



Implementing Bicycle Improvements in Redwood City, CA

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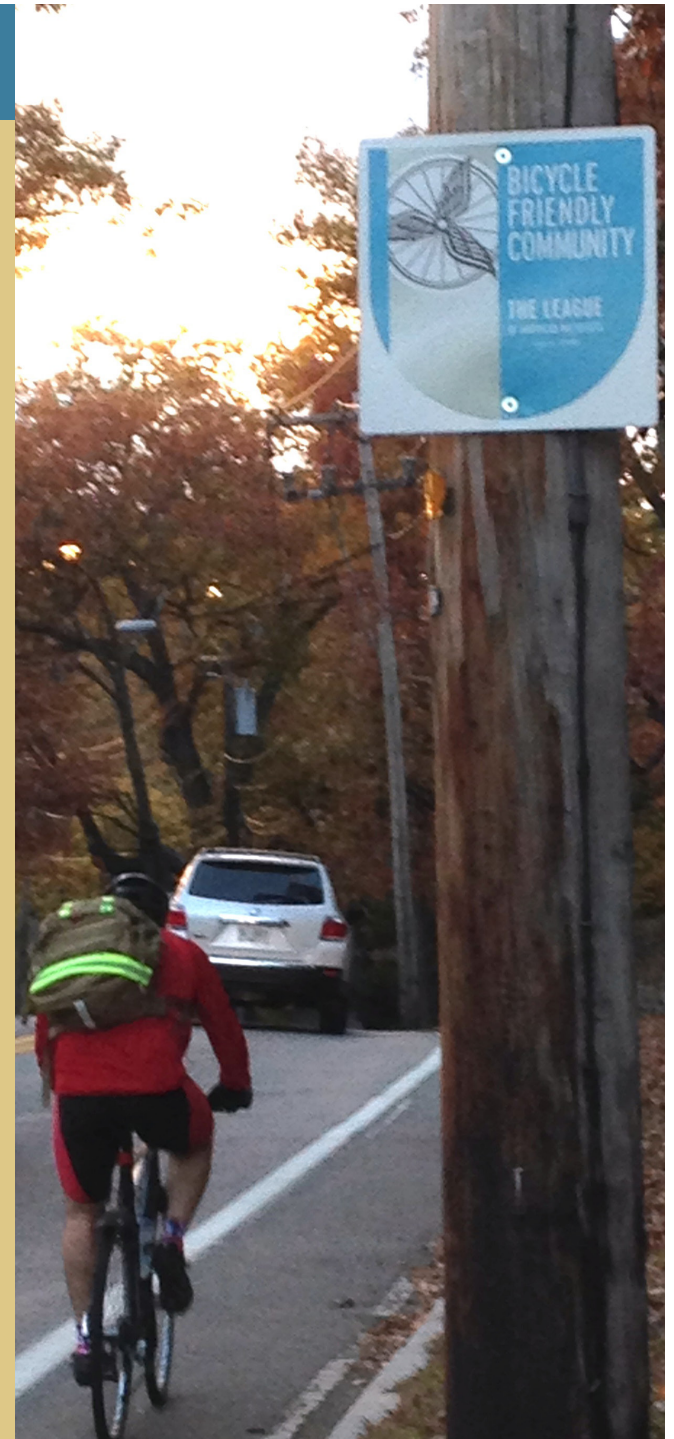
Most of all, I would like to thank **the Lord God**: *"I can do all things through **Christ** who strengthens me."* <Phillippians 4:13>





Table of Contents

Chapter 1: Introduction	7
Chapter 2: Background	11
Chapter 3: Case Studies	16
Davis, CA	19
Portland, OR	25
San Francisco, CA	31
Chapter 4: Existing Conditions	39
Chapter 5: Recommendations	47
Chapter 6: Conclusion	55
References	57



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Chapter 1: Introduction

Chapter 1: Introduction



Introduction and Project Purpose

Bicycling has emerged as a sustainable alternative transportation method for cities worldwide. Because of the many benefits of bicycling, many cities have prioritized bicycle infrastructure improvement in an effort to both facilitate ease in bicycle use and encourage more people to ride bicycles. The progress that has been made by notable cities over the years has resulted in impressive numbers of bicycle participation and mode share today. This report analyzes and discusses what certain communities have done to become bicycle friendly, as well as provides recommendations based on that information to improve bicycling in Redwood City, CA.

Redwood City, CA is a city with much potential. Its city motto is “Climate Best by Government Test”, a statement proven by their consistently mild year round weather. It is strategically located between two major cities in the Bay Area, and its terrain is relatively flat. It has a rich history and has a progressive approach to policy.

As a city’s population grows and its boundaries expand, the city must prioritize controlled and sustainable development, of which transportation is a huge part. This report will address the issue of sustainability in transportation through analyzing the potential for bicycle infrastructure improvement.

Bicycling has been identified as a healthy alternative to driving that has many benefits, including improved air quality, better public health, and fuel conservation. Many cities around the world have recognized and embraced the benefits of bicycling and have invested much into bicycle infrastructure. This has encouraged people to bike more, and in many parts of the world, cycling is the main form of

Chapter 1: Introduction

everyday transportation. Cycling is not as widespread in the United States, but several cities have distinguished themselves as being outstandingly bicycle-friendly with a high mode share of bicyclists. This report will analyze what has made certain bicycle-friendly communities so successful, and apply those lessons to Redwood City in the form of implementation measures, as well as linking it with existing bicycle networks in the region.

Residents and employees of the city will be able to utilize the network to have a sustainable alternative to driving. This infrastructure will include improvements in the areas of engineering, education, evaluation, encouragement, and enforcement. Currently, Redwood City sees the value of cycling and does have a partial bike network, but it is incomplete and could be improved upon. This project will help the city's planning efforts by promoting the city's vision of increased bicycle usage and enhanced quality of life, as well as improving sustainability. The city will be able to take the completed project and use it to further optimize biking citywide as well as cultivate a healthy bicycle culture. As stated in the circulation section of Redwood City's General Plan, one of the city's goals is to make bicycling as safe and comfortable as possible for riders of all ages, so this project will help accomplish that by making bicycling available to more people.

The project draws on research conducted in CRP 410/411 regarding Redwood City's existing bicycle network and examines how it can be integrated with existing regional trails and networks. All of the proposed improvements are illustrated by application in the Broadway Corridor. The report explains in detail how the improvements will be implemented specifically relating to the Broadway Corridor.



Chapter 1: Introduction

The purpose of this report is as follows: 1) to explore what makes a community bicycle friendly, and 2) to develop recommendations for bicycle infrastructure improvements in Redwood City, CA to earn it a rating of Bronze or higher from the League of American Bicyclists. The report will apply lessons learned from best practices of three exceptional bicycle-friendly communities on the West Coast to shape recommendations to make bicycling a more popular, safe, and efficient transportation alternative in Redwood City, thus addressing the larger issue of sustainability. These improvements will be illustrated by application in the Broadway Corridor area of Redwood City.

Report Organization

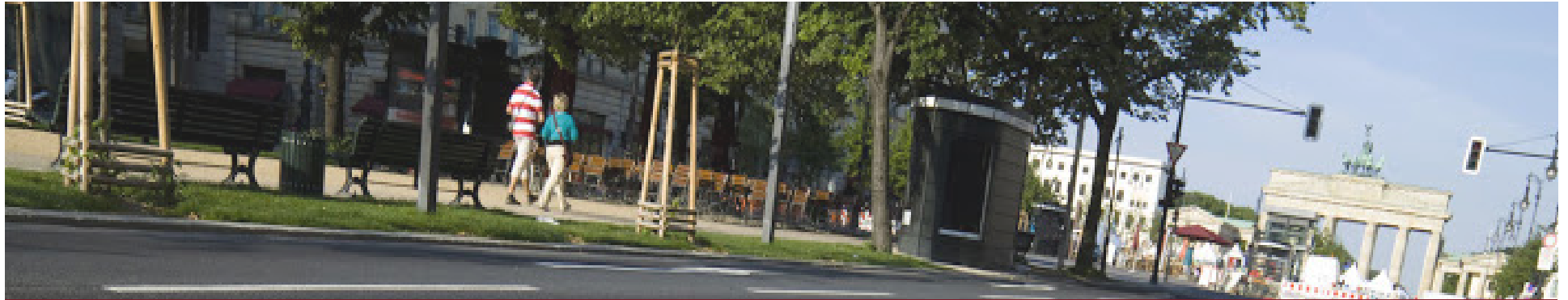
Chapter 2 of this report discusses the relevance of bicycle improvements to planning, the history and benefits of bicycling, and its context in the greater issue of sustainability. The chapter then describes the Bicycle Friendly America program from the League of American Bicyclists and its criteria and ranking system.

Chapter 3 analyzes case studies of three exceptionally bicycle friendly communities on the West Coast: Davis, Portland, and San Francisco, and goes on to evaluate them based on the “5 E’s” criteria set by the League of American Bicyclists. Each section concludes with a discussion of lessons learned, and their applicability to Redwood City.

Chapter 4 then discusses existing bicycle conditions in Redwood City, again based on the 5 E’s. Opportunities and constraints are identified in order to move forward with recommendations for improvement.

Next, Chapter 5 uses the information and findings gathered from the case studies and existing conditions analysis to craft recommendations and specific implementation measures to improve bicycle friendliness in the Broadway Corridor of Redwood City. Recommendations are designed to improve bicycle conditions in Redwood City to the point that, if the city were to apply, it would earn a rating of Bronze or higher from the Bicycle Friendly America program of the League of American Bicyclists.

Chapter 6 concludes the report by concisely summarizing all of the information presented, and offering closing thoughts on bicycling, urban transportation, and sustainability.



Chapter 2: Background



Chapter 2: Background



Introduction

Sustainability has become arguably the leading priority of planners and designers of the built environment, especially in the fields of transportation and land use planning. Recent events in the past century, such as industrialization, the rise of the automobile, and the establishment of the highway system have resulted in land use patterns that are very separated and spread out, leading to what experts have named “urban sprawl”. This is ultimately unsustainable and inefficient.

A widespread automobile-dependent lifestyle in a community creates problems such as congestion, pollution, declining health, and waste of money and resources. Investing in alternative transportation modes can greatly avoid or alleviate these problems, and be immensely beneficial to a community. Bicycling has been shown to be one of the healthiest, most cost-efficient and sustainable ways of traveling, so many cities across the United States and the world have invested in heavy citywide bicycle infrastructure, resulting in increased bicycle usage and improved quality of life.

History

The roots of the modern bicycle as a form of transportation start in the late 1800's, before the advent of the automobile. During this time, the bicycle became lighter and more practical to ride with the application of features such as pneumatic tires and the chain drive. Bicycles also became cheaper, allowing more people to utilize them for regular transportation as well as recreation. At this point, everyday destinations were within reasonably short distances from people's homes in urban areas, so using bicycling to get to those places was

Chapter 2: Background

very practical. However, the introduction of the automobile in the early 20th century radically changed urban form and transportation patterns in the United States, and eventually caused metropolitan areas to rapidly expand further than was practical for bicycle travel. As a result, according to John Forester (2005), “the greater speed of the automobile, its greater and more flexible carrying capacity, its suitability for multi-purpose, multi-stop trips, its ease and comfort, all caused most bicycle riders to switch to motoring for all trips, and some small number to switch many trips to motoring”. Later in the 20th century, with fuel shortages and increased environmental awareness, bicycling slowly began to rise in popularity again. However, presently, the majority of Americans consider biking to be no more than a recreational activity.

Context

Sustainability is an important issue in the field of planning. The American Planning Association (APA) defines the issue of sustainability as “whether the Earth’s resources will be able to meet the demands of a growing human population that has rising aspirations for consumption and quality of life, while maintaining the rich diversity of the natural environment or biosphere.” The planet has a limited amount of resources, and as its population keeps expanding, so does the need for resources to support that growth. But at the same time, humans have a responsibility to take care of the earth, not only for their own sake, but also for the sake of future generations. The APA goes on to say that a sustainable community must meet all four dimensions of the issue: community, societal values, biodiversity, and natural systems. Some of the global indicators of unsustainability include soil degradation, climate change, species extinction, and economic inequity. From all of this, it can be seen that sustainability is a serious issue that has far-reaching consequences.

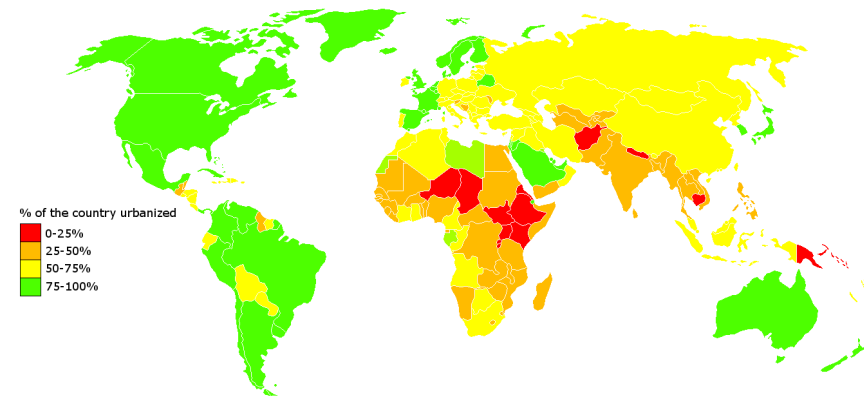
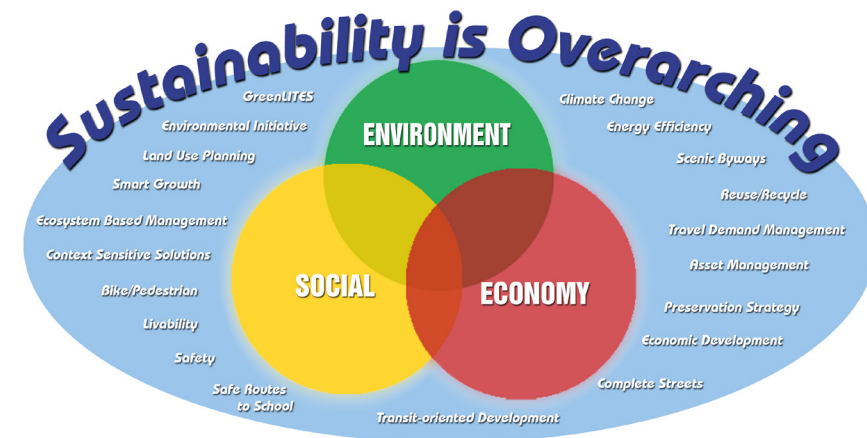


Figure 2.1: The countries of the world by urbanization. Green represents 75-100% urbanization, yellow represents 50-75%, orange represents 25-50%, and red represents 0-25%.



Chapter 2: Background



Table 2.1

Total Fatalities and Pedalcyclist Fatalities in Traffic Crashes, 2003–2012

Year	Total Fatalities	Pedalcyclist Fatalities	Percent of Total Fatalities
2003	42,884	629	1.5%
2004	42,836	727	1.7%
2005	43,510	786	1.8%
2006	42,708	772	1.8%
2007	41,259	701	1.7%
2008	37,423	718	1.9%
2009	33,883	628	1.9%
2010	32,999	623	1.9%
2011	32,479	682	2.1%
2012	33,561	726	2.2%

Source: USDOT

One of the planning areas in which sustainability is a primary issue is that of transportation planning. Transportation is absolutely crucial for any civilization to function, and it affects everything. The rise of the automobile and the construction of the highway system in the latter half of the 20th century saw the emergence of the suburb and the occurrence of urban sprawl. People were living auto-oriented lifestyles, and separated land uses with low-density housing only made the situation worse. Today, fuel is certainly not unlimited, and yet vehicles must consume it to function, so the situation appears hopeless. According to the APA, some of the contributors to unsustainability include overconsumption, pollution, and dependence on non-renewable resources. This is where alternative transportation comes into play. This could take the form of hybrid/electric vehicles, carpooling incentives, ridesharing, mass transit, and bicycling.

Benefits and Drawbacks of Bicycling

Bicycling addresses all three contributors to unsustainability mentioned above. It is incredibly energy-efficient: A 7.2kg road bicycle with a carbon frame uses 11,546,658,000 Joules of energy during its production compared to 118,284,466,000 for a “generic car” produced in America in 2008 (qtd. in Peach 2011). Because bicycling is a zero-emissions activity, if a significant amount of people in a given city switched from a driving lifestyle to a bicycling one, that city’s air quality would improve dramatically. And bicycles do not require fuel, so non-renewable resource depletion is not an issue. Also, in regards to construction, painting bike lanes is less energy intensive than automobile roads. Finally, bicycling includes many health benefits, such as burning calories, toning muscles, increasing stamina, and improving cardiovascular fitness and overall heart health.

Bicycling is not without its drawbacks, however. One of the main reasons why people are hesitant of bicycling is safety. There have been numerous accidents that have occurred as a result of traffic conflict between bicyclists and drivers. As table 2.1 shows, in 2012 alone, 49,000 bicyclists were injured and 726 were killed in collisions with automobiles (USDOT 2012). Many roads do not have designated lanes for bicycles, and harsh climate or terrain also present challenges to bicycling. Many people are also simply intimidated by the thought of traveling by bicycle, or finding it inconvenient. Many of these factors are beyond human control, but cities can work to optimize bicycling as much as possible.

Bicycle Friendly America

The League of American Bicyclists is a non-profit organization dedicated to bicycle safety, advocacy, and education. Bicycle Friendly America (BFA) is one of its programs, focusing on assessment and standards of bicycle-friendliness for communities to work toward. BFA is the result of combined knowledge of experts such as engineers, advocacy groups, and governments. Standards, and consequently rankings, exist for states, communities, universities, and businesses, and any of those can apply for an evaluation. The League has defined 5 essential categories that make a community bicycle friendly. They are as follows:

1. Engineering: Tangible facilities that improve bicycling for people, such as lanes, pathways, signage, paint, buffers, and parking.
2. Education: Programs that inform and teach people about bicycling facts, safety, opportunities, and responsibilities.

3. Encouragement: Cultivating a healthy bike friendly culture through programs, events, implementations, and incentives

4. Enforcement: Making sure that roads are a safe place for all users, and that both drivers and bicyclists follow the rules of the road, as well as theft prevention.

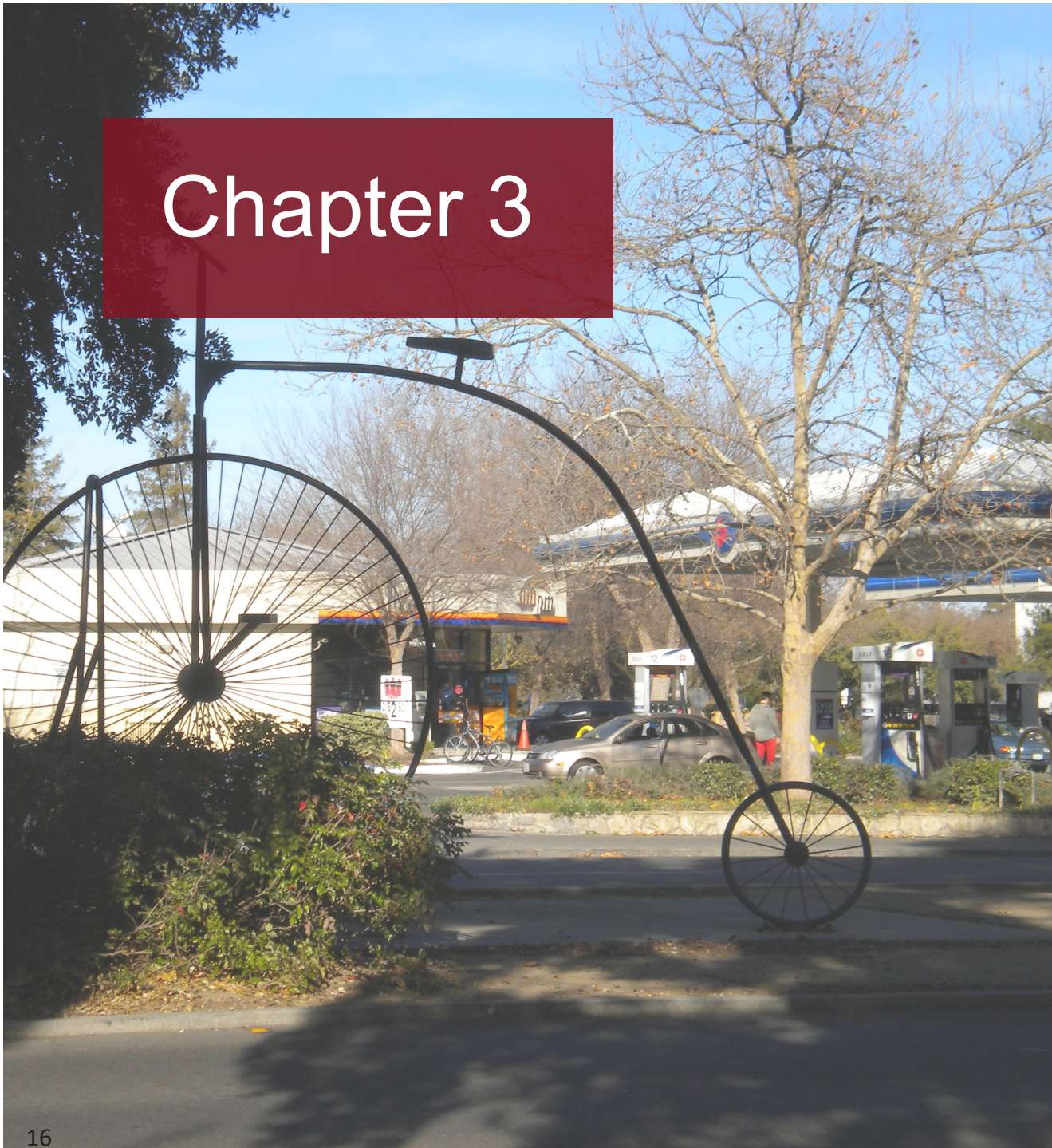
5. Evaluation and Planning: Standards such as a Bicycle Master Plan that helps evaluate current conditions and guide the vision for the future.

These “5 E’s” often overlap in what they cover. The League of American Bicyclists evaluates communities using the above evaluation criteria and assigns rankings based on the results.

This report analyzes case studies of three cities on the West Coast that have ranked high on the League of American Bicyclists and are considered exceptionally bicycle friendly communities. Each case study will focus on the community’s reasons, methods, and innovations contributing to bicycle-friendliness in the context of each of the 5 categories.

Following this, the report describes existing bicycle conditions in Redwood City and evaluates them based on the 5 categories. Building on that foundation, recommendations for Redwood City are developed that would improve the city’s bicycle infrastructure and earn it a spot on the League of American Bicyclists’ list of Bicycle Friendly Communities. The report applies the recommendations to the Broadway Corridor of Redwood City.

Chapter 3





Case Studies

Introduction

The following section analyzes case studies of three West Coast cities that have achieved a Bicycle Friendly America rating of Gold or higher: Davis, CA, Portland, OR, and San Francisco, CA. These three examples will provide best practices and lessons learned that can be applied to Redwood City. In each, biking is a significant aspect of the community culture, and bike infrastructure is widespread. Each case study examines background and history, then the five E's of a bicycle friendly community: engineering, education, encouragement, enforcement, and evaluation/ planning, concluding with lessons learned.



A photograph of a street scene in Davis, California. In the foreground, a large, black metal sculpture of a bicycle wheel and frame stands on a sidewalk. Behind it, there are trees, some with bare branches and some with green leaves. In the background, a gas station with a blue and white canopy is visible. A blue semi-transparent box with white text is overlaid on the left side of the image.

Davis, CA

Quick Facts:

Population: 65,222 (2010)
Total Land Area: 9.919 sq. miles
Population Density: 6,600/sq mi
Bike mode share: 14% (2010)
BFA Rating: Platinum

Chapter 3: Case Studies

Davis



Background and History



Davis is a city in the Central Valley of California, and the largest urbanized area in Yolo County. It is a primarily agricultural community, and is also home to the University of California, Davis, which has a student population of 34,155 (Fall 2013). Its nickname is “Bike City USA”, and for good reason. Davis has been given a Platinum rating (one of four) from the League of American Bicyclists, and is a model for cities nationwide. Davis provides an ideal environment for biking: flat terrain, few barriers, and a supportive culture. In the 1960s, Davis was the first city in the United States to install bike lanes on its streets. Ever since then, Davis has increasingly implemented and improved more bike infrastructure, including road reconfigurations, bike-specific General Plan policies, and plentiful bike parking, both citywide and campus wide. In the 1980’s, bicycle mode share was around 25%.

The city experienced a drop in bicycling interest in the early 21st century, but that decline is being reversed by the formation of new bike advocacy groups and ongoing cooperation between the university and the city to maintain a cohesive network and once again make biking a primary mode of transportation in the city. As of 2010, 95% of the city's arterial streets have bike lanes and the city continues to innovate with bicycle-centric infrastructure in an effort to continue encouraging and promoting bicycle use (Bike San Diego). UC Davis runs Transportation and Parking Services (TAPS), which provides services and resources to students. The city of Davis was the first to earn a rating of Platinum from the League of American Bicyclists in 2005, and UC Davis was the second university to also earn a Platinum rating in 2013, further confirming and cementing the area's status as a bicycle-friendly community.

Engineering

The city of Davis has plenty of engineering features that optimize biking. One such feature is a neighborhood greenway developed in 1989, which is a multi-use trail that loops around the city, with "spokes" radiating into downtown and out into the country. The development of the greenway has complemented city development, and as of now, it forms 80% of the city's perimeter (Buehler and Handy). Some other innovations include bike-only roundabouts, bike signal heads to improve traffic flow, and detection technology that increases efficiency and safety (Demerjian 2009). The university contains bikeways that are built to Caltrans standards and wider than normal to accommodate the high volumes of bicycles. Both the city and the university provide abundant bike parking of various designs at key destinations to support the high demand. For further security, there are 76 bicycle lockers available on the UC Davis campus.



Chapter 3: Case Studies

Davis



Signage and road markings are plentiful throughout the city. They follow Caltrans standards and are highly visible. Standard signal lights are also implemented citywide, and at certain strategic locations, a combination of standard lights and bicycle “signal heads” are used to facilitate flow.

Education

Davis’s website offers plentiful educational resources for bicycle safety, including a thorough list of advice and facts for cyclists to remember while on the road. Also, many advocacy groups exist that provide education programs for all levels of cyclists. Safe Routes to School is being implemented in 11 elementary and middle schools around the city, and in 2013, parents, the community, and stakeholders participated in audits that evaluated the program based on walkability and bikeability and identified ways to improve it.

Encouragement

In order to encourage biking, Davis implements a variety of policies, such as lowering fines for cycling offenses, not giving parking permits to university freshmen, and providing free bike lights to anyone in need. The city also holds Bike Safety Week once a year, in which cyclists are encouraged to be extra safe.

Enforcement

The police have held events in which tables were set up at key street corners to make sure that bicyclists were following the rules of the

road. Bicyclists were also asked to sign a safety pledge. Bicyclists who do not have safety lights on their bikes can be fined between \$25 and \$35. The University's Transportation and Parking Services (TAPS) department is responsible for bicycle safety, regulation, and compliance enforcement. Many residents, especially students, are not mindful of proper bicycle road protocol, and so the police have placed heavy emphasis on enforcing safety, which also ties in with education.

Evaluation and Planning

The city, in cooperation with the Bicycle Advisory Commission, members of local agencies, advocacy groups, and the community, has devised a number of goals and objectives to help guide development of bike programs. Both the city and the university have their own Bicycle Plans, adopted in 2009 and 2011, respectively.



Chapter 3: Case Studies

Davis



Lessons Learned

Davis is certainly a world-class bicycle city, and many lessons can be learned from analyzing its approach over the years. The first lesson is that bike policy has an intrinsically political nature. Davis' bike lanes would never have gotten installed in 1967 if members of the community had not lobbied for them. Demographics are another factor that given Davis an advantage. Its status as a college town has contributed immensely to its bike culture. A city's policies reflect the desires of its citizens, and so in order for bike improvements to be implemented, they must have the support of the community. Another important factor is funding. The State of California has dedicated funding for bicycle projects, totaling around \$5 million per year. In order to be eligible for these funds, a local agency must have a bike plan that addresses the elements described in Section 891.2 of the Streets and Highways Code, which include a maps of relevant data, a description of community involvement, and the estimated number of existing and anticipated bicycle commuters in the plan area.

Davis and Redwood City share a few things in common. They both have populations between 60,000 and 80,000, and have relatively flat terrain. In terms of demographics, Redwood City is not a college town, so it does not have the advantage of a population that is in support of a biking lifestyle as much as Davis does. However, Davis' proliferation of bike lanes and other bike network engineering is something to be striven for.



Portland, OR

Quick Facts

Population: 583,776 (2010)

Area: 145.09 sq mi

Population Density: 4,375.1/sq mi

Bike Mode Share: 25%

BFA Rating: Platinum

Chapter 3: Case Studies

Portland

Background and History

Portland, OR is a city in the Pacific Northwest region of the United States. It is the most populous city in Oregon, and is known for its environmentally green approach to land use planning. Portland is the first U.S. city to enact a comprehensive plan to reduce CO2 emissions and has aggressively pushed green building initiatives (Grist). It is another one of the four cities that have been given a Platinum rating from the League of American Bicyclists. The city boasts an impressive 368 miles of existing and planned bikeways as of July 2013 (Maus 2013).

Even as the bicycle first rose as a viable mode of transportation in the 19th century, individuals and organizations in Portland worked to establish biking's popularity by opening bike shops, and publishing maps of preferred potential bicycle routes in the city. With the rise of the automobile, the bicycle declined in popularity, even as it also improved in affordability. However, the second half of the twentieth century saw a resurgence in bicycle popularity. Portlanders started to question the automobile-oriented lifestyle that had developed in their city, which eventually led Dan Sathos, a representative from

Jacksonville, OR, to sponsor the Bicycle Bill. This legislation required the state to set aside 1% of its highways funds for bicycle and pedestrian developments to create better places to walk and bike (Cohen). As a result of this and other efforts, the network began to expand, and in the 1990s, bicycling became prominent in both culture and public policy. Portland adopted a Bicycle Master Plan in 1996, which envisions a 600-mile network of bike infrastructure. In 2010, the city adopted the Portland Bicycle Master Plan for 2030, which envisions vast expansion of the network.

From then on, Portland has continued its rise as a bike-friendly city, and is now nationally recognized as such. The city has won numerous accolades in recent years, including best bicycling city in 1995 and 1999 by Bicycling Magazine, and Bicycle Friendly America ratings of Gold (2003) and later Platinum (2008) by the League of American Bicyclists. Portland was the first large city to receive the Platinum award from the League.



Chapter 3: Case Studies

Portland

Engineering

Portland has pioneered a number of engineering innovations in bicycle improvement. It was the first city to implement bike boxes at intersections, which improve visibility of bikers to drivers and reduce conflict. Portland has also implemented various other engineering innovations with great success, such as bike boulevards, cycle tracks and buffered bike lanes. According to Bike Portland, bike boulevards are low-speed streets that prioritize bikes and allow cyclists to travel with relatively little traffic conflict, and a cycle track is a seven-foot bike lane separated from vehicular traffic by a row of parked cars, and separated from pedestrian traffic by a three-foot buffer. In particular, an 1,800-foot stretch of cycle track was installed downtown by shifting parking away from the curb. As a result, 97% of cyclists observed rode on the new cycle track instead of on the vehicular lanes, reducing conflict. Surveyed bicyclists felt safer riding on the cycle track.

Bike Portland also evaluated buffered bike lanes that were installed on two one-way streets downtown. To install the lanes, on-street parking had to be removed. Similarly, the survey found that cyclists chose to ride their bikes more and felt safer after the lanes were installed.



Chapter 3: Case Studies

Portland



Education

Portland has a Safe Routes to School program with straddles the line between education and encouragement. The program has been implemented in numerous schools citywide, and has been met with much success. Another innovation that Portland is known for is the bike train, which is a program designed to help children get safely to school. According to biketrainpdx.org, a bike train is a group of people that bike together on a pre-planned route. More riders join in along the way at pre-determined meet up points, and kids arrive to school more attentive, alert, and ready to learn. Bike trains also help kids get used to commuting early. The bike train program is sponsored by Umbrella, which is an organization that exists to build up communities in the context of street-based activities. Bike Train's goal is to get the program implemented at every elementary school in the city. The previously mentioned Bike Portland is a news source that provides articles and updates on the Portland bike scene. The city's website contains plenty of resources such as maps, clinics, and bike parking information.

Encouragement

Many bicycle advocacy groups are active in Portland, including the Bicycle Transportation Alliance, which offers resources on safety, free legal clinics, and also works to improve bicycling conditions in Portland. Every first Wednesday in October, the city observes International Walk + Bike to School Day, which encourages parents to get out of their cars and walk or bike with their kids to school. Also, Portland's SmartTrip program reaches out to households in an effort to get more people to walk or bike instead of drive.

Enforcement

The Portland Police Bureau is committed to ensuring safe road conditions for all users, including bicyclists. The police have adjusted their procedure to better investigate cases in which bicyclists are injured. Also, the police adopted a Community Policing Agreement in 2009 that clearly outlines enforcement policies for bicycling.

Evaluation and Planning

Portland is on the cutting edge in bicycle planning, so it frequently updates its Bicycle Master Plan to reflect the evolving needs of the city's infrastructure. The city also implements bike counts at key locations citywide, in an effort to gauge characteristics of the city's bicycle engineering and policies. Portland has also approved a Bike Share program, sponsored by Alta Bicycle Share. The program is still in the development phase.

Lessons Learned

Portland is an excellent example of a bike-friendly city. This is the result of two main factors. First, Portland has substantial bike infrastructure on its streets. Cyclists are able to utilize the extensive network of bike boulevards, lanes, and cycle tracks to get to any destination in the city relatively easily. Second, along with the infrastructure, the city has developed a strong bike-supportive culture, especially in recent decades, that has helped lobby for and pass bike legislation. There is also an abundance of bike shops, advocacy groups, and other support services for bikers.

Portland's bike story is an incredibly successful one. It is bigger than Redwood City in every way, but many of the principles behind its approach to bicycle planning can still be applied to Redwood City. In contrast with Davis, but similarly to Redwood City, Portland is not a college town by nature, and its citizens are more diverse demographically.







San Francisco, CA

Quick Facts

Population: 837,442

Total Land Area:

Population density: 17,867/sq mi (2010)

Bike mode share: 20% (2011)

BFA Rating: Gold

Chapter 3: Case Studies

San Francisco

Background and History

San Francisco is a major city in the Bay Area of California. It is the most densely populated city in California, and second most densely populated city in the United States after New York City (demographia). The city is known for its tourist attractions, foggy weather, and many steep hills. It is also quite diverse, with Whites making up less than 50% of the population in 2010 (US Census). Its density, walkability, and multi-modal transportation infrastructure contribute to its reputation for being green.

Biking in San Francisco has risen in popularity over the last few decades. This is due in part to the compact nature of the city, as well as its relatively mild climate. However, the many steep hills and heavy automobile traffic deter cycling in some areas. Despite these factors, cycling has emerged as a popular mode of transportation. In 1973, the city enacted its “Transit First” policy in an effort to encourage multi-modalism. This set the precedent for bicycle network development, and in 1999 was expanded to include pedestrians and bicyclists. In 1997, the city published its first bike plan (Peach 2011). In 2005, San Francisco developed the Bicycle Plan Policy Framework, which presented both short and long term



plans for an improved bicycle network. Despite some opposition to the program, bicycling rose in popularity among the citizenry, as people developed a more positive attitude towards it. Areas that experience higher levels of bicycling also experience increased economic vitality and quality of life, and now, bicycling is a big part of San Francisco’s culture. In 2011, the League of American Bicyclists awarded San Francisco a gold status on its Bicycle Friendly Communities list.



Engineering

San Francisco has widely implemented bicycle engineering improvements all across the city's streets. According to the San Francisco Bicycle Plan, as of 2008, the city has 23 miles of streets with bike paths, 45 miles of streets with bike lanes, and 132 miles of streets with bike routes. The most common road markings are sharrows, which is short for "share the lane arrows", and indicate that the road must be shared between cars and bicycles. A notable example of this is "The Wiggle", which is an area leading to downtown that provides cyclists with the most optimal route to travel (right, top).



San Francisco has also implemented various bicycle facilities with specific purposes. There are bike boxes at busy intersections on Market Street and elsewhere, which help to reduce turning conflict between cars and bicycles. On Market and Valencia, there is a bicycle bay that makes left turns significantly easier for bicyclists (right, middle). Both Valencia and 14th Streets have implemented green waves, in which traffic lights are timed at 13 miles an hour, the average cycling speed. When approached properly, this system can greatly streamline bicycle commutes down those streets. Certain sections of Market Street, the busiest street in the city, contain buffered bike lanes with green paint and posts that separate them from automobile traffic (right, bottom).



Education

The San Francisco Bicycle Coalition is the main source of bicycle education in the city. It offers urban cycling workshops including adult learn to ride, intro to urban cycling, traffic skills 101, and youth and family classes. San Francisco also has a Safe Routes to School program, which partners with 15 public elementary schools to improve health and air quality, decrease traffic, and fight childhood obesity, according to its website.



Chapter 3: Case Studies

San Francisco



Encouragement

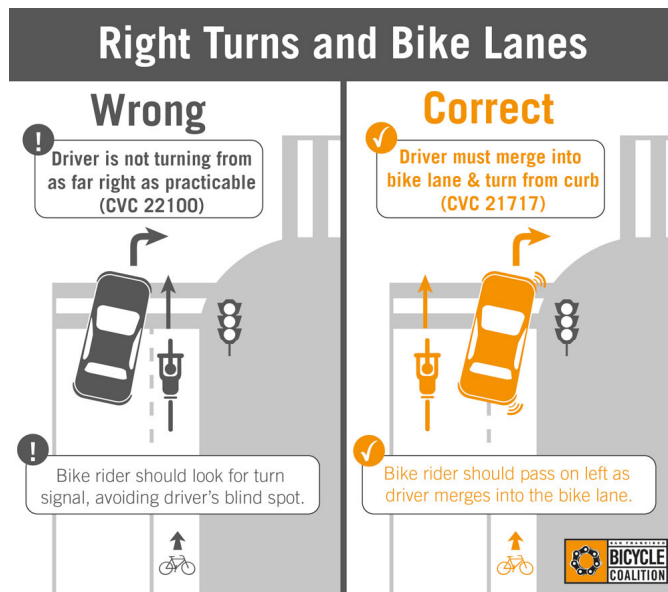
San Francisco has fostered a widespread, diverse, and active bicycle culture. Many advocacy groups, non-profit organizations, and community programs exist to promote bicycling within the city.

Sunday Streets

Originating in Bogota, Colombia, Sunday Streets was started in San Francisco in 2008. According to its website, “Sunday Streets are events that encourage recreation, community activities and fun in San Francisco. Sunday Streets closes stretches of city streets to automobile traffic, and opens them to people for several hours on a various Sundays throughout the year, so participants can enjoy a large, temporary, public space where they can bike, walk, run, dance, do yoga, or do any other physical activity. Non-profit and health organizations offer free activities and share information about their services during the event.” Not only are these events fun opportunities for participants to take part in neighborhood block parties; they also promote pedestrian and bicycle-friendly activities that help encourage people to integrate these sustainable modes of transportation into their everyday lives. The program has been met with much success and large turnouts.

San Francisco Bicycle Coalition

The San Francisco Bicycle Coalition (mentioned earlier) is a nonprofit advocacy group that works to promote bicycling in San Francisco. According to its website, through its advocacy, education, and working programs with the City and community agencies, it creates safer streets and more livable communities for all San Franciscans. The Coalition organizes events like the previously mentioned Sunday Streets, and hosts numerous programs focusing on education and safety.



An instructional graphic from the SF Bicycle Coalition

Bay Area Bike Share

Launched in August 2013, Bay Area Bike Share is a program that allows users to rent bikes for short periods of time and use them to make short trips around the city. When finished, users can either renew their bikes or return them to any station. The program has been very successful in San Francisco. As of November 2013, 73,002 of about 80,000 rides have been made in San Francisco (Cabanatuan).

Bike to Work Day

In 2004, in an effort to encourage commuting by bike, the Metropolitan Transportation Commission granted the Bay Area Bicycle Coalition a contract to organize the first Bike to Work Day in the Bay Area. Every year since then, the event has seen high participation levels from riders, volunteers, and sponsors. According to Bike to Work Day's website, more than one million Bay Area residents live within five miles of their workplace, an ideal distance for bicycling. The event is a way to encourage people to integrate cycling into a normal part of their daily routine, be sustainable, and boost health and vitality.

Enforcement

Safety has been a pressing issue with bicyclists in San Francisco, and in the past, bicyclists have felt unfairly treated by the Police Department. San Francisco has experienced a significant number of bike-related accidents in the past decade, some of them fatal. As a result, the city and the SFBC are trying to work together to identify dangerous intersections and keep all users of the road accountable to improve safety.



Chapter 3: Case Studies

San Francisco



Evaluation and Planning

The city's Transit First policy states "Bicycling shall be promoted by encouraging safe streets for riding, convenient access to transit, bicycle lanes, and secure bicycle parking." To properly bring this to fruition, the San Francisco Municipal Transportation Agency (SFMTA) updated its bike plan in 2009. Its main goal is to "increase safe bicycle use" over the next 5 years. It contains updates and proposed network improvements to help guide development and promote cycling as an attractive transportation alternative.

Lessons Learned

San Francisco has a lively and prevalent bicycle culture, which is the biggest factor contributing to its success as a bicycle-friendly community. Although its network is not comprehensive, people can get to almost any destination by bike relatively easily. Safety, especially regarding traffic conflicts with automobiles, is still a major issue, but efforts are being taken by the city as well as advocacy groups like the San Francisco Bicycle Coalition to minimize the number of accidents.

Although San Francisco is much bigger than Redwood City both in area and population, it offers some good lessons that can be applied. Community advocacy groups are a crucial part of promoting a bicycle-friendly culture, so Redwood City should encourage the formation of more. Also, education is important to ensure safety on the road.

Case Studies Conclusion and Summary

The three case studies reviewed are similar yet different. As can be seen, each of them has several things in common as well as unique innovations that set them apart. Also, each of the 5 E's is crucial in making a community bicycle friendly. As shown by the case studies, there is much overlap between the 5 criteria. The following is a summary:

The most physically tangible aspect of bicycle friendliness is **engineering**. A community needs facilities like bike lanes, paths, parking, and bike boxes in order to support bicycles on the street. Having proper bicycle infrastructure on the road also greatly improves safety by separating bicycles from other users of the road such as cars and pedestrians.

Education is crucial in ensuring that people know how to properly utilize the bicycle for travel on city streets. This can start as early as elementary school with programs like Safe Routes to School or bike trains, but adult education is also very important. The more people know about biking and safety, the wiser the decisions they make on the road will be.

Bicycle infrastructure is useless if people are too afraid to ride, and this is where **encouragement** comes in. In all three case studies, bicycle advocacy groups are a huge part of promoting bicycle culture and encouraging more people to bike by making them feel that they are a part of something bigger than themselves.

Enforcement ensures that all users of the road are following the rules, leading to fewer conflicts. Drivers need to get more accustomed to looking out for bicyclists when turning, and if

necessary, to share the road. On the other hand, bicyclists need to realize that they are operating vehicles as well, and they share the same responsibilities, and therefore consequences, of drivers. Increased enforcement on the streets will reduce accidents and help establish a mindset of coexistence between bikers and drivers.

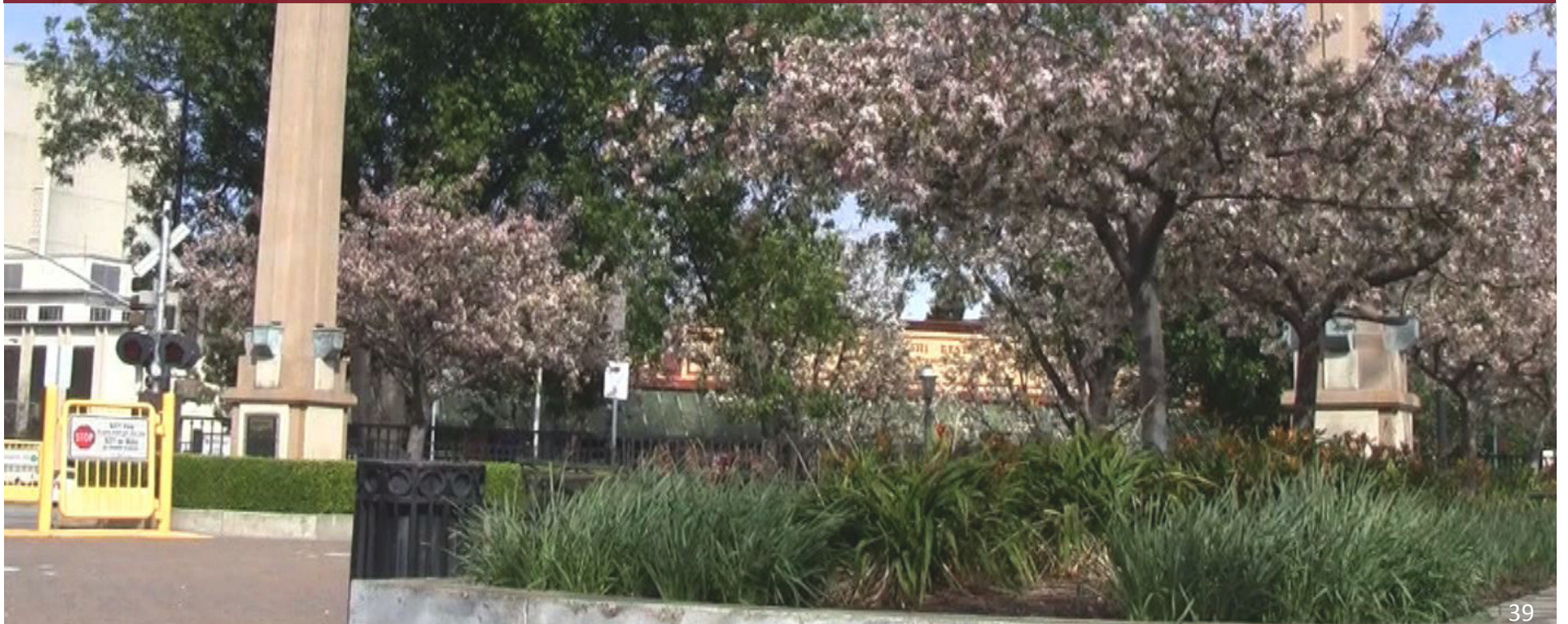
Finally, cities need to establish a system of **evaluation**, both to assess existing conditions and to plan for the future, both short and long range. Establishing a Bicycle Master Plan is the best way to do this. Public user feedback must be gathered and analyzed to know what should to be improved and what new needs must be met, bringing the 5 E's back full circle.







Chapter 4: Existing Conditions



Chapter 4: Existing Conditions



Background

Redwood City is a city in the peninsula of the Bay Area in California, and county seat of San Mateo County. The city covers a total area of 34.6 square miles, which includes a significant water portion. As of 2010, the city's population was 76,815, with a population density of 2,218.5 people per square mile. The city is home to several technology companies, notably Oracle, Electronic Arts (EA), and Evernote. According to the Redwood City General Plan, the city has many features that make cycling pleasurable, including a mild climate, relatively flat terrain, and proximity to many recreational and shopping destinations. Because of these factors, bicycling is on the rise as a mode of transportation. Redwood City holds tremendous potential for bicycle infrastructure, and the city has recognized this and already made efforts to make it a priority and establish a network throughout the city. The Plan states, "Redwood



Chapter 4: Existing Conditions

City's commitment is to accommodate all categories of bicycle riders, to encourage healthier lifestyles and a healthier environment" (pg 105). The following section summarizes Redwood City's existing and future conditions for bicycle infrastructure. The existing conditions will be analyzed using the 5 E's from the American League of Bicyclists. Following this is an analysis of how the city could do better, applying principles from the case studies in the earlier section of this report. The development of recommendations will be guided by the information obtained from this analysis.

In particular, recommendations for bicycle infrastructure improvements in Redwood City will focus on implementation in the Broadway Corridor area, which was researched by the Cal Poly CRP 410/411 classes.

Methodology

Existing conditions in Redwood City and along the Broadway Corridor will be analyzed using the same criteria of 5 E's used for the case studies. To obtain this information, the General Plan of Redwood City, the Downtown Precise Plan, and the San Mateo Comprehensive Pedestrian and Bicycle Plan were consulted. Internet research was also conducted to obtain miscellaneous information.

Engineering

According to the General Plan, the city has adopted the "8-80" principle, meaning that streets should be safe enough for cyclists from ages 8-80 to ride on (pg 105). To help achieve this goal, all three classes of bike lanes are present within Redwood City. This is illustrated in Appendix A. However, bike paths exist on only a

few streets. Class I facilities in Redwood City include the Redwood Shores trail and the Bay Trail along U.S. 101 between the Whipple Avenue and Holly Street interchanges. Class II facilities in Redwood City include the bike lanes on Alameda de La Pulgas between Woodside Road and Jefferson Avenue, and Industrial Way between Whipple Avenue and the San Carlos city limit. Class III facilities are the most common, some of which can be found on portions of Broadway and Roosevelt Avenue. Although arterials such as El Camino Real and Woodside Road often provide the most direct routes, few cyclists use them because they are not bicycle-friendly, being predominantly automobile-oriented. As a result, most cyclists tend to take more roundabout routes on side streets to get to their destinations (Redwood City General Plan pg 106).

Education

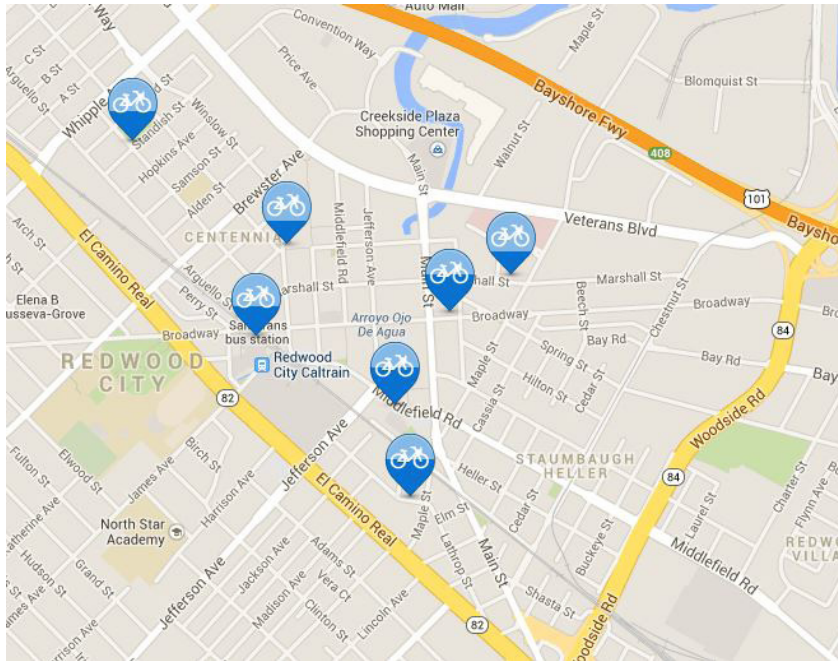
Redwood City is part of the Silicon Valley Bicycle Coalition, which promotes cycling in the area through advocacy and lobbying. One of their programs is Safe Routes to School, which further utilizes the 5 E's to teach children about bicycle safety. Safe Routes to School is implemented throughout San Mateo County, and serves to both promote bicycling and raise awareness for safety. The Coalition also provides education resources on its website for all users.

Encouragement

Bay Area Bike Share

On August 28, 2013, Bay Area Bike Share was launched. Bike sharing provides bicycles for short-term public use. The Bay Area Bike Share website explains that users can check out bicycles from

Chapter 4: Existing Conditions



Bike Share Stations in Redwood City

specific stations for up to 30 minutes, then return them to any of those stations when finished. Figure 3 shows the locations of all Bay Area Bike Share stations within Redwood City. Note that all stations are in the Downtown area. As of now, according to Jessica Manzi, Director of Transportation, there will be at least one new station in the Stanford in Redwood City Development Area.

Enforcement

Besides standard police presence, Redwood City is lacking in bicycle enforcement policies.

Evaluation and Planning

Redwood City recognizes the importance of planning for future bicycle development, and as such, the General Plan outlines several goals and policies to progress in that direction, such as implementing wayfinding signs, prioritizing bicycle safety at intersections, and requiring new developments to provide bicycle facilities that connect to existing ones (pg 137).

The General Plan states in pages 109-110 that there are a few projects being planned to expand the bicycle network. One of these is the San Francisco Bay Trail, which would connect various cities within the Bay Area via a 400-mile network of paved bike and pedestrian paths. Currently, portions of that network include existing bike paths between Whipple and Holly Streets, as well as around Redwood Shores.

Another project that the General Plan states is currently in progress is the San Mateo County Comprehensive Bike Plan. The first phase

Chapter 4: Existing Conditions

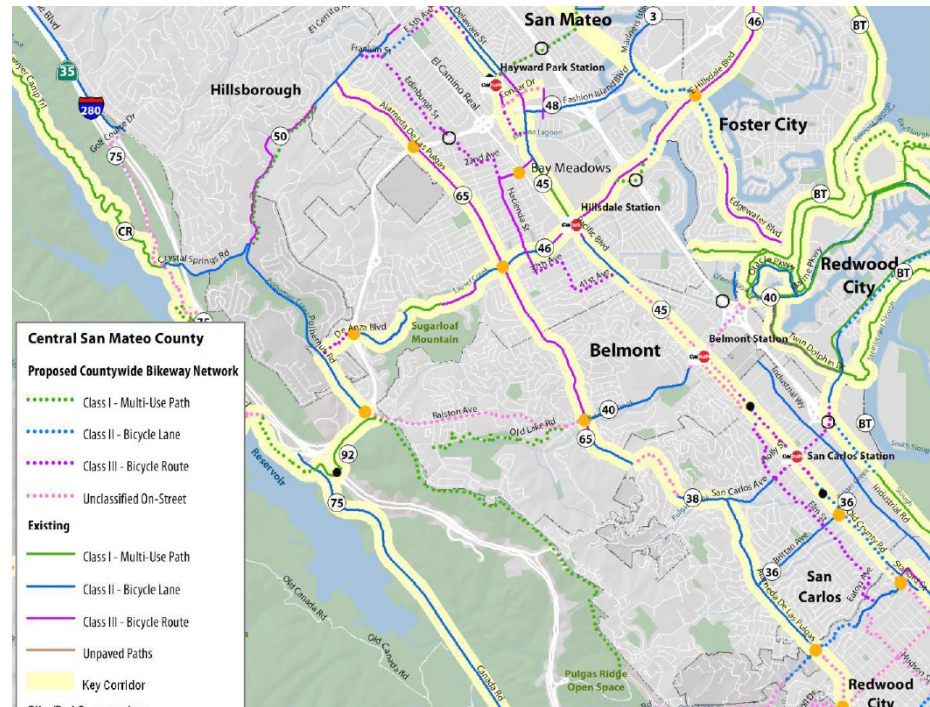
of this project consists of building a north-south bikeway between San Francisco and Palo Alto. In the future, new bike lanes, wider shoulder lanes, and other improvements will be incorporated. Also, the Caltrain Bicycle Master Plan includes plans for relocating bicycle facilities to more convenient locations at the station, specifically lockers at the southbound platform and parking on the northbound platform (pg 110).

Finally, Redwood City plans to take advantage of its ideal bicycle environment by providing more convenient bicycle parking at various employment centers (Redwood City General Plan pg 110). This would include the Stanford Medical Center, which is a major hub of traffic and employment. The city wants to make traveling to and from downtown and the Stanford area easier for people, and because driving is not always an attractive option for commuters, increasing the bicycle infrastructure on Broadway would help achieve that goal.

San Mateo County adopted an updated comprehensive Bike and Pedestrian Plan in 2011. This document serves to cast vision and guide future development of bicycle facilities for the whole county. The plan states that the extent of Redwood City's Bicycle Master Plan is the Circulation chapter of its General Plan. A Complete Streets Advisory Committee has also been proposed.

Related/Regional Projects

The Countywide Bikeway Network focuses on countywide bicycle transportation and network linkage. The San Mateo County Comprehensive Bike and Pedestrian Plan identifies the existing key bike projects in the area, many of which run through Redwood City.



Central San Mateo County Bikeway Network, including the Redwood Shores Trail to the East

Chapter 4: Existing Conditions



Example of typical major street in Redwood City lacking in bicycle infrastructure

One of these is the North-South Bikeway, which has been partially implemented and is ongoing, as of 2010. According to the CCBP, this bikeway envisions El Camino Real to be the corridor to link multiple cities in the County. Currently, the street experiences high traffic volumes, so the bikeway is meant to provide alternate north/south routes running parallel to El Camino Real. The San Mateo Bay Trail is another project that runs through Redwood City, and will be completed with grant funding. As can be seen in the Appendix of this report, the network is still incomplete around Redwood City.

Opportunities and Constraints

Because the City is so supportive of bicycle network infrastructure citywide, there is tremendous potential for future bicycle development and improvements. Bicycle facilities exist citywide, and people of the city do want to bike more. The San Mateo Comprehensive Bicycle Plan identifies four issues that must be addressed to be a bicycle-friendly community: safety, access, quality of life, and an effective implementation program. Redwood City needs to tackle all four of these issues.

The city's bicycle network lacks connectivity, making travel difficult. Bike lanes exist in various forms around the city, but there is no comprehensive network in place.

Another constraint is safety. Currently, many people do not feel safe riding their bicycles because of the lack of infrastructure, high traffic volume, and the fear of accidents with cars. As a result, cycling is not a very popular mode of transportation in Redwood City.

Existing Broadway Corridor Study Area Conditions

The only existing bicycle facilities in the project area are in the Stanford in Redwood City Development Area, which has Class II lanes. Bicycle facilities on the rest of the study area on Broadway are inconsistent. Broadway Street is relatively wide and accommodates two lanes of traffic in each direction, with parking at the curb. Currently, the area experiences rather high volumes of traffic traveling at high speeds. This is dangerous for cyclists, and one rider testified that he only rode on the sidewalk because he felt so unsafe riding on the street.

Bikes lanes could be added by reallocating parking and adjusting lane widths in certain areas. Also, the existing Class II bike lanes between Douglas and 2nd Avenues could be expanded.



Broadway at Woodside is an extremely high-volume intersection





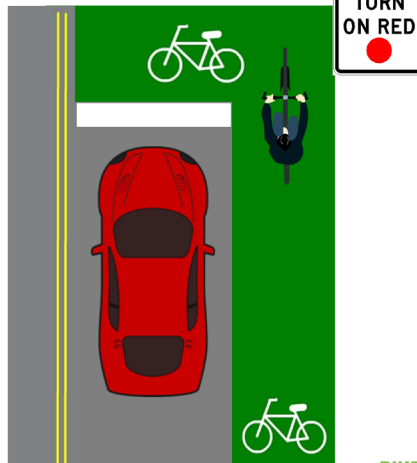
Chapter 5: Recommendations



Chapter 5: Recommendations



Let's Get Behind The Bike Box



This section provides recommendations on implementation measures (actions) that could be utilized by Redwood City for it to attain a Bicycle Friendly America rating of Bronze or higher. These recommendations will draw on findings from the case studies, and will be classified according to the 5 E's criteria. Specifically, the implementation measures will be illustrated through application in the Broadway Corridor.

Recommendation 1: Improve bicycle infrastructure to boost safety and ridership

Action 1.1: Add more bike lanes to link bicycle network

Redwood City's existing bike network is disjointed, so new bike lanes must be installed on certain links to connect the major routes. The Broadway Corridor is one of these strategic areas, because it links downtown with the Stanford in Redwood City development. Currently, Class II lanes exist in the Stanford area, but the rest of the Corridor is inconsistent. Adding bike lanes in the rest of the Corridor would provide a safer environment for bicyclists, making the area a more attractive route to bike on. It would also better link Downtown, Stanford, and the surrounding neighborhoods. With additional bike lanes, Broadway can link up to the surrounding county bike routes, such as Marsh Road, East Bayshore Road, and Bay Road.

Action 1.2: Install Bike Boxes

Bike boxes help prevent turn conflicts by allowing bicyclists to stop in front of cars at stoplights. Bike boxes make bicyclists more visible to motorists, improving safety. These should be implemented at every intersection at which left turns are an option. (Note: bike boxes are only effective when stopped bikes are queued up in front of stopped cars at a red light.)

Chapter 5: Recommendations

Action 1.3: Add more bike parking

Adequate bike parking is crucial to attract people to bike to certain destinations. Therefore, additional racks should be installed at key locations, such as Summit Preparatory Charter High School, the Stanford in Redwood City campus, and in the retail/commercial area. Additional security can also be provided by possibly also including enclosed bike lockers.

Action 1.4: Synchronize traffic lights to prioritize cyclists

The Broadway Corridor is almost 1.5 miles long, with seven total intersections with traffic lights. Synchronizing the lights to accommodate the average bicycling speed would greatly streamline bicycle travel through the area, the success of which has been demonstrated by Valencia Street in San Francisco.

Action 1.5: Ensure sufficient lighting in the Broadway Corridor

To not discourage people from biking at night, the city should make sure that the area has sufficient lighting in the form of streetlights. These should be maintained on a regular basis.

Recommendation 2: Expand community programs to encourage residents to ride their bikes more

Action 2.1: Increase outreach by bicycle advocacy groups

Redwood City's existing bicycle advocacy groups should conduct public outreach to increase membership among citizens of Redwood City. Also, Bike to Work Day should be increasingly promoted, encouraged, and endorsed by the advocacy groups as well as the city government, in an effort to get more people on their bicycles.



Chapter 5: Recommendations



Action 2.2: Expand Bay Area Bike Share

Currently, Redwood City has seven Bike Share stations located in and around the downtown area. At least one more station should be added in the Broadway Corridor in order to expand the program and make the Corridor a stronger transportation link.

Action 2.3: Provide bike lights

Similarly to the city of Davis, the city should provide free bike lights to anyone who needs one, to uphold the law and encourage safe night biking practices.

Action 2.4: Promote the Merits of Bicycling

The city should write and publicize pamphlets describing the many benefits of biking such as improved health, cleaner air, and energy efficiency, to encourage people who may be hesitant or timid about biking on city streets.

Action 2.5: Partner with technology companies in Redwood City to promote bicycling

Because Redwood City is home to so many technology firms, an opportunity exists for those companies to utilize their influence and resources to promote biking among both their employees and the public. This could be done through Bike to Work Days, sponsored fundraisers, and casual bike marathons, as well as providing bicycle parking, lockers, and showers on site at the various campuses.

Action 2.6: Start Sunday Streets in the Broadway Corridor Area

As demonstrated by San Francisco and other cities, Sunday Streets is a community activity that can serve as both a fun event and a way to encourage bicycling. These could be held once every few months.

Recommendation 3: Introduce and develop education programs that will teach children and adults the basics of bicycle protocol and road safety

Action 3.1: Implement School Programs

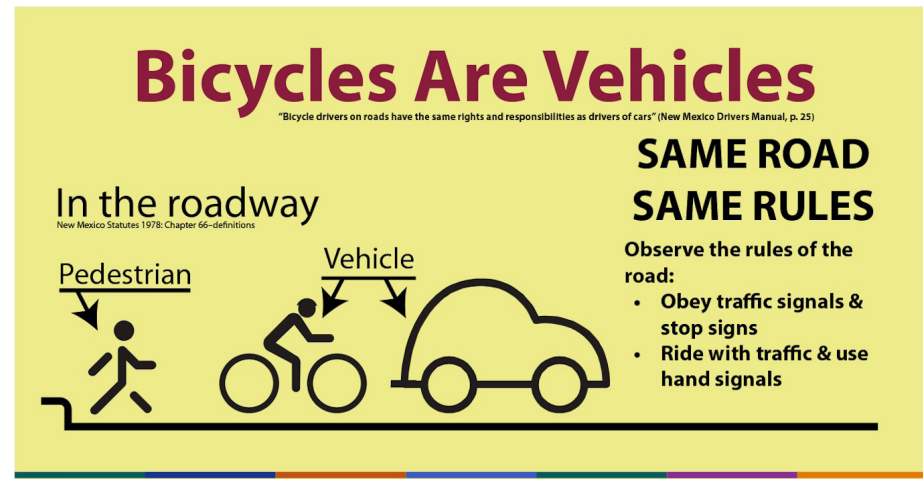
Promoting a sustainable lifestyle needs to start early, and high school is a good age to start encouraging such practices in kids. Therefore, Summit Prep should incorporate bike safety and protocol education programs (like Portland's Safe Routes to School program), as well as start monthly Bike to School days. Teenagers will find biking more attractive when they see many of their peers participating in such programs.

Action 3.2: Provide Adult Bike Programs

The city should sponsor free public bicycle education programs for adults. This will encourage adults who may not feel comfortable or safe biking in the city to do so. It will also help people who bike already to know the rules of the road in order avoid conflict with automobiles and pedestrians, and to be safe.

Action 3.3: Provide bicycle education for motorists

Not only do bicyclists need to know about the rules of the road, but drivers must also be properly educated. This will make drivers more aware of other users of the road, and will help reduce conflicts and collisions.



Chapter 5: Recommendations



Recommendation 4: Improve enforcement of bicycle-related traffic laws

Action 4.1: Provide more police enforcement at dangerous intersections

The police should be on the lookout for bike offenders, as well as traffic conflict with cars. All traffic laws should be enforced for both motorists and bicyclists.

Action 4.2: Include real time speed display on speed limit signs

Speed limits must be strictly enforced. Cars tend to speed down a wide street such as in the Broadway Corridor, so making them aware of how fast they are actually going is important. The more drivers slow down, the quicker they will be able to stop to avoid potential accidents with pedestrians and bicyclists.

Recommendation 5: Identify and improve areas that are dangerous for biking

Action 5.1: Conducting a public survey to target areas that are deemed dangerous to bike

To improve safety, the city should collect feedback from the public regarding which areas are considered dangerous to bike, and focus on improving them by devoting funds and personnel to them.

Action 5.2: Dedicate city funds to improve dangerous areas

Once target areas have been identified, the city must immediately focus on installing the necessary infrastructure to improve safety, such as traffic calming measures, bike lanes, signage, and/or traffic lights.

Chapter 5: Recommendations

Action 5.3: Mandate speed limits around schools to be 20 miles per hour or less.

Schools are high-traffic areas that require extra care to be taken when driving through. In order to avoid accidents as well as encourage bicycling, speed limits around schools should be lowered and enforced.

Recommendation 6: Establish long-term goals and monitoring programs to improve bicycling citywide

Action 6.1: Develop a Bicycle Master Plan

The city should write and regularly update a dedicated Bicycle Master Plan, in order to reflect the changing conditions of the network and evolving needs of the community. This should be done in partnership and coordination with the County, to ensure connectivity in the regional network.

Action 6.2: Monitor conditions through regular surveying and evaluation

Bicycle conditions in Redwood City should be closely monitored to ensure that goals are being met and consistency is upheld. These evaluations should be done on a regular basis such as once a month, and will also help in maintenance of infrastructure.







Chapter 6: Conclusion



The image is a composite of three aerial photographs. The top photograph shows a wide expanse of blue water with a network of dark, winding channels and some green land patches. The middle photograph is a dark, almost black, rectangular area. The bottom photograph shows a detailed view of a coastal urban area. It includes a large marina with many white sailboats, a parking lot filled with cars, a multi-lane highway with traffic, and various buildings and industrial structures. A large body of water is visible on the right side of the bottom photograph.

Chapter 6: Conclusion

Redwood City is ideally positioned to earn a spot on the League of American Bicyclists' Bicycle Friendly Communities list. If the city were to implement the actions recommended earlier and then apply to the program, it could very well earn a ranking of Bronze or higher according to the Bicycle Friendly America standards. The case studies of Davis, Portland, and San Francisco have shown that getting named a "Bicycle Friendly Community" is really quite simple in principle.

As communities embrace sustainable transportation modes, they can help reverse harmful trends caused by total automobile dependency. As can be seen, bicycling is a healthy alternative mode of transportation that has many benefits and can greatly improve communities, the environment, and people's quality of life. Not only is it invigorating, cost-efficient, and resource-saving for the individual bicyclist, but it also brings communities together at many different levels. Biking can be fun group activities for both adults and children, and it allows people to feel more confident and part of something bigger through advocacy groups. As a result of widespread community support and demand, cities worldwide have taken great strides to come up with innovative solutions and establish impressive bicycle infrastructure on their streets, thus changing the transportation culture. In the face of this expansion, cities need to continue to make their streets a safe place to

accommodate all modes of transportation, including the bicycle. As communities continue to develop and expand, they need to manage that growth to ensure that they have sufficient capacity and resources to accommodate it. In an age in which resources are becoming scarce and the world is being threatened with issues like climate change, overcrowding, and pollution, sustainability is the principle that must guide all planning decisions. Transportation is a significant aspect of any functioning economy, and the more sustainable it is, the more it can benefit society at large. We have a responsibility to steward the earth's resources responsibly, not only for our current situation, but also for future generations. Biking may seem like a small change, but it is a step in the right direction.



The background of the slide is a photograph of bicycle wheels and components, including spokes, tires, and a chain. A semi-transparent red horizontal band is overlaid across the middle of the image. The word "References" is written in white, sans-serif font within this red band.

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Image Links

Cover, top: bostoncyclistsunion.org

Cover, bottom, and page 39, cover: <http://peninsulapress.com/wp-content/uploads/2012/04/Redwood-City-Sign.jpg>

Page 3, cover: <http://cdn.desktopwallpapers4.me/wallpapers/photography/1920x1080/2/19727-bike-against-the-wall-1920x1080-photography-wallpaper.jpg>

Page 4, cover: http://bicyclesafetyinstitutedotorg3.files.wordpress.com/2013/05/1966_anseladams.jpg

Page 7, cover: http://upload.wikimedia.org/wikipedia/commons/3/36/Cyclists_at_red_2.jpg

Page 8, top: <http://www.sfexaminer.com/imager/bicycle-use-spikes-in-san-francisco-report-shows/b/original/2648848/caa6/ABIKERIDE1213.jpg>

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Appendix



Southeastern San Mateo County Bicycle Network Map. Source: <http://michaeltelson.com/BikeMap/sm2.pdf>



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