CITY OF DAVIS GREENBELT MASTER PLAN

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San Luis Obispo

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of the Requirements for the Degree

Master of City and Regional Planning / Master of Science in Engineering (Transportation

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by

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ABSTRACT

City of Davis Greenbelt Master Plan

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The City of Davis is currently updating its *Parks and Recreation Facilities Master Plan*. During the update, greenbelts were identified as a highly used and desired facility. This *Greenbelt Master Plan* serves as a plan focused on the opportunities greenbelts can provide as recreational and transportation facilities. This report has analyzed community feedback, greenbelt coverage, greenbelt capacity, and existing local, state, and federal design guidelines. The final plan is a set of goals, objectives, policies, and programs, along with a greenbelt map, which is aimed at improving the greenbelt infrastructure in Davis through the year 2020.

Keywords: greenbelt, greenways, shared-use path, bike path, greenstreet

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CITY AND REGIONAL
PLANNING DEPARTMENT
CALIFORNIA POLYTECHNIC
STATE UNIVERSITY

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1.0 Executive Summary

Introduction

The City of Davis is currently updating its *Parks and Recreation Facilities Master Plan*. During the update, greenbelts were identified as a highly used and desirable facility. The *Greenbelt Master Plan* focuses on the opportunities greenbelts can provide as recreational and transportation facilities. This report analyzed community feedback, greenbelt coverage, greenbelt capacity, three greenbelt design alternatives, and existing local, state, and federal design guidelines. The final plan is a set of goals, objectives, policies, and programs, along with a greenbelt map, which is aimed at improving the greenbelt infrastructure in Davis through the year 2020.

Final Plan

The final plan is based on a moderate growth alternative, and was developed after analyzing community feedback and examining different greenbelt plans. The final plan has four goals, including:

Goal 1: Equally accessible and ample greenbelts for all Davis residents

Goal 2: A well connected and easily navigable greenbelt network

Goal 3: Innovatively designed and universally accessible greenbelts

Goal 4: A well maintained greenbelt system

The final plan will result in an estimated 195.5 acres of greenbelt space by the year 2020. This is the same as the no change alternative, and equates to 2.63 acres of greenbelt per 1,000 residents. 97% of parcels will be within a ½ mile of a greenbelt using this plan. The

final plan requires that all greenbelts developed in the future are in accordance with the map below. The preliminary phasing for this map will result in the construction of the following greenbelts in the order as they appear.

1. Arboretum under Interstate 80 to South Davis
2. Drummond Avenue and Cowell Boulevard
3. Putah Creek to Mace Boulevard
4. B Street Connector from 14th Street to 5th Street
5. B Street Connector from 5th Street to 1st Street
6. 14th Street Connector
7. Pole Line Road to Mesquite Drive
8. Pole Line to East 14th Street
9. Wildhorse Golf Club to Perimeter Greenbelt
10. Lake Boulevard to West Davis City Limits
11. Along West Davis City Limits
12. From Olympic Drive to Perimeter Greenbelt

These greenbelts will be designed in accordance with the goals, objectives, and policies developed in this plan. Many of these connections will use greenbelt connectors instead of greenbelts. Greenbelt connectors are smaller greenbelts that can be used in developed areas and are constructed on existing right-of-ways.

Figure 1.0: Final Greenbelt Map

Source: City of Davis and Brandon Haydu

2.0 Introduction

2.1 Purpose

The purpose of this project is to create a *Greenbelt Master Plan* for the City of Davis. The plan will guide greenbelt development to meet community desires with goals, objectives, policies, and programs, and a map with existing and planned greenbelts.

Davis greenbelts are landscaped, shared-use paths that wander through and around the City of Davis. Greenbelts have been a positive amenity for the City of Davis since the 1960's when the Covell Greenbelt was first built. They have also contributed to Davis's nationally renowned bicycle infrastructure. Greenbelts benefit a wide range of users, such as: walkers, roller skaters, runners, bicyclists and others who want to recreate outdoors. Furthermore, greenbelts act as transportation infrastructure, open spaces, storm water drainage areas, and recreational facilities.

Greenbelts exist in many cities, and have different definitions for each municipality. For example, in the City of San Luis Obispo, CA, greenbelts are used to enclose the city in a buffer of open space. Their definition is much different than Davis's. San Luis Obispo's greenbelts are much larger, and rather than crisscrossing through the city, they surround the city with a buffer of open space. The City of Portland, OR also has greenbelts, but they use the term recreational trails. Recreational trails are similar to greenbelts in that they are landscaped, shared-use paths, but they are significantly larger. The City of Boulder, CO has greenbelts that are much like the City of San Luis Obispo's greenbelts; they include large parcels of land that surround the city in open space.

This plan defines greenbelts as landscaped, shared-use paths that are used to meet the recreational and transportation needs of Davis residents. This plan is different than *Davis, Naturally*, which is a report created by Davis's Open Space and Habitat Commission evaluating all open spaces in Davis. This plan is also different than the *City of Davis Comprehensive Bicycle Plan*, which primarily addresses the circulation of cyclists. The policies in this plan focus specifically on greenbelts, but are consistent with the previous two documents which use similar corridors.

The construction of greenbelts in Davis is focused around residential development. In the past, this has been low density single family residential development. However, higher density residential infill development is currently being encouraged in the *General Plan*. Infill development uses much less land than the low density developments of the past because it is constructed within developed areas. Recently, this has become a problem for the development of greenbelts because *General Plan* policies and standards are focused on large developments, rather than small infill projects.

The current greenbelt requirement for the City of Davis is as follows: "Ten percent of the area in new residential development areas shall be greenbelt..." (City of Davis, 2007, p. 246). However, the requirement is problematic because there is limited space for recreational facilities within greenbelts built for infill developments. The smaller infill projects are subject to the *General Plan* requirements, but in many cases cannot physically comply with the requirements, or the requirements do not match the needs of the development or the larger community.

The City of Davis is currently developing its *2008 Parks and Facilities Master Plan*. In the *Community Needs Assessment* section of the plan, Davis residents mentioned that greenbelts were an important part of the City. In fact, 68 percent of residents said greenbelts were “very important,” and 73 percent said walking and hiking trails were “very important.” Furthermore, over 50 percent of residents said that greenbelt expansion and acquisition of open space was the most important park system improvement (City of Davis, 2008). The *Greenbelt Master Plan* clarifies what community members want greenbelts to provide, and provides a plan to achieve those desires.

This plan is focused on improving the greenbelt system in Davis to match the changing needs of the city. The goals, objectives, policies, and standards created in this project are designed to match the scale of new infill developments and implement needed greenbelt connections. This plan took a comprehensive approach to develop the plan, by using community and city staff input and feedback, independent data collection, and ideas from other greenbelt systems around the nation.

2.2 Setting

The City of Davis is approximately 10 square miles in size, and is located in the Central Valley of Northern California (Figure 2.0). Davis is surrounded by agricultural fields; except for the southwest side of the city which borders the University of California, Davis (UC Davis). The city has a very flat terrain, and the lowest and highest points within the city are 25 feet and 61 feet respectively. The city’s small size and flat agricultural terrain make it an easy town to ride bicycles in. The city also lies on the

eastern section of the Putah Creek Plain. This results in mild, shallow flood hazards which are mostly mitigated with channels and detention ponds.

Davis also has a wonderful climate for outdoor recreation. The City of Davis has a Mediterranean climate, which includes hot dry summers and cold wet winters. The average annual temperature in Davis is 62 degrees Fahrenheit. However, temperatures in the summer typically exceed 90 degrees Fahrenheit, and temperatures in the winter drop below 40 degrees Fahrenheit.

Interstate 80 bisects the city from east to west connecting the city to San Francisco, approximately 70 miles to the west, and Sacramento, approximately 15 miles to the east. California State Route 113 runs north to south through the city and connects to Woodland 11 miles to the north. State Route 128 runs through the west side of Davis and connects the city to Winters 14 miles to the west. Davis also has railroads running north to south along F Street and east to west along 2nd Street. An Amtrak station is located at 2nd Street and G Street (Figure 2.1). These corridors are all constraints for greenbelt infrastructure because they are difficult to cross and act as barriers to an interwoven greenbelt network.

Figure 2.0: City of Davis Regional Setting

Source: Google Maps

The California Department of Finance has estimated the population of Davis to be 66,005 people as of 2009 (State of California, 2009). These estimates are made from the 2000 Census count which recorded 60,308 people living in Davis (U.S. Census Bureau, 2000). As of 2009, there were 32,153 students at UC Davis, and many of these students were residents of Davis (UC Davis, 2009). When the 2000 Davis population is broken down into five year cohorts, it is clear that college students comprise a large portion of the 60,308 residents (Figure 2.2). In fact, the two biggest age cohorts include the 15 to 19 and the 20-24 age cohorts.

Figure 2.2: City of Davis Population by Cohort

Source: 2000 Census, SF1, P12

The City of Davis's median household income of \$42,454 is slightly higher than the national average of \$41,994 as of 1999 (U.S. Census Bureau, 2000). As Figure 2.3 shows, there is a large portion of residents who have a household income of over \$60,000.

Figure 2.3: City of Davis Household Income

Source: 2000 Census, SF3, P52-53

2.3 Background

Planning Process

A six step methodology was used to develop a comprehensive greenbelt plan, and Appendix B provides more detail about the planning process. Step one was extensive research on greenbelt plans, design standards, and capacity measurements. The second step was the analysis of existing greenbelts in Davis. The third step was the analysis of existing greenbelt capacities. The fourth step was the projection of future population and development in Davis. The fifth step was the development and analysis of three alternative plans: (1) a no change alternative, (2) a moderate change alternative, and (3) an extensive change alternative. The final step was the development of the final greenbelt plan.

Research

Research of existing greenbelt policies and greenbelt infrastructure provided the framework for this plan, and the full analysis can be viewed in Appendix A. The first part of research focused on greenbelt user characteristics. The second part of research focused on existing federal, state, and local policies. The final part of research was the analysis of three case studies. Greenbelt users, including pedestrians, runners, bicyclists, and small wheel vehicles, were analyzed using *American Association of State Highway and Transportation Officials (AASHTO's) Guide for the Development of Bicycle Facilities*, *AASHTO's Guide for the Planning, Design, and Operation of Pedestrian Facilities*. The primary design standards included the *AASHTO's Guide for the Development of Bicycle Facilities*, the *California Manual on Uniform Control Devices (MUTCD)*, the City of

Davis *General Plan*, and the City of Davis *Comprehensive Bicycle Plan*. Two capacity measurements were analyzed, the *Federal Highway Administration's (FHWA) Shared-use path LOS calculator* and the *Transportation Research Board's (TRB's) Highway Capacity Manual*; the FHWA methodology was used for analysis in this report because of its in depth methodology. This plan also did case studies on greenbelts in Boulder, CO, Portland, OR, and San Luis Obispo, CA.

Existing Greenbelt Use and Capacities

The goals, objectives, and policies developed in this plan were based off existing greenbelt use and capacities, as well as, community feedback which is discussed further in Appendix C. As of 2009, the City of Davis has 165.5 acres of greenbelts within the city limits and a population of 66,005. This equates to a total of 2.5 acres of greenbelt space per 1,000 residents in Davis. Eighty-eight percent of parcels are located within a ½ mile of a greenbelt, and the majority of parcels that are not within a ½ mile of a greenbelt are located in central Davis. The capacity of greenbelts for bicyclists, pedestrians and other greenbelt users in Davis is currently excellent. Three of the busiest greenbelts in Davis were analyzed to determine their peak hour capacity; two operated at a Level of Service A and one operated at a Level of Service B. Community feedback noted that central Davis was in greatest need of greenbelt connections; the community also thought greenbelts could be improved by using more native plants and watering less, increasing the amount of water fountains, improving maintenance, separating pedestrians, and including dirt running paths.

Future Growth

To help analyze where future greenbelt development should occur, future growth in Davis was analyzed; more detailed analysis can be viewed in Appendix D. Davis is expected to grow 13% in population between 2009 and 2020 to a total population of 74,283 people. This growth will be matched by a growth rate in housing of 1% per year. Existing greenbelt development is tied to residential growth, and if all planned residential development occurs there will be an additional 30 acres of greenbelts developed in Davis.

