CU-BOULDER
TRANSPORTATION MASTER PLAN

Prepared For

CU-BOULDER

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TRANSPORTATION CONSULTANTS, INC.

alta PLANNING + DESIGN

CU-BOULDER
TRANSPORTATION MASTER PLAN

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CHAPTER 1

Introduction

1.1 Overview

This document represents the Transportation Master Plan is an element of the Campus Master Plan for the University of Colorado Boulder. This master planning effort is intended to align the facilities development plan with the strategic goals of the *Flagship 2030 Strategic Plan* and the *2009 Conceptual Plan for Carbon Neutrality at the University of Colorado at Boulder* and the University of Colorado Boulder's status as a signatory to the American College and University President's Climate Commitment.

Colorado Revised Statute (CRS) 23-1-106 requires that higher education institutions have an approved master plan for facilities in place prior to the submission of capital construction requests. Each capital request must be in conformance with the campus master plan. CU-Boulder's current Campus Master Plan was approved in March 2001 and will expire in 2011. The 2011 Transportation Master Plan was developed in conjunction with other Master Plan elements using the goals established by the Flagship 2030 plan.

As the Flagship University of the State of Colorado, CU-Boulder is a dynamic community of scholars and learners situated on one of the most spectacular college campuses in the country. As one of 34 U.S. public institutions belonging to the prestigious Association of American Universities (AAU) – and the only member in the Rocky Mountain region – there is a proud tradition of academic excellence, with four Nobel laureates and more than 50 members of prestigious academic academies.

CU-Boulder is renowned for its commitment to sustainability, consistently being ranked in the top 10 higher education institutions and receiving the Sierra Club's 2010 top rating in the "Most Eco-Enlightened U.S. Universities." Transportation is a major component of this sustainability effort, with a greater than 80% non-single occupant vehicle (SOV) use by students and 50% for its work force.

The *Flagship 2030 Strategic Plan* proposes several long-range goals that will impact campus transportation needs:

- Increasing enrollment at historic rates resulting in 5,300 more students by 2030 (2,650 by 2020);
- Developing the East Campus as a full campus, possibly with academic and residential uses;
- Developing residential colleges where students can live with faculty in a living/ learning environment;
- Increasing the number of non-freshmen residents in residence halls from 2% (2008) to 20% by 2020;

- Redevelopment of the area north of Boulder Creek between 17th Street and Folsom Street;

- Increasing the tenure-track faculty by 300 positions (of which 100 faculty have already been hired); and

- Internationalizing the institution as a part of the global economy, including seeking more international students.

In addition, the State of Colorado and the University of Colorado have adopted broad sustainability goals to:

- Reduce greenhouse gas (GHG) emissions by 20% by 2020;

- Become carbon neutral by 2050.

The master plan adopts the goals listed in the Sustainability Task Force document, which are to:

- Move toward a higher proportion of transportation fuels derived from renewable resources;
- Increase the number of passenger miles traveled;
- Reverse the growth in the average length of trips taken; and,
- Work to reduce the growth in the number of trips taken while retaining the current modal hierarchy of pedestrians, bicycles and skateboards, transit, car share/carpool and single occupancy vehicles (SOV).

1.2 Transportation Vision Statement

During the Campus Master Plan process, a vision emerged for the Campus Transportation Master Plan that describes the aspirations of the Boulder Campus. The vision is one where:

- Mobility and accessibility are ensured for all CU-Boulder faculty, staff, students, visitors and vendors regardless of race, age, income or disability; and

- CU-Boulder bicycle and pedestrian facilities, public transit systems, campus streets and surrounding community streets are all safe and well-maintained and take users when and where they need to go; and

- An integrated, market-based pricing system for the parking supply helps to not only manage the demand on the transportation and parking system but also helps to pay for its improvements and for programs and services to reduce travel demand; and

- The impacts of travel activities are recognized and CU-Boulder functions as a good neighbor to mitigate the negative impacts on surrounding communities; and

- The CU-Boulder campuses are transformed by a growth pattern that creates complete campus communities with ready, safe and close access to classrooms, research and laboratories, jobs, shopping and services and are connected by reliable and cost-effective transit and alternative travel mode facilities; and

- Technology is implemented including:
  - clean fuels and vehicles;
  - traffic operation systems that manage traffic flow and reduce delay and congestion on nearby roadways;
  - advanced and accessible traveler information that allows for informed travel choices; and
  - transit systems and strategies that synchronize schedules and routes to speed travelers to desired destinations; and

- There is a viable choice to leave autos at home and take advantage of a seamless network of accessible pedestrian and bicycle paths that connect to nearby bus, rail and other alternative travel modes that can carry users to school, work, shopping, recreation and services; and

- CU-Boulder works with regional and local agencies and stakeholders to take effective action to protect the earth's climate and to serve as a model for national and international action; and

- CU-Boulder's transportation investments and travel behaviors are driven by the need to reduce the impact on the earth's natural habitats; and

- All who work, learn, and teach at CU-Boulder and those who visit enjoy a higher quality of life.

1.3 Sustainable Transportation Challenges at CU-Boulder

CU-Boulder is well on its way to implementing this vision. The university has been a partner with the City of Boulder, Boulder County and regional agencies in developing award-winning transportation programs, including the Community Transit Network, the extensive City/County bikeway network, and many innovative and creative Travel Demand Management programs. The results are truly impressive as CU-Boulder has one of the lowest SOV modal shares among major universities and Boulder traffic volumes have actually declined during the last decade despite campus enrollment growth. But as CU-Boulder embarks on planning for the next two decades, it faces many issues that will challenge its ability to both physically and financially meet its projected growth and its sustainability goals, including:

- Parking and Transportation Services' (PTS) revenue streams are currently strained to offset its existing operating costs, which include the new debt service for the recently completed Center for Community parking structure. This new structure has increased PTS' bond repayment costs by over $1.2 million per year. Current parking fees and fines need to be increased to cover current operating costs. New funding mechanisms and sources (beyond the parking fee and fine assessments that have traditionally funded PTS' operations) are necessary to offset needed expanded and new Travel Demand Management (TDM) programs. Will the university increase parking fees and fines and consider new revenue sources, including the potential of charging all campus users for transportation services?

- CU-Boulder's Travel Demand Management programs have been very successful, but unless these programs continue to expand the university will need to build additional parking to address future parking demand. Building new parking is significantly more expensive than TDM. The university will need to off-set projected growth in travel demand as well as to reduce green house gas emissions to achieve its sustainability commitments. In the past, although CU-Boulder invested in TDM, it has also continued to build new parking. Is the university willing to commit to investing first in TDM to address growth and future lost parking spaces due to build-out before allowing for new parking to be built? Is the university willing to commit to more significant funding of TDM services and facilities?

- The university's parking system currently has limited supply in the high demand areas of Main Campus and an under-utilized supply at East Campus and the current price of parking does not reflect the cost of providing that parking. Excess supply and under-priced parking are major deterrents to successful TDM programs. Will the university implement parking pricing strategies to help decrease overall travel and parking demand on main campus, to better utilize existing parking supply and to encourage more alternative transportation use?

- The Main Campus of the university is nearing build-out. Although there are a variety of viable alternative transportation options offered on Main Campus, there are still enhanced and new pedestrian, bicycle and transit infrastructure and services needed. However, much of CU-Boulder's growth is expected to occur on East Campus where transit, bike and pedestrian facilities and services are lacking. There are inadequate links/services between East Campus and Main Campus and without these links, the university will not be able to maintain and/or reduce its single-occupant vehicle (SOV) use from this growth area. The costs to install the necessary infrastructure and to implement the needed transit enhancement and bike and pedestrian facilities on both campuses and to connect the campuses will be significant. Will the university commit to funding these investments and what source will the funding come from?

- Approximately 36% of the university's total parking supply is not within the management and control of PTS (over 4,000 parking spaces). Much of this parking is provided with no direct permit or other fee charged to users. Without centralized oversight of the parking supply, the university will not have consistency in its approach to parking management and will not be as successful as it can be in achieving a change in travel behaviors and in reducing parking demand. Will the university consolidate all of its parking supply and manage and price it consistently among all the entities and campuses?

- The university's *Flagship 2030 Strategic Plan* has long range goals of creating university villages that provide "mixed-use, education related spaces" and "developing residential colleges where students can live with faculty in a living/learning environment." It is important that the university develop its remaining land in a manner that encourages and supports more students and faculty living on campus as having more of the campus population live on or near campus will help reduce travel demand. It is also important that the development provides necessary services and activities in close proximity in order to reduce the reliance on the automobile which should result in less demand for parking. Will the university ensure this type of planning for and development of new academic, administrative and residential buildings and areas?

1.4 CU-Boulder Transportation Goals

The Transportation Master plan of the Master Plan will work in conjunction with the *Flagship 2030 Strategic Plan* and provides guidance on how to address these challenges and recommendations to

- Provide a framework and guidance for transportation planning and management over the next 20 years in order to help the university achieve a sustainable transportation future;

- Reduce congestion in and around the campuses and to reduce the total number of motor vehicles driven to campus, which will result in reduced parking and travel demand;

- Provide convenient and viable alternative mode options to the campus community in order to encourage the use of transportation modes other than the single-occupant vehicle;

- Better manage the available parking supply and to price it to ensure financial sustainability and to encourage alternative mode use;

- Ensure TDM and parking management strategies are considered and incorporated into projects as the campuses develop and to use other methods, such as providing more on-campus housing and building university villages (which integrate student, faculty, and staff housing along with education, retail and service facilities), to minimize or eliminate the need to build new parking;

- Achieve greenhouse gas emission (GHG) reductions in campus transportation by 2020 in comparable proportion (about 20%) that the transportation sector contributes locally to campus GHG;

- Develop viable financial strategies to address current financial deficits of Parking and Transportation Services as well as to identify funding for new and expanded efforts to achieve a reduction is travel and parking demand;

- Develop both long-range and short-term strategies to move people between the various properties that compose CU-Boulder; and

- Align the university's transportation planning goals with regional transportation efforts;

1.5 Approaches to Managing Transportation

Traditionally, when traffic and parking demand increases, cities and entities such as universities tend to expand roadways and build more parking. CU-Boulder and the City of Boulder have a solid history of managing demand through travel demand management programs. The university has good non-SOV use by its students at 80% and reasonable use by its workforce at 50%. However, over the years although the university has invested in TDM, it has also continued to build parking (most recently completing a 376 space underground parking structure in 2010). In addition, parking pricing has remained relatively inexpensive at the university and under-priced parking works as a disincentive to encouraging alternative modes use.

As mentioned earlier, the university is facing challenges of a growing student and employment population that will continue to increase traffic and the demand for parking, declining funding sources for parking and TDM programs, and the university has made an aggressive commitment to reduce carbon by 20% by the year 2020 and to be carbon neutral by 2050. In order to meet these challenges, the university will need to take a more aggressive approach to funding and implementing TDM.

TDM can reduce roadway congestion, result in avoided costs for roadway and parking expansion, provide savings to users, help the university achieve its environmental goals, and provide for more efficient land use and for better community livability.

In addition, TDM is usually significantly less expensive than more traditional approaches. CU-Boulder's experience shows that TDM costs approximately four times less than providing expensive underground parking. This *least-cost* planning approach is the best approach to help the university address the challenges it is facing. Therefore it is recommended that the following should be considered in all future transportation decision-making:

- TDM should be implemented first before considering street capacity improvements and adding parking;

- Land is a scarce and valuable asset at CU-Boulder, planned land uses should discourage vehicular use and encourage the use of alternative modes;

- The supply and price of parking are two key factors in choice of travel mode and the university should use these variables to achieve financial sustainability and to encourage use of alternative modes of transportation;

- Consistent parking management and pricing throughout CU-Boulder can address inequities that currently exist; and

- Transportation investments to improve commuting to campus by affiliates should consider the costs of accommodating each type of trip to campus (i.e., bike, pedestrian, transit, carpool/vanpool, etc.).

1.6 Related Planning Efforts

The Transportation Master Plan builds on past transportation planning efforts of the CU-Boulder Campus and its regional partners. Appendix A summarizes the previous planning efforts to ensure that this plan is in harmony with successes of the past and continues to build upon them.

1.7 Report Organization

This report is organized into eight chapters:

1. Introduction
2. Current Conditions
3. Assessment of Data and Demand Projections
4. Managing Demand and Supply
5. Analysis of Options for Transportation Infrastructure Improvements and Service/Program Changes
6. Alternative TDM Programs
7. Funding Strategies
8. Summary of Recommendations

CHAPTER 2
Current Conditions

This chapter discusses various factors affecting CU-Boulder's transportation and parking supply and demand based on various sources, including the Office of Planning Budget and Analysis (PBA), Parking and Transportation Services (PTS), the Environmental Center, and the *University of Colorado 2010 Commuter Survey*.

CU-Boulder currently has about 30,000 students and 7,260 faculty and staff spread among three campuses: Main Campus, East Campus, and Williams Village, depicted in Figure 2-1. About 7,000 students are housed on these campuses, with almost 23,000 commuting to CU-Boulder from off-campus housing.

2.1 Existing Mode Share

In the spring of 2008, 3,078 faculty, staff and students participated in an online commuter survey, hosted by SurveyMonkey.com. This survey was intended to determine the "modal share" (the proportion of commute trips made using each method of transportation) of trips made to and from the University of Colorado Boulder by faculty, staff, and students. During 2010, a similar survey was conducted four times – winter, spring, summer and fall with 6,384 affiliate participants. (The following chapters use only the fall and spring surveys.) Existing mode share was obtained from a weighted average of the four. The results of the 2010 survey are shown in Table 2-1 along with the results from the *University of Colorado 2008 Commuter Survey*.

Table 2-1
CU-Boulder Mode Share

Faculty/Staff	2008[1]	2010[2]
Telework/Didn't Come	2.3%	6.2%
Walk	3.8%	6.0%
Bike	8.5%	9.4%
Skateboard	0.1%	0.0%
Bus	25.9%	20.8%
Car/Vanpool	8.9%	7.4%
Motorcycle/Scooter	0.6%	0.5%
Drive alone	45.3%	47.0%
Other	4.6%	2.7%
Students	**2008**	**2010**
Telework/Didn't Come	2.2%	5.6%
Walk	22.2%	25.3%
Bike	14.9%	15.9%
Skateboard	1.2%	1.5%
Bus	32.0%	27.6%
Car/Vanpool	2.8%	3.5%
Motorcycle/Scooter	4.2%	0.5%
Drive alone	18.5%	18.9%
Other	2.1%	1.1%

Source
1. *University of Colorado 2008 Commuter Survey*
2. *University of Colorado 2010 Commuter Survey*

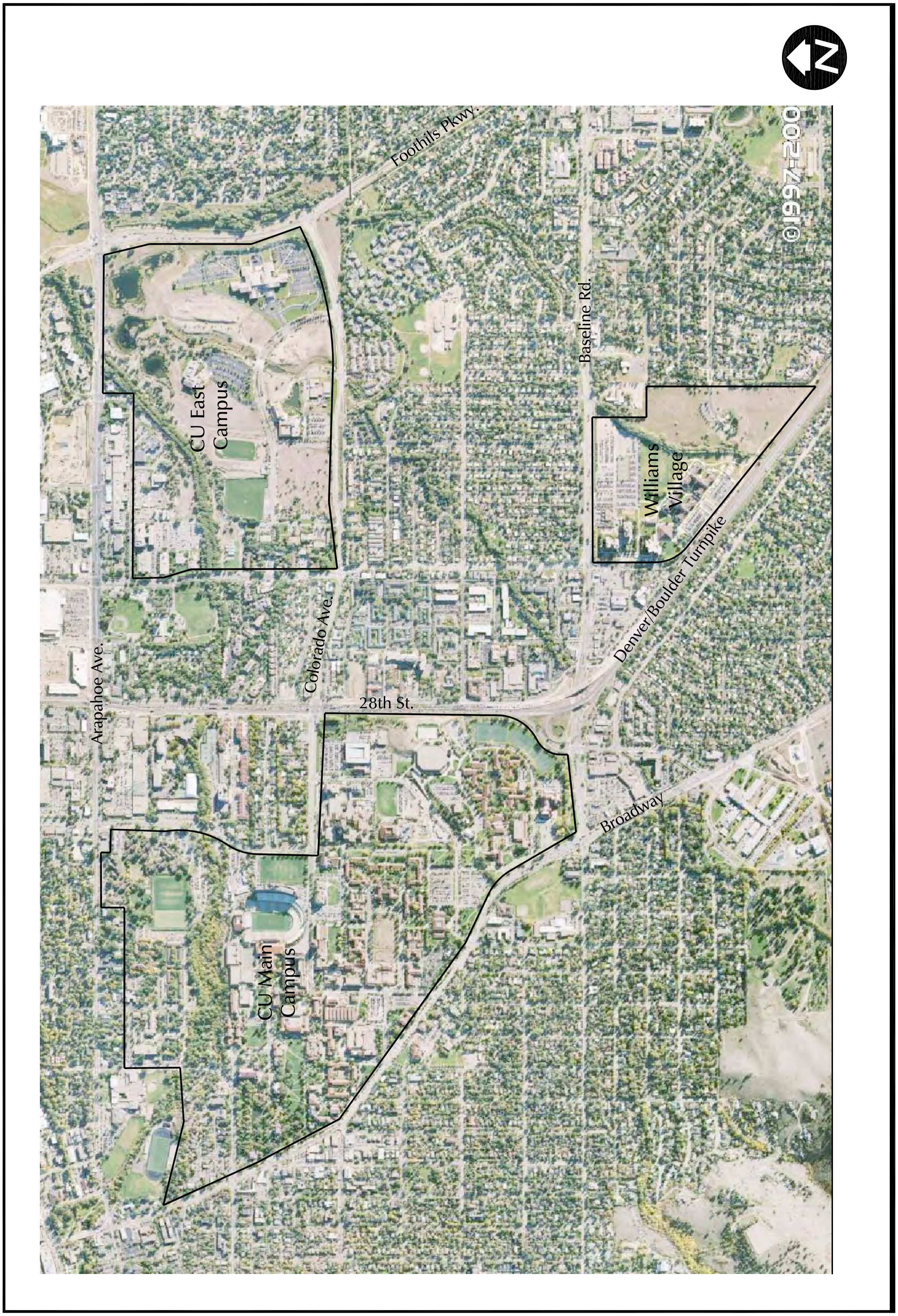


Figure 2-1

Campus Locations

CU-Boulder Transportation Master Plan

As shown in Table 2-1, the 2010 drive alone share is approximately 47 percent for faculty/staff and 19 percent for students. Carpools and vanpools account for another 7 percent of faculty/staff trips and 4 percent of student trips. Comparing to 2008, the faculty/staff vehicular use (including motorcycle/scooters) has increased slightly while student vehicle use is about the same.

In addition to looking at overall mode share, the 2010 data was evaluated to determine if there are any differences in mode share between faculty and staff working on the Main Campus and those primarily working on the East Campus. Table 2-2 shows the results of the analysis. This table and most others in this report are based on the 2010 Spring and Fall *Commuter Survey*

Table 2-2
CU-Boulder Mode Share
Faculty/Staff

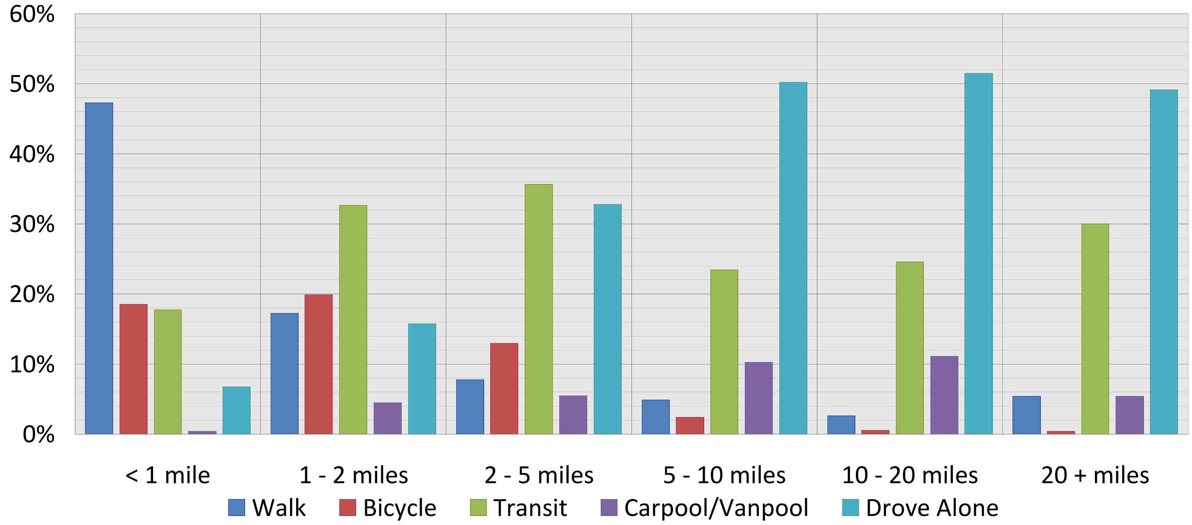
Faculty/Staff	2010	Main Campus	East Campus
Telework/Didn't Come	6.1%	6.0%	5.0%
Walk	5.9%	7.0%	5.0%
Bike	8.4%	9.0%	6.7%
Skateboard	0.0%	0.1%	0.0%
Bus	21.7%	24.0%	17.0%
Car/Vanpool	7.7%	7.6%	9.0%
Motor cycle/scooter	0.3%	0.3%	0.3%
Drive alone	47.3%	44.0%	55.0%
Other	2.7%	2.0%	2.0%

As shown, vehicular use is significantly higher for faculty and staff working at the East Campus. This is most likely due to the lower level of transit service and bicycle/pedestrian facilities at the East Campus. Since a majority of the future growth at the university is planned to occur on the East Campus, the higher vehicle use and lower transit use could pose a challenge to the university in meeting its sustainability goals.

Finally, an additional analysis was performed on the 2010 data to determine mode share by commuting distance. The results are shown in Figure 2-2.

As shown, vehicle use is very low (less than 10 percent) for affiliates that live within a mile of campus and increases to almost 60 percent for affiliates that live more than 5 miles from campus. As a result, significant shifts away from vehicle use can be obtained by providing additional housing near campus.

Figure 2-2
Mode Split by Commute Distance



2.2 Existing TDM Programs

CU Boulder has developed and funded a comprehensive package of TDM programs since 1992. These programs are jointly managed by Parking and Transportation Services (PTS) and the Student Environmental Center through a Sustainable Transportation Partnership (STP) agreement. PTS has 2 full-time equivalent employees dedicated to TDM while the Environmental Center has one full-time staff member and several student employees involved in TDM programs.

The two programs work collaboratively on marketing the use of alternative modes of transportation and often joint venture on transit and bicycling projects. PTS provides transportation information packets to new staff members at a "new employee orientation" that takes place about every two weeks. PTS also staffs 16 new student orientation sessions held throughout the summer, the new faculty orientation held each fall, and a table at the information fair that occurs at the beginning of each school year to provide information to all campus constituents. In addition, PTS maintains a web site, issues campus e-memos and Buff Bulletins, regularly places local newspaper ads and press releases and networks with on and off-campus departments to promote transportation alternatives.

The Environmental Center sends an annual mailing to parents of new students each summer, educating parents and in-coming students about all the reasons a student does not need at car at CU and the different places a person can go using transit. PTS provides information about alternatives through the on-line permit registration process as well as via a mailing to all potential new permit holders. Both entities have web sites that link to each other and to transportation resources in the community.

Existing TDM programs at CU-Boulder include:

Transit:

- Student Bus Pass Program – available to over 30,000 students. Includes regional coverage, Regional Transportation District (RTD) SkyRide to Denver International Airport
- Faculty/Staff EcoPasses – full and part-time continuing employees working with a 20% or greater full-time equivalent appointment are eligible
- Late-night transit
- CU Ski Bus
- Buy up of additional off-peak frequency on the Stampede bus route
- Guaranteed Ride Home with EcoPass

Automobile:

- Ridematching through Zimride
- Reserved priority parking spaces are set aside for carpools at Wolf Law, Leeds School of Business and the Center for Community
- Car sharing through eGo CarShare with six vehicles

Bicycle:

- Bike racks around most buildings and in heavily used areas
- Regular surveys of bike parking
- Bike Station located near the UMC with staffing during fall and spring, providing maintenance and repair services
- Mobile Mechanic
- Buff Bikes – bike sharing and semester rentals

Marketing, Outreach and Web Services:

- Periodic Commuter Surveys to monitor auto and alternative mode use
- Website “connection” programs to link individuals to various modes of transportation
- Maps, brochures, and pamphlets on the various programs

This comprehensive approach to TDM has been successful in reducing the travel and parking demand at CU-Boulder. Comparison of cordon counts on the Main Campus indicates an increase of 62% in bicycle use on the Main Campus and 23% in pedestrians entering campus from 1998 to 2010.

2.3 Non-Motorized Travel and Facilities

This section inventories the current conditions and supply of pedestrian and bicycling facilities accessing and throughout campus as well as programs for bicyclists and pedestrians on campus.

2.3.1 Pedestrian Facilities

Discussion and analysis of pedestrian facilities on the CU-Boulder campus are divided into four categories: corridors, crosswalks, sidewalks and underpasses/overpasses.

Typical pedestrian traffic looking east down the Central Campus Walkway, one of CU's more prominent pedestrian corridors

Corridors

Pedestrian corridors are areas of campus where pedestrian movement is prioritized and given preference to other forms of transportation. Pedestrian corridors serve to move large numbers of individuals, especially at peak-travel times, such as passing periods.

To effectively and safely separate bicyclists and pedestrians, it is important that there be a contiguous network of corridors and bikeways available.

Crosswalks

The major crosswalks on campus are located along the 18^{th}/Colorado Avenue corridor and Regent Drive. Though the installation of the bike and pedestrian underpass on Regent has significantly improved traffic flow, there remain crossing issues between the Engineering complex and the parking structure. The 18^{th}/Colorado corridor is a major concern for pedestrian and bicyclist safety, as it is the only throughway used by transit, as well as service vehicles and bicyclists.

Students utilize the crosswalk where 18^{th} and Colorado Avenue meet.

Sidewalks

Sidewalks are the most ubiquitous pedestrian facility available on campus. During passing periods (times of peak travel) sidewalks can experience heavy amounts of activity, making them only suitable for pedestrians. When skateboarders and bicyclists attempt to use sidewalks during passing periods, they must travel at the speed of pedestrians or use another facility. On-campus bicycle routes heighten the convenience of their use and discourage the use of sidewalks for bicycle/ skateboard travel.

Table 2-3
Times of Peak Travel

Monday-Wednesday-Friday	Tuesday-Thursday
7:50-8:10 am	7:50-8:10 am
8:55-9:15 am	9:05-9:40 am
9:55-10:15 am	10:35-11:10 am
10:55-11:15 am	12:05-12:40 pm
11:15 am-12:15 pm	1:35-2:10 pm
12:55-1:15 pm	3:05-3:40 pm
1:55-2:15 pm	4:40-4:55 pm
2:55-3:15 pm	
3:55-4:15 pm	
4:55 – 5:15 pm	

As the campus has grown, CU has also accommodated and formalized many "cow paths" across campus with sandstone pavers and later concrete. These paths are designed to protect grass/sod, and accommodate the shortest points of travel between buildings. CU selectively installs railing and fences to discourage crossing at certain points on campus. The fencing protects the grass and minimizes unwanted, informal paths from developing.

"Cow Path" in Front of Benson Earth Sciences

Under/Overpasses

Bridges, overpasses and underpasses allow for the uninterrupted flow of pedestrian and bicyclists movement separate from vehicle traffic, and are therefore much safer than at-grade crossings. However, safety concerns and conflicts can be high inside under- and overpasses and at their entrances/exits. Attempts to address speeding cyclists and skateboarders in underpasses have run into both jurisdictional complications as well as a lack of regulatory legislations appropriate to the task. According to the City of Boulder 2008 Transportation Master Plan, there are approximately 60 underpasses, 66 bridges and 2 overpasses to support non-vehicular transportation adjacent or within the City of Boulder. Of these numbers, roughly 24 underpasses and 12 bridges are within the campus boundaries.

2.3.2 Bicycle Facilities

Multi-Use Paths

The primary multi-use path on campus is the Broadway path. This path plays a critical role in the campus and City of Boulder bicycle transportation system. As a critical artery in the network, bicycle counts were conducted along this path to estimate its use. The Broadway facility is striped for bicyclists to travel in opposite directions, and also has a designated space for pedestrian travel. Despite these delineations, crossover (pedestrians in the bicycle areas and vice versa) is common

Another important multi-use path for the City and CU-Boulder is the Boulder Creek Path. The Boulder Creek Path runs just north of Main Campus and runs directly through East Campus. Boulder Creek access will play an important role in the non-motorized travel between East and Main Campus as CU-Boulder grows.

The other clearly marked path on campus is called the “East-West Corridor” located along Pleasant Street east towards Folsom Field. This section does not function well as pedestrians and bicycles often ignore the lane markings. Physical dividers would help define the paths more clearly but are impractical due to the service requirements and large volumes of pedestrians during class change periods.

There are other areas that are designated as bicycle paths on campus, however, the painted designations are often ignored as was discovered during field visits. Other observations included that “paths” were not clearly identified as such on campus, and resembled sidewalks or an unmarked, paved area.

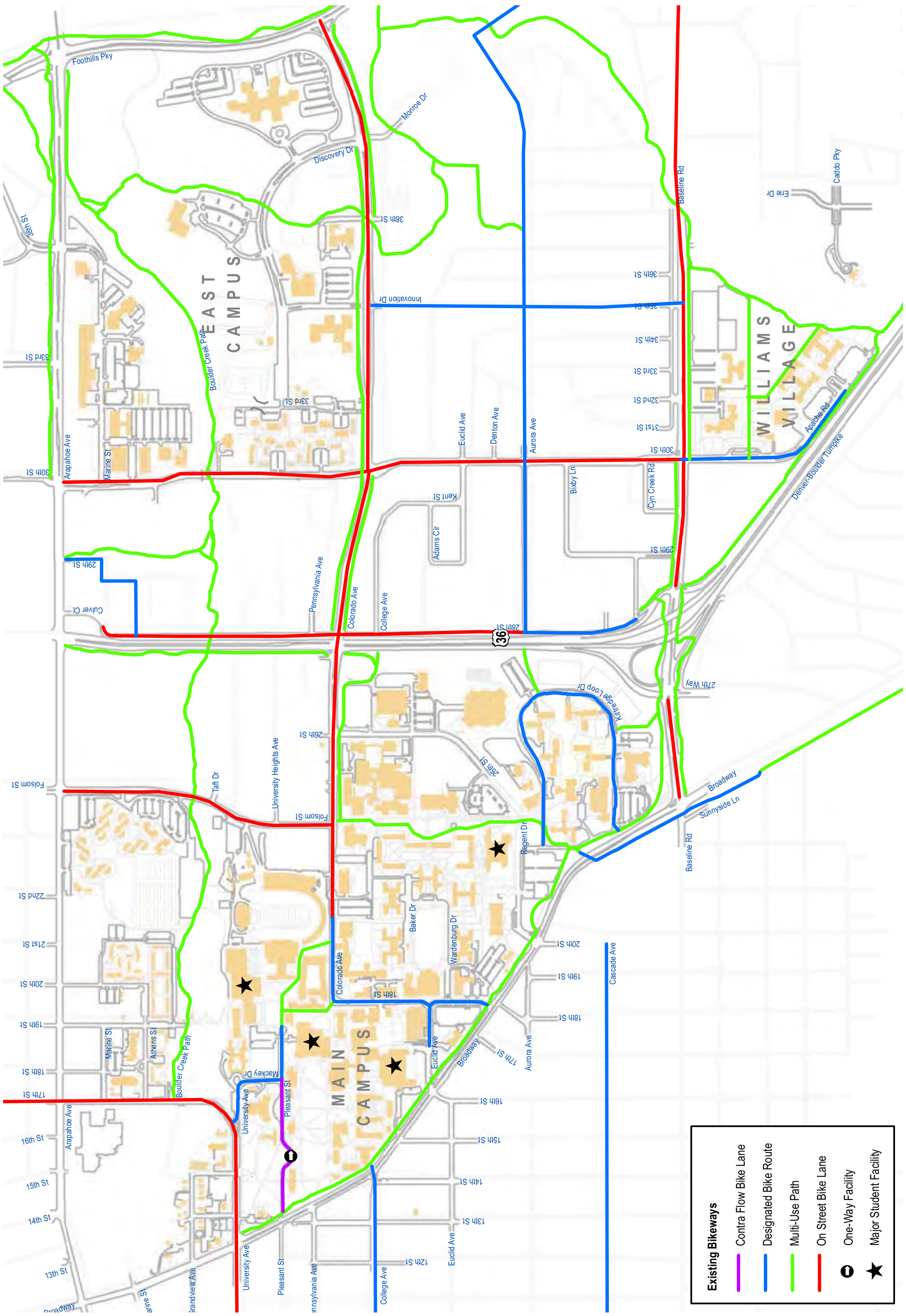


Figure 2-3

Existing Bicycle Network

CU-Boulder Transportation Master Plan

Path Safety

There are different methods for encouraging bicyclists and pedestrians to use the proper section of a multi-use path. One of the most effective methods is physically separating the facility with elevation changes, landscaping, or other means. However, this may not be practical in all parts of campus due to space restrictions.

Pavement markings and signage are also helpful to encourage proper path use; however these can be ignored (pictured) when people aren't paying attention, especially as markings begin to fade. Keeping pavement stencils in good condition reinforces the proper use of the path and the message that CU-Boulder cares about its bicycling and pedestrian community.

Pedestrians and bicyclists on campus often use the wrong lane, especially during passing periods when there are large numbers of people moving throughout campus. This can create hazardous situations.

Enforcement campaigns can also be helpful, but in light of previous efforts at CU-Boulder, the most effective way to increase proper path use is through educating the campus community and promoting "self-policing". Self-policing is conducted by bicyclists and pedestrians who are simultaneously and courteously using the path. As more bicyclists use a corridor, it will become apparent that pedestrians should not walk in the bike sections of the path. As pedestrians become familiar with this expectation, it becomes an unspoken form of "campus knowledge." Messages about courteous and proper path use will give pedestrians and bicyclists courage to ask their peers to be in the correct part of the path. Self-policing can be supported through educational and marketing campaigns and new student orientation at the beginning of the school year.

Bike Lanes

According to the *Pedestrian Safety Committee Final Report*[1] from April 2010, there are currently two bike lanes that run through the campus. One lane is along Colorado Avenue and the second is along Pleasant Street. The Pleasant Street bike lane is a contraflow bike lane, meaning that it runs against the one-way (westbound) traffic.

[1] Pedestrian Safety Committee, Final Report – April, 2010, available from CU-Boulder Facilities Management

Bike Parking

Sufficient bicycle parking is necessary to support a thriving bicycle network by providing a safe place for bicyclists to lock or store their bikes while on campus. Currently, CU-Boulder houses a robust bicycle parking system.

This sign restricts non-bicycle traffic at the University of Oregon in Eugene.

According to the 2009 Bicycle Parking Assessment, conducted by the university, there are 9,433 parking spaces in 1,159 racks across campus. For a university with an estimated student population of 30,000, not including staff and faculty who commute via bicycle, the university is currently providing bicycle parking for roughly 30% of its students.

Similarly, the university began conducting a semi-annual bike parking census in 2007 to provide the utilization rates for existing bicycle parking supply, as well as update the complete bicycle parking inventory.

Bike racks can be installed at the request of the university community. The request is evaluated for need and prioritized with other needed racks on campus. Once a rack is determined to be needed and funded, it is designed into the campus landscape according to planning principles that balance convenience and aesthetics. Racks are generally placed along edges of open spaces and along walks next to buildings. Placement in this manner gives the perception of maintaining open space while increasing the number of racks in a given area over aggregated solutions. The FY10 budget for bike rack installation was $102,000.[2]

Bicycles fill the racks near the Eaton Humanities Building and Norlin Library

The data is compared to previous census results and then incorporated in the evaluation of existing campus bicycle parking facilities. Utilization rates for existing parking and number of bicycles not parked at racks (labeled "errata") demonstrate the performance of the existing bicycle parking as well as identifying where more facilities are needed.

[2] Bike Rack Installs 2009-2010, CU Environmental Center.

The study uses building entrances to assess parking capacity due to the large size of buildings on campus. These data are separated into categories by distance: within 200' and within 50' of the entrance. (The Victoria Transport Policy Institute[3] and other bicycle planning organizations recommend placing parking 50' from an entrance for maximum effectiveness.) A total of 1,451 building entrances were identified and mapped. The average distance between parking and an entrance is 124 feet for the entire campus.

With the campus-standard CORA-10 rack[4], optimal utilization is estimated to be between 65 and 75%. Based on staff observation, utilization higher than 75% results in a rack appearing to have full capacity, whereas, utilization below 65% results in the rack appearing empty. Therefore, the 65% and 75% range maintains sufficient open space for a marginal number of bicycles, while not appearing underutilized.

The data are analyzed per door, per entrance as a precise assessment of parking needs at destination points and parking capacity and bicycle counts are divided proportionally across entrances. Therefore, if one rack has five entrances within 50', those five entrances share the rack at 1/5 capacity, with a target utilization of 75%.

2.3.3 Non-Motorized Programs and Services

A successful bicycle and pedestrian system depends on continual encouragement and education efforts from the university faculty, staff and students. Developing and providing university-wide bicycle, pedestrian and skateboarding programs builds the framework to support a sustainable non-motorized network at CU Boulder. As non-vehicular, active transportation increases and more bike facilities are added, it is imperative that the proper resources and community support are also expanded upon to ensure that walking, cycling and skateboarding are safe and desirable methods of transportation at the CU Boulder campus.

Bike Station

The CU Boulder Bike Station - Sustainable Transportation Program is a partnership of the CU Environmental Center and Parking and Transportation Services. The station serves as the central location for the university Bike Program and provides the following services for faculty, staff and students:

- Bicycle registration
- "Buff Bikes" 48-hour bicycle rental program, free for faculty, staff & students.
- Pilot "Buff Bike Corral" valet bike parking service offered during fall football games.
- Semester Rentals
- "Quick Fix program" free minor maintenance assistance for registered bicycles.
- Mobile Mechanic
- Bicycle and pedestrian path maps and transit schedules and maps.
- Refurbish and resale program for abandoned bikes found on campus.

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[3] Victoria Transportation Policy Institute – www.vtpi.org

[4] CORA refers to a specific brand and style of rack – www.cora.com

According to the *Pedestrian Safety Committee Final Report*, published April 2010, approximately 2,400 bikes are registered each calendar year through the bike program.

Due to the demand for the Bike Station's services, a second bike station will be installed next to the Engineering complex. This bike station will provide similar services as the other bike station, and accommodate the continued growth of bicycling on the CU campus.

Boulder B-Cycle Program

Boulder B-cycle is a community nonprofit formed to implement and operate a bike-share system in the City of Boulder. The program partners with the City of Boulder, to create a transportation solution that's clean, green, healthy, and sustainable. The program launched in May, 2011 and a bike sharing station was installed on the north side of the Boulder Creek Path adjacent to Athens Court family housing.

Bicycle Program Manager

The Bike Station is operated by the Transportation Options Program of the university's Parking and Transportation Services Department, which currently employs 2 full-time staff. By assigning designated staff for the operation and maintenance of the Bike Program, the university's demonstrates commitment to the longevity and growth of the bicycle network. Similarly, the department provides a stable resource which facilitates the continual support of bicycling as a safer and more desirable transportation option.

Pedestrian Safety Committee

In 2006 the CU Boulder Pedestrian Safety Committee was established in response to increasing usage of pedestrian corridors by travelers of all modes such as bicyclists, skateboarders and service/delivery vehicles, which resulted in increased risk for pedestrians. Some of the programs implemented by the committee included the following:

- Educational awareness campaigns from 2006-2009
- Identifying locations for new service vehicle hubs
- Creation of pedestrian safety zones with set speed limits.
- Encouraged the enforcement of violations.
- Establishing communication with companies for compliance of vehicular traffic.

Safety Campaign

In 2009, an education campaign addressed "dangerous, irresponsible, reckless and careless" behavior amongst CU students. The campaign focused on encouraging safe, non-reckless bicycling and skateboarding that minimizes danger and risk to pedestrians. In their efforts to make a safer campus for everyone, campaign participants utilized art and guerilla style means to portray their message.

Text Alerts

CU Boulder provides for its students real-time info via text alerts about campus closures, extreme weather, and other emergencies.

CU NightRide

CU NightRide is a student-operated program dedicated to meeting the safety needs of CU students, faculty, and staff by providing night-time transportation to support a safe academic and socially responsible environment both on campus and in the community.

2.3.4 Non-Motorized Counts

Background

In 1998, the University of Colorado Boulder conducted counts as a part of the development of the Transportation Element of its Master Plan. Counts were conducted at nine locations around the campus. The following locations were used for the 1998 Count:

- 17th Street (South of the Boulder Creek)
- Athens Court (at the Boulder Creek crossing)
- Lot 169 West (at the Boulder Creek crossing)
- Lot 169 East (at the Boulder Creek crossing)
- 28th & College tunnel
- 28th & Aurora tunnel
- 28th & Baseline
- South Broadway tunnel
- Broadway & College tunnel

For the 2010 counts, three locations from the 1998 counts were modified and an additional five locations were added to better estimate the bicycle and pedestrian travel to campus with those changes included. There were a total of 14 count locations in 2010.

The three modified locations are:

- Lot 169 West was moved to the top of the trail leading from the Boulder Creek near the northwest corner of Folsom Field and the northeast corner of the recreation center.
- The count location at Lot 169 East was relocated to the opposite side of campus to Broadway & Regent.
- The 28th Baseline count location was moved approximately ¼ mile east near the law school.

The additional count locations for 2010 are as follows:

- Folsom Field & Colorado;
- Broadway & 18th;
- Broadway & 16th;
- Broadway & Pennsylvania; and
- Broadway & University.

Methodology

The 2010 counts were conducted in a slightly different manner from 1998. In addition to adjusting some of the locations, the 2010 counts started at 7:30 am (as opposed to 8:30 am in 1998), no afternoon counts were taken, outbound traffic was counted (outbound was excluded in 1998), and skateboarders were added as a count designation. These changes were made to provide a more complete estimation of non-motorized travel accessing campus. The weather was clear/partly cloudy the morning of October 6th, with temperatures in the low to mid 50's.

Findings

In total 11,417 individuals were counted walking, biking or skateboarding to campus, Wednesday October 6th. This number represents a significant percentage of individuals travelling to campus by non-motorized transportation. Some basic assumptions were made about individuals travelling to campus, as displayed in Table 2-4.

Table 2-4
2010 Count Figures/Mode Share Estimates

Off-Campus Students	25,600
Faculty/Staff	6,730
Total Potential Commuters	32,330
Total Inbound Count (bike/ped/skate)	11,417
Pedestrians (7,426)	23.0%
Bicyclists (3,764)	11.6%
Skateboarders (227)	0.7%
Total est. Non-Motorized Mode Share	35.3%

In some regards the count results correspond with the findings from the *2010 University of Colorado Commuter Survey*, which found that 16% of students and 9% of faculty/staff typically use a bike to get to campus. The *Commuter Survey* also reports that 25.3% of students and 6% of faculty typically walk to campus. These numbers are somewhat lower than the count totals. This could be attributed to double counting, pass through traffic, multiple trips by the same person as well as individuals that drive, park in the residential neighborhoods, and then walk in to campus; or on-campus students who also traversed the count location sites.

The 2010 counts do not presuppose to be an exhaustive summary of all non-motorized travel to campus. There are individuals who access campus at numerous places whether it be an officially designated crossing or at an informal crossing of convenience that did not fall under count supervision. Furthermore, the CU-Boulder campus plays an integral role in the greater City of Boulder bicycle and pedestrian network; therefore it is likely that there were people included in the counts who use the CU network to get to their destination, though it might not be their destination.

Despite these factors, the counts still allow some general assumptions to be made about non-motorized traffic in and around campus. As shown in Table 2-4, from the 2010 counts we can estimate that nearly a quarter of all individuals coming to campus do so by foot. Additionally, about percent 12% came to campus by bicycle. The results also tell us where more bicyclists, pedestrians and skateboarders are accessing campus. Understanding this data will allow the plan to address the areas of greatest significance to CU-Boulder's connectivity with the greater City of Boulder bicycle and pedestrian network.

The count results were compiled in 15 minute increments, allowing for peak hour data to be collected. Campus-wide, the busiest times for non-motorized activity were between 10:00 and 11:00 am, with peak travel beginning at 10:45 am. These results coincide with the class schedule on Monday/ Wednesday/Friday, where classes end at 10 minutes to the hour, and new classes start at the top of each hour. For a full break out of count data at each location, refer to Appendix 1.

The count results in Table 2-5 break out the count totals by aggregated skateboard, bicycle and pedestrian activity.

Table 2-5
2010 Count Locations Ranked by Activity

	Skates	Bikes	Peds	Total
Folsom & Colorado	26	738	977	1741
16th & Broadway	19	405	1030	1454
Broadway & College	40	199	1123	1362
Broadway & University	28	403	711	1142
28th & College	21	500	492	1013
Lot 169 & Stadium	0	151	493	644
17th & University	8	217	478	703
Broadway & Pennsylvania	12	80	568	660
Athens Court	7	49	481	537
18th & Broadway	33	96	379	508
Baseline & Broadway	2	366	105	473
28th & Aurora	4	213	295	512
South Broadway Tunnel	7	296	54	357
Broadway & Regent	20	51	240	311
TOTALS	277	3,764	7,426	11,417

Analyzed by specific mode choice, the count locations rank differently.

The count data shows that the most popular places for pedestrians accessing campus were along Broadway (with the exception of Folsom and Colorado), as shown in Figure 2-4. This can be explained by the proximity of residential housing on the western border of campus, and Broadway which serves as the major boundary of campus to the south and west. The high levels of pedestrian activity at Folsom Field and Colorado can be explained by Colorado and Folsom being major arterial roads connecting campus from the west and north, respectively.

Figure 2-4
2010 Pedestrian Counts

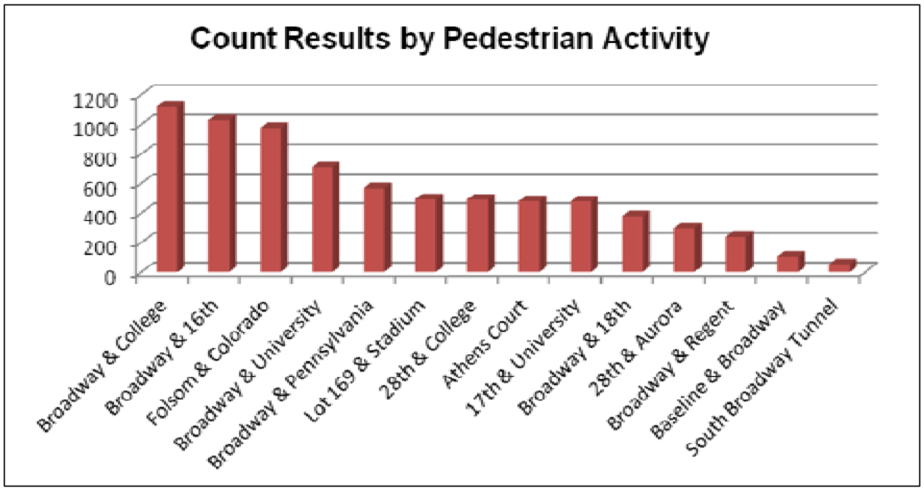
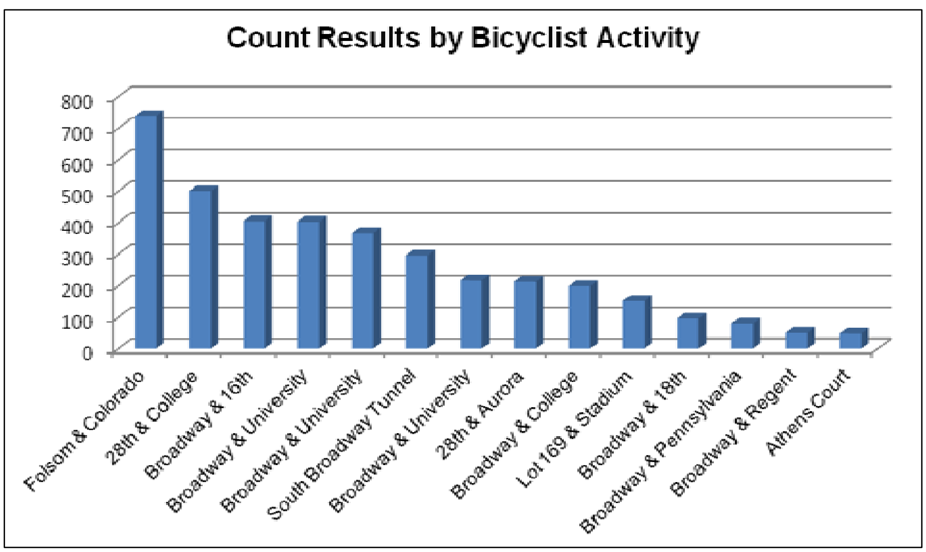


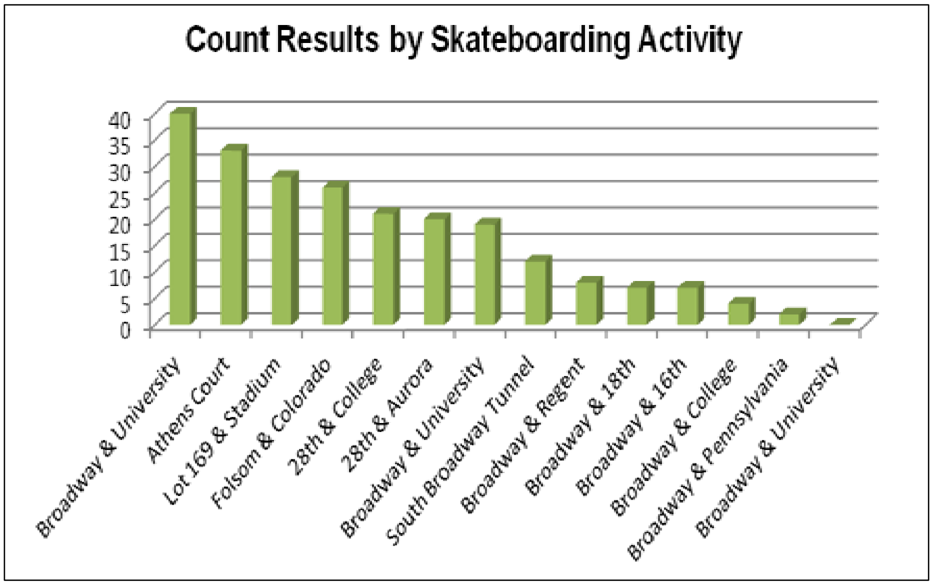
Figure 2-5
2010 Bike Counts



The top locations are equally distributed around campus, with high numbers coming from the east (28^{th} and College), south (Baseline and Broadway), west (Broadway and University/16^{th}) and north (Folsom Field & Colorado Avenue). With the exception of 16^{th} and Broadway, the remaining count locations all connected to campus via some level of bicycle facility, whether it is an off-street bike path or on-street bike lane.

Skateboarding activity is displayed in Figure 2-6.

Figure 2-6
2010 Skateboarding Counts



Skateboarding was prevalent in many of the same locations where bicycle and pedestrian numbers were high, but also at count locations where walking and biking counts were moderate or low by comparison, e.g. 18th and Broadway.

1998-2010 Comparison

As mentioned earlier, some of the count locations from the 1998 counts were used or slightly modified, making an accurate comparison of bicycle and pedestrian activity and access possible at certain locations accessing the CU-Boulder campus. Because the 2010 counts started an hour earlier than the 1998 counts, the 2010 data had to be modified to exclude the first hour of counts. After this adjustment, the results show moderate to significant increases in walking and bicycling at many of the locations. This comparison is outlined in Table 2-6.

Table 2-6
2010 Count Data Comparison

	1998		2010		% change	% change
Location	Bikes	Peds	Bikes	Peds	(bike)	(ped)
Broadway/Baseline	177	45	279	74	58%	64%
28th & College	194	243	398	375	105%	54%
28th & Aurora	150	183	164	218	9%	19%
South Broadway Tunnel	104	32	200	50	92%	56%
Broadway & College	176	1098	153	940	-13%	-14%
17th & University	110	206	179	384	63%	86%
Athens Court	15	280	38	383	153%	37%
Lot 169/Stadium	21	221	119	408	467%	85%

Only one of the locations reported a decrease in bicycle and pedestrian levels. The College Avenue underpass (beneath Broadway) reported a 13% drop in bicycling and 14% in walking figures. The underpass makes for a convenient way to cross Broadway, so it would be expected to see high levels of use. There are several factors that may explain the decline in activity at this location.

One reason for a decline may be attributed to the considerable change that “the Hill” community has undergone in the past few years. The commercial district is not as economically prosperous as it once was, and students now have more housing options to choose from than the Hill. In addition, the RTD *Hop* altered its route along Broadway and in so doing, relocated some of its stop locations. These factors could have contributed in the decline of non-motorized access at this location.

Another factor for the decline might be that bicyclists and pedestrians are choosing to access campus at other points, due to the design of the underpass. The unique design of this underpass marks the intersection between the Broadway multi-use path and an underpass with high levels of non-motorized use. The high levels of activity at this intersection are uncontrolled, making it potentially hazardous.

Count Data Verification

To assure that the data collected on October 6th was not atypical, a sample follow-up count was conducted on the following day to compare count results. Table 2-7 shows the outcome of this effort.

Table 2-7
Count Data Comparison by Day

Date	Location	Skates	Bikes	Peds	Total
10/6	Lot 169/Stadium Dr	0	151	493	644
10/7	Lot 169/Stadium Dr	0	144	505	649
10/6	28th/College Ave	21	500	492	1013
10/7	28th/College Ave	19	512	457	988
10/6	Broadway/University Ave	28	403	711	1142
10/7	Broadway/University Ave	38	391	755	1184

Comparing the counts taken at the same location, but on different days, shows a nominal difference in total skateboard, bicycle and pedestrian activity. Because of the consistency of the data recorded over the two-day period, we can infer that the counts taken, campus wide, reflect a typical travel day for most students and faculty/staff.

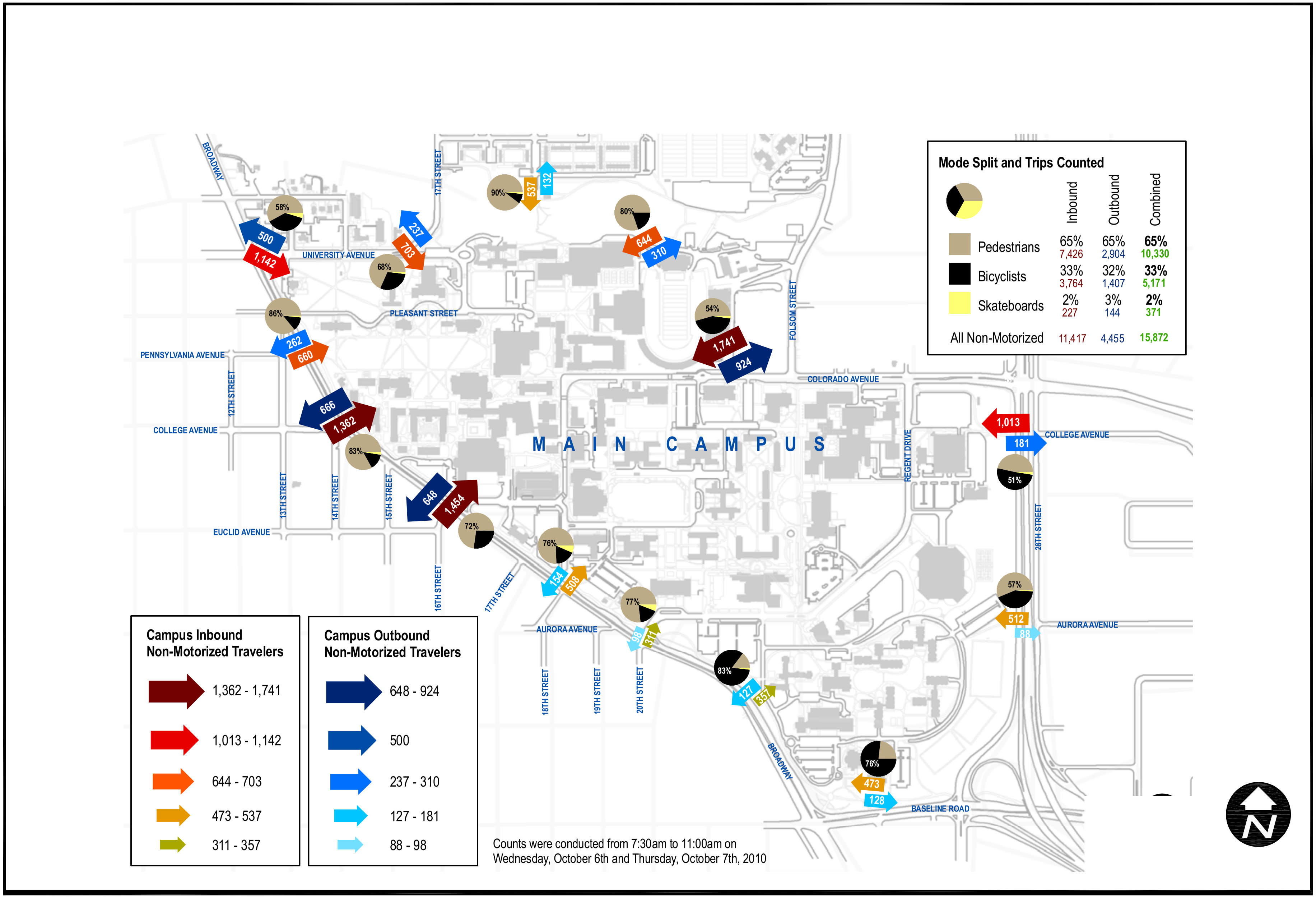
Conclusion

The 2010 counts represent a professionally executed count methodology. Successive counts should use the 14 locations used in the 2010 effort and additional locations as growth/expansion of the university warrants. Additional efforts should also monitor bicyclists, pedestrians and skateboards between 7:30 and 11:00 am. Goals could be set to see an increase in non-motorized travel to campus, using the 2010 count as a baseline.

The 2010 results show high levels of walking and bicycling. Skateboarding was not recorded in significant levels and represented approximately 2% of non-motorized travel. Helmet use, while not officially recorded, was informally noticed by count volunteers as low.

The count data shows the importance of Broadway as a pedestrian and bicycle access point and corridor. Ongoing efforts to enhance non-motorized utilization should focus on Broadway and its connection to the greater City of Boulder network. As the East Campus is developed, bicycle and pedestrian access should be considered and linkages improved between the two. Currently, the Boulder Creek path serves both Main and East Campus – and access points to the Boulder Creek should be re-examined to strengthen its connection to campus and its utility as a bikeway.

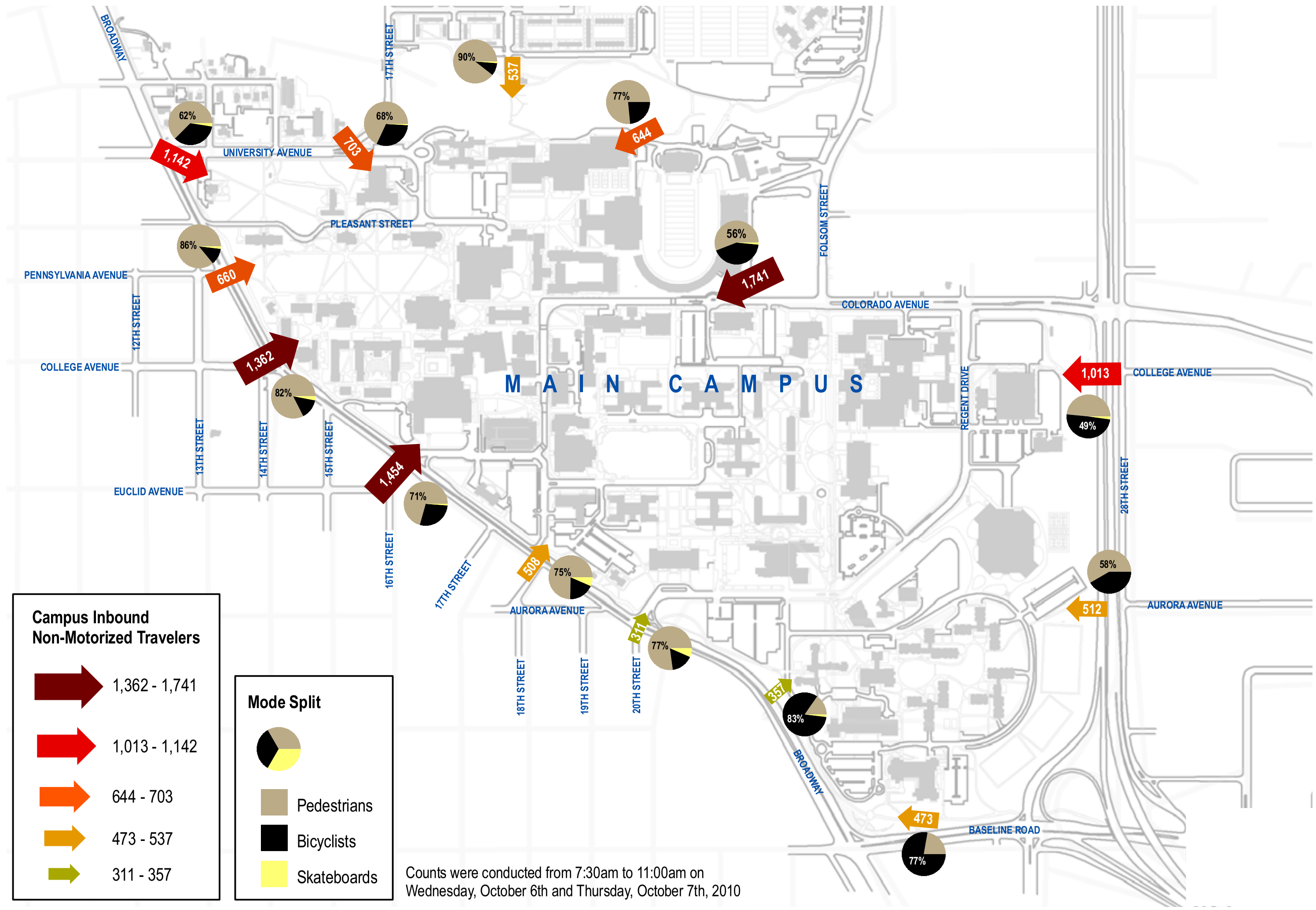
For a complete graphic depiction of the 2010 count data, please refer to Figures 2-7 to 2-9 on the following pages.



AM Non-Motorized Transportation Counts and Splits (Toward and Away from CU Boulder Main Campus)

CU-Boulder Transportation Master Plan

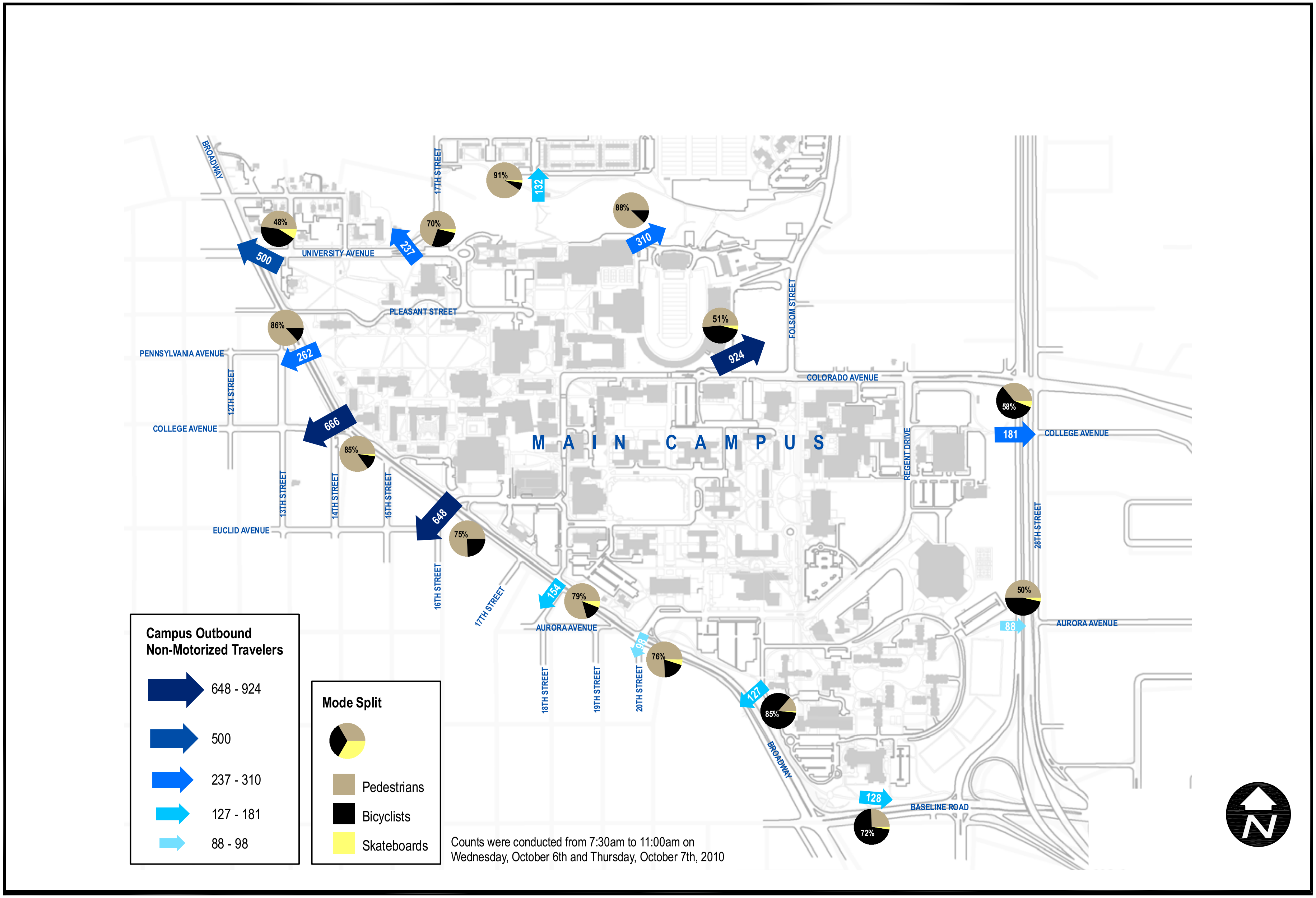
Figure 2-7



Peak Direction AM Non-Motorized Transportation Counts and Splits (Toward CU Boulder Main Campus)

CU-Boulder Transportation Master Plan

Figure 2-8



Peak Direction AM Non-Motorized Transportation Counts and Splits (Away from CU Boulder Main Campus)

CU-Boulder Transportation Master Plan

Figure 2-9

2.4 Transit

2.4.1 Existing Transit Services

The CU-Boulder Campus is served by transit at different scales from regional to local to campus-only. It is served by 28 total routes, 20 directly serving campus and eight more with nearby transfer connections. As Table 2-8 shows, this puts CU-Boulder in the top 9% of universities with regard to campus transit service. The City of Boulder, Boulder County, and CU have participated in extensive amounts of cooperative planning. Most transit services are based on the philosophy of high-frequency, direct routing along major arterial streets. Transit services are provided by three different operators: RTD, CU, and the City of Boulder/Special Transit. The services of each will be described in that order.

Table 2-8
Number of Routes Serving University Campuses

	Number of Bus Routes Serving Other Campuses			
	1-5	6-10	11-20	21+
Number of Campuses	30	29	22	8
Percent of Campuses	34%	33%	25%	9%

n = 89.

Source: TCRP Synthesis 78: Transit Systems in College and University Communities, 2008

2.4.1.1 RTD-Operated Transit

Figure 2-10 shows the RTD transit routes to all three of the CU-Boulder Campus locations. Table 2-9 provides additional information about the routes.

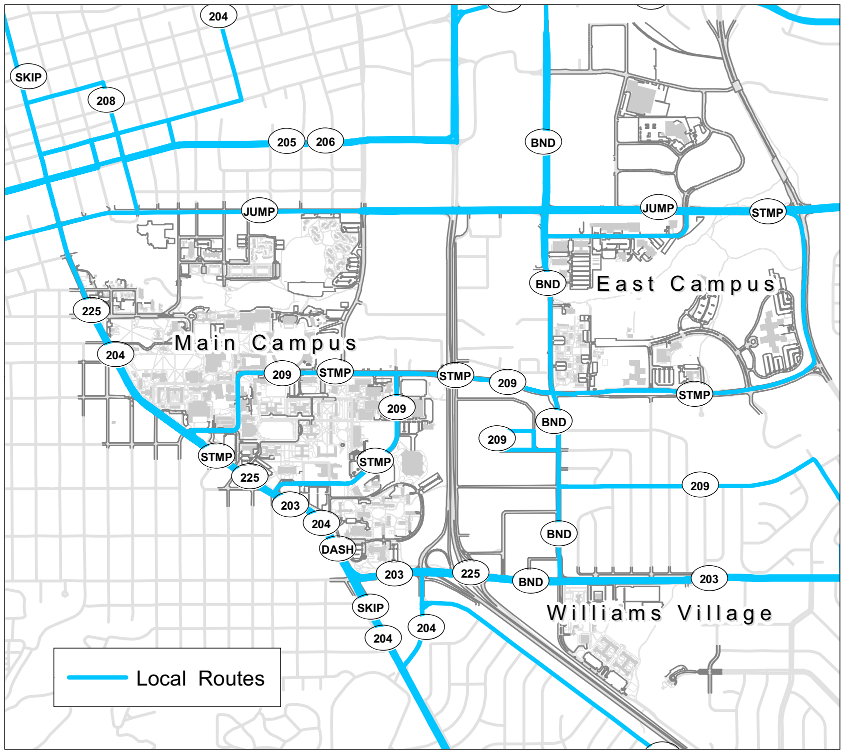
Main Campus

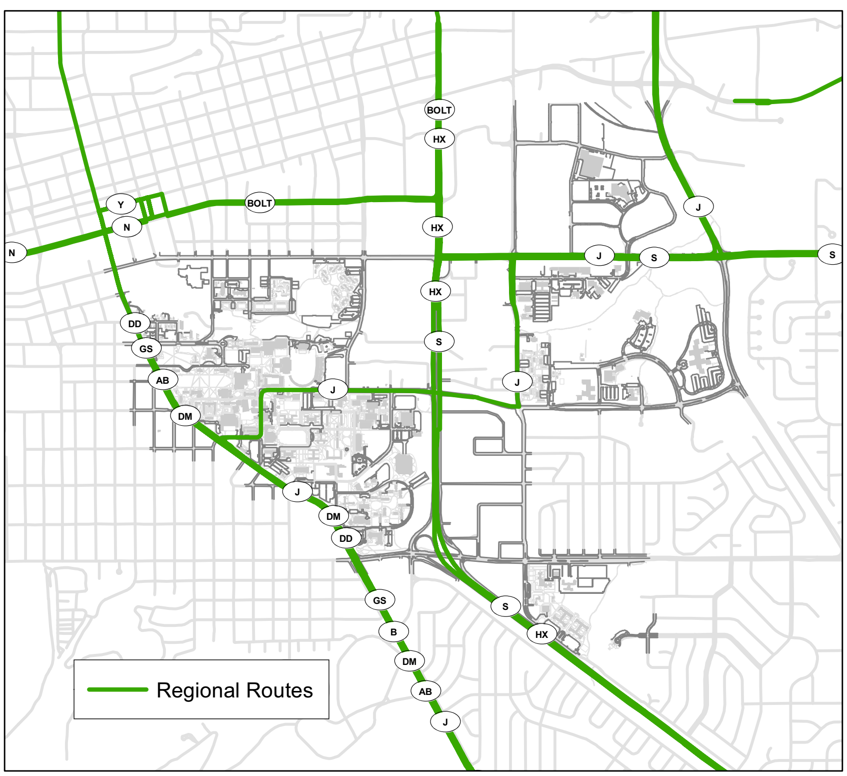
The CU-Boulder Main Campus is directly served by sixteen routes, of which eight are local routes and eight are regional/SkyRide. Of the eight local routes serving Main Campus, five serve the west edge of the Main Campus and are oriented north-south along the Broadway corridor (203, 204, 225, Dash, & Skip). Two routes are oriented east-west along the 18th Street/Colorado Avenue corridor (209 and Stampede). The eighth local route touches the south edge of the Main Campus along Baseline Road (Bound).

Of the five local routes serving the west edge of campus along Broadway, four also serve as the connecting routes for many other routes that converge at the Boulder Transit Center (203, 204, 225, and Dash). The Skip provides connections with a two-block walk from the Boulder Transit Center to Broadway and provides transfer opportunities to other routes it intersects. The HOP provides connections from CU to the Boulder Transit Center, but not in the opposite direction.

Seven routes serve the Boulder Transit Center and require transfers to reach the CU Campus. Those seven routes are: 205, 206, 208, Jump, Bolt, N, and Y. These routes provide important connections to City of Boulder and Boulder County locations of Gunbarrel, East Boulder, Valmont/55th/East Arapahoe, Lafayette & Louisville, Longmont, Nederland, and Lyons, respectively.

Of the eight regional/SkyRide routes serving Main Campus, five are oriented north-south along the Broadway corridor (AB, B/BX, DD, DM, GS). Route J passes east-west through the Main Campus via the 18th Street/Colorado Avenue corridor. The remaining two regional routes touch the east edge of Main Campus along 28th Street (HX and S).





RTD Bus Routes

CU-Boulder Transportation Master Plan

Figure 2-10

Table 2-9
RTD Routes Serving CU-Boulder and Nearby Connecting Routes

		Route Extents		Weekday Frequency		Connections				Main Campus								East Campus					WV	
Route Number or Abbrev.	Route Name	From	To	Peak (minutes)	Off-Peak (minutes)	BTC	Folsom/Arapahoe	28th/Canyon	28th/Colorado	Baseline: B'dway to US-36	B'dway: Univ to Euclid	B'dway: Euclid to Regent	B'dway: Regent to Baseline	Colorado/18th	Folsom: Colo to Canyon	Regent: B'dwy to Colorado	28th Street: Baseln to Arap.	Arapahoe: 30th to Footh.	Colorado: 28th to Footh.	Discovery	Marine: 30th to Arapahoe	30th Street: Colo to Arap	Baseline: US-36 to	30th Street: Baseln to Colo
<u>Local Routes</u>																								
203	Boulder/Lafayette via Baseline (see also 225)	Boulder Transit Center	East Boulder Community Center	30	30	✓				✓	✓	✓	✓										✓	
204	Table Mesa/Moorhead/N. 19th	Broadway/Lee Hill Road	Table Mesa Dr/ Vassar	15	30	✓				✓	✓	✓	✓											
205	28th Street/Gunbarrel	Heatherwood	Boulder Transit Center	15	30	✓		✓																
206	Pearl/Eisenhower	Fairview HS	Boulder Transit Center	30	30			✓																
208	Iris/Valmont	Boulder Transit Center	55th/Arapahoe	30	30	✓																		
209	CU/Thunderbird (see also	CU	Thunderbird/Pima	10	15				✓			✓		✓		✓			✓					
225	Boulder/Lafayette via Baseline (see also 203)	Boulder Transit Center	Lafayette	30	30	✓				✓	✓	✓	✓										✓	
BOUND	30th Street	30th/Diagonal	NOAA/NIST, Broadway/27th	10	10					✓												✓	✓	✓
DASH	Boulder/Lafayette via Louisville [via South Boulder Road]	Boulder Transit Center	Louisville and Lafayette	15	15	✓					✓	✓	✓											
JUMP	Boulder/Lafayette via Arapahoe	Boulder Transit Center	Lafayette	10	10	✓	✓											✓						
SKIP	Broadway	Broadway/Lee Hill Road	Fairview HS	6	10						✓	✓	✓											
STMP	Stampede	Broadway/Euclid	Arapahoe/Foothills	10	10							✓		✓		✓		✓	✓		✓	✓		
<u>Regional & SkyRide Routes</u>																								
AB	DIA/Boulder via US 36	Boulder Transit Center	DIA	30	60	✓					✓	✓	✓											
B/BF/BX	Boulder/Denver	Boulder Transit Center	Market Street Station	10	30	✓					✓	✓	✓											
BOLT	Longmont/Boulder	23rd/Main Longmont	Boulder Transit Center	30	30			✓																
DD	Boulder/Colorado Blvd.	Boulder Transit Center	Colorado/I-25 (Colorado Station)	30	--	✓					✓	✓	✓											
DM	Boulder/Anschutz-Fitzsimons	Boulder Transit Center	Anschutz - Fitzsimons	30	--	✓					✓	✓	✓											
GS	Golden/Boulder	Boulder Transit Center	Federal Center Building	30	--	✓					✓	✓	✓											
HX	28th Street/Civic Center	28th/Walnut	Civic Center Station	15	--			✓	✓								✓							
J	Longmont/East Boulder/CU	23rd/Main Longmont	Table Mesa Shopping Center	30	--				✓			✓	✓	✓				✓						
N	Nederland/Boulder	Nederland High School	Boulder Transit Center	60	120	✓																		
S	Denver/East Boulder	Denver Union Station	49th/Pearl Pkwy	30	--				✓								✓	✓						
Y	Lyons/Boulder	Lyons pnR	Boulder Transit Center	60	--	✓																		

Sources: RTD Website, December 2010.

East Campus

The CU-Boulder East Campus is directly served by six routes, of which four are local routes and two are regional. Of the local routes, the Stampede passes along the northern, eastern, and southern edges (Colorado Avenue) of East Campus, while the 209 touches the 30th/Colorado corner. The Bound serves the western 30th Street edge. The other local route, the Jump, serves the northern Arapahoe Avenue edge. The local routes provide all-day service.

The two regional routes serving East Campus both pass along the northern, Arapahoe edge. They are the J and S routes. The J route also runs along the western, 30th Street edge of East Campus on its way to and from Main Campus. Both routes have very limited peak service only, with no off-peak service. Each provides a handful of trips to Boulder in the morning and out of Boulder in the evening.

The East Campus is also indirectly served by two local routes and two regional routes which come within several blocks of East Campus through the Arapahoe/28th (Regional Route HX) and Canyon/28th Street intersections (205, 206, Bolt).

Williams Village Campus

The Williams Village Campus is served by three local routes, two on Baseline Road and one on 30th Street. The 203 and 225 pass east-west along Baseline Road and then travel north-south along Broadway. As such, they connect both campuses. Because neither route enters the Williams Village Campus or the Main Campus, these routes are less convenient than the Buff Bus at making this connection. The Bound route travels north-south along 30th Street, passing by the 30th/Baseline corner of Williams Village Campus and continuing west on Baseline.

2.4.1.2 CU-Operated Transit (Buff Bus)

The Buff Bus is sponsored (funded) by Housing and Dining Services, and operated and administered by Parking and Transportation Services (PTS).[5] It is provided for students living in residence halls. Figure 2-11 shows the Buff Bus routes. The Buff Bus operates each day and night throughout the fall and spring semesters when classes are in session.

The Buff Bus shuttle connects students who live in Williams Village with the Main Campus. It operates between 6:48 am and midnight on weekdays and 10:00 am and midnight on weekends. Late-night service is also provided Tuesday through Sunday mornings between midnight and 3:30 am. The buses run most frequently, at 4-minute frequencies, between 7:19 am and 10:35 am, approximately on 5-minute frequencies from then until 4:16 pm, with decreasing frequencies thereafter.

Source: City of Boulder

The Buff Bus also shuttled residents of College Inn to Main Campus dining facilities at meal times. This service operates 7:30 – 9:30 am Monday through Friday and 5:00 pm – 12:00 midnight Sunday through Friday. The service operates with 15-minute frequencies. This service operated through the 2010-2011 school year end and is being discontinued.

2.4.1.3 Transit Operated by the City of Boulder/Special Transit (the HOP)

The CU-Boulder Main Campus is also served by the HOP. It operates on seven- to ten-minute frequencies from 7:00 am to 7:00 pm, 15-minute frequencies from 7:00 pm to 10:00 pm, and 30-minute frequencies from 10:00 pm to midnight.[6] It has route patterns running in each direction, clockwise and counterclockwise, connecting CU,

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[5] University of Colorado: http://www.colorado.edu/parking/commuting/bus/buffbus.html and Buff Bus schedule brochure for August 2009 – May 2010.
[6] City of Boulder: http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=8832&Itemid=2973

29th Street shopping area, Downtown Boulder/Pearl Street Mall, and the Hill. Figure 2-12 shows the routing.

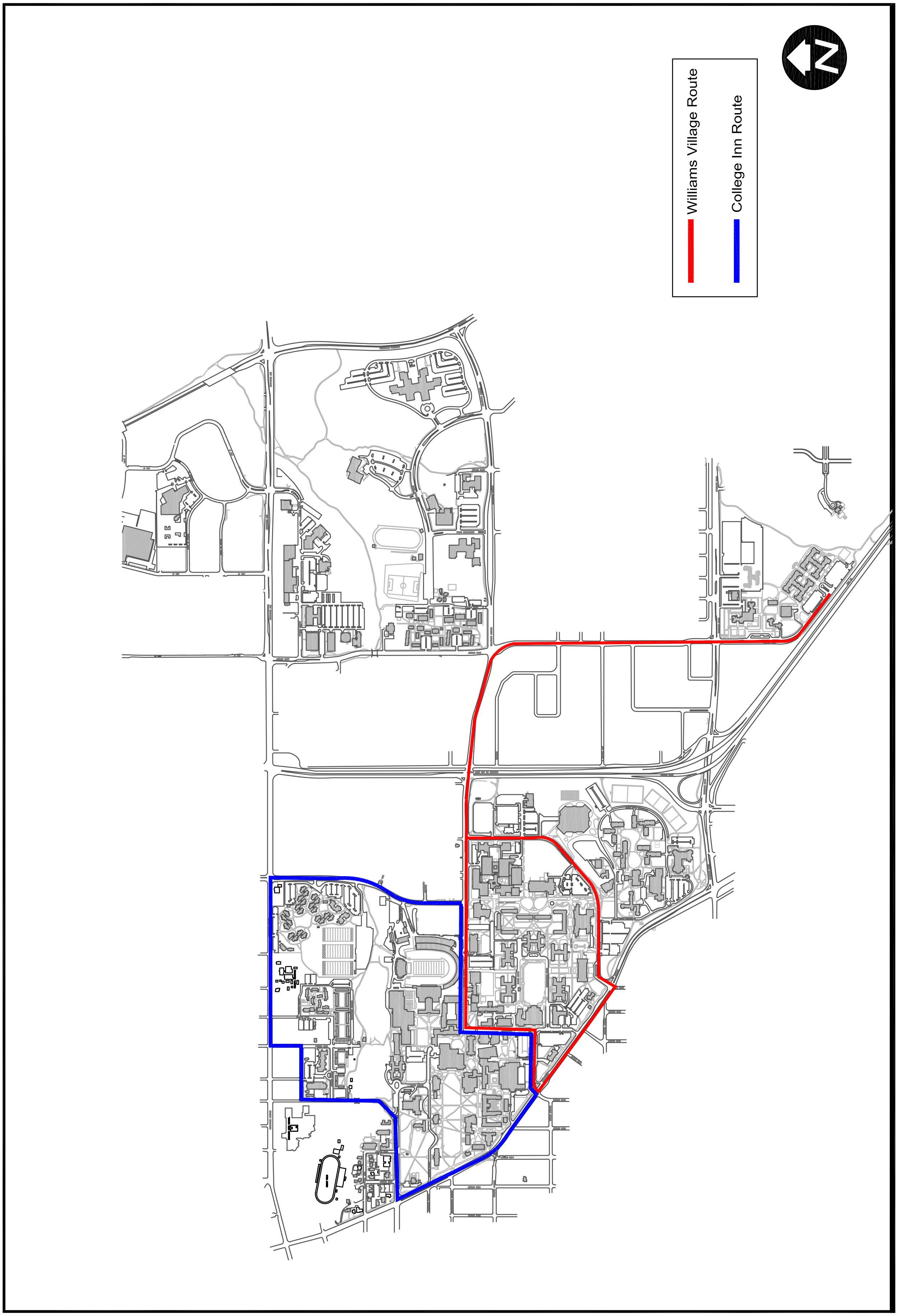
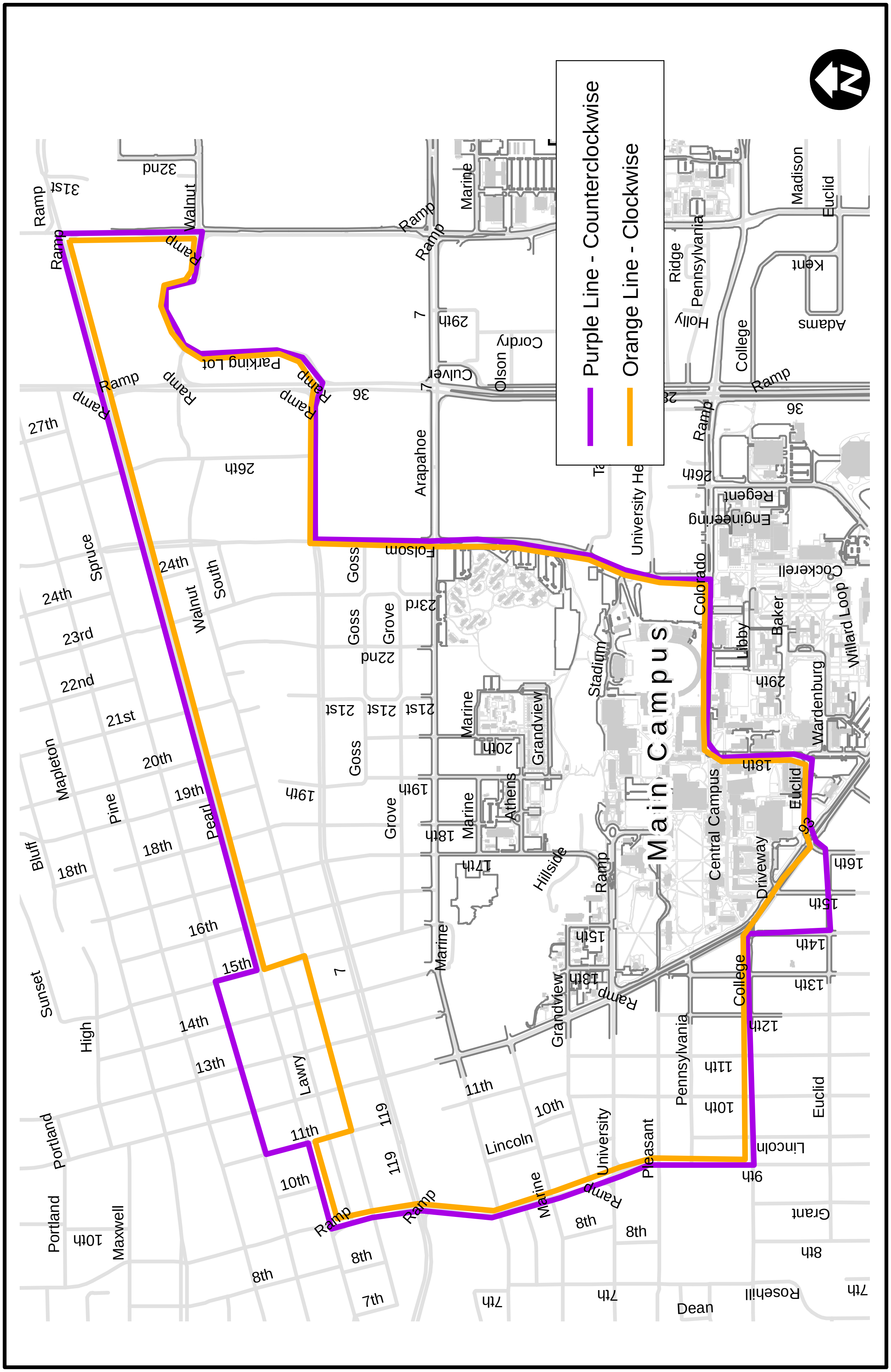


Figure 2-11

Buffs Bus Routes

CU-Boulder Transportation Master Plan



HOP Route

CU-Boulder Transportation Master Plan

Figure 2-12

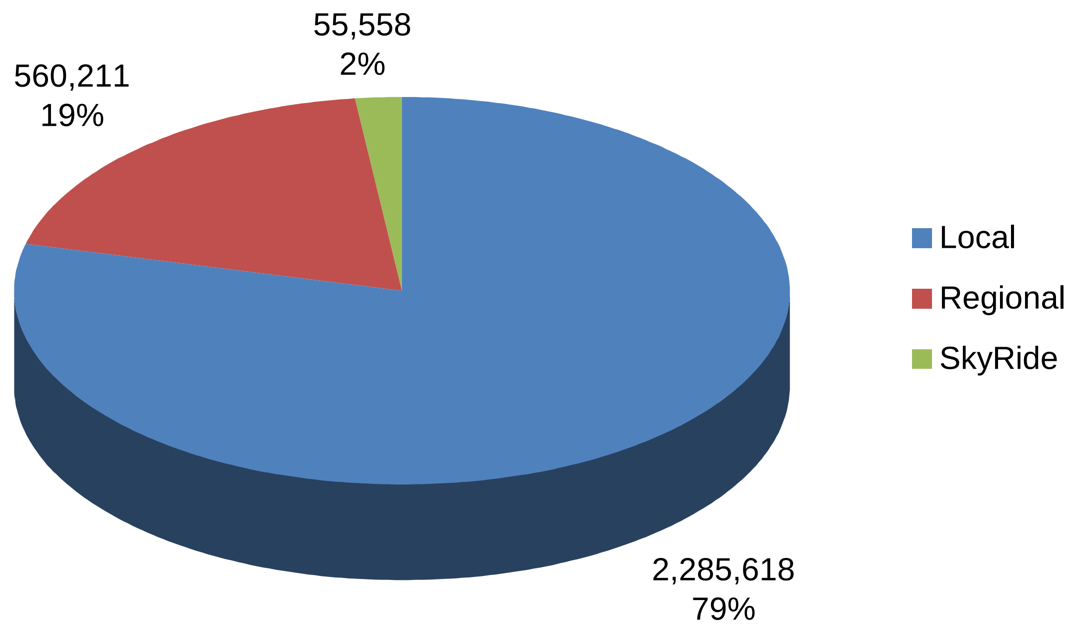
2.4.2 Transit Ridership

Student rider data (boardings) are available by route. Ridership data are important to tracking utilization of services, cost-effectiveness of resources used, and market share. The data also reveal trends over time which can be useful in forecasting future conditions.

2.4.2.1 Existing Ridership

Table 2-10 shows 2009 information for all RTD routes plus the HOP route for which CU student ridership are available. In total, over 2.9 million student trips were made in 2009. Figure 2-13 shows that 79% of 2009 CU student boardings are served by local routes, 19% are by regional routes, and 2% are by skyRide routes.

Figure 2-13
CU Student Boardings by Type of Service



Figures 2-14 and 2-15 show changes in route-level ridership between 2003 and 2009. Figure 2-14 shows routes with more than 50,000 annual riders. HOP and 209 ridership has remained nearly the same over this period. Most other routes have seen large increases.

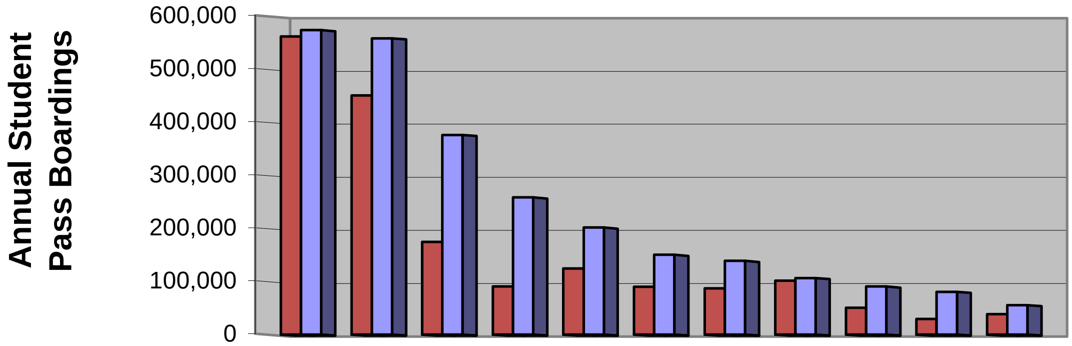
Figure 2-15 shows routes with less than 50,000 annual riders. Some routes have seen large increases in ridership, others have been stable, and a few have lost ridership during this time. The ridership on the J route increased substantially (by 3x) when re-routed from Regent to 18th Street/Colorado Avenue.

Table 2-10
2009 Boardings for Routes Reporting CU Student Pass Use

Route Number	CU Student Boardings	Total Boardings	CU Student Share
203	80,795	211,132	38%
204	138,993	365,673	38%
205	47,202	355,919	13%
206	11,790	164,247	7%
208	7,499	154,387	5%
209	106,823	134,021	80%
225	49,000	147,168	33%
228	7,206	96,215	7%
BOUND	150,442	405,012	37%
DASH	258,374	701,959	37%
HOP	573,753	877,702	65%
JUMP	90,796	542,633	17%
LYNX	2,753	32,063	9%
SKIP	558,439	1,625,538	34%
STAMPEDE	201,753	220,813	91%
Boulder Local Subtotal	2,285,618	6,034,482	38%
B	376,186	1,664,244	23%
BOLT	47,442	395,651	12%
CC[1]	80	2,245	4%
DD	10,499	61,543	17%
DM	9,199	69,865	13%
GS	23,225	104,986	22%
HX	10,625	141,768	7%
J	28,574	62,144	46%
L	29,024	302,400	10%
N	14,789	98,979	15%
S	7,902	46,603	17%
T	986	39,558	2%
Y	1,681	16,201	10%
Intercity Subtotal	560,211	3,006,187	19%
AB	55,558	378,068	15%
SkyRide Subtotal	55,558	378,068	15%
2009 Total	2,901,387	9,418,737	31%

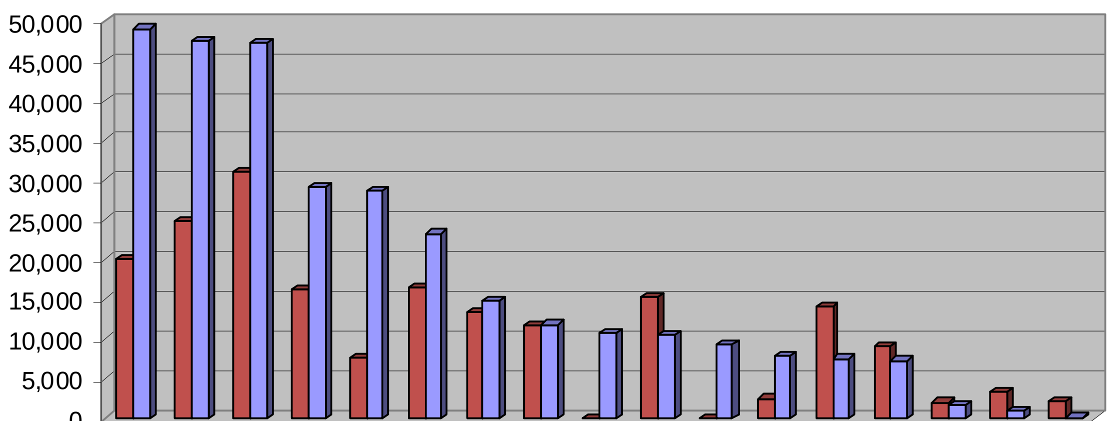
Notes: [1]Discontinued during 2009.
Sources: *RTD. Key 5 data for student boardings.CU for HOP.*
RTD. On-Line File: Performance_2009.xls for totals.

Figure 2-14
2009 CU Student Pass Boardings by Route
(Routes With More Than 50,000 Riders Per Year)



	HOP	SKIP	B	DASH	STMP	BND	204	209	JUMP	203	AB
2003	561,912	451,183	174,708	90,829	125,000	90,053	87,078	101,825	50,585	29,113	38,302
2009	573,753	558,439	376,186	258,374	201,753	150,442	138,993	106,823	90,796	80,795	55,558

Figure 2-15
2009 CU Student Pass Boardings by Route
Routes with Less Than 50,000 Riders Per Year



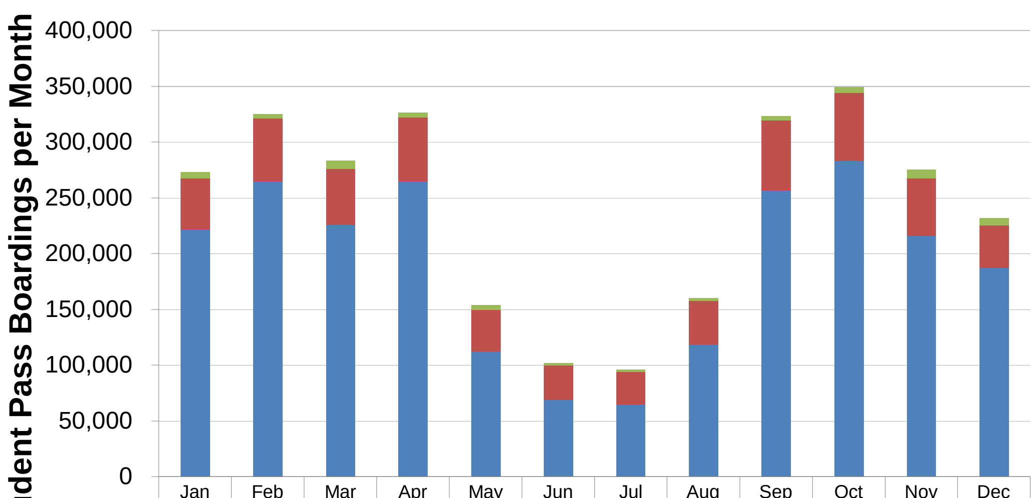
	225	BOLT	205	L	J	GS	N	206	HX	DD	DM	S	208	228	Y	T	CC
2003	19,979	24,714	30,955	16,126	7,649	16,379	13,353	11,650	0	15,246	0	2,471	13,952	9,079	2,034	3,383	2,069
2009	49,000	47,442	47,202	29,024	28,574	23,225	14,789	11,790	10,625	10,499	9,199	7,902	7,499	7,206	1,681	986	80

Additional analysis was completed to understand the share of riders who board routes that directly serve one of the CU-Boulder campus locations. This gives an indication of the preference for one-seat rides versus rides requiring a transfer. The data show that 93% of CU student boardings are on routes with direct service (one-seat ride) to campus, while 7% are on routes requiring a transfer to reach campus.

Depending upon the route, student ridership comprises anywhere from 2% to 91% of total annual ridership. Local routes average 28% CU student boardings, regional routes 19%, and SkyRide 15%. When looking at direct versus indirect routes, direct routes average 30% CU student ridership while indirect routes average 6%.

Figure 2-16 shows the seasonal variation in ridership by month of the year, including all RTD services and the HOP. January through April represents the Spring Semester, June and July the Summer Semester, and September through November the Fall Semester. May, August, and December are all "shoulder" months between semesters. When approached this way, Fall Semester averages 316,100 riders per month. Spring Semester averages 302,300 riders per month, and Summer Semester 99,000 riders per month. The shoulder months average 182,000 riders. Using Fall Semester as the basis of comparison, the Spring Semester averages 95.6% as many riders as the Fall Semester. Summer Semester averages 31.3% as many riders as the Fall Semester.

Figure 2-16
2009 CU Student Boardings by Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SkyRide	5,838	4,134	7,406	4,236	4,242	2,054	2,063	2,605	4,172	4,893	7,881	6,035
Regional	45,889	56,166	50,472	57,314	37,482	30,914	29,136	39,301	62,423	60,907	51,558	38,651
Local	221,609	264,983	225,841	265,129	112,297	69,049	64,811	118,474	256,938	283,347	216,158	186,982

2.4.2.2. Ridership Trends – All RTD Routes

Figure 2-17 shows ridership trends for all routes for which CU student boardings are reported. To be consistent with data from the 2005 *CU Transportation Master Plan* ("Transplan 2005"), these boardings exclude City of Boulder HOP services. The average annual growth rate in CU student boardings over the 17-year period is 7.0% per year.[7] Using a rolling five-year average to account for fluctuations up and down, annualized growth rates in CU student boardings have ranged from 2.9% to 11.7% per year.

Over time, the local routes in the City of Boulder and Boulder County have been the workhorse of the CU student boarding trends. RTD's SkyRide service was added to the Student Pass in 1997. As noted above, in 2009, local boardings represented 74% of all CU student boardings, with this share ranging from 72.3% to 79.0% over the last 17 years. Using five-year rolling averages, the annualized growth in local CU student boardings has been between 3.1% and 12.8% per year, with that growth slowing in recent years.

Regional trips have represented between 19.4% and 25.0% of CU student boardings since 1992. Rolling five-year average growth rates have regional trips between 2.0% and 13.4% per year, with growth increasing in recent years. This suggests that there have been an increasing number of longer-distance trips by CU students. CU student enrollment growth averaged 1.1% growth per year over the period from 1992-2009, with rolling five-year growth rates between 0.0% and 3.1% per year growth.

2.4.2.3 Ridership Trends - Routes with Direct Service to CU

Tables 2-11 through 2-13 show ridership trends for routes with direct service to CU-Boulder, from 2001 through 2009. Table 2-11 shows ridership trends for non-students, Table 2-12 for students, and Table 2-13 for the sum of students and non-students. The data reveal that non-student ridership has had little annual growth (0.2% per year average) over the last nine years. Student ridership, on the other hand, has grown 6% per year over the last nine years. Together, the total growth in direct-to-campus ridership is 1.9% per year. Figure 2-18 shows these trends more graphically.

Several other conclusions come out of these data analyses:

- For local routes with direct service to CU, the share of student riders has risen from 31% to 42% from 2001 to 2009.
- For regional routes with direct service to CU, the share of student riders has risen from 12% to 21% from 2001 to 2009.
- Overall, the share of student riders has risen from 26% to 35% from 2001 to 2009.
- Without the CU student ridership increases, many of the local routes would be showing a gradual loss of ridership overall.
- Because CU student ridership growth is exceeding non-student rider growth in the community, there may be an increasing gap in expectations.
- Total boardings peaked in 2008 when gas prices rose to $4 per gallon.

[7] Some of the growth in student ridership may be attributable to the incorrect coding of CU employees as students when boarding. This observation has been made by CU staff. RTD has provided driver training. New fareboxes with proximity "smart card" technology will improve the accuracy of the data and reduce the burden on drivers to differentiate similar-looking student and employee passes. The new farebox data are expected to be usable in 2012.

Figure 2-17
CU Student RTD Bus Pass Boarding Trends, excluding the HOP
1992 - 2009

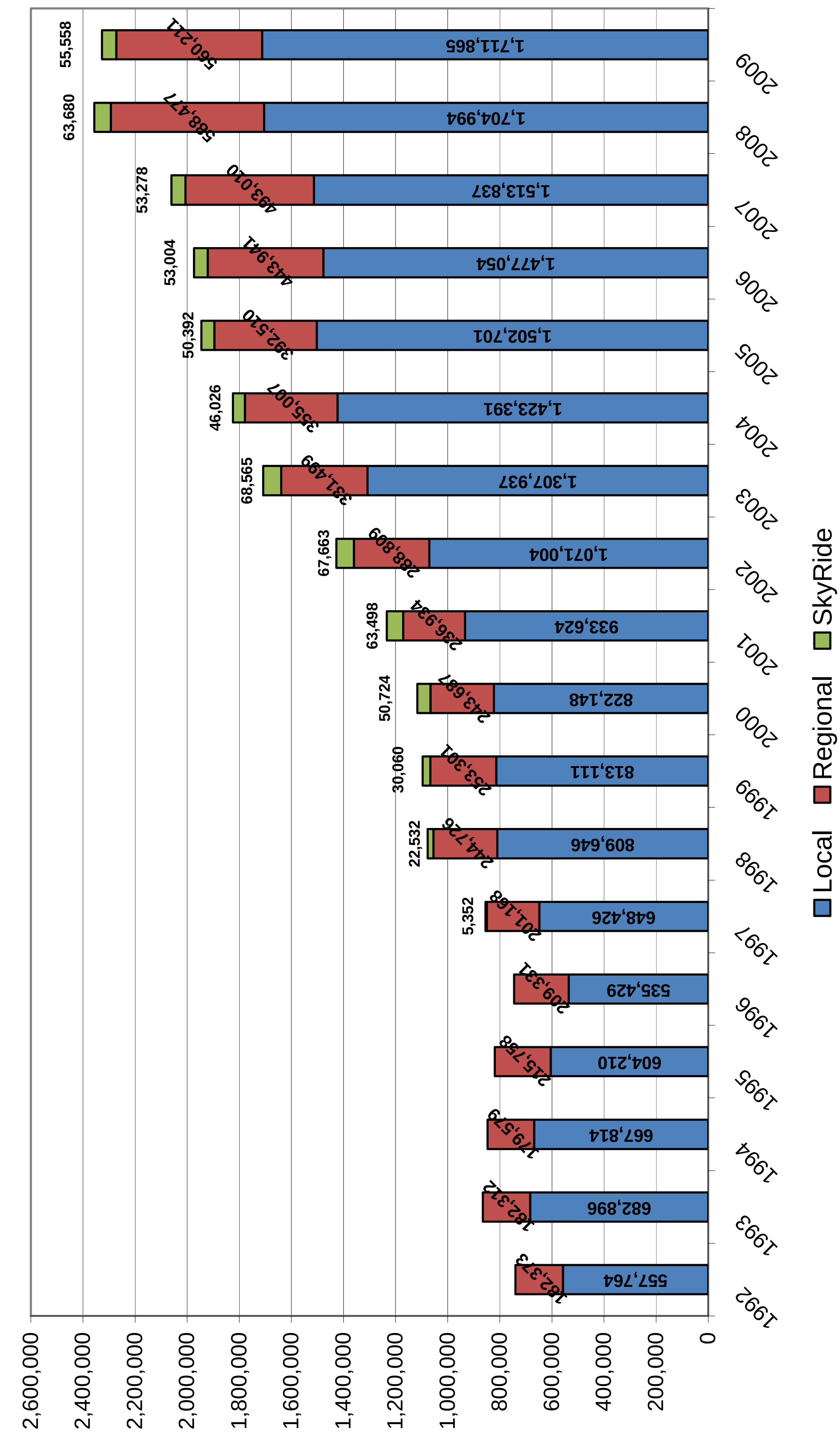


Table 2-11
Non-Student Annual Boardings
(Direct-to-Campus Routes)

Route	2001	2002	2003	2004	2005	2006	2007	2008	2009
Local Routes									
203	92,977	93,359	90,636	119,439	124,771	131,535	151,025	143,814	130,337
204	279,121	243,263	203,529	244,764	232,038	227,305	229,808	240,567	226,680
209	57,342	52,254	45,746	27,763	28,072	27,289	28,785	29,550	27,198
225	68,457	67,266	43,135	53,608	53,097	50,309	53,446	82,596	98,168
Bound	363,934	328,765	259,348	267,719	245,270	246,513	270,975	287,167	254,570
Dash	378,583	363,400	208,865	408,673	403,547	407,182	452,113	468,308	443,585
HOP	423,798	401,894	346,331	306,435	293,676	268,434	315,840	358,761	303,949
Jump	434,153	402,709	584,645	398,742	412,475	417,116	452,208	504,242	451,837
Skip	1,172,933	1,043,739	961,884	943,044	985,411	976,472	1,070,385	1,151,872	1,067,099
Stampede	n/a	13,099	39,886	22,684	18,827	15,961	14,239	20,183	19,060
Local Subtotal	3,271,298	3,009,748	2,784,005	2,792,871	2,797,184	2,768,116	3,038,824	3,287,060	3,022,483
Regional & skyRide Routes									
AB	324,520	331,660	289,077	272,057	239,725	267,416	320,136	360,556	322,510
B/BX	1,018,522	885,065	913,218	996,293	1,145,686	1,195,808	1,360,089	1,477,882	1,288,058
DD	121,811	105,698	91,418	88,685	88,165	73,312	71,231	79,659	51,044
DM	n/a	n/a	n/a	n/a	5,872	17,934	25,534	58,644	60,666
GS	74,931	66,299	62,572	63,683	70,601	72,110	80,447	88,769	81,761
HX	n/a	75,216	87,430	111,280	100,928	97,864	117,115	134,261	131,143
J	18,207	23,037	20,494	22,128	32,554	32,595	31,264	39,997	33,570
S	31,211	24,708	17,223	22,976	26,250	26,622	39,034	32,106	38,701
Regional Subtotal	1,672,662	1,511,682	1,481,432	1,577,102	1,709,781	1,783,662	2,044,851	2,271,874	2,007,454
GRAND TOTAL	4,943,960	4,521,430	4,265,437	4,369,973	4,506,965	4,551,778	5,083,675	5,558,934	5,029,937

Sources: LSC, 2010.

Table 2-12
Annual Boardings - CU Students
(Direct-to-Campus Routes)

Route	2001	2002	2003	2004	2005	2006	2007	2008	2009
Local Routes									
203	25,331	29,113	39,285	42,320	59,065	63,689	67,433	76,412	80,795
204	89,769	87,078	93,928	91,177	105,443	111,335	115,156	131,079	138,993
209	84,853	101,825	80,463	103,015	117,560	106,669	100,375	108,292	106,823
225	24,444	19,979	12,903	18,913	22,641	26,048	20,476	34,542	49,000
Bound	84,472	90,053	85,375	72,475	89,605	104,426	123,761	155,104	150,442
Dash	84,194	90,829	225,171	255,842	262,931	228,548	230,798	259,513	258,374
HOP	627,354	561,912	565,104	561,175	508,466	521,459	565,865	602,682	573,753
Jump	57,062	50,585	47,761	50,220	67,475	71,939	65,935	89,179	90,796
Skip	418,595	451,183	505,434	534,313	538,767	529,254	544,762	581,830	558,439
Stampede	n/a	59,442	150,596	172,903	173,740	170,181	172,234	190,446	201,753
Local Subtotal	1,496,074	1,541,999	1,806,020	1,902,353	1,945,693	1,933,548	2,006,795	2,229,079	2,209,168
Regional & skyRide Routes									
AB	46,233	51,069	41,529	46,026	50,392	53,004	53,278	63,680	55,558
B/BX	138,037	174,708	201,866	235,899	249,347	289,298	321,876	383,464	376,186
DD	12,085	15,246	16,980	15,705	18,440	19,640	19,204	15,662	10,499
DM	n/a	n/a	n/a	n/a	530	1,850	2,978	6,228	9,199
GS	15,498	16,379	18,197	20,563	22,901	21,717	24,698	31,087	23,225
HX	n/a	7,306	7,924	8,793	6,343	4,238	5,994	9,449	10,625
J	7,727	7,649	7,718	12,183	20,895	26,917	25,548	33,617	28,574
S	2,519	2,471	2,556	2,448	3,695	5,278	6,968	6,148	7,902
Regional Subtotal	222,099	274,829	296,770	341,617	372,543	421,941	460,543	549,335	521,767
GRAND TOTAL	1,718,173	1,816,828	2,102,790	2,243,970	2,318,236	2,355,489	2,467,338	2,778,414	2,730,935

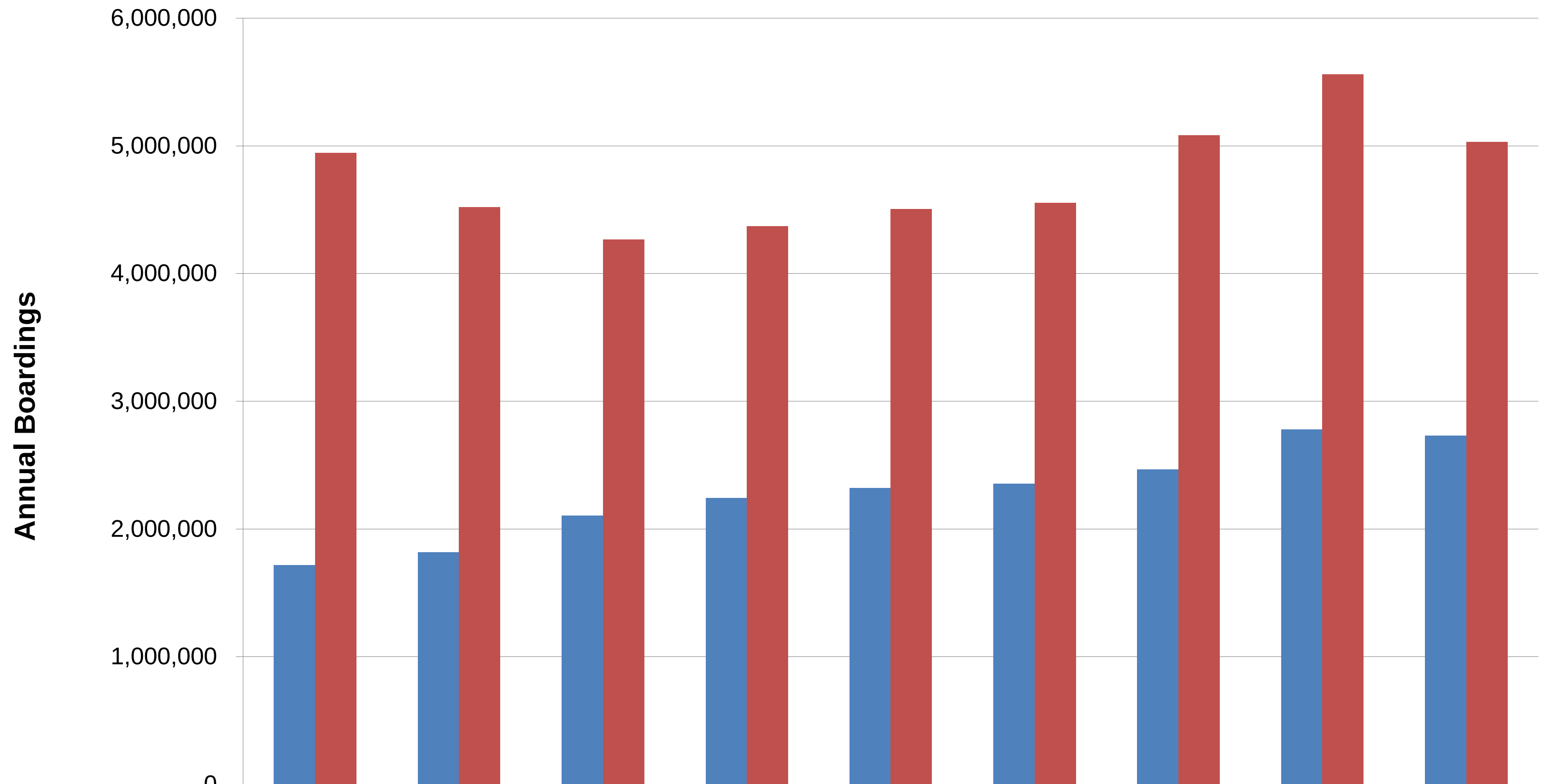
Sources: RTD. Key 5 Data.xlsm, 2010 for all but HOP data. HOP data from CU, 2011.

Table 2-13
Total Annual Boardings - All Riders
(Direct-to-Campus Routes)

Route	2001	2002	2003	2004	2005	2006	2007	2008	2009
Local Routes									
203	118,308	122,472	129,921	161,759	183,836	195,224	218,458	220,226	211,132
204	368,890	330,341	297,457	335,941	337,481	338,640	344,964	371,646	365,673
209	142,195	154,079	126,209	130,778	145,632	133,958	129,160	137,842	134,021
225	92,901	87,245	56,038	72,521	75,738	76,357	73,922	117,138	147,168
Bound	448,406	418,818	344,723	340,194	334,875	350,939	394,736	442,271	405,012
Dash	462,777	454,229	434,036	664,515	666,478	635,730	682,911	727,821	701,959
HOP	1,051,152	963,806	911,435	867,610	802,142	789,893	881,705	961,443	877,702
Jump	491,215	453,294	632,406	448,962	479,950	489,055	518,143	593,421	542,633
Skip	1,591,528	1,494,922	1,467,318	1,477,357	1,524,178	1,505,726	1,615,147	1,733,702	1,625,538
Stampede	N/A	72,541	190,482	195,587	192,567	186,142	186,473	210,629	220,813
Local Subtotal	4,767,372	4,551,747	4,590,025	4,695,224	4,742,877	4,701,664	5,045,619	5,516,139	5,231,651
Regional & skyRide Routes									
AB	370,753	382,729	330,606	318,084	290,117	320,420	373,414	424,236	378,068
B/BX	1,156,559	1,059,773	1,115,084	1,232,192	1,395,033	1,485,106	1,681,965	1,861,346	1,664,244
DD	133,896	120,944	108,398	104,390	106,605	92,952	90,435	95,321	61,543
DM	N/A	N/A	N/A	N/A	6,402	19,784	28,512	64,872	69,865
GS	90,429	82,678	80,769	84,246	93,502	93,827	105,145	119,856	104,986
HX	83,460	82,522	95,354	120,073	107,271	102,102	123,109	143,710	141,768
J	25,934	30,686	28,212	34,311	53,449	59,512	56,812	73,614	62,144
S	33,730	27,179	19,779	25,424	29,945	31,900	46,002	38,254	46,603
Regional Subtotal	1,894,761	1,786,511	1,778,202	1,918,720	2,082,324	2,205,603	2,505,394	2,821,209	2,529,221
GRAND TOTAL	6,662,133	6,338,258	6,368,227	6,613,944	6,825,201	6,907,267	7,551,013	8,337,348	7,760,872

Sources:
RTD. On-Line File: Performance_2001_Table.xls
RTD. On-Line File: Performance_2002_Tables_&_Charts.xls
RTD. On-Line File: Performance_2003_Tables_Charts.xls
RTD. On-Line File: Performance_2004.xls
RTD. On-Line File: Performance_2005_Table.xls
RTD. On-Line File: Performance_2006.xls
RTD. On-Line File: Performance_2007.xls
RTD. On-Line File: Performance_2008.xls
RTD. On-Line File: Performance_2009.xls
City of Boulder. HOP data, 2010.

Figure 2-18
Boarding Trends for Routes with Direct Service to CU Boulder



	2001	2002	2003	2004	2005	2006	2007	2008	2009
Student Boardings	1,718,173	1,816,828	2,102,790	2,243,970	2,318,236	2,355,489	2,467,338	2,778,414	2,730,935
Non-Student Boardings	4,943,960	4,521,430	4,265,437	4,369,973	4,506,965	4,551,778	5,083,675	5,558,934	5,029,937

2.4.3. Affiliate Home Locations and Transit Use

The definition of CU affiliates includes students, faculty, and staff. Affiliate locations are based on home addresses from CU records. Figure 2-19 shows affiliate locations within one-quarter mile of a transit stop. The map reflects the *availability* of transit, not the actual use by affiliates.

By mapping the location of affiliates and merging it with survey data, the relationship between transit mode share and distance from campus can be seen. The left side of Figure 2-20 shows transit mode share from zero to five miles from campus. Transit mode share is lowest one mile or less from campus. At that distance, more people walk (47%) than bicycle (19%) or take transit (18%). In the range of more than one mile and up to five miles, transit has the highest share of any mode of travel to campus.

The right side of Figure 2-20 shows that transit mode share drops in the range from more than five miles and up to twenty miles. In that range, transit mode share is lower (23-25%) as compared to either shorter trips (as described above) or longer trips over twenty miles (30%).

These data are consistent with the averages reported by RTD's 2008 Customer Survey[8]. It had indicated that the average trip distance for Boulder Local riders was 8.1 miles and Regional riders 25.9 miles.

Table 2-14 shows some additional transit analysis of the data. The first set of columns show the number of affiliates by county, providing some indication of location efficiency factors such as the balance of housing costs and transportation costs against income.

The second set of columns shows the number of persons within ¼-mile of a transit route, by county. A total of 86.6% of those affiliates living in Boulder County have transit access. At the bottom of that set of columns is the number which represents the maximum *potential* of affiliates to use transit without a car, roughly 77%.[9]

The third set of columns shows the number of persons within ¼-mile of a transit stop. The final column then computes the difference between the route (line layer) and stop (point layer) level of analysis to show the effect of bus stop density on potential transit access. In the case of Broomfield County, because there are fewer bus stops per mile than in other locations, the potential to use transit is nearly 15% lower than the routing would otherwise offer.

In terms of affecting CU's future VMT and carbon neutral goals, these data suggest that transit trips in the five to twenty mile range would need to be more convenient to have an impact. Because walking and biking become less attractive options with distance, transit and carpooling become the most viable options to single-occupant vehicles. Walk access is key to making transit convenient in the first place.

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[8] 2008 Bus Customer Satisfaction and Travel Characteristics, February, 2008, The Howell Research Group, http://www.rtd-denver.com/PDF_Files/08%20Bus%20Report.pdf

[9] Bike-to-transit access could increase this number slightly. Of total transit boardings, typically 1-2% involve bike access.

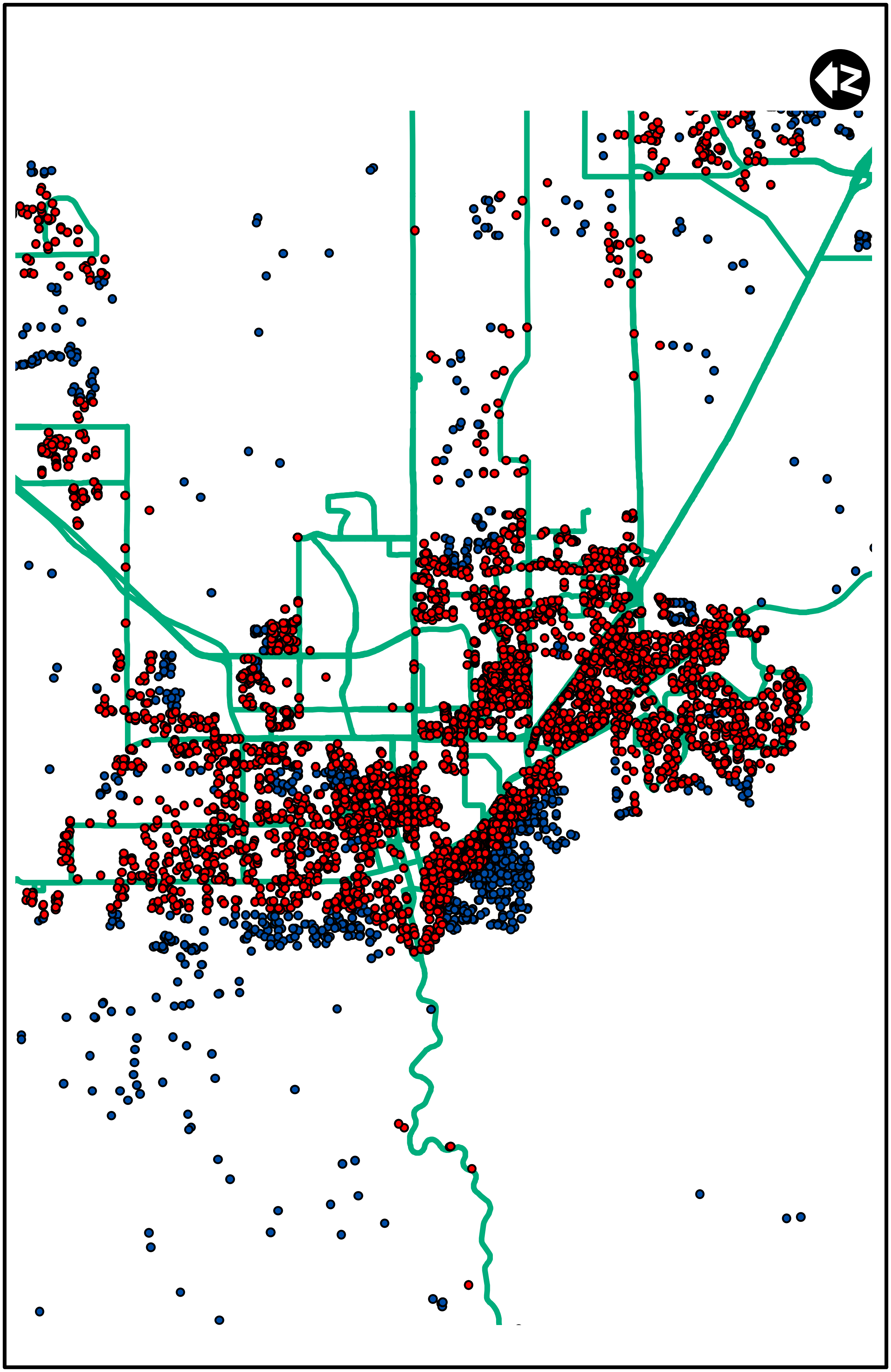
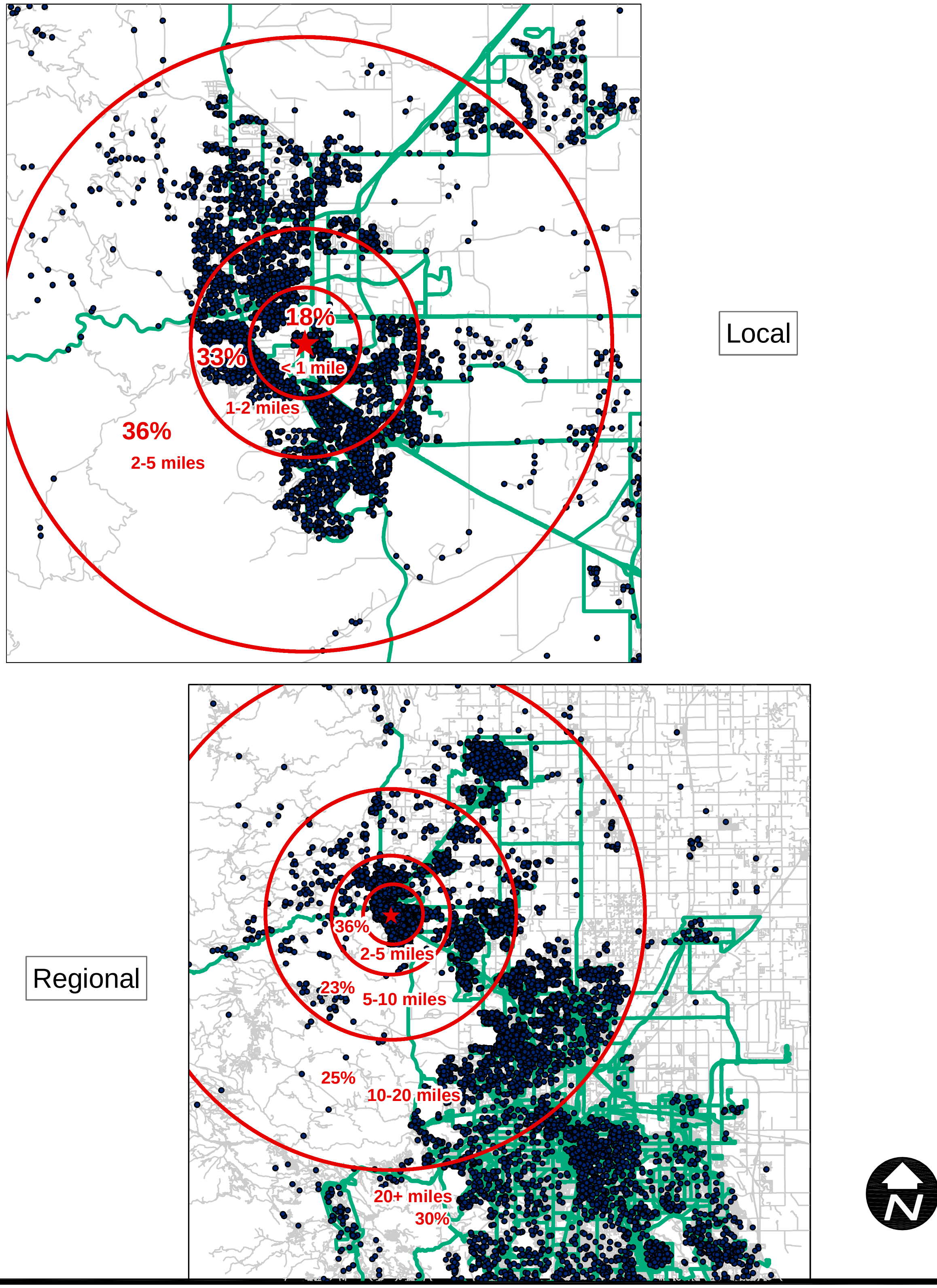


Figure 2-19

Affiliates within One-Quarter Mile of a Transit Stop

CU-Boulder Transportation Master Plan



Transit Mode Share

CU-Boulder Transportation Master Plan

Figure 2-20

Table 2-14
Affiliate Transit Accessibility by County

County	Estimate of Total Affiliates		Affiliates with 1/4 Mile of a Transit Route (Line Layer Analysis)		Affiliates with 1/4 Mile of a Transit Stop (Point Layer Analysis)		Effect of Bus Stop Density
	No.	Pct.	No.	Pct.	No.	Pct.	
Adams	1,112	3.1%	730	65.6%	650	58.5%	-7.2%
Arapahoe	1,216	3.4%	635	52.2%	517	42.5%	-9.7%
Boulder	25,499	72.0%	22,087	86.6%	21,414	84.0%	-2.6%
Broomfield	837	2.4%	509	60.9%	387	46.3%	-14.6%
Denver	1,536	4.3%	1,438	93.6%	1,403	91.3%	-2.3%
Douglas	465	1.3%	150	32.2%	109	23.4%	-8.9%
Jefferson	2,526	7.1%	1,617	64.0%	1,368	54.1%	-9.9%
Larimer	482	1.4%	0	0.0%	0	0.0%	0.0%
Weld	210	0.6%	6	2.9%	0	0.0%	-2.9%
Other	1,530	4.3%	0	0.0%	0	0.0%	0.0%
Total	35,413	100.0%	27,173	76.7%	25,848	73.0%	-3.7%

Source: CU-Boulder Data, LSC Analysis, 2011.

2.4.4 Current Transit Funding Models

There are currently four different funding models for transit service to and among the CU-Boulder campuses. CU contributes to the funding of transit services by a variety of means and at different levels depending on who operates the service. Each of the four models will be described.

2.4.4.1 Buff Bus Funding Model

The Buff Bus is funded by CU Housing, operated by CU PTS, and performance monitoring is done by both CU Housing and PTS. The Buff Bus system operates using 30-foot, 40-foot, and 60-foot buses with different cost rates by vehicle. The 40-foot vehicles cost about 20% more than the 30-footers to operate. The 60-foot articulated buses cost about 5% more than the 40-footers to operate. Using an average of the 40-foot and 60-foot costs, the 2010 hourly operating cost is about $85 and the program has seen an average 7.0% growth in costs per year over a four-year period.

2.4.4.2 Stampede Funding Model

The Stampede is jointly funded by RTD and CU, operated by RTD, with performance monitoring done by both RTD and CU. In 2009, the average hourly operating cost was

$138. CU participates in the funding of this service in order to guarantee the desired level of service throughout the day.

RTD charges CU the *marginal* cost per hour which is $76 per hour because CU is "buying up" service during off-peak hours. The Stampede makes use of hours of the day where RTD would otherwise be parking buses and splitting more workers' shifts in areas of the city where there is less demand during the off-peak. Over the last five years, this service has averaged 5.2% per year growth in cost.

2.4.4.3 HOP Funding Model

The HOP is funded by RTD, the City of Boulder, and CU. Over the last ten years, the funding shares have averaged 54.5% RTD, 30.9% City, and 14.6% CU. Costs have risen by an average of 3.5% per year since 2001, with the 2009 operating cost at $1.9 million. The HOP is operated by Special Transit under contract to the City of Boulder. Performance monitoring is done by the City of Boulder.

The 2009 cost per hour was $70. The cost to CU is approximately $10.50 per hour. Costs for this service have grown by an average of 2.2% per year over the last five years.

2.4.4.4 RTD Funding Model

RTD services are grouped into service classes for purposes of cost and performance monitoring against service standards. "These standards are based on the performance of the least productive 10% of the routes in each service class for either the ridership or economic measure, or on the least productive 25% of routes in both measures."[10]

The average cost per hour for the urban local class of service was $126 in 2009. Route 209 meets the average cost per hour, whereas previously mentioned, the Stampede is $138 per hour.

CU supports the achievement of RTD's legislatively-mandated 20% fare recovery ratio by paying for Student Passes through student fees and for its employee's EcoPasses through a funding formula drawing on PTS revenues, a charge to all auxiliary departments, a fixed contribution from the General Fund, and reimbursement from the CU System for its employees. CU's boardings represent 31% of the total boardings of all routes recording student pass use (refer back to Table 2-10), with an inference that CU fares represent a proportional share. The cost to CU is approximately $8 per operating hour for these services ($126 x 0.20 x 0.31). Costs for all urban local services have increased at an average of 2.9% per year over the last five years.

[10] RTD. Service Standards. Revised December 17, 2002. Page 4.

2.5 Vehicular Travel and Facilities

2.5.1 Surrounding Roadway Network

The CU-Boulder campuses are located within the City of Boulder and served by the City's street network which is displayed in Figure 2-21. The street network is the primary transportation system and serves a variety of modes and vehicular types, including automobile, truck, transit, bicycles and pedestrians. Boulder's street system is largely built out and constrained by Boulder being a mature community, so the emphasis is to operate the system as safely and efficiently as possible. The street system is defined by a Street Functional Classification, consisting of a hierarchy of streets from the local streets to collector streets to freeways. These functional classes establish a common understanding of the use of the street and its character, regulate access from adjacent properties and determine how the costs of new street construction are shared between the city and surrounding properties. The most important roadways and planned improvements are described below.

US 36 is a four-lane freeway facility which connects Boulder with the rest of the Denver metro area to the southeast. The freeway terminates at Baseline Road where US 36 becomes a principal arterial, known as 28th Street, north to Iris Avenue, where it transitions to a two-lane roadway connecting Boulder north to Lyons and Estes Park. The US 36 Corridor, between Boulder and Denver, was the subject of an Environmental Impact Study, beginning in 2003, and concluded in 2009 with recommendations for adding a managed lane (Buses, High Occupancy Vehicles and toll paying vehicles), in each direction from I-25 to just west of Cherryvale road, bike facilities and transit stations.

Broadway is generally a four-lane north-south principal arterial within the City of Boulder and provides important vehicular, transit, bike and pedestrian access to Main Campus. The Broadway, Euclid to 18th Street, Project will reconfigure the Euclid and 18th Street intersections, add a pedestrian underpass, and construct transit and bike/pedestrian improvements, as shown in Figure 2-22. Broadway is a state highway (SH 93 south of Canyon Boulevard) and south of the City limits becomes a two-lane roadway with continuity south to the City Of Golden.

Arapahoe Road is a west-east roadway connecting Boulder with Lafayette and I-25 on the east. The classification changes from collector on the west to minor arterial between 9th Street and Folsom Street to principal arterial east of Folsom Street. From Folsom Street to Cherryvale Road, Arapahoe Road has a six-lane cross-section. From 28th Street east to Lafayette, Arapahoe Road is State Highway 7.

Foothills Parkway (SH 157) is a four lane north-south expressway facility (limited access with at-grade intersections) connecting US 36 on the south with SH 119 on the north.

Diagonal Highway (SH 119) is a four lane expressway (limited access with at-grade intersections) connecting Boulder with Longmont on the northeast.

Boulder Canyon (SH 119) is a two lane west–east route connecting Boulder with Nederland and the Peak to Peak Highway.

Baseline Road is a west-east roadway connection Boulder with Lafayette on the east. The classification changes from collector (two-lanes) on the west to principal arterial (four-lanes) between Broadway and Foothills Parkway and minor arterial (generally two-lanes) east of Foothills Parkway.

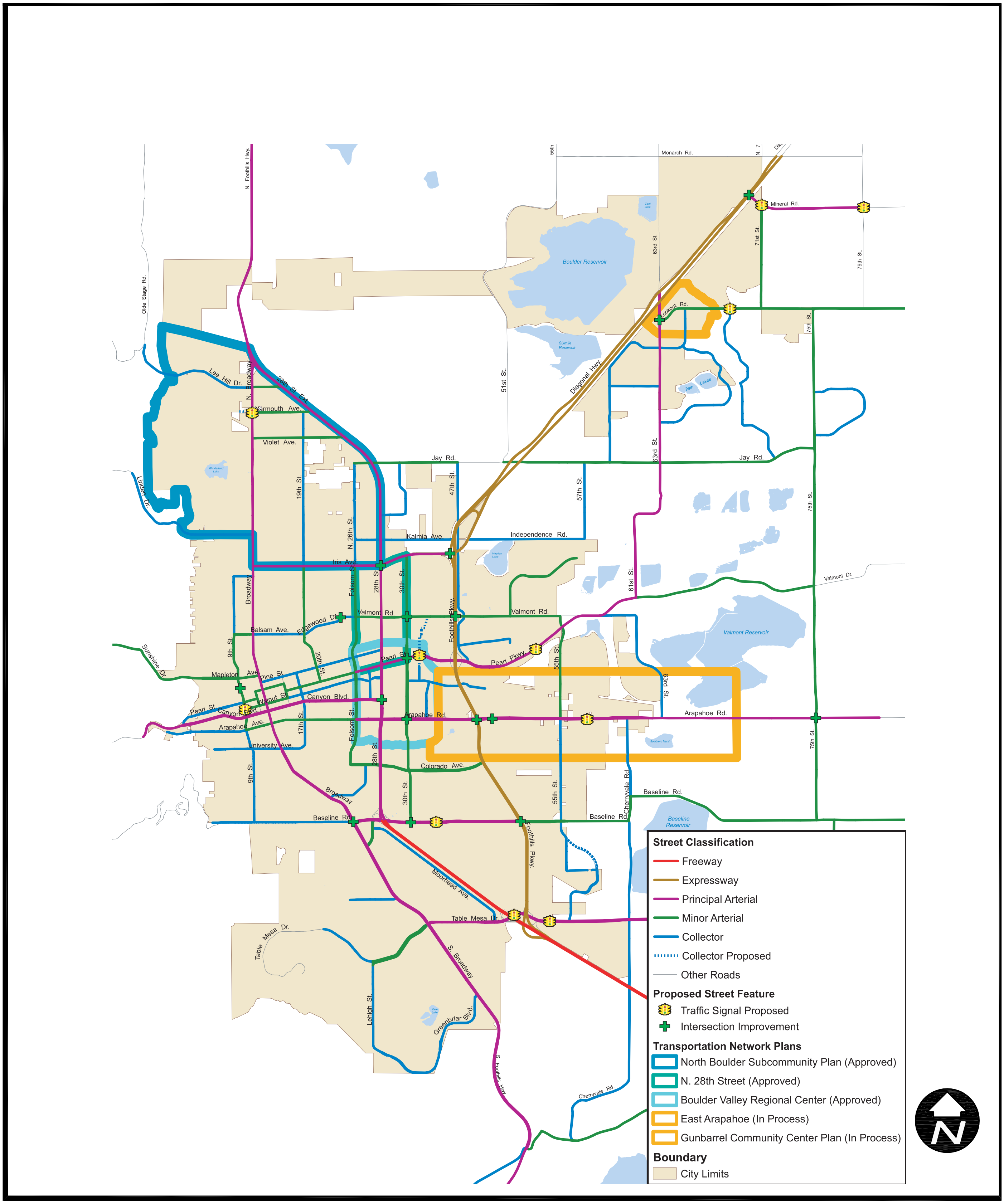
Table Mesa Drive/South Boulder Road is an west-east route connecting Boulder with Louisville on the east. West of Broadway it is classified as a collector/minor arterial. East of Broadway it becomes a four-lane principal arterial.

Folsom Street is a north-south collector/minor arterial connecting Jay Road on the north with Colorado Avenue on the south.

30th Street is a north-south four-lane minor arterial connecting Iris Avenue on the north with Baseline Road on the south.

Colorado Avenue is a west-east four-lane minor arterial connecting Folsom Street on the west with Foothills Parkway on the east. It becomes a two-lane local street from Folsom west through Main Campus to 18th Street.

Regent Drive is a two-lane collector connecting Colorado Avenue on the north with Broadway on the southwest.



LSC TRANSPORTATION CONSULTANTS, INC.

Proposed Function Class and Proposed Street Facilities

CU-Boulder Transportation Master Plan *Figure 2-21*

alta PLANNING + DESIGN

Figure 2-22

Broadway, Euclid to 18th Street Improvements

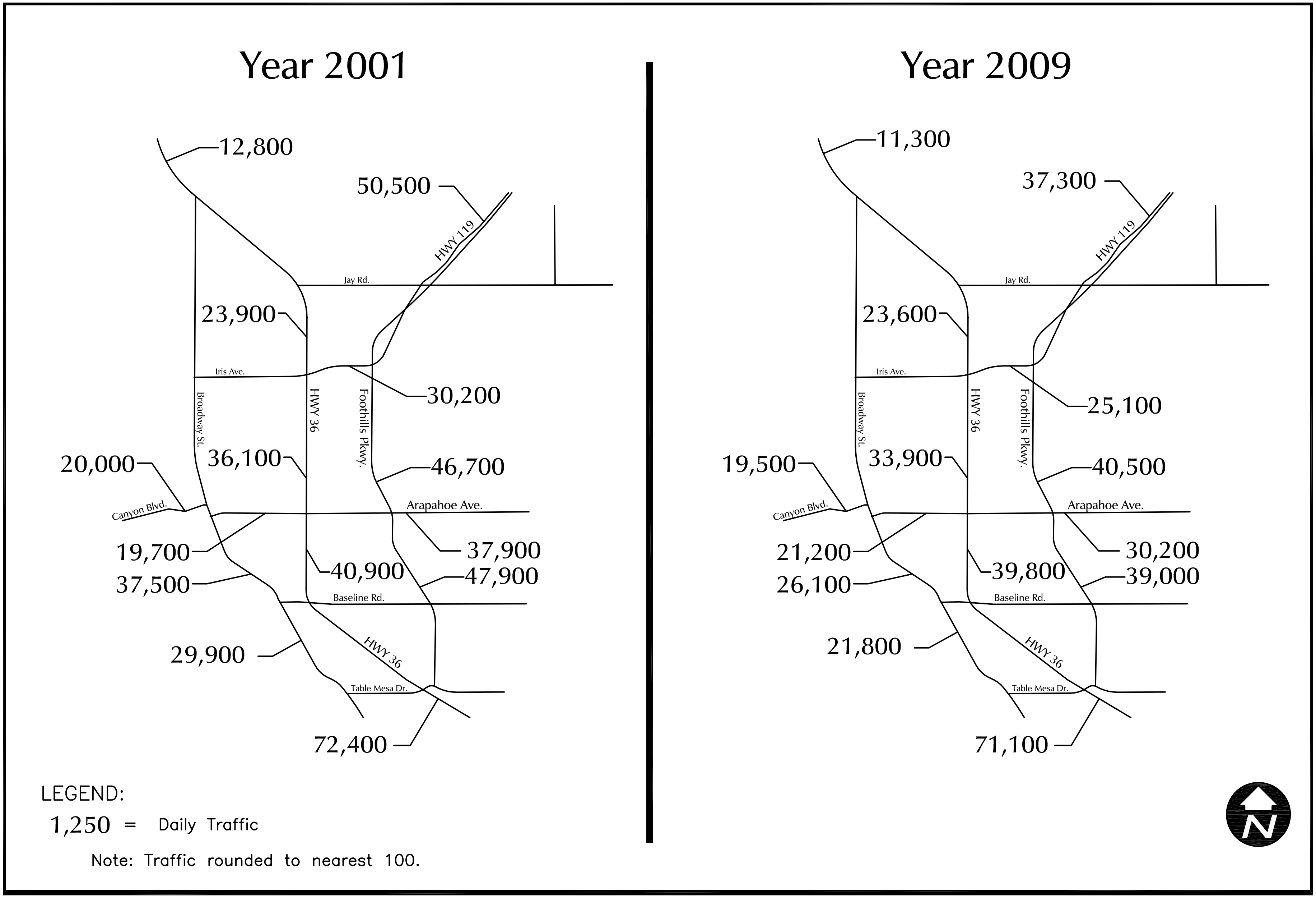
CU-Boulder Transportation Master Plan

2.5.2 Traffic Conditions

2.5.2.1 2001 – 2009 Traffic Volume Comparison

To determine the traffic volumes patterns in the last decade, the Colorado Department of Transportation (CDOT) traffic volumes along State Highways (SH) in the City of Boulder were obtained and compared. Traffic data from 2001 along US 36, SH 7, SH 93, SH 119, SH 157 was compared to 2009 traffic data. The results are shown in Figure 2-23. As shown, data for a total of 14 locations was compared. Traffic volumes decreased from 2001 to 2009 at all but one location (Arapahoe Avenue east of Broadway Street). Overall, traffic volumes decreased by approximately 13 percent from 2001 to 2009.

To determine if this reduction is due to the Travel Demand Management (TDM) practices that the university and City of Boulder have implemented, or due to the overall reduction in traffic volumes that has occurred in the last couple of years, a volume comparison was performed along US 36 at Wadsworth Boulevard. CDOT has an automatic traffic recorder (ATR) along US 36 at this location that is continuously collecting traffic. An analysis of the data shows that the traffic volumes along US 36 in the vicinity of Wadsworth Boulevard has decreased by 2 percent from 2001 to 2009. In addition, according to the *2009 Annual Report on Traffic Congestion in the Denver Region*, published by the Denver Regional Council of Governments (DRCOG), total vehicle-miles traveled in the Denver Region has increased by approximately 12 percent from 2001 to 2009 with most of that growth occurring between 2001 and 2005. However, it should be noted that some of that growth in vehicle-miles is due to the construction of new roadways. As a result, the growth in vehicle-miles of travel on existing roadways should be lower. Regardless, it appears that the reduction in traffic volumes experienced in the City of Boulder and the areas surrounding the university is not consistent with the rest of the Denver Region and indicates that the various TDM practices that have been implemented are being effective.



Years 2001-2009 Traffic Volume Comparison

CU-Boulder Transportation Master Plan

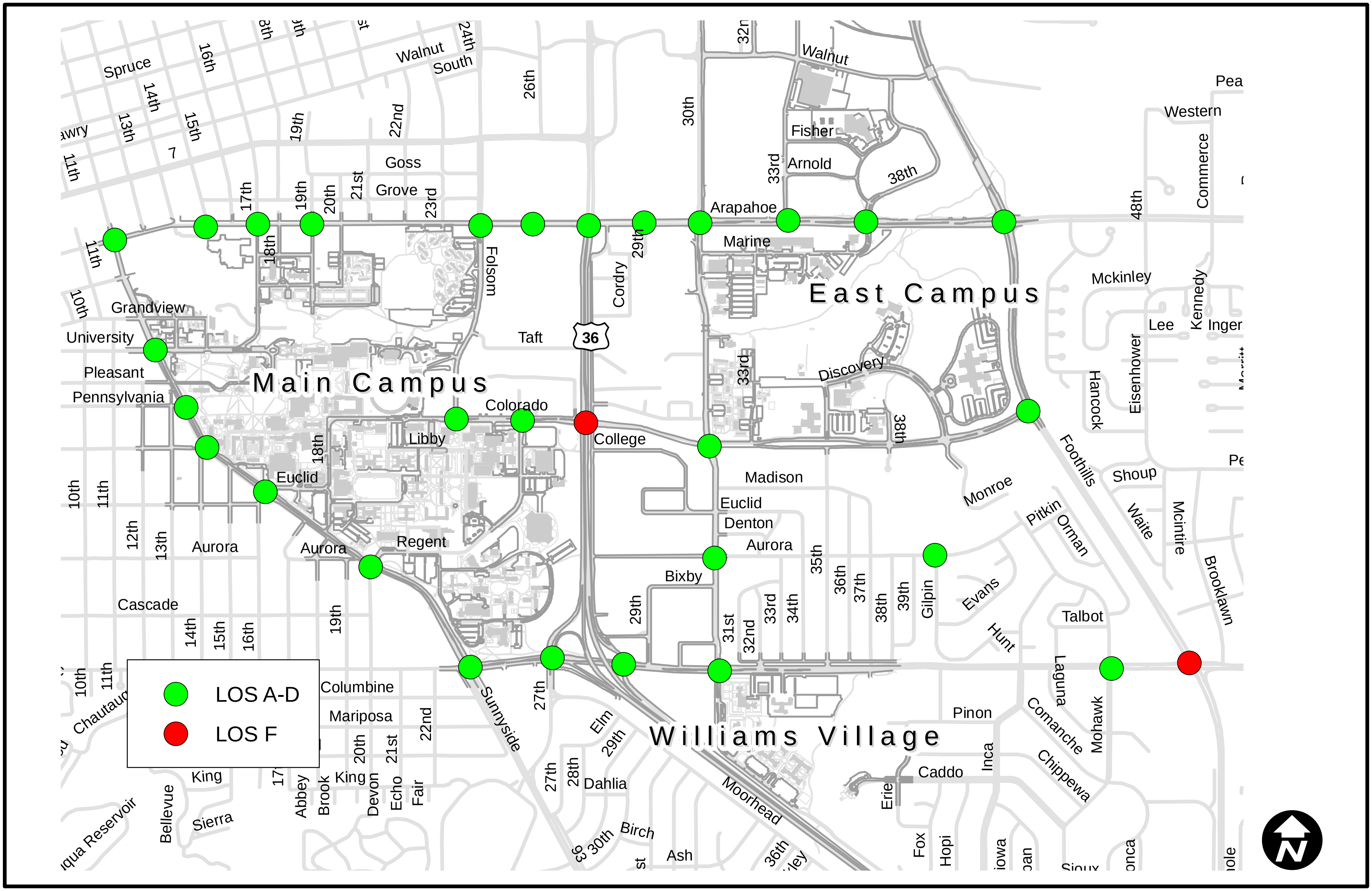
Figure 2-23

2.5.2.2 Intersection Level of Service

Level of service (LOS) is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Six LOS are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions.

The City of Boulder evaluated all its signalized intersections in 2009. Levels of Service for the intersections surrounding CU-Boulder are illustrated in Figures 2-24 and 2-25 for the morning and evening peak hours, respectively. In general, operations are better during the morning peak hour, with all nearby intersections operating at LOS D or better, with the exception of the 28th/Colorado and Baseline/Foothills Parkway intersections which operate at LOS F. These two intersections also operate at LOS F during the evening peak hour along with Broadway/Baseline, 28th/Arapahoe and Colorado/Foothills Parkway. In addition, the two Baseline/US 36 ramp intersections along with Arapahoe/Foothills Parkway operate at LOS E.

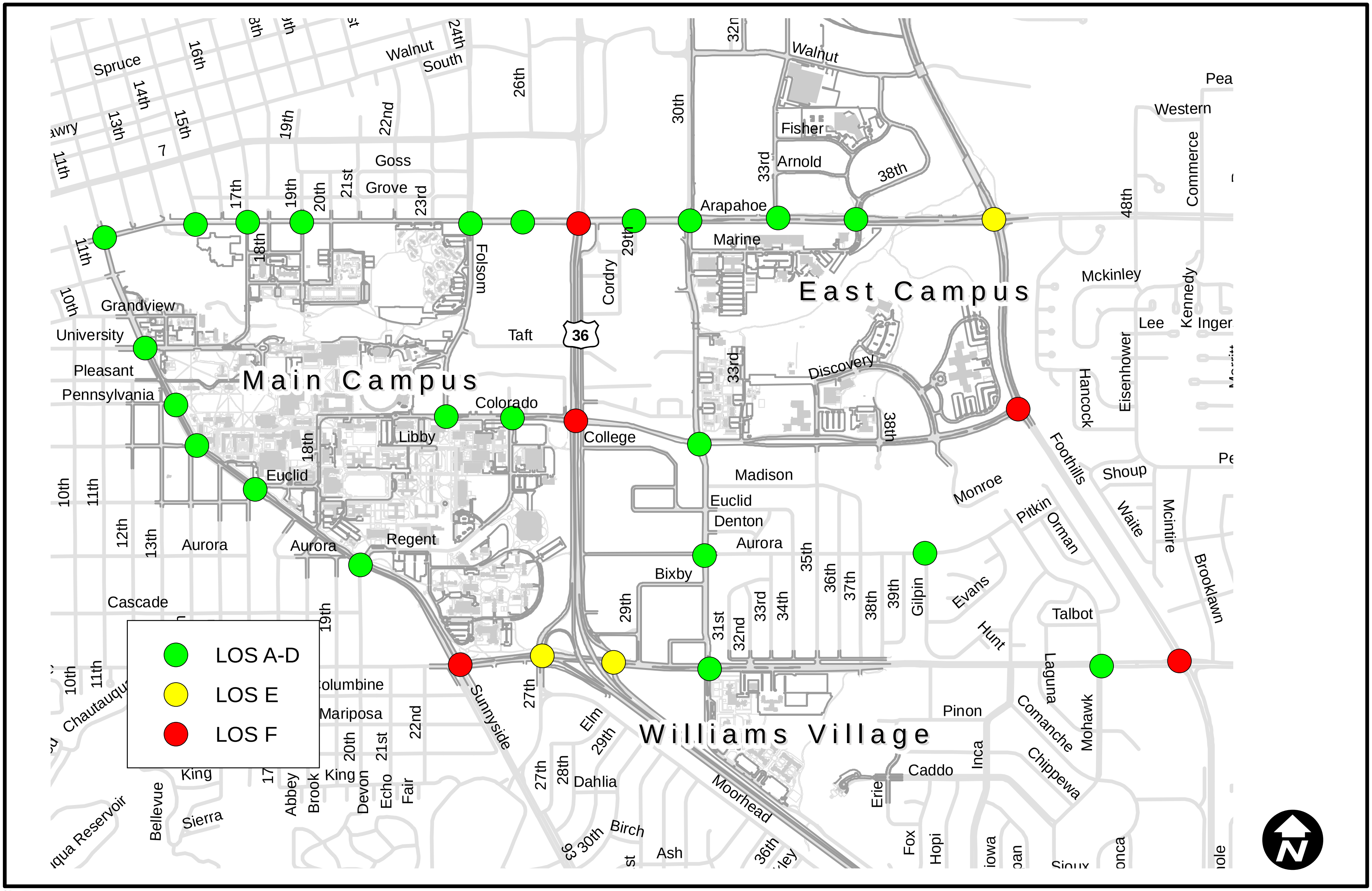
The City has improved the 28th/Colorado, Arapahoe/Foothills Parkway and Arapahoe/30th Street intersections in recent years. As Figure 2-21 indicates, improvements are planned at Broadway/Baseline, Baseline/30th and Baseline/ Foothills Parkway.



Signalized Intersection AM Level-of-Service

CU-Boulder Transportation Master Plan

Figure 2-24



Signalized Intersection PM Level-of-Service

CU-Boulder Transportation Master Plan

Figure 2-25

2.6 Parking Management, Supply and Demand

2.6.1 Systems Operations

Parking and Transportation Services (PTS) is an auxiliary (i.e., self funding) department of the university and uses revenues generated from parking user fees to offset parking administration, maintenance and development costs. No general fund (i.e., tax or tuition) dollars are allocated to support parking operations. Parking and Transportation Services is responsible for administration, maintenance and enforcement of most campus parking facilities, and coordinating parking arrangements for sporting and special events. PTS controls the distribution of parking permits for about 65% of the Main Campus, East Campus, and Williams Village Campus parking supply. The remaining 35% of this supply is controlled by Housing and Family Housing (19%), the Research Property System on East Campus (13%), the Athletic Department (2%), and a variety of other departments (2%). These non-PTS controlled spaces, which are generally underutilized, offer an opportunity to supplement the campus parking supply without building new parking, and to delay the costs of new parking development.

2.6.2 Parking Supply

PTS-managed parking facilities are located throughout the Main, East, and Williams Village Campuses as shown in Figures 2-26, 2-27, and 2-28. Family Housing and Research Properties spaces are situated primarily on East Campus, with some Family Housing spaces located north of Main Campus. Housing controlled spaces are located on the Williams Village Campus and family housing areas while Athletics controlled spaces are focused around the stadium and on the East Campus. This disbursed pattern of parking resulted from the expansion of the campus over a number of decades and the placement of parking in locations where land was available after building construction. The most concentrated campus parking supply, including roughly 24% of all Main Campus parking is provided in three structured garages, the Regent AutoPark, Euclid AutoPark, and the Center for Community underground garage. Surface lots on Main Campus vary in size from just a few spaces to several hundred spaces and provide about 76% of the Main Campus parking supply. Meters control short-term parking along streets and within some parking lots. In addition to traditional single space meters, PTS has installed computer-based multi-space meters in nine parking lots using “pay-by-space” or “pay-and-display” formats. These devices provide users with a broader range of payment options, including currency, coin, credit cards, and “smart chip” based cash cards sold by PTS.

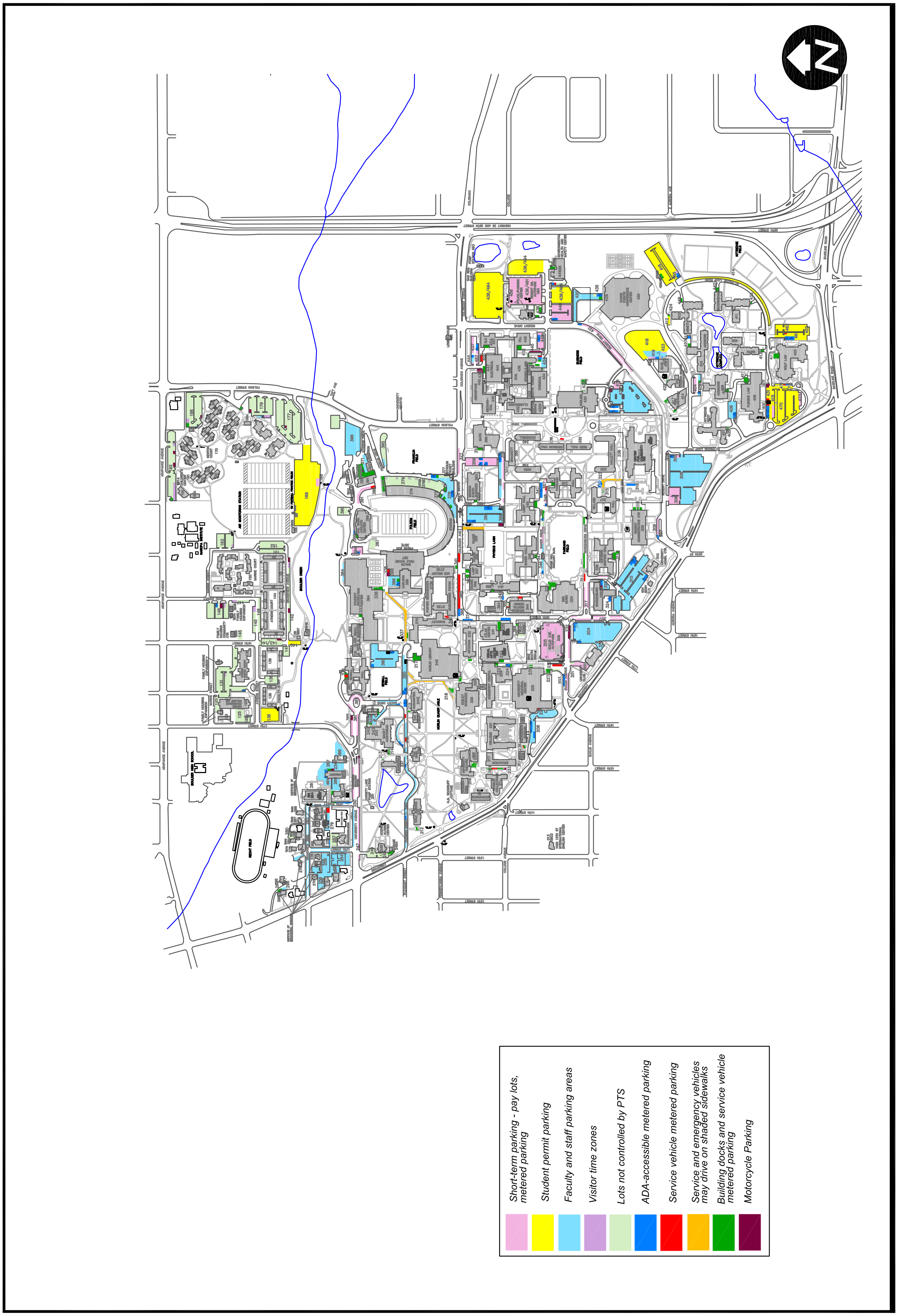


Figure 2-26

Main Campus Parking Lots

CU-Boulder Transportation Master Plan

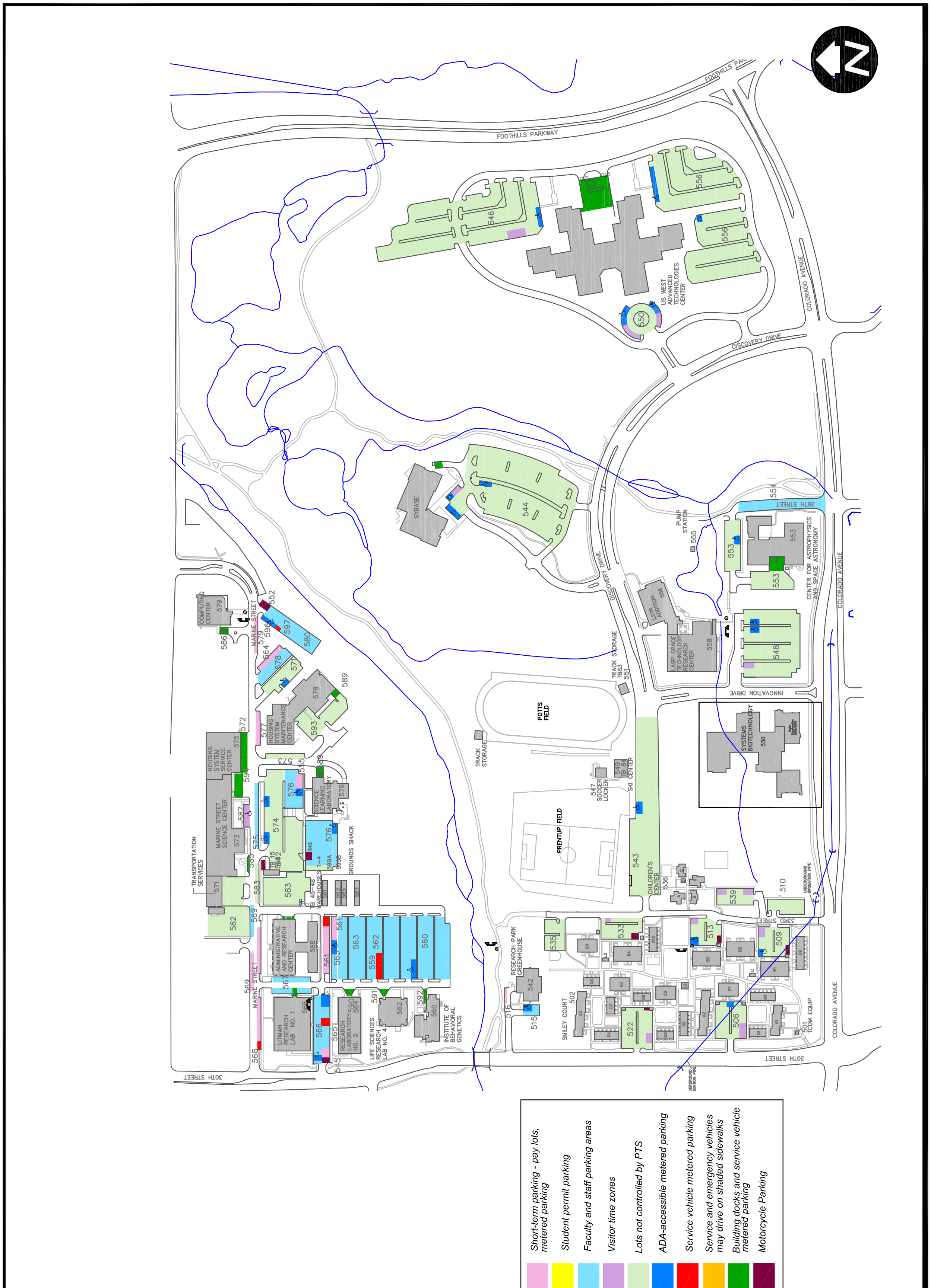
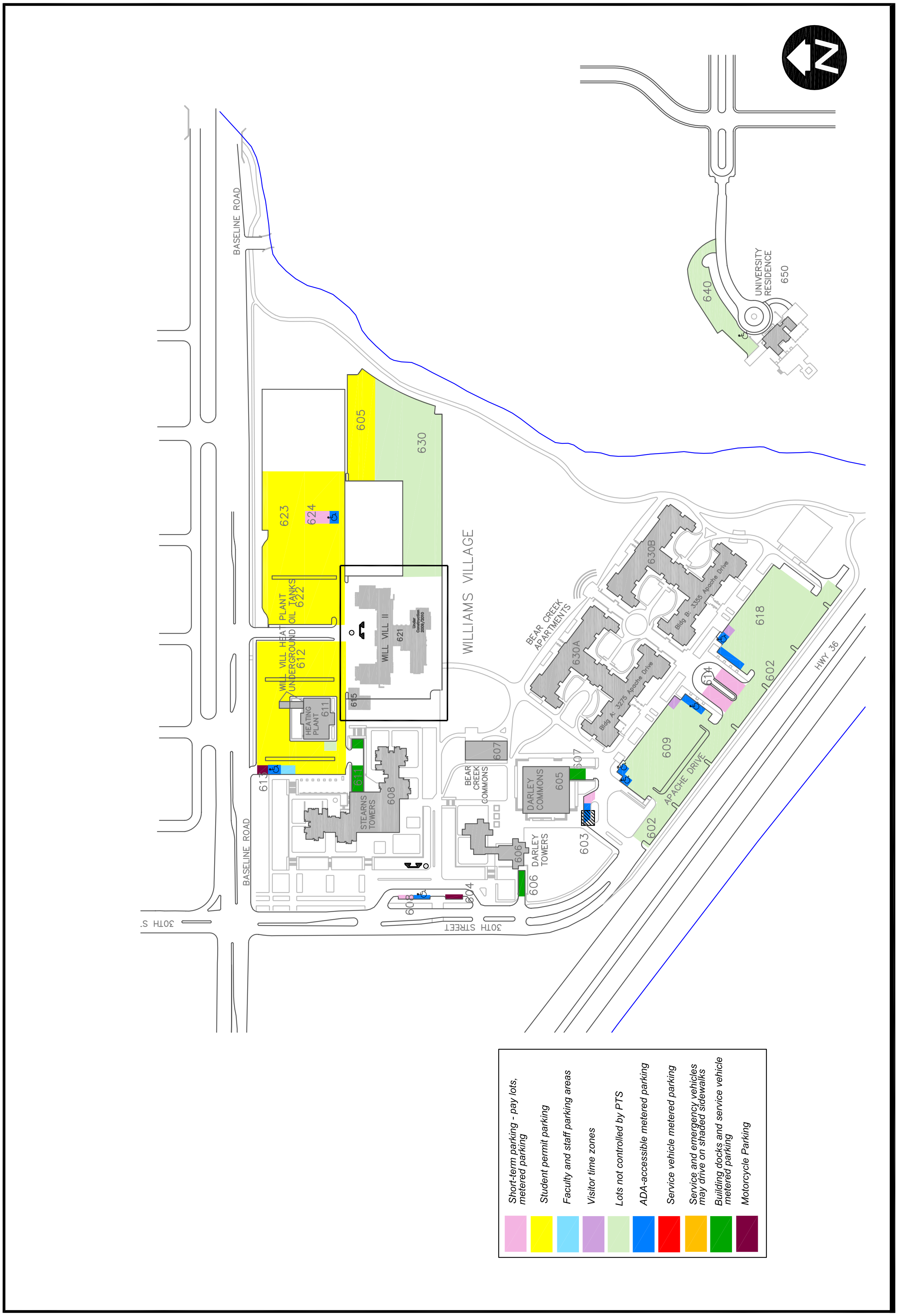


Figure 2-27

East Campus Parking Lots

CU-Boulder Transportation Master Plan



Williams Village Parking Lots

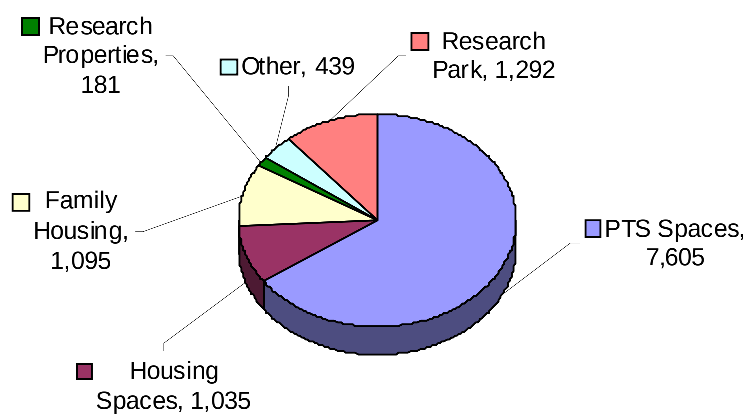
CU-Boulder Transportation Master Plan

Figure 2-28

There are a total of 10,355 parking spaces on Main Campus, East Campus and Williams Village Campus. In addition, there are 1,292 spaces at the Research Park for a combined campus total of 11,647 spaces. Of the Research Park spaces, 1,027 are leased and used by Sybase[11] and the Advanced Technologies Center. The remaining 265 are parked in by CU employees of the Laboratory for Atmospheric and Space Physics (LASP) and the Center for Astrophysics and Space Astronomy (CASA).

Of the total parking supply available at CU-Boulder, PTS manages approximately 7,605 spaces. This means that PTS does not manage at least 4,042 spaces, comprising about 35% of the total supply. These include 1,095 Family Housing spaces, 1,035 Housing Spaces, 1,292 Research Park spaces (East Campus), 181 Research Properties spaces, and 439 spaces controlled by Athletics and other groups. This fact is important for purposes of policy and pricing consistency.

Figure 2-29
Total Parking Supply



Another way to look at the parking supply is by user type or group, as shown in Table 2-15 and Figures 2-30 and 2-31.

[11] Acquired by CU Boulder in 2011, the parking is now a part of the Research Properties.

Table 2-15
CU Campus-Wide Parking Supply by User Group

User Group	Main Campus	East Campus (1)	Williams Village	All Campuses	Percent
Restricted (Attended, Docks, Reserved, Service, Other)	311	1,775	49	2,135	18.3%
Meters/Short Term (incl. ADA)	1,082	106	17	1,205	10.3%
Motorcycle	197	46	16	259	2.2%
Student Total (2)	2,636	302	1,332	4,270	36.7%
Faculty/Staff Total (2)	2,926	852	0	3,778	32.4%
Total	**7,152**	**3,081**	**1,414**	**11,647**	**100.0%**

Notes:
(1) Includes Research Park in Restricted
(2) Student and Faculty/Staff totals include regular, disabled, reserved, metered and short term spaces

Figure 2-30
Campus Parking Supply By User Group

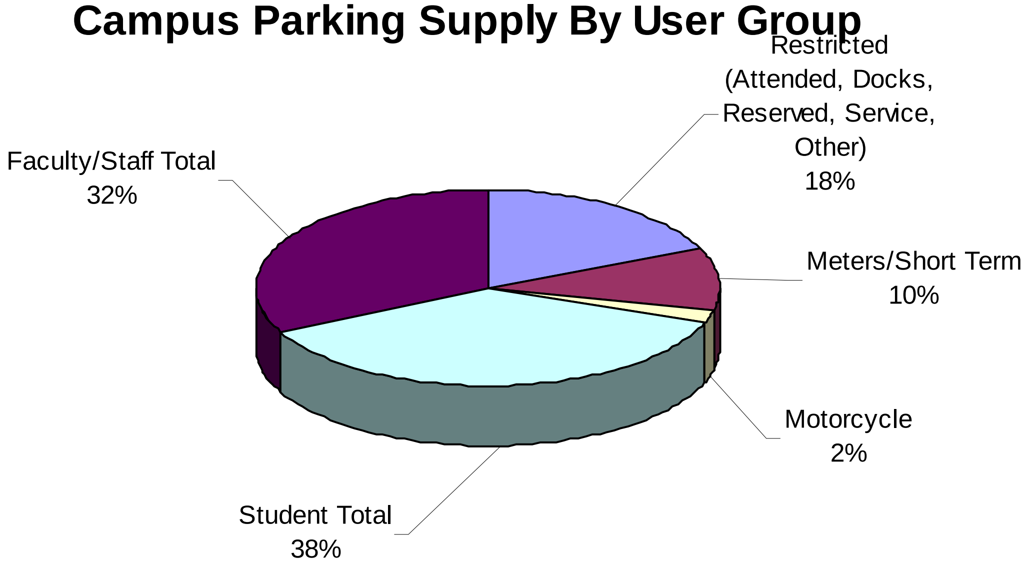
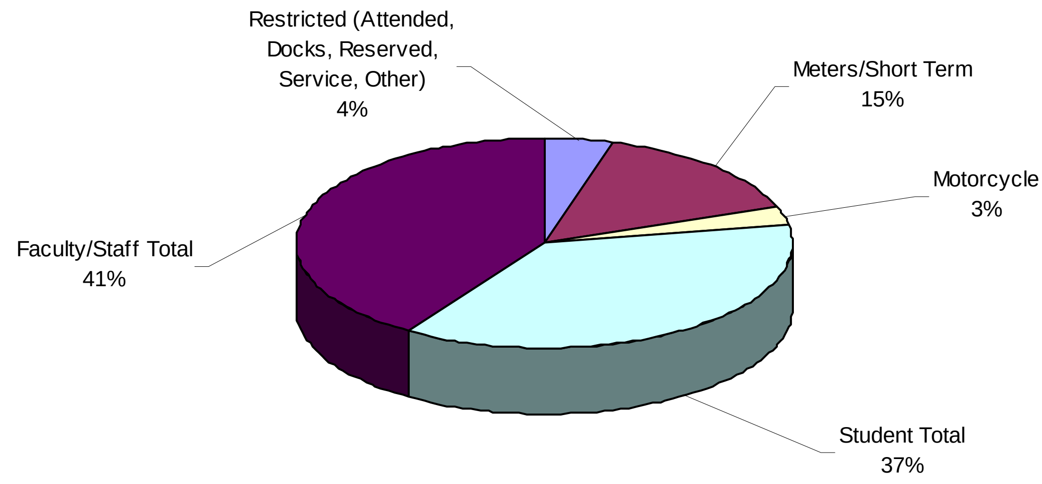


Figure 2-31
Main Campus Parking Supply By User Group

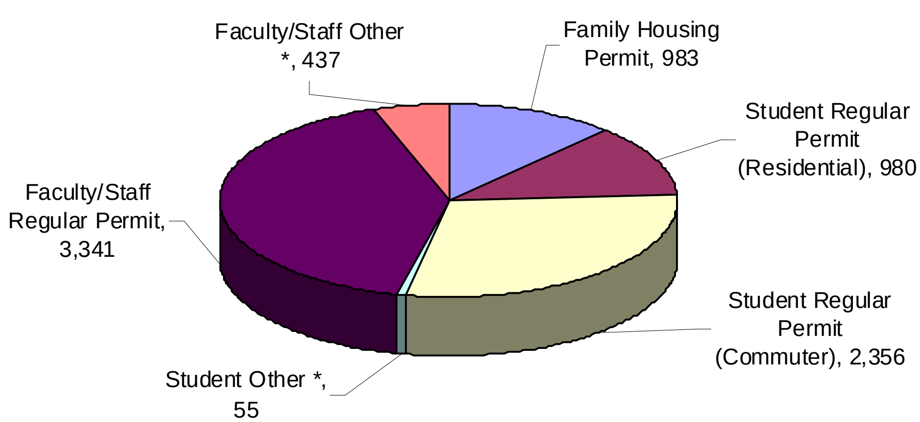


Of the total campus supply, 70% is available for student and faculty/staff parking. Of the Main Campus supply, 78% is available for student and faculty/staff parking. Both groups may park in short-term and metered spaces not designated for their groups.

2.6.2.1 Student and Faculty/Staff Parking Supply

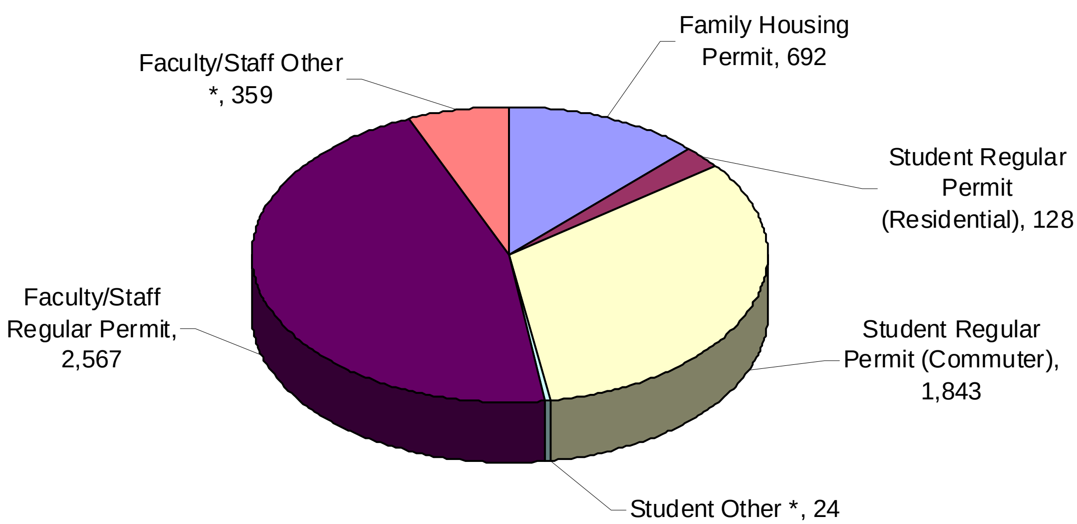
Even though 70% of the total campus parking supply is available for student and faculty/staff parking, there are designations for how this parking is used. Not all of it can be used by commuters for all-day parking. Figures 2-32 and 2-33 show how the student and faculty/staff spaces are utilized.

Figure 2-32
CU Campus-Wide Student and Faculty/Staff Parking Supply



* Other includes disabled, reserved, short-term and miscellaneous parking spaces designated for faculty/staff use.

Figure 2-33
Main Campus Student and Faculty/Staff Parking Supply



Of the total campus parking supply, 49% is available for student and faculty/staff commuter permit parking, 17% is available for resident parking, and 4% is available to students and faculty/staff for other purposes. This equals the 70% of the total campus supply that is available for student and faculty/staff parking. On Main Campus, 62% of the supply is available for commuter parking, 11% for resident permit parking, and 5% for other purposes. The total is the 78% of Main Campus spaces available for student and faculty/staff parking.

2.6.2.2 Visitor Parking Supply

Visitor parking supply at CU-Boulder includes the Euclid AutoPark, signed "pay on foot" lots, and on-street metered parking. In 2003, PTS coordinated development of a visitor parking signage plan for the campus and worked with the City of Boulder's Transportation Department for sign development and installation. The visitor parking signs are posted around and within the campus and direct drivers to visitor parking areas and some major campus destination points. The signs use the standard international parking symbol (white on blue "P").

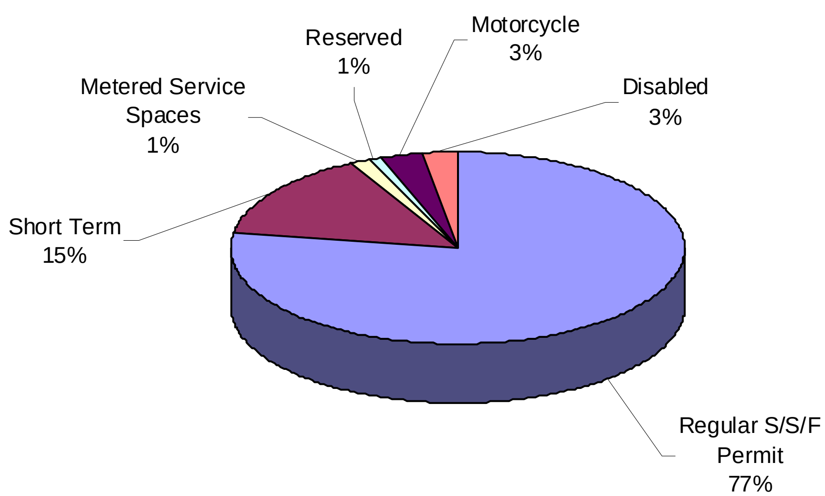
Visitors to CU, excluding Research Park visitors, can park in a total of 1,108 metered and short-term parking spaces on campus. The majority of these spaces (980) are located on Main Campus and represents over 14% of the total Main Campus parking supply. Metered time limits vary from 15 minutes to 10 hours. The hourly parking rate for the majority of meters is $1.50 per hour. At the Euclid AutoPark the rates start at $1.75/hr (first 3 hours) and then are $3/hr for additional hours until 5 pm, M-F. Visitors can purchase temporary parking permits to allow them to park from one day to four weeks in various lots, but not in the Euclid AutoPark.

Students and faculty/staff are also permitted to park in the metered and short-term spaces. There is no definite way to measure how many visitor spaces are actually available to visitors as opposed to CU employees and students on any given day. It is also not known how many visitors actually park on the campus (for special events, cultural activities, athletic activities, parents, museum patrons, etc.), or how much of the short-term parking supply is regularly occupied by students and faculty/staff.

2.6.2.3 PTS Revenue-Generating Parking Supply

PTS controls 7,387 spaces, 65% of the 11,438 spaces that make up the total supply of CU-Boulder parking. The vast majority of PTS-controlled spaces generate revenue for the parking system, although some, such as service spaces, do not.

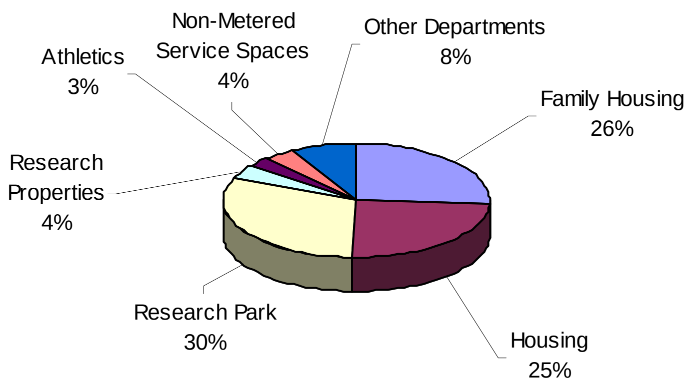
Figure 2-34
PTS Revenue-Generating Parking Supply



2.6.2.4 Parking Supply Not Generating PTS Revenue

There are over 4,000 spaces on CU property (including 2,750 on Main Campus, East Campus, and at Williams Village Campus) that are <u>not</u> controlled and managed by PTS. Figure 2-35 shows the departments that manage these spaces. Much of this parking inventory is underutilized. It is conservatively estimated that almost 700 parking spaces could be made available to accommodate the parking needs of CU-Boulder's commuting affiliates through improved utilization of the entire campus parking inventory, primarily on the East Campus. Furthermore, this could be accomplished without detrimentally affecting parking availability for the specific elements of the campus population that some of these spaces were built to serve. Making these spaces available to all campus commuters could delay the need for development of new parking facilities and the encumbrance of significant expenses associated with their construction.

Figure 2-35
Parking Supply Not Generating PTS Revenue



* Other Departments includes the Alumni Center, College Inn, Facilities Management, Foundation Center, Housing Services, International English, President's Office, and the Transportation Center.

This June, 2010 photo shows several underutilized lots on the East Campus

Family Housing bundles the cost of parking into rents and provides the first parking space as part of the rent; additional space permits may be purchased at a cost of only $10 per month which is significantly lower than other campus parking permits. According to the CU Family Housing Departments, there are a total of 811 Family Housing apartment units serving the CU-Boulder campus, meaning that 811 of the 1,095 spaces in the Family Housing inventory are provided as a benefit bundled into rent payment and leases. Bundling parking costs into rent is deceptive as the user does not realize the actual cost of parking.

2.6.2.5 Parking Supply over Time

Between 1990 and 2003, the Main Campus parking supply increased 34%. This is mainly due to the construction of the Euclid and Regent AutoParks in the early 1990s. Since 2003, the Main Campus parking supply has decreased by 4% due to new academic and administrative building construction on existing lots.

The number of visitor spaces on campus increased 44% between 1990 and 2002, but has decreased 11% since then.

2.6.2.6 Main Campus Parking Supply Ratio Over Time

Comparing the total campus population in 1990, 1998, 2003 and 2010 to the Main Campus parking supply shown in Table 2-16 provides information about the change in the Main Campus parking supply ratio over time. This information is summarized in Table 2-17.

Table 2-16
Changes in Main Campus Parking Supply Since 1990

	1990	1998	2003	2010
Regular	4,581	5,484	5,461	5,467
Short Term	770	1,032	1,107	1,025
Disabled, Service, Reserved & Motorcycle	N/A	440	669	660
Totals	5,351	6,956	7,237	7,152

Table 2-17
Main Campus Parking Supply Ratio Over Time

Year	Main Campus Spaces/Population
1990	0.19
1998	0.23
2003	0.21
2010	0.19

The ratio increased between 1990 and 1998, but fell between 1998 and 2010. The 2010 ratio is about the same as it was in 1990. It should be noted that the tight parking supply in the early 1990's led to the construction of the Regent and Euclid parking structures in 1991. While the current Main Campus parking supply ratio has returned to the 1990 level, the university's TDM programs, especially the student bus pass and faculty/staff EcoPass programs, have allowed the university to grow without adding new parking.

2.6.2.7 Parking Supply Ratios

A common way to look a parking supply is to compare the ratio of spaces to the campus population. This section looks reviews these ratios.

Table 2-18
Ratio of Campus Population to Parking Spaces

	Campus-Wide	Main Campus
Total Spaces to Total Population	0.31 [A]	0.19 [B]
Residence Hall Spaces to Residence Hall Population	0.16 [C]	0.04 [D]
Family Housing Spaces to Family Housing Units	1.35 [E]	N/A [F]
All Non-Residential Spaces to Commuting Population	0.28 [G]	0.21 [H]

A 11,647/37,336 = 0.31 (.28 if 1,292 Research Park spaces are excluded)
B 7,152/37,336 = 0.19
C 1,035 housing spaces/6,613 resident students = 0.16
D 152 housing spaces/4,113 Main Campus resident students = 0.04
E 1,095/811 = 1.35
F Number of family housing students on Main Campus is not known
G 10,355 total spaces (excluding Research Park) - 1,035 housing spaces – 1,095 family housing spaces = 8,225 spaces/(7,260 faculty/staff + 22,389 commuting students) = 0.28
H 7,152 total Main Campus spaces – 152 residence hall spaces – 773 family housing spaces = 6,227 spaces/29,649 commuting affiliates = 0.21

Table 2-19
Ratio of Student and Faculty/Staff Population to their respective Parking Supplies

All Campuses	
Faculty/Staff Spaces to Faculty/Staff Population [A]	0.48
Student Spaces to Student Population [B]	0.18
Main Campus	
Faculty/Staff Spaces to Faculty/Staff Population [C]	0.36
Student Spaces to Student Population [D]	0.13

A Includes permit, disabled, reserved, short-term & other spaces dedicated to faculty/staff.
B Includes permit, disabled, reserved, short-term & other spaces dedicated to students. Permit spaces include undergraduate residential housing spaces, Family Housing spaces, and commuter spaces.
C Includes permit, disabled, reserved, short-term & other spaces dedicated to faculty/staff.
D Includes permit, disabled, reserved, short-term & other spaces dedicated to students. Permit spaces include undergraduate residential housing spaces, Family Housing spaces, and commuter spaces.

2.6.3 Parking Fees

2.6.3.1 Permit Structure

Parking and Transportation Services manages the permit system for about 65% of the campus parking supply. Other departments that control the distribution of permits include Family Housing (9.5% of spaces), Athletics (2%), Research Properties (1.5%), and several other departments.

There are four broad categories of permits: Business, Faculty/Staff, Student, and Temporary. Business Permits are issued to departments, vendors, contractors, etc., while temporary permits are for visitors and faculty/staff/students needing temporary access.

Faculty/staff permits are purchased annually and paid for by monthly payroll deduction. Faculty/staff permits are distinguished by location and type of lot: motorcycle, gravel lot, less proximate lot, and proximate lot. Student permit designations include motorcycle, gravel lot, less proximate lot, proximate lot, and Main Campus residence hall core. Because permits are sold based on the location of the space, each permit is associated with a specific lot.

The majority of commuter students park in less proximate lots located at the Regent AutoPark, near the Kittredge housing complex and at the law school (Lots 436, 402, 416, and 308). Student permits are issued by the semester, the academic year, or summer session.

While permits are sold by the designation "proximate" or "less proximate" lots are not designated as such, since these distinctions are relative to a person's work or residence hall location. Parkers within the same lot may pay different rates based on where the lot is located relative to their department or housing location. Lots, however, are designated as student or faculty/staff lots.

Within the supply of "Regular" faculty/staff parking spaces, there are several faculty/staff permit designations, but the two main types are "Regular" and "Buffalo". Faculty/staff parking permits are allocated by department, so that there is a designated number of parking permits associated with each department. Once a department has used up its allocation, faculty and staff from that department can continue to obtain permits if space is still available, but permits over the allocation are called "Buffalo" permits. If the parking system needs to revoke permits (e.g., due to the addition of another department or loss of parking spaces), Buffalo permits can be called back at any time.

2.6.3.2 Assessment of CU Parking Permit Rates and Fines

Faculty/staff and student permit fees vary by the location of the assigned parking lot and its proximity to the work location or housing of the permit holder. Faculty/staff permits are typically issued on a monthly basis and student permits are issued by the semester, academic year, or summer. The annual student permit is simply twice the price of the semester permit and covers fall and spring semesters but not summer semester. Beginning in September 2002, CU began allowing faculty/staff buying parking permits via direct payroll deduction to use pre-tax salary to pay for the permits. The out-of-pocket cost to these faculty/staff parkers is therefore 28% lower than the rates shown in Table 2-20.

Table 2-20
FY 10 Parking Permit Rates
Fall 2010 Campus Parking Permit Rates

	Faculty/Staff (Monthly)	Student (Semester)
Motorcycle	$15.50	$62.00
Remote/Shuttle	$11.75	$46.75
Unimproved	$31.00	$114.75
Peripheral *	$39.25	$144.50
Proximate	$46.75	$174.25
Lot 436 – Main Campus Resident Hall Parkers		$182.75

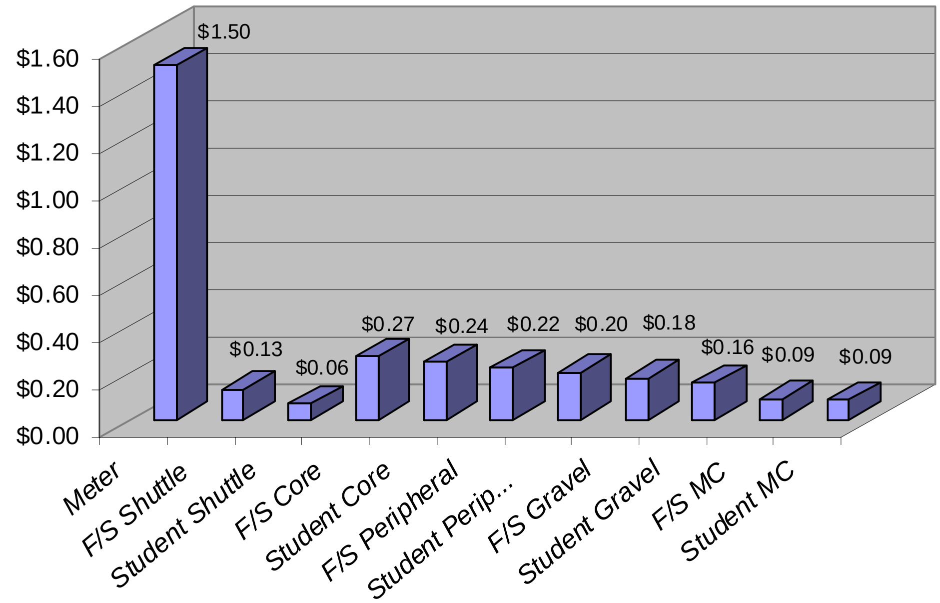
* Proximate and Peripheral are relative to a person's work or residence hall location. Parkers within the same lot may pay different rates based on where the lot is located relative to their department or housing location.

The majority of students are issued permits in peripheral parking lots. Permits are lot-specific and there are separate allocations for residential and commuter parking. Parking fees are set to cover CU's parking costs and contribute to future capital projects. Parking costs, including debt service and maintenance, will increase as surface lots are replaced by structures. This will cause parking fees to increase.

Meter rates are $1.50 per hour. Compared to hourly meter rates, deep discounts are offered to those whose purchase monthly or semester permits. Figure 2-36 shows the hourly equivalent price for all parking, assuming an eight-hour day and a 90-day semester or a 22-day month.

Motorcycle fees are assigned at 1/3 the cost of the proximate auto permit fee. The rationale is that motorcycles use roughly 1/4 to 1/3 the space of cars with the addition of some administrative costs to sell multiple permits for the same space (3 motorcycles to one car).

Figure 2-36
Hourly Parking Fees



2.6.3.3 Fee History

Table 2-21 shows faculty/staff parking permit fee increases between 1990 and 2010. The larger increase between 1990 and 1996 is due primarily to the costs associated with the construction of two new parking structures in the early 1990s.

Table 2-21
Faculty/Staff Monthly Permit Fee Increases Since 1990
In Actual and Inflation-Adjusted Dollars

	Actual Dollars (not adjusted for inflation)				In 2010 $				Cost Increase in 2010 $	Cost Increase in 2010 $
	1990	1996	2002	2010	1990	1996	2002	2010	1990-2010	2002-2010
Motorcycle	$2.00	$6.00	$10.00	$15.50	$3.80	$9.47	$12.64	$15.50	308%	23%
Unimproved	$8.00	$18.00	$24.00	$31.00	$15.21	$28.42	$30.33	$31.00	104%	2%
Peripheral	$8.00	$24.00	$30.50	$39.25	$15.21	$37.89	$38.55	$39.25	158%	2%
Proximate	$10.00	$30.00	$38.50	$46.75	$19.01	$47.36	$48.66	$46.75	146%	-4%

* Based on the Denver-Boulder-Greeley, CO Consumer Price Index – All Urban Consumers. CPI in 1990 = 120.9; CPI in 1996 = 153.1; CPI in 2002 (half year) = 184.6, CPI in 2010 = 210.98

Table 2-21 shows that, in 2010 dollars, faculty/staff permit fee increases between 1990 and 2010 ranged from 308% for motorcycle parking (starting at a low base rate of $6.00/month) to 146% for proximate parking, but most of this increase came in the 1990s when the impact of new garage construction was reflected in the parking rates. Over the last 8 years between 2002 and 2010, rate increases ranged from 23% for motorcycle parking to 2% for unimproved and peripheral parking. Proximate parking rates actually declined by 4% in adjusted dollars even though proximate permits account for over 70% of faculty/staff permits.

Since 1997, student permit fees have increased as shown in Table 2-22.

Table 2-22
Student Semester Permit Fee Increases Since 1990
In Actual and Inflation-Adjusted Dollars

	Actual Dollars (not adjusted for inflation)			In 2010 $			Cost Increase in 2010 $	Cost Increase in 2010 $
	1997	Jul-02	2010	1997	2002	2010	1997-2010	2002-10
Motorcycle	$24.00	$38.25	$62.00	$37.89	$48.34	$62.00	64%	28%
Gravel	$72.00	$89.25	$114.75	$113.67	$112.79	$114.75	1%	2%
Peripheral	$96.00	$144.75	$144.50	$151.56	$182.94	$144.50	-5%	-21%
Proximate	$120.00	$136.00	$174.25	$189.46	$171.88	$174.25	-8%	1%

* Based on the Denver-Boulder-Greeley, CO Consumer Price Index – All Urban Consumers. CPI in 1990 = 120.9; CPI in 1996 = 153.1; CPI in 2002 (half year) = 184.6; CPI in 2010 = 2010.98

Table 2-22 shows that the inflation-adjusted change in student parking permit fees from 2002 to 2010 ranged from a 28% increase for motorcycle parking spaces to a 21% decrease for peripheral parking permits (which are the majority of student permits).

Permit prices are usually adjusted annually to reflect US consumer price index-pegged inflation rates. This practice has been in place since FY01. FY11 rates were 3% above FY10 rates on average. However, it appears that FY12 rates will not increase.

2.6.3.4 Comparison of Parking Rates with Peer Universities

To provide a comparison of CU parking rates with other universities, data was collected from Big Twelve, Big Ten, PAC 10, and other AAU universities. Each university has a unique set of parking rates, so in many cases, rates were extrapolated to a time period that is comparable to how CU charges for parking. Data for each university is displayed in Table 2-23 along with 2010-11 CU-Boulder parking rates.

Table 2-23
Parking Rates Survey 2010
Peer Universities

University	City	Population	Garage/ Close-In	Surface	Campus Housing	Commuter	Shuttle/ Park-n-Ride	Reserved	Motorcycle	Storage
Pac 10										
Oregon State	Corvallis, OR	55,125		$177					$60	
Washington State	Pullman, WA	27,619	$548	$105					$65	
Arizona	Tucson, AZ	1,023,320	$568	$468			$203	$1,200	$116	
Arizona State	Phoenix, AZ	6,595,778	$780	$480					$280	
Cal-Berkeley	Berkeley, CA	102,455		$654	$1,165		$45		$216	$358
Oregon	Eugene, OR	154,620		$750				$2,250	$203	
Stanford	Palo Alto, CA	60,171	$726	$282					$93	
UCLA	Los Angeles, CA	4,065,585		$780	$984			$1,440	$117	
USC	Los Angeles, CA	4,065,585	$828	$477	$549					
Washington	Seattle, WA	602,000		$1,692				$2,880	$564	
Big Ten										
Illinois	Champaign, IL	80,286		$540			$127		$68	
Iowa	Iowa City, IA	68,903	$621	$280			$180			$288
Michigan	Ann Arbor, MI	112,852	$611	$141			$70			$196
Michigan State	East Lansing, MI	45,562	$268	$179	$111	$89				
Penn State	State College, PA	39,898		$620		$310				
Purdue	West Lafayette, IN	31,530	$250	$100	$100			$1,000		
Indiana	Indianapolis	807,584	$451	$181	$204				N/A	
Minnesota	Minneapolis, MN	385,542	$1,527	$786			$34	$1,659	$112	
Northwestern	Chicago, IL	2,851,268	$465				$25		$162	
Ohio State	Columbus, OH	769,360	$629	$345		$118	$85		$20	
Wisconsin	Madison, WI	235,626		$105	$135		$60		$16	
Big Twelve										
Baylor	Waco, TX	126,217		$225					$35	
Iowa State	Ames, IA	56,814		$108	$108		$108	$457	$43	
Kansas	Lawrence, KS	92,048	$230	$125	$190		$90			
Kansas State	Manhattan, KS	52,836		$150					$150	
Missouri	Columbia, MO	102,324	$168	$144		$120				
Oklahoma	Norman, OK	109,063			$195	$195		$889	$38	
Oklahoma State	Stillwater, OK	46,157	$120		$44	$54			$29	
Texas A+M	College Station, TX	86,679	$444	$275	$225			$534	$88	
Nebraska	Lincoln, NE	254,001	$600	$480		$480		$924		
Texas	Austin, TX	786,382	$743	$175					$69	
Texas Tech	Lubbock, TX	225,856	$520	$173	$260	$144	$52		$96	

Table 2-23 (continued)
Parking Rates Survey 2010
Peer Universities

University	City	Population	Garage/ Close-In	Surface	Campus Housing	Commuter	Shuttle/ Park-n-Ride	Reserved	Motorcycle	Storage
Other AAU Universities										
Florida	Gainesville, FL	104,875	$134	$134	$134	$134	$134		$96	
NY - Buffalo	Buffalo, NY	270,240								
NY - Stony Brook	Stony Brook, NY	14,577								
North Carolina	Chapel Hill, NC	53,546	$553	$421				$685	$175	
New Jersey - Rutgers	New Brunswick, NJ	51,579	$545		$175	$257				
Virginia	Charlottesville, VA	46,335	$468		$444	$192		$468	$192	$192
California - Davis	Davis, CA	62,947		$480				$1,056	$204	
California - Irvine	Irvine, CA	209,716			$960	$636		$852	$372	
Calif. - San Diego	San Diego, CA	1,306,301	$924	$624					$252	
Calif.-Santa Barbara	Santa Barbara, CA	86,353			$648	$432				
Maryland	Baltimore, MD	637,418			$419	$217			free	
Pittsburgh	Pittsburgh, PA	311,647	$736		$680	$340				
Local										
CSU	Ft Collins, CO	136,509			$243	$188			$99	
Colorado College	Colo. Springs, CO	399,827		$225						
Univ. of North Colorado	Greeley, CO	92,625		$260					$115	
Metro/Auraria	Denver, CO	610,345	$404	$320						
UCCS	Colo. Springs, CO	399,827	$330	$165					$42	
UCD/Anschutz/UCHSC	Denver, CO	610,345	$684	$432				$900		
Total Average			**$547**	**$370**	**$380**	**$244**	**$93**	**$1,146**	**$135**	**$259**
Average Urban			**$682**	**$492**	**$600**	**$338**	**$72**	**$1,462**	**$173**	**$358**
CU Boulder	**Boulder, CO**	**100,160**	**$449**	**$372**	**$372**	**$372**	**$94**	**--**	**$171**	**--**

This comparison indicates that the CU-Boulder rates are about average for peripheral lots but $100 to $200 per year lower for close-in lots. Also, while CU doesn't charge any more for reserved spaces, other universities charge up to $1,500 per year for a reserved space.

2.6.3.5 Other Universities Parking Rate Practices

The research into parking rates at peer universities found parking rate practices that may be of interest to CU-Boulder.

Carpools/Vanpools: CU charges the same rates whether a vehicle is an SOV or carpool – the carpoolers get a break by dividing the permit cost among the riders. Priority spaces as provided. Indiana and Michigan State offer reduced rates for car-pools. CU-Boulder may want to consider pricing incentives to encourage more carpool use. Many universities sponsor/fund university vanpools. CU-Boulder could explore the cost-effectiveness of sponsoring vanpool services, especially to and from major transit centers in the city.

Income-Based Faculty/Staff Rates: Northwestern University provides a sliding scale: F/S with salaries under $30,000 pay $49.75 per month while F/S with salaries over $200,000 pay $219.25 per month. Equity issues associated with parking costs could be further considered by CU-Boulder.

Reserved Parking: Several universities offer reserved parking (an individual space reserved for faculty/staff members) as shown in Table 8-8. The rates are generally double the regular campus rate.

Garage Parking: Several universities charge higher rates to park in a garage shielded from the elements. CU-Boulder currently charges the same fee for structured parking as it does for surface parking.

Close-In Parking: Several universities charge higher rates for parking spaces located near the campus core in comparison with more remote lots. As is addressed in other places in this document, moving to a demand- and market-based parking system is recommended for CU-Boulder.

Shuttle Parking: Several universities offer shuttle lots where users can park for lower rates and use transit to reach core campus locations. It will be important for CU-Boulder to provide shuttle services from remote lots in order to encourage better utilization of these lots.

Storage Lots: Several universities provide student storage lots. At Michigan, freshmen and sophomores are only eligible for storage lots. Appeals are considered.

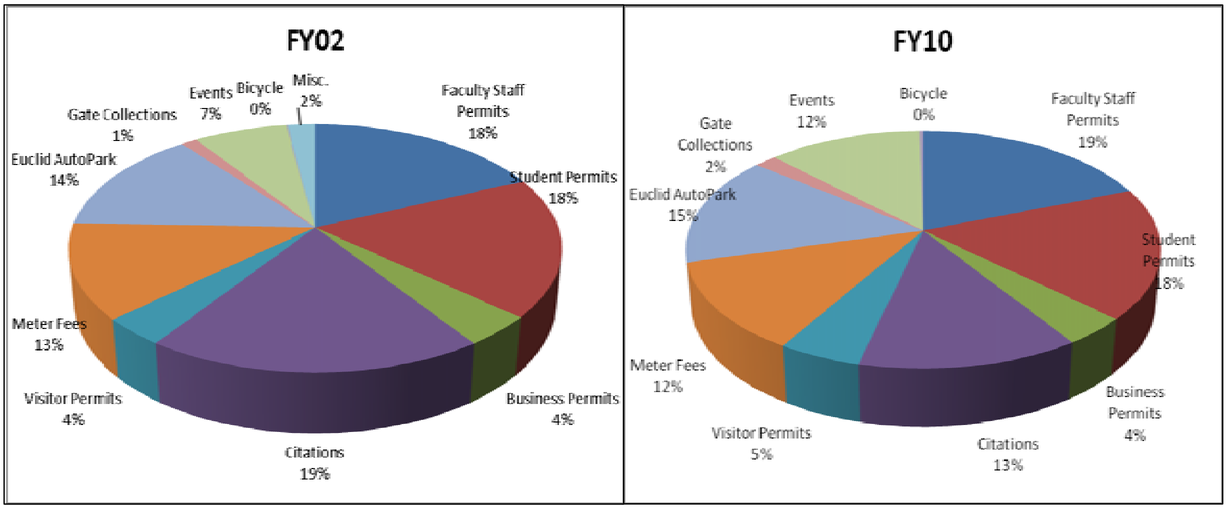
Vendors: Most universities offer daily permits to vendors. CU-Boulder offers daily and monthly permits to vendors.

2.6.4 Parking Revenues and Expenses

2.6.4.1 Revenues

The CU-Boulder parking system generated slightly over $7.4 million in revenue in FY10. Revenues have increased 23% since FY02. Increased revenues are due to increased permit sales and increased permit rates as well as inflationary adjustments assigned to the cost of metered parking, event management, and other operations. Citation revenues have fallen 17% overall since FY02. Figure 2-37 illustrates actual FY10 parking revenues by source, alongside actual FY02 revenue. Note that the percentage breakdown of revenue by source is fairly constant over time.

Figure 2-37
FY 02 and FY10 PTS Parking Revenues by Source



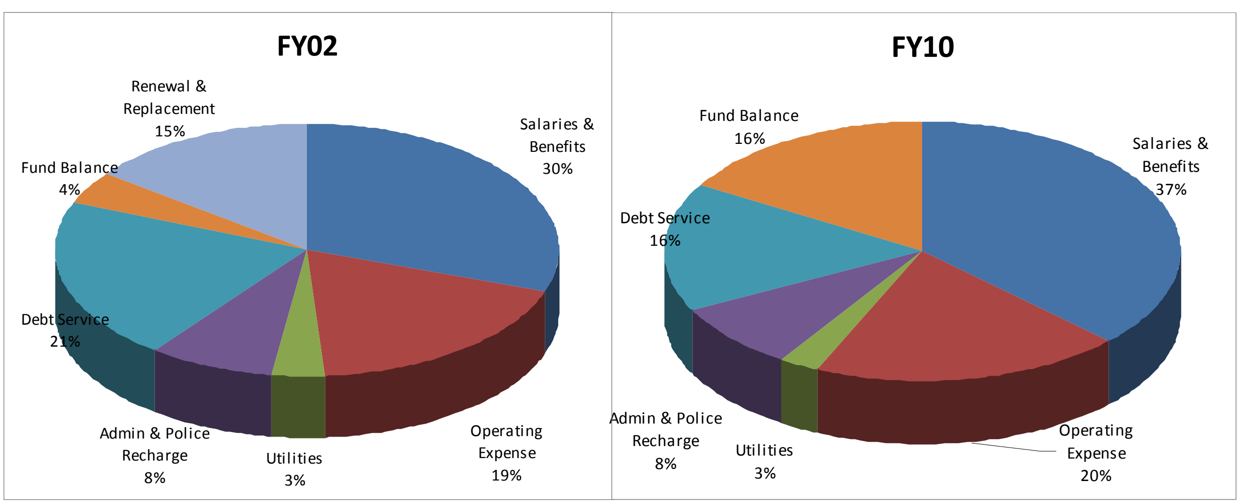
Total Revenues = 6,045,793 **Total Revenues = $7,423,551**

2.6.4.2 Expenses

Actual PTS expenses have increased 23% since FY02 with annual changes in total revenue ranging from a 2% decline to a 59% increase. Debt service remained constant between FY02 and FY10. In FY11, PTS incurred new debt for an additional parking structure which doubled its bonded indebtedness. Staff salaries and benefits have generally increased by 58% over this time period, while hourly salary and benefit expenses have remained the same.

Operating costs expenses have increased 59% while utility costs have declined by 2% since FY02. Figure 2-38 shows FY02 parking expenses by category.

Figure 2-38
FY10 Parking Expenses by Category



Operating expenses include expenses associated with the regular maintenance of parking lots and structures, information technology expenses, and funding for the faculty/staff EcoPass program.

Debt service expense covers bond interest and principal on lots and garages that have not been fully paid off as well as debt service on the Police/Parking building (Public Safety and PTS are managed jointly and are co-housed in the same building). Since 1991, annual debt service expense has been around $1.2 million. This annual expense of roughly $1.2 million is scheduled to continue until 2014 when the Euclid and Regent parking structures and the Police/Parking building at 1050 Regent Drive will be paid off. Beginning in FY11, debt service of $1,233,127 for the Center for Community project will begin and continue for 25 years. During the four years of over-lapping bond repayments, PTS will drain its fund balance unless parking rates are raised significantly.

2.6.5 Existing Parking Demand

Previous parking studies conducted for CU-Boulder estimated parking demand by multiplying the percentage of each user group expected to be traveling to campus each day by the percentage of drive alone (SOV) users and carpol drives. For this analysis, the percentages derived from the *2010 CU-Boulder Commuting Spring and Fall Survey* and the current population estimates were used and are shown in Table 2-24. The faculty/staff driving ratio is the drive alone plus motorcycle percentage (47.5%) plus the carpool percentage (7.67%) divided by two (assuming two-person carpools) which results in a 0.514 driving ratio. The Commuter Survey also had a question asking those who drive where they parked. This percentage was used in the analysis. The presence factor takes into account varying schedules of faculty/staff.

Table 2-24
Parking Demand

	Population	Driving Ratio[1]	Percent Parking On-Campus[2]	Presence Factor	Parking Demand Ratio	On-Campus Total Space Demand	Off-Campus Parking Demand
Faculty/Staff	7,260	0.514	0.72	0.97	0.359	**2,606**	**1,013**
Commuter Students	22,389	0.246	0.71	0.65	0.114	**2,552**	**1,038**
Resident Students Driving to Campus	7,021	0.101	0.79	0.65	0.052	**365**	**97**
Family Housing Students Driving to Campus	666	0.101	0.79	0.65	0.052	**35**	**9**
Subtotal	**37,336**					**5,558**	**2,157**
Resident Students	7,021		0.25	0.97	0.238	**1,669**	
Family Housing Students	666		0.25	0.97	0.238	**158**	
Faculty/Staff in Family Housing	150				1.5	**225**	
Total						**2,052**	
Retirees Parking on Campus						**150**	
Vendors & Contractors						**89**	
Daily Lot Parking Passes						**46**	
University Vehicles						**465**	
Visitors						**776**	
						1,526	
						9,136	

Notes:
(1) Driving ratio is a weighted combination of drive-alone (SOV) users and car/van pool users (HOV) assuming an occupancy rate per HOV vehicle of 2.0 for faculty/staff and students
(2) Obtained from *2010 Spring/Fall Commuter Survey*

Because resident hall demand is based on students who want to park their cars on campus (not how much they drive them), the parking demand ratio for this group is based on the ratio of the number of permits sold, divided by the number of students. This was then multiplied by a presence factor estimated by PTS.

For commuting students, the driving ratio was derived from the *2010 Commuting Spring/Fall Survey* drive alone/motorcycle/carpool mode shares as was the percentage parking on-campus. The presence factor was taken from the previous parking studies. It is lower than the faculty staff presence factor since students tend to be on campus for short periods than faculty/staff.

In addition, PTS provided estimates of daily parking by retirees, vendors and contractors, University vehicles, and visitors. Table 2-24 indicates that the 2010 affiliate population generates an average daily parking demand of about 9,136 spaces. To compare this with CU Boulder's parking supply, current parking data is shown in Table 2-25. PTS provided the number of regular, short-term, disabled, and reserved spaces available for faculty/staff and student parking on the Main Campus, East Campus (including the Research Park) and Williams Village. To reduce time and energy spent on finding a parking space, it is good practice to provide a supply that is somewhat more than the projected demand. The effective factors take this into account. These factors are the same as used in previous studies. For short-term spaces, the effective supply was assumed to be the current utilization, which was estimated by PTS to be 0.70%.

The effective parking supply for the resident and commuter population is estimated at 9,576 spaces. Based on a comparison of the estimated demand and supply, it appears that CU-Boulder has a surplus of about 438 spaces. However, most of the surplus is on the East Campus and Williams Village, with Main Campus lots having a high utilization rate. The tight Main Campus supply results in many vehicles being parked off-campus. Over 2,100 vehicles are estimated to be parked off-campus.

Table 2-25
Effective Parking Supply

	Faculty/Staff Commuter	Student Commuter	Resident Hall	Family Housing	ADA	Reserved	Other(1)	Motorcycle	Short Term(2)	Research Park(3)	Service(4)	Total
Total Spaces	3,359	2,553	980	983	223	103	519	259	1,108	1,292	268	**11,647**
Effective Factor	90%	90%	95%	90%	60%	95%	90%	90%	70%	40%	80%	
Effective Spaces	**3,023**	**2,298**	**931**	**885**	**134**	**98**	**467**	**233**	**776**	**517**	**214**	**9,576**

Notes:
1. "Other" - includes Alumni, Athletics, Facilities, Foundation, Jila, Transportation Center & President's office
2. Short Term - includes 664 spaces that would be generally at $1.50/hr, 398 spaces at Euclid AutoPark at $1.75/hr (first 3 hours) and $3/hr (additional hrs till 5pm M-F), and 46 other spaces
3. Effective Factor calculated based on current use by CU affiliates
4. Service spaces are not available for commuter parking

2.6.6. Parking Utilization

PTS staff has an ongoing program of counting unused parking spaces throughout the campus parking lots and a subsequent reevaluation of permit sales and allocations by lot. Based on utilization data for selected lots, collected by PTS from the fall of 2008 to the fall of 2010, the overall average utilization (vehicles present/spaces available) was 69% for all three campuses and 76% for the Main Campus. Other breakdowns are given in Tables 2-26 and 2-27. The Research Park has a low utilization of 38%. Healthy parking systems aim for a 85-90% utilization.

Table 2-26

	Main Campus	East Campus	Williams Village	All Campuses
Parking Spaces	7,152	3,081	1,414	11,647
Utilization	76%	48%	57%	69%

Table 2-27

Agency	Utilization
Parking Services	72%
Housing	83%
Family Housing	71%
Research Properties	73%
Research Park	38%
Average	69%

CHAPTER 3

Assessment of Data and Demand Projections

This chapter presents the *Flagship 2030* projections of student enrollment, faculty/staff projections, and other forecasts affecting travel and parking at CU-Boulder. Based on these projections, forecasts of commuting vehicle miles of travel, transit ridership, and parking demand are developed.

3.1 Campus Population Projections

The office of Planning, Budgeting and Analysis (PBA) provided projections of student enrollment through 2020 as shown in Table 3-1. PBA also provided projections of faculty/staff through 2020 as shown in Table 3-2. Using PBA's mid estimate and carrying the same growth rate of approximately 0.86% per year through 2030 yields the affiliate population projections shown in Figure 3-1.

Table 3-1
Student Enrollment Projections

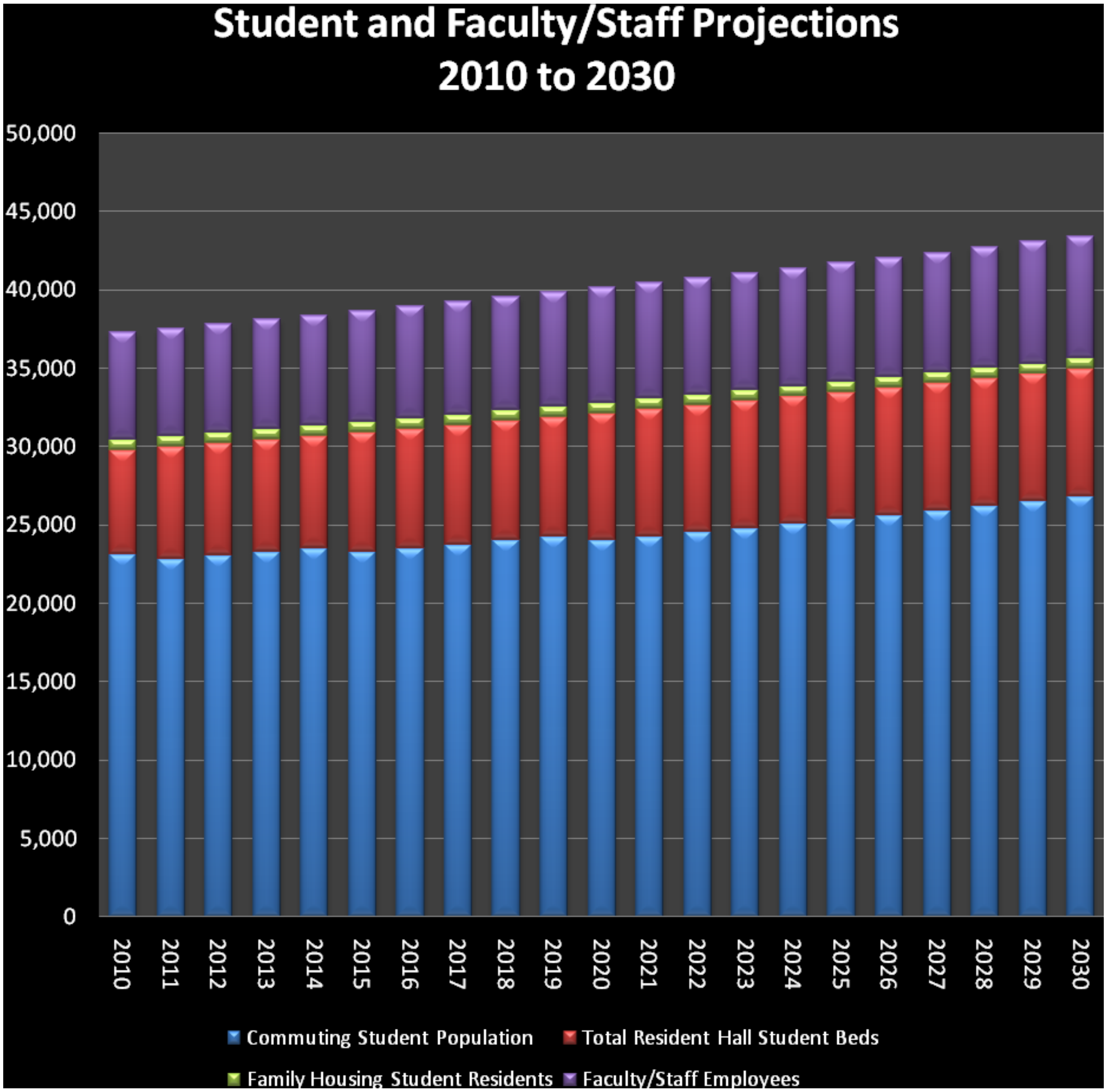
Fall of:	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2030
Undergraduate	25,222	25,388	25,548	25,702	25,856	26,009	26,162	26,251	26,339	26,427	26,516	27,401
Graduate	4,854	5,013	5,175	5,338	5,503	5,671	5,840	5,947	6,056	6,168	6,281	7,550
Total	30,076	30,402	30,723	31,040	31,359	31,680	32,002	32,198	32,395	32,595	32,797	34,951

Table 3-2
Projections of Faculty/Staff

	2010*	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2030
Instructional	2,207	2,225	2,243	2,261	2279	2,297	2,315	2,333	2,351	2,369	2,373	2,583
Non-Instructional/ Research	1,773	1,808	1,842	1,877	1,912	1,947	1,981	2,016	2,051	2,085	2,120	2,307
Classified/Unclassified Staff	3,280	3,293	3,306	3,320	3,333	3,346	3,360	3,373	3,386	3,400	3,414	3,715
Total	**7,260**	**7,326**	**7,392**	**7,458**	**7,524**	**7,590**	**7,656**	**7,722**	**7,788**	**7,854**	**7,907**	**8,605**

* Actual employment

Figure 3-1


Student and Faculty/Staff Projections
2010 to 2030
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Commuting Student Population
Total Resident Hall Student Beds
Family Housing Student Residents
Faculty/Staff Employees

3.2 Commuting Travel Estimates

Estimates of commuting vehicle miles of travel were developed by taking the affiliate population, applying current mode use percentages (see discussion on the *University of Colorado 2010 Commuter Spring/Fall Survey* in Section 2.1) and multiplying by average commuting trip length. The calculations for VMT include the calculation of all commuting vehicles traveling to and from campus, including all vehicle-miles (both auto and transit) attributed to the university's commuting affiliates. Transit VMT includes both RTD buses as well as the university-operated Buff Bus. Carpool/vanpool occupancy was assumed at 2 persons per vehicle while bus occupancy (with the exception of Buff Buses) was assumed at approximately 8.9 persons per vehicle. The VMT was then obtained by multiplying the resulting vehicles by an average commuting trip length. A one-way trip distance of 11.0 miles for faculty/staff and 13.9 miles for students was used for vehicle commuter trips. For transit commuter trips, a one-way trip distance of 14.3 miles for faculty/ staff and 6.8 miles for students was used. These distances were obtained from the *University of Colorado 2010 Commuter Spring/Fall Survey* (with the exception of the faculty/staff vehicle distance which was based on Fall 2010 PTS permit data). The results of the 2010 VMT calculation are shown in Table 3-3.

Table 3-3
2010 Vehicle-Miles Traveled Calculations

Affiliate Breakdown	
Commuting Students	22,389
Resident Students	7,021
Family Housing	666
Faculty/Staff	7,260
Total Campus Population (1)	37,336
Family Housing Units	816

Mode Share (2)			Trips	Vehicle Occupancy (3)	Vehicles	Average Round Trip Length (4)	Weekday Vehicle Miles Traveled
Commuting Students	Bike	14.9%	3,338				
	Transit	30.1%	6,730	8.9	756	13.6	10,284
	Drive Alone	22.2%	4,975	1	4,975	27.8	138,305
	Car/Van Pool	3.4%	752	2	376	27.8	10,453
	MC/Scooter	0.7%	157	1	157	27.8	4,365
	Walk	20.4%	4,574				
	Other	8.3%	1,863				
		100.0%	22,389				163,406
Resident Students	Bike	12.8%	980				
	Transit	23.0%	1,771				695 (5)
	Drive Alone	6.8%	520	1	520	2	1,040
	Car/Van Pool	5.1%	390	2	195	2	390
	MC/Scooter	0.8%	59	1	59	2	118
	Walk	43.3%	3,330				
	Other	8.3%	637				
		100%	7,687				2,243
Faculty/Staff	Bike	8.4%	608				
	Transit	21.7%	1,575	8.9	177	28.6	5,061
	Drive Alone	47.3%	3,431	1	3,431	22	75,482
	Car/Van Pool	7.7%	557	2	279	22	6,127
	MC/Scooter	0.3%	20	1	20	22	440
	Walk	5.9%	428				
	Other	8.8%	641				
		100.0%	7,260				87,110
						Total Weekday Vehicle-Miles Traveled	252,760

Notes:
(1) Population estimates based on 2010 data from the Office of Budget, Planning and Analysis and growth rates from the *Flagship 2030 Strategic Plan*.
(2) Mode split based on data found in the *Spring/Fall 2010 Commuter Survey*. Other category includes, skateboard, working from home, not working, and other.
(3) Assumes an average occupancy of 2.0 for student car/van pools and 2.0 for faculty/staff car/van pools. Projected number of buses calculated by assuming an average bus occupancy
(4) Calculated based on average trip distance. Trip distance for commuting students is based on *Spring/Fall 2010 Commuter Survey* while trip distance for Faculty/Staff is based on geocoded PTS permit address information.
(5) Buff Bus annual VMT obtained from CU. Daily VMT calculated by assuming 9 months of service, 4.33 weeks per month, and 5.45 weekday-equivalents per week based on the existing weekday and weekend schedule.

As shown, existing VMT associated with the university's commuting trips is approximately 252,760 miles per weekday.

3.3 Future Commuting Travel Projections

Estimates of future commuting travel for university affiliates were projected based on projected population growth and the continuation of the current set of TDM programs.

As discussed in Section 2.1 (see Table 2-2), vehicular use is significantly higher for faculty and staff working at the East Campus. This is most likely due to the lower level of transit service and bicycle/pedestrian facilities at the East Campus. Since a majority of the future growth at the university is planned to occur on the East Campus, the Drive Alone and Carpool/Vanpool mode shares were assumed to be higher in 2020 and 2030 compared to the 2010 shares for these modes.

Using the same methodology as Section 3.2, VMT was estimated for 2020 and 2030 using the affiliate population estimates discussed in Section 3.1. The results are shown in Table 3-4 along with estimates for 2010. As shown, existing VMT associated with the university's commuting trips is approximately 252,760 miles per weekday. With no changes in the university's TDM programs, VMT is expected to grow to approximately 296,954 by the Year 2030 due to population growth and slight shifts in mode type due to growth at East Campus. This means there will be an additional 44,194 miles per weekday of travel to and from the campus. This demand will also result in a demand for an additional 1,700 on-campus parking spaces to accommodate this increased travel demand.

Table 3-4
Commuting Vehicle-Miles Traveled

Faculty/Staff	2010	2020	2030
Bicycled	8.4%	8.0%	8.0%
Carpooled/Vanpooled	7.7%	8.0%	8.0%
Drove Alone	47.5%	49.6%	49.6%
Transit	21.7%	20.2%	20.2%
Walked	5.9%	5.4%	5.4%
Worked at Home/Didn't Come/Other	8.8%	8.8%	8.8%
Commuting Students			
Bicycled	14.9%	14.9%	14.9%
Carpooled/Vanpooled	3.4%	3.4%	3.4%
Drove Alone	22.9%	22.9%	22.9%
Transit	30.1%	30.1%	30.1%
Walked	20.4%	20.4%	20.4%
Worked at Home/Didn't Come/Other	8.3%	8.3%	8.3%
Weekday SOV VMT	219,750	237,512	258,857
Weekday HOV VMT	33,009	35,040	38,097
Total Vehicle-Miles Traveled	**252,760**	**272,552**	**296,954**
Fuel Consumption (gal.)(2)	13,414	12,346	11,778
CO2 Emissions (mt. tons)	118	109	104
On-Campus Parking Demand	9,125	10,203	10,826
Off-Campus Parking Demand	2,157	2,369	2,570
Total Parking Demand	**11,281**	**12,572**	**13,396**

1. Assumes 1,500 student housing beds that are currently planned. Faculty/staff SOV split increases due to most new growth occuring at East Campus where the SOV split is higher than Main Campus.
2. Year 2030 fuel consumption assumes a 25 percent reduction which is consistent with current EPA goals.

Table 3-4 also shows calculation of daily fuel consumption and metric tons of CO_2 emissions for each alternative. The fuel consumption was calculated using the VMT estimates, the current affiliate vehicle mix obtained from PTS, and the Environmental Protection Agency (EPA) fuel consumption estimates for each vehicle class. The specific mix used and miles-per-gallon (MPG) estimates for each class are shown in Table 3-5.

Table 3-5

Vehicle Type	Percent	MPG
2-Door Sedan	8%	28
3-Door Hatchback	1%	28
4-Door Sedan	42%	26
5-Door Hatchback	2%	26
Station Wagon	8%	22
Van	5%	21
Sport-Utility	19%	19
4-Wheel Drive Utility	4%	16
Truck	10%	16
Motorcycle/Moped	0%	50

The daily CO_2 emissions for each alternative were calculated assuming 19.4 pounds of CO_2 per gallon of fuel. Please note that fuel consumption and emissions are expected to decrease from Year 2010 to Year 2030 even with a growth in VMT due to improvements in vehicle fuel consumption of 25 percent as set forth by recent federal standards.

CHAPTER 4
Managing Demand and Supply

This chapter discusses approaches to managing travel demand at CU-Boulder along with options for managing the parking supply, improving bike/pedestrian facilities, and improving transit services. It examines innovative programs at other universities and assesses what best practices would be applicable to CU-Boulder.

4.1 Travel Demand Management

Travel Demand Management is an essential component of CU-Boulder's Transportation Master Plan. It aims to reduce auto trips and to encourage more affiliates to walk, bicycle, use public transit, share car trips, and to work, shop, and play locally.

Although there is no single agreed definition of travel demand management, the definition proposed here is:

> *"A set of tools to offer people better travel information and opportunities and help people choose to reduce their need to travel especially by auto."*

Travel demand management is a broad set of tools and techniques ranging from land use planning to educating affiliates on the benefits of walking or bicycling to campus. Its measures and tools are described under the following main subheadings:

Reduce the need to travel	• Land use – intensification • University villages with housing, academic, retail, and service facilities • Tele-working, video conferencing
Provide for travel choices	• Allocation of street space (to public transit, walking, bicycling, high occupancy vehicles) • Improved public transit services • Construction of walking and bicycling networks
Influence travel choices	• School, Business, and Community Travel TDM Plans • Improved Travel Information • Pricing of parking and roads (i.e., US 36)

Travel demand management initiatives are important for CU-Boulder for the following reasons:

- A coordinated approach to transportation – with priority given to walking, bicycling, and public transit trips – will help to develop a more sustainable land use pattern for the university and the Boulder Valley.
- Travel demand management projects help to make more efficient use of existing and future road infrastructure. Reducing the number of trips being made by car will free up road capacity for transit, high occupancy vehicles, commercial, freight, and other priority users.
- Travel demand management projects can increase public transit patronage and therefore increase the benefits from public transit investments.

- Increasing the proportion of trips made by walking and bicycling will have health, social and environmental benefits.
- Travel demand management projects are cheap for the transportation benefit they deliver – especially when compared to other transportation infrastructure construction costs including expensive parking structures.
- A number of trips may be avoided completely by enhancing the use of available telecommunication technology.

4.2 CU-Boulder's Mode Share Compared To Other Universities

CU-Boulder has been a partner with the City of Boulder, Boulder County and regional agencies in developing award-winning transportation programs, including the Community Transit Network, the extensive City/County bikeway network, and many innovative and creative Travel Demand Management programs. The results are truly impressive as CU-Boulder has one of the lowest Single Occupant Vehicle modal splits among major universities and Boulder traffic volumes have actually declined during the last decade despite campus enrollment growth.

To see how CU-Boulder compares to other universities, an internet search and review of information in individual campus master plans and research reports resulted in mode share data depicted in Table 4-1. It is difficult to compare such data since each university is located in unique environments (rural, suburban, and urban) where the level of transit service and parking availability could be quite different from the Boulder area. In addition, the provision of on-campus or nearby housing could also be quite different. Nonetheless, CU-Boulder compares favorably with these universities in non-SOV use (walking, bicycling, and transit).

Table 4-1
Summary of University Mode-Split Studies for Students

University Location (Study Year)	Bus	Bike/Walk	Other	Subtotal Non-Auto Modes	Drive	Carpool
University of Florida, Gainesville, FL (2005)[1]	22%	70%	0%	92%	8%	
University of Colorado at Boulder, CO (2010)	28%	40%	8%	77%	19%	4%
University of California at Davis, CA (2007)	18%	42%	7%	67%	28%	5%
North Dakota State University, Fargo, ND (2009)[2]	7%	32%	3%	42%	53%	5%
Camosun College, Victoria, BC Canada (2006)	34%	6%	0%	41%	59%	
California State University, Chico, CA (2008)	5%	28%	0%	33%	57%	9%
Miami University, Oxford, OH (2008)	9%	23%	1%	32%	68%	
University of California at Santa Cruz, CA (2004)	28%	4%	0%	32%	39%	29%
University of Texas at Austin, TX (2007)	15%	2%	8%	25%	75%	

Notes:

"Auto" includes single-occupant vehicles, motorcycles, carpools, and vanpools. Some universities reported driver/rider or single-occupant/carpool separately, but not all. Those are combined here for easier comparison.

"Bus" includes public transit, campus-provided transit, and private residential-based shuttle bus services.

"Bike/Walk" includes pedestrians and bicyclists, plus skateboarders / in-line skaters if identified by the survey.

"Other" includes one university's research (UC-Davis) which had multi-modal trip (i.e. drive, park-n-Ride, bus, walk trip). For most surveys, "other" included telecommuting (CU-Boulder), trip-reduction/trip not made that day, travel demand management, and unidentified "other" responses.

1 UF study compared at freshmen and alumni, noting that freshmen had higher rates of transit and NMT use. Data in this table are for freshmen only. As alumni, individuals had more transit and non-motorized transportation awareness than their parents, but that their actual trip-making pretty closely resembeled parental transportation habits and modal choices.

2 UND study looked at students as they progressed through college, noting freshmen tended to live on campus and have less access to cars. Seniors tended to live off-campus and have almost universal access to cars.

Sources: Individual Campus Transportation Master Plans (by various entities) and TCRP Synthesis 78.

4.3 Survey of TDM Programs at Other Universities

Many other universities are facing similar growing travel and parking demand pressures as CU-Boulder. To find out how other universities are dealing with these challenges, peer university websites were reviewed for their provisions of TDM programs.

4.3.1 Bicycle Facilities

Table 4-2 displays the results for bicycle facilities at 32 universities. Most universities have a network of bike paths/routes, including published maps. Showers/lockers were available on only about 25% of the surveyed institutions, with a couple providing them for a charge and others free with campus ID. Bicycle lockers for rent were found on about 10% of the universities. Most of the universities had a bike registration programs and 6 had a bike sharing program.

Table 4-2
Bicycle Facilities - Other Universities

College/University	Bicycles: Bike Paths	Showers/ Lockers	Bike Racks/ Lockers	Bike Registration Required	Bike Sharing Program
PAC 10					
Cal-Berkely	X		X	X	
USC			X	X	
UCLA	X	X	X		
Arizona	X		X	Strongly Recommended	X
Arizona State	X		X	Recommended	X free rental for 2 weeks
Oregon	X		X	X	
Oregon State		X	X Lockers for Rent	Recommended	
Stanford	X	X $16/$35/year	X	X	
Washington	X	X	X Lockers for Rent	Recommended	
Washington State	X		X		X free with ID
Big Ten					
Ohio State	X		X	Recommended	
Iowa	X		X	Recommended	
Michigan	X		X Lockers for Rent	X	
Michigan State	X		X	X	x Rental
Penn State	X		X	X	
Purdue	X	X	X	X	
Indiana	X	X fee	X		
Northwestern	X	X free with Campus ID	X	available	
Wisconsin	X		X	available	
Minnesota	X	x rental	X	Recommended	X $60/year
Illinois	X		X		X
Big Twelve					
Texas		X	X Lockers for Rent	X	
Texas Tech	X		X		
Texas A+M	X		X		
Baylor	planned		X		
Oklahoma			X	X	
Oklahoma State	X		X	X	
Missouri			X	X	
Kansas			X	Recommended	
Kansas State	bike lanes		X	X	
Nebraska	partial		X	Recommended	
Iowa State	partial		X	X	

Table 4-3 contains highlights of cycling programs at two universities with "Excellent" rated institutions as compiled by the Victoria Transport Policy Institute.

Table 4-3
Highlights of Cycling Programs at "Excellent" Rated Institutions

University of British Columbia (UBC)	University of Victoria (UVIC)
• Bike Kitchen (Non-profit, student run, full service bike shop). • BIKE CO-OP (membership $20-$30) access 50 – 100 public bikes for on-campus riding • Bike locker rentals ($23.00/month) • Secure bike parking facilities • Numerous bike racks (600+) • Shower facilities • Can-cart rental (bicycle utility carts) • Great website resources; best of survey • Shower, change room and locker facilities	• 120 large lockers designated for cyclists • 60 bike lockers to rent with more being built • SPOKES bike bursary program • Excellent website (links, maps, information) • Over 2,900 bike parking spaces • Change rooms and showers with towel service • Pressurized air hose • Bike Kitchen to be available in 2009 • Four free electric bike charging stations to be available in 2009 • Bike engraving program (for security) • Spring cycling safety program

CU-Boulder compares favorably with its peer universities and the above "excellent" rated institutions. CU-Boulder currently does not provide, or provides in a limited manner, the following programs and facilities:

- Secure bike parking facilities;
- Shower, change room, and locker facilities;
- Electric bike charging stations;
- Bicycle utility carts.

4.3.2 Transit Program Incentives

Table 4-4 displays the results of transit incentives and programs at peer universities. Most peer institutions provided discounted (30% of peers) or free passes (34% of peers) to students. Forty-one percent offered student bus passes similar to CU-Boulder's programs.

Faculty/staff can obtain discounted bus passes at 25% of the peer institutions and free bus passes at 41% of the peer institutions.

Shuttles are available at 94% of peer universities with the other 6% offering this service to disabled affiliates. Almost all of these services were provided free to holders of a campus ID.

CU-Boulder has been a leader in transit programs and incentives with the student bus pass programs, the faculty/staff EcoPass program, and the Buff Bus services.

Table 4-4
Public Transportation/Shuttles - Other Universities

		Public Transportation				Shuttles			
	Student		Cost			Shuttle	Shuttle	Bike	
College/University	Enrollment	Available	Students	Staff/Faculty	EcoPass	Available	Parking	Racks	Cost
PAC 10									
Cal-Berkely	35,843	X	$69.50 (part of reg. fee)	$408/year	X	X		X	free with Campus ID
USC	33,747	X	$4 off transit price	$30 subsidy/month if no parking permit		X	$6		free
UCLA	39,984	X	1/2 price		X	X		X	free
Arizona	38,057	X	1/2 price	1/2 price		X	X		free
Arizona State	55,552	X	discount	discount	X	X		X	free
Oregon	23,389	X	discount	discount	X U-Pass	X disability			free
Oregon State	23,671	X	free with ID	free with ID		X			free
Stanford	19,535	X	free with GoPass	free with EcoPass	Eco Pass GoPass	X		X	free
Washington	47,361	X	free with ID	free with ID	X U-Pass	X disability			free
Washington State	26,101	X	free with ID	discounted rates		X			free
Big Ten									
Ohio State	64,077	X	unlimited rides with $9/$13.50 fee per quarter	N/A		X			free
Iowa	30,825	X	discounted rates	discounted rates		X			free
Michigan	41,924	X	free with ID	free with ID	M-Card	X			free with Campus ID
Michigan State	47,131	X	discounted rates			X			discounted fare
Penn State	44,817	X		discounted rates		X			free
Purdue	39,726	X	free with ID	free with ID		X			free with Campus ID
Indiana	42,646	X	free with ID	N/A	S Pass	X		X	free
Northwestern	16,475	X	reduced rates		U Pass (FT students only)	X			free with Campus ID
Wisconsin	42,099	X	free with ID	free with ID		X	X		free with Campus ID
Minnesota	51,721	X	reduced rates	discounted rates	U Pass	X		X	free
Illinois	5,027	X	free with ID	free with ID	i-card	X			free
Big Twelve									
Texas	49,696	X	free with ID	free with ID		X		X	free with Campus ID
Texas Tech	31,637	X	free with ID			X			free with Campus ID
Texas A+M	51,798	X	free	free		X			free
Baylor	13,886					X			free
Oklahoma	29,721	X	free with ID	free with ID		X			free
Oklahoma State	23,307	X				X			
Missouri	32,415	X	1/2 price		FASTPass	X			free
Kansas	30,004	X	free with ID	free with ID		X	$205/year (incl $140 bus pass)	X	
Kansas State	23,581	own car/bike recommended - no public transportation available				X			
Nebraska	24,610	X	free with ID	free with ID and parking permit	UNL/StarTran	X			free with ID and UNL Pass
Iowa State	28,682	X	free with ID	free with ID		X	X		free

4.3.3 Case Studies of Comprehensive TDM Programs

Several universities have innovative TDM programs including not only transit, bike and pedestrian programs and facilities, but coordinated parking management and supporting housing programs. The Victoria Transport Policy Institute (www.vtpi.org) provided the following case studies.

University of Victoria Travel Choices Program
(http://web.uvic.ca/sustainability/TransportationTravelChoices.htm)

The University of British Columbia Office of Campus Planning and Sustainability's *Travel Choices Program* is a comprehensive parking and transportation demand management program that encourages the use of public transit, cycling and walking and less reliance on single occupant vehicles. The program goals are:

- To reduce the number of commuter trips by students, faculty and staff to and from the University of Victoria.
- To shift travel time away from peak-hours to reduce traffic congestion and improve local air quality.
- To shift the mode of travel from the Single Occupant Vehicle to either High Occupant Vehicles (carpool, rideshare, car-share, public transit, etc.) or Active Transportation (cycling, walking, roller-blading etc.).
- To improve the efficiency of campus circulation on Ring Road.

The Travel Choices Program provides the following services and incentives.

Universal Bus Pass

The Universal Bus Pass (U-Pass) provides students with unlimited access to Victoria region public transit. All students taking at least one (1-unit) on-campus course are charged $69.25 for a four-month pass as part of their UVic student fees.

Employee Bus Pass

The UVic Employee Bus Pass Program, which offers discounted bus passes to employees at a cost of $33 per month, compared with $75 for a regular pass, with a subsidy provided by the UVic Transportation Demand Management (TDM) Program[1].

Carsharing

Four carshare vehicles are available on campus for faculty or staff who sometimes need a car for professional travel or personal use.[2] In addition, the campus motor pool fleet is available for rental by UVic staff and faculty. Vehicles, including mini vans and a hybrid car, and are available for short or long term rentals. Charges are based on length of rental plus mileage driven. Insurance and gas are provided.

Ridesharing

A rideshare permit allows the user to easily find a great parking stall on campus. Those who have a permit and have three or more people in the vehicle get priority parking in designated rideshare stalls between 7 a.m. and 10 a.m. After 10 a.m., any available rideshare stalls revert back to general parking.

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[1] For information see http://web.uvic.ca/vpfin/financialplanning/campusplanning/transitindex.htm

[2] For information see http://web.uvic.ca/sustainability/EmployeeCarShareProgram.htm.

Cycling Amenities

The University of Victoria has more than 2,900 bike parking spaces. Cyclists can use covered bicycle shelters, secure bike lockers, clothing storage lockers, shower and change room facilities, plus a Bike Kitchen (a workshop with bike stands, compressed air, and basic tools for quick repairs and minor adjustments), electric bike charging stations, bikeracks on public transit buses, and the SPOKES bicycle bursary program, which fixed up old bicycles for use by students, faculty and staff.

Campus Safewalk Program

Campus Security Services provides SafeWalk services between buildings and vehicles on campus at any time of day or week.

Videoconferencing

The University has videoconferencing facilities that can be used to substitute for physical travel. These facilities can accommodate up to 25 people in various configurations. They have three cameras per room, an Elmo visual presenter, twelve push-to-talk microphones and two 50' TV viewing monitors.

Parking

Table 4-5 illustrates current (2008-09) parking fees The Flexi-Pass allows employees to park up to 12 days per calendar month on campus, to accommodate people who use alternative modes part time.

Table 4-5
University of Victoria Parking Prices
http://web.uvic.ca/security/parking/parkrate08-09.pdf

	Annual	Monthly	Daily	Hourly
Parkade	$1,575.00	NA	$10	$1
General Reserved	$688.80	$131.25	$10	
General	$393.75	$75.60	$6	$1
Motorcycle	$122.85		$6	
Family Housing	$196.88			
Flexi-Pass	$294.00			

The Travel Choices Program has had the following impacts:

- Since 1996, the campus population increased 19% but vehicle traffic to campus decreased 17%.
- More than 65% of people travel to and from campus each day using sustainable transportation, including public transit, cycling, carpooling and walking.
- In 2006, 27% of the campus population used transit as their main mode of travel.

University of British Columbia TREK Program (www.trek.ubc.ca)
The University of British Columbia (UBC) TREK Program is one of North America's oldest and most comprehensive campus transportation and parking management programs. This program includes:

- A UPass program that began in 2003. This provides unlimited regional public transit service to all regular students.
- Numerous transit service improvements (including planned development of a new below-grade transit station in the campus center).
- A reduction in the commuter parking supply of approximately 25% since 1997, accompanied by an increase in parking prices (from $2.00 per day in 1997 to $4.50 per day in 2007) and increased parking regulation and enforcement on nearby streets.
- Adjusted morning class start times, so some classes begin at 8:00 a.m., some at 8:30 a.m., and others at 9:00 a.m. As a result, 12% more transit trips per day were accommodated on the same number of buses.
- Numerous walking and cycling improvements.
- Various programs and services to encourage use of alternative modes, including a comprehensive carpooling program (including a web-based ride-matching service, preferred carpool parking and a rewards program), an emergency ride home program, additional campus shuttles, a car-sharing program, a public bike program, bicycle carts and traffic calming measures.
- Additional campus area housing and commercial services to help reduce the number of trips to campus.

The TREK program produces an annual *Transportation Status Report* which provides statistics on the program and its impacts. During the ten year period from 1997 to 2007, campus daytime population increased 32%. Although total person-trips increased by 14%, vehicle trips declined 20% due to large shifts to public transit.

Stanford University (http://transportation.stanford.edu)
Stanford University in Palo Alto, California planned to expand campus capacity by 25%, adding more than 2.3 million square feet of research and teaching buildings, public facilities and housing without increasing peak period vehicle traffic. By 2000, 1.7 million square feet of new buildings had been developed while automobile commute trips were reduced by 500 per day. To accomplish this the campus transportation management plan includes:

- A 1.5 mile transit mall
- Free transit system with timed transfers to regional rail
- Bicycle network
- Staff parking "cash-out"
- Ridesharing program
- Other transportation demand management elements

By using this approach the university was able to add $500 million in new projects with minimal planning or environmental review required for individual projects. The university also avoided significant parking and roadway costs. Planners calculate that the University saves nearly $2,000 annually for every commuter shifted out of a car and into another mode. This also reduced regional agency traffic planning costs.

Public benefits included decreased congestion and improved safety on surrounding roadways and the regional traffic system, reduced air, noise and water pollution, and improved local transit options. All of Stanford's transportation services are available to students, employees and the general public.

BruinGO (www.sppsr.ucla.edu/its/UA/index.html)

The Santa Monica Municipal Bus Lines offers a transit-pass program called *BruinGO* that allows 68,000 UCLA students, staff, and faculty to ride the bus without paying a fare. UCLA's Institute of Transportation Studies examined how BruinGO affected transit ridership to campus and parking demand on campus during its first year (2000-2001), and found that:

- Faculty/staff made 73% more bus trips per day and 6% fewer vehicle trips per day to campus after BruinGO began.
- Students made 51% more bus trips per day and 11% fewer vehicle trips per day to campus after BruinGO began.
- BruinGO reduced parking demand on campus by 1,380 spaces.
- Use of UCLA's ID card as a transit pass reduced average bus boarding time by 26%.
- The program's benefit-cost ratio is 5.4 to 1.

CU-Boulder compares favorably to cutting edge universities, having student and faculty bus pas pass programs; bike share and bike station programs; car-share and ride-matching programs. Programs that may be applicable to CU-Boulder include:

- Rideshare permits (University of Victoria);
- Flexi-Pass for alternate mode users (University of Victoria);
- Market-based parking rates (University of Victoria);
- Transit station (University of British Columbia);
- Reduced commuter parking supply/parking rate increases (University of British Columbia);
- Increase parking regulations and enforcement on nearby streets (University of British Columbia);
- Staggered class start times (University of British Columbia);
- Additional campus housing and commercial services (University of British Columbia);
- Transit mall (Stanford);
- Staff parking "cash-out" (Stanford).

4.4 Lessons for CU-Boulder

From the review of data and programs from peer institutions, it is apparent that CU-Boulder is one of the leading universities in developing innovative, comprehensive, and effective TDM programs. However, to meet its sustainability goals and continue its enrollment growth without increasing congestion or building expensive parking facilities, CU-Boulder can draw upon the experience of other universities. Some of the most effective approaches to reducing SOV use and shifting to other modes include:

- Additional on-campus housing – CU-Boulder's student walk/bike rate of 35% is much less than some other universities (see Table 4-1), reflecting the high-priced Boulder housing market and the lack of enough housing units within bicycling/walking distance of CU-Boulder. Providing additional housing on or near campus will increase the walk/bike mode share.

- Parking management through pricing, limited supply, and flexible permits can have a significant impact on reducing SOV use and in avoiding construction of costly parking facilities.

- Providing bus passes to all affiliates at minimal cost to the users. CU-Boulder has been a leader in this approach and it has been proven that once a user has a bus pass, the zero-marginal cost of transit trips leads to increased transit usage. CU-Boulder affiliate transit use contributes substantially to the City of Boulder's high transit ridership, which has reduced vehicular travel in the Boulder Valley. CU-Boulder should maintain its commitment to these programs.

- Transit service enhancements need to be continually planned, reviewed, and updated. More frequent bus service and convenient routes can lead to higher ridership, but transit service is costly and needs to be assessed and monitored to ensure that it is cost-effective for the amount of SOV shift that it achieves.

- Bike and pedestrian facilities need to be upgraded to accommodate the larger numbers of bicyclists and pedestrians and to address the "missing links" in the system. Conflicts between these users need to be carefully considered in facility design.

- Rideshare, car share and incentive programs can lead to reduced SOV use. These programs, while not resulting in large mode shifts, are relatively cost-effective for the dollars invested.

- Bike sharing, bike stations, bike parking, and incentive programs have been effective and popular at CU-Boulder. CU-Boulder does lack covered and secured parking, showers, and locker facilities, and it should further assess the potential SOV reductions it may be able to achieve through expansion of these types of facilities and programs.

CHAPTER 5

Analysis of Options for Transportation Infrastructure Improvements and Service/Program Changes

This chapter identifies and discusses various options for changes to CU-Boulder's transportation system. These options respond to several of the Transportation Master Plan goals listed in Chapter 1. These include:

- To reduce congestion in and around the campuses and to reduce the total number of motor vehicles driven to campus, which will result in reduced parking and travel demand;
- To provide convenient and viable alternative mode options to the campus community in order to encourage the use of transportation modes other than the single-occupant vehicle;
- To better manage the available parking supply and to price it to ensure financial sustainability and to encourage alternative mode use;
- To ensure TDM and parking management strategies are considered and incorporated into projects as the campuses develop and to use other methods, such as providing more on-campus housing and building university villages (which integrate student, faculty, and staff housing along with education, retail and service facilities), to minimize or eliminate the need to build new parking;
- To achieve greenhouse gas emission (GHG) reductions in campus transportation by 2020 in comparable proportion (about 20%) that the transportation sector contributes locally to campus GHG;

Most of the options fall under the umbrella of Travel Demand Management, with infrastructure improvements discussed for those parts of the campus that will be undergoing development. Using the framework from Section 4.1, the options are organized under the following categories:

- Reduce the need to travel
- Provide for travel choices
- Influence travel choices

5.1 Reduce the Need to Travel

As a flagship university, CU Boulder's primary purpose is the education of its students which means daily interaction among students, faculty and staff. This means that students, faculty and staff need to travel from their place of residence to classrooms, research labs, offices, dining facilities, social venues and recreation facilities. The options in this category, therefore, focus on reducing the distances between these buildings housing these activities and reducing unnecessary travel.

5.1.1 Increase On-Campus Housing

In the fall of 2010, CU Housing and Dining Services provided 6,044 traditional residence hall beds, 977 apartment beds at Bear Creek and 808 family housing units housing approximately 525 students. Thus, with a fall 2010 enrollment of 29,952, CU-Boulder housed 7,546 students for a percentage of 25.2%. Fortunately, there is a stock of several thousand apartments and rental units located near campus, but not nearly enough to provide housing for all CU students within walking distance of the campus. Affordable housing, however, is difficult to obtain in the City of Boulder. The shortage is due to many reasons including the city's limited growth ordinances, a strong real estate market, high rental rates and an attractive environment. The high cost of living drives many students, faculty and staff to surrounding communities to find affordable housing. Thus, well over half of the students and most of the faculty/ staff live in areas where they must "commute" to campus. These commuters contribute to environmental pollution and increase the demand for parking.

Providing more on-campus housing would alleviate some rent pressure on students, slow the growth of commuters into Boulder and reduce the demand for on-campus parking. On-campus housing also provide students with a more meaningful college experience, where academics, housing, recreation and social activities can be provided in close proximity. The Williams Village Master Plan provides for the addition of an additional 1,000 beds as well as some 200 faculty/staff dwelling units. 500 of these beds are under construction and will open in 2011. There will likely be 585 more undergraduate housing beds between Kittredge Central and the Quad redevelopment plans. As the East Campus develops, consideration should be given to including a large housing component. Also, the university owns several hundred family housing units and undergraduate units in an area north of Boulder Creek and south of Arapahoe Avenue. As this area redevelops, more units could be added.

5.1.2 Land Use Standards

Reducing the space devoted to parking in conjunction with new construction can create a higher density environment thereby reducing the distances between housing, classrooms, research labs, social and recreational facilities. A more pedestrian friendly environment can be created where walking is emphasized. This is an important strategy to reduce vehicular travel and encourage alternative modes use.

5.1.2.1 Parking Standards

Past university practices for new buildings on campus often relied on parking standards designed to provide ample vehicular parking without regard to the school's TDM programs. For example the Williams Village Micro Master Plan used 0.5 spaces per bed for undergraduate housing, 0.75 spaces per bed for graduate housing and 1.5 spaces per unit for family housing and faculty housing. The result was a projected need for almost 2,000 parking spaces on the campus expected to house 3,280 affiliates. Reducing these parking standards to reflect the current and expected vehicular use could reduce this need by almost a third to 1,382 spaces. Recommended standards include:

- Residential dormitory buildings – new buildings shall provide a maximum of 0.15 parking spaces per bed immediately adjacent to the building. Such spaces shall be used primarily for ADA, service and visitor uses. The building project shall also consider helping to provide 0.15 parking surface spaces per bed in remote parking on campus if sufficient remote parking is not available.

- Family apartments – new housing buildings shall provide 0.75 parking spaces per dwelling unit.

- Faculty/staff dwelling units - new housing buildings shall provide 1.0 parking space per dwelling unit.

- Academic/Research and other university buildings – parking needed depends on their specific use, occupant load and other factors. Often these needs are estimated based on national standards for similar buildings. It is recommended that CU-Boulder reduce standard rates by 30 to 75% to recognize the university's TDM programs and sustainability goals. Consideration should also be given to using centralized parking facilities rather than providing parking immediately adjacent to the building.

5.1.2.2 Bicycle Standards

Based on CU's experience with existing facilities and its encouragement of bicycling as a preferred mode, the following standards are recommended:

- All new buildings shall provide appropriate connections of the building site to the existing and planned campus bicycle network.

- It is recommended that CU-Boulder develop and adopt a bicycle parking standard for new development on campus to ensure that adequate bicycle parking is provided. Consideration should be given to providing some of this parking in covered and/or secure environments.

5.1.2.3 Transit Standards

Improvements to transit services and facilities are usually not considered in new construction since it is difficult to link specific transit improvements to a new building. Nevertheless, the transit analysis included in this report identifies a number of transit enhancements that will be needed over the next two decades to serve campus growth. It is recommended that consideration be given to transit amenities such as shelters, transit stop/bike/ped integration during the planning of new university buildings.

5.1.3 Integrated Trip Reduction Strategies

Most of the recommendations in this report are aimed at shifting the travel modes from single occupant driver to higher occupancy travel (transit or carshare) or to the active modes (walking and cycling). However, Transportation Demand Management also includes strategies that work to actually reduce the number of trips taken, not simply increasing the mode share of alternative modes. Recommended strategies include:

5.1.3.1 Trip Planning

Trip planning education and awareness campaigns can remind people of the importance of dovetailing their errands into one trip; conscientious trip planning leads to an overall reduction in green house gas emissions as well as reduces congestion on the road network.

5.1.3.2 Workplace Based Trip Reduction Programs

There are a number of workplace related strategies which not only meet TDM objectives but double as employee benefits:

- Telecommuting
- Flexible work hours (supports carsharing: expands ridematching opportunities)
- Flex-time (staff work longer days in exchange for shorter work week)
- Flex start/end time

5.1.3.3 Distance Education

The university may wish to consider the trip reduction benefits associated with increasing on-line classroom opportunities. On-line learning can be integrated into full-time and part-time students who not only physically attend the campus regularly but also distance education students. Key to promoting this tool is investment in web-based infrastructure.

5.1.3.4 "Satellite" Campus

There is some consideration of the benefits of opening and operating a downtown campus, with high tech links to the Main Campus. With the rapidly increasing inventory of affordable housing in the downtown area, this option may very well prove to be a strong, successful TDM measure. With this facility, students may reduce the number of times they have to travel to Boulder for their course instruction.

5.2 Provide for Travel Choices

This section is organized by travel mode. While the emphasis of this plan is on alternative modes, CU Boulder recognizes that for many affiliates commuting by auto is the only viable option. Subsections on auto travel and parking are included.

5.2.1 Non-Motorized Travel

The 2011 Transportation Master Plan seeks to build upon the successes of CU-Boulder's previous efforts by providing recommendations that are implementable while pushing the university to expand its level of service to pedestrians and bicyclists.

Previous plans relied heavily on enforcement to provide separation of uses between bicyclists and pedestrians. The 2011 plan recommends physical separation improvements that will provide path users with better physical delineation that should allow users to be more responsible in avoiding conflicts. By providing a system where conflict between bicyclists and pedestrians are minimized, the university can incentivize proper use of campus bikeways and pedestrian corridors, and rely less on enforcement.

5.2.1.1 Network Connections, Key Locations Recommendations

Introduction

This section discusses the recommended bicycle and pedestrian network for the University of Colorado Boulder. It also presents design recommendations for key locations within the campus that challenge the overall flow of non-motorized travel/ access within campus. Finally, this section addresses the recommended campus network and its connections to and synthesis with the larger City of Boulder bikeways network.

Bicycle and Pedestrian Network Recommendations

The University of Colorado Boulder is located in one of the most progressive bicycle cities in the United States. Like many university communities, CU-Boulder features active levels of bicycling and walking to, from and within campus. This plan outlines a pedestrian and bicycle network that allows CU to continue to encourage and support walking and bicycling as a viable commuting and intra-campus travel option.

Overall bicyclists, pedestrians and skateboarders are all utilizing the same space for intra-campus travel. The purpose of this network plan is to outline projects that will help facilitate greater levels of non-motorized travel within campus and mitigate the conflict between varying user-types. As CU Boulder continues to expand, non-motorized facilities must be included in the development of East Campus as well as Main Campus.

Recommended Pedestrian Network

The Campus Pedestrian Corridors are shown in Figure 5-1. There are two types of pedestrian-oriented designations on the CU-Boulder Campus: *Major Pedestrian Corridors* and *Pedestrian Only Corridors*. Together, these facilities comprise the pedestrian network on campus and lay the groundwork for CU-Boulder's attractive and safe pedestrian environment. The purpose of identifying a pedestrian network on campus is to prioritize current/future improvements, maintenance, and other issues that face the pedestrian environment on campus. There are many paths, rights of way and sidewalks that are used every day on campus, but are not major corridors. The purpose of this discussion is to identify *key* pedestrian corridors on campus and acknowledge them for planning and development purposes.

Major Pedestrian Corridors

Major pedestrian corridors are thoroughfares heavily used throughout the day, and support large volumes of pedestrian traffic during peak-travel times. Because of their significance to the greater pedestrian network, service vehicles, bicycles and skate-boards would ideally refrain from using these parts of campus during peak travel times. For planning purposes and future development, Major Pedestrian Corridors (MPCs) should take priority with respect to maintenance and snow removal. As Main

Campus develops and East Campus continues to grow, designating additional MPCs will ensure that CU-Boulder continues to be a pleasant place to walk.

Pedestrian Only Corridors

Pedestrian Only Corridors (POCs) are special areas on campus. These areas combine thematic and physical design that prioritizes pedestrian movement and enhances the overall beauty of the campus. There are currently two POCs in development stages. The Central Campus Walkway and the University Memorial east pathway through Fine Arts Green are scheduled to be the first POC pilot project on campus. POCs will be designated and designed for pedestrian use only by adding enhanced amenities for bicycle parking and new service routes, schedules or delivery points to discourage vehicles and bicycles from utilizing these areas of campus. In the future, CU-Boulder may want to designate other areas of campus as POCs as growth and need warrant.

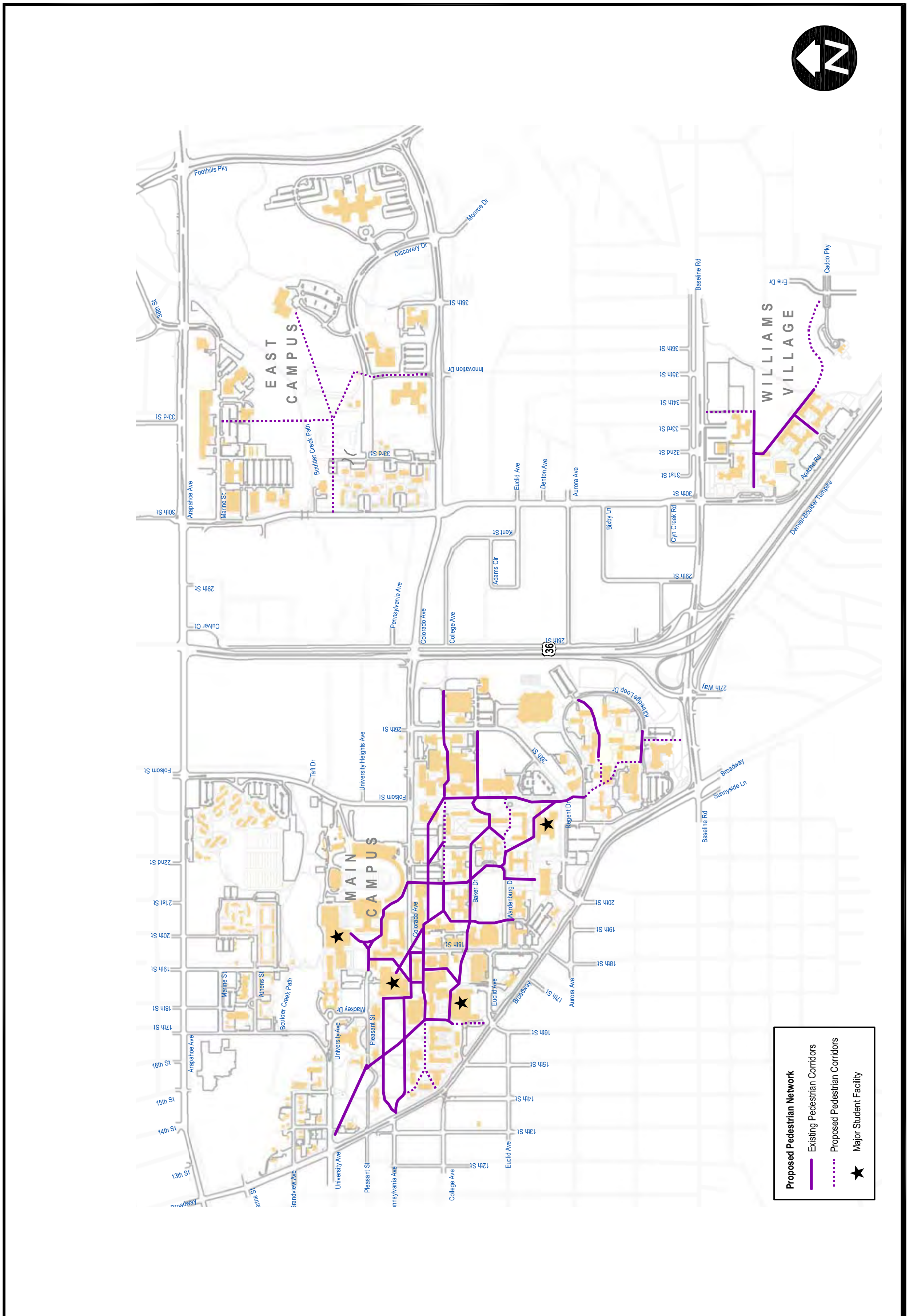


Figure 5-1

Proposed Pedestrian Network

CU-Boulder Transportation Master Plan

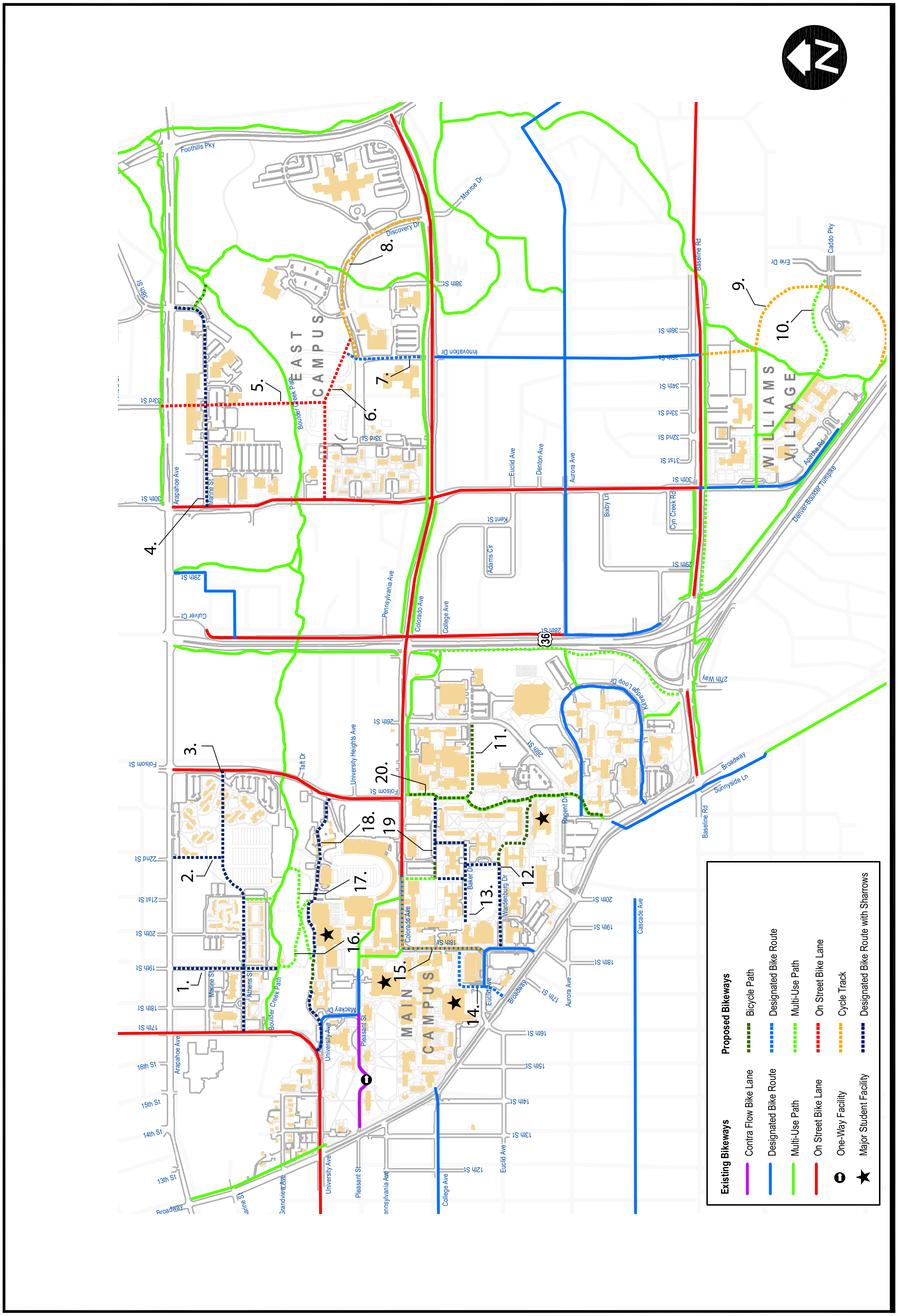
Bicycle/Skateboard Network

To encourage bicycle/skateboard use off Major Pedestrian Corridors and restrict their use on Pedestrian Only Corridors, a connected, viable network must be implemented for bicyclists and skateboards to travel throughout campus. The recommendations in this plan establish a network of varying facilities to provide enhanced convenience and connectivity for non-motorized travel to, from and between campuses.

Figure 5-2 illustrates the needed additions to the existing bike network. They are listed in Table 5-1. It is important to note that some of these projects require significant physical construction and/or funding and therefore may take longer to build. This network is designed to provide bicyclists a viable, uninterrupted system of routes to get through campus. *A primary component to improving the bikeway network will require that off-street facilities provide separation from pedestrian use if/when space permits*. In areas of new development/facilities, all off-street bicycle and pedestrian facilities should be separated if space permits.

Separation can be provided via elevation changes, landscaping, fencing, bollards and other design features. This is most relevant to the East-West Bikeway and to the path that runs north and south from the Engineering Complex towards the Kittredge Loop.

Pavement texture/color, elevation change and landscaping provide attractive separation on Vassar Street, through the Massachusetts Institute of Technology



Proposed Bicycle Network with Classifications

CU-Boulder Transportation Master Plan

Figure 5-2

Table 5-1
Proposed Campus Bikeways

Project ID	Corridor	Facility Type	Limit 1	Limit 2	Length (miles)
1	19th St	Shared Lane Marking	Arapahoe Ave	Grandview Ave	0.18
2	22nd St	Shared Lane Marking	Arapahoe Ave	Grandview Bike Path	0.08
3	Marine Court	Multi-use Path	19th St	Dal Ward	0.15
4	Marine St	Shared Lane Marking	Arapahoe Ave	30th St	0.42
5	35th St	Bike Lanes	Shadow Creek Dr	Arapahoe Ave	0.16
6	Shadow Creek Dr	Bike Lane	30th St	Discovery Dr	0.4
7	Innovation Dr	Bike Route	Colorado Ave	Shadow Creek Dr	0.12
8	Discovery Dr	Cycletrack	Colorado Ave	Innovation Dr	0.36
9	35th South	Cycletrack	Baseline Road	Bear Creek Apartment Path	0.5
10	Williams Village	Bike Path	Bear Creek Apartments	Caddo Pkwy	0.2
11	Leeds-Engineering	Multi-Use Path	North-South Bikeway	Regent Dr	0.13
12	Wardenburg Dr	Shared Lane Marking/ Multi-Use Path	18th St	North-South Bikeway	0.34
13	Baker Dr	Shared Lane Marking	SE corner of Libby Hall	SW corner of Baker Hall	0.2
14	UMC/Bike Station	Bike Route	18th St	Broadway	0.12
15	18th St/Colorado	Cycletrack	Euclid Ave	Colorado Ave Bike Lanes	0.2
16	Marine – Boulder Creek Connector	Multi-use Path	Marine St	Boulder Creek	0.05
17	Lot 169 Path	Multi-use Path	Lot 169	Rec Center	0.2
18	Stadium Drive	Shared Lane Marking	Folsom Street	17th St	0.53
19	Libby Drive	Shared Lane Marking	Duane Physics/ Colorado Connector	Cockerell Dr	0.12
20	North-South Bikeway	Multi-Use Path	Colorado Ave	Broadway Multi-Use Path	0.42

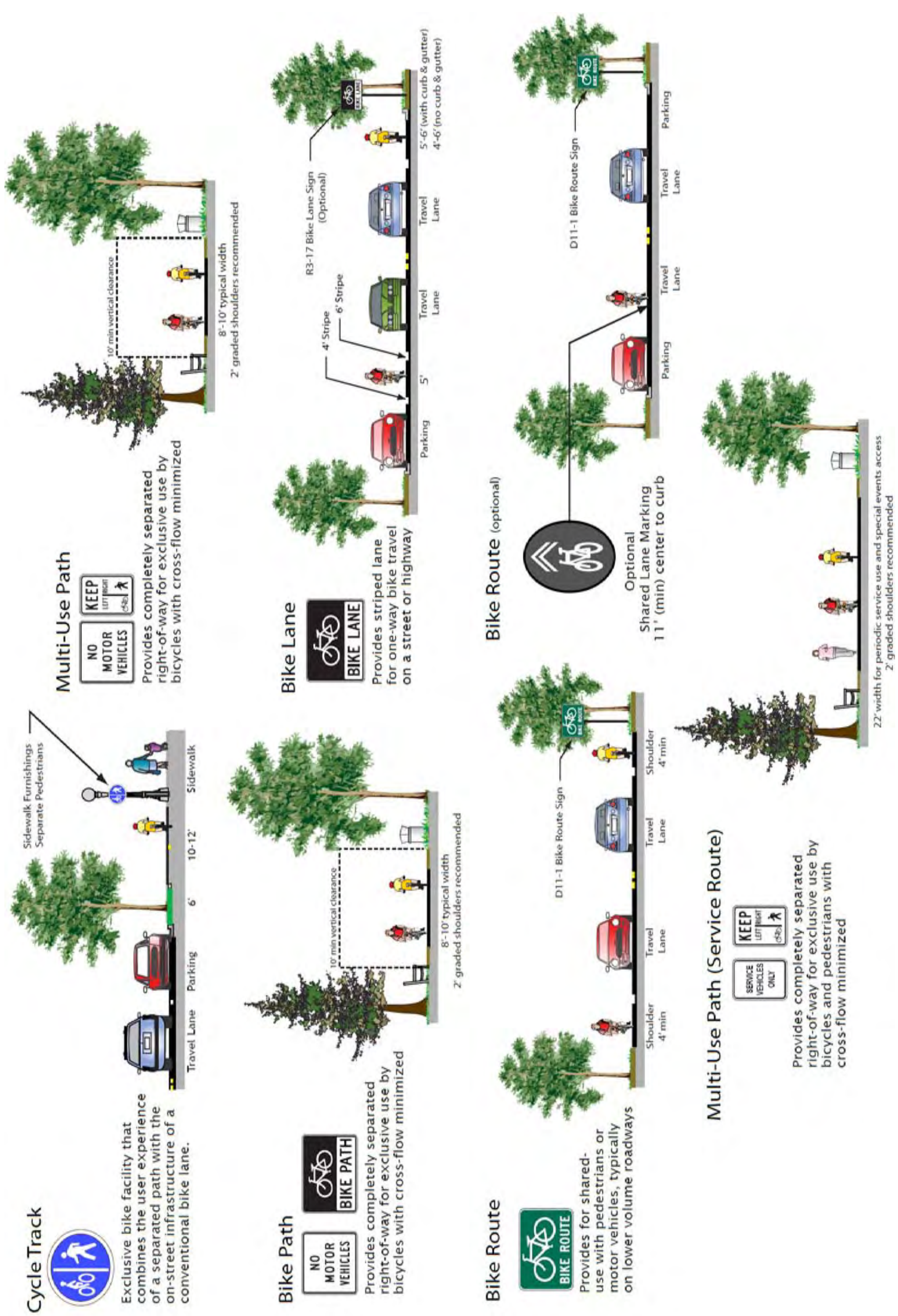
There are seven different types of bicycle facilities in use or proposed on the CU Boulder campus (and examples of where each facility is recommended/located on campus):

1. Cycle track – example: for use on 18th/Colorado or developing area (East Campus)
2. Multi-use Path – example: Broadway Path

3. Bike Path – example: Wardenburg Drive extension to Center for Community Path
4. Bike Lane – example: 33rd Street (East Campus)
5. Shared Lane Marking, “Sharrow” – example: Baker/Wardenburg Drive
6. Bike Route – example: Pleasant Street extension between Folsom Field and the Recreation Center.
7. Multi-Use Path (Service Vehicle Compatible) – example – Engebretson’s Quadrangle.

Each facility has different aspects and features that make it useful for bicyclists, depending on the physical context of implementation. While a cycle track is the most physical separated facility, it may not be feasible or economical to install these throughout campus. The proposed improvements take advantage of the natural features of campus, balance competing access needs, and seek to enhance their utility through the provision of these bicycle facilities. Figure 5-3 highlights the distinct facilities recommended in this plan and their basic spatial requirements.

Figure 5-3



Cycle Track
Exclusive bike facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane.
Travel Lane
Parking
6'
10-12'
Sidewalk
Sidewalk Furnishings Separate Pedestrians
Multi-Use Path
NO MOTOR VEHICLES
KEEP
Provides completely separated right-of-way for exclusive use by bicycles with cross-flow minimized
10' min vertical clearance
8'-10' typical width
2' graded shoulders recommended
Bike Path
BIKE PATH
Provides completely separated right-of-way for exclusive use by bicycles with cross-flow minimized
Bike Lane
BIKE LANE
Provides striped lane for one-way bike travel on a street or highway
Parking
5'
4' Stripe
6' Stripe
Travel Lane
R3-17 Bike Lane Sign (Optional)
5'-6' (with curb & gutter)
4'-6' (no curb & gutter)
Bike Route
BIKE ROUTE
Provides for shared-use with pedestrians or motor vehicles, typically on lower volume roadways
Shoulder 4' min
D11-1 Bike Route Sign
Bike Route (optional)
Optional Shared Lane Marking
11' (min) center to curb
Multi-Use Path (Service Route)
SERVICE VEHICLES ONLY
Provides completely separated right-of-way for exclusive use by bicycles and pedestrians with cross-flow minimized
22' width for periodic service use and special events access

5.2.1.2 Campus Connections

An important facet of the recommended network is it how it synthesizes with the greater City of Boulder network. To maximize the convenience of bicycle travel to campus, it is important that the campus network provides convenient and multiple connections to bikeways in the City of Boulder. In the development of the proposed CU bikeway network, connections to the City of Boulder's bikeway network were examined to ensure that the CU bikeways were integrated with Boulder. Table 5-2 lists the proposed CU bikeways and their connections to the Boulder bikeway network.

Table 5-2
Proposed Bikeways Connecting to Boulder Bikeways

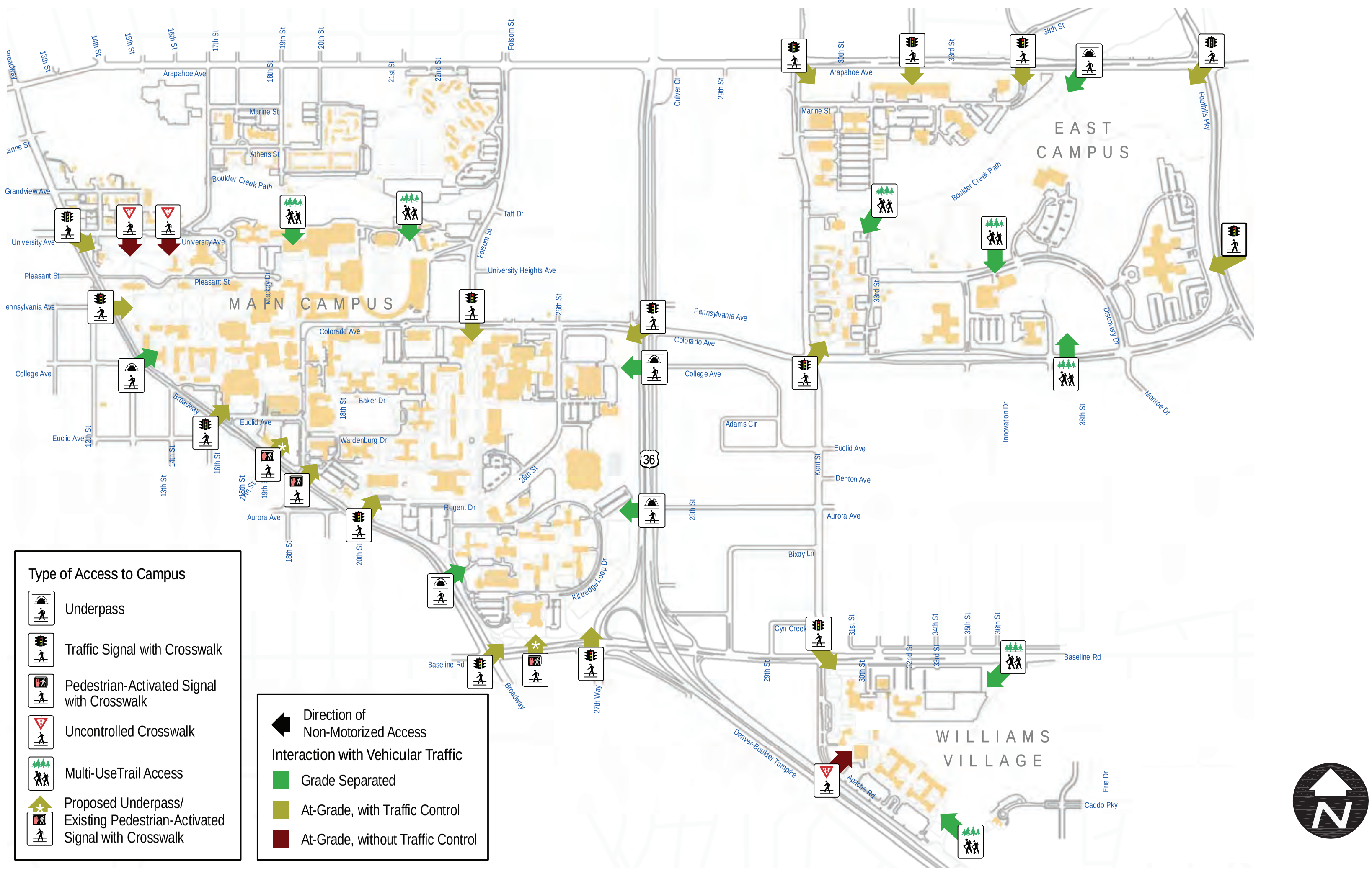
Proposed CU Facility	Proposed Facility Type	Connecting Boulder Facility	Connecting Boulder Facility Type
University Ave	Shared Lane Marking	University Ave	Bike Lane
Stadium Dr	Shared Lane Marking	Folsom St	Bike Lane
Athens Ct	Multi-use Path	Boulder Creek	Multi-use Path
Lot 169 Path	Multi-use Path	Boulder Creek	Multi-use Path
Regent Dr	Shared Lane Marking	Broadway Path	Multi-use Path
Regent Dr	Shared Lane Marking	Colorado Ave	Bike Lane
Libby Dr	Shared Lane Marking	Colorado Ave	Bike Lane
Discovery Dr	Cycletrack	Boulder Creek	Multi-use Path
Innovation Dr	Bike Route	Colorado Ave	Multi-use Path/ Bike Lane
Innovation Dr Extension	Bike Path	30^{th} St	Bike Lane
Marine St Connector	Multi-use Path	Boulder Creek	Multi-use Path
Marine St	Shared Lane Marking	30^{th} St	Bike Lane
Marine St	Shared Lane Marking	Arapahoe Ave	Multi-use Path
35^{th} St	Bike Route	Boulder Creek	Multi-use Path

The proposed CU bikeway network seeks to increase bikeway connections to the existing and proposed City of Boulder bikeway network. The completion of the CU bikeway network will greatly increase the convenience of biking in and through campus.

In addition to bikeway connections, this plan also addressed pedestrian connectivity to campus. There are five types of connections that pedestrians can use to access campus:

1. Underpass
2. Traffic Light/Signal
3. Pedestrian Activated Signal
4. Unsignalized Pedestrian Crossing
5. Trail Access

The distribution of these connection types are spread throughout Main and East Campus. Figure 5-4 displays the locations of the five connection types.



Points of Access for Non-Motorized Travelers To and From CU Boulder Main and East Campus

CU-Boulder Transportation Master Plan

Figure 5-4

TRANSPORTATION CONSULTANTS, INC.

5.2.1.3 Key Campus Locations and Design Concepts

In the development of this plan, two campus locations received specific attention because of their importance to the movement of non-motorized users connecting with the City of Boulder network, and moving within the greater campus network. The 18th Street/Colorado Avenue corridor and the College Avenue underpass beneath Broadway were examined to heighten the safety of pedestrians, bicyclists and skateboards and minimize any conflict that may exist between the various user groups. This section discusses the process with which the concepts evolved and the specific recommendations for each site.

18th Street & Colorado Avenue

The 18th/Colorado corridor is the primary artery for transit and motorized traffic within Main Campus. As such, it is the point of convergence for pedestrians, bicyclists, service vehicles and others who use the corridor on a daily basis. During passing periods, the corridor supports heavy amounts of pedestrian activity as students cross 18th and Colorado. Passing periods substantially impacts bus operations and time tables and bicyclists are left to operate in the same space as buses and pedestrians crossing at other places than the crosswalk. The fundamental ideals behind the following design options were to provide designs that increased the utility of the corridor for bicyclists, minimized transit conflicts, and prioritized pedestrian crossings.

Design Concepts 2-4 were presented to representatives from CU and the City. As a result a new concept was developed to try to support individuals travelling to/from campus by transit, bicycle and to minimize pedestrian conflict through this corridor. The new concept was called the "Hybrid" (following page), acknowledging that at this point completely restricting transit access through the corridor was not an option, but providing a transformative environment that emphasized bicyclist and pedestrian safety was a top priority.

A dedicated and separated cycle track is located on the west side of 18th and north side of Colorado is it runs east towards Folsom. The median separates the dedicated traffic lane with green space, permeable surface for rainwater collection, and additional bike parking facilities. This concept would substantially increase the convenience of intra-campus bicycle travel, by separating it from bus/vehicle traffic. It would also allow transit vehicles to have their own lane(s) and enhance safety by channeling pedestrian crossings at officially designated points along the corridor (at present, the open "feel" of the corridor permits crossing at any point of convenience for pedestrians.

Design Concept 1: Hybrid

The hybrid concept also addresses vehicular access/travel, as well as transit routing. The hybrid model recommends limiting vehicular access to only transit vehicles, and private ADA access. All other private use/service vehicles would be restricted from this corridor. The transit lane of the hybrid model is currently proposed with three scenarios:

1. Transit access limited to north on 18th, east on Colorado via a one-way travel lane.
2. Transit access can travel in both directions, with "pull out" areas located within the median to allow buses to yield to each other when traveling within the corridor.
3. Peak-hour model, wherein transit flow is reversible along the one lane corridor, depending on the time of day.

In each of these scenarios, vehicle access is limited to transit and ADA access only. Bicycles will only be permitted along the cycle track, and the pedestrians will be limited to the median for bus stop access or along the expanded corridor frontage. Because each building along this corridor has varying service vehicle needs, a planning effort will be made to address each building's service vehicle needs and prepare alternate routing information so that the integrity of the corridor can be maintained for pedestrians, bicyclists, and transit users.

Design Concept 1 originated from the following three designs which were presented to members of the CU planning staff and representatives from the city.

Design Concept 2: Cycle Track

The first concept reviewed was an option that completely restricts vehicular access to the 18th/Colorado corridor. As shown in this conceptual design, the current street layout would be replaced with a two-way cycle track. With the extra space acquired from the street closure, additional sidewalk, green space, and street amenities would be added to the buffer of the cycle track. This concept is the most transformative in its restriction of vehicular access.

Design Concept 3: "Woonerf" and Pedestrian Mall

This concept derives from the Dutch term, "Woonerf" which translates into a street where bicyclists and pedestrian travel takes priority over vehicular travel. In this option, transit vehicles (and other ADA/Service vehicles) using this corridor would have to yield to bicycle and pedestrian travel. To emphasize this shift, the corridor would be treated with a textured concrete or pavement, as well as incorporate greening features, chicanes and other amenities for pedestrians. As a pedestrian-priority street, this type of design could lead to transit delays during periods of peak-pedestrian activity (passing periods – see Table 5-1).

Design Concept 4: Bike Lanes and Transit Lane

This concept would be the least transformative of all of the first round recommendations. This concept calls for a designated bike lane on 18th and Colorado. The street alignment would remain relatively unchanged, but bicycling would be supported by providing bike lanes throughout the corridor. This concept would not change how/where buses stay. One downside to this concept is that buses would pull into the bike lane to pick up and drop off passengers, requiring bicycles to leave the bike lane and maneuver around the bus. The concept also shows the use of a color treatment to the bike lane, making the lane stand out and communicating to pedestrians and vehicle users that they can expect to see bicyclists in this portion of the road.

College Avenue/Broadway Underpass

The College Avenue/Broadway underpass is one of the major access points for pedestrians and bicyclists coming from "the Hill" and western Boulder and travelling to the CU campus and the Broadway Multi-Use Path. It is the convergence of bicyclists and pedestrians coming from the underpass and crossing through or utilizing the Broadway Multi-Use Path. Because of the design of the underpass, it can present a challenge for bicyclists traveling on the Broadway Multi-Use Path to see individuals coming out from the underpass. The Broadway Multi-Use Path slopes down towards this point on campus, increasing speeds of bicyclists and pedestrians. This location was the only count location that experienced a decrease in pedestrian and bicycle activity. Designs to improve sight lines and safety may help the large numbers of bicyclists, pedestrians and skateboarders accessing/leaving campus at this location.

The following designs were developed to address and minimize the conflicts at the Broadway underpass.

Concept 1: Channelized Intersection

This concept formalizes the path as it connects with the Broadway underpass. The channelized design instructs bicyclists that they can expect to see pedestrians and bicyclists coming out from the tunnel, as well as instructing users as to the ideal position to cross under the tunnel. This concept also divides bicycle traffic from pedestrian travel beneath the bridge, with a barrier. This concept utilizes pavement markings, striping, and signage and pavement treatments to create a more structured, predictable environment in a heavily used campus access point.

Concept 2: Roundabout

This concept would be similar to the existing layout of College Avenue Underpass. Currently the underpass/path intersection uses colored/painted concrete in with circular features. While the use of color has not been thoroughly studied in off-street bicycle facilities, the City of Portland found that colored pavement treatments were successful reducing conflict between bicyclists and cars at places where the risk of conflict was greater (intersections, highway off-ramps, etc) for on-street, bike lanes.

At present, there is no hardscape to prevent/organize travel through this corridor. The lack of designation can lead to conflict, especially at times where sight is limited or conditions prevent stopping in short distances. Another factor that can contribute to conflict is that the Broadway Multi-Use Path slopes down towards the underpass, allowing bicyclists to accumulate speed without additional effort. This design forces users to maneuver in compliance with other users of the underpass.

The image to the right displays some of the problems with the existing concept. Bicyclists and pedestrians disregard the layout because it is unclear what is expected. Concept 1 and Concept 2 address this concern by making changes to the built environment that instruct bicyclists, pedestrians and skateboards how to navigate this intersection. Providing a more formal path of engagement at the intersection will help minimize conflict between path users.

The College Avenue Underpass design, while attractive, does not adequately instruct users how to safely navigate the area

5.2.1.4 Bike Parking Recommendations

This section presents research on bicycle parking standards and practices at other universities and provides recommendations for CU-Boulder on developing and implementing a formal bicycle parking policy. Table 5-3 presents a summary of the research conducted on bicycle parking standards and practices at several University of California campuses.

Table 5-3
Bicycle Parking Standards at University of California

Campus	Bicycle Rack Standard	Bicycle Parking Requirements	Other Related Services
UC Berkeley[1]	 **Ribbon Rack**  **Inverted U rack**	• Minimum 10% of total campus population • 10% of new parking should be secure parking UCB attempts to add more bike racks to areas that exceed 90% utilization.	• P&T Staff and local bicycle coalitions provide valet bicycle parking upon request for special campus event s (e.g. Football games)
UC Los Angeles[2]	 **Inverted U rack**	• Minimum bicycle parking requirements are determined by applying bike mode share for campus population to peak hour of building occupancy.	• UCLA has on-demand bicycle lockers at various locations on campus to provide campus cyclists with a more secure bicycle parking option
UC San Diego[3]	 **Inverted U rack**	• Classroom –10% of seating capacity. • Office / Research – 5-10% of population occupancy • Libraries – 5% of average attendance rate • Dining facilities – 5% of seating capacity • Student housing – 10-30% of number of beds	• UCSD Medical Center, Hillcrest provides bicyclists with a secure bicycle parking option in a "bicycle cage" at street level of the parking structure • UCSD campus shuttles all have triple bicycle racks to improve bicycle carrying capacity
UC Santa Cruz[4]	 **Inverted U rack**	• Classroom –1:12 (parking spaces to seats) • Office / Research – 1:15 (parking spaces to employees) • Student housing – 1:5 (parking spaces to beds)	• UCSC provides a van shuttle to transport bicycles on a trailer from the campus entrance (bottom of the hill) to the campus core (top of the hill)

1. Source: 2006 Bicycle Master Plan
2. Source: 2006 Bicycle Master Plan
3. Source: 1993 Bicycle Circulation and Parking Planning Study
4. Source: 2008 UC Santa Cruz Bicycle Plan

Bicycle Parking Recommendations for CU Boulder

Based upon a comprehensive review of conditions at CU-Boulder and a consideration of bicycle parking standards at peer universities, it is recommended that CU-Boulder consider both existing facility standards and new facility standards:

- **Campus Core Bicycle Parking Standard** – it is recommended that CU-Boulder develop and adopt bicycle parking standards for the core campus area.

- **New Development Bicycle Parking Standard** – it is recommended that CU-Boulder develop and adopt a bicycle parking standard for new development on campus to ensure that adequate bicycle parking is provided.

Covered Bicycle Parking

Due to inclement weather in Colorado, it is recommended that CU develop and adopt a standard for providing covered bicycle parking to encourage bicycling year round – even on rainy or snowy days. CU-Boulder's initial covered bicycle parking installation has been well received by the cycling community. Utilization of this covered bicycle parking suggests that additional covered bicycle parking installations are warranted. Over time as funding is available, CU-Boulder should strive to increase the percentage of total bicycle parking that is provided as covered bicycle parking.

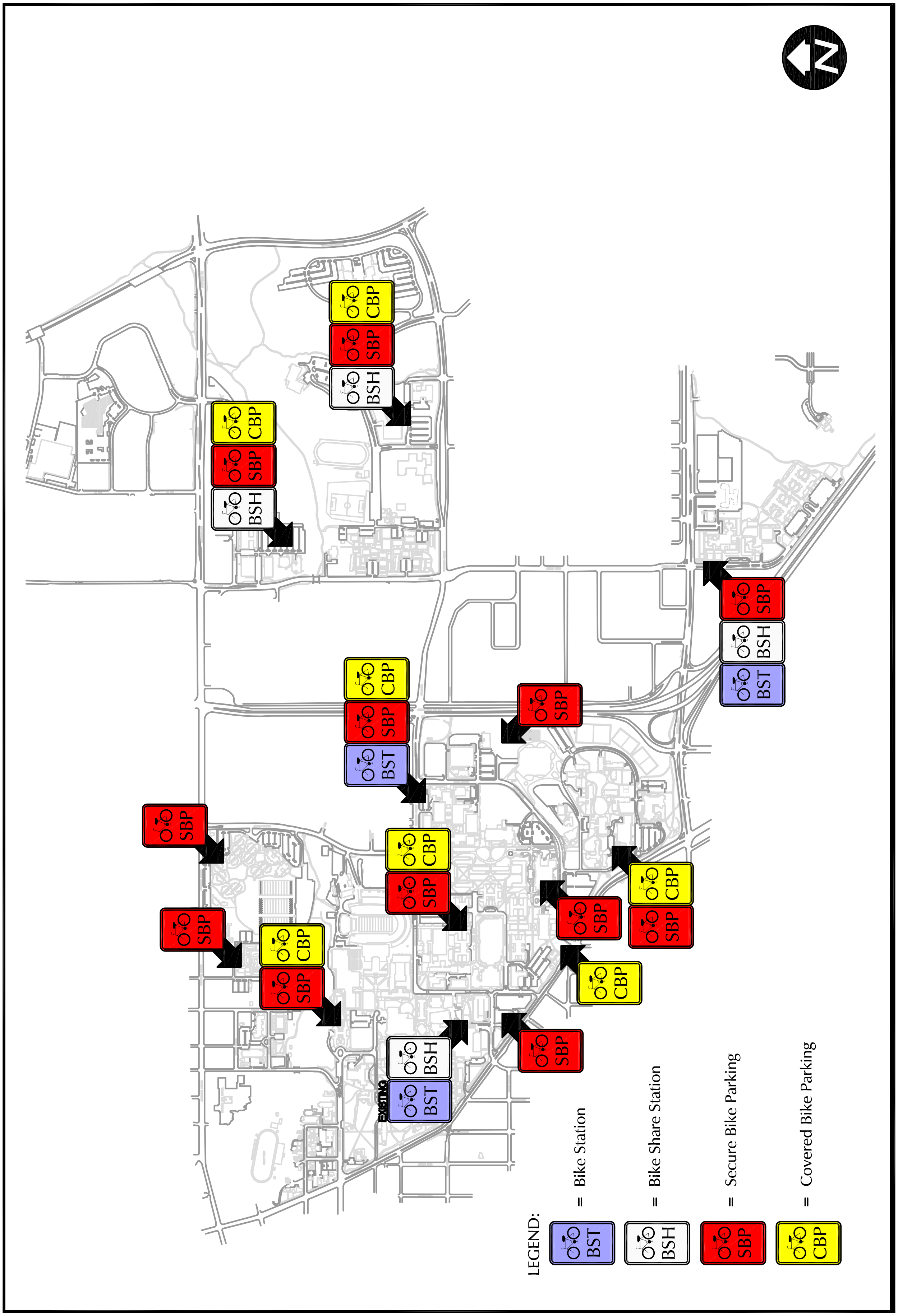
Secure Bicycle Parking

As a means of providing a safer, more secure bicycle parking option on campus, it is recommended that CU begin providing more secure bicycle parking options, such as the following:

- Bicycle Lockers
- Indoor bicycle storage rooms
- Bicycle cages in parking structures
- Bicycle Garages (see photo from PSU)
- Consider allowing bicycles to be parked in offices or residence halls.

Secure Bike Parking/Bike Station/Bike Share Locations

Figure 5-5 illustrates proposed locations for new bike stations, secure bike parking, and bike sharing facilities. Table 5-4 lists the recommended locations for secure bicycle parking and bike sharing facilities on campus.



Proposed Secure Bike Parking/Bike Sharing/Bike Stations

CU-Boulder Transportation Master Plan

Figure 5-5

Table 5-4
Bicycle Support Facilities

Bike Facility	Recommended Locations
Bike Station	Williams Village, Engineering Complex
Bike Share Station	University Memorial Center, Williams Village, East Campus (North), East Campus (South)
Covered Bike Parking	Broadway & Euclid, Recreation Center, Engineering Complex, Baker/Libby Hall, Kittredge Complex, Williams Village, East Campus
Secure Bike Parking	Sewall Hall, Marine Court, Newton Court, Baker/Libby Hall, Engineering Complex, Kittredge Complex, Williams Village, East Campus, Broadway & Euclid

5.2.1.5 Bikeway Project Prioritization

The proposed bikeway network for CU-Boulder will enhance the convenience of intra-campus travel for bicyclists. Because all of the projects cannot be constructed simultaneously; and to provide guidance for implementation; the following criteria are recommended to rank each facility to assign it an implementation score. Based on the implementation scoring, CU-Boulder can then pursue funding and plan for the construction of projects based on their relationship to the campus bikeway network. The following criteria are used for scoring proposed bikeway projects:

- Counts
- Anticipated Benefit
- Cost
- Gaps
- Connectivity

Counts

Based on the data collected during the 2010 count effort, proposed facilities that connect to the highest areas of bicycle activity will rate high in this area.

Anticipated Benefit

Some facilities will serve greater number of bicyclists based on their length or parts of campus that they will serve and connect to. Facilities that go through high-traffic parts of campus and provide longer/un-interrupted service will score high in anticipated benefit.

Cost

Funding facilities is a primary focus for all new services and facilities on a university campus. Facilities that are lower in cost are easier to implement and will therefore rate high in this scoring category.

Gaps

Gaps in the bikeway network discourage bicycle use. Facilities that connect an existing gap in the campus-network will meet this scoring criterion.

Connectivity

Proposed bikeways that connect to the greater City of Boulder network enhance the convenience of bike commuting to campus. Bikeways that connect to City of Boulder bikeways will qualify for this scoring criterion.

For a complete breakdown of criteria scoring, please refer to Table 5-5.

Table 5-5
Campus Bikeway Scoring

Criteria	Score	Description
Counts	2	Facility connects to one of the top five bicycle count locations
	1	Facility connects to one of the count facilities ranked 6-10 in bicycle activity
	0	Facility does not connect to one of the top ten count locations for bicycle activity
Anticipated Benefit	2	Facility has major anticipated benefit, serving large portions of intra-campus activity
	1	Facility has moderate anticipated benefit, serving moderate portions of intra-campus activity
	0	Facility has minor anticipated benefit or is a part of a developing part of campus.
Cost	2	Project less than $100,000
	1	Project costs between $100,000 - $350,000
	0	Project costs more than $350,000
Gaps	2	Project connects a gap between two existing campus bikeways
	1	Project connects a gap between an existing and proposed campus bikeway
	0	Project connects a gap between two proposed campus bikeways.
Connectivity	2	Project connects to an existing City of Boulder bikeway
	1	Project provides secondary connectivity to a City of Boulder bikeway
	0	Project does not connect to a City of Boulder bikeway

The projects listed in Table 5-6 were analyzed under the scoring criteria in Table 5-5. The total aggregate results, for planning and prioritization purposes are included in the following page.

Table 5-6
Bikeway Prioritization and Scoring

Project ID	Corridor	Counts	Anticipated Benefit	Cost	Gaps	Connectivity	Total Score
20	North South Bikeway	2	2	1	2	2	9
15	18th St/Colorado	1	2	1	2	2	8
18	Stadium Drive	2	2	2	0	2	8
11	Leeds-Engineering	2	1	2	1	1	7
17	Lot 169 Path	1	1	1	1	2	6
19	Libby Drive	0	2	2	1	1	6
4	Marine St	0	1	2	0	2	5
13	Baker Dr	0	2	2	0	1	5
14	UMC/Bike Station	1	1	2	1	0	5
16	Marine – Boulder Creek Connector	0	1	2	0	2	5
3	Marine Court	0	1	1	0	2	4
5	35th St	0	0	2	0	2	4
6	Shadow Creek Dr	0	0	2	0	2	4
7	Innovation Dr	0	0	2	1	1	4
10	Williams Village	0	0	1	1	2	4
1	19th St	0	0	2	1	1	4
12	Wardenburg Dr	0	1	1	1	0	3
2	22nd St	0	0	2	1	0	3
8	Discovery Dr	0	0	0	0	2	2
9	35th South	0	0	0	0	2	2

5.2.1.6 Funding

Identifying funding sources for the recommended facilities in this chapter is the key to seeing the 2011 Transportation Master Plan come to fruition. Universities typically draw upon the following sources of funding to construct bicycle and pedestrian facilities and supporting infrastructure:

1. User Fees (e.g. parking permit revenue, parking citation revenue)
2. Campus General Funds
3. Capital Improvement Funds
4. Student Fees/Referendum
5. Various Grant Funding Sources
6. Alumni Donor/Gifts

These funding sources, where appropriate, are included in Table 5-7 on project by project basis. Table 5-7 lists the recommended projects with estimated costs and funding sources. (Please also see the financing strategies chapter – Chapter 7).

Table 5-7
Project Costs and Funding Sources

Project ID	Corridor	Facility Type	Projected Cost	Prioritization Score	Potential Funding Sources
1	19th St	Shared Lane Marking	$5,040	4	3,4
2	22nd St	Shared Lane Marking	$2,240	3	4
3	Marine Court	Multi-use Path	$112,500	4	3,5
4	Marine St	Shared Lane Marking	$11,760	5	2
5	35th St	Bike Lanes	$6,400	4	1,3
6	Shadow Creek Dr	Bike Lane	$16,000	4	2,5
7	Innovation Dr	Bike Route	$1,200	4	4
8	Discovery Dr	Cycletrack	$360,000	2	3,6
9	35th South	Cycletrack	$500,000	0	3,6
10	Williams Village	Bike Path	$150,000	4	3,5
11	Leeds-Engineering	Bike Path	$97,500	7	2,4
12	Wardenburg Dr	Shared Lane Marking/Bike Path	$139,480	3	3,5
13	Baker Dr	Bike Path/Shared Lane Marking	$41,700	5	1,2
14	UMC/Bike Station	Bike Route	$1,200	5	4
15	18th St/Colorado	Cycletrack	$200,000	8	2,4
16	Marine – Boulder Creek Connector	Multi-use Path	$2,000,000	5	2,3
17	Lot 169 Path	Multi-use Path	$2,000,000	6	2,4
18	Stadium Drive	Bike Path/Shared Lane Marking	$58,160	8	1,5
19	Libby Drive	Bike Path/Shared Lane Marking	$3,360	6	1,5
20	North South Bikeway	Multi-use Path	$600,000	9	3, 6
21	Williams Village Apartment Complex	Bike Station	$200,000	n/a	3,6
22	Engineering Center	Bike Station	$200,000	n/a	3,6
23	University Memorial Center	Bike Share Station	$55,000	n/a	3,6

Table 5-7
Project Costs and Funding Sources

Project ID	Corridor	Facility Type	Projected Cost	Prioritization Score	Potential Funding Sources
24	Williams Village Apartment Complex	Bike Share Station	$55,000	n/a	3,6
25	East Campus (North)	Bike Share Station	$55,000	n/a	3,6
26	East Campus (South)	Bike Share Station	$55,000	n/a	3,6
27	Recreation Center	Secure Bike Parking	$200,000	n/a	2,5
28	Marine Court	Secure Bike Parking	$200,000	n/a	2,5
29	Newton Court	Secure Bike Parking	$200,000	n/a	2,5
30	Baker/Libby Hall	Secure Bike Parking	$200,000	n/a	2,6
31	Engineering Complex	Secure Bike Parking	$200,000	n/a	2,6
32	Kittredge Complex	Secure Bike Parking	$200,000	n/a	3,5
33	Williams Village Complex	Secure Bike Parking	$200,000	n/a	3,5
34	East Campus (North)	secure Bike Parking	$200,000	n/a	2,3
35	East Campus (South)	Secure Bike Parking	$200,000	n/a	3,5
36	Broadway & Euclid	Secure Bike Parking	$200,000	n/a	3,5

5.2.2 Future Transit Considerations

This section projects the growth in demand for transit service at the three CU campus locations of Williams Village, East Campus, and Main Campus. Service options which respond to the future need are also discussed, followed by recommendations.

Transit technologies, including gondola, streetcar, and advanced bus, were evaluated with the analysis provided in Appendix C. The conclusion from that analysis was that advanced bus strategies have the greatest potential to improve transit accessibility and ridership, with a maximum level of flexibility and implementability, and with a minimum level of environmental impacts and financial requirements.

5.2.2.1 Williams Village

The Buff Bus currently provides 15 buses per hour during the highest peak period of 7:19 AM to 10:35 AM. Currently there are two 60-foot articulated buses and four 40-foot standard buses in that fleet mix. CU uses a crush load figure of 120 passengers per articulated bus and 80 per standard bus.[1] CU reports that these crush loads are

[1] This is higher than RTD standards of 75 per articulated bus (60 seated, 15 standees or a 1.25 ratio total:seated) and 50 per standard bus (40 seated, 10 standees).

achieved during the most intense loading of the peak period (peak 15 minute period), so this establishes a base capacity (transit supply) number that matches demand as follows:

= 15 vehicles per hour x weighted average of vehicle capacities
= 15 x (2 x 120 + 4 x 80)/6
= 15 x 93.33
= 1,400 per hour (only if sustained for an entire hour)
= 350 passengers during the peak 15-minute period

Future Base Demand

The current demand helps to establish an estimate of future demand that can be used as the base expectation. From the discussion above, 350 peak 15-minute trips are served. This demand comes from a current total of 2,400 students (6 Williams Village towers @ 235 students each plus two Bear Creek housing units @ 500 students each). The peak 15-minute trip rate is therefore 350 trips/2,400 students = 0.1458 trips per student in the peak 15 minutes.

The future student population at Williams Village is expected to grow to 3,400 students with the addition of two Williams Village North housing units. Additionally 200 faculty and staff units are expected to be built at this campus location. Although the faculty/staff units are intended for families, and the total number of persons would be greater than 200, not all of the family members would be anticipated to use the Buff Bus (i.e. minor children of faculty/staff and/or spouses who may have another employer than CU). The analysis therefore uses 200 faculty/staff members as the basis for demand estimation of this population. The total future population of demand then is expected to be 3,600 persons. Multiplied by the trip rate, the total future demand in the peak 15-minutes is forecast to be 525 passengers. This represents 50.0% more than the current demand.

Aggressive Demand

An aggressive demand estimate goes beyond current trip rates to take into account other economic factors such as gas prices, CU and City parking policies, actual vs. expected housing unit growth, and other TDM policies intended to curb VMT and greenhouse gas emissions. The effect of these influences on travel choice is much less predictable, so an assumption is made that collectively the effect would be a 15% increase in transit trip making over today's trip rate. The total demand would be 604 passengers in the peak 15-minute period (525 x 1.15).

Service Options

The future demand estimate range of 525 to 604 passengers during the peak 15-minute period prompts the question, "*What transit supply is needed to meet this demand?*" The following are generalized responses to this question:

- Change the Buff Bus vehicle fleet mix to include more articulated buses and thereby increase capacity.

- Increase Buff Bus frequency to increase capacity.

- Provide or promote other transit services (i.e. RTD's 203/225 routes on Baseline) to spread demand.

These generalized responses are explored in turn, beginning with the option to change the Buff Bus vehicle fleet mix. Table 5-8 shows the computations that identify whether, by changing the fleet mix, forecast demand can be met. Highlighted cells show where fleet mix and the number of buses per hour have been changed to meet forecast demand.

Table 5-8
Buff Bus Vehicle Fleet and Hourly Capacity

Scenario	Total Students + Faculty/Staff	Bus Fleet Mix		Maximum Load		Buses Per Hr	Capacity (Pax/hr)	15-Minute Capacity	Est. 15-Min Demand	Capacity = Demand?
		Artic	Std	Artic	Std					
Current 2010	2,400	33.3%	66.7%	120	80	15	1,400	350	350	Yes
Current + WV North	3,400	33.3%	66.7%	120	80	15	1,400	350	496	No
Current + WV North	3,400	100.0%	0.0%	120	80	15	1,800	450	496	No
Current + WV North	3,400	100.0%	0.0%	120	80	17	2,040	510	496	Yes
Future Base	3,600	33.3%	66.7%	120	80	15	1,400	350	525	No
Future Base	3,600	100.0%	0.0%	120	80	15	1,800	450	525	No
Future Base	3,600	100.0%	0.0%	120	80	18	2,160	540	525	Yes
Future Aggressive	3,600	33.3%	66.7%	120	80	15	1,400	350	604	No
Future Aggressive	3,600	100.0%	0.0%	120	80	15	1,800	450	604	No
Future Aggressive	3,600	100.0%	0.0%	120	80	21	2,520	630	604	Yes

Notes: Artic = 60-foot articulated bus, Std = 40-foot standard bus, Pax = passengers, hr= hour. CU Load Standards.
Source: LSC, 2011.

The results of the analysis indicate that by changing only the bus fleet, from a mix of articulated buses and standard buses, to all articulated buses, the demand of the Williams Village North expansion cannot be met (350 passenger capacity vs. 496 passenger demand in the peak 15-minutes). At least two more articulated buses will be needed. With the addition of faculty/staff housing units (Future Base), the demand can be met with the addition of one more bus trip per hour (total of 18 buses cycling per hour). If the demand is more aggressive in growth, then up to 21 buses cycling per hour (approx 2-minute 45-second frequencies), or equivalent, will be needed.

Table 5-9 addresses the policy question, "*What if CU were to place limitations on buses passing through main campus such that articulated buses were not allowed?*" Table 5-9 shows that with only 40-foot standard buses, even current 2010 demand would require additional capacity equivalent to three additional buses, or a 20.0% increase in operating costs.

Table 5-9
Buff Bus Vehicle Fleet and Hourly Capacity if Served by Only Standard Buses

Scenario	Total Students + Faculty/Staff	Bus Fleet Mix		Maximum Load		Buses Per Hr	Capacity (Pax/hr)	15-Minute Capacity	Est. 15-Min Demand	Capacity = Demand?
		Artic	Std	Artic	Std					
Current 2010	2,400	33.3%	66.7%	120	80	15	1,400	350	350	No
Current 2010	2,400	0.0%	100.0%	120	80	18	1,440	360	350	Yes
Current + WV North	3,400	0.0%	100.0%	120	80	25	2,000	500	496	Yes
Future Base	3,600	0.0%	100.0%	120	80	28	2,240	560	525	Yes
Future Aggressive	3,600	0.0%	100.0%	120	80	31	2,480	620	604	Yes

Notes: Artic = 60-foot articulated bus, Std = 40-foot standard bus, Pax = passengers, hr= hour. CU Load standards.
Source: LSC, 2011.

Looking at the future aggressive demand scenario, service would need to be increased to approximately 2-minute frequencies, or double today's service to meet demand using only 40-foot buses. Operating costs would also more than double.

Table 5-10 answers a second policy question, "*What if CU did not increase capacity, but instead relied on RTD services which pass by on Baseline?*" If the CU Buff Bus fleet mix and operating budget did not change, then demand could potentially be met by RTD's routes 203 and 225. The Bound also passes through the 30th/Baseline intersection at the northwest-most corner of this CU campus. Table 6-14 shows the potential demand shifted to RTD's routes, during the peak hour if this policy choice were to be made.

Table 5-10
Demand Potentially Served by RTD's Routes 203 & 225

Scenario	Total Students + Faculty/Staff	Bus Fleet Mix		Maximum Load		Buses Per Hr	Buff Bus Capacity	15-Minute Capacity	Est. 15-Min Demand	Potential RTD Demand
		Artic	Std	Artic	Std					
Current 2010	2,400	33.3%	66.7%	120	80	15	1,400	350	350	0
Current + WV North	3,400	33.3%	66.7%	120	80	15	1,400	350	496	146
Future Base	3,600	33.3%	66.7%	120	80	15	1,400	350	525	175
Future Aggressive	3,600	33.3%	66.7%	120	80	15	1,400	350	604	254

Notes: Artic = 60-foot articulated bus, Std = 40-foot standard bus, Pax = passengers, hr= hour. CU Load Standards

Source: LSC, 2011.

The current RTD service delivers a combined four vehicles per hour capacity along Baseline east of 30th Street. Spreading the potential hourly demand across all RTD vehicles could serve some, but not all of the demand without also increasing RTD service levels. The extra demand created by the buildout of Williams Village North is shown as 148 passengers in the peak 15-minute period. RTD's service standards target a maximum load of 75 passengers (60 seated, 15 standing) on an articulated bus, which would be RTD's peak 15-minute service capacity. [2]

There are three conclusions from the analysis in Table 5-10: (1) The Baseline/30th bus stop is relatively remote for most students to access, so additional investments in a stop along Baseline and crossing treatments would be needed to make this a viable choice. (2) In the short term, additional riders on RTD's routes could be achieved without increases in costs to either CU or RTD. (3) In the longer-term RTD would need to make fleet changes to favor larger buses and/or increase frequencies to meet demand not served by the Buff Bus and these costs could be passed onto CU.

Williams Village Service Recommendations

- Monitor demand and utilization carefully with the opening of Williams Village North which will take the student and faculty/staff population from 2,400 to 3,600.

[2] West of 30th Street, and including the Bound route, there are 10 vehicles per hour of capacity between 30th and Broadway, which could mean as much as 188 passenger capacity (10 veh/hr x 75 pass/veh x ¼ hour). However, the extra Bound capacity is of little help for a Williams Village to Main Campus trip as a transfer from the Bound to another route would be required at Broadway. Because Williams Village houses freshmen students primarily, there is not expected to be any demand between there and the Wolf Law building on Baseline and 28th/US-36.

- Make short-term, incremental shifts in fleet mix to increase the proportion of service delivered with articulated buses (two have been ordered for 2011-12).

- Make long-term Buff Bus fleet mix decisions after Main Campus design decisions have been made and implemented, i.e. 18th/Colorado. There is expected to be a 2-year lead time between any such decision and actual implementation.

- Make design decisions at Williams Village which are aligned with Buff Bus operating investments.
  - If the choice favors RTD service supplying some of the needed transit capacity, Williams Village North building and site design should improve upon recommendations in this report for a traffic and pedestrian signal at 35th street and collaborate with the City of Boulder, Boulder County, and RTD to implement transit hub/superstop/FastConnect facilities along Baseline Road.

- Adjust Buff Bus operating budgets and/or RTD service buy-up budgets according to the above decisions.

- Complete a design study to more fully evaluate the potential for a US-36 slip ramp stop at the south edge of the Williams Village/Bear Creek Campus and its concomitant site impacts.

5.2.2.2 East Campus

East Campus to Main Campus service is currently provided by the Stampede route. Other routes which also provide service between East Campus and other destinations include the Jump (along Arapahoe), Route 209 (touches the southwest corner of East Campus at 30th/Colorado), and regional routes J and S (limited daily service). The following discussion focuses on the Stampede and 209 as the primary services for the East Campus.

Overall Stampede ridership has grown at 2.5% per year since 2003, with total ridership in the range of 185,000 to 220,000 per year. Changes to summer frequencies, from 15-minutes to 30-minutes caused annual ridership numbers to drop a few years ago. The annual ridership numbers have since rebounded. The Stampede's ridership has been growing closer to six percent (5.9%/year) over the last three years. The Stampede is currently generating 1,200 riders per weekday (varies 800-1,200 by season), averaging of 4 passengers/ hour per vehicle throughout the day, and a maximum peak load of 43 passengers/ hour per vehicle.[3] RTD's peak loading data provide accuracy to the same peak-15 minute level as was previously discussed for the Buff Bus.

Annual ridership on the 209 has remained flat since 2001, with total ridership generally between 130,000 and 150,000. Student ridership on the 209 has also remained fairly constant. Maximum peak loads have ranged from 34 to 58 passengers/hour per vehicle (Fall 2009 and Spring 2010, respectively).

[3] RTD Ridecheck Data, 2010.

Together, the student demand for these two routes has grown at 1.5% per year over the last five years. These data offer one of the sources for establishing forecasts of future base demand.

Future Base Demand

Future base demand for East Campus transit service can be estimated and forecast by a number of different methods. Table 5-11 shows the range of estimates, which methods are summarized below.

Table 5-11
Annualized Transit Demand Forecast Rates for East Campus

	Method				
	Ridership Trend	Building Expansion	Students & Faculty/Staff	DRCOG Travel Model	Composite of All Methods
Low Rate	0.0%	3.0%	0.8%	0.7%	1.3%
High Rate	3.8%	6.0%	1.1%	2.1%	3.6%
Combined Rate	1.5% *(weighted)*	4.5%	1.0%	1.4%	2.5%

Sources: Ridership trend information from RTD boarding statistics, 2009.
Building expansion information from CU Facilities estimate, 2010.
Student and Faculty/Staff growth from CU Facilities estimates, 2010.
DRCOG Travel Model, as used by RTD for US-36 and NW Rail Travel forecasting, 2010.
Composite is a calcualtion by LSC, 2010.

The ridership trend method considered the Stampede annual student ridership growth (3.8%), and total annual growth (near 0.0%). This method also considered the combination of the Stampede and the route 209 together, which resulted in a weighted average of 1.5% growth rate.

The building expansion method is based on estimates of construction of buildings. Depending upon allocations between Main Campus and East Campus as well as outside economic factors affecting general investment and funding, this is estimated at 3% to 6% per year. This method also accounts for more recent growth of the Stampede at 5.9% per year.

The next method considered student growth alone for all of CU-Boulder (0.77%). It also considered faculty growth alone for all of CU-Boulder (1.1%). The combined rate averages the two at 1.0% per year. These numbers could be low for East Campus overall, but it is unclear at this time how many faculty and staff would have full-time offices on East Campus versus sharing office and/or classroom time between East and Main Campuses.

The DRCOG travel model is generally used for regional and sub-area forecasting and is not accurate at the route-by route level. This statement of accuracy was confirmed through discussions with RTD staff and with Boulder area planning staff members familiar with regional model applicability. The composite of Boulder Local routes generated the low rate estimate of 0.7% per year. This is the rate that can be used for the growth of all East Campus trips to destinations other than Main Campus. A combination of the Stampede and 209 together generated the high rate estimate of

2.1% per year. This is the rate that can be used for the growth of transit trips between East and Main Campuses.

Table 5-12 evaluates the implications of low and high growth rates for the future base growth. It includes both 2020 and 2030 horizon years to more closely anticipate when changes might be needed. The following summarizes the findings of the table:

- The Stampede will have 1,360 to 1,720 riders per day, and 300 to 370 riders per hour in 2020.

- To meet demand in 2020, under the low growth (1.3%/year) scenario, no changes will be required.

- To meet demand in 2020, under the high growth scenario, half the fleet can be upgraded to 60-foot articulated buses or frequencies of standard buses can be improved from 10-minutes (6 per hour) to 7.5 minutes (8 per hour).

- The Stampede will have 1,540 to 2,460 riders per day, and 330 to 530 riders per hour in 2030.

- To meet demand in 2030, under the low growth scenario, all (100%) of the fleet can be upgraded to 60-foot articulated buses or frequencies of standard buses can be improved from 10 minutes (6 per hour) to 7.5 minutes (8 per hour).

- To meet demand in 2030, under the high growth scenario, all (100%) of the fleet can be upgraded to 60-foot articulated buses <u>and</u> frequencies improved from 10-minutes (6 per hour) to 7.5 minutes (8 per hour) or frequencies of standard buses can be improved from 10 minutes (6 per hour) to 5 minutes (12 per hour).

Table 5-12

East Campus / Stampede Future Demand Estimation - Future Base Forecast

Scenario	Annual Growth		Daily	Peak Hr	Peak Load	Maximum Hrly Load		Std Bus	Buses	Capacity	Capacity =
	Hi/Low	%	Demand	Demand	per Bus	Artic	Std	Ratio	per Hr	(pax/hr)	Demand?
Current 2010	n/a	n/a	1,200	258	43	75	50	100%	6	300	Yes
Future Base 2020	Low	1.3%	1,360	292	49	75	50	100.0%	6	300	Yes
Future Base 2020	High	3.6%	1,720	370	62	75	50	100.0%	6	300	No
Future Base 2020	High	3.6%	1,720	370	62	75	50	100.0%	8	400	Yes
Future Base 2020	High	3.6%	1,720	370	62	75	50	50.0%	6	375	Yes
Future Base 2030	Low	1.3%	1,540	331	55	75	50	100.0%	6	300	No
Future Base 2030	Low	1.3%	1,540	331	55	75	50	100.0%	8	400	Yes
Future Base 2030	Low	1.3%	1,540	331	55	75	50	0.0%	6	450	Yes
Future Base 2030	High	3.6%	2,460	529	88	75	50	100.0%	6	300	No
Future Base 2030	High	3.6%	2,460	529	88	75	50	100.0%	12	600	Yes
Future Base 2030	High	3.6%	2,460	529	88	75	50	0.0%	8	600	Yes

Notes: Annual growth rates from previous table. Std Bus ratio of 100% = all 40-foot standard buses, 0% = all 60-foot articulated buses. Pax/hr = passengers per hour.
Source: LSC, 2010

Aggressive Demand

The aggressive demand forecast for the Stampede uses the highest growth rate of 6% per year based on building construction and possible occupancy conversion. There are indications that several existing buildings' employees may become much more closely associated with CU, i.e. be filled with CU staff/faculty, who would commute more between East and Main campuses. If that growth rate prevails on East Campus, then Table 5-13 shows the likely outcomes and resulting service needs. The following summarizes the findings of the table:

- The Stampede will have 2,150 riders per day and 460 riders per hour in 2020.
- To meet 2020 demand with 40-foot standard buses, frequencies would need to be increased from 10 minutes (6 per hour) to 6 minutes (10 per hour).
- To meet 2020 demand by changing fleet mix and minimizing operating costs, all 60-foot articulated buses and frequencies of 8.6 minutes (7 per hour) would be required.
- To meet 2030 demand with 40-foot standard buses, frequencies would need to be increased from 10 minutes (6 per hour) to 3.5 minutes (17 per hour).
- To meet 2030 demand by changing fleet mix and minimizing operating costs, all 60-foot articulated buses and frequencies of 5 minutes (12 per hour) would be required.

A compounded 6% per year growth amounts to 80% growth by 2020 and 320% growth by 2030. It is believed that this aggressive rate is also likely to accommodate the transit effect of aggressive low-cost remote-parking scenarios. There is a tradeoff in terms of land being used for cheap surface parking (absent buildings) or new buildings. When buildings consume developable land, cheap surface parking and cheap daily parking rates are no longer possible. The cost of parking then reaches parity with the Main Campus and there is no advantage to remote parking.

Table 5-13

East Campus / Stampede Future Demand Estimation - Future Aggressive Forecast

Scenario	Annual Growth		Daily	Peak Hr	Peak Load	Maximum Hrly Load		Std Bus	Buses	Capacity	Capacity =
	Hi/Low	%	Demand	Demand	per Bus	Artic	Std	Ratio	per Hr	(pax/hr)	Demand?
Current 2010	n/a	n/a	1,200	258	43	75	50	100%	6	300	Yes
Future Aggressive 2020	High	6.0%	2,150	462	77	75	50	100.0%	6	300	No
Future Aggressive 2020	High	6.0%	2,150	462	77	75	50	100.0%	10	500	Yes
Future Aggressive 2020	High	6.0%	2,150	462	77	75	50	0.0%	7	525	Yes
Future Aggressive 2030	High	6.0%	3,850	828	138	75	50	100.0%	6	300	No
Future Aggressive 2030	High	6.0%	3,850	828	138	75	50	100.0%	17	850	Yes
Future Aggressive 2030	High	6.0%	3,850	828	138	75	50	0.0%	12	900	Yes

Notes: Annual growth rates from previous table. Std Bus ratio of 100% = all 40-foot standard buses, 0% = all 60-foot articulated buses. Pax/hr = passengers per hour.

Source: LSC, 2010

Service Options

Service options for the East Campus were based on a combination of responses to demand, as in the case of the Stampede above, and of response to accessibility. In the case of accessibility, the analysis considered the ability to travel to/from the East Campus without requiring a transfer.

Stampede

Stampede route alternatives considered ways to increase accessibility to the whole of East Campus as the buildings fill in the majority of the site's footprint. Figure 5-6 shows several variations on routing that were among those considered. This was not a formal alternatives evaluation process, so the point of the exercise was to identify concepts that would be further evaluated and pursued as East Campus develops. Alternative A shows the current route. Alternatives B and C considered ways to reach more of the East Campus site with existing roadways as the basis for routing. Alternatives D and E assumed that a north-south crossing of Boulder Creek would be built and explored access from that point-of-view.

Figure 5-7 shows the concept, based on current re-routing in 2010 and 2011, as well as other considerations that emerged as the preference to pursue in the short term. This preference was based on the following:

- Full-length route preserves access between the Broadway/Euclid superstop and the northern edge of East Campus along Arapahoe and Marine Street.
- The route, as configured, provides more direct service in the eastbound direction from Main campus to Systems Biotech, LASP, CASA, MacAllister Building, and the coming Geosciences Building.
- Configuration of the route places layover/recovery time at the end of the route on Marine Street. This is an improvement over the current route which has recovery time occurring in the middle of the "run," causing passenger delays.
- Overlapping route patterns ("short-turn") create additional frequency between Main Campus and East Campus while also minimizing operating costs. It is anticipated that the short turn route may be operated only in peak periods.
- The short-turn pattern would turn vehicles at the Folsom Field guard station. This would not add more transit vehicles to the 18th Street/Colorado Avenue segment of Main Campus which is the consideration of pedestrian, bicycle, and vehicular safety improvements in other parts of this report. Infrastructure improvements would be needed to accommodate the turn radius of 40-foot buses at this or a nearby location.

Figure 5-6

Stampede Route Alternatives

CU-Boulder Transportation Master Plan

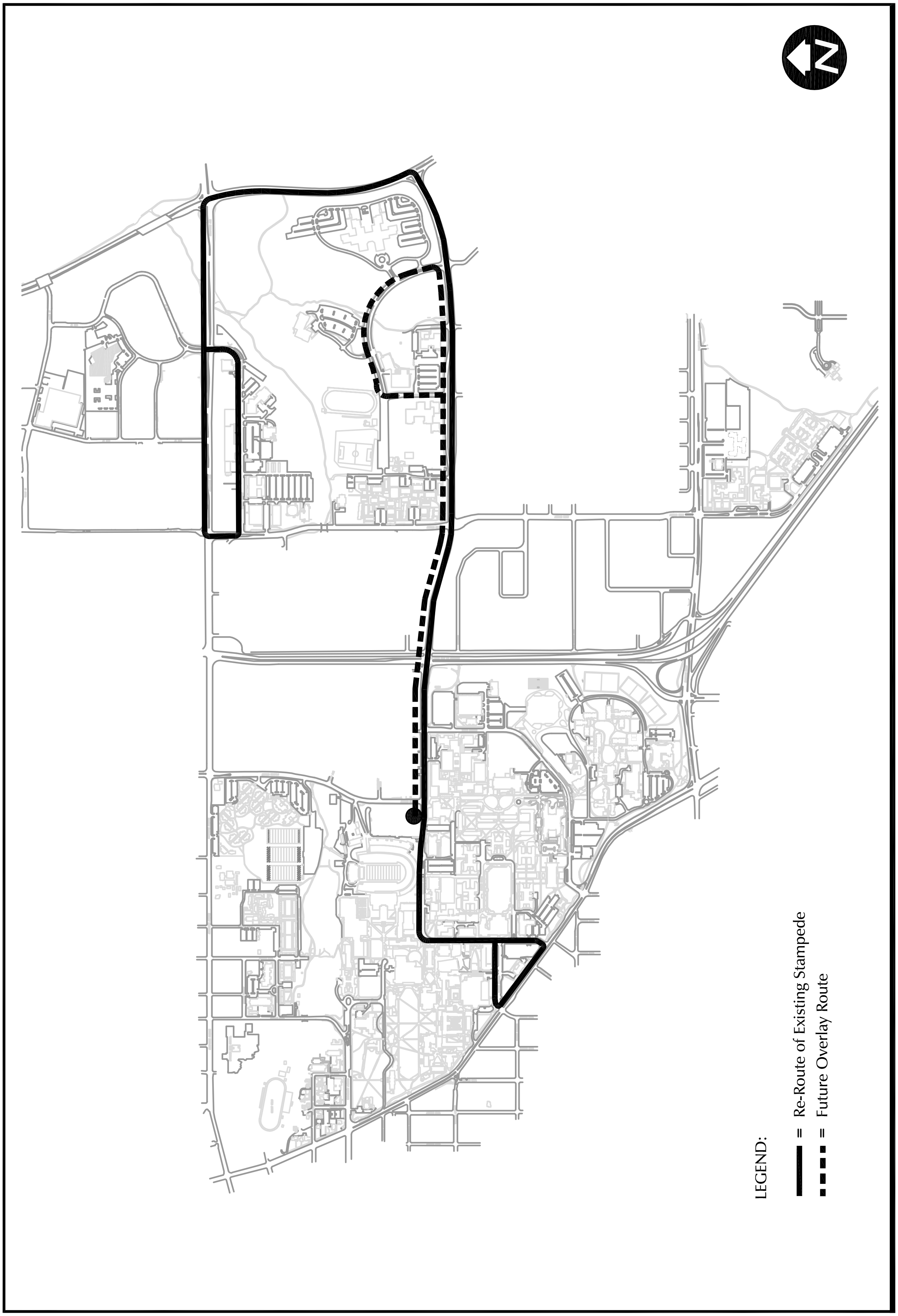


Figure 5-7

Preferred Stampede Route

CU-Boulder Transportation Master Plan

Bound

The Bound was evaluated for accessibility to the East Campus. The policy question posed by the alternatives considered was whether to pull the Bound off of 30th Street into the East Campus, and if so, for what portion of the route: between Arapahoe and College Avenue; between Arapahoe and Baseline, or other.

The following summarizes discussions with stakeholders who made observations about the alternatives:

- Pulling routes off of major arterials is counterproductive to the concepts of the community transportation network (CTN) which favor routing on major arterials for travel time competitiveness with the auto and customer expectancy.
- There is a preference at this time to design East Campus to be pedestrian and bicycle friendly and not bisect the campus with the type of conflicts currently being resolved on Main Campus through 18th/Colorado.
- The neighborhood to the south of East Campus has generally not favored any increase in vehicular access or "cut-through" traffic. Until such time as transit service were to be seen favorably or as desirable there, past neighborhood input should be respected.
- Although the connection between Williams Village and East Campus may be seen as a good "line on the map", loads at Williams Village usually mean that the buses are full, so there would not be any room for East Campus passengers to board the bus headed for Main Campus. Focus on providing East Campus to Main Campus capacity with the Stampede.

After consideration, the recommendation from stakeholders for the Bound was to retain the current routing in the vicinity of East Campus.

Two concepts received favorable consideration beyond the boundaries of East Campus. One was the possible extension of the Bound from its current north-western extent at 28th/Iris, further west along Iris to Broadway. The Iris extension would provide direct access between North Boulder and East Campus and a possible connection to the Skip.

The second concept that received favorable consideration was the establishment of a Superstop/FastConnect as a slip-ramp stop on US-36 along the southern edge of Williams Village.[4] If that linkage were made, then the Buff Bus, the Bound, or both routes could serve that connection point. As far as the Bound was concerned, there was still open discussion about whether this would be a deviation of the regular route or whether this connection would be made with a second route pattern.

Other Local Routes

The evaluation of Bound alternatives was indicative of and set the precedent for other local routes. Routes evaluated for deviation to East Campus included the HOP, the Jump, and interlining extensions of the Skip. The recommendation was the same for these routes to retain the current routing.

[4] This concept has been under consideration for many years, and was not included in the voter-approved FasTracks Plan. It would require a new source of funding. The conceptual-level cost is estimated in the range of $10 - $15 million.

Regional Routes

Like the local routes, consideration was given to some regional routes providing more direct service to the East Campus. The regional routes closest to the East Campus location are: the Bolt, HX, J, and S.

Consideration was given to whether the Bolt ought to travel on 30th and Arapahoe to downtown Boulder, or via 30th/Baseline/Broadway, rather than 28th and Canyon. At present and for the foreseeable future, stakeholder opinion was that such a change would disadvantage more riders bound for downtown than would benefit riders bound for East Campus.[5] Approximately 12% of current Bolt riders are by CU students.

HX and S currently enter and exit Boulder via 28th Street/US-36. Consideration was given whether either or both of these routes ought to travel 30th Street instead, to provide access along the western edge of East Campus. For both routes, a strong case was made to retain the 28th Street routing where superstops have been built, providing many high-quality connections. Route S currently travels along Arapahoe, the northern edge of East Campus, so it was felt that the 30th Street edge was not needed. The HX has a good connection at Colorado Avenue with the Stampede, and this connection is proposed to be improved with additional Stampede service. Therefore, it is recommended these routes retain their current routing.

Route J passes along both Arapahoe (northern edge) and 30th Street (western edge) portions of East Campus. If vehicular access were allowed north-south through the center of East Campus, many felt that it would be logical to re-route J, north-south through East Campus. This concept is shown in Figure 5-8.

East Campus Service Recommendations

- Monitor East Campus growth in terms of both campus population and transit utilization. Ensure that transit utilization and mode split is at least keeping pace with transit growth.

- Reconfigure the current Stampede route to provide two-way service along the full length of Colorado Avenue along the south edge of east campus, and maintaining the service along Arapahoe and Marine Streets. Two-way service along Arapahoe will also benefit the Center for Innovation and Creativity (CINC) to the north by providing a closer stop.

- Although the longer-term growth trend is lower, more recent growth rates of nearly six percent per year and building expansion on the East Campus that will increase the number of faculty and staff traveling between Main Campus and East Campus, it is recommended CU and RTD be prepared to supply additional capacity on the Stampede by Fall 2012. Additional capacity may be supplied by either providing articulated buses or increasing the frequencies of service. Increased frequency will do more to serve the needs of students, staff, and faculty, as well as attracting ridership. A short-turn route pattern of the Stampede is recommended to achieve the frequency objective, which may facilitate infrastructure improvements on campus.

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[5] While both East and Main Campuses could be served by the 30th/Baseline/Broadway routing, the Main Campus connection could alternately be achieved by retaining the current 28th/Canyon routing, and then extending the Bolt from the Boulder Transit Center to Main Campus, south along Broadway.

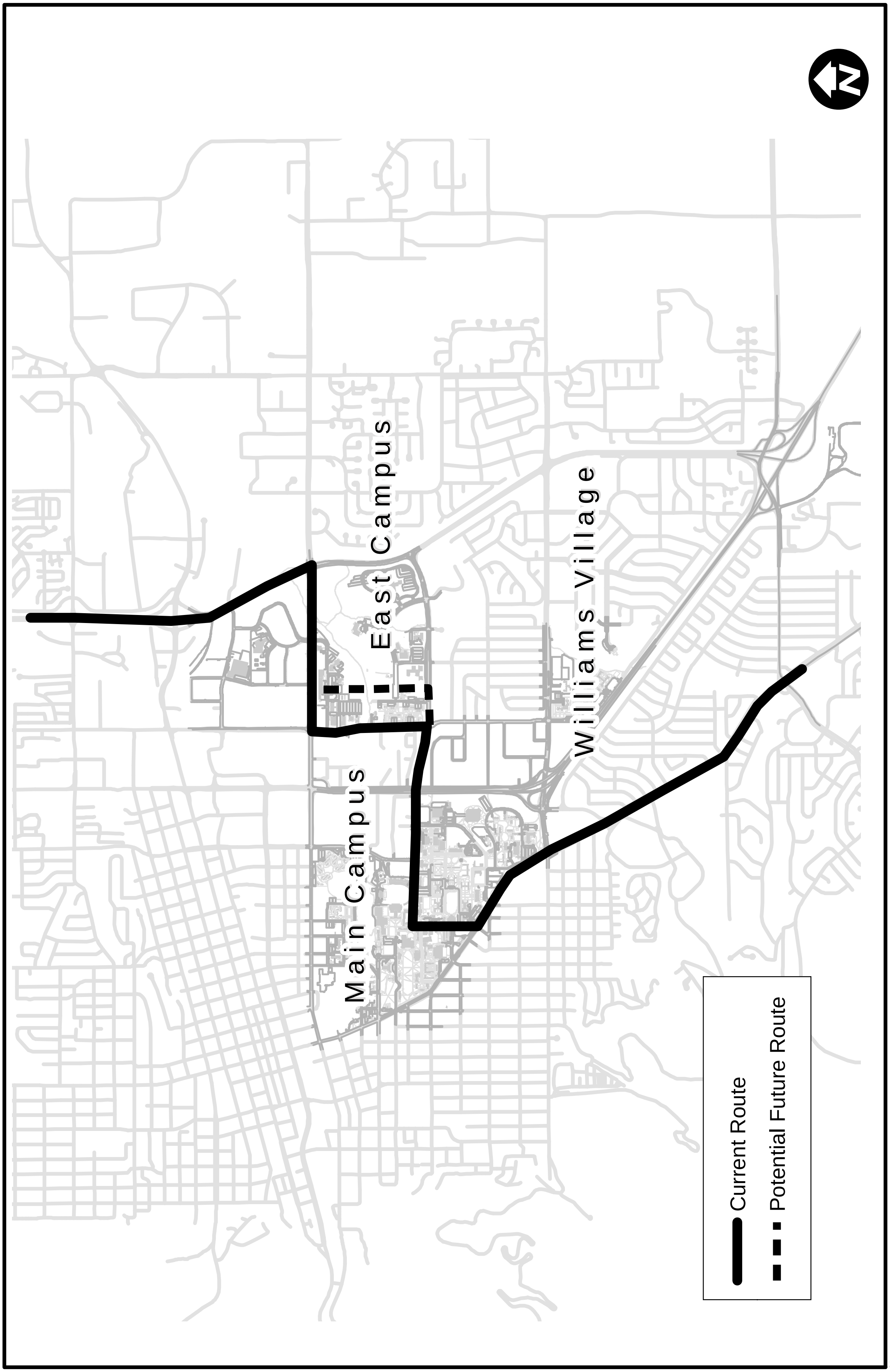


Figure 5-8

Route J Options

CU-Boulder Transportation Master Plan

- With RTD, plan to extend the Bound along Iris to provide a direct connection to more of North Boulder, and a one-transfer connection with the Skip.

- Complete a design study to more fully evaluate the potential for a US-36 slip ramp stop at the south edge of the Williams Village/Bear Creek Campus and its concomitant site impacts.

- If a Boulder Creek crossing allows north-south vehicular access through East Campus, re-align the regional route J to make the most of this opportunity to provide direct transit access.

5.2.2.3 Main Campus

Transit service to CU Boulder's Main Campus takes into consideration three areas: (1) travel along the western Broadway edge of campus, (2) travel through campus on the Euclid/18th Street/Colorado Avenue corridor, and (3) travel along the eastern 28th Street edge of campus.

Broadway Corridor Demand

Table 5-14 provides a base demand growth rate estimate for buses along Broadway, including both local and regional routes. Broadway local routes included the 203, 204, 225, Dash, and Skip. Based on actual ridership, local route's total ridership is growing more slowly at 2.3% per year. Broadway regional routes included the AB, B, DD, DM, and GS and that ridership is growing more quickly at 4.8% per year. Although the student ridership is growing at 7% to 8% per year on average, it represents less than a third of total ridership on the Broadway routes. Because of this, total ridership is the determining factor for changes to capacity and frequency.

The student and faculty/staff population growth rate is the same as was discussed for the East Campus. It is growing at about 1.0% per year, with a low and high rate just below and above this rate.

Table 5-14
Annualized Transit Demand Forecast Rates for Main Campus - Broadway

	Method			
	Ridership Trend Broadway Routes	Students & Faculty/Staff	DRCOG Travel Model	Composite of All Methods
Low Rate	2.3%	0.8%	0.1%	1.1%
High Rate	4.8%	1.1%	1.3%	2.4%
Combined Rate	3.6% (weighted)	1.0%	0.7%	1.7%

Sources: Ridership trend information from RTD boarding statistics, 2001-2009.
Student and Faculty/Staff growth from CU Facilities estimates, 2010.
DRCOG Travel Model, as used by RTD for US-36 and NW Rail Travel forecasting, 2010.
Composite is a calcualtion by LSC, 2010.

Using the DRCOG regional travel model, and considering only the same local and regional routes described above, the range of growth is expected to be 0.1% per year to 1.3% per year. The average of the two is a modest 0.7% per year.

The composite growth rate of all these methods is 1.1% to 2.4% per year, with an average of 1.7% per year. This is the long-term growth rate for Eco Pass, Student Pass, and ridership growth along Broadway. Because these routes all use the RTD funding model, the service changes and monitoring all are done by RTD. As such, no further development of these forecasts is warranted. CU, however, should monitor ridership with RTD to ensure that CU Student Pass and faculty/staff Eco Pass contributions are commensurate with the growth in CU's utilization. Proposed new fareboxes, being implemented by RTD beginning in 2011, should provide some additional data and tools to monitor this. Better data are not expected prior to 2012, after the proverbial "bugs" are worked out of the new farebox system and data processing streams.

Euclid/18th Street/Colorado Avenue Corridor Demand

Along the Euclid/18th Street/Colorado Avenue Corridor, the total growth rate is the combination of the HOP, Stampede, 209, Buff Bus, and J Routes. The HOP route ridership is growing at an annual average 2.3%/year. The Stampede and 209 route ridership, as previously discussed for East Campus, is growing at an annual average 2.5% per year. The Buff Bus ridership is growing at an average annual rate of 3.0% per year over the long term, which is an estimated average between no growth in the typical year (fixed student population) and large spikes in growth when new residence halls are opened. Route J has grown at 3.8% per year in recent years. Together, this growth means a composite growth of about 3.0% per year in riders. Strategies for the largest contributors of this growth, the Buff Bus, Stampede, and 209 have already been discussed. The CU contribution to the HOP and Route J should be monitored to match funding with ridership growth.

Based on vehicular and non-motorized (bike/ped) conflicts through 18th/Colorado, the most important constraints in this corridor are the number of buses rather than the number of riders. Analysis, from a street and landscape design perspective, is addressed in Section 5.2.1.3. This section addresses the transit contribution to that design.

Table 5-15 shows the number of buses passing during the peak-hour, in the peak direction. Two-way bus volumes are also shown. Because many of the buses operate only in one direction, the two-way volumes are only incrementally higher.

Table 5-15
Bus Volumes in the Euclid/18th/Colorado Corridor - Peak Hour

Routes	Existing		2020 Base		2020 Aggressive		2030 Base		2030 Aggressive	
	1Way	2Way	1Way	2Way	1Way	2Way	1Way	2Way	1Way	2Way
Buff Bus - Coll. Inn[1]	4	4	4	4	4	4	4	4	4	4
Buff Bus - Will. Vill.	15	15	17	17	20	20	21	21	21	21
209	6	6	6	6	8	8	6	6	8	8
Stampede	6	6	6	6	8	8	8	8	10	10
HOP	8	16	10	20	10	20	12	24	12	24
J	2	2	2	2	2	2	2	2	2	2
Total	41	49	45	55	52	62	53	65	57	69
Average Headway	1 min 28 sec	1 min 13 sec	1 min 20 sec	1 min 5 sec	1 min 9 sec	0 min 58 sec	1 min 8 sec	0 min 55 sec	1 min 3 sec	0 min 52 sec

Notes: [1]Buff Bus is proposed to be discontinued for the 2011-2012 school year.
Source: LSC, 2011

Also shown are the forecast numbers of buses in 2020 and 2030 under base and aggressive conditions. In this instance, “aggressive” has a dual meaning of both the higher of two growth rates for *passenger volume influence on the number of vehicles needed* as well as the decisions that could be made about *bus fleet mix* (shares of standard and articulated). Currently, in the peak direction, there are 42 buses per hour, operating at 90-second headways.[6] To put this frequency in perspective within the Denver region, only the 16th Street Mall in downtown Denver has more frequent service at 75-second peak headways (48 buses per hour) in one direction.

Through iterative development and evaluation of design alternatives, the preferred option is to increase overall safety in this corridor by reducing the transit-way to one lane in a significant segment of 18th Street and Colorado Avenue, likely between Euclid and the guard house near Folsom Field. A more thorough traffic operations evaluation, possibly simulation, is recommended to complete the evaluation of this preferred concept.

Two-way transit operations are preferred on this one-lane segment, using signalization, bus pull-outs or short passing segments, and/or modest bus volume reductions. Some combination of these three actions is expected to result in satis-factory preservation of the majority of existing transit operations while significantly improving the safety and efficiency of travel for pedestrians and bicyclists.

28th Street Corridor Demand

The eastern edge of Main Campus is served by the HX and S regional routes. Over the last eight years, the HX has been growing at an average 6.8% per year, with the student portion of the ridership at 5.5% per year, and the non-student ridership at 8.3% per year. The route S has been growing at an average 4.1% per year, with the student portion of the ridership at 15.4% per year, and the non-student ridership at 2.7% per year. Combined the two routes have been growing at an average 8.0% per year, with the student portion of the ridership at 8.3% per year, and the non-student ridership at 7.9% per year.

RTD’s FasTracks long-term planning anticipates that the HX service will improve from 15-minute frequencies to 10-minute frequencies. This improvement and the implementation of the Northwest Rail line are expected to make the route S obsolete.[7] In the short-term, however, minor scheduling adjustments may increase the regularity of the departures and be perceived as more convenient to customers. CU and RTD should jointly monitor these two services to ensure there is alignment between funding increases, especially student and faculty/staff pass sales, and service enhancements. Cost/benefit analyses will help both organizations to choose an appropriate funding model and to expand future service at the right time.

[6] There are 122 buses per hour passing through the Broadway/Euclid intersection at peak times, total in all directions. This is comprised of 72 in the N-S direction along Broadway (approx 36 buses each direction) and 50 in the E-W direction along Euclid/18th/Colorado (42 in peak direction and 8 in off-peak direction). The Mall Shuttle has 48 buses per direction, and the comparison here is curb-face capacity, whereas Broadway/Euclid is focused on intersection capacity or total capacity across 4 curb faces. A similar curb-face bus volume problem was solved on 17th Street in Downtown Denver by distributing total bus volumes across three consecutive blocks known as the X, Y, and Z stops.
[7] The HX and S currently serve different markets at both ends of the routes. Additional analysis should be done with the implementation of NW Rail to assure that reconfigured routes provide equal or better service in all markets.

Service Options

Broadway Corridor

In the Broadway corridor, transit service is already very good. To maintain the existing high transit mode shares, service need only keep pace with growth. Capacity has been less an issue than connectivity. To increase transit modal shares, several connectivity concepts were explored including the following:

- Working with RTD to enhance customer understanding and gate assignments of existing routes at the Boulder Transit Center (BTC).
- Selectively extending route service from the Boulder Transit Center to the CU campus.
- Implementing additional community transit network (CTN) recommendations to improve existing transfers and connections.

Enhance Customer Understanding. Through conversations with stakeholders, it was identified that experienced transit users are aware of and able to make efficient use of the five potential routes between the BTC and CU Main Campus. Routes 203, 204, 225, Dash, and Skip are all relatively accessible, but at different gates, and in the case of the Skip can be two blocks away. Inexperienced or new transit users aren't aware of these opportunities and may perceive a lower-quality connection at the BTC than is actually available.

The perception of a lower-quality connection can be especially true in the off-peak when the route 204 drops from 15-minute to 30-minute frequencies. In an idealized situation for CU, all these routes' services would be evenly spaced, creating an effective average frequency of 6 minutes. Because of transfers with other routes at the BTC, multiple routes are scheduled such that the effective frequency of service in the off-peak is 15 minutes, with multiple buses departing at the same time. Transit riders, in the off-peak, can use the Dash reliably at 15-minute off-peak headways, or the combination of 203/225 also at 15-minute off-peak headways.

Selective Extension of Routes from BTC. Extension of some routes from the BTC to CU's Main Campus could reduce the need for a transfer. Extension of routes also comes with it the following considerations:

- Increase in operating cost for the extension of service.
- Increase in the bus volumes on Broadway, particularly at Broadway/Euclid stop.
- The extension of service for some routes proves to be inefficient in attracting riders to change modes.

On the first point, extension of service from the BTC to the CU Main Campus is approximately two miles round-trip and roughly eight additional minutes of travel time round-trip. If an additional bus is required for this, it can amount to $50,000 to $200,000 per year, depending on whether the additional bus can be scheduled efficiently or not.

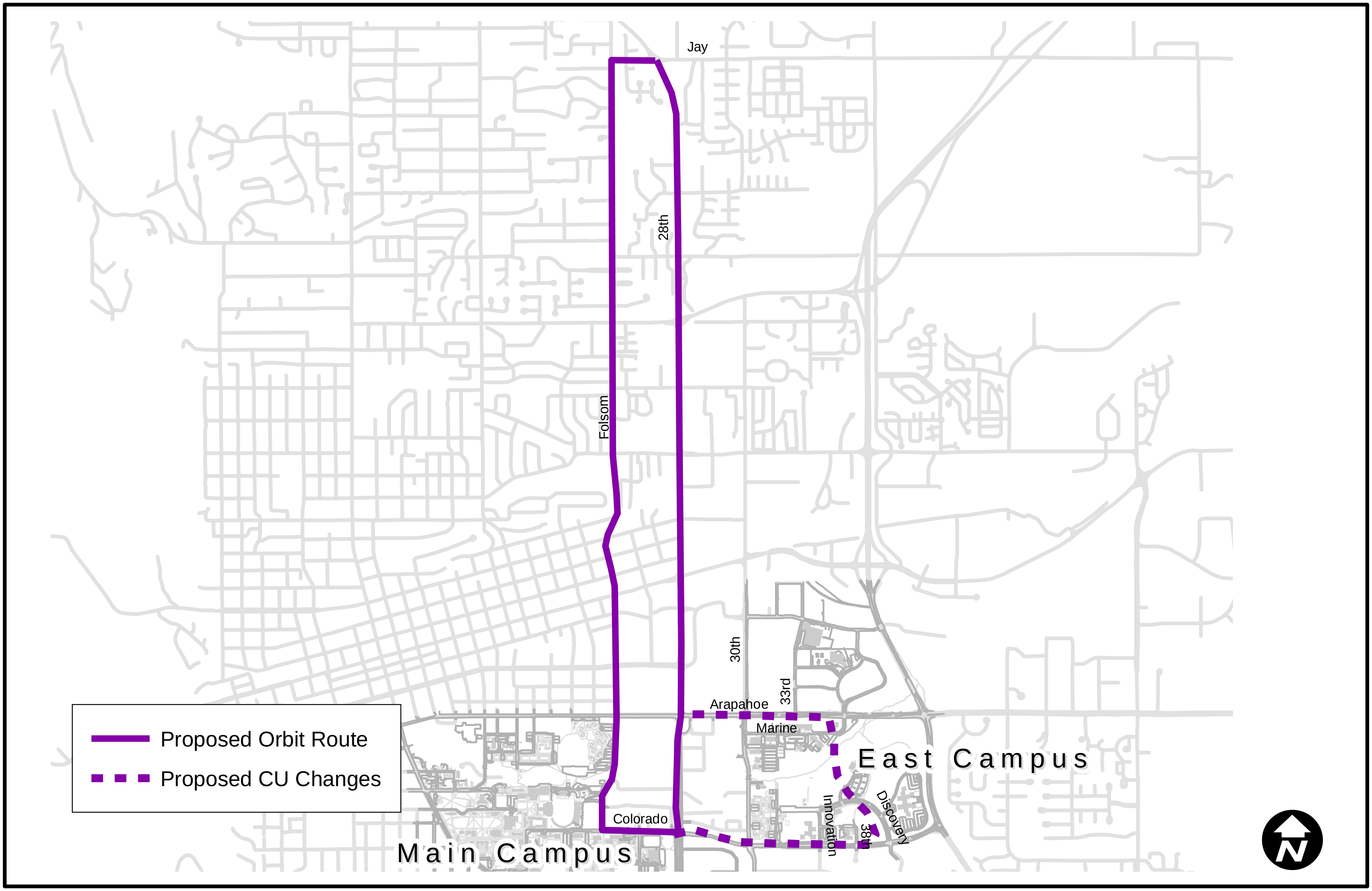
On the second point, the Broadway/Euclid grade separation, currently under construction, will alleviate some pedestrian, bicycle, and auto conflicts from side-street and crossing movements. The through-volumes of buses, however, are expected to keep the bus-loading area at near capacity for the allotted curb area. Hence, if additional buses were to travel this corridor, it will be important to do so selectively.

Finally, for some routes coming in from Boulder County, transfers are made prior to reaching the Boulder Transit Center. Examples include transfers made at 28th/Canyon (i.e. Bolt to HOP) and Arapahoe/Folsom (Jump to HOP). Adding a no-transfer capability at the Boulder Transit Center to CU Main Campus may still be perceived as an inferior choice (worse total travel time) as compared to a good transfer in the right location. It is for these reasons that extension of routes from the BTC to CU Main Campus be pursued only after other actions, and then only done selectively with additional data collection to support them.

For all routes reporting student pass boardings, the student pass average use is 31%. The Bolt, N, and Y all have lower student pass boardings than the average. Of those, the Longmont market is the largest community and has a 12% student pass use rate. For this reason the Bolt route is suggested as a priority for route extension in the Broadway corridor. Similarly, among local routes, the route 205 is also suggested for extension.

<u>Implement CTN Recommendations</u>. During the consideration of the second option to extend service from the BTC to CU Main Campus, stakeholder discussion returned several times to community transportation network (CTN) recommendations. In particular, the Orbit bus route was suggested as the most pivotal to improving transfers outside of downtown to access Main Campus as approached on southbound Folsom. The Orbit route, proposed by a previous study, is shown in Figure 5-9.

Other comments noted that the further east of Broadway transit users were, the lower the quality of transit service and connections seemed to be, at least until the 30th Street Bound route was reached. In this sense, the proposed Orbit bus service fills a gap in the transit network. It will be important to consider the effect of the Orbit on routes sharing the Folsom approach and the 18th/Colorado Corridor, especially the HOP. It is important for the university to work with RTD in developing the Orbit route to ensure that it maximizes service to university affiliates. Consideration should be given to route adjustments that might better serve the East Campus as transit demands increase.



Proposed Orbit Route

CU-Boulder Transportation Master Plan

Figure 5-9

Euclid/18th Street/Colorado Avenue Corridor

The preferred design is a one-lane, two-way bus operation with pull-outs or signalization. This section provides additional information to frame the more detailed analysis that is recommended as a next-step towards the ultimate decision to implement the preferred design.

The length of this corridor is approximately 1,750 feet (0.33 miles). The diagonal cross-walk at the 18th/Colorado corner is approximately 800 feet from the Euclid/18th inter-section and 950 feet from the outside (eastern) edge of the turn-around loop at the Folsom Field guardhouse.

Table 5-16 shows the expected operating speeds of various modes traveling through the 18th/Colorado corridor. Bus speeds are low, about half of normal, for safe operations in a highly-pedestrian environment. These speeds match those in practice on the 16th Street Mall in Denver. With a cycle track provided, bicycles may be the fastest-moving mode in the corridor.

Table 5-16
Expected 18th/Colorado Operating Speeds with New Design Conditions

		Travel Time (minutes)		
Mode of Travel and Speed Assumptions	**Speed**	**800 ft**	**950 ft**	**1750 ft**
Ped travel speed low (no stops)	2 mph	4.5	5.4	9.9
Ped travel speed high (no stops)	3 mph	3.0	3.6	6.6
Bike travel speed low (no stops)	10 mph	0.9	1.1	2.0
Bike travel speed high (no stops)	15 mph	0.6	0.7	1.3
Bus travel speed low with stops	6 mph	1.5	1.8	3.3
Bus travel speed high with stops	8 mph	1.1	1.3	2.5

Source: LSC, 2010

Regarding transit travel, this table says that it will take 2.5 to 3.3 minutes for one bus to travel end-to-end of this corridor segment. Arrival rates of buses in the peak direction are less than 1.5 minutes, so a queue of 2-4 buses will develop and delays will occur if buses are held in the peak direction until the entire corridor "clears" of buses traveling in the off-peak direction. This finding means that some traffic control device, other than the existing gates, will be required to meter the flow of buses in both directions.

There are more elements of this speed evaluation that will need to be considered in a full traffic operations analysis (simulation). Some of the buses running through this corridor have fare-free boarding and multiple-door boarding, similar to the 16th Street Mall. Other buses do not. There are fewer proposed stops in the 18th/Colorado Corridor than the 16th Street Mall. The 16th Street Mall has more controlled crossings of pedestrians due to the presence of signals.

Table 5-17 shows the flows of buses, by direction, in the AM, Mid-Day, and PM peak periods. In the AM peak period, buses are arriving at an average rate of just under 1.5

minutes apart in the westbound direction on Colorado, and 7.5 minutes in the east-bound direction. During the PM peak period, some buses reverse direction, some do not, and others remain bi-directional. As such, the PM peak is much closer to being balanced in terms of the number of buses each direction. The Stampede is currently a one-way, reversible operation, but proposals for that route may make it a two-way operation.

Table 5-17
Existing Euclid/18th/Colorado Corridor Bus Volumes
(EB/WB is direction on Colorado Avenue)

Routes	AM Peak Hour		Mid-Day Off Peak		PM Peak Hour	
	EB	WB	EB	WB	EB	WB
Buff Bus - Coll. Inn[1]	0	4	0	0	0	4
Buff Bus - Will. Vill.	0	15	0	14	0	12
209	0	6	0	4	0	6
Stampede	0	6	6	0	6	0
HOP	8	8	8	8	8	8
J	0	2	0	0	2	0
Total	8	41	14	26	16	30
Average Headway	7 min 30 sec	1 min 28 sec	4 min 17 sec	2 min 18 sec	4 min - 15 sec	2 min 0 sec

[1]College Inn Route is proposed to be eliminated after the 2010-2011 school year.
Source: LSC, 2011

Based on this flow of buses, several options exist to manage the flows of buses:

- With signalization or passing areas or both, set a "primary" and "secondary" direction by time of day. Buses traveling in the secondary or non-peak direction would be metered and delayed.
- Regulate the directional flow, like an HOV lane, by time of day and prohibit all travel in the non-peak direction. Possibly allow bi-directional operation mid-day when there are fewer buses.
- Select a permanent direction for the flow of vehicles and make it a one-way street.

Three areas become critical for the proper design and operation of this facility. The areas near Folsom Field and Euclid/18th are areas for queuing or turn-around, depending upon the option selected. The 18th/Colorado corner is an important passing location since the corner limits sight-distance.

Transit signals and pedestrian signals at key crosswalk may improve both the safety and corridor travel times. Basic, two-direction signals (as opposed to four-legged inter-section) are estimated to cost $50,000 to $80,000 to implement. More advanced vehicle detection and priority detection systems could increase costs. Table 5-18 presents pros/cons list of the three traffic/transit control options.

Table 5-18
Evaluation of Traffic/Transit Control Options along 18th/Colorado

Traffic Control Option	Pros	Cons
Signalized Control	• Maintains all the convenience of the current two-way operations • Improve safety of operations through time-separation of buses. • Has the potential to achieve the broadest range of goals for this corridor of any of the options.	• More capital cost intensive than other options. • Could take a little education and enforcement to get pedestrians used to waiting for a walk-signal. • Will retain more right-of-way for transit uses than other options for signal control devices and potential passing areas.
Reversible, HOV-like Control	• Improve safety through physical and time-separation • Impacts to operations are minimized by peak period of the day, favoring the peak direction.	• Uncommon application for a setting like this. HOV lanes more known for highway applications. • Could be confusing to the peds and transit customers, especially given that there a quarter of the student population is new each year • Some loss of convenience compared to current operations.
One Way Operation	• Simplest solution of the three • Most predictability for pedestrians and cyclists. • Narrowest right-of-way need for transit	• Greatest loss of convenience of the three options • Potential for significant loss of ridership on some routes • Counter to efforts which have brought more transit to this corridor over time.

Source: LSC, 2011

28th Street Corridor

Transit facilities on 28th Street are already well-designed. Transit operations are managed by RTD and should be jointly monitored by RTD and CU to verify that services continue to meet customer expectations as connecting services, like the Stampede, are modified. No alternatives are considered at this time.

Main Campus Service Recommendations

Broadway Corridor

- The Broadway corridor has well-established local and regional bus routes with well-established transit infrastructure including pedestrian underpasses and the under-construction Broadway/Euclid project.

- Transit services will primarily expand based on RTD service standards for loading and frequency. CU's funding share will expand with Student Pass and Eco Pass pricing for students and faculty/ staff, respectively.

- Transit services are expected to expand incrementally based on load standards and overall ridership for the next ten years. FasTracks plans over the longer-term may provide additional increases, but will be beyond the ten-year horizon of this plan.

- Market, educate, and otherwise increase the level of understanding about the existing services between the Boulder Transit Center and the CU Main Campus.

- The Orbit is identified in this analysis as having a high priority among CTN recommendations for implementation, to increase connectivity to Main Campus with convenient transfers, for routes like the Bolt and 205.

- Extension of routes from the BTC to CU Main Campus should pursued only after the marketing/education actions and CTN actions above, and then only done selectively with additional data collection to support it.

Euclid/18th Street/Colorado Avenue Corridor

- Based on transit alternatives, both baseline and aggressive, bus volumes in this corridor are expected to increase 4 to 14 buses per hour by 2020 and 14 to 22 buses per hour by 2030. This is on top of 42 buses per hour currently. More buses means that more people will be using transit and meeting the goals of the plan (VMT, carbon emission reductions), and that there will be more opportunity for motorized and non-motorized conflicts. Safety and incident monitoring in this corridor is recommended to document trends and identify the appropriate phasing for more comprehensive actions and solutions.[8]

- Through iterative development and evaluation of design alternatives, the preferred option is to increase overall safety in this corridor by reducing the transit-way to one lane in a significant segment of 18th Street and Colorado Avenue, likely between Euclid and the guard house near Folsom Field. A more thorough traffic operations evaluation, possibly simulation, is recommended to complete the evaluation of this preferred concept.

- Traffic analysis and simulation will need to consider three locations for bus queuing: Euclid/18th, 18th/Colorado (Engine Alley), and the Folsom Field guard station. Two of those, Euclid/18th and Folsom Field guard station, should also be considered for turn-around locations.

28th Street Corridor

- CU and RTD should jointly monitor the HX and S services to ensure there is alignment between funding increases, especially student and faculty/staff pass sales, and service enhancements.

- CU and RTD should verify that services in this corridor continue to meet customer expectations as connecting services, like the Stampede, are modified.

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[8] A combination of Public Safety (actual accidents) and PTS (operational observations from drivers or by PTS staff) is recommended.

5.2.2.4 Transit Project Prioritization

The range of transit alternatives presented in this chapter is comprehensive, considering many dimensions of demand and policy choices. To provide guidance for implementation, the following criteria are recommended to rank/prioritize transit services. Based on the ranking/prioritization, CU-Boulder can then pursue funding and plan for the project based on their relationship to other mode-based projects contained in this Transportation Master Plan. The following criteria are used for scoring proposed transit projects:

- Ridership (a measure of benefit)
- Carbon Benefit (a measure of benefit)
- Institutional Interest (a measure of benefit)Institutional Capacity (a measure of cost)
- O&M Cost (a measure of cost)
- Scalability (a measure of cost)

Ridership

This is the measure of the total number of persons expected to use a proposed service throughout the day or the volume of peak-hour utilization. High transit utilization at peak times has the most benefit in terms of reducing the need for parking and of reducing congestion that would otherwise result from additional vehicles on the roads at peak times. Sustained ridership throughout the day also shows that a service is useful and attractive for reasons other than avoiding peak congestion.

Carbon Benefit

Carbon benefit is gauged by the expectation of reductions in use of gasoline and/or reductions in total emissions from cars. This may result from a reduction in total vehicle miles traveled, such as a high volume of persons making short trips by transit, or fewer people making longer trips by transit. It may also result from transit service intercepting persons at their point of origin, eliminating cold-start emissions all together.

Institutional Interest

This is a qualitative measure of the level of urgency felt by an organization or several organizations to change the status quo. It is said that necessity is the mother of invention. This may be gauged both by how important it is to do something, in and of itself, such as improving the environment, or how important it is to move beyond the consequences of continuing existing actions, such as traffic congestion or parking shortages.

Institutional Capacity

This is a qualitative measure of the amount of effort required among one or more organizations to initiate new services or modify existing services. The more organizations required, the more difficult the goal is to achieve. Also, the further outside the existing way an organization operates, the more difficult the goal is to achieve.

Cost

This is the consideration of the dollars required to implement a service. Because prior discussion has set aside advanced technologies other than enhanced bus, which would require significant capital investment, this measure considers primarily operating and maintenance expenses. Operating and maintenance expenses are the requirements to pay drivers, mechanics, dispatchers, service analysts and others associated with direct service delivery.

Scalability

This is a qualitative measure indicating whether a solution may be implemented in pieces, gradually, or whether it requires wholesale change.

Table 5-19 shows how these evaluation criteria are used in terms of assigning high, moderate, and low ratings, and then giving numeric values to them. Table 5-20 shows how the evaluation criteria were applied to transit service alternatives discussed earlier in this chapter.

Table 5-19
Transit Project Scoring

Criteria	Score	Description
Ridership	2	High expectation of significant peak-hour and/or sustained demand throughout the day.
	1	Moderate expectation of peak-hour and/or sustained demand throughout the day.
	0	Low expectation of peak-hour and/or sustained demand throughout the day.
Carbon Benefit	2	High expectation of significant reduction in cold-start vehicle emissions and/or significant reductions in total VMT.
	1	Moderate expectation of reductions in cold-start vehicle emissions and/or reductions in total VMT.
	0	Low expectation of reductions in cold-start vehicle emissions and/or reductions in total VMT.
Institutional Interest	2	High level of awareness and agreement among CU staff, faculty, and administrators that improvement is needed.
	1	Moderate level of awareness and/or agreement among CU staff, faculty, and administrators that improvement is needed.
	0	Low level of awareness and/or agreement among CU staff, faculty, and administrators that improvement is needed.
Institutional Capacity	2	High level of autonomy of one organization to make relevant decisions or high agreement among multiple organizations.
	1	Moderate level of autonomy of one or cooperation among multiple organizations needed to make relevant decisions.
	0	Low level of autonomy of one organization or cooperation among multiple organizations needed to make relevant decisions.
Cost	2	High expectation that the anticipated costs of the transit service are within forseeable funding availability.
	1	Moderate expectation that the anticipated costs of the transit service are within foreseeable funding availability.
	0	Low expectation that the anticipated costs of the transit service are within foreseeable funding availability.
Scalability	2	High ability to implement the proposed transit service in pieces/segments or to provide gradually over time.
	1	Moderate ability to implement the proposed transit service in pieces/segments or to provide gradually over time.
	0	Low ability to implement the proposed transit service in pieces/segments or to provide gradually over time.

Source: LSC, 2011

Table 5-20
Transit Service Scoring

Service Alternative	Ridership	VMT Savings	Institutional Interest	Institutional Capacity	O&M Cost	Scalability	Total Score
Buff Bus - Williams Village Service Increase	2	2	2	2	1	2	11
Stampede Reconfiguration of Existing Service	1	1	2	1	2	2	9
Stampede Overlay of New Service	2	2	1	1	1	1	8
Bolt Extension from 14th/Walnut to CU	1	2	1	1	1	1	7
HX Service Frequency Increase	2	1	1	1	0	2	7
J Re-Route Onto East Campus	1	1	1	1	1	2	7
Implement the Orbit	2	2	2	0	0	1	7
205 Extension from BTC to CU	1	1	1	1	1	1	6
Bound Extension to Iris	1	1	1	1	1	1	6
Bound Re-Route Onto East Campus	1	1	1	0	1	1	5
Bolt Re-Route Onto East Campus	0	1	1	0	2	1	5
HX Re-Route Onto East Campus	0	1	1	0	2	1	5
S Re-Route Onto East Campus	0	1	1	0	2	1	5

Source: LSC, 2011.

Transit Project Funding Evaluation

The funding sources for the recommended transit services in this chapter are a necessary component of implementation. Universities typically draw upon a variety sources of funding to operate & maintain transit services. Table 5-21 presents the results of university transit research on funding sources, showing results both for transit service operated by universities themselves and by others to/through the university. Federal and state funding sources are generally more available to universities when the university is the operator of a city's transit service. To the degree that university transit service is an add-on to (above & beyond) transit service provided by the local city/county/region, universities typically must cover the costs of the transit service through their own funding sources. Table 5-22 links prior tables and shows transit service alternatives and the potential funding sources for CU.

Table 5-21
Sources of Funding for Transit Services to Universities

Funding Source	Number of Universities Using Each Source	
	University Operated	Not University Operated
1 Federal	5	29
2 State	5	26
3 Public Transit Operator	0	6
4 Local Government	3	24
5 School General Fund	12	8
6 Student Fees	15	18
7 Parking Fees	8	11
8 Fares	4	22
9 Advertising	9	20
10 Private Subsidy	2	2
11 Other	12	17

n=60
Source: TCRP Synthesis 78: Transit Systems in College & University Communities, 2008.

Table 5-22
Transit Service Prioritization and Scoring

Service Alternative	Projected Increase In Annual Costs to CU Above Existing Services	Priority Score	Potential Funding Sources
Buff Bus - Williams Village Service Increase	$161,500	11	5,6,7,9
Stampede Reconfiguration of Existing Service	$0	9	3,4,6,8
Stampede Overlay of New Service	$267,444	8	3,4,6,7,8,9
Bolt Extension from 14th/Walnut to CU	$172,500	7	3,6,8
HX Service Frequency Increase	$27,600	7	3,6,8
J Re-Route Onto East Campus	$0	7	3,6,8
Implement the Orbit	$496,800	7	3,4,6,8,9
205 Extension from BTC to CU	$131,100	6	3,6,8
Bound Extension to Iris	$248,400	6	3,6,8
Bound Re-Route Onto East Campus	$124,200	5	3,6,8
Bolt Re-Route Onto East Campus	$0	5	3,6,8
HX Re-Route Onto East Campus	$0	5	3,6,8
S Re-Route Onto East Campus	$0	5	3,6,8

Source: LSC, 2011.

5.2.3 Ridesharing Options

Ridesharing includes carpools and vanpools. Carpools are generally informal arrangements between two or more persons who share a ride to or from CU-Boulder. Vanpools, on the other hand, are a formal arrangement involving four to eight commuters, who travel together in a vehicle provided by a vanpooling agency, and who pay a monthly fare for the service.

Both carpooling and vanpooling are potentially attractive means of commuting to CU Boulder for persons without access to convenient transit services or who live too far to cycle or walk to campus. The options described in this section are intended to enhance the attraction of ridesharing, and reduce the cost (in terms of time and money) of carpooling and vanpooling as compared with driving alone.

5.2.3.1 Ride Matching

The greatest deterrent to ridesharing is the difficulty in finding carpool and vanpool partners with similar commuting schedules. A ridematching service available to students, faculty and staff enables prospective ridesharers to meet and form carpools and vanpools.

A ridematching service operates similar to a dating service. Prospective ridesharers provide information regarding their home location, the hours they wish to travel, whether they prefer a nonsmoking vehicle, and any considerations. The ridematching agency then matches each person with other commuters who live nearby and who wish to travel at similar times, providing a name and contact information for each match. Each prospective ridesharer's name also remains in the ridematch database to be matched with other prospective ridesharers. It is the up to prospective ridesharers to form a carpool or vanpool — the ridematch agency simply acts as an "introduction service."

CU uses Zimride (a social network for ride-sharing) for its ride-matching program. The benefit of joining an existing service is the expanded pool of commuters from which to choose (not just those people travelling only to the university).

5.2.3.2 Preferential Parking

A means of encouraging ridesharing is to provide preferential parking for carpools and vanpools close to key buildings on campus. This would eliminate the long walks for many commuters, particularly those parking in less proximate lots.

PTS currently provides designated, reserved parking for carpools in various lots, as demand dictates. Reserved priority parking spaces are set aside for carpools at Wolf Law, Leeds Business and the Center for Community. To further encourage ridesharing, the number of designated carpool parking stalls could be increased, in high profile areas, so that carpooling gains recognition from increased visibility. The key attraction of preferential carpool parking is the guarantee of a parking space by either the guarantee of a convenient location without the need to search for a space, or the guarantee that a space would be available in an otherwise crowded facility.

5.2.3.3 Reduced Parking Prices for Carpools

Generally, it is very difficult to encourage carpooling, especially where average commute trips are less than 30 minutes, as the extra effort required to organize is usually not an equal trade off for the benefit of sharing the cost of gas. Furthermore, the cost of parking on campus would have to increase substantially in order to make that cost share attractive. Other incentives, therefore, are required to encourage carpooling on campus. Currently, carpool parking permits are priced at the same rate as general or reserved parking — there is no price reduction for carpools and vanpools. Carpool permits are issued to carpools with a minimum of two persons.

Some universities, institutions and other parking operators charge a reduced price for carpools as compared with other vehicles. CU could lower rates for carpools, but would have to set up administrative policies and enforce them to ensure this program is not abused.

5.2.3.4 Vanpools

While CU Boulder does not have an active vanpool program it may be an more attractive program once the planned US 36 managed lanes are in place.

5.2.4 Other Supporting TDM Options

This section describes TDM options which could be implemented at CU Boulder to support cycling, walking, transit, ridesharing and parking management initiatives, and to overcome additional barriers to using alternative transportation.

5.2.4.1 Guaranteed Ride Home

For many people, a significant obstacle to using alternative modes of transportation is the concern that they might need their car to get home in case of a family emergency, or if they have to work late. A guaranteed ride home program alleviates this concern, and enables people to switch from the safety of driving their cars to other transportation choices.

Essentially, a guaranteed ride home is a free or low-cost ride home in case of a daytime emergency, working late or other circumstances which prevent a person from using their usual non-automobile mode or a reasonable alternative. Examples of circumstances in which a guaranteed ride home might be required include a member of a carpool who has to work late past the time when the carpool leaves, or someone whose child becomes ill at school and must get to the school faster than possible by transit. At CU Boulder, guaranteed rides home are provided for all faculty/staff who hold EcoPasses.

5.2.4.2 Fleet Vehicles

One reason many employees give for driving their cars to work is that they need their car for work related trips. A way to eliminate this deterrent to using alternative transportation is to provide fleet vehicles which CU Boulder staff and faculty can use for work-related trips away from campus, or for moving heavy goods on campus. Currently, fleet vehicles are available to CU faculty and staff, but they must be picked up on the East campus and often they are not available after hours.

CU is currently testing out a card key system that would make the reservation/ pick-up process easier to use and available after hours. If successful, the system could allow vehicles to be stationed at more convenient locations on the Main Campus and at Williams Village. The fleet vehicle program could also be expanded to provide guaranteed rides home.

5.2.4.3 Car-Sharing

Car share programs provide convenient access to vehicles for students and affiliates who prefer to use alternative modes for commuting or other trips, but occasionally have the need to make trips where alternative mode use is impractical. CU contracted with eGo CarShare to provide this service which began in 2008 with three vehicles and expanded in 2010 to six vehicles. This program is aimed at providing cars on campus that are easily available – as a means of reducing the number of cars resident students need to bring to campus. It is also aimed at providing cars for students, faculty and staff who commute to campus, so that they can commute on foot, bike, bus or carpool and still have access to a car when they need it to attend a meeting, run an errand, etc. Affiliates can subscribe to this service and rent vehicles on an hourly or daily basis. Vehicles can be picked up at convenient locations on the Main Campus and at Williams Village. Members have access to all 24 cars (and a pick-up) in the program in Boulder and Denver. Rental rates vary from $2.50-6.50 per hour plus $0.30 per mile.

CU should encourage the expansion of this program and provide marketing and promotion. Incoming students (especially resident students) should be encouraged to avail themselves of this program in lieu of bringing a car to campus. CU benefits by not having to provide parking for these students.

5.2.4.4 Staggered Class Start Times

Both transit and the road network are stressed during the peak travel times but outside the ‘peak hour’ the facilities are underutilized. Currently, classes at CU

Boulder begin at on the hour starting at 9 AM. As a result, most students and faculty arrive on campus between 8:30 and 9 AM. During this time, traffic congestion on campus and on adjacent roads is significant, and crowding on buses is at its worst. At class change times, pedestrian and bike facilities reach crush capacity, especially along "Engine Alley' and the Colorado/18th St. corridor. CU Boulder has the good fortune of being able to influence the peaks, as it has control over class times and work hours.

Staggered class start times in the morning would reduce peak transit and traffic demands, and would increase transit ridership by spreading peak demands over a longer period of time.

5.2.5 Proposed Campus Roadway Connections

With the Main Campus almost built out, street improvements will focus on improving bike, pedestrian and transit access, as well as reducing modal conflicts. An example is the Broadway/Euclid/18th project shown in Figure 2-22. The Colorado/18th corridor is also recommended for limited vehicular use as described in previous sections.

Figure 5-10 displays the recommended street improvements for the CU Boulder campus. These include:

North of Boulder Creek

1. Athens Street: construct connection between 20th and Folsom Streets as a low speed local street.
2. 22nd Street: construct connection between Arapahoe and Athens Street extension as a low speed local street.

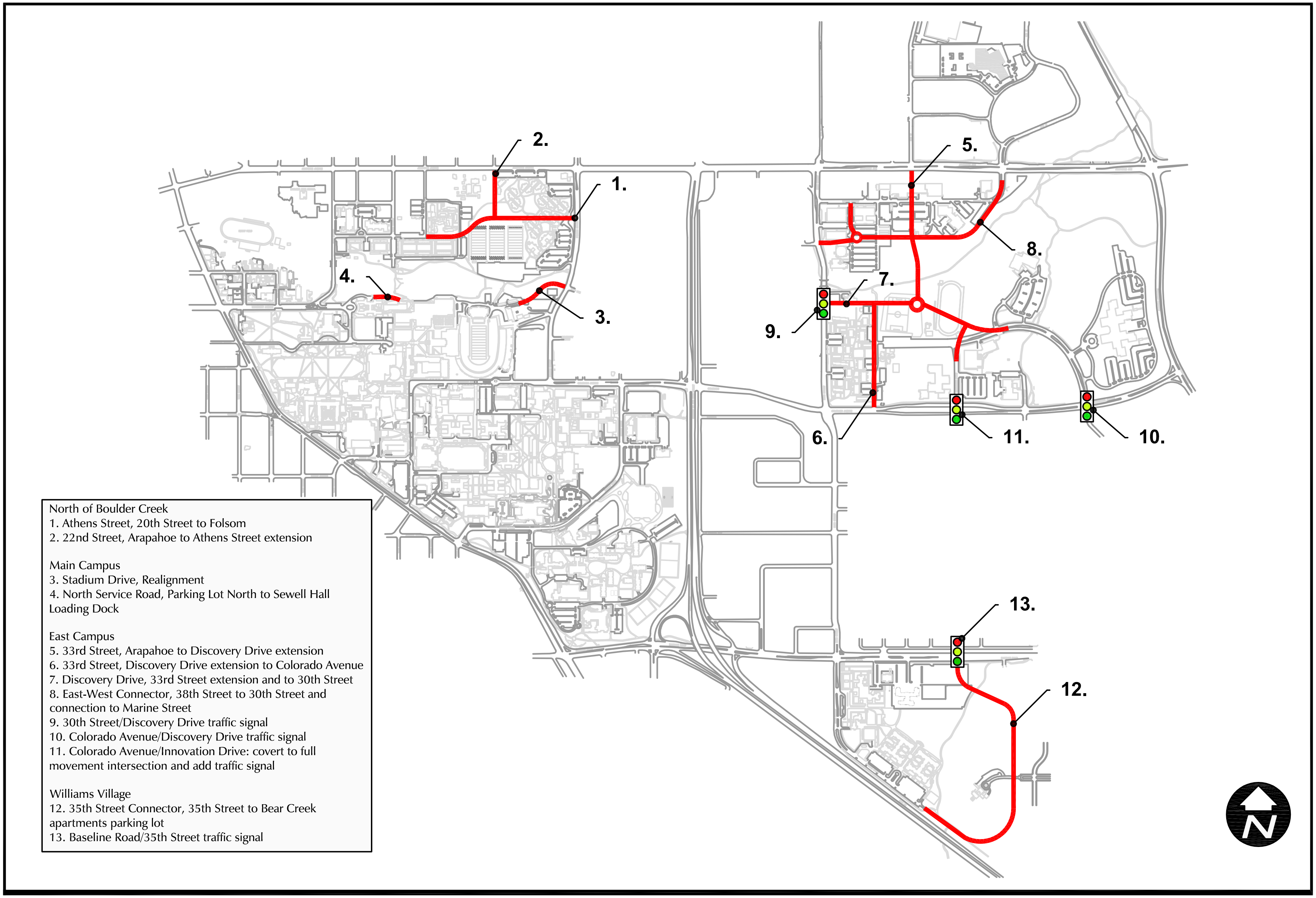
These connections will improve connectivity in this area for vehicles, bikes and pedestrians. Athens Street will have continuity between 17th and Folsom Streets, thus providing some relief for heavily congested Arapahoe Ave.

Main Campus

3. Stadium Drive: realign if new parking structure is built.
4. North Service Road: construct service road connection from parking lot north of the Recreation Center to the loading dock behind Sewell Hall.

East Campus

5. 33rd Street: construct connection from Arapahoe south over Boulder Creek to Discovery Drive extension.
6. 31st Street: improve connection between Discovery Drive extension and Colorado Avenue.
7. Discovery Drive: construct extension west to the 33rd Street extension and to 30th Street opposing Shadow Creek Drive.
8. East-west connector: construct local street connecting 38th Street with 30th Street opposing the south access to Scott Carpenter Park. Includes connection to Marine Street.
9. 30th Street/Discovery Drive traffic signal.
10. Colorado Avenue/Discovery Drive traffic signal.
11. Colorado Avenue/Innovation Drive: covert to full movement intersection.



Proposed Street Improvements

CU-Boulder Transportation Master Plan

Figure 5-10

These connections will improve connectivity for vehicles, bikes and pedestrians. The bridge over Boulder creek will provide an internal connection between the East Campus and the Research Park. This will allow rerouting of some bus routes as described above. It will provide another vehicular route from the Research Park to Arapahoe which may provide some relief to the Colorado/Foothills Parkway intersection.

Williams Village

12. 35th Street Connector: construct low-speed street from 35th Street southeast across Bear Creek looping back to the Williams Village parking south of the Bear Creek apartments.
13. Baseline Road/35th Street traffic signal when traffic volumes warrant.

This connection will provide access to the faculty/staff housing planned east of Bear Creek as part of the Williams Village Micro-Master Plan. The connection of this road to Caddo Parkway will be designed for emergency vehicles and non-motorized users.

Costs for these connectors are given in Table 5-23.

Table 5-23
Street Connection Costs

Map Key	Street/Project	From	To	Description	Cost
1	Athens Street	20th St.	Folsom St.	Construct two-lane low speed street	$765,000
2	22nd St.	Arapahoe Ave.	Athens St.	Construct two-lane low speed street	$234,000
3	Stadium Drive	Stadium	Folsom St.	Construct two-lane low speed street	$300,000
4	North Service Rd.	Rec Center Parking Lot	Sewell Hall	Construct service drive	$600,000
5	33rd St.	Araphaoe Ave.	Discovery Dr.	Construct two-lane collector street	$600,000
				Boulder Creek Bridge	$2,000,000
6	31st St.	Discovery Dr.	Colorado Ave.	Construct two-lane collector street	$495,000
7	Discovery Dr. Extension	Discovery Dr.	30th St.	Construct two-lane collector street	$1,000,000
8	East-west Connector	38th St.	30th St.	Construct two-lane collector street	$1,400,000
9	Traffic Signal	30th St.	Discovery Dr.	Install Traffic Signal	$300,000
10	Traffic Signal	Colorado Ave.	Discovery Dr.	Install Traffic Signal	$300,000
11	Traffic Signal	Colorado Ave.	Innovation Dr.	Install Traffic Signal/Pipe Ditch/Add Turn Lane	$600,000
12	35th St. Connector	Bear Creek Apartments	35th St.	Construct two-lane low speed street	$1,200,000
13	Traffic Signal	Baseline Rd.	35th St.	Install Traffic Signal	$300,000
					$10,094,000

5.2.6 Service and Emergency Access

Access to buildings needs to be provided for essential services and in emergency situations.

5.2.6.1 Service Access

Service access and parking should be better managed to avoid the conflicts between pedestrians and vehicles that are currently too prevalent on campus sidewalks. The maintenance and delivery requirements for nine million square feet of building space, and the equipment contained therein, generate a constant influx of service vehicle traffic to the campus. Consistent with planning tenets, many roadways that previously transected the campus have been eliminated in favor of a more contiguous, pedestrian-oriented environment. Given the absence of proximate roadway access to many campus buildings, service vehicles must drive, and park, on campus sidewalks. Fortunately, pedestrian/vehicle collisions that lead to injury have been extremely rare, although pedestrians often complain of sidewalks obstructed by service vehicles. Vehicles associated with new construction, and those associated with projects maintaining or replacing aging facilities, add to the problem. Service vehicles and emergency vehicles sometimes find their paths blocked by other service vehicles parked along sidewalks.

A variety of regulatory strategies has been tried, but has proven ineffective at significantly reducing sidewalk traffic and parking. In fact, most of the vehicles now driving and parking along campus sidewalks are in compliance with CU-Boulder parking regulations, which include the issuance of permits to park on sidewalks.

The Department of Facilities Management has installed some physical barriers to close off vehicular access to the plazas and other pedestrian areas on which vehicles are inappropriate, but many areas cannot be blocked off due the need to retain emergency access. The campus is also too large for physical barriers to be the principal solution. Permitted sidewalk parking should be reduced. Instead, most maintenance and delivery vehicles could be directed to designated service parking areas. Designating more service parking could help to alleviate the pressure to park on sidewalks along with stronger campus policy. Minimal construction vehicles should be accommodated within staging areas, designating an access point/path for construction sites connecting to the nearest service drive, while encouraging construction employee vehicles to be largely accommodated at remote locations.

5.6.1.2 Emergency Access

Based on the Uniform Fire Code, as adopted by the State of Colorado and CU-Boulder, fire apparatus access routes need to be added where any part of buildings are located more than 150 feet from existing fire apparatus access. Access routes are reviewed by the CU-Boulder Fire Marshall, the Boulder Fire Department, and facility planners. Campus emergency access is along a variety of routes: state highways, city streets, university streets, service alleyways, and wide sidewalks serving as fire lanes. Figure 5-11 is a map of the existing and proposed fire lanes, which need to have at least 12 feet in width of clear access.

Non-fire emergencies such as a flood, chemical release, hazardous material spill, or gas leakage are also important concerns on campus. Especially in light of the many laboratory science facilities on campus, the need for adequate access and evacuation routes is pronounced.

Some portions of the Main Campus need to be made more accessible for emergency apparatus. According to the Boulder Fire Department, an existing area with problematic fire apparatus access is "Engine Alley," the central east-west walkway in the academic core of campus, where many service vehicles are parked each day. This has been addressed by prohibition of service vehicle parking in this or any other fire lane, as specified in the Uniform Fire Code, although vehicle travel still remains an issue.

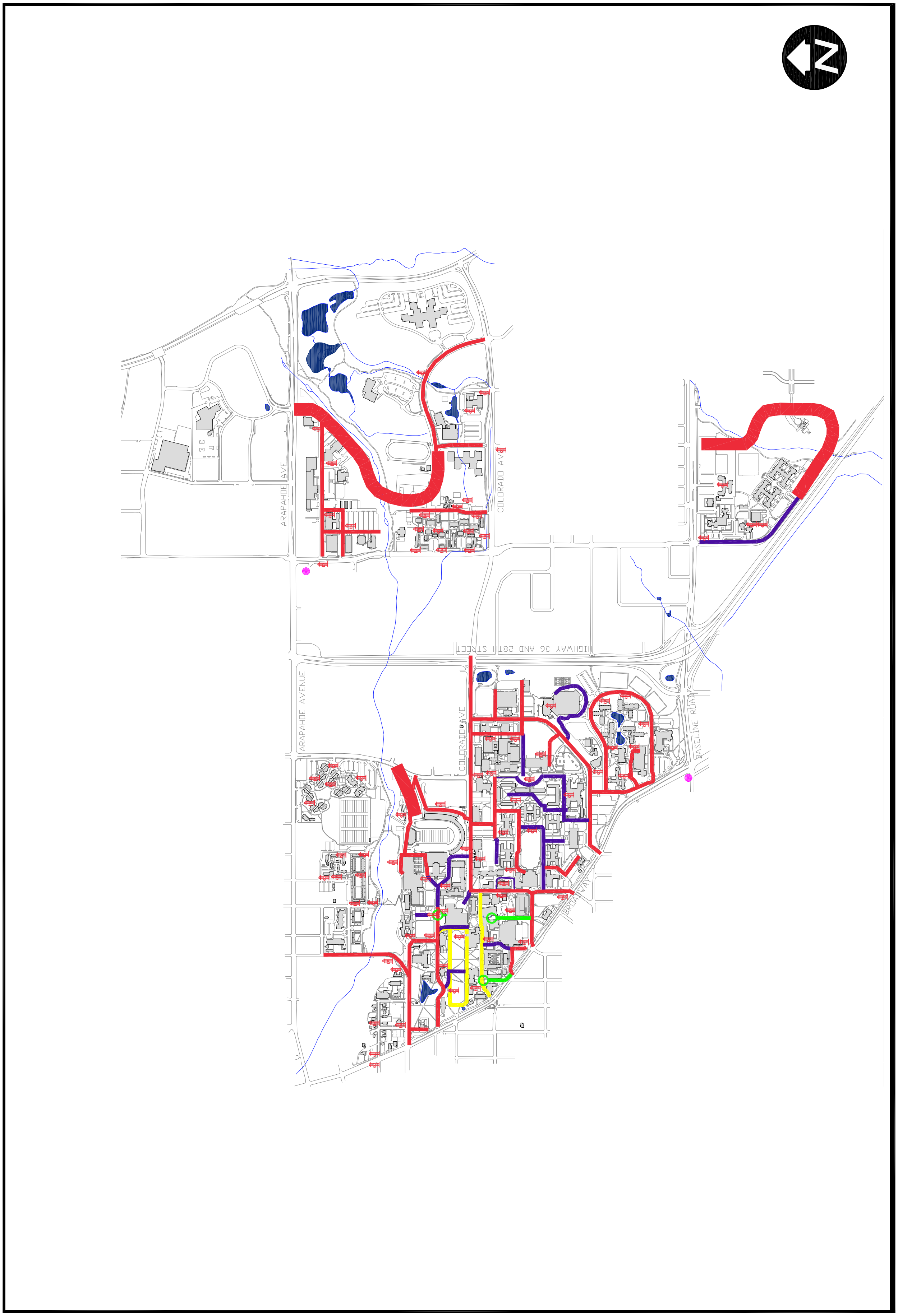


Figure 5-11

Fire Lanes

CU-Boulder Transportation Master Plan

Also of concern is access around large building complexes such as the Engineering Center, high-rise structures, building bridges, and below-grade spaces. These concerns should be addressed through upgrade of building fire protection systems, access improvements and regulation, parking restriction, and by careful design of future development.

Trees can limit emergency access if placed improperly. Trees along emergency routes should be trimmed as not to interfere with access. Placement of new plantings should consider emergency routes and future growth so that Fire Department vehicle access is not adversely affected in the future.

Adequate access by Fire Department vehicles will continue to be included during all phases of new construction and site development. It is the campus practice for the Boulder Fire Department to be invited to provide input for all site and building developments. Boulder Fire Department apparatus requirements with regard to width, height, and turning radius are to be addressed for necessary access in site and building designs.

As the campus continues to grow in density and size, the safety and welfare of all persons and property can be assured by the following: attention to access during design, construction, and operations; provision of an adequate and accessible supply of water; and compliance with adopted building codes.

5.2.6.3 Service and Emergency Access Goals & Guidelines

Goal

Necessary access will be ensured to service buildings and to provide emergency services.

Guidelines

- Provide more adequate service vehicle parking.
- Evaluate current service and delivery parking and add additional sites for drop-off and pick-up of materials if space allows within reasonable proximity of each building.
- Keep emergency access routes and walkways in general, unobstructed by parked vehicles through better enforcement.
- Continue review of all development proposals to ensure access for building services and for emergencies.
- Coordinate the routes and close-in parking with overlapping requirements to meet needs of handicapped persons. Avoid placing handicapped parking in loