rank: 19

Total Miles: 2.77

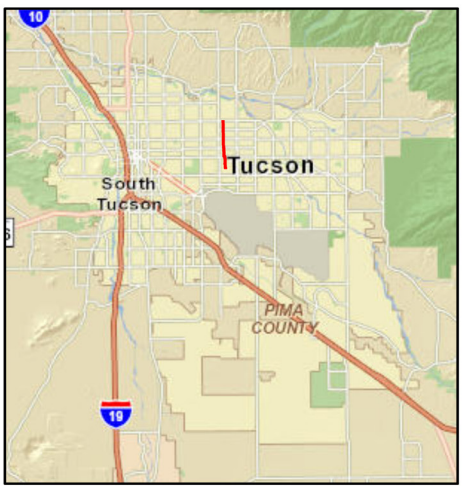
Estimated Total Cost: $765,876

0 0.25 0.5
Mile



Design Elements

- Arcadia Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Future Shared-use-path
- School
- Park



Design Elements

- Calle Campana de Plata Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Existing Speedhumps
- Existing Shared-use-path
- Library
- School
- Park

N W E S

CALLE CAMPANA DE PLATA

Bicycle Boulevard Master Plan

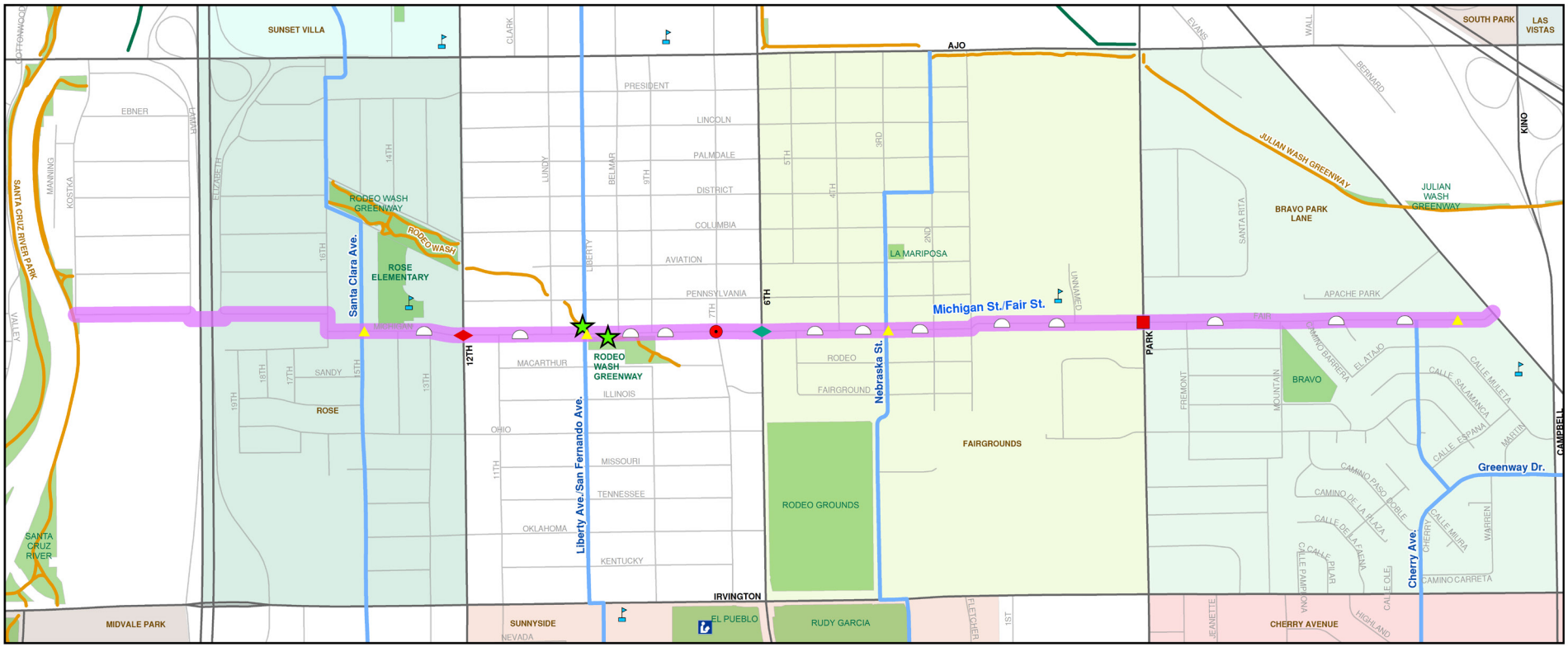
Rank: 20

Total Miles: 0.59

Estimated Total Cost: $89,608

0 0.175 0.35

Mile



Design Elements

- Michigan St./Fair St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

MICHIGAN ST. FAIR ST.

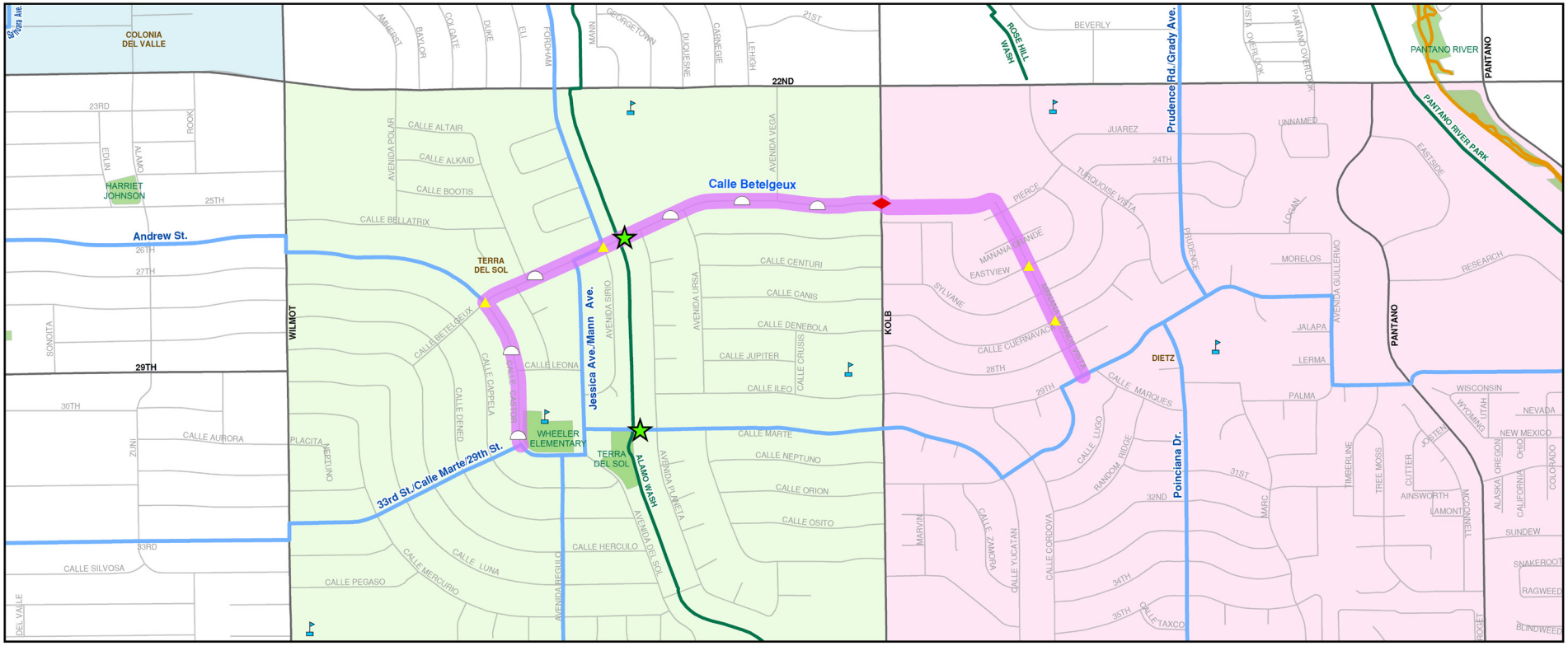
Bicycle Boulevard Master Plan

Rank: 21

Total Miles: 2.66

Estimated Total Cost: $324,080

0 0.25 0.5
Mile



Design Elements

- Calle Betelgeux Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

CALLE BETELGEUX

Bicycle Boulevard Master Plan

Rank: 22

Total Miles: 1.47

Estimated Total Cost: $148,565

0 0.25 0.5
Mile

CHERRYBELL STRAV PINAL VISTA

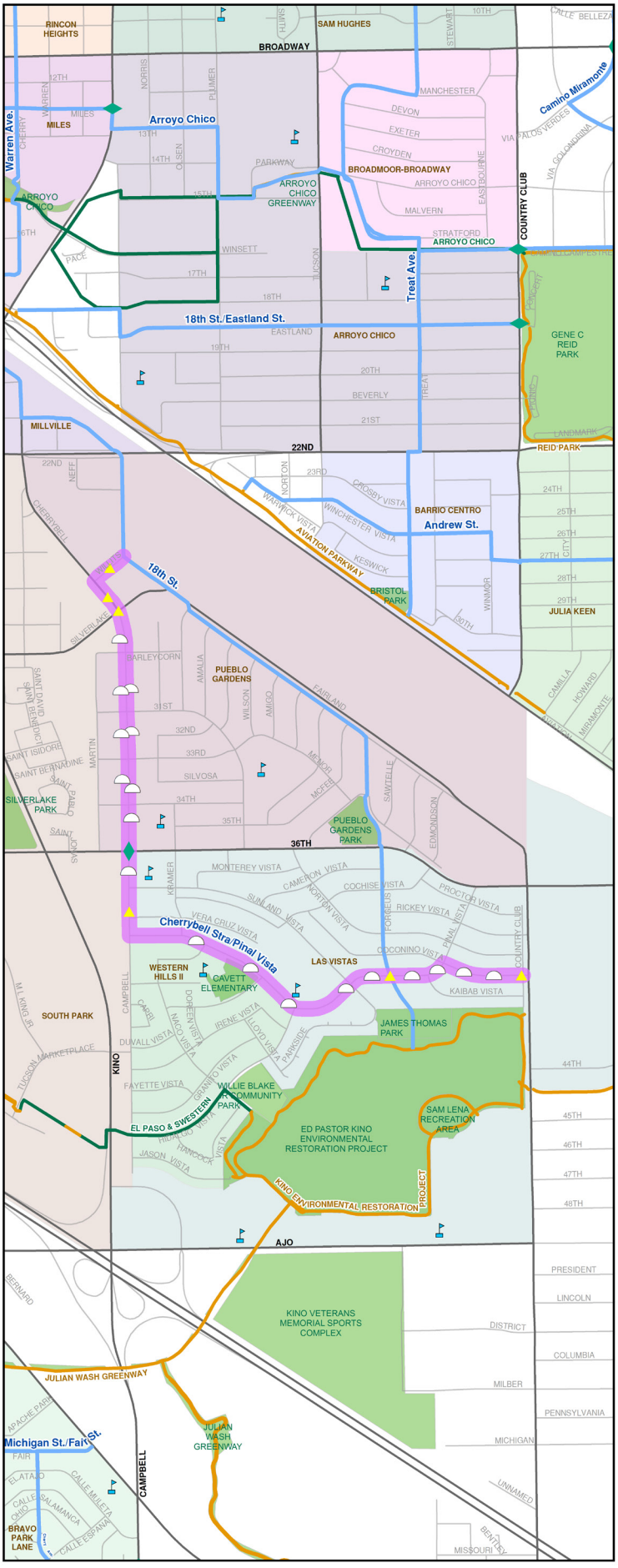
Bicycle Boulevard Master Plan

Rank: 23

Total Miles: 2.10

Estimated Total Cost: $256,986

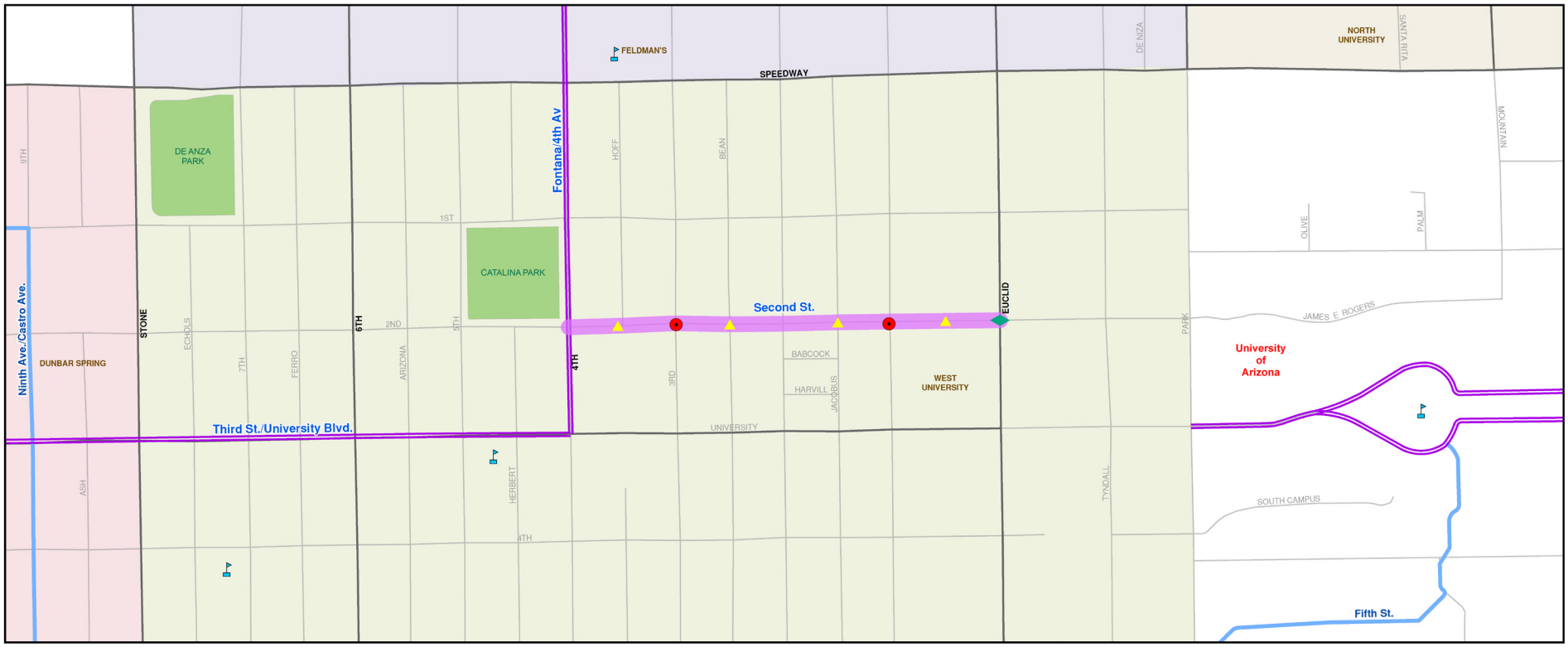
0 0.25 0.5
Mile



Design Elements

- Cherrybell Strav/Pinal Vista Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N
W E
S



Design Elements

- Second St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Traffic Circles
- School
- Park

N W E S

SECOND ST.

Bicycle Boulevard Master Plan

Rank: 24

Total Miles: 0.36

Estimated Total Cost: $187,091

0 0.125 0.25
Mile

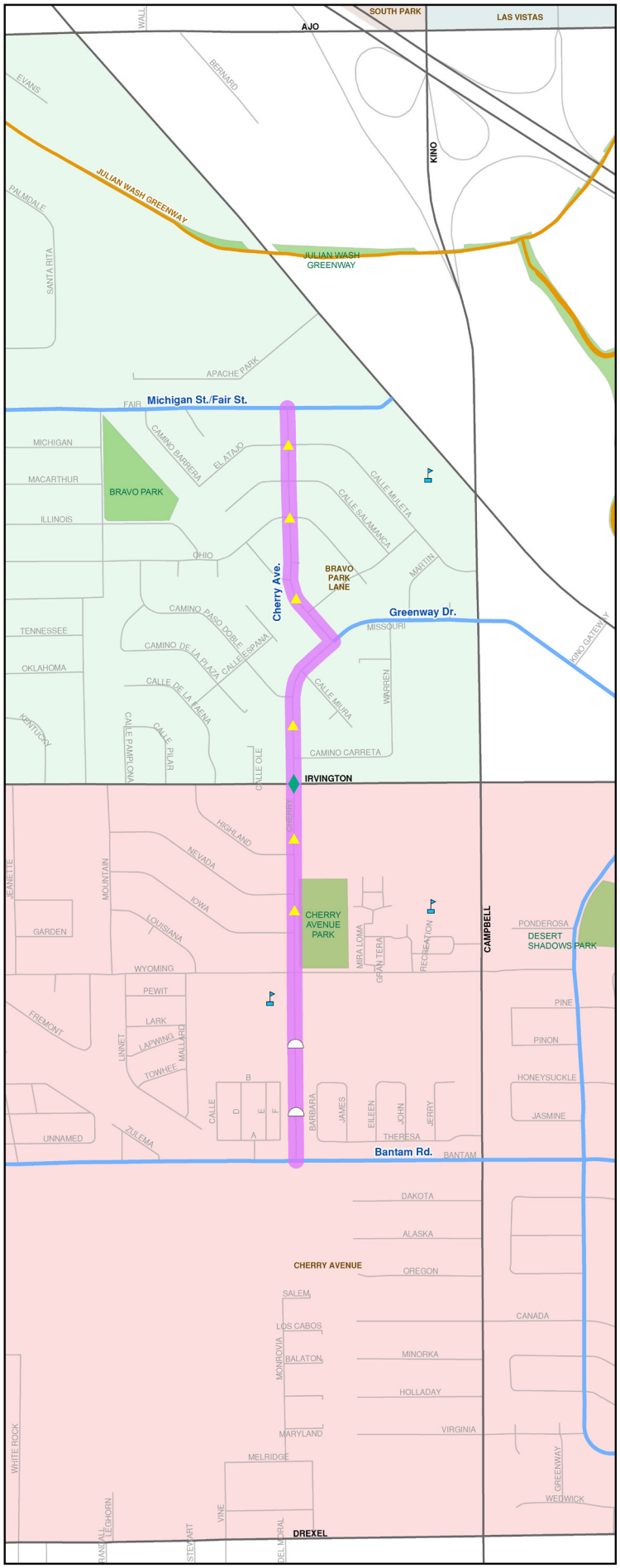
CHERRY AVE.

Bicycle Boulevard Master Plan

Rank: 25

Total Miles: 1.05

Estimated Total Cost: $252,296



0 0.125 0.25
Mile

Design Elements

- Cherry Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Existing Shared-use-path
- School
- Park

ROGER RD. CONNECTION

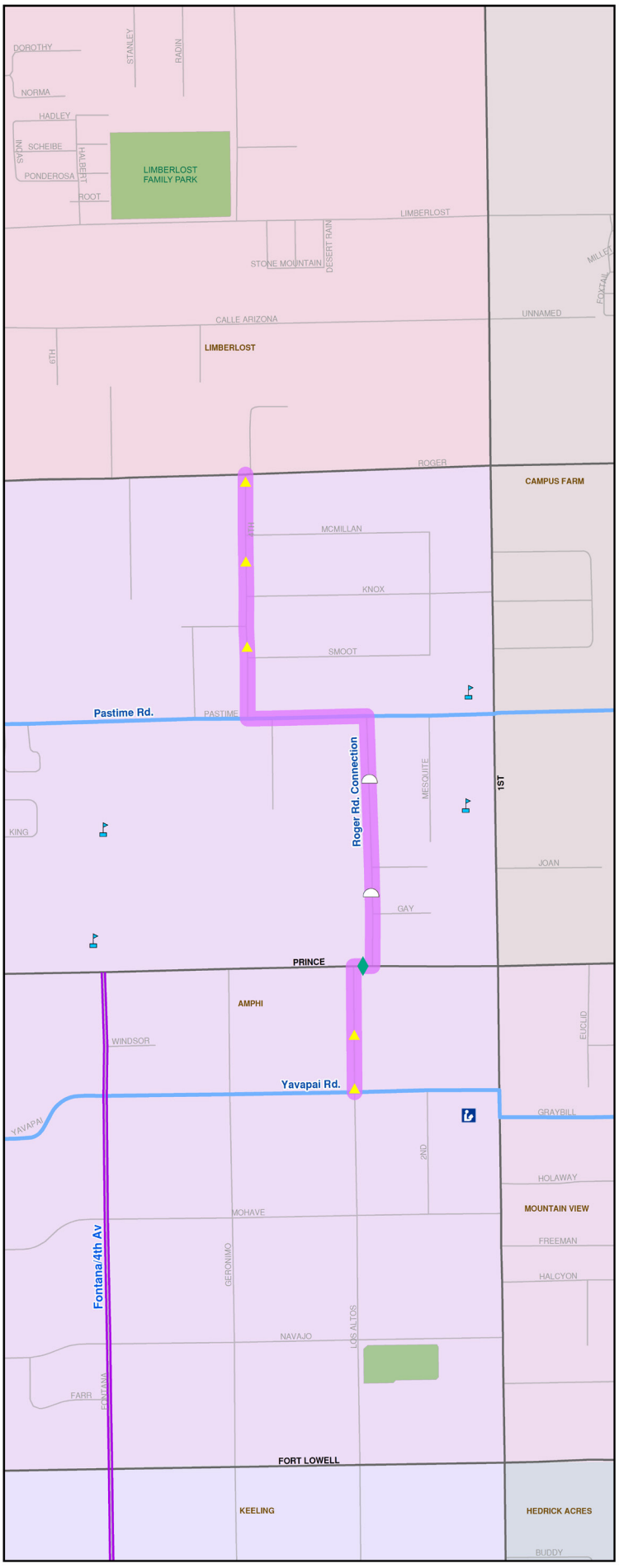
Bicycle Boulevard Master Plan

Rank: 26

Total Miles: 0.76

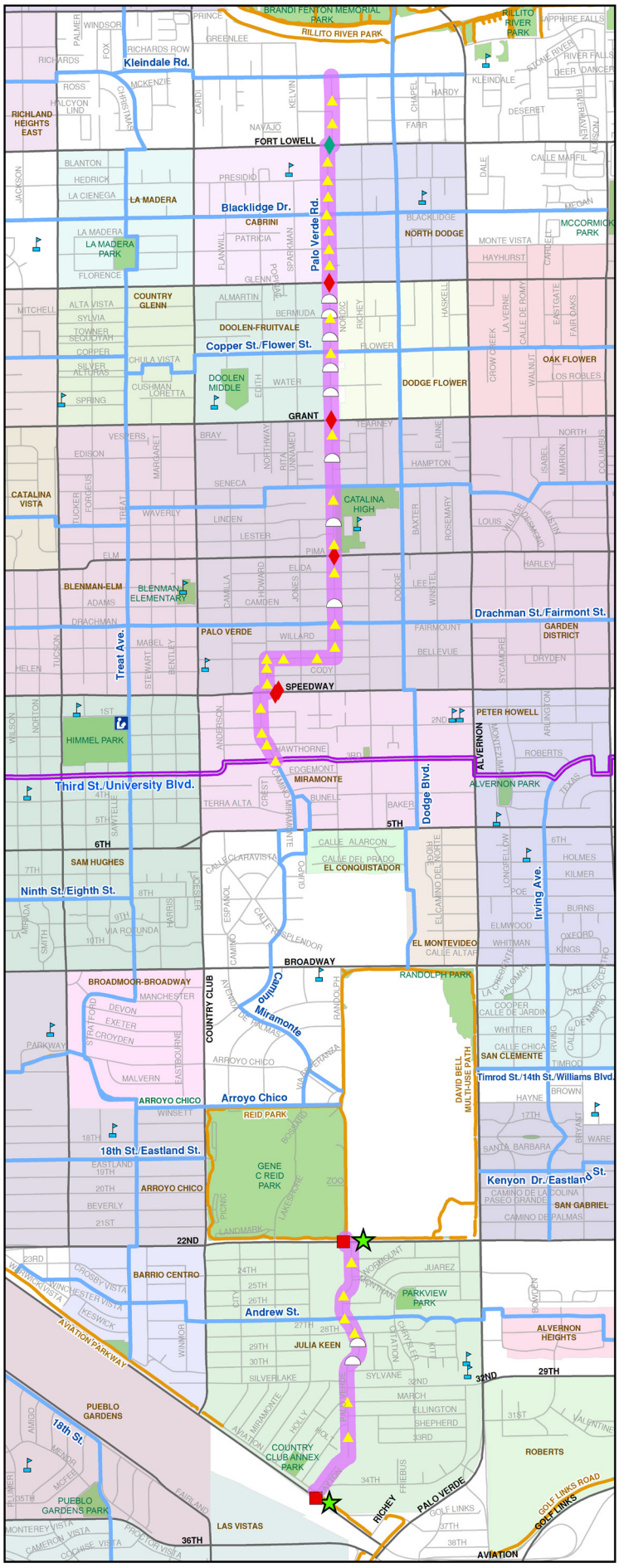
Estimated Total Cost: $215,912

0 0.125 0.25
Mile



Design Elements

- Roger Rd. Connection Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Library
- School
- Park



PALO VERDE RD.

Bicycle Boulevard Master Plan

Rank: 27

Total Miles: 3.83

Estimated Total Cost: $812,314

0 0.5 1
Mile

Design Elements

- Palo Verde Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Library
- School
- Park

N
W E
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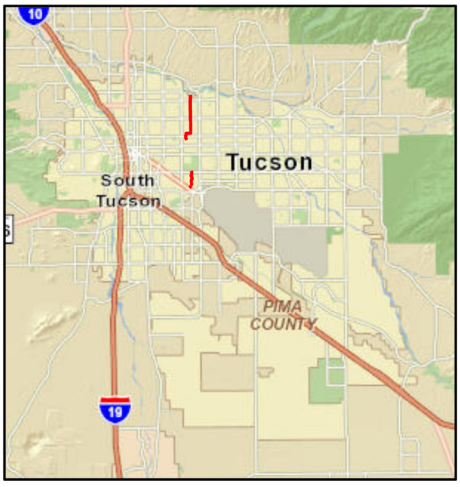
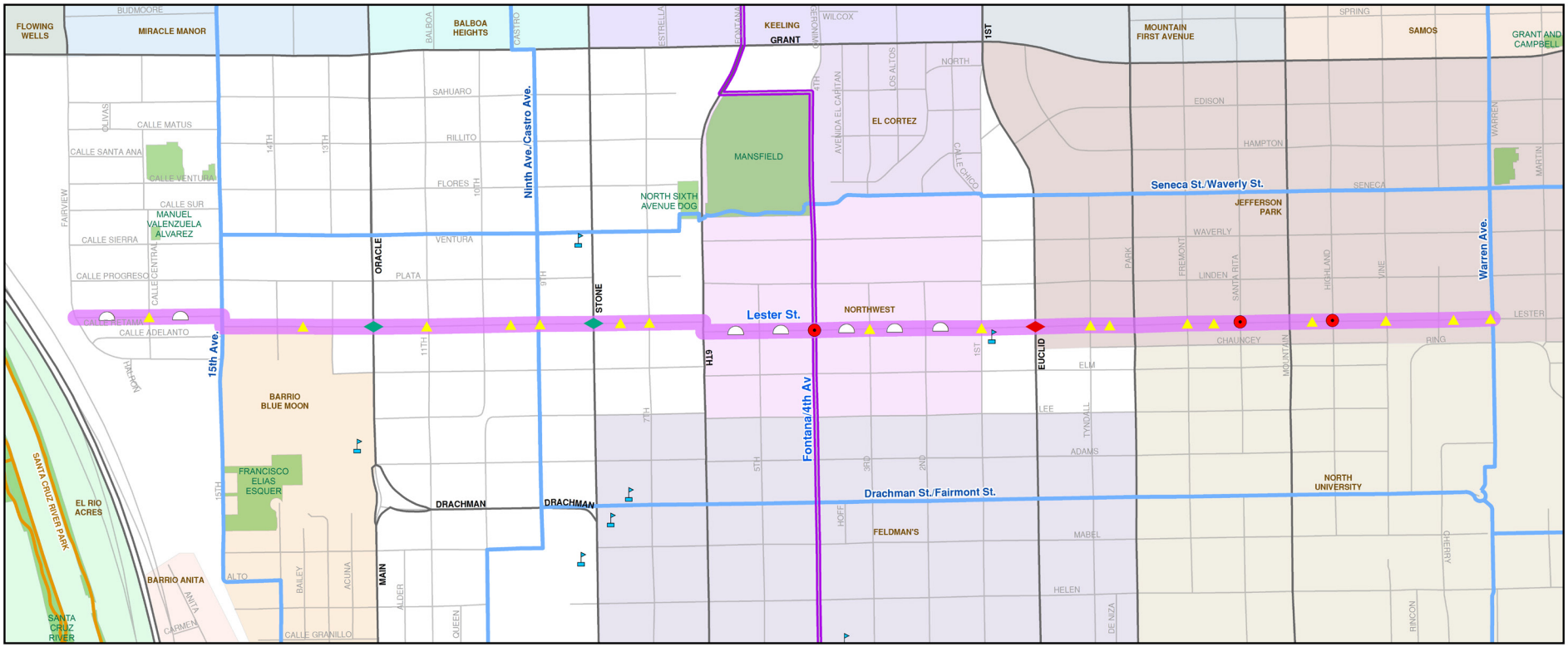




Design Elements

- Lester St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Existing Shared-use-path
- School
- Park

N W E S

LESTER ST.

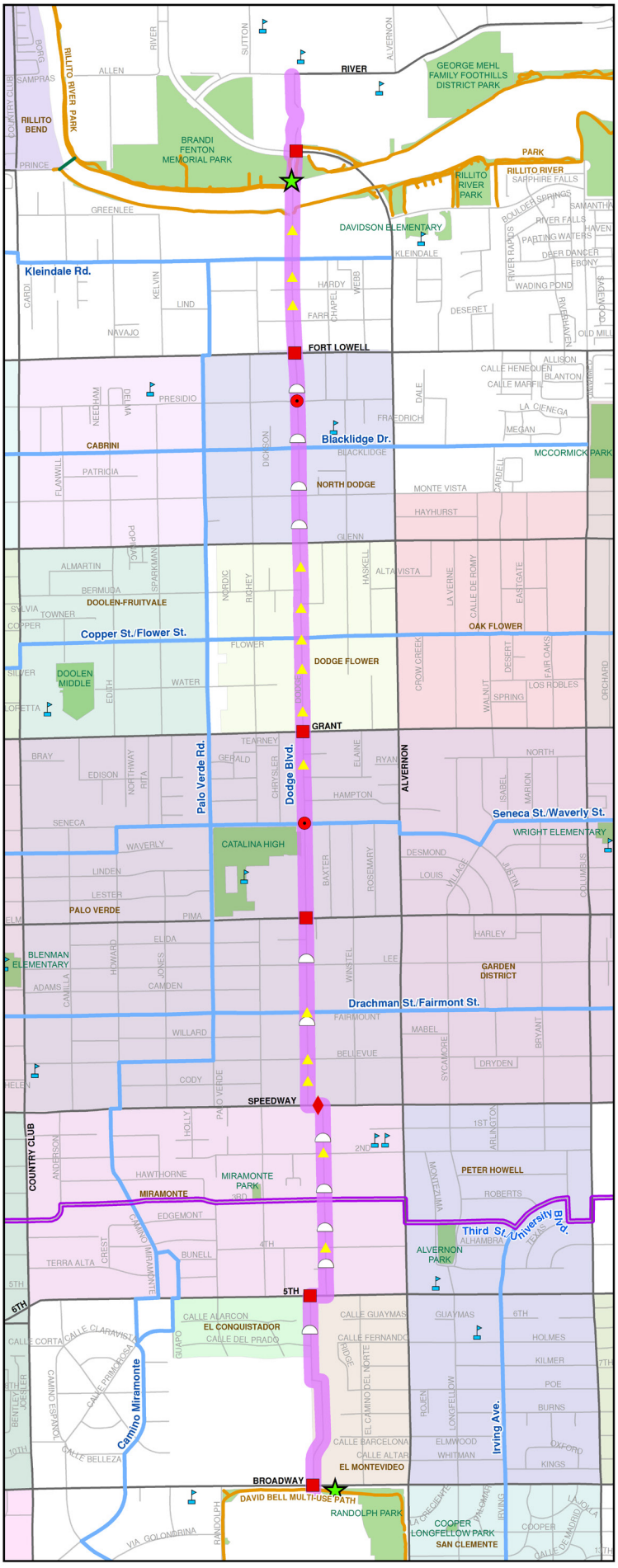
Bicycle Boulevard Master Plan

Rank: 28

Total Miles: 2.35

Estimated Total Cost: $639,842

0 0.25 0.5
Mile



DODGE BLVD.

Bicycle Boulevard Master Plan

Rank: 29

Total Miles: 3.87

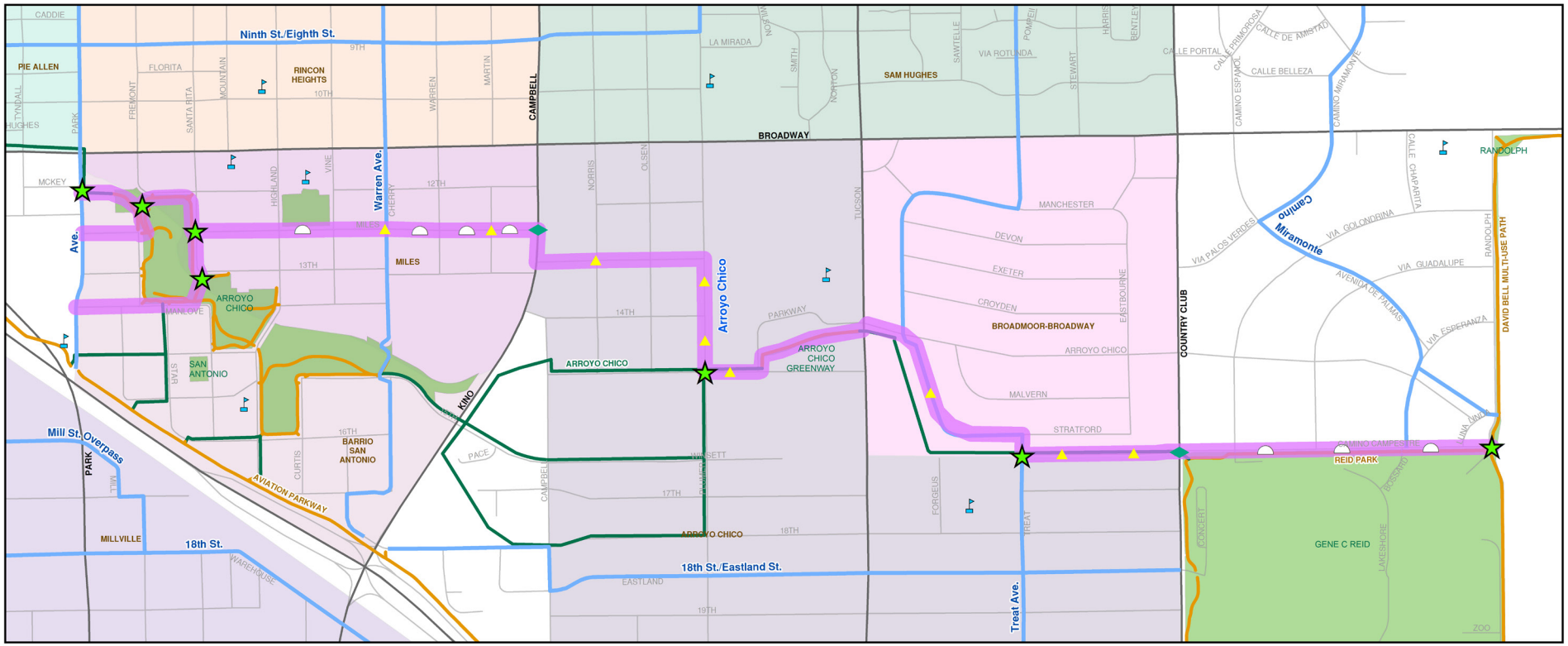
Estimated Total Cost: $340,096

0 0.25 0.5
Mile

Design Elements

- Dodge Blvd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Speedhumps
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N
W E
S



Design Elements

- Arroyo Chico Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

ARROYO CHICO

Bicycle Boulevard Master Plan

Rank: 30

Total Miles: 3.15

Estimated Total Cost: $322,600

0 0.25 0.5
Mile

EL RIO DR.
DRAGOON AVE.

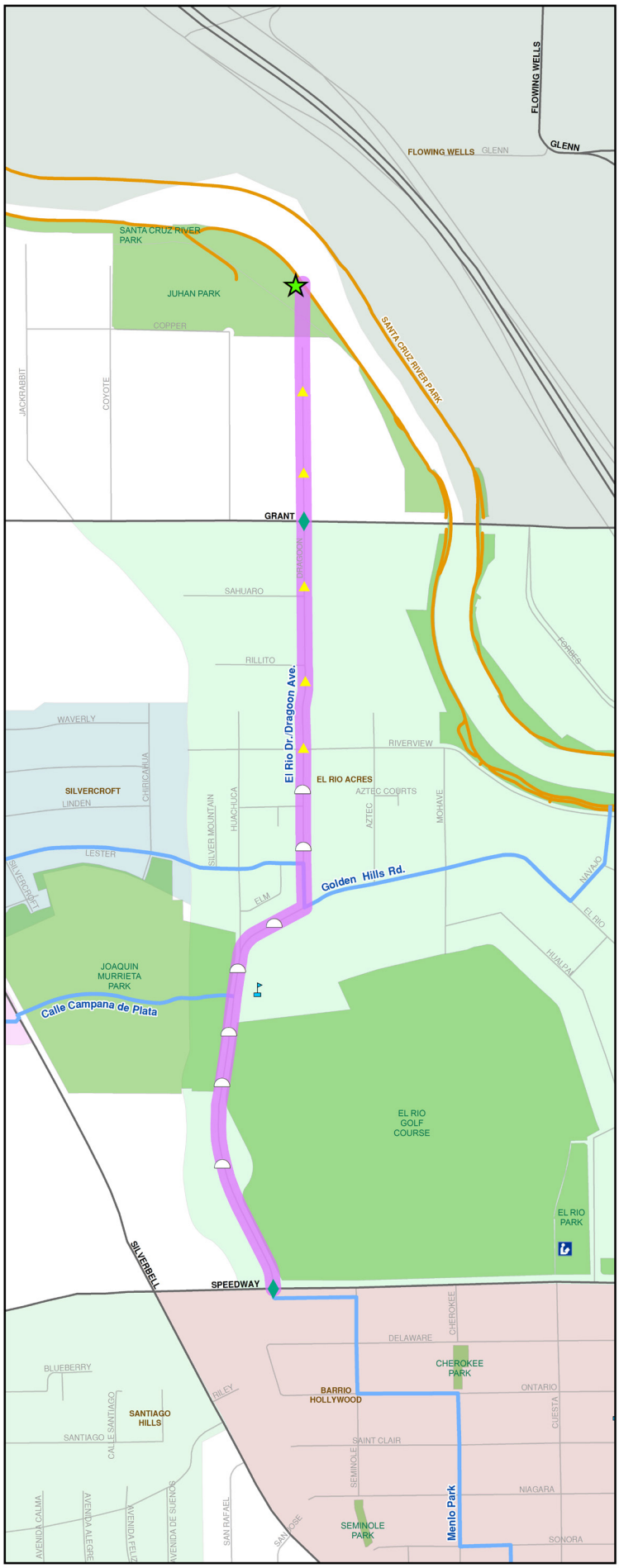
Bicycle Boulevard Master Plan

Rank: 31

Total Miles: 1.41

Estimated Total Cost: $414,742

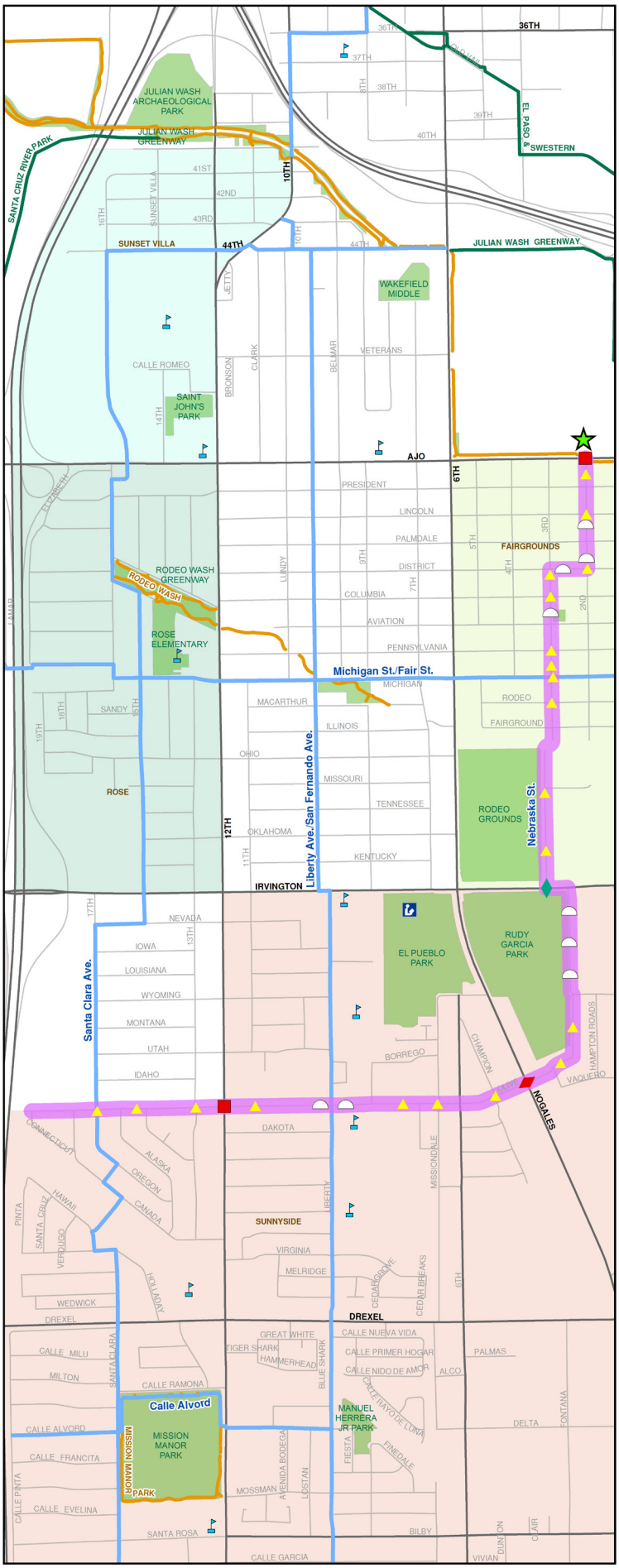
0 0.125 0.25
Mile



Design Elements

- El Rio Dr./Dragoon Ave. Bicycle
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Existing Shared-use-path
- School
- Park

N
W E
S



NEBRASKA ST.

Bicycle Boulevard Master Plan

Rank: 32

Total Miles: 2.84

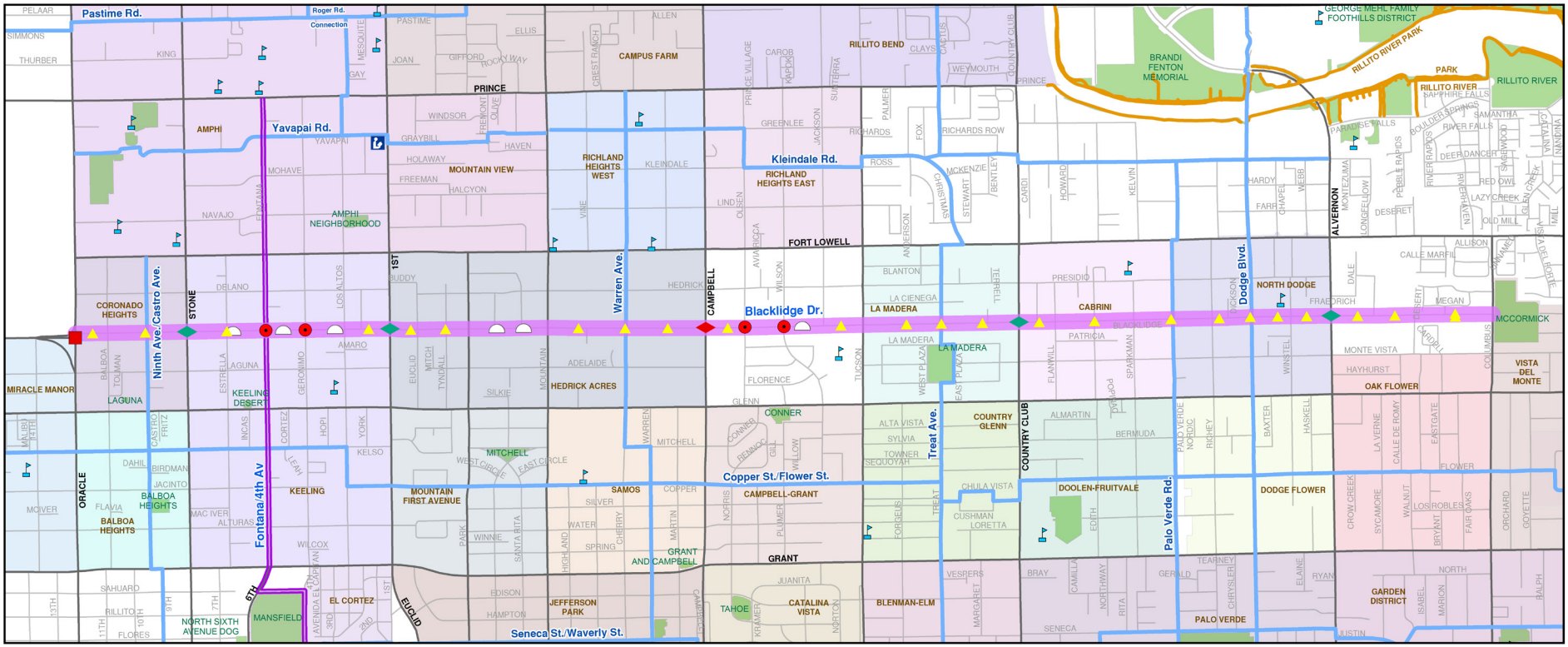
Estimated Total Cost: $429,204

0 0.25 0.5
Mile

Design Elements

- Nebraska St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N
W E
S



Design Elements

- Blacklidge Dr. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Existing Shared-use-path
- Library
- School
- Park

N W E S

BLACKLIDGE DR.

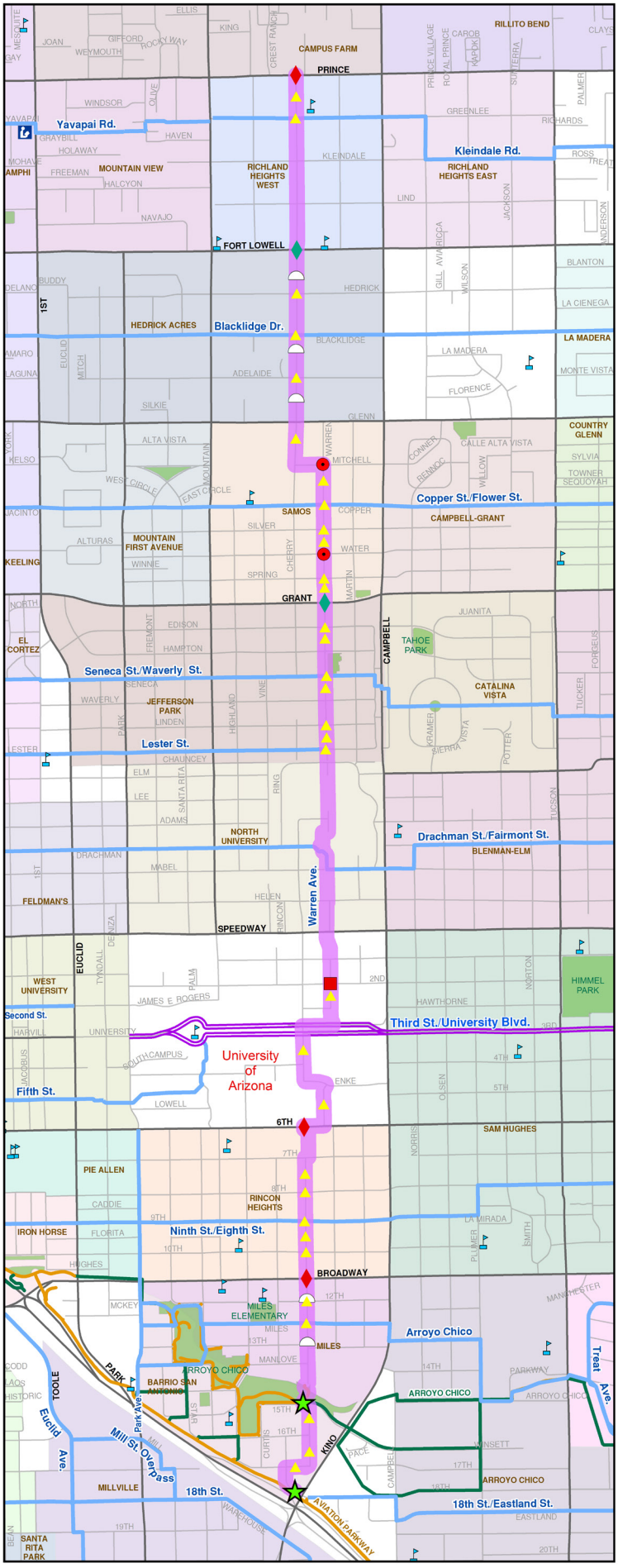
Bicycle Boulevard Master Plan

Rank: 33

Total Miles: 4.51

Estimated Total Cost: $1,161,770

0 0.5 1
Mile



WARREN AVE.

Bicycle Boulevard Master Plan

Rank: 34

Total Miles: 4.56

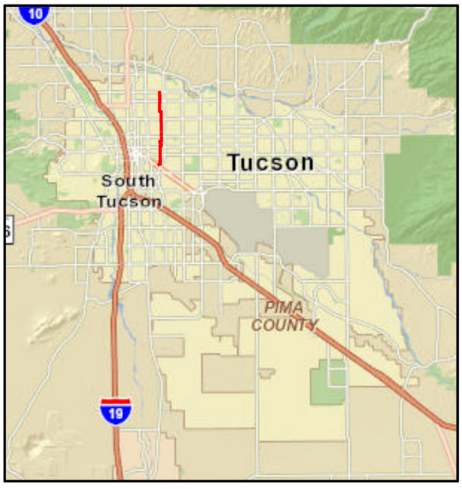
Estimated Total Cost: $953,854

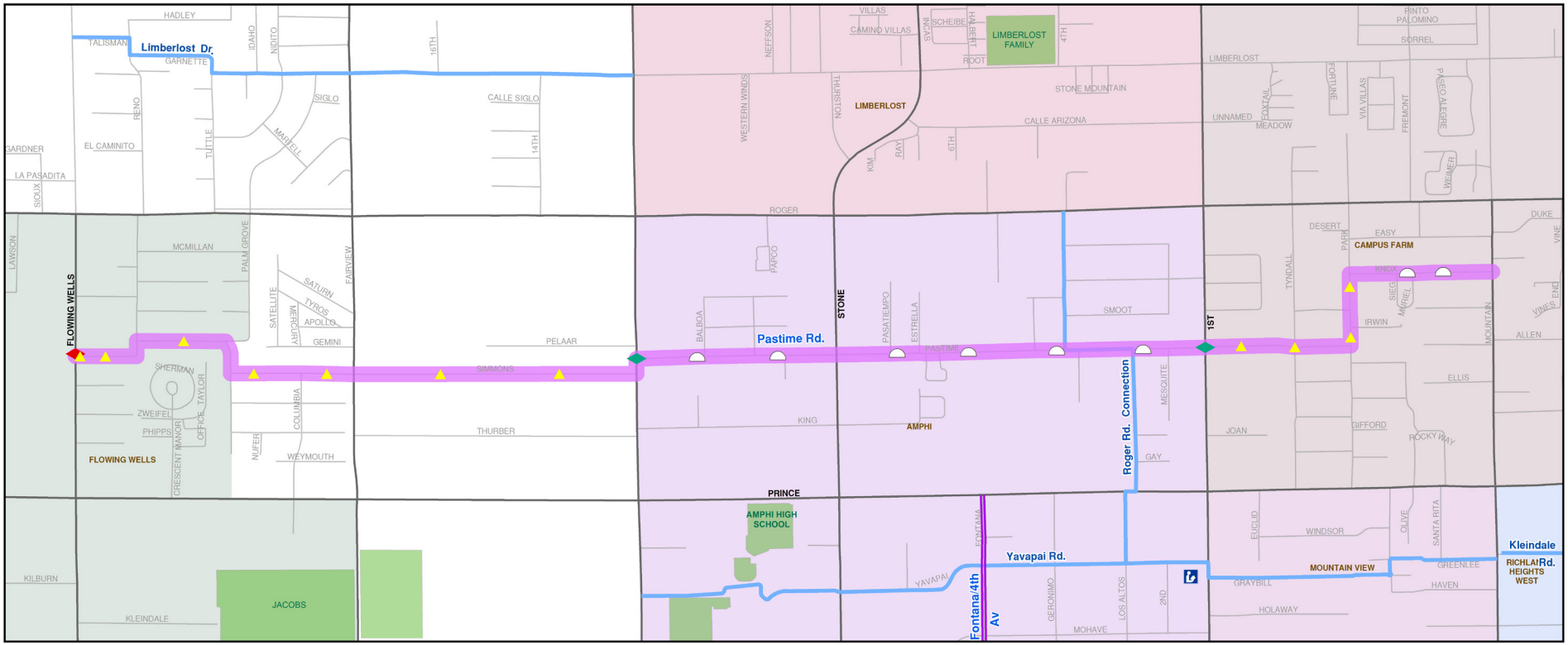
0 0.5 1
Mile

Design Elements

- Warren Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S





Design Elements

- Pastime Rd. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Speedhumps
- Library
- School
- Park

PASTIME RD.

Bicycle Boulevard Master Plan

Rank: 35

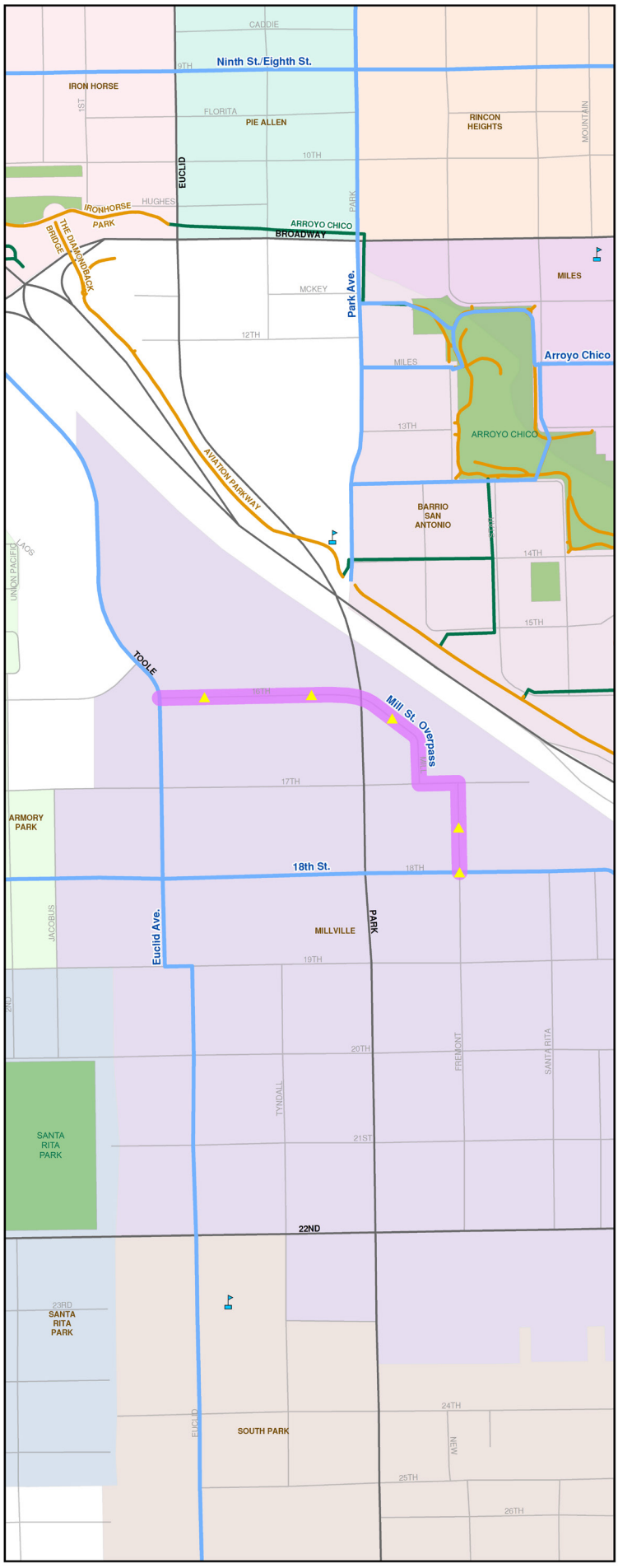
Total Miles: 2.73

Estimated Total Cost: $475,737

0 0.25 0.5
Mile

MILL ST. OVERPASS

Bicycle Boulevard Master Plan



Rank: 36

Total Miles: 0.45

Estimated Total Cost: $45,042

0 0.125 0.25

Mile

Design Elements

- Mill St. Overpass Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

SARNOFF DR.

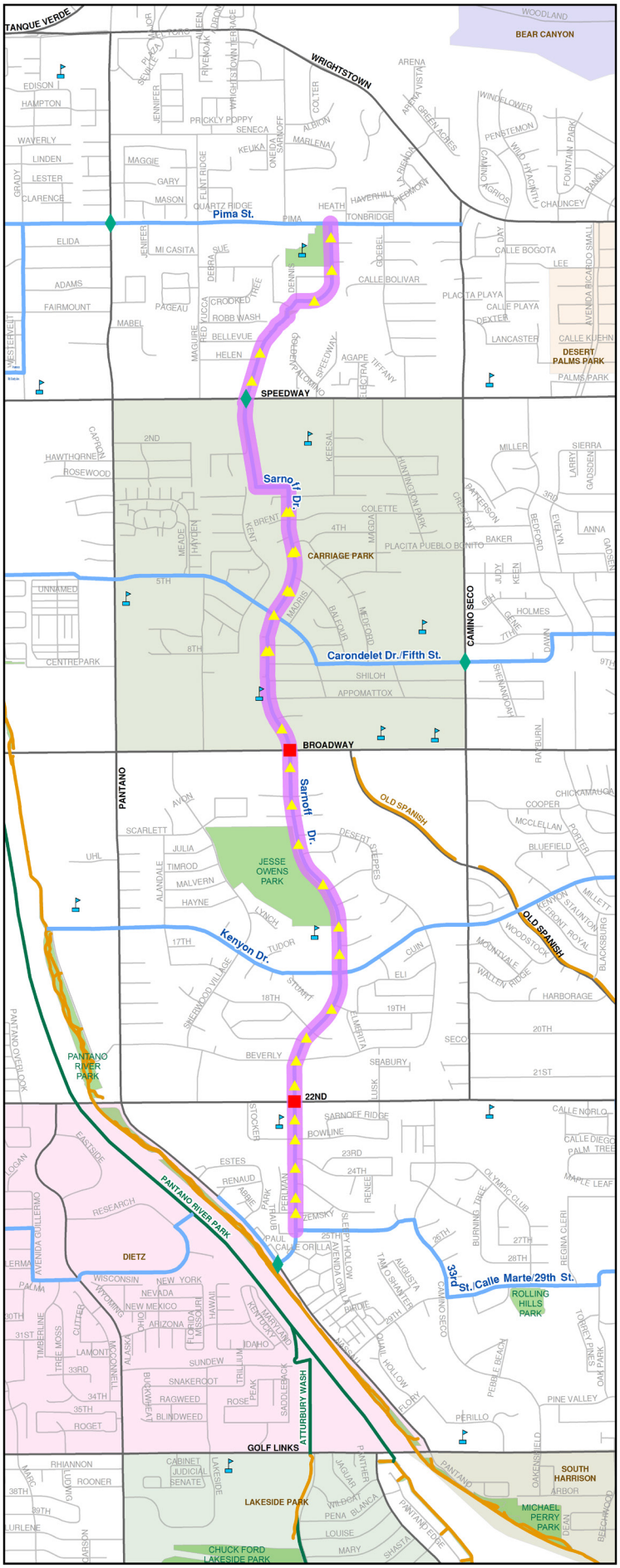
Bicycle Boulevard Master Plan

Rank: 37

Total Miles: 3.20

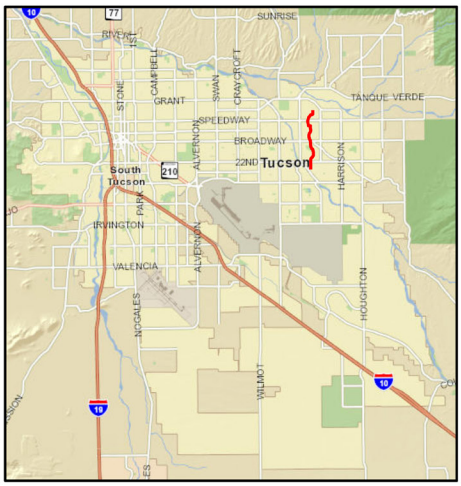
Estimated Total Cost: $553,996

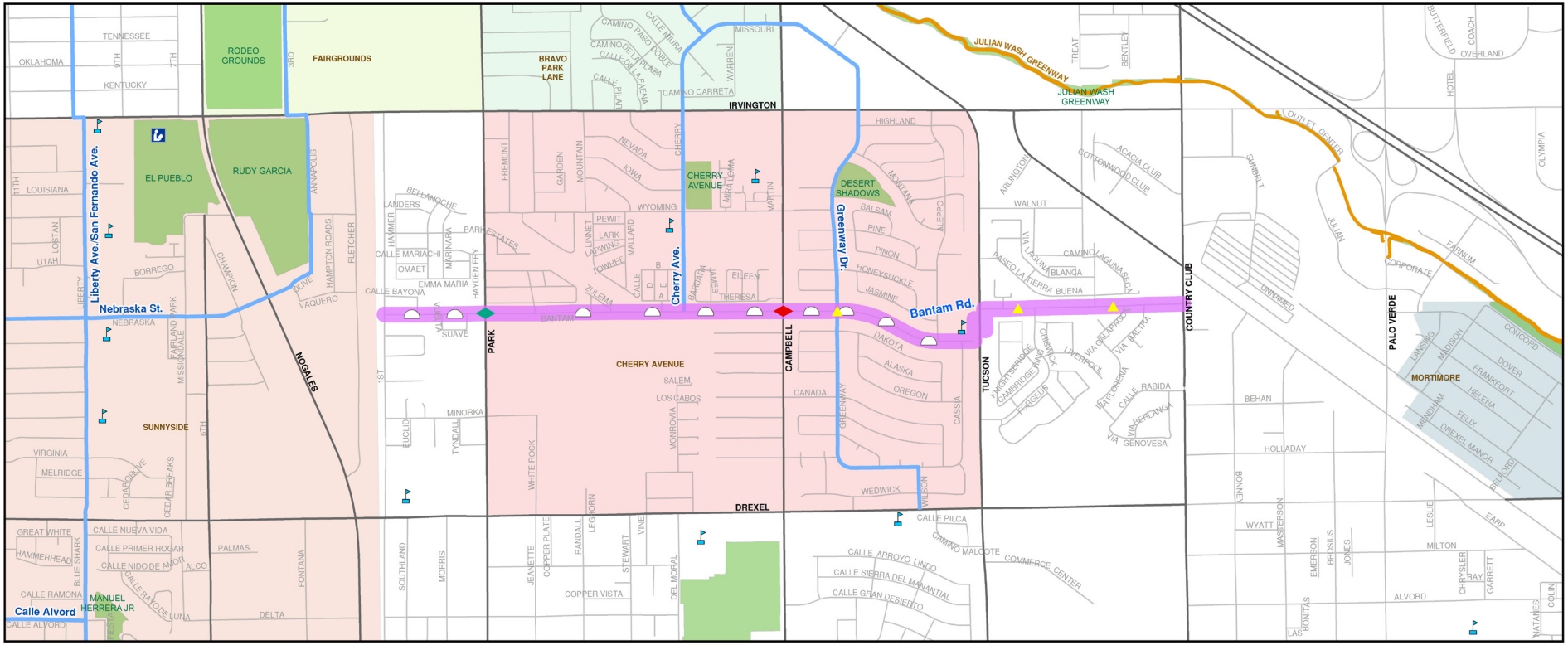
0 0.25 0.5
Mile



Design Elements

- Sarnoff Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Traffic Signal
- School
- Park





Design Elements

- Bantam Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Speedhumps
- Existing Shared-use-path
- Library
- School
- Park

N W E S

BANTAM RD.

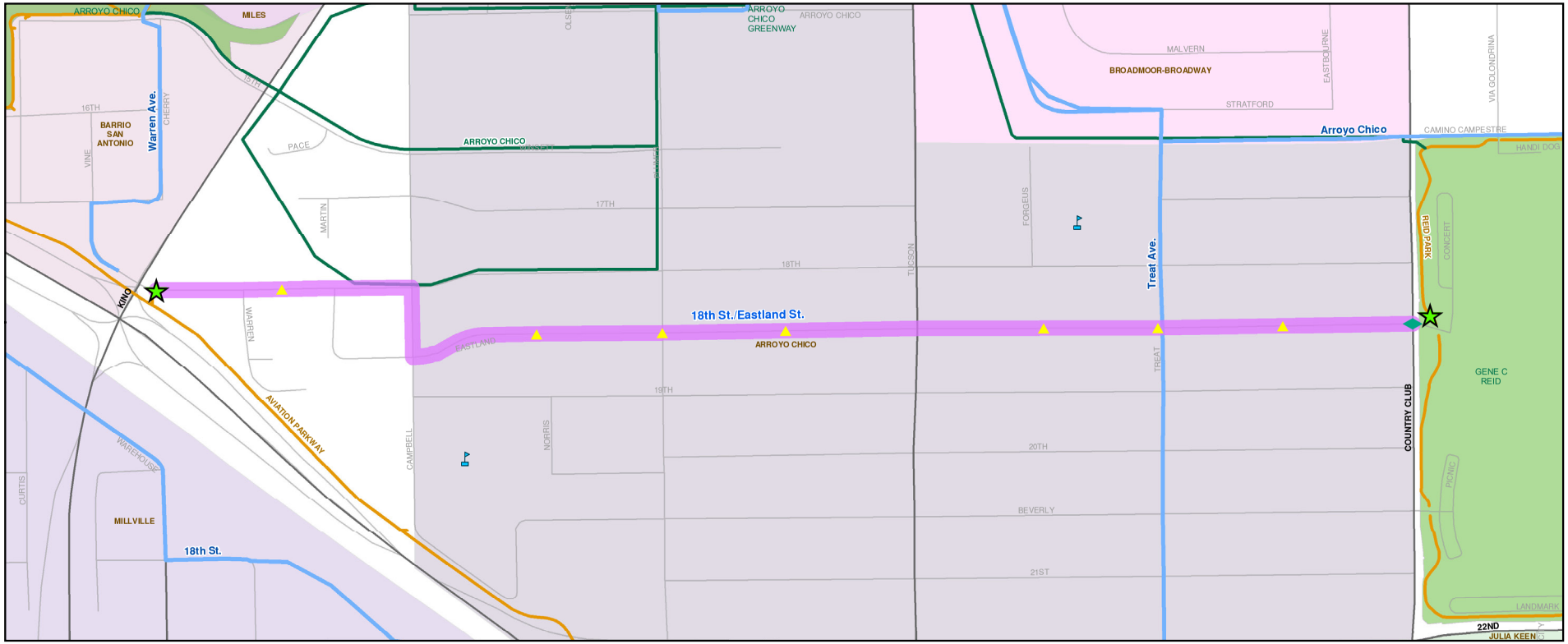
Bicycle Boulevard Master Plan

Rank: 38

Total Miles: 2.16

Estimated Total Cost: $277,369

0 0.25 0.5
Mile



Design Elements

- 18th St./Eastland St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

18TH ST. EASTLAND ST.

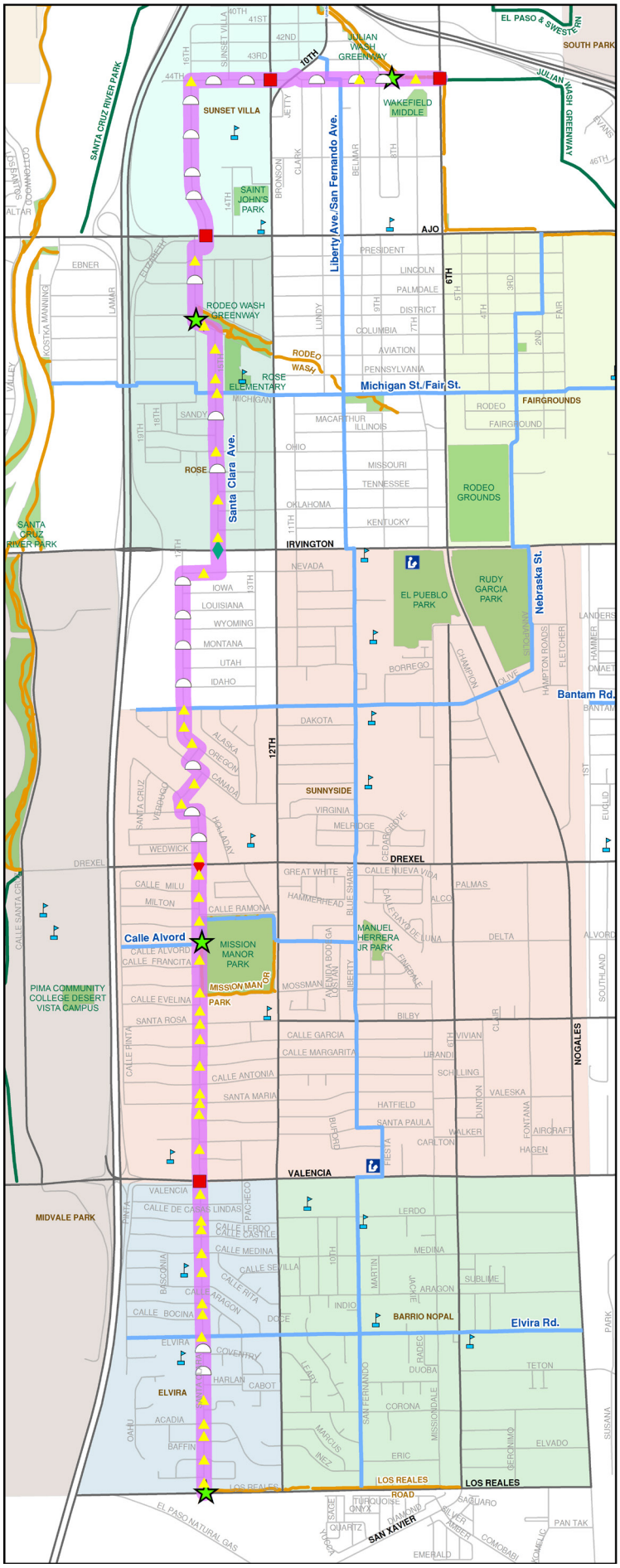
Bicycle Boulevard Master Plan

Rank: 39

Total Miles: 1.33

Estimated Total Cost: $260,175

0 0.125 0.25
Mile



SANTA CLARA AVE.

Bicycle Boulevard Master Plan

Rank: 40

Total Miles: 5.66

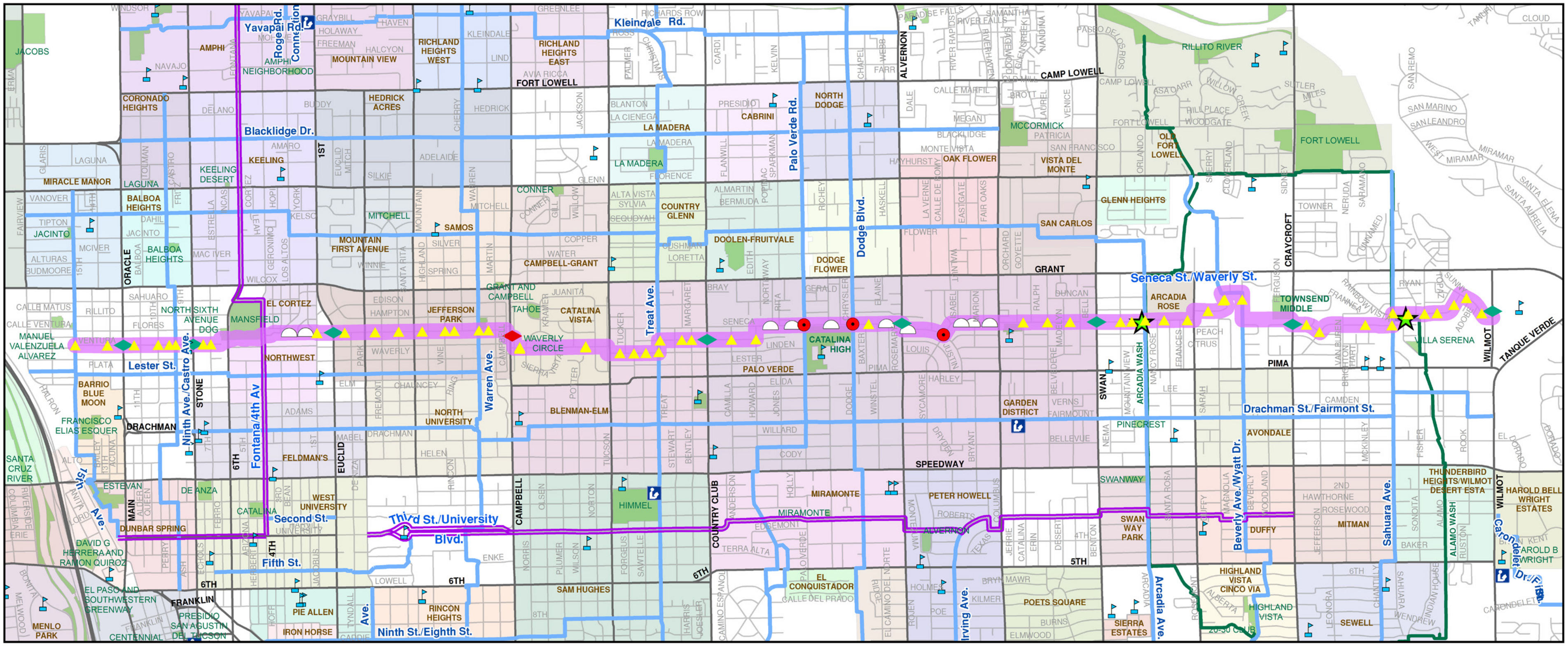
Estimated Total Cost: $725,947

0 0.5 1
Mile

Design Elements

- Santa Clara Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N
W E
S



Design Elements

- Seneca St./Waverly St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

SENECA ST. WAVERLY ST.

Bicycle Boulevard Master Plan

Rank: 41

Total Miles: 8.19

Estimated Total Cost: $1,999,525

0 0.5 1
Mile

GREENWAY DR.

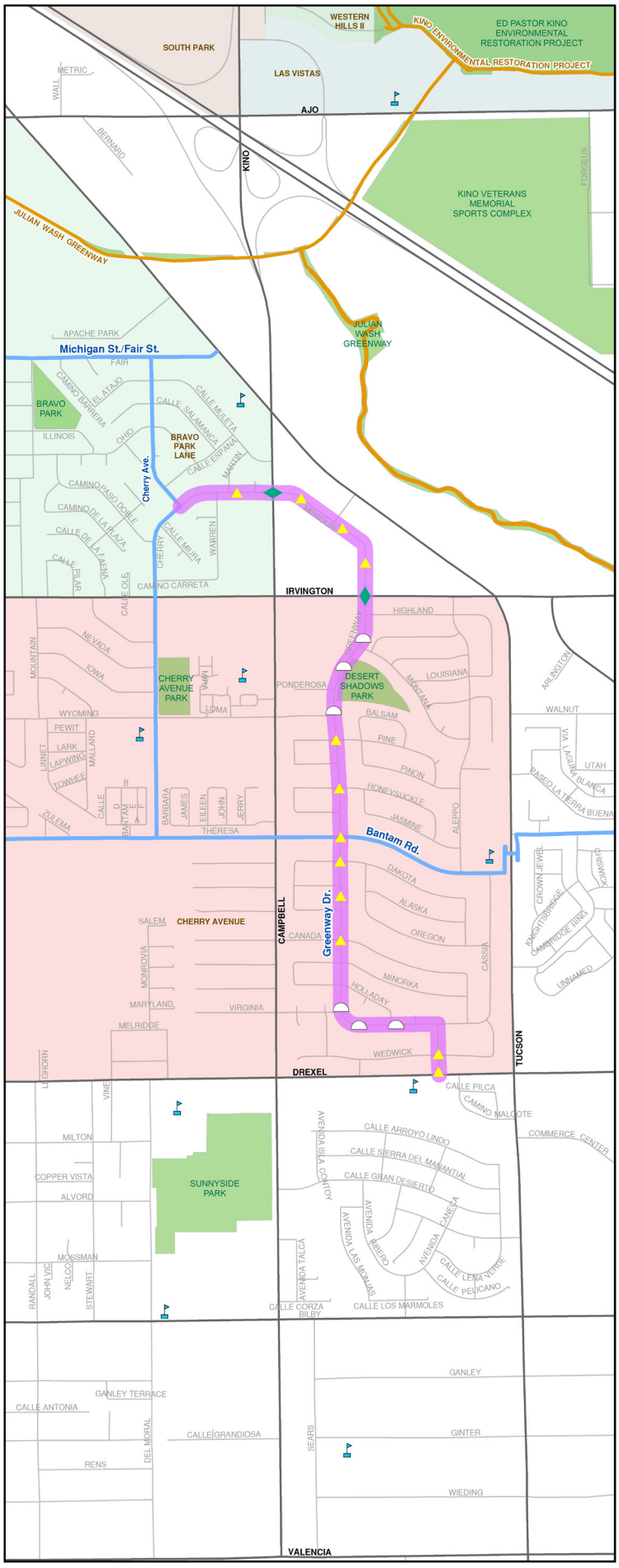
Bicycle Boulevard Master Plan

Rank: 42

Total Miles: 1.74

Estimated Total Cost: $475,882

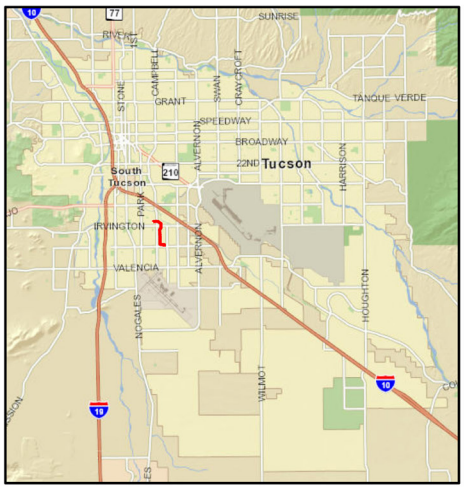
0 0.25 0.5
Mile

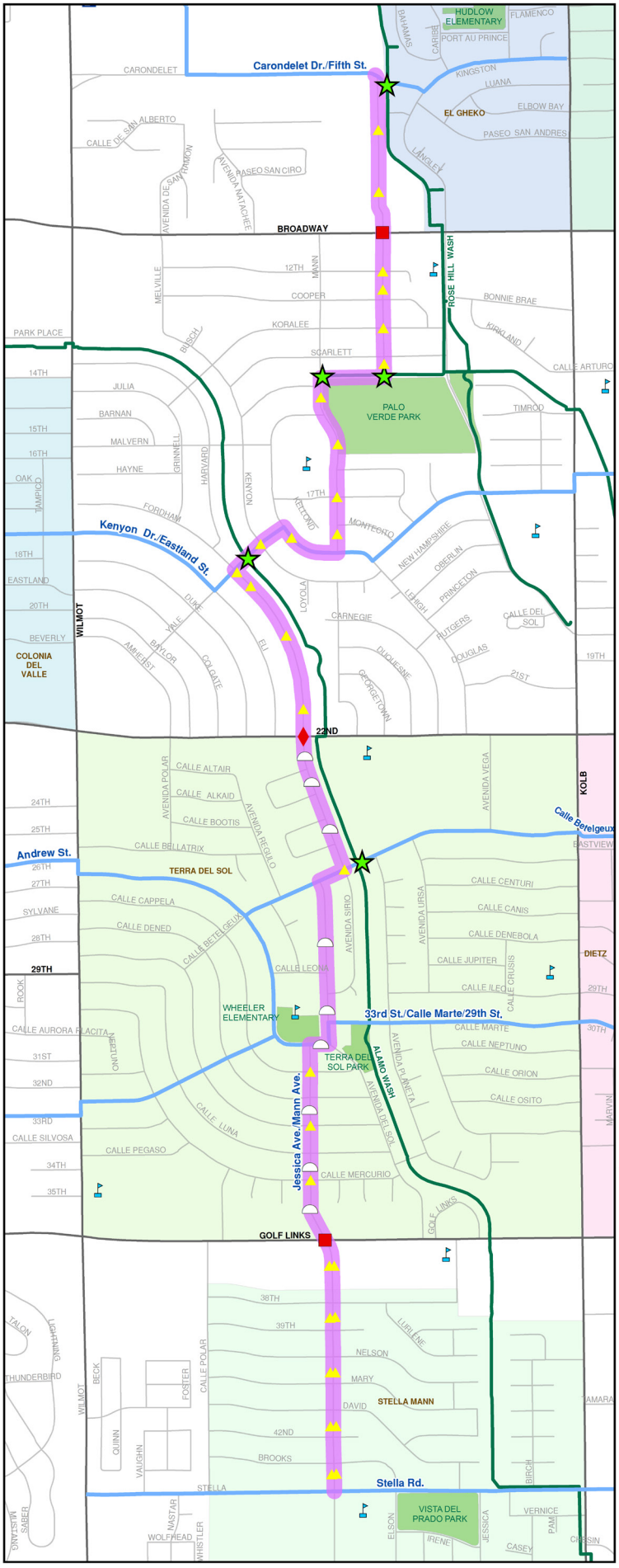


Design Elements

- Greenway Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Existing Shared-use-path
- School
- Park

N
W E
S





JESSICA AVE. MANN AVE.

Bicycle Boulevard Master Plan

Rank: 43

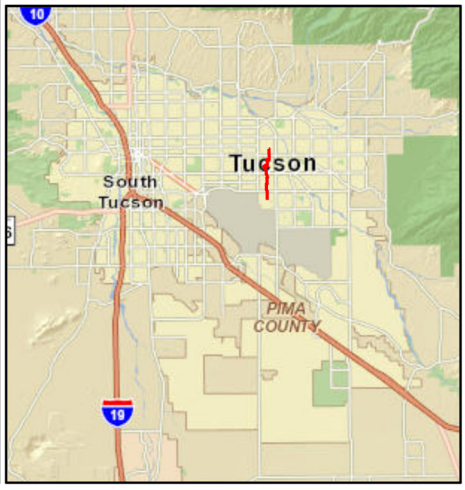
Total Miles: 3.32

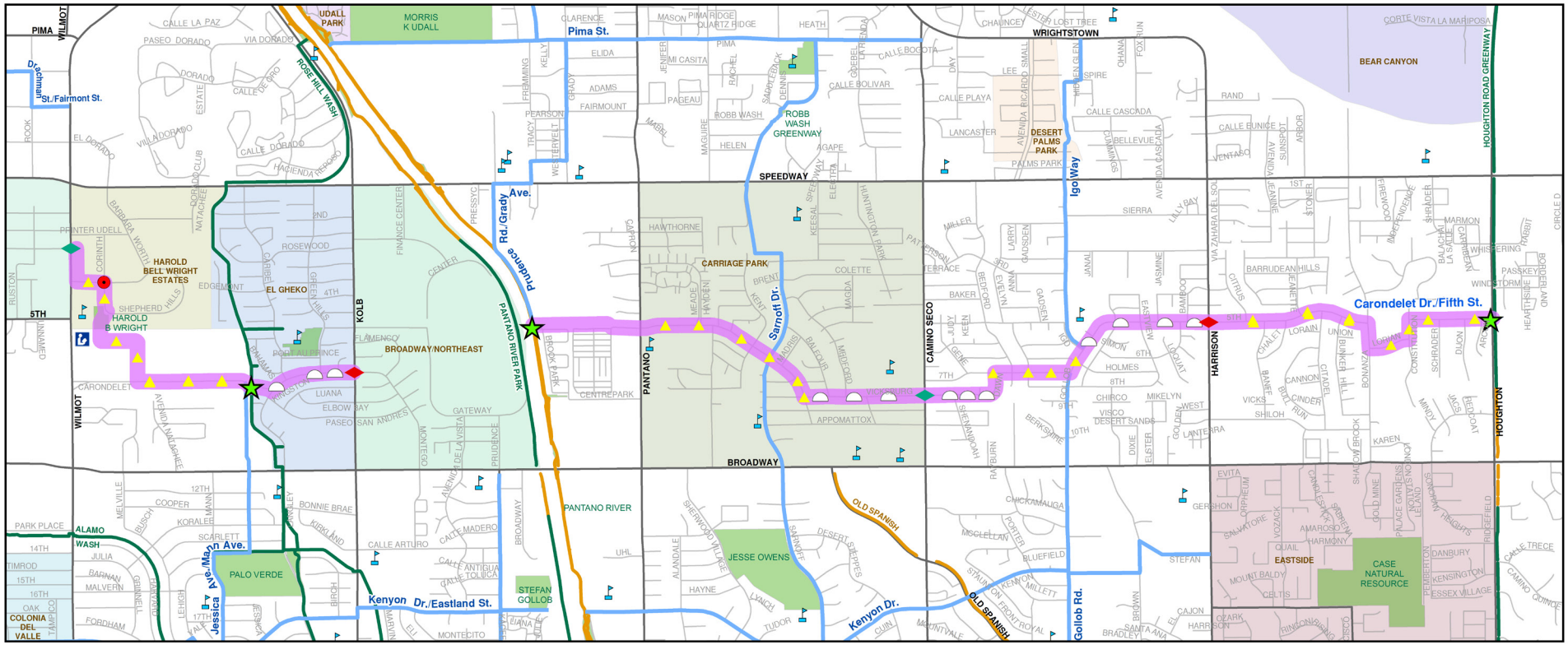
Estimated Total Cost: $362,910

0 0.25 0.5
Mile

Design Elements

- Jessica Ave. Mann Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park





Design Elements

- Carondelet Dr./Fifth St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

CARONDELET DR. FIFTH ST.

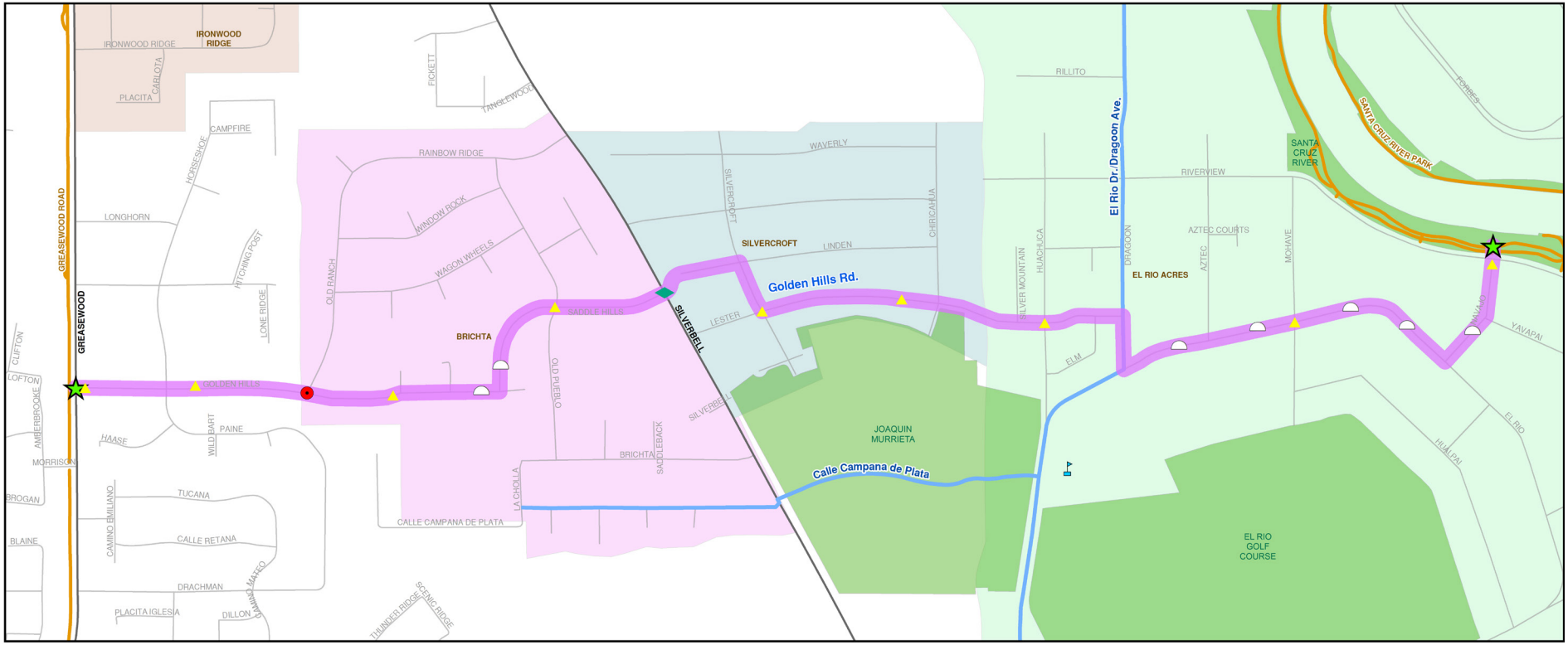
Bicycle Boulevard Master Plan

Rank: 44

Total Miles: 5.29

Estimated Total Cost: $760,044

0 0.5 1
Mile



Design Elements

- Golden Hills Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- School
- Park

GOLDEN HILLS RD.

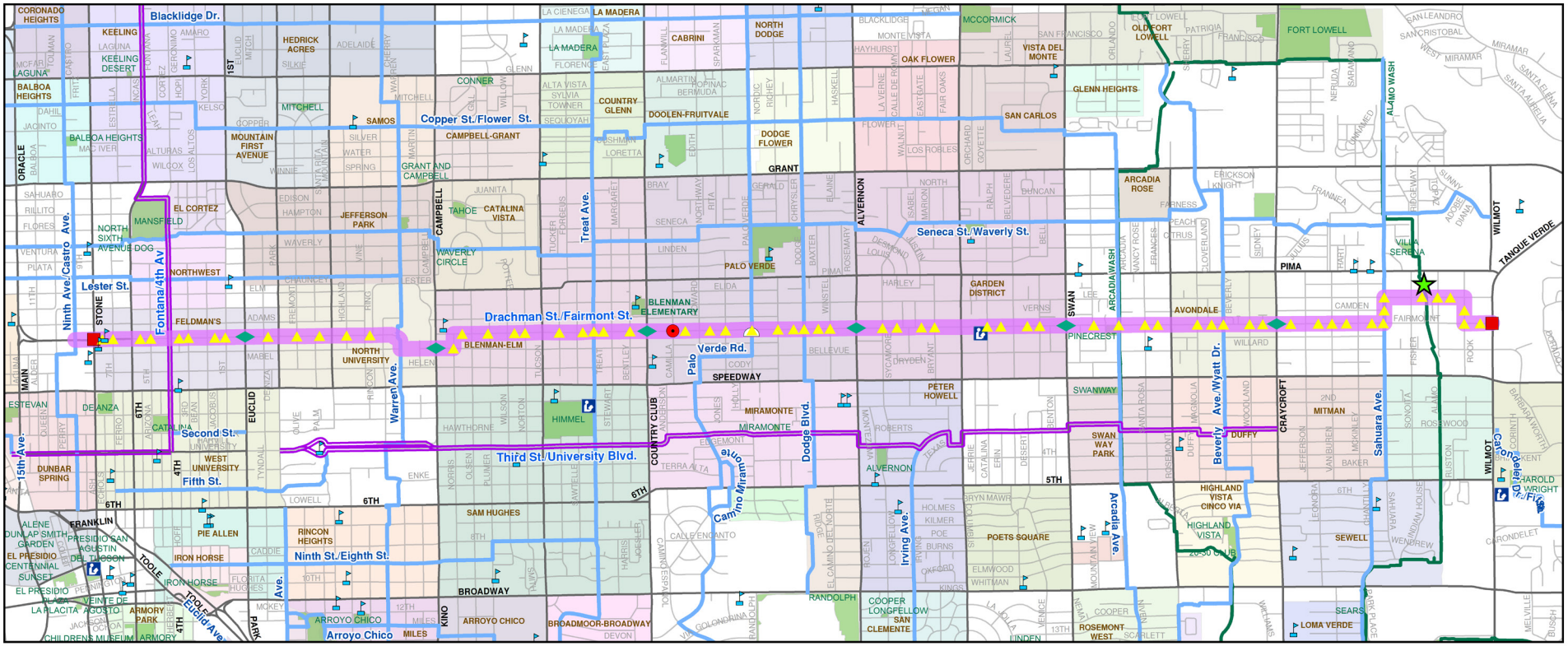
Bicycle Boulevard Master Plan

Rank: 45

Total Miles: 1.88

Estimated Total Cost: $299,814

0 0.125 0.25
Mile



Design Elements

- Drachman St./Fairmont St. Bicycle Boulevard
- Bicycle Boulevards
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Traffic Signal
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Future Shared-use-path
- Library
- School
- Park

N W E S

DRACHMAN ST. FAIRMONT ST.

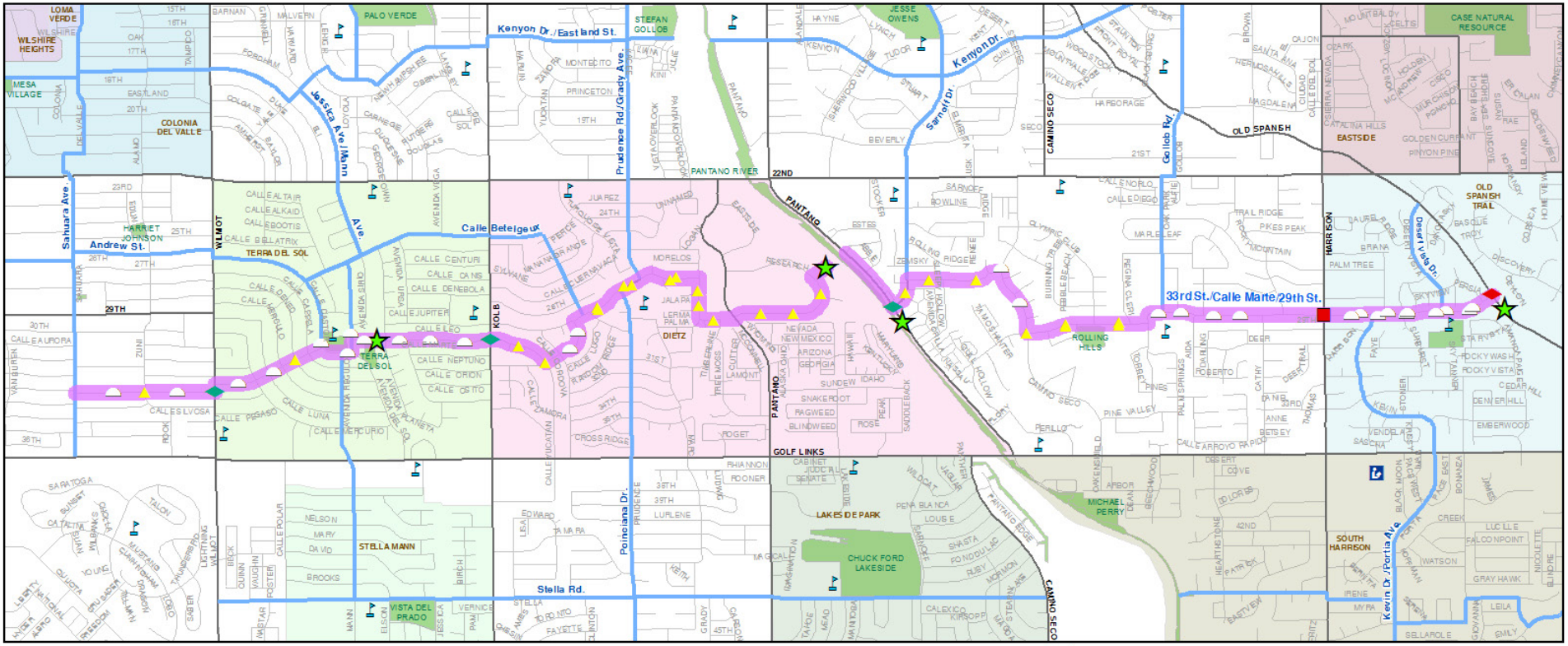
Bicycle Boulevard Master Plan

Rank: 46

Total Miles: 7.13

Estimated Total Cost: $1,769,477

0 0.5 1
Mile



Design Elements

- 33rd St./Calle Marte/29th St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

33RD ST. CALLE MARTE 29TH ST.

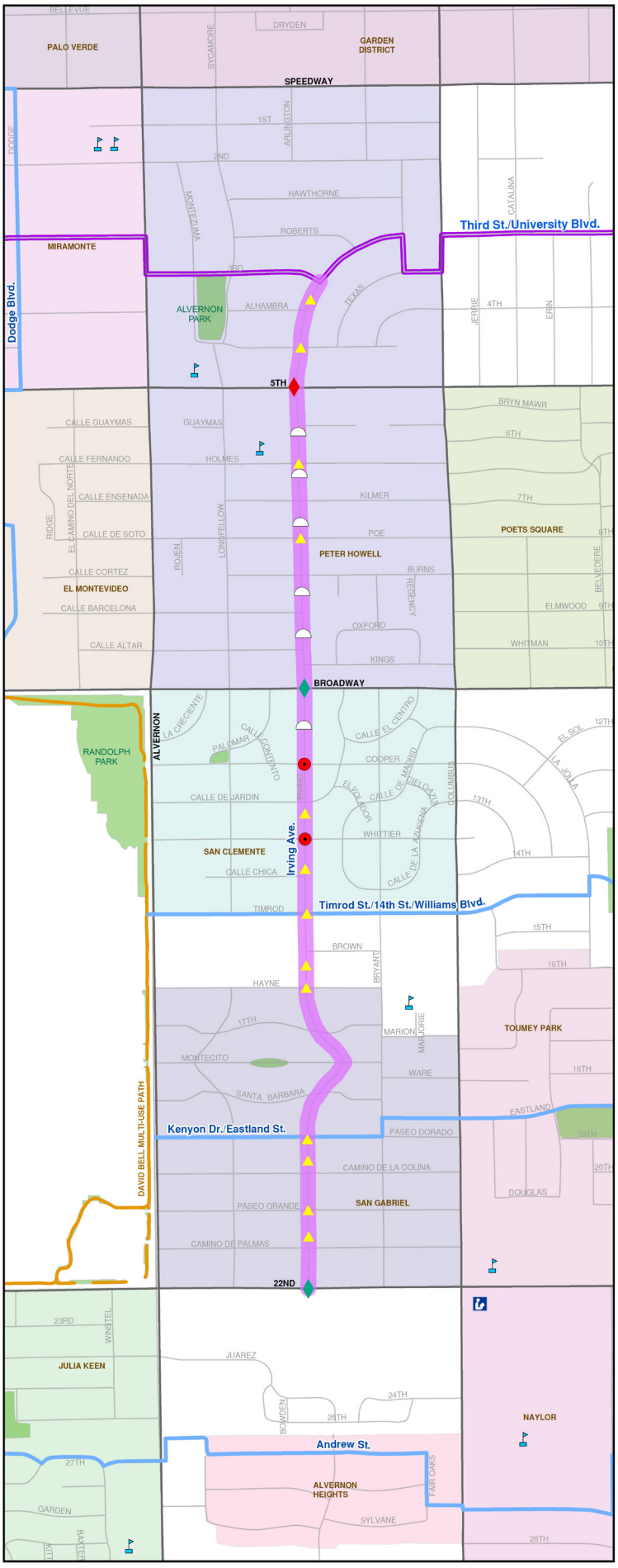
Bicycle Boulevard Master Plan

Rank: 47

Total Miles: 6.12

Estimated Total Cost: $834,154

0 0.5 1
Mile



IRVING AVE.

Bicycle Boulevard Master Plan

Rank: 48

Total Miles: 1.73

Estimated Total Cost: $547,739

0 0.25 0.5
Mile

Design Elements

- Irving Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Existing Shared-use-path
- School
- Library
- Park

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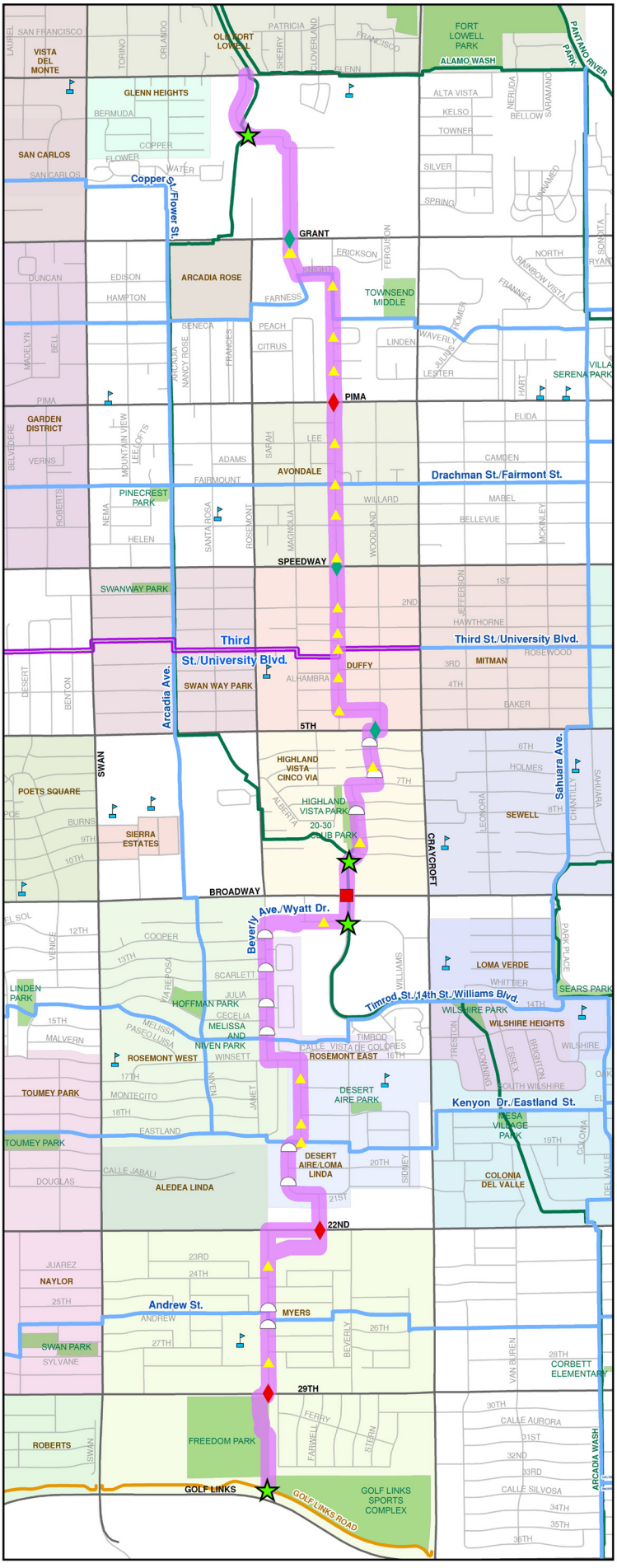

BEVERLY AVE. WYATT DR.

Bicycle Boulevard Master Plan

Rank: 49

Total Miles: 5.65

Estimated Total Cost: $1,081,661

0 0.5 1
Mile

Design Elements

- Beverly Ave./Wyatt Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

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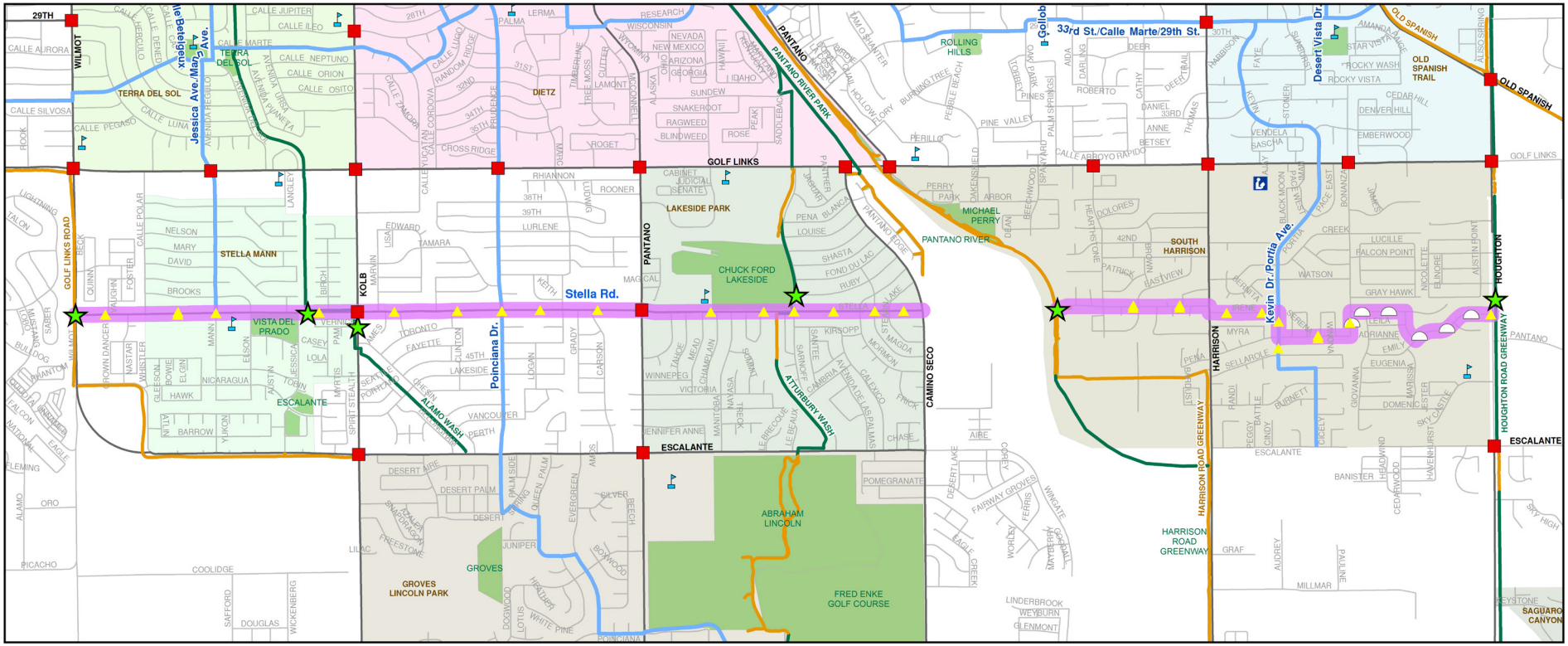


Design Elements

- Stella Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

STELLA RD.

Bicycle Boulevard Master Plan

Rank: 50

Total Miles: 4.82

Estimated Total Cost: $222,680

0 0.5 1
Mile

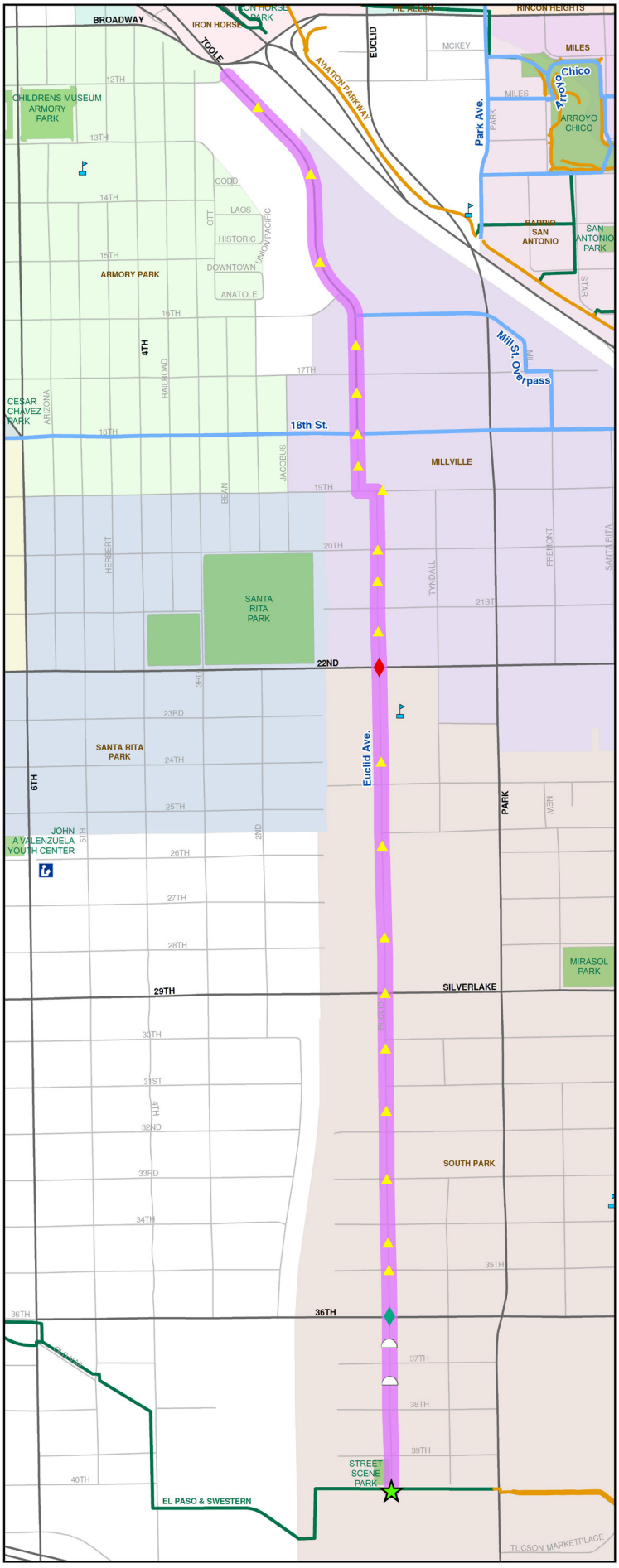
EUCLID AVE.

Bicycle Boulevard Master Plan

Rank: 51

Total Miles: 2.26

Estimated Total Cost: $403,825

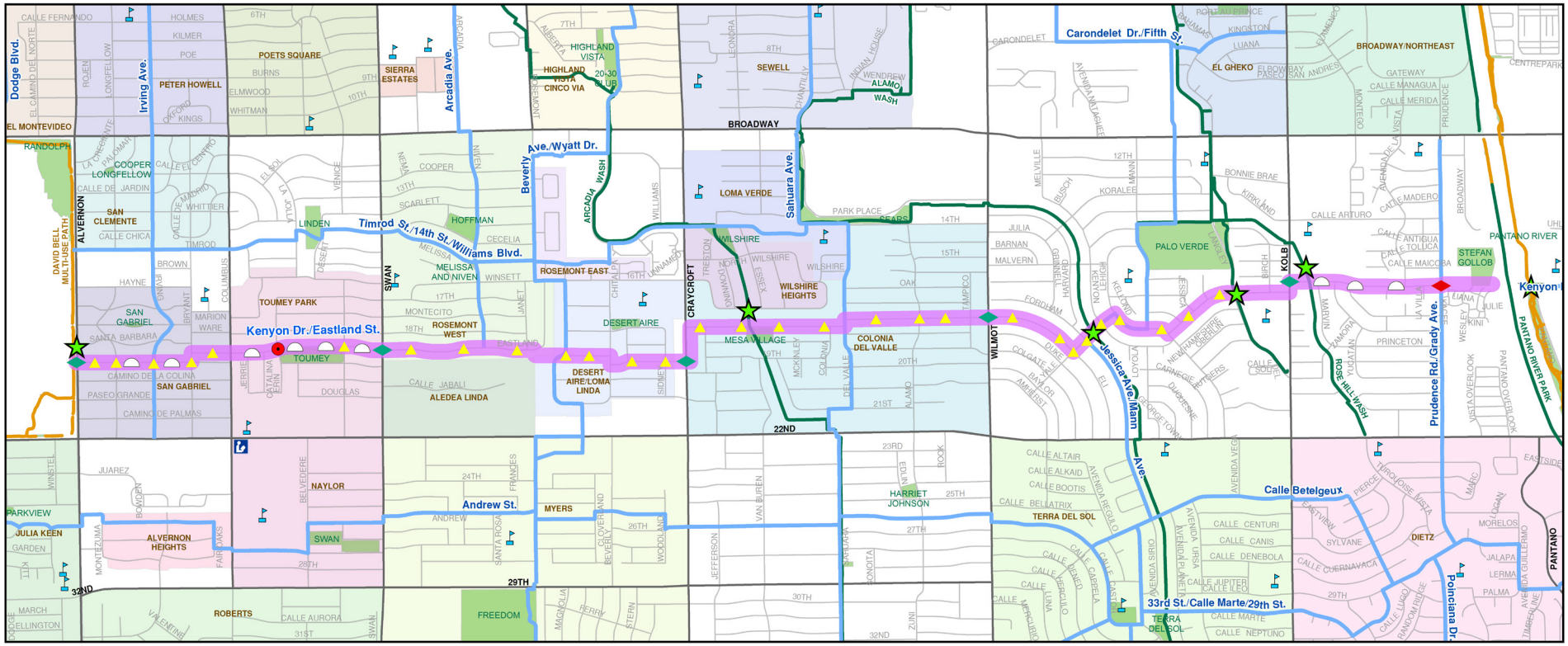


0 0.25 0.5

Mile

Design Elements

- Euclid Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park



Design Elements

- Kenyon Dr./Eastland St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park

N W E S

KENYON DR. EASTLAND ST.

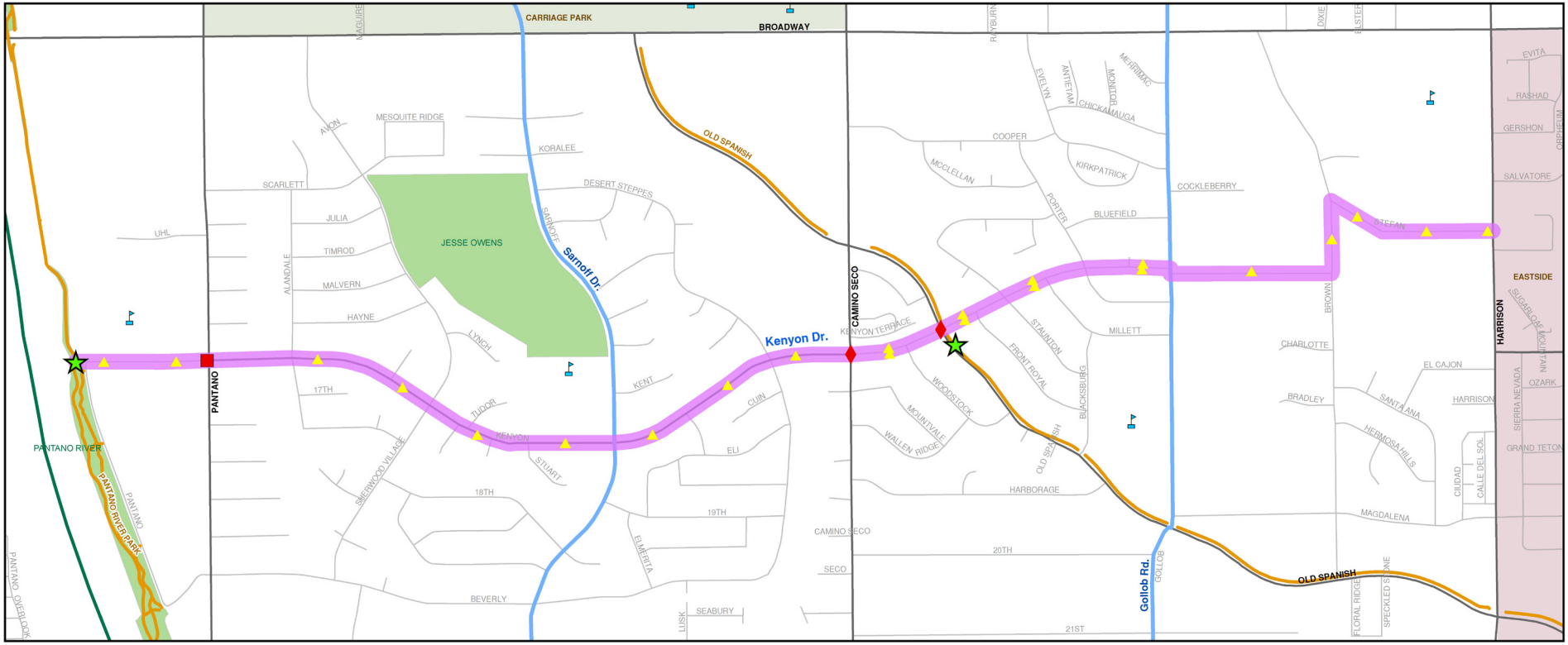
Bicycle Boulevard Master Plan

Rank: 52

Total Miles: 5.11

Estimated Total Cost: $1,219,789

0 0.5 1
Mile



Design Elements

- Kenyon Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Traffic Signal
- Existing Push Button Crossing
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

KENYON DR.

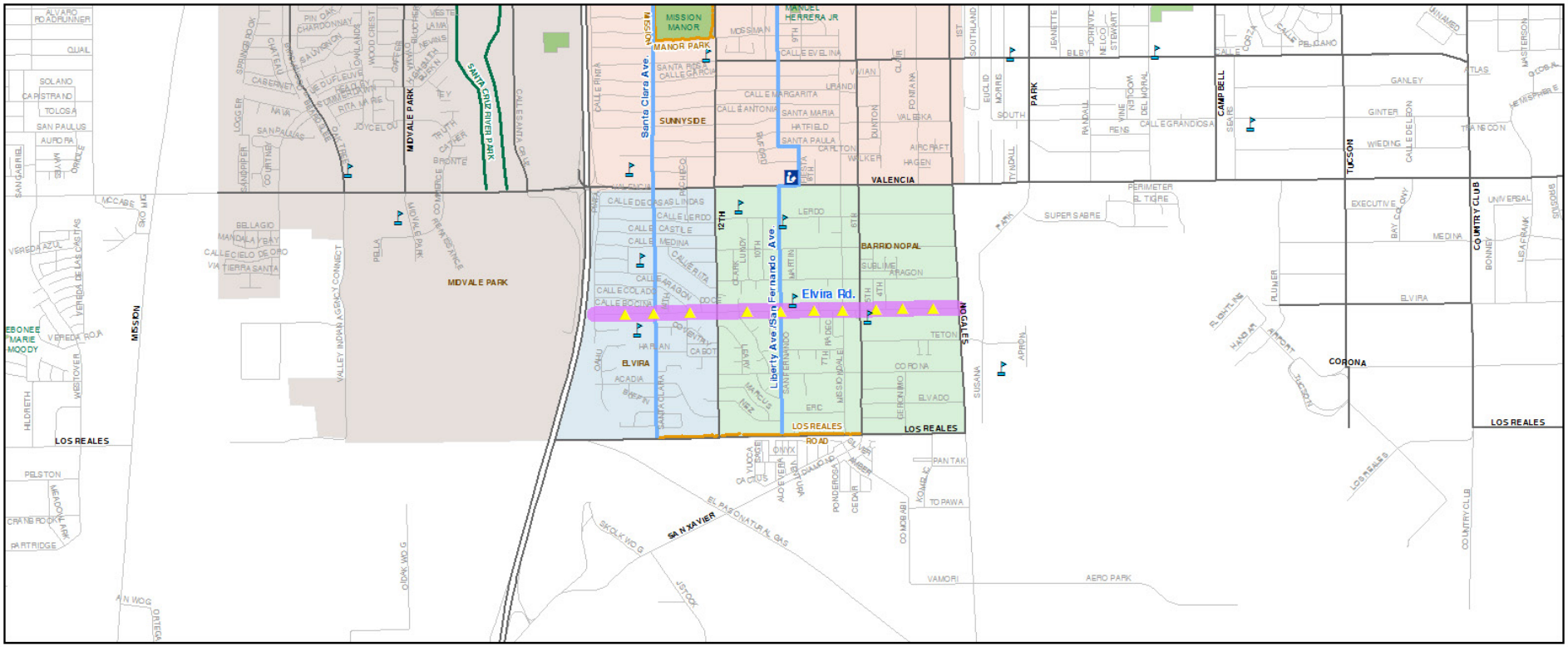
Bicycle Boulevard Master Plan

Rank: 53

Total Miles: 2.43

Estimated Total Cost: $263,320

0 0.25 0.5
Mile



Design Elements

- Elvira Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Future Shared-use-path
- Existing Shared-use-path
- Library
- School
- Park

ELVIRA RD.

Bicycle Boulevard Master Plan

Rank: 54

Total Miles: 1.46

Estimated Total Cost: $92,913

0 0.5 1
Mile

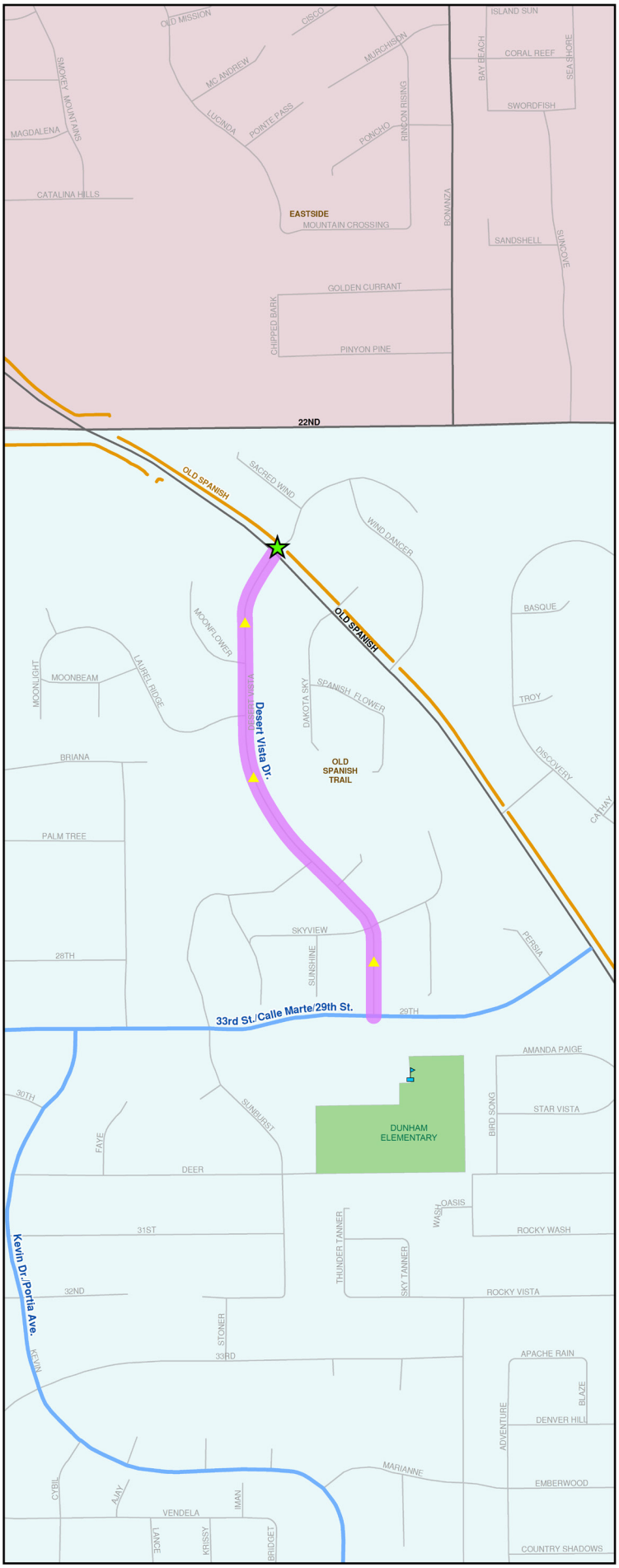
DESERT VISTA DR.

Bicycle Boulevard Master Plan

Rank: 23

Total Miles: 2.10

Estimated Total Cost: $256,986

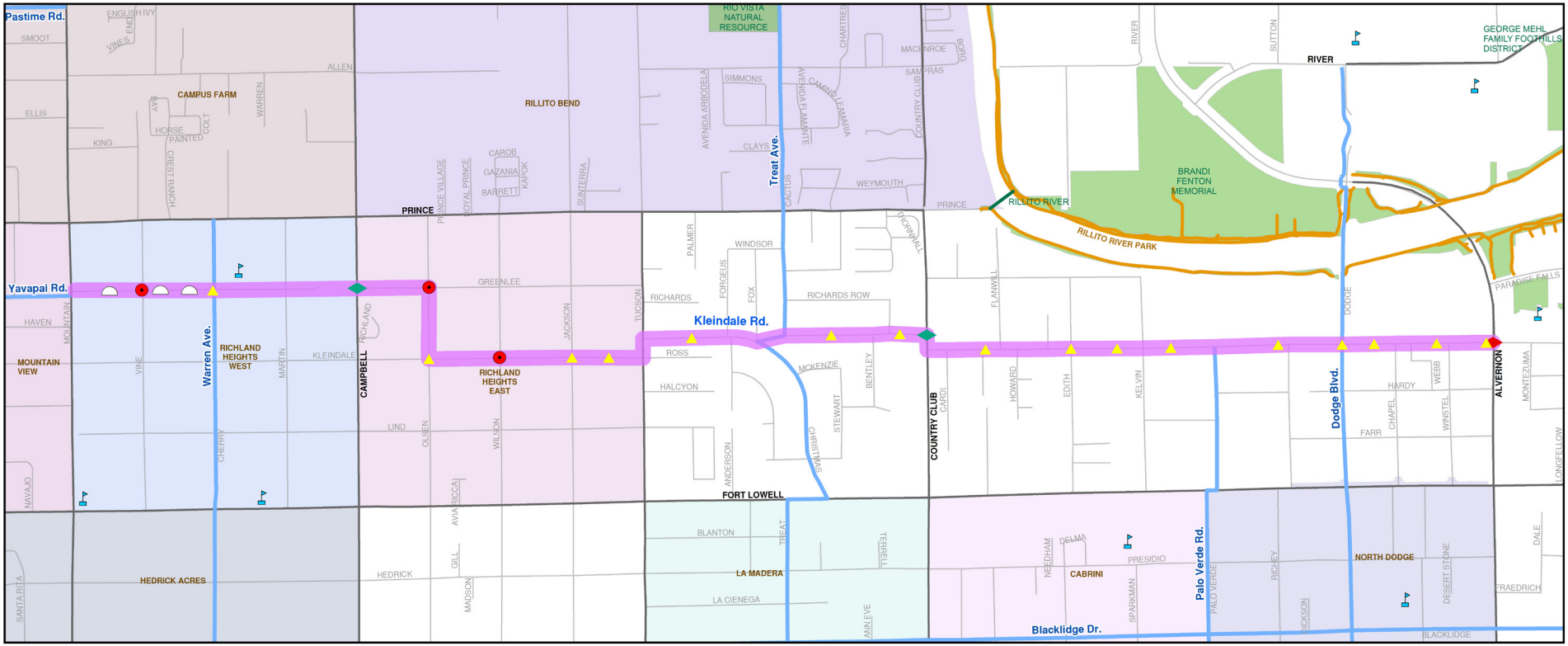


0 0.125 0.25

Mile

Design Elements

- Desert Vista Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Shared-use-path
- School
- Park



Design Elements

- Kleindale Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Push Button Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

KLEINDALE RD.

Bicycle Boulevard Master Plan

Rank: 56

Total Miles: 2.67

Estimated Total Cost: $570,472

0 0.25 0.5
Mile

GOLLOB RD.

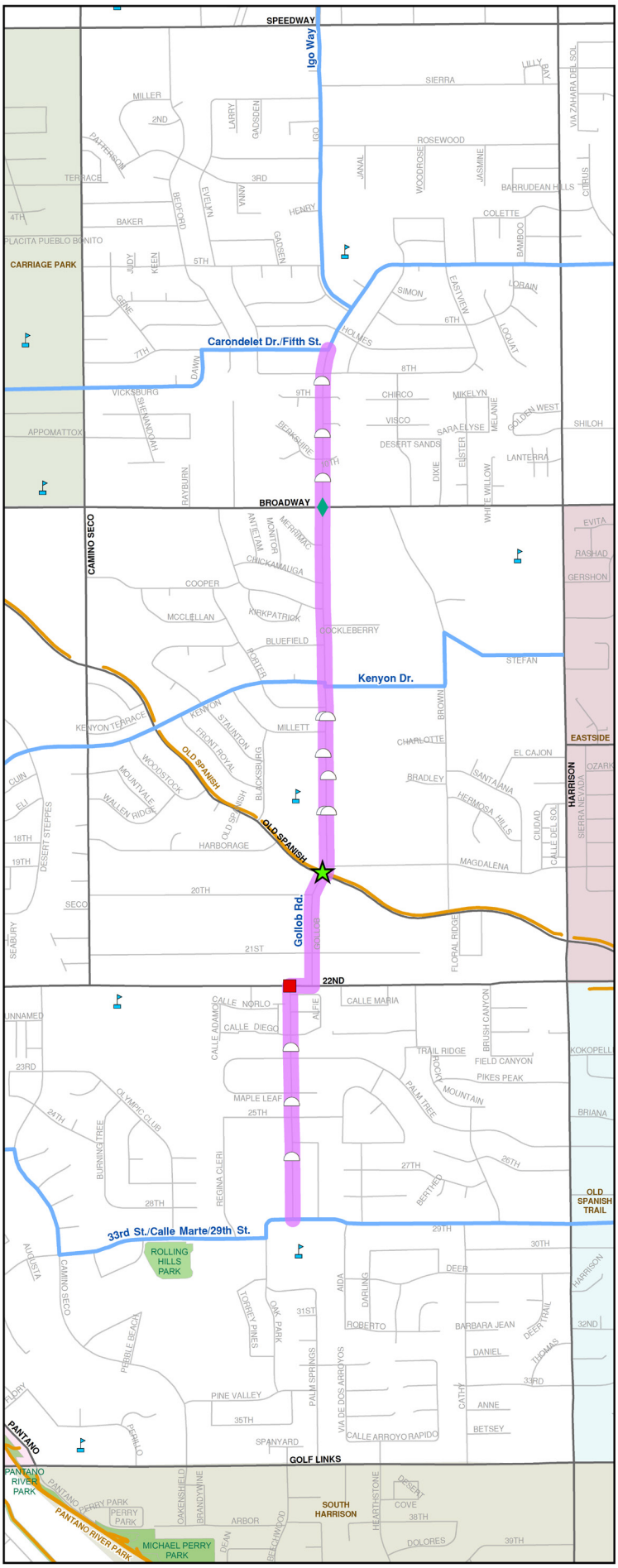
Bicycle Boulevard Master Plan

Rank: 57

Total Miles: 1.88

Estimated Total Cost: $410,528

0 0.25 0.5
Mile



Design Elements

- Gollob Rd. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- School
- Park

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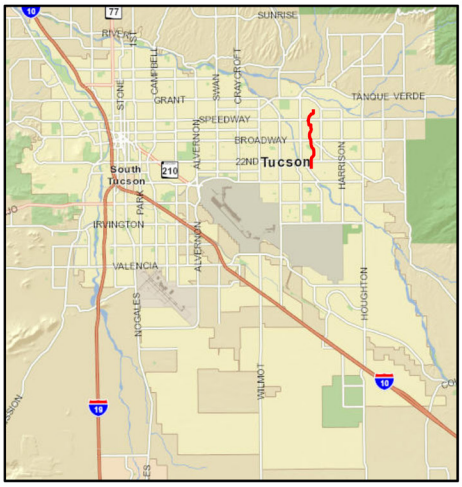


POINCIANA DR.

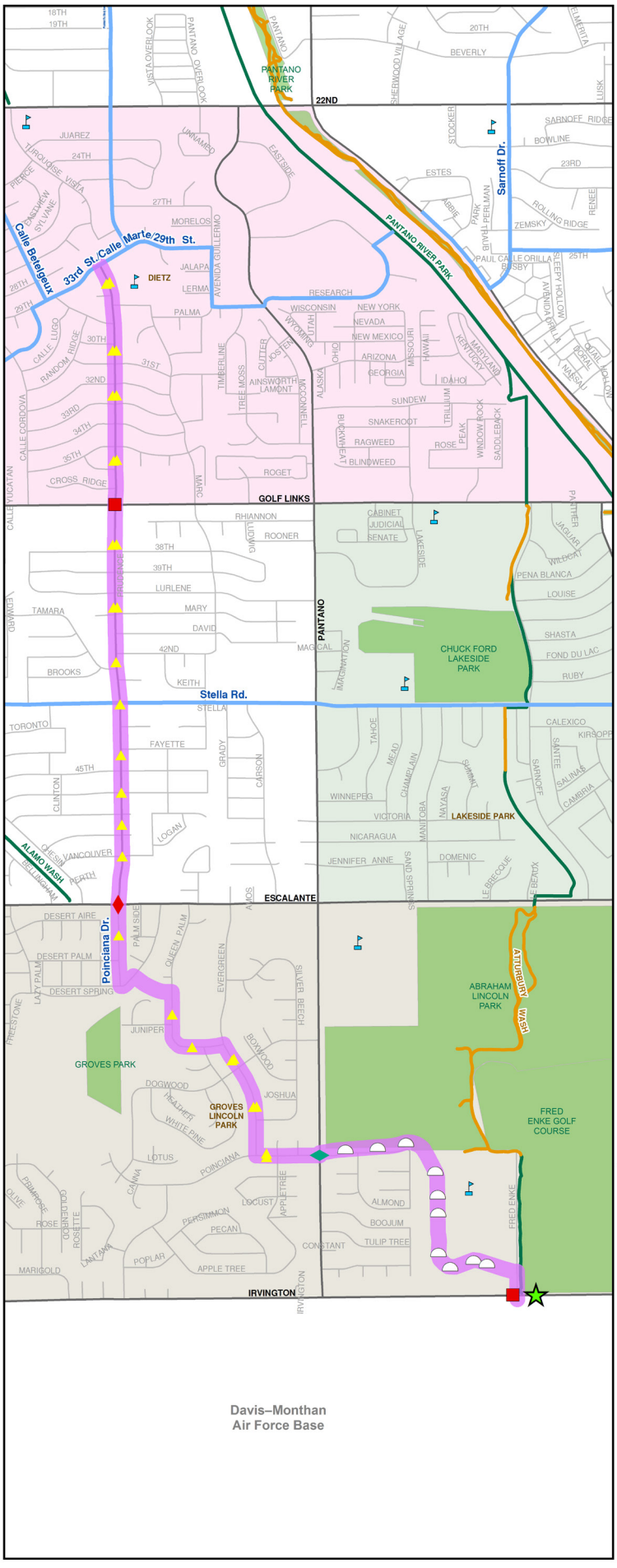
Bicycle Boulevard Master Plan

Rank: 58

Total Miles: 3.53

Estimated Total Cost: $498,322

0 0.25 0.5
Mile



Design Elements

- Poinciana Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- Traffic Signal
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N
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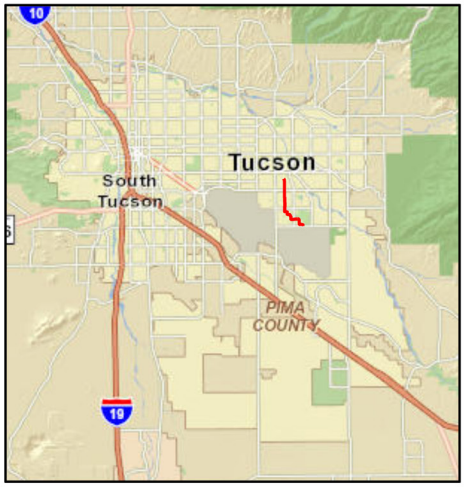
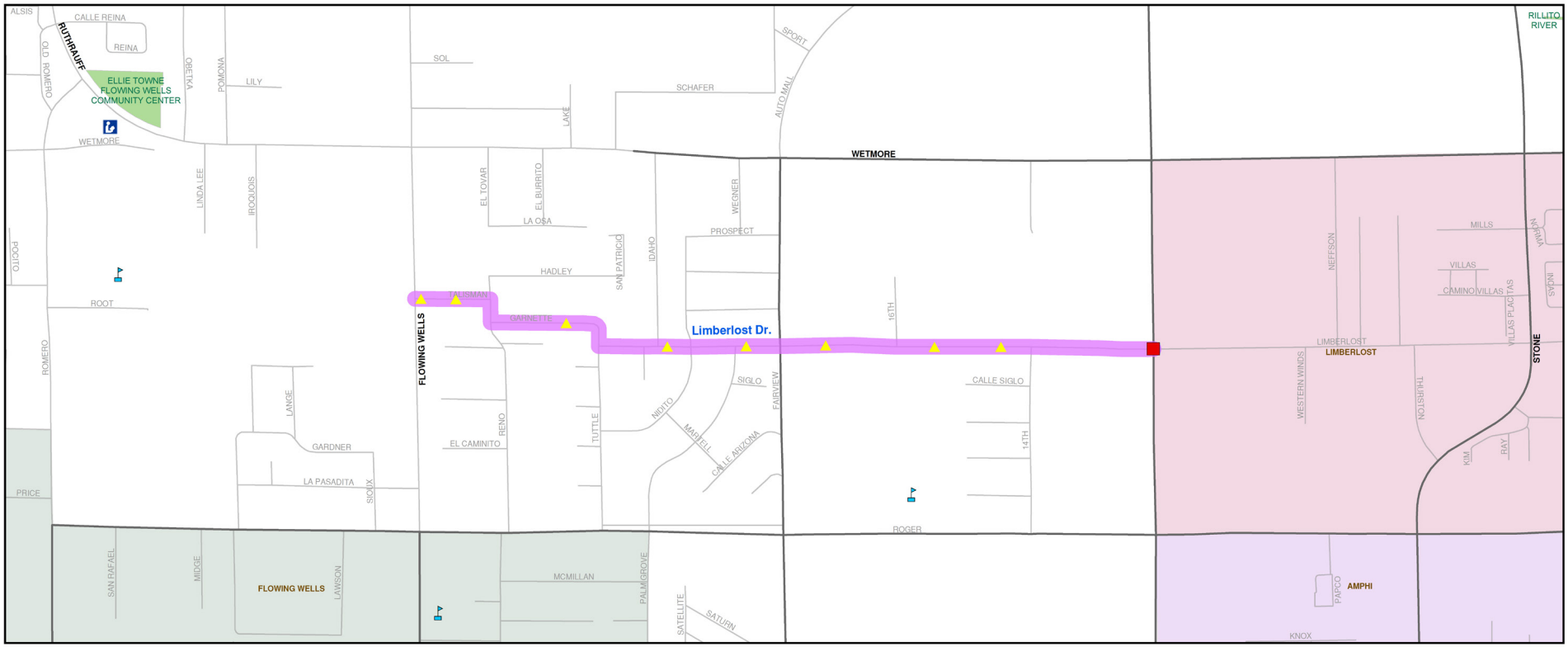




Design Elements

- Limberlost Dr. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Traffic Signal
- Existing Traffic Circles
- Library
- School
- Park

LIMBERLOST DR.

Bicycle Boulevard Master Plan

Rank: 59

Total Miles: 1.04

Estimated Total Cost: $63,473

0 0.25 0.5
Mile

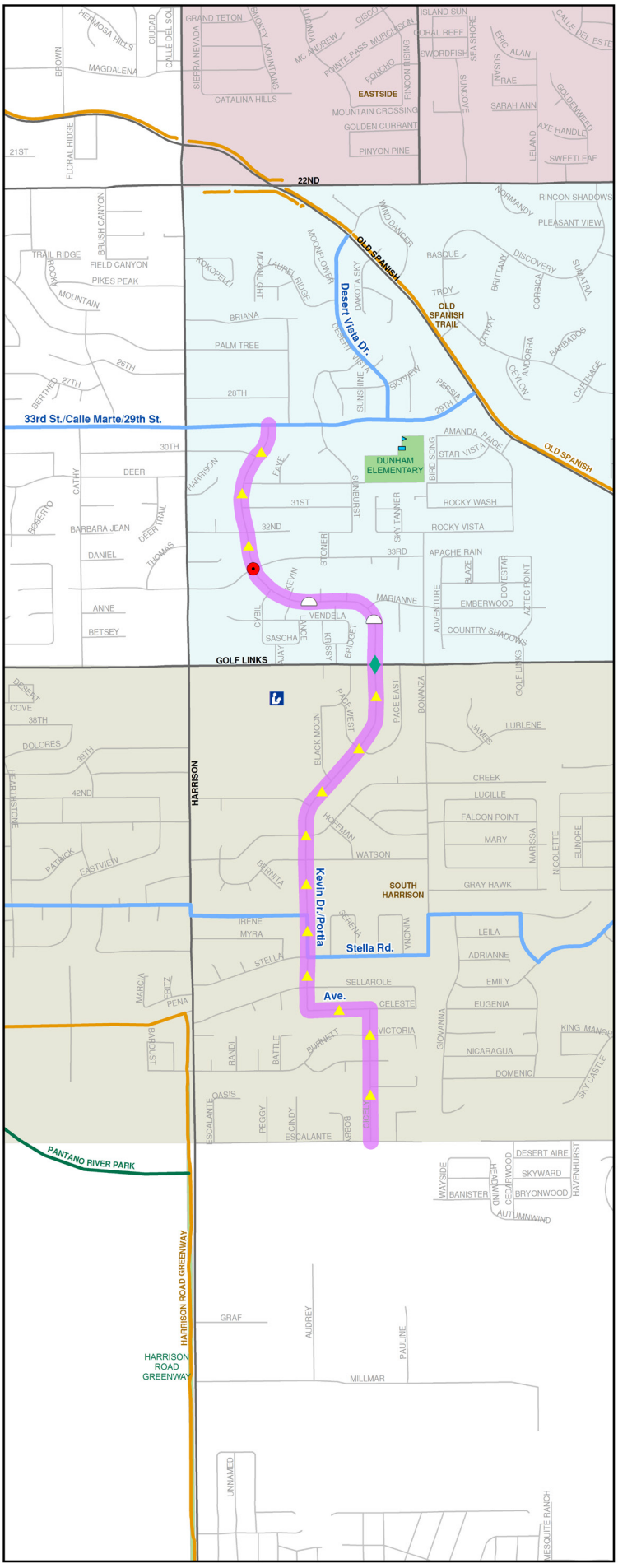
KEVIN DR. PORTIA AVE.

Bicycle Boulevard Master Plan

Rank: 60

Total Miles: 1.89

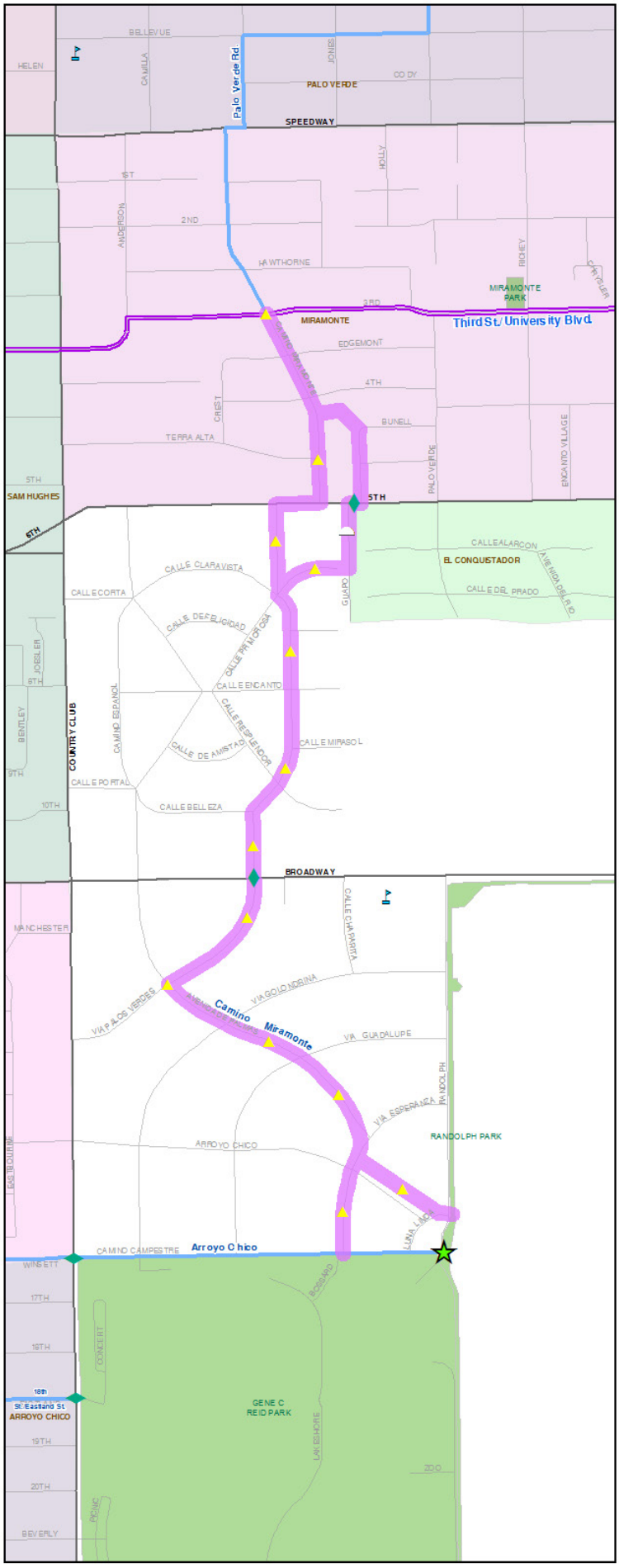
Estimated Total Cost: $293,166



0 0.25 0.5
Mile

Design Elements

- Kevin Dr./Portia Ave. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Traffic Circles
- Existing Speedhumps
- Existing Shared-use-path
- Future Shared-use-path
- Library
- School
- Park



CAMINO MIRAMONTE

Bicycle Boulevard Master Plan

Rank: 61

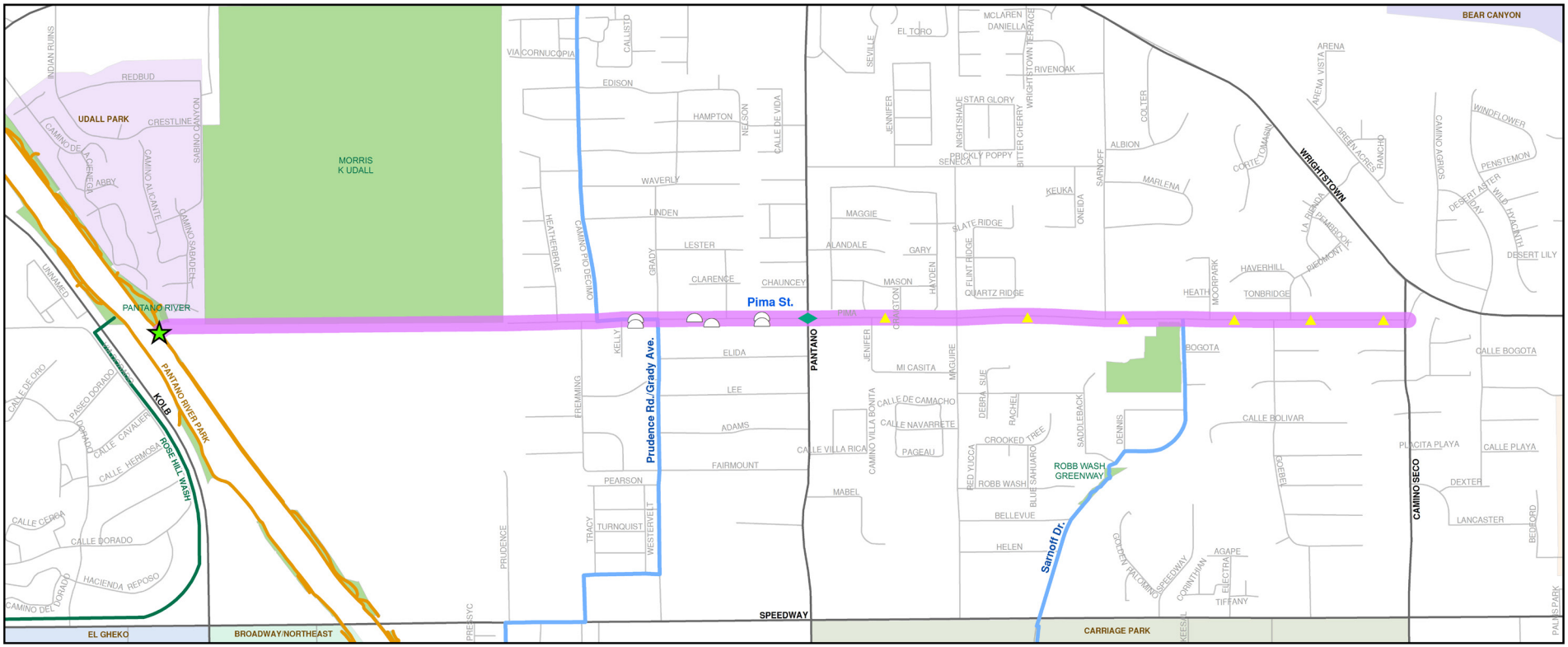
Total Miles: 2.07

Estimated Total Cost: $428,176

0 0.125 0.25
Mile

Design Elements

- Camino Miramonte Bicycle Boulevard
- Future Bicycle Boulevards
- Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- School
- Park



Design Elements

- Pima St. Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Proposed Enhanced Crossing
- Existing Speedhumps
- Shared Use Path Connection
- Existing Shared-use-path
- Future Shared-use-path
- School
- Park

N W E S

PIMA ST.

Bicycle Boulevard Master Plan

Rank: 62

Total Miles: 2.09

Estimated Total Cost: $541,051

0 0.25 0.5
Mile

IGO WAY

Bicycle Boulevard Master Plan

Rank: 63

Total Miles: 1.17

Estimated Total Cost: $321,280

0 0.125 0.25

Mile

Design Elements

- Igo Way Bicycle Boulevard
- Future Bicycle Boulevards
- Proposed Traffic Calming
- Existing Push Button Crossing
- School
- Park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