Alternatives

Three alternative plans were developed for presentation to the community, and can be viewed in Appendix E. The first plan involves no change in greenbelt policy. The no change alternative would result in 90% of parcels being within a ½ mile of a greenbelt, and 2.63 acres of greenbelt per 1,000 residents. The second alternative involves moderate change to policy. This alternative would result in 97% of parcels being within a ½ mile of a greenbelt, and maintains 2.63 acres of greenbelt per 1,000 residents. The third alternative involves extensive policy change. This alternative would result in 99% of parcels being within a ½ mile of a greenbelt, and increases greenbelt acreage to 2.93 acres of greenbelt per 1,000 residents. After presenting the alternatives to the community, the moderate change alternative was the best match for the community. Therefore, the moderate change alternative was chosen as the guidance for the final plan.

3.0 Final Plan

The final plan has been developed to supplement the Parks and Facilities Master Plan, The Comprehensive Bicycle Plan, and The Greenbelt Master Plan. The final plan is based on the moderate growth alternative, because it most closely resembled the community's desires. The final plan is the result of extensive community outreach and planning analysis, and tries to match the community's wants as closely as possible while still maintaining planning feasibility. The plan outlines goals, objectives, and policies; provides a suggested phasing plan; provides conceptual designs; and analyzes potential impacts of future greenbelt development.

3.1 Overview

After extensive research and community outreach, residents' aspiration for the city to develop more greenbelts in Davis is clear. The lack of greenbelts throughout central Davis is apparent, and this plan proposes many solutions to remedy this problem. Central Davis was the area that needed greenbelt connections most, according to residents; this corresponded to the GIS analysis of greenbelts which showed central Davis as the largest area without greenbelts within a half mile of parcels. Greenbelts provide many amenities, but the majority of Davis residents use greenbelts to walk, bicycle, run, view nature, or walk their dog. Residents find bike, walking and running paths; separation from cars; and open space to be the most important features of greenbelts. Greenbelt users also expressed concern over the following issues: minimal greenbelt maps and signage, insufficient amount of water fountains, not enough native or drought tolerant vegetation, problems with maintenance, and not enough areas for dogs. This plan

aims to address these concerns and desires with goals, objectives, and policies, as well as by developing phasing and design guidelines.

3.2 Goals, Objectives, and Policies

The goals, objectives, and policies of the Greenbelt Master Plan aim to produce future greenbelt infrastructure that meets the wants and desires of the community. These goals, objectives, and policies have been developed based on analysis of present greenbelt infrastructure, community feedback, and projections of future growth in Davis. Developers are encouraged to follow all of the goals, objectives, and policies below.

Goal 1: Equally accessible and ample greenbelts for all Davis residents

Objective 1.1: All parcels in Davis should be within a ½ mile of a greenbelt.

Policy 1.1.1: City constructed greenbelts should begin in central Davis,
and then move toward non-central locations.

Objective 1.2: There should be a minimum of 2 greenbelt acres per 1,000
residents.

Policy 1.2.1: 10% of the area in new residential development shall be
greenbelt if parcel is designated for a greenbelt on
greenbelt map. In-lieu fee towards construction of

greenbelts on greenbelt map shall be paid if residential development parcel is not designated on greenbelt map.¹

Objective 1.3: All greenbelts should provide multiple access points.

Goal 2: A well connected and easily navigable greenbelt network

Objective 2.1: All greenbelts should be developed according to a master plan.

Policy 2.1.1: A greenbelt map shall be developed that creates a well connected and equally accessible network of greenbelts.

The map should connect greenbelts to open spaces, parks, schools, work places, shopping, major destinations, and should be integrated with the bicycle network.

Objective 2.2: All access points should have a greenbelt entrance sign.

Objective 2.3: Maps of the greenbelt network should be located at all major greenbelt access points and at community parks.

Goal 3: Innovatively designed and universally accessible greenbelts

Objective 3.1: Greenbelts (excluding greenbelt connectors) should have a minimum width of 35 feet and an average width of 100ft and

¹ The purpose of the fee is to provide greenbelts for all residents of Davis, including those of new developments. The in-lieu fee will be used for the construction of new greenbelts on the greenbelt map. Residential infill projects provide housing for residents who will recreate in greenbelts; these residents provide the nexus for the in-lieu fee developers of new residential projects pay for. Since infill projects are small, a greenbelt that is 10% of the parcel size would not be able to meet other goals and objectives. Therefore, an in-lieu fee insures that new developments provide their fare share of greenbelt infrastructure.

provide facilities for pedestrians, bicycles, runners, small wheeled vehicles, and wheelchairs.

Policy 3.1.1: All greenbelts (excluding greenbelt connectors) shall have bike paths with a minimum width of 10 feet with 2 feet unpaved (runner friendly) shoulders on each side.

Policy 3.1.2: All grades should be in accordance with the Americans with Disabilities Act and the Comprehensive Bicycle Plan.

Objective 3.2: Greenbelt connectors should be used where designated on the greenbelt map.

Policy 3.2.1: All greenbelt connectors should have designated and separate areas for bicycles and small wheeled vehicles; pedestrians and wheelchairs; runners; and native vegetation.

Objective 3.3: Greenbelts may provide storm water drainage and management capabilities.

Objective 3.4: Greenbelts should have minimal impacts on the environment.

Policy 3.4.1: All greenbelts should use native and/or drought tolerant plantings where possible.

Policy 3.4.2: Where appropriate, greenbelts shall provide habitat for native species.

Objective 3.5: Greenbelts shall have amenities that provide a pleasurable experience for users.

Policy 3.5.1: Water fountains and benches should be placed every mile.

Policy 3.5.2: Trash and recycling cans with doggie bag dispensers should be placed every two miles.

Policy 3.5.3: All paths on greenbelts should be well lighted at night.

Policy 3.5.4: Greenbelts (excluding greenbelt connectors) should incorporate play areas, public art, and/or fenced dog areas where possible.

Objective 3.6: Greenbelts should provide a unifying landscape element and maintain view corridors.

Goal 4: A well maintained greenbelt system

Objective 4.1: Greenbelts should be designed and constructed to be low maintenance.

Policy 4.1.1: Bike paths within greenbelts shall be constructed of Portland cement.

Policy 4.1.2: Trees and plants should be planted far enough away from bikes paths to prevent root damage to pavement.

3.3 Greenbelt Connections and Map

This section explains where future greenbelt connections should be placed. The placement of future greenbelt connections were chosen based off four questions:

1) Are residents in this location without an existing greenbelt within a half mile?

- 2) Has the community expressed the need for a greenbelt in this location?
- 3) Is there a connection missing between two existing greenbelts?
- 4) Is it feasible and logical to place a greenbelt in this location?

Using these questions, seven greenbelt and five greenbelt connector locations were chosen and are shown in Figure 3.0.

Greenbelt Locations

Drummond Avenue and Cowell Boulevard (#2)

This connection is needed because it would connect two adjacent greenbelts. It is a feasible and logical connection because the connection is small, the existing parcel is undeveloped, and there is already a bike tunnel under the road. The community has also expressed a need for this connection.

Putah Creek to Mace Boulevard (#3)

This connection would connect the Willowbank greenbelt to Mace Boulevard which is an integral piece of Davis's bicycle infrastructure. This connection is also feasible and logical because it is small and on an undeveloped parcel. Furthermore, the community has expressed interest in this connection.

Pole Line Road to Mesquite Drive (#7)

The community has ranked this the most important connection behind linkages through central Davis. This is a feasible and logical route because it is necessary to connect east Davis to downtown; the parcel is currently being used as a cemetery and could accommodate both uses.

Wildhorse Golf Club to Perimeter Greenbelt (#9)

This is an important link to provide a connected loop of greenbelts around Davis. This route also serves to connect two areas with extensive greenbelts. The existing condition of the parcel is also undeveloped.

Lake Boulevard to West Davis City Limits (#10)

This connection runs through an area that is undeveloped, and can connect Aspen greenbelt with the far west side of Davis. This area of Davis is not currently served by a greenbelt within a half mile, and would extend greenbelt availability to more Davis residents.

Along West Davis City Limits (#11)

This connection will help finish the loop of greenbelts around Davis. It will also provide greenbelt access to Davis residents who do not currently have access within a half mile. The existing parcel is undeveloped in this location.

From Olympic Drive to Perimeter Greenbelt (#12)

This is an important link that will connect west Davis to north Davis and connect Evergreen greenbelt to Perimeter greenbelt. This link would also help complete the loop of greenbelts around Davis. The existing parcel is only lightly developed, and has plenty of undeveloped property to be used as greenbelt.

Greenbelt Connector Locations

Interstate 80 to South Davis (#1)

This is a short link that could connect south Davis to UC Davis and downtown, and would also connect the Putah Creek greenbelt with the Arboretum. There are existing

signs directing bicyclists and pedestrians. This link could be a greenbelt connector along Da Vinci Court, Research Park Drive, and West Chiles Road. This could also be a complete greenbelt if land to the west of the Putah Creek greenbelt is purchased and annexed by Davis. This option, however, would need consent from multiple landowners.

B Street Connector from 14th Street to 5th Street (#4)

This is one of the most important connections in Davis. This route would provide greenbelts to many residents who do not have access to a greenbelt within a half mile. This route travels through the center of Davis, and it connects the Davis Community Park, Davis Senior High School, and downtown. This connection would also help connect north, west and south Davis. This link needs to be a greenbelt connector because this area is heavily developed.

B Street Connector from 5th Street to 1st Street (#5)

This greenbelt connector is important because it would provide greenbelt access to residents of downtown Davis. This connection would also serve as a connection between south and north Davis. A greenbelt connection through downtown would also serve as an iconic feature in Davis, and would give visitors to Davis an example of the city's greenbelt system. This area is heavily developed, and a greenbelt connector would best serve this area.

14th Street Connector (#6)

The 14th Street Connector is necessary to connect west Davis and downtown. This link would also connect Davis Senior High School, Davis Community Park, and Sycamore

Park. Because this section is in a heavily developed area, a greenbelt connection would serve this area best.

Pole Line to East 14th Street (#8)

This route is necessary to connect east Davis to downtown, and it links Chestnut Park, Oliver Wendell Holmes High School, and the Davis Community Park. This route is feasible and logical because it utilizes an existing underpass, and connects key features.

Figure 3.0: Final Greenbelt Map

Source: City of Davis and Brandon Haydu

3.4 Greenbelt Phasing

No specific phasing plan was developed for the *Greenbelt Master Plan* because construction of greenbelts is tied to residential development. Nevertheless, a general outline of the order in which greenbelts should be developed is shown in Figure 3.1, and explained below. Maps and signage should be placed in all existing greenbelts before new greenbelts are developed. Maps and signage were expressed to be an amenity that is missing with existing greenbelts, and adding maps and signage will make it easier for users to find the nearest greenbelt. Once maps and signage are in place, greenbelt development should start with small greenbelt connections because their cost is lower; these include the first three connections on the phasing map (1-3 in Figure 3.1). Once these are developed, focus should be placed on the greenbelts in central Davis (4-8 in Figure 3.1). Greenbelts on the periphery (9-12 in Figure 3.1) of Davis should be constructed last because residents living in the periphery of Davis already have extensive greenbelt access. The greenbelt projects should be constructed in the order below:

1. Arboretum under Interstate 80 to South Davis
2. Drummond Avenue and Cowell Boulevard
3. Putah Creek to Mace Boulevard
4. B Street Connector from 14th Street to 5th Street
5. B Street Connector from 5th Street to 1st Street
6. 14th Street Connector
7. Pole Line Road to Mesquite Drive
8. Pole Line to East 14th Street

9. Wildhorse Golf Club to Perimeter Greenbelt
10. Lake Boulevard to West Davis City Limits
11. Along West Davis City Limits
12. From Olympic Drive to Perimeter Greenbelt

If residential development occurs on one of the parcels slotted for a greenbelt, then the greenbelt should be constructed no matter what place it is on the phasing map. Ongoing maintenance and the installment of additional water fountains, benches, trash cans, and lighting should continue throughout the development of future greenbelts.

Figure 3.1: Greenbelt Phasing Map

Source: City of Davis and Brandon Haydu

3.5 Greenbelt Connector Design Concepts

Many residents have mentioned the need for more greenbelts through central Davis, and GIS analysis confirms the absence of greenbelts in central Davis. Greenbelt connectors have been created to expand greenbelt infrastructure into developed areas of Davis. The main difference between greenbelt connectors and traditional greenbelts is that they are built within city right of ways as opposed to on undeveloped land. Therefore, greenbelt connectors need to be designed to accommodate vehicle traffic, non-motorized traffic, and recreationists. Two major greenbelt connectors are planned through downtown Davis. The first is the B Street greenbelt connector. This will have two general

design layouts. The first section will consist of one southbound lane for motorized traffic with an adjacent bicycle lane flowing in the same direction. On the northbound side of B Street a counter flow bicycle lane will be marked and will have adjacent landscaped areas and pedestrian/running paths (Figure 3.2).

Figure 3.2: B Street Greenbelt Connector Cross-section Concept

Source: Brandon Haydu

The second section of the B Street greenbelt connector will consist of a bicycle boulevard through the downtown section of Davis. This will allow for motorized traffic to flow in both directions, but will be designed to favor bicyclists and pedestrians (Figure 3.3). While it is not shown in the cross-section, traffic calming features should be used along the bicycle boulevard to calm and divert motorized traffic. This design should also be used for the 14th Street greenbelt connector. Other greenbelt connectors can use these layouts or designs similar to the two proposed. The main goal is to minimize paved areas, increase native landscaping, and provide facilities for all greenbelt users.

Figure 3.3: B Street or 14th Street Greenbelt Connector Cross-section Concept

Source: Brandon Haydu

Greenbelt connectors have not been used in Davis, and their design has not been studied extensively. Therefore, any greenbelt connector that is developed should have a trial period for at least six months and preferably a whole year. This will allow traffic counts to be taken, and will allow for feedback from the community. These trials will allow city staff to fix problems in the development and operation of greenbelt connectors. Once greenbelt connectors have been developed and studied for an extensive period of time, design guidelines should be developed for greenbelt connectors.

Figure 3.4 shows a conceptual illustration for a greenbelt connector along B Street. This design would provide the maximum space allowable for bicyclists and pedestrians, and would minimize the room for automobile travel. This would hopefully lower automobile traffic along this corridor, and make it a more pedestrian and bicycle friendly corridor. Traffic calming features, such as the raised intersection, could be used to slow and hopefully divert through traffic.

Figure 3.4: B Street Greenbelt Connector Concept View 1

Source: Brandon Haydu

Figure 3.5 shows a closer view of the conceptual greenbelt connector. This illustration emphasizes that greenbelt connectors should be able to accommodate all greenbelt users by providing surfaces and paths that attract different users. The layout also shows that greenbelt connectors can offer extensive landscaping, bicycle, pedestrian, and running paths, and vehicle traffic lanes using existing right-of-ways. This figure also shows in detail how a contra flow bicycle lane can provide access for two directions of bicycle traffic while limiting motorized vehicle traffic to one lane.

Figure 3.5: B Street Connector Concept View 2

Source: Brandon Haydu

3.6 Impacts

Figure 3.6 shows the greenbelts that will be developed following the final plan. The final plan will result in 30 additional acres, or 195.5 total greenbelt acres, if all “green light” and “yellow light” sights are developed. The impacts of the final plan will also shape coverage of future greenbelts. With a population of 74,283 by 2020 and a total of 195.5 acres of greenbelts, there will be a total of 2.63 acres of greenbelts per 1,000 residents. This is slightly more than the existing 2.5 acres of greenbelts per 1,000 residents. Furthermore, the final plan will result in more extensive greenbelt coverage,

even in central Davis. Figure 3.6 shows that 99% of parcels will be within a half mile of a greenbelt when the all greenbelts are developed.

Figure 3.6: Future Greenbelt Coverage with Final Plan Fully Developed

Source: City of Davis and Brandon Haydu

The capacity of greenbelts will be slightly changed with the final plan. However, the capacity will not be changed significantly enough to impact the LOS of greenbelt shared-use paths. Table 3.0 shows that the LOS of greenbelts will remain the same with the final plan.

Table 3.0: Shared Use Path LOS with Final Plan

Year	Greenbelt Acreage	Population	People/Acre	Arthur Volume	LOS Score	Arthur LOS
2009	165.5	66,005	398.82	64	3.68	B
2020	195.5	74,283	379.96	61	3.69	B
Year	Greenbelt Acreage	Population	People/Acre	Monarch Volume	LOS Score	Monarch LOS
2009	165.5	66,005	398.82	15	4	A
2020	195.5	74,283	379.96	14	4	A
Year	Greenbelt Acreage	Population	People/Acre	Lillard Volume	LOS Score	Lillard LOS
2009	165.5	66,005	398.82	22	4	A
2020	195.5	74,283	379.96	21	4	A

Source: FHWA Shared Use Path LOS Calculator

While a full traffic impact study is out of the scope of this project, preliminary analysis finds that the final plan will have an impact on parking and traffic in central Davis. There is an existing traffic volume of approximately 5,000 daily trips on B Street between 14th Street and 5th Street. By 2015 the city's traffic model estimates that there will be approximately 6,500 daily trips on B Street between 14th and 5th Street (Table 3.1). This road will be developed into a greenbelt connector which would remove parking and turn the road into a bicycle boulevard or a one way street with bicycle lanes in both directions. This design may cause some traffic to be diverted to adjacent roads, F Street and Oak Avenue, and cause parking to be diverted to cross streets. The existing traffic volume on 14th Street between F Street and Sycamore Lane is approximately 5,500 daily trips. This volume is supposed to increase to 6,000 by 2015 (Table 3.1). This road will also be developed into a greenbelt connector, and will most likely have traffic calming features installed and parking removed. Therefore, traffic will be diverted to Covell Boulevard and 8th Street, and parking will be diverted to cross streets. Traffic volumes on the other streets which will contain greenbelt connectors were not readily available at the

city. Further research with regard to the traffic impacts greenbelt connectors will have on the city is needed to adequately assess greenbelt connector's viability.

Table 3.1: Downtown Traffic Volumes

Downtown Traffic Volumes		
Street	2009	2015
B Street	5,000	6,500
14th Street	5,500	6,000

Source: City of Davis Public Works Department

4.0 References

American Association of State Highway and Transportation Officials. (1999). *Guide for the development of bicycle facilities*. Washington, DC.

American Association of State Highway and Transportation Officials. (2004). *Guide for the planning, design, and operation of pedestrian facilities*. Washington, DC.

Americans with Disabilities Act. (1994). *ADA standards for accessible design*. Retrieved from <http://www.ada.gov/stdspdf.htm>

California Department of Transportation. (2006). *California manual on uniform traffic control devices*. Sacramento, CA.

California State Parks. (2002). *Public opinions and attitudes on outdoor recreation in california 2002*. Sacramento, CA.

City of Boulder. (2001). *Greenways master plan*. Boulder, CO.

City of Boulder. (2010). *Go boulder: bikeways*. Retrieved from http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=8843&Itemid=2976

City of Davis. (1998). *Parks and recreation facilities master plan*. Davis, CA.

City of Davis. (2002). *Davis open space acquisition and management plan*. Davis, CA.

City of Davis, Public Works Department and Bicycle Advisory Commission. (2006). *City of davis comprehensive bicycle plan*. Davis, CA.

City of Davis. (2007). *General plan*. Davis, CA.

City of Davis. (2008). *Stormwater manual of quality control standards for new development and redevelopment*. Davis, CA.

City of Davis. (2008). *Community needs assessment*. Davis, CA.

City of Davis. (2008). *Environmental scan*. Davis, CA.

City of Davis. (2009). *Residential Development Status Report*. Davis, CA.

City of San Luis Obispo. (2008). *General Plan*. San Luis Obispo, CA.

Department of City Planning, New York City. (1993). *A greenway plan for new york city*.
New York, NY.

Federal Highway Administration. (2002). *Rails-with-trails: lessons learned*. Cambridge,
MA.

Federal Highway Administration. (2006). *Shared-Use path level of service calculator*.
McLean, VA.

Jones, Stan. (1989). *The davis greenway plan*. Davis, CA.

Office of Safety Research and Development Federal Highway Administration. (2006).
Shared-use path level of service calculator—a user's guide. Washington, DC.

Portland Parks & Recreation. (2006). *Recreational trails strategy*. Portland, OR.

Portland Parks & Recreation. (2009). *Trail design guidelines for portland's park system*.
Portland, OR.

Safe Routes to School. (2007). *Safe routes to school guide*. Retrieved from
<http://www.saferoutesinfo.org/guide/pdfs.cfm>

State of California, Department of Finance. (2007). *Population Projections for California
and Its Counties 2000-2050*. Sacramento, CA. Retrieved from
<http://www.dof.ca.gov/research/demographic/reports/projections/p-1/>

State of California, Department of Finance. (2009). *E-5 population and housing estimates for cities, counties and the state, 2001-2009, with 2000 benchmark*. Sacramento, CA.

State of California, Governor's Office of Planning and Research. (2003). *General plan guidelines*. Sacramento, CA.

Transportation Research Board. (2000). *Highway capacity manual 2000*. Washington, DC.

University of California, Davis. (1999). *Arboretum waterway improvement plan*. Davis, CA.

University of California, Davis. (2009). *News & information: UC Davis facts*. Retrieved from http://facts.ucdavis.edu/student_population_headcount_fall.lasso

U.S. Census Bureau. (2000). *Census 2000 summary file 1 (SF 1) 100-percent data*. Washington, DC.

U.S. Census Bureau. (2000). *Census 2000 summary file 3 (SF 3) sample data*. Washington, DC.

Appendix A: Background Research

A.1 Greenbelt User Characteristics

Background research found that greenbelt users vary drastically depending on their mode of transportation. Pedestrians, those in wheelchairs, and runners generally

travel at low speeds, while bicyclists and small wheel vehicles (scooters, skateboards, and roller skates) generally travel at higher rates of speed. Users also need different pavement types; wheeled vehicles need paved surfaces, while pedestrians and runners generally do not. Table A.0 shows the general greenbelt user characteristics.

Table A.0: Greenbelt User Characteristics

Greenbelt User Characteristics				
	Pedestrians	Runners	Bicyclists	Wheelchairs /Small Wheel Vehicles
Speed	3.4 mph	6.5 mph	12.8 mph	1 mph/10.1mph
Surface Needed	Any	Dirt/Unpaved	Pavement	Smooth Pavement
Passing Space	4.67 feet	5 feet	8 feet	5 feet
Other Design Characteristics	Can easily stop and turn	Need soft surface	Wide range of capabilities	Need shallow grades and smooth pavement.

Source: FHWA Shared-Use Path Level of Service Calculator

Pedestrians

Pedestrians encompass a wide range of users, and there is no single “design pedestrian.” Pedestrians range from quick and nimble young adults, to slower seniors and children. According to American Association of State Highway and Transportation Officials (AASHTO), pedestrian walking speeds range from approximately 2.5 to 6.0 ft/sec (AASHTO, 2004, p. 10). The Federal Highway Administration’s (FHWA) *Shared Use Path Level of Service Calculator* found an average speed of 3.4 mph for pedestrians (FHWA, 2006, p. 10). Design speeds should match the population that will be using the facility, and slower design speeds should be used where there are high children or elderly populations (2004, p. 10).

While pedestrians are unique because they can stop and turn in place, designing for pedestrians' spatial needs is important so they have room to pass each other and space to see the path they are walking along. Passing pedestrians generally need a pathway with a width of 4.67 feet (2004, p. 11). The space needed by pedestrians is represented visually in Figure A.0. These spatial bubbles show that people need more space when they are walking for recreation in comparison to a public event where many people are present. This shows that people like their privacy when recreating or walking for relaxation.

Figure A.0: Spatial Bubbles

Source: AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2004, pp. 11

Runners

Runners are similar to pedestrians because they can stop and turn in place, but they travel at higher rates of speed and require softer surfaces. According to the *Shared-Use Path Level of Service Calculator*, the average speed for runners is 6.5 mph (FHWA, 2006, p. 10). Runners desire softer surfaces than pedestrians because running is a high impact sport. Therefore, dirt trails or unpaved surfaces are preferred by runners.

Bicyclists

Bicyclists are another greenbelt user group that has a wide range of abilities and skill levels. Unlike pedestrians, bicyclists have the ability to travel at higher speeds, and bicyclists need space to stop and turn. According to the *Shared-Use Path Level of Service Calculator*, the average speed is 12.8 mph for an adult bicyclist and 7.9 mph for a child bicyclist on a shared-use path (FHWA, 2006, p. 10). A bicyclist needs 40 inches of width

and 100 inches of height based exclusively on their profile. Therefore, four feet is the minimum design width for bicycle facilities (AASHTO, 1999, p. 5).

The skill level of bicyclists varies from riders who are comfortable riding in any conditions to children with limited bike handling skills or traffic sense. The FHWA differentiates bicycle users by type; the user types include advanced or experienced riders, basic or less confident adult riders, and children riders. Advanced riders want direct access to destinations and are bicycling for convenience and speed. Advanced riders are comfortable riding with motor vehicle traffic, and use their bicycles as they would a motor vehicle. Basic riders use their bicycles for transportation, but prefer using neighborhood streets, shared use paths, and bike lanes because they are less comfortable riding with traffic. Children riders generally do not travel as far as adults, but still need access to key destinations. Residential streets and shared use paths are facilities that can accommodate children bicyclists. (1999, p. 6)

Wheelchairs and Small Wheel Vehicles

Wheelchairs and small wheel vehicles (scooters, skateboards, roller skates, and in-line skates) are the most varied of greenbelt users. However, these users require the most consistent infrastructure. Uneven pavement makes travel extremely difficult for these users, and steep grades are difficult to navigate for them. Wheelchair users also need a wider space to pass each other than pedestrians do; two people in wheelchairs need a minimum of 5 feet to pass (AASHTO, 2004, p. 11). Speed variances are drastic between wheelchair users and in-line skaters. Wheelchairs average about 1 mph, and in-line skaters average approximately 10.1 mph (FHWA, 2006, p.10; ADA, 1994, p. 567).

A.2 Design Standards and Guidelines

State and Federal

Office of Planning and Research (OPR) General Plan Guidelines:

The California Governor's Office of Planning and Research (OPR) assists local governments in developing general plans by preparing guidelines. While the OPR *General Plan Guidelines* is written for developing general plans, it is also useful for planning greenbelts which do not have specific guidelines. The *General Plan Guidelines* state that particular information needs to be written in a city's General Plan.

The OPR *General Plan Guidelines* state that the Open Space element must mention possible connections between major recreational spaces and open-spaces; some of these include utility easements, riverbanks, and trails. The OPR *General Plan Guidelines* also states that the general plan should address:

- “demands for trail-oriented recreational use,” (OPR, 2003, p.83)
- “retention of all publicly owned corridors for future use (e.g., abandoned rail lines, utility corridors, easements, etc.),” (2003, p.83)
- “inventory recreational trails and areas and assess the demand for them” (2003, p.85)
- “integration of local trails with state and federal trail systems” (2003, p.86)

The OPR Guidelines also suggest that the Circulation element assess existing bicycle and pedestrian routes, and mention where new routes are needed. (2003, p.59)

American Association of State Highway Officials' (AASHTO's) Guide for the Development of Bicycle Facilities (GDBF):

AASHTO's GDBF describes the minimum design standards for various bicycle facilities used throughout the nation. The three facilities covered are signed shared roadways, bike lanes, and shared use paths.

Signed shared roadways (Caltrans facilities Class III) are routes that are identified and signed as preferred bike routes. They are safe and common routes used by bicyclists, and connect to bike lanes and shared use paths. While they do not have marked lanes, they should be given priority by responsible agencies and provide better routes than alternative roads. Some features that can make bike routes better alternatives include: providing direct access to common destinations, adjusting traffic control devices to favor bicyclists, removing street parking where necessary, maintaining and providing smooth surfaces for bicyclists, and creating wider shoulders than on nearby roads (AASHTO, 1999, p. 19).

Bike lanes (Caltrans facilities Class II) are lanes that are signed and marked on the roadways as a designated lane for bicyclists. The width of bike lanes should be a minimum of 4 feet when there is no parking allowed. The minimum width of bike lanes should be increased to 5 feet if parking is allowed. The bicycle lane should always be directly next to the travel lane. Bicyclists tend to ride approximately 32 to 40 inches from the curb face, and obstacles and debris should be cleared from this area. Bicycle lanes should be widened if obstacles, such as drain grates, are present within the bike lane. In addition to a marked lane, bicycle lanes should provide all of the amenities and considerations of a bicycle route (1999, p. 22)

Shared use paths (Caltrans facilities Class I) are physically separated from motor vehicle traffic, and have minimal crossings with motor vehicle traffic. These paths are for non-motorized modes of transportation, and are commonly designed for two-way travel. Shared use paths serve as connections between land uses, and also as recreational facilities. Shared-use paths should not be placed adjacent to roadways because it causes people to ride against traffic, and it creates more areas for motorized vehicle and bicycle conflict. If a shared use path must be constructed near an existing road, a separation of 5 feet should exist between the shared use path and the road. If there is not room for a 5 feet gap, a barrier with a minimum height of 42 inches should be constructed between the shared use path and the road (1999, p. 33).

The width of shared use paths should be at least 10 feet; although, 8 foot wide paths are acceptable if bicycle and pedestrian traffic is low. Where heavy traffic exists on paths, 12 or 14 foot paths may be necessary to accommodate all users. Shared use paths must also have clearance from vegetation poles, walls or other obstructions on both sides of the trail. A minimum clearance of 2 feet is required, but 3 feet is recommended. The slope within the cleared areas should be a maximum of 1:6. If slopes next to the paths exceed 1:3, a minimum of 5 feet of clearance is recommended. Shared use paths must also have a minimum of 8 feet vertical clearance for users and 10 feet minimum clearance for maintenance vehicles (1999, p. 33).

California Manual on Uniform Traffic Control Devices (MUTCD):

The California *MUTCD* (*MUTCD*) is similar to the FHWA's *MUTCD*, but it is designed specifically for California by Caltrans. The *MUTCD* explains which types of

signs and pavement markings are allowed for use in California, and it explains how and where signs and markings shall be placed. Chapter 9 explains, “signs, pavement markings, and highway traffic signals specifically related to bicycle operation on both roadways and shared-use paths” (Caltrans, 2006, p. 9A-1).

The *MUTCD* also explains that all signs, signals, and markings should be maintained to, “command respect from both the motorist and the bicyclist,” and that, “an agency should be designated to maintain these devices.” (2006, p. 9A-2) The signs used to mark bicycle facilities should be standard signs, with proper shape, legend, and color. Signs should also be retro-reflective to be more visible at night.

The *MUTCD* has specific sign and marking requirements for shared-use paths. Signs for shared-use paths need to be a minimum of 3 feet and a maximum of 5 feet from the pavement edge. These signs also need to be a minimum of 4 feet and a maximum of 5 feet in height. Popular signs used for shared use paths include, “No Motor Vehicles,” “No Bicycles,” “Shared-use Path Restriction Sign,” turn and curve warning signs, “Intersection Warning signs,” “Bicycle Surface Condition Warning,” “Bicycle Warning,” and other signs informing pedestrians, bicyclists, and motorists about shared-use paths. A yellow line can be used to designate travel directions; solid lines and broken lines should be used respectively for non-passing zones and passing zones. Broken lines should have 3 foot stripes with 9 foot gaps (2006, p. 9C-1). Typical signs and markings used for shared-use paths are shown in Figure A.1.

Figure A.1: Typical Shared-Use Path Signs and Markings

Source: California MUTCD, 1996

The *MUTCD* also has sign and marking requirements for bike lanes. These standards include placing “Bike Lane” signs at the beginning of each lane and at each place the bike lane changes direction. Signs should also be placed every half mile along the bike lane. “Wrong Way” bicycle signs may also be used on the opposite side of bike lane signs to direct bicyclists to the correct side of the road. These signs may be supplemented with “Ride With Traffic” signs. A solid white stripe should be used to designate a bike lane. The white stripe should be dashed within 100 feet of an intersection with blocks of less than 400 feet, and should be dashed within 200 feet of an intersection when speeds are higher than 35mph (2006, p. 9C-4). Typical signs and markings used for bike lanes are shown in Figure A.2.

Figure A.2: Typical Bike Lane Signs and Markings

Source: California MUTCD1996

Sign and marking requirements are also designated for bike routes by the *MUTCD*. Bicycle routes should be green in color, and have a route designation. Directional arrows may also be used below bike route signs to guide bicyclists. Shared roadway markings or “sharrows” may be used on bike routes with parallel parking. These markings should be placed a minimum of 11 feet from edge of the paved road (2006, 9C-5). Typical signs and markings, including the “sharrow” pavement marking, used for bike routes are shown in Figure A.3.

Figure A.3: Typical Bike Routes Signs and Markings

Source: California MUTCD1996

Rails-With-Trails: Lessons Learned:

Rails-With-Trails (RWT), which are different than Rails-to-Trails, are shared-use paths constructed on functioning railroad corridors. There are no existing standards for RWTs, but *Rails-With-Trails: Lessons Learned* analyzes 21 existing RWTs. The document provides design suggestions, but explains that RWTs design guidance should

be gained from other design standards related to RWTs. The suggestions in *Rails-With-Trails: Lessons Learned* include: maximizing setback between trails and railroad tracks, providing fencing where heavy trespassing occurs, and minimizing the number of at-grade crossings.

The report found that the trails studied had a train frequency of 1 to 9 trains per hour for 25 percent of the trails, 1 to 16 trains per day for 55 percent of the trails, 1 to 4 trains per week for 13 percent of the trails, and an unknown frequency for 7 percent of the trails. The widths of corridors studied were 0 to 60 feet for 30 percent of the trails, 61 to 100 feet for 25 percent of the trails, over 100 feet for 25 percent of the trails, and unknown for 20 percent of the trails. The RWTs studied had an average corridor width of 126 feet and an average trail width of 8 to 10 feet (FHWA, 2002, p. 57).

Safe Routes to School:

The National Safe Routes to School Program is funded by the Federal Highway Administration, and is an organization promoting walking and bicycling to school. The program emphasizes four focus areas. These include: education, encouragement, enforcement, and engineering. Engineering is pertinent to greenbelt planning and design because greenbelts play a vital role in safe routes to school (Safe Routes to School, 2007, p. 1-13). Pedestrian and bicycling infrastructure must be in place before students and parents will feel comfortable walking and cycling to school according to the *Safe Routes to School Guide* (Safe Routes to School, 2007, p. 3-2).

Three design features which are important for promoting walking and biking to school include: maps, paths, and universal design. School route maps show students the

safest way to walk and bike to school, and guide students to areas where walking and bicycling infrastructure is best (2007, p. 3-8). Paths can provide shorter links to schools and create a more relaxing environment for children (2007, 3-34). Universal design provides routes that all users, including persons with a disability, can use to travel to school (2007, 3-20).

Americans with Disabilities Act:

The *Americans with Disabilities Act (ADA) Standards for Accessible Design* lays out specific design standards for accessible design. These standards include specific widths and grades needed by wheelchair users. According to the ADA, 5 feet is needed for two wheelchair users to pass, and 4 feet is needed for one wheelchair user and one pedestrian to pass. Wheelchair users also need a minimum of 5 feet by 5 feet to turn in place. Slopes that are to be used by wheelchair users should be a maximum of 1:16 and preferably 1:20 (ADA, 1994, p.570).

City of Davis

General Plan:

The City of Davis *General Plan* is the overarching planning document for the city. All other planning documents must be consistent with the *General Plan*, and the *Greenbelt Master Plan* (GMP) will be consistent with the *General Plan*. The *General Plan* contains greenbelt development standards, greenbelt design standards, and stormwater management standards.

The City of Davis has a number of development standards to meet Section V Chapter 9 Goal POS 3. The standards indicate greenbelt placement should be located near high density residential areas with limited greenbelt access. The standards include:

- *New residential development areas should be oriented around the greenbelt system.*
- *The location and design of greenbelts may be used to provide a buffer between disparate land uses.*
- *Some areas in greenbelts should be located in close proximity to the highest density residential development in an area, when possible.*
- *Provide convenient greenbelt access points in all new development.*
- *New greenbelt links should be created in places where access to the existing greenbelt/bikeway system is currently lacking (City of Davis, 2007, p. 246).*

The City of Davis also has greenbelt design standards to meet Section V Chapter 9 Goal POS 3. These standards indicate how greenbelts should be developed. The standards indicate the size of greenbelts, how they should look, and what type of landscape features they should include, such as:

- *Ten percent of the area in new residential development areas shall be greenbelt. The City may find developments to be in conformance with this requirement if they provide dedicated open space in keeping with Standard POS 6.2a, or in-lieu fees to be used for greenbelt acquisition or improvement*

- *Greenbelts should serve as a visually unifying landscape element.*
- *Greenbelts should provide view corridors to points of orientation throughout the City; both for local, short range views to local landmarks, and long range views such as views to the Vaca Hills, Sutter Buttes and Sierra Nevada range.*
- *Greenbelts should be sited where feasible and appropriate to incorporate existing riparian or other wildlife or botanical habitat areas.*
- *Greenbelts should vary from a minimum width of 35 feet to an average width of 100feet (2007, p. 246).*

Greenbelts are also coupled with stormwater management in various chapters of Section V. These standards indicate how greenbelts should accommodate stormwater drainage and be used as flood retention and detention systems. The standards include:

Section V Chapter 9 Goal POS 3.

- *Greenbelts should be located and designed to accommodate the management of stormwater drainage (2007, p. 246).*

Section V Chapter 6 Policy Water 3.1.

- *Flood retention and detention facilities should be integrated with parks, athletic fields and natural areas.*
- *Prepare management plans for storm drains and channels that stress recreation, long-term landscape maintenance and wildlife habitat (2007, p. 212).*

Section V Chapter 6 Policy Water 3.2

- *All new development shall include drainage facilities that are designed to accommodate a minimum of a 10-year recurrence design flow. In addition, all new development shall route the 100-year recurrence event and appropriately mitigate for both the increase in flows from the site due to development, and for runoff volumes which have historically occurred on the site. Storm drainage facilities with open, naturalistic channels are encouraged, where feasible. Such facilities can minimize impacts on the city's system, add to the water table, and provide an open space amenity, although long term maintenance costs must be considered. In addition, properly designed plantings within and adjacent to drainage facilities can serve to treat urban runoff, reducing downstream impacts.*
- *New development's detention and retention facilities shall be designed so as not to cause significant negative impact to other drainage facilities in the watershed.*
- *Implement on-site storm drainage treatment facilities in City projects wherever feasible.*
- *Operate City storm drainage treatment facilities as demonstration projects, and include long term water quality monitoring (2007, p. 213).*

Davis Greenway Plan:

The *Davis Greenway Plan* was designed as a concept plan in 1987 by Mark Francis who was the Professor and Director of the Center for Design Research at UC Davis. The *Davis Greenway Plan* was completed in 1989 as Stan Jones's thesis in

Landscape Architecture at UC Davis. In 1991, the *Davis Greenway Concept* was adopted by the City of Davis as the Open Space Element of the General Plan. The plan is also incorporated into the existing *General Plan*, and is the framework for much of the greenbelt planning in Davis.

The *Davis Greenway Plan Report* divides the greenway system into four parts; these include: greenstreets, a green ring, connector greenways, and natural habitat areas. Greenstreets are described as tree-lined streets with bike lanes. The green ring is described as a ring of open space around the city that will provide hiking and biking trails, drainage swales, and wildlife habitat. Connector greenways are described as strips of open space along corridors that connect Davis to other cities. Natural habitat areas are large areas of land that have sensitive habitat, and may be used for hiking and nature viewing. This system of greenways was envisioned to create a hub, spoke, and rim of greenways through Davis, which would offer all residents access to greenways (Jones, 1989).

Comprehensive Bicycle Plan:

The *Comprehensive Bicycle Plan (CBP)* guides bicycle education, enforcement, engineering, and encouragement for the City of Davis. The *Greenbelt Master Plan (GMP)* is consistent with the *CBP* because greenbelts are an integral part of bicycle facilities in Davis.

The *CBP* has multiple goals, objectives, and design guidelines which are used in this document. The four focus areas are engineering, education, enforcement, and

encouragement. This plan will only cover the engineering section of the *CBP* because the other three focus areas are out of the scope of the *GMP*. The engineering goals and objectives relevant to greenbelts include:

- *GOAL: Provide bike lanes along all arterial and collector streets. Provide separated bike paths adjacent to arterial and collector streets only where justified, with full consideration of potential safety problems this type of facility can create (City of Davis, 2006, p. 9).*
- *Objective: Develop standards to be used for planning decisions on where to place pathways adjacent to arterials. Issues such as speed and volume of motor vehicles, number of driveways and other curb cuts, and the age and skill level of the bicycle driver shall be considered (2006, p. 9).*
- *GOAL: Ensure that bicycle routing is an integral part of street design so that lanes and pathways form an integrated network (2006, p. 9).*
- *Objective: Identify weak links and discontinuities in the existing network, and develop a plan for prioritizing and funding solutions (2006, p. 9).*
- *GOAL: Provide adequate bike parking (2006, p. 10).*
- *GOAL: Design bike routes as integral parts of new greenways, open space areas (where appropriate) and "greenstreets" to complete and expand the existing bikeway system (2006, p. 11).*

- *Objective: Develop criteria for bicycle access to open space areas preserved outside the city limits. The criteria should be available for open space plan consultants (2006, p. 11).*
- *Objective: Adopt standards for the mixed use of off-street routes by bicyclists, pedestrians, equestrians, skaters and persons with disabilities (2006, p. 11).*
- *GOAL: Plan bikeways to provide attractive, shaded linkages between destinations (2006, p.11).*
- *Objective: Explore alternative street cross-sections for collectors and minor arterials that will result in more shaded bike lanes (2006, p. 11).*
- *GOAL: Maintain roadways and bicycle related facilities so they provide safe and comfortable conditions for the bike driver (2006, p. 11).*
- *Objective: Complete efforts to establish a routine inspection program for all Class I facilities (2006, p. 11).*
- *GOAL: Design bicycle facilities to minimize maintenance costs by specifying quality materials and standard products (2006, p. 12).*

The CBP also calls out a specific request for the General Plan to update its policy regarding greenbelts and bikeways. The request states:

Require compliance with bikeway policies and standards for new development including bikeways within greenbelts. Ensure interconnection of new facilities with the existing bikeway system (2006, p. 5).

The CBP includes design standards for bicycling infrastructure. Many of these design standards are more stringent than the state standards. The CBP has standards

regarding speed, grades, over and undercrossings, and cross sections. The design speed for bikeways is 20 MPH in most areas, and 30 MPH where grades exceed 4%. The grade recommended for bikeways is less than 2% so that a wide range of riders can be accommodated (2006, p. 17). Grade separated crossings are ideal for bike paths that cross arterial streets and highways; lighted undercrossings with grades of less than 5% are better than overcrossings (2006, p. 18). Figure A.3 shows the recommended cross sections for bicycle facilities in Davis, but state standards should be the absolute minimum standards if city standards cannot be met.

Figure A.3: City of Davis Cross Sections

Source: City of Davis, 2006, p. 22a

The *CBP* also has design guidelines regarding intersections, bike lanes, bike paths, alternative routes, and parking. Davis's design standards recommend installing

bicycle loop detectors at intersections, and note that overpasses and underpasses do not work well at intersections. Bike lane requirements in Davis require a minimum of 7' when no parking is present and 8' where parking is present. Bike path design in Davis recommends minimizing the number of driveways that cross bike paths due to their intersection characteristics. Alternative routes are suggested by the *CBP* to accommodate all types of bicyclists. Bicycle parking in Davis needs to match the land use and location of the site the parking is for. All bicycle parking should allow common bike locks to work, should be illuminated at night, should be as or more convenient than motor vehicle parking, should equal at least 30% of available motor vehicle spaces, and should, if possible, be sheltered (2006, p. 19-22).

Finally, the *CBP* recommends that bicycle routes be coordinated with rest facilities and other transportation modes. Rest facilities include areas where cyclists can eat, fill up their water bottles, and air up their tires. Other transportation modes include bus and rail. Therefore, bus stops and rail stops should be linked to bicycle parking and bicycle routes (2006, p. 22).

Parks and Recreation Facilities Master Plan:

The *Parks and Recreation Facilities Master Plan (PRFMP)* is the primary planning document for park and recreational facilities in the city. The *Greenbelt Master Plan* is a recreational facility, and, therefore, is consistent with the *PRFMP*. The 1998 *PRFMP* mentioned greenbelt availability. The *PRFMP* acknowledged that there was 349.8 acres of greenbelts and open space in Davis, which resulted in 6.7 acres of greenbelt and open space per 1,000 residents. However, no standards were created for

greenbelts. The *PRFMP* is being updated as of 2009, and more emphasis is being placed on greenbelts (City of Davis, 1998).

Open Space Acquisition and Management Plan:

The *Open Space Acquisition and Management Plan (OSAMP)* provides the framework for how open space protection and stewardship goals are achieved in Davis. According to the *OSAMP*, the state defines open space land as, “any parcel or area of land or water which is essentially unimproved and devoted to an open space use...” (City of Davis, 2002, p. 6).

The *OSAMP* has two guiding principles. The first is that Davis only acquires open space from willing sellers. The second is that open space must be located within the Davis Planning Area Boundary.

The *OSAMP* has several goals, policies, and practices that relate to greenbelts.

- *Goal: Protect the maximum feasible area of important strategically located open space within the Davis Planning Area. Importance is determined by the extent to which parcels help meet other goals (2002, p. 8).*
- *Policy: Acquire lands that facilitate the protection of other open space lands in the same area through interruption of sprawl, establishing linkages, buffering, and aggregation of protected open space lands (2002, p. 8).*

- *Goal: Acquire open space within each of the following acquisition categories: Urban Fringe, Community Separator, Agriculture, Biological and Natural Resources, and Scenic Resources.*
 - *Scenic Resources: Protect views of significant landmarks and community gateways (2002, p. 9).*
- *Goal: Provide management of open space lands and resources that are owned or otherwise protected by the City in a manner consistent with the identified reason(s) why the site was originally acquired (2002, p. 10).*
- *Policy: Allow public access only where it is consistent with the resource protection goals for a site.*
- *Policy: Where public access is appropriate, minimize evidence of human use and impacts through site design, use regulations, and visitor education.*
- *Policy: Coordinate with local landowners and farmers to minimize the occurrence of trespass and related impacts on private lands (2002, p. 11).*

Other Local Plans:

The primary plans relating to greenbelts were covered before, but there are more documents that relate to planning in Davis. These plans are not closely related to greenbelts, and will not be discussed. However, they do offer detailed information pertaining to their topic. These plans include:

- *Core Area Specific Plan*
- *Gateway/Olive Drive Specific Plan*

- *East Davis Specific Plan*
- *South Davis Specific Plan*
- *Alternative Transportation Task Force*
- *University of California, DAVIS PLAN*
- *Yolo County Bicycle Transportation Plan*

A.3 Level of Service (LOS) and Capacity Measurements

Shared –Use Path Level of Service Calculator-A User’s Guide

The FHWA *Shared-Use Path Level of Service Calculator- A User’s Guide* (*SUPLOS*) is a tool used by planners and transportation engineers. The calculator can be used for shared use paths on rail-trails, greenway trails, linear parks, waterfront paths, and side-paths along road corridors. The *SUPLOS* calculates LOS by using an existing or proposed trail volume, trail width, presence of a centerline, and mode split. The five modes included in this LOS analysis include: adult bicyclists, pedestrians, runners, in-line skaters, and child bicyclists. These inputs are used to measure the capacity of the trail. The measurement uses an A through F grading system, with A being excellent and F being failing. A detailed description of various grades is shown in Table A.1.

Table A.1: Shared Use Path Level of Service Chart

Shared Use Path Level of Service		
Grade	LOS Score	Description
A	$X \geq 4.0$	Excellent. Trail has optimum conditions for individual bicyclists and retains ample space to absorb more users of all modes, while providing a high-quality user experience. Some newly built trails will provide grade-A service until they have been discovered or until their ridership builds up to projected levels.
B	$3.5 \leq X < 4.0$	Good. Trail has good bicycling conditions, and retains significant room to absorb more users, while maintaining an ability to provide a high-quality user experience.
C	$3.0 \leq X < 3.5$	Fair. Trail has at least minimum width to meet current demand and to provide basic service to bicyclists. A modest level of additional capacity is available for bicyclists and skaters; however more pedestrians, runners, or other slow-moving users will begin to diminish LOS for bicyclists.
D	$2.5 \leq X < 3.0$	Poor. Trail is nearing its functional capacity given its width, volume, and mode split. Peak-period travel speeds are likely to be reduced by levels of crowding. The addition of more users of any mode will result in significant service degradation. Some bicyclists and skaters are likely to adjust their experience expectations or to avoid peak-period use.
E	$2.0 \leq X < 2.5$	Very Poor. Given trail width, volume, and user mix, the trail has reached its functional capacity. Peak-period travel speeds are likely to be reduced by levels of crowding. The trail may enjoy strong community support because of its high usage rate; however, many bicyclists and skaters are likely to adjust their experience expectations, or to avoid peak-period use.
F	$X < 2.0$	Failing. Trail significantly diminishes the experience for at least one, and most likely for all user groups. It does not effectively serve most bicyclists; significant user conflicts should be expected.

Source: FHWA LOS Calculator

Highway Capacity Manual (HCM)

The *HCM* is a quantity of service measurement tool for transportation engineers and planners. The manual explains how Level of Service (LOS) and capacities for bicycle and pedestrian facilities can be measured and assessed; the *HCM* provides information on facilities that are relevant to greenbelts including: shared use path facilities, on-street bicycle lanes, and walkways (TRB, 2000, p. 19-3).

The *HCM* provides LOS calculations for shared off-street paths with use by multiple non-motorized modes of transportation. The methodology accounts for the flow rate of pedestrians, the flow rate of bicycles, the flow rate of pedestrians in the opposing direction, and the flow rate of bicycles in the opposite direction. The methodology also takes into account if the path is 8 feet wide or 10 feet wide (2000, p. 19-4). An A through F grading system rates LOS from excellent to poor operating conditions; the factors used for grading shared use paths can be found in Table A.2.

Table A.2: HCM Shared Use Path LOS Chart

LOS Criteria for Shared Off-Street Paths	
LOS	Frequency of Events, 10-ft wide paths (events/h)
A	≤90
B	>90-140
C	>140-210
D	>210-300
E	>300-375
F	>375

Source: Transportation Research Board HCM 2000, p. 19-4

LOS calculations for bike lanes are also provided by the *HCM*. The methodology also calculates LOS based on the number of conflicting events. The variables for bike lane LOS calculations include: bicycles per hour, standard deviation of travel speed by bicyclists, and the mean bicycle speed (2000, p. 19-5). The number of conflicting events can be calculated using Table A.3 below. An A through F grading system rates LOS from excellent to poor operating conditions; the factors used for grading bike lanes can be found in Table A.4.

Table A.3: HCM Bicycle Lane Events Chart

Effect of Bicycle Mean and Standard Deviation of Speeds on Events for One-way on-street Bicycle Facilities										
Bicycle Flow Rate (Bicycles/h)	Standard Deviation (mi/h)	Bicycle Mean Speed (mi/hr)								
		7.5	8.1	8.7	9.3	9.9	10.6	11.2	11.8	12.4
100	0.9	14	13	12	11	10	10	9	9	8
	1.9	29	26	25	23	22	20	19	18	17
	2.8	42	39	36	34	32	30	28	27	25
200	0.9	27	25	23	22	21	19	18	17	16
	1.9	57	53	49	46	43	40	38	36	35
	2.8	84	78	73	68	64	60	56	54	51
300	0.9	41	38	35	33	31	29	27	26	25
	1.9	86	79	74	69	65	61	57	55	52
	2.8	126	117	109	102	96	89	85	80	76

Source: Transportation Research Board HCM 2000, p. 19-5

Table A.4: HCM Bicycle Lane LOS Chart

LOS Criteria for Bicycle Lanes	
LOS	Frequency of Events, (events/h)
A	≤40
B	>40-60
C	>60-100
D	>100-150
E	>150-195
F	>195

Source: Transportation Research Board HCM 2000, p. 19-3

Pedestrian walkway LOS calculations are provided by the *HCM* as well. Space is the primary factor that affects walkway LOS. The variables that impact walkway LOS are walkway width and pedestrian flow rate (2000, p. 18-4). An A through F grading system rates LOS from excellent to poor operating conditions; the factors used for grading walkways can be found in Table A.5.

Table A.5: HCM Walkways and Sidewalks LOS Chart

Average Flow LOS Criteria for Walkways and Sidewalks				
LOS	Space(ft ² /p)	Flow Rate (p/min/ft)	Speed (ft/s)	v/c Ratio
A	>60	≤5	>4.25	≤0.21
B	>40-60	>5-7	>4.17-4.25	>0.21-0.31
C	>24-40	>7-10	>4.00-4.17	>0.31-0.44
D	>15-24	>10-15	>3.75-4.00	>0.44-0.65
E	>8-15	>15-23	>2.50-3.75	>0.65-1.0
F	≤8	variable	≤2.50	variable

Source: Transportation Research Board HCM 2000, p. 18-4

A.4 Case Studies

Davis has an extensive greenbelt system with numerous design standards and guidelines. To improve Davis's already excellent greenbelt network, it is imperative for Davis to study other greenbelt systems throughout the United States. The following

section reviews three cities that have admirable greenbelt systems, and summarizes some of their key characteristics.

Portland, Oregon

Like the City of Davis, the City of Portland, Oregon is a bicycle friendly community with an extensive greenbelt system. Portland, OR, Boulder, CO, and Davis, CA are the only cities designated platinum level bicycle cities by the League of American Bicyclists. However, Portland is a much larger city than Davis, and had a population of 529,025 as of 2000. While Davis is not likely to have as many trails and greenbelts as Portland, Portland does offer an example of various greenbelt ideas. Portland can also provide a comparison for the City of Davis as to the amount of greenbelt space provided for every 1,000 residents.

According to Portland's *2006 Recreational Trails Strategy*, Portland is 68 miles shy of completing its 220 mile network of regional recreational trails (City of Portland, 2006, p. 1). These trails are divided into three categories: regional trails, community connectors, and local access trails.

- *Regional trails* connect to nearby communities and major natural features such as rivers and streams. These trails can be composed of a two foot wide soil surface or 14' wide concrete surfaces (there is no standard).
- *Community connectors* link popular land uses, and are often found within a neighborhood using street rights-of-way.

- *Local access trails* connect local features such as parks, community centers, and schools; Portland has 80 miles of paths in developed parks and nearly 60 miles of trail in natural areas (2006, p.11).

While Portland does not have design standards, it does have design guidelines in the *Trail Design Guidelines for Portland's Park System*. Guidelines are used because of the wide range of trail types that Portland offers. Portland has four main goals for trail design; these include: safety, connectivity, context, and diversity.

- *Safety* is the first goal for trail design in Portland. To design a safe trail, the guidelines recommend: (1) separating trails from vehicles; (2) minimize vehicle crossings of trail; (3) if trail must co-exist with road then choose route with lower speeds and volumes; and visibility and crime prevention should be designed in all settings.
- *Connectivity* is the second goal for trail design. Emphasis is placed on connectivity because longer trails are increasingly useful to commuters and exercisers. Numerous access points to bicycle and pedestrian networks are important for connecting various transportation infrastructure.
- *Context* is the third goal, and is aimed at shaping the trail to meet the opportunities and constraints of the surrounding area.
- *Diversity* is the final goal, and is intended to include all age groups and user types (including those with disabilities) in the design of trails. Therefore, different trails should be designed to meet different users' needs (City of Portland, 2009, p. 3).

Portland's trails are very popular and a Portland Parks & Recreation survey found that in 2004 77 percent of residents used trails each year, and 50 percent used trails monthly. Furthermore, 74 percent of respondents were satisfied with the quality and quantity of trails. A survey completed by the Oregon Parks and Recreation Department found that hiking and running or walking for pleasure were the most common activities on trails. Bicycling was the third most popular activity (2006, p. 2).

San Luis Obispo, California

San Luis Obispo (SLO) is another city with an extensive greenbelt system. Like Davis, it is a university town, and has a similar population of 44,174 residents as of 2000 (U.S. Census Bureau, 2000). SLO's greenbelts offer trails for cyclists, nature viewers, hikers, runners, and outdoor enthusiasts. However, as mentioned before, SLO's greenbelt system differs from Davis's greenbelt system because SLO's greenbelts work as an open space buffer around the city, and do not interconnect through the city.

SLO's greenbelts have been created by the City of San Luis Obispo and the Land Conservancy of San Luis Obispo County as open space around the city. SLO's *General Plan* says that greenbelts should be used for, "...watershed; wildlife habitat; grazing; cultivated crops; and outdoor recreation..." (City of San Luis Obispo, 1994, p. 1-19). The greenbelt system offers large amounts of open space for residents, and is placed evenly around the city for easy access by residents in different parts of the city.

While SLO's greenbelts are designated as open space areas buffering the city, SLO does have small linear open space areas through the city. The San Luis Creek open

space is a linear parcel of open space running through the downtown of SLO. It allows residents access to the creek, and offers pleasant views for nearby shops and restaurants. The city also has the Railroad Safety trail which runs from the north side of the city, near the Cal Poly campus, to the south side of the city. Bike lanes connect to the trail, and there is also a bicycle boulevard which connects the downtown to the trail. A bicycle boulevard is a corridor where bicyclists and motorists share the same road, but motorists are diverted off of the boulevard to reduce the volume of motor vehicles. In addition to diverting motorized traffic, bicycle boulevards use traffic calming devices such as speed humps, traffic circles, and raised crosswalks to slow any remaining traffic on the boulevard. Bicycle boulevards are an excellent way to give bicyclists a safe and comfortable route while still allowing residents access to their homes.

Boulder, Colorado

Boulder is similar to Davis, in regards to greenbelts, because it is a university town with a large cycling population; Boulder also has an extensive greenbelt system. Boulder has a population that is roughly 50% larger than Davis, with 94,673 residents as of 2000. Boulder is in a mountainous area, with a large greenbelt surrounding the city. Boulder also has a number of greenways (similar to Davis greenbelts) that traverse through the city, and has a *Greenways Master Plan* to help guide development.

As of the 2001 *Greenways Master Plan*, there were 47 miles of multi-use paths, and 17 miles of these were along greenways (City of Boulder, 2001, p. 160). Moreover, there are 74 existing bicycle underpasses (Go Boulder, 2010). Just as in Davis, there are a large number of multi-use paths on the periphery of Boulder, and not many running

through the downtown. There is an extensive bike lane network in the downtown to connect the multi-use paths on the periphery of the city. In select areas of downtown there are contra flow bicycle lanes. Contra flow bicycle lanes allow bicycle traffic to flow in both directions on either side of the road, while limiting motor vehicle to flow in just one direction. Many of the multi-use paths throughout the city connect to the unpaved multi-use paths and hiking trails located in the greenbelt surrounding the city. This allows residents of Boulder to access open-space without using roads.

Boulder's greenways serve as riparian and wetland protection, water quality enhancement, storm drainage, alternative transportation routes, recreation, and protection of cultural resources. There are specific goals for each of the six greenway service areas. Riparian and wetland protection goals include: protecting areas with high habitat value and areas with endangered species, and restoring native species habitat. Water quality enhancement goals include: preserving and enhancing ecologically important areas and stream corridors function. Storm drainage goals include: minimizing flood hazards and storm drainage problems. Alternative transportation goals include: beautiful, well connected, well maintained, and well signed pedestrian and bicycle infrastructure. Recreation goals include: promoting health, strong communities, environmental stewardship, and youth development. Protection of cultural resources goals include: protecting and educating the public about historic and archeological resources (2001, 75).

Key Lessons Learned

Three case studies provide examples of how other cities develop greenbelts and greenways. Portland's community connectors are one example that Davis can use through

its developed area because these paths use existing street rights-of-way. Portland also offers two key goals that Davis can incorporate into their planning of greenbelts. These include connectivity and diversity. Many of the greenbelts in Davis are the same and do not have varied terrain for different users. Furthermore, many of Davis's greenbelts are not well connected. The biggest lesson Davis can learn from San Luis Obispo is to develop a ring of open space around the periphery of the town. This band allows San Luis Obispo to create many trails that would not be possible within more urban settings. Boulder and San Luis Obispo also offer two interesting bicycle facilities. Boulder has developed contra flow bicycle lanes and San Luis has developed a bicycle boulevard; both of which may be good ways to provide infrastructure for bicyclists and motor vehicles within a limited right-of-way.

Appendix B: Planning Process

B.1 Part 1: Background

The first part of the Greenbelt Master Plan is the background section, and is the exploration of Davis's existing greenbelt requirements, the examination of state and national guidelines, and the review of three other cities with greenbelt systems. The documents that are reviewed in this section include: the City of Davis's *General Plan*, *Comprehensive Bicycle Plan*, *Parks & Recreation Facilities Master Plan*, and *The Greenway Plan*. The goals, policies, standards, and regulations from these documents

have been used as the framework for the Greenbelt Master Plan. The *1999 American Association of State Highway and Transportation Officials Guide for the Development of Bicycle Facilities* and *California MUTCD* was also reviewed for greenbelt design ideas. The three cities that are analyzed include Portland, OR, San Luis Obispo, CA, and Boulder, CO. These cities were chosen for their extensive greenbelt systems, and because they are similar to the City of Davis in character or size.

B.2 Part 2: Research

The second part of the Greenbelt Master Plan is the discovery of current greenbelt usage in Davis. Some of this information was gathered from the current and previous Parks and Recreation Facilities Master Plans. Although these Master Plans had some information on greenbelt usage, their detail was not focused enough. They had information on the percentage of residents that used greenbelts, whether these residents found greenbelts important, and if the greenbelts needed improvement. However, they did not have information on how people used greenbelts (for walking, biking, rollerblading, etc.), why people used greenbelts (for commuting, recreation, etc.), or what greenbelts were in use.

This information was gathered in two ways.

- First, there was a community input meeting where Davis residents could express their views about greenbelts.
- Second, a survey was conducted to gather more detailed information. This was done using SurveyMonkey, which is a web based survey tool. The survey was available at the first meeting and was posted to the City of Davis website. There

was also a press release distributed to *The Davis Enterprise* to notify the public about the survey. The results were compiled to help explain how, why, and what greenbelts are being used in Davis.

B.3 Part 3: Capacity Analysis

The third part of this project determined existing greenbelt capacities. This project determined capacities based on the acreage of greenbelts per 1000 residents and the distance between residents and greenbelts. GIS was used to determine greenbelt acreage and the distance between residents and greenbelts. US Census data was used to determine the population.

Capacities were also be measured by calculating the Level of Service (LOS) for shared use paths. This measurement followed the guidelines of the *Shared Use Path Level of Service Calculator* which was published by the US Department of Transportation Federal Highway Administration. This tool measures capacity in LOS with a rating of A to F. A is designated as operating at a high LOS, and F is the designation for operation at a low LOS. The information needed to determine LOS for a shared use path was trail width, centerline presence, trail user volume, and trail user mix (mode split). New trail user volume data needed to be collected for a minimum of three, two-way, hourly counts. The LOS could also be calculated using estimates. To get accurate trail user volume data with a limited amount of resources, I conducted three, two-way hourly counts for three of the most popular greenbelts in Davis. The popularity was determined with the help of the Davis Parks and General Services Department and

Public Works Transportation Planners and Engineers. I used these volumes as a measure for all greenbelts in Davis. Once this data was collected, I calculated the LOS.

B.4 Part 4: Projections

The fourth part of my project forecasted future greenbelt usage by using population projections. By projecting future populations, I was able to estimate how many residents will use greenbelts in the future. I estimated the amount of greenbelt space needed based off of the amount of greenbelt users there will be in the future. The number of future greenbelt users was determined by using the same percentage of current greenbelt users as a fraction of total population.

B.5 Part 5: Alternatives

The fifth part of my project was the analysis of future greenbelt capacities. This was done by creating three greenbelt plans for Davis. The first plan showed greenbelts with no change in current infrastructure. The second plan showed greenbelts with moderate changes. The third plan showed greenbelts with extensive changes. The capacities were determined using the same calculations that were used for current greenbelt capacities. However, projected greenbelt usage numbers were used to calculate future capacities. These three plans also reflected residents input from the first community meeting and the survey. A map showing the greenbelt system for each scenario was developed, and used to show future greenbelt capacity.

B.6 Part 6: Final Plan

The final part of the project was the compilation of the previous steps. I held a second community meeting in which residents gave feedback on the plan they liked best from part five of my methodology. All of the information was gathered to compose a single, final plan. It is a unified document with a set of goals, objectives, policies, and standards for greenbelts. It also includes a map of where future greenbelts should go. The final product is a Greenbelt Master Plan for the City of Davis.

Appendix C: Existing Greenbelt Use and Capacities

This section describes the existing conditions of greenbelt infrastructure in Davis. The amount of greenbelt acreage, the type of greenbelts available, the capacity of current greenbelts, and the community's thoughts about greenbelts are all covered. This section provides the framework for planning future greenbelt infrastructure in Davis.

C.1 Greenbelt Overview

Davis has an extensive greenbelt system that covers much of the city. While greenbelts have various definitions, Davis greenbelts are characterized as linear parcels which are landscaped and include paved bicycle paths. Many of the greenbelts in Davis are landscaped with lawn, trees, bioswales, and storm water detention ponds. Greenbelts

in Davis generally range from a width of about 35 to 100 feet wide, and may include play areas or public art. Many of the greenbelts in Davis also connect to schools and parks.

The major greenbelts in Davis are shown in Figure C.0, and include:

- Aspen Greenbelt
- Evergreen Greenbelt
- Arroyo Greenbelt
- Perimeter Greenbelt
- Senda Nueva Greenbelt
- Covell Greenbelt
- Wildhorse Greenbelt
- Green Meadows Greenbelt
- Mace Ranch Greenbelt
- Rosecreek Greenbelt
- Willow Creek Greenbelt
- Putah Creek Greenbelt
- Willowbank Greenbelt
- El Macero Greenbelt

Figure C.0: Davis Greenbelt Location

Source: City of Davis and Brandon Haydu

C.2 Greenbelt Availability

As of 2009, the City of Davis has 165.5 acres of greenbelts within the city limits as shown in Figure C.1. With a population of 66,005, there is a total of 2.5 acres of greenbelt space per 1,000 residents in Davis. While there is currently no standard for greenbelt space per 1,000 residents, 2.5 acres is lower than the *Parks and Facilities Master Plan* standard of 5 acres per 1,000 residents for park space. As of 2009, Davis has 191.6 acres of total park space or 2.9 acres per 1,000 residents (City of Davis, 2008, p. 20).

Figure C.1: Existing Greenbelt and Bicycle Network

Source: City of Davis GIS and Brandon Haydu

The 165.5 acres of greenbelts are dispersed unevenly throughout the city. Approximately 88% of parcels are within a $\frac{1}{2}$ mile of a greenbelt; the parcels which are not within a $\frac{1}{2}$ mile of a greenbelt are primarily located in central Davis as shown in Figure C.2. The absence of greenbelts within central Davis is the result of greenbelt planning beginning in the 1960's after central Davis was already developed. While there is currently no standard for the distance greenbelts should be located from all dwelling units, the standard is 1 $\frac{1}{2}$ miles for community parks and $\frac{3}{8}$ of a mile for neighborhood parks (2008, p. 21).

Figure C.2: Existing Greenbelt Coverage

Source: City of Davis GIS and Brandon Haydu

C.3 Greenbelt Capacity

Greenbelt capacity measures how many users a greenbelt can handle at one time. For example, a large greenbelt, with multiple paths, will have a larger capacity than a small greenbelt with one path. While one greenbelt may have more capacity than another, this does not mean that the greenbelt is adequately serving the population. The Level of Service (LOS) of a greenbelt determines how many people are using a given greenbelt. Using the previous example, if many people are using the large greenbelt, it may be operating at a lower LOS than a small greenbelt with only a few users. Using LOS to

measure a greenbelt allows planners to determine how a greenbelt is serving the population.

Using the FHWA LOS calculator for shared use paths, it is possible to determine the LOS of greenbelt shared use paths in Davis. The three busiest paths in Davis, found in Figure 5.0, were examined at three different time periods. These paths were determined to be the busiest because of their location near elementary schools and commuter routes.

The three greenbelts included Arroyo Park Greenbelt during the A.M. peak period, Mace Ranch Greenbelt at Monarch Lane during the mid-day, and Putah Creek Parkway at Lillard Drive during the P.M. peak. Traffic of adult bicyclists, pedestrians, runners, in-line skaters, and child bicyclists was counted, and analyzed using the FHWA Shared-Use Path LOS Calculator (Table C.0).

According to the FHWA Shared-Use Path LOS Calculator, Davis greenbelt paths are operating well above capacity. The busiest greenbelt, Arroyo Park Greenbelt, had a LOS grade of 3.68, and operated at a LOS B during the peak hour between 8 and 9am. According to the FHWA, a LOS B equates to a trail that is, “Good. Trail has good bicycling conditions, and retains significant room to absorb more users, while maintaining an ability to provide a high-quality user experience.” (FHWA, 2006, p. 15). Monarch Greenbelt and Lillard Greenbelt both had an LOS grade of 4.0 and operated at a LOS A. According to the FHWA, a LOS A equates to a trail that is, “Excellent. The trail has optimum conditions for individual bicyclists and retains ample space to absorb more users of all modes, while providing a high-quality experience.” (2006, p. 15).

Table 5.0: Davis Greenbelt LOS Analysis

Segment Name	Path Width	Centerline	Volume (users per hour in 1 direction) and Mode Split							Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*							
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	LOS Score	LOS Grade
Arthur A.M. Peak	10.0	0	64.0	69.3%	9.4%	5.5%	2.4%	13.4%	100.0%	3.68	B
Segment Name	Path Width	Centerline	Volume (users per hour in 1 direction) and Mode Split							Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*							
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	LOS Score	LOS Grade
Monarch MidDay	10.0	0	15.0	20.0%	10.0%	0.0%	0.0%	70.0%	100.0%	4.00	A
Segment Name	Path Width	Centerline	Volume (users per hour in 1 direction) and Mode Split							Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*							
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	LOS Score	LOS Grade
Lillard P.M. Peak	10.0	0	22.0	72.7%	20.5%	6.8%	0.0%	0.0%	100.0%	4.00	A

Source: FHWA Shared-Use Path LOS Calculator and Brandon Haydu

C.4 Greenbelt Users

Greenbelts are widely used in Davis, and they are a popular amenity among residents. Two surveys, the Community Needs Assessment Survey and the Greenbelt Survey, were conducted to determine how recreational facilities and greenbelts are viewed in Davis. The Community Needs Assessment survey was a statistically valid telephone survey, and the Greenbelt Survey was a web based survey and not statistically valid. California State Parks' Planning Division also conducted a survey on Public Opinions and Attitudes on Outdoor Recreation in California. These surveys give planners a better idea of how community members use and rate greenbelts, and help planners develop ways to improve greenbelt infrastructure.

The surveys found that greenbelts are a positive amenity, and find greenbelts and shared use paths to be very important. Greenbelts in Davis are primarily used by walkers, runners, and bicyclists. These users enjoy greenbelts because of the natural setting and separation from cars. While users were generally pleased with existing greenbelts, there were improvements that users would like to have. The primary improvements users

would like to see include: more greenbelts through central Davis, using more native or drought tolerant plants, separate paths for walkers and runners, more water fountains, play areas, and more maps and guidance.

Community Needs Assessment

The *Community Needs Assessment* telephone survey was conducted for the *Parks and Recreation Facilities Master Plan Update*. 400 randomly selected residents were asked about their views on recreational facilities in Davis. The survey's results have a margin of error of plus or minus 4.9 percent (City of Davis, 2008, p. 3). The results show that trails and trail activities are very important to Davis residents, and the expansion of greenbelt facilities is the top priority for recreational facility expansion in Davis. The survey showed that:

Infrastructure

- 73% considered walking/hiking trails very important
- 68% found greenbelts very important
- 59% found open space very important (2008, p. 5)

Improvements

- The two most important improvements residents would like to see are the expansion of the greenbelt system and the acquisition of natural areas (2008, p. 6).

Activities

- 71% of residents find biking very important

- 68% find walking/hiking/ wildlife viewing very important (2008, p. 7)

Greenbelt Survey

To better understand the thoughts of Davis residents, a web survey was hosted on www.cityofdavis.org. This website was open to all residents, and was available from March 6th, 2009 until September 30th, 2009. There were 216 responses; however, there was no way to determine if residents completed the survey more than once or if they were in fact Davis residents. Therefore, the survey will not be used to represent the opinions of Davis residents. It will merely serve as a collection of ideas on how to improve current greenbelt infrastructure.

Respondents of the survey were reported as approximately 64% female and 36% male. 42% were listed as 45 to 65 years old, 34% were listed as 31 to 45 years old, 15% were listed as 19 to 30 years old, 8% were listed as over 65, and 1% was listed as under 18. 90% of these respondents were not students, and 10% were students. 34% of residents reported living in East Davis, 23% reported living in North Davis, 18% reported living in central Davis, 15% reported living in South Davis, and 10% reported living in West Davis (Figure C.3).

Figure C.3: Web Survey Demographics

Source: Greenbelt Web Survey

According to the survey, residents of Davis like existing greenbelts and would like to see more developed. Approximately 88% of respondents rated greenbelts in Davis as a “good” commodity, 12% rated them as a “fair” commodity, and 0% rated them as a “poor” commodity. Moreover, 97% of respondents believe that greenbelts should be constructed through developed areas (Figure C.4).

Figure C.4: Web Survey Greenbelt Ranking

Source: Greenbelt Web Survey

The survey found that a large portion of residents use greenbelts for walking, running, and bicycling; they also find amenities for these activities to be the most important. 54% of respondents reported using greenbelts for both recreation and transportation, 40% reported using greenbelts for recreation only, and only 6% reported using greenbelts for transportation only. The form of use varied widely, but walking/running and bicycling were the most popular uses of greenbelts with 83% and 74% respectively. Nature Viewing and dog walking were the next most popular activities, with 47% and 45% respectively. Users were asked about their three favorite amenities greenbelts provide; 61% said separation from cars, 60 % said walking/running trails and bike paths, 48% said open space, and 46% said wildlife/natural areas (Figure C.5).

Figure C.5: Web Survey Greenbelt Usage

Source: Greenbelt Web Survey

The Greenbelt Survey illustrates that a large portion of respondents want more greenbelt connections in central Davis and near the cemetery (Figure C.6). This correlates to the greenbelt coverage map which shows that many parcels are not within a half mile of a greenbelt in central Davis (Figure C.2). Other notable connections are the Putah

Creek to Mace Boulevard, the Arboretum under Interstate 80 to South Davis connection, and the Drummond Avenue and Cowell Boulevard connection. These are important connections because they are small gaps between large greenbelts.

Figure C.6: Web Survey Desired Greenbelt Connections

Source: Greenbelt Web Survey

Davis residents were generally pleased with greenbelts as depicted in Figure C.3, but had a number of recommendations regarding amenities that could improve Davis greenbelts (Figure C.7). The most common recommendations included using more native plants and watering less, increasing the amount of water fountains, improving maintenance, separating pedestrians, and including dirt running paths. Other amenities which were highly recommended include: adding small play areas, increasing the amount of maps and guidance, and providing dog areas.

Figure C.7: Web Survey Greenbelt Amenities

Source: Greenbelt Web Survey

Public Opinions and Attitudes on Outdoor Recreation in California

The 2002 *Public Opinions and Attitudes on Outdoor Recreation in California* was a survey sponsored by California State Parks Outdoor Recreation Planning department. The survey resulted in 2,512 Californians responding to a telephone survey (California State Parks, 2002, p. 7). The survey found that 70.1% of Californians spend the same or more time recreating outdoors than they did five years ago (2002, p. 11). Ninety-one

percent of Californians participated in walking for fitness or pleasure, making it the most popular outdoor activity (2002, p. 26). Finally, the five activities that Californians would like to participate in more often include: camping in developed sites, trail hiking, walking for fitness or pleasure, wildlife viewing, and bicycling on paved surfaces (2002, p. 40).

Appendix D: Future Growth

Future growth shapes who uses greenbelts, how many new greenbelts are developed, how many people use greenbelts, and where new greenbelts are developed. This section will explain how many people are expected to live in Davis in the future, and it will also explain where new development is planned for the future.

D.1 Future Population

Future greenbelt use depends greatly on population growth, which influences the number of people who use greenbelts. Davis is located in Yolo County which is projected to grow by 22% from 2009 to 2020 (California Department of Finance, 2007, p. P-1 Report). To predict how many people will live in Davis in 2020, the share of growth population projection will be used. While the cohort projection method is generally more accurate, this method does not have great accuracy in a college setting where a student population is always present. The share of growth population projection method is more accurate for college towns, and will be used to predict future population in Davis. The share of growth uses the formula below:

$$DPf = \{(DPe - DPp) / (YPe - YPp) * (YPf - YPe)\} + DPe$$

Where:

DPf=Davis 2020 Population

YPf =Yolo County 2020 Population

DPe=Davis 2009 Population

YPe=Yolo County 2009 Population

DPp=Davis 2000 Population

Ypp=Yolo County 2000 Population

Using the share of growth population projection method, Davis will grow by 13% between 2009 to 2020. Therefore, Davis will have an estimated population of 74,283 by 2020 (Table D.1 and Figure D.0).

Table D.1: Population Projections

Population		
Year	City of Davis	Yolo County
2000	60,308	170,190
2009	66,005	200,709
% Change	9%	18%
2009	66,005	200,709
2020	74,283	245,052
% Change	13%	22%

Source: California Department of Finance, P-1 Report

Figure D.0: Population Projections

Source: California Department of Finance, P-1 Report

D.2 Future Development

Just as population change will influence the amount of people who use greenbelts, future development will alter the amount of greenbelt acreage that exists in Davis. Davis has a target housing growth rate of 1%, and has selected “green light” and “yellow light”

sites to manage development (City of Davis, 2009, p. 3). “Green light” sites are parcels that may be developed first. “Yellow light” sights are parcels that may be developed after the “green light” sites. Assuming all “green light” and “yellow light” sites are developed to match population growth; under existing conditions, new development will be responsible for constructing an additional 30 acres of greenbelts in Davis (Figure D.1).

Figure D.1: Green and Yellow Light Sights in Davis

Source: City of Davis GIS, Residential Development Status Report, and Brandon Haydu

Appendix E: Alternatives

Three alternative scenarios were created to exemplify how greenbelt development might look under different policy decisions. Alternatives make it easier for community

members to understand what planners are designing for their community. The alternatives also serve as a guide for planners to understand what the community wants. Community input can be interpreted many different ways, and it is easier for planners to understand what the community wants by showing them actual plans. The first alternative scenario was the option of no greenbelt policy change. The second alternative scenario contained moderate greenbelt policy changes. The third alternative scenario depicted Davis greenbelts with extensive greenbelt policy change.

E.1 No Change

The no change alternative keeps existing greenbelt policy language. The guiding policy statement for the no change alternative is Section V Chapter 9 Goal POS 3 which states:

Ten percent of the area in new residential development shall be greenbelt.

This policy will result in 30 acres of new greenbelts, 195 total greenbelt acres, if all “green light” and “yellow light” sites are developed. The construction of these greenbelts will mirror the development of parcels and create a greenbelt network similar to Figure E.0.

Figure E.0: Future Greenbelts with No Change Alternative

Source: City of Davis GIS and Brandon Haydu

The impacts of the no change alternative will shape coverage of future greenbelts. With a population of 74,283 by 2020 and a total of 195.5 acres of greenbelts, there will be a total of 2.63 acres of greenbelts per 1,000 residents. This is slightly more than the existing 2.5 acres of greenbelts per 1,000 residents. The no change alternative will result in 90% of parcels which are located within a half mile of a greenbelt. However, the coverage will be similar to the existing conditions because there is a large area in central Davis with no greenbelt coverage within a half mile (Figure E.1).

Figure E.1: Future Greenbelt Coverage with No Change Alternative

Source: City of Davis and Brandon Haydu

The capacity of greenbelts will be slightly changed with the no change policy alternative. However, the capacity will not be changed significantly enough to impact the LOS of greenbelt shared use paths. Table E.0 shows that the LOS of greenbelts will remain the same with the no policy change alternative, assuming there is no change in mode choice or travel behavior.

Table E.0: Shared Use Path LOS with No Change Alternative

Year	Greenbelt Acreage	Population	People/Acre	Arthur Volume	LOS Score	Arthur LOS
2009	165.5	66,005	398.82	64	3.68	B
2020	195.5	74,283	379.96	61	3.69	B
Year	Greenbelt Acreage	Population	People/Acre	Monarch Volume	LOS Score	Monarch LOS
2009	165.5	66,005	398.82	15	4	A
2020	195.5	74,283	379.96	14	4	A
Year	Greenbelt Acreage	Population	People/Acre	Lillard Volume	LOS Score	Lillard LOS
2009	165.5	66,005	398.82	22	4	A
2020	195.5	74,283	379.96	21	4	A

Source: FHWA Shared Use Path LOS Calculator

E.2 Moderate Change

The moderate change alternative will make modest changes to existing policy.

The moderate change alternative will be guided by the policy:

Ten percent of the area in new residential development shall be greenbelt if parcel is designated on greenbelt map. In-lieu fee towards development of greenbelts on map shall be paid if parcel is not designated on greenbelt map.

Figure E.2 shows the greenbelt map, and corresponding greenbelts that will be developed under the moderate change alternative. The moderate change alternative will also result in 30 additional acres, or 195.5 total greenbelt acres, if all “green light” and “yellow light” sights are developed.

Figure E.2: Future Greenbelts with Moderate Change Alternative

Source: City of Davis GIS and Brandon Haydu

The impacts of the moderate change alternative will shape coverage of future greenbelts. With a population of 74,283 by 2020 and a total of 195.5 acres of greenbelts, there will be a total of 2.63 acres of greenbelts per 1,000 residents. This is slightly more than the existing 2.5 acres of greenbelts per 1,000 residents. Moreover, the moderate change alternative will result more extensive greenbelt coverage, even in central Davis. 97% of parcels will be within a half mile of greenbelts (Figure E.3).

Figure E.3: Future Greenbelt Coverage with Moderate Change Alternative

Source: City of Davis GIS and Brandon Haydu

The capacity of greenbelts will be slightly changed with the moderate change policy alternative. However, the capacity will not be changed significantly enough to impact the LOS of greenbelt shared use paths. Table E.1 shows that the LOS of greenbelts will remain the same with the moderate policy change alternative.

Table E.1: Shared Use Path LOS with Moderate Change Alternative

Year	Greenbelt Acreage	Population	People/Acre	Arthur Volume	LOS Score	Arthur LOS
2009	165.5	66,005	398.82	64	3.68	B
2020	195.5	74,283	379.96	61	3.69	B
Year	Greenbelt Acreage	Population	People/Acre	Monarch Volume	LOS Score	Monarch LOS
2009	165.5	66,005	398.82	15	4	A
2020	195.5	74,283	379.96	14	4	A
Year	Greenbelt Acreage	Population	People/Acre	Lillard Volume	LOS Score	Lillard LOS
2009	165.5	66,005	398.82	22	4	A
2020	195.5	74,283	379.96	21	4	A

Source: FHWA Shared Use Path LOS Calculator

E.3 Extensive Change

The extensive change alternative will make far-reaching changes to existing policy. The extensive change alternative will be guided by the policy:

17.5% of the area in new residential development shall be greenbelt if parcel is designated on greenbelt map. In-lieu fee towards development of greenbelts on map shall be paid if parcel is not designated on greenbelt map.

Figure 7.4 shows the greenbelt map, and corresponding greenbelts that will be developed under the extensive change alternative. The extensive change alternative will result in 53 additional acres, or 218 total greenbelt acres, if all “green light” and “yellow light” sights are developed.

Figure E.4: Future Greenbelts with Extensive Change Alternative

Source: City of Davis GIS and Brandon Haydu

The impacts of the extensive change alternative will shape coverage of future greenbelts. With a population of 74,283 by 2020 and a total of 218 acres of greenbelts, there will be a total of 2.93 acres of greenbelts per 1,000 residents. This is the more than the existing 2.5 acres of greenbelts per 1,000 residents. Furthermore, the extensive change alternative will result more expansive greenbelt coverage, even in central Davis. 99% of parcels will be within a half mile of greenbelts as seen in Figure E.5.

Figure E.5: Future Greenbelt Coverage with Extensive Change Alternative

Source: City of Davis GIS and Brandon Haydu

The capacity of greenbelts will not be changed significantly with the extensive change policy alternative. Table E.2 shows that the LOS of greenbelts will remain the same with the extensive policy change alternative.

Table E.2: Shared Use Path LOS with Extensive Change Alternative

Year	Greenbelt Acreage	Population	People/Acre	Arthur Volume	LOS Score	Arthur LOS
2009	165.5	66,005	398.82	64	3.68	B
2020	218	74,283	340.75	55	3.71	B
Year	Greenbelt Acreage	Population	People/Acre	Monarch Volume	LOS Score	Monarch LOS
2009	165.5	66,005	398.82	15	4	A
2020	218	74,283	340.75	13	4	A
Year	Greenbelt Acreage	Population	People/Acre	Lillard Volume	LOS Score	Lillard LOS
2009	165.5	66,005	398.82	22	4	A
2020	218	74,283	340.75	19	4	A

Source: FHWA Shared Use Path LOS Calculator

E.4 Community Feedback

A community meeting was held to gain feedback from Davis residents. Approximately 15 residents were present at the meeting. The majority of residents preferred the extensive change alternative. However, some were concerned about any growth; this group thought maintenance was more important. Citizens were generally receptive to building greenbelt connectors through downtown; although, some showed concern about traffic problems the connectors may cause. The idea of developing a bicycle boulevard along B Street's greenbelt connector as opposed to a contra-flow bike lane sounded appealing to Davis's Bicycle/Pedestrian Coordinator. Residents were generally receptive to developing a greenbelt map and building greenbelt connectors through central Davis, as long as maintenance of existing and new greenbelts were to be held to a high standard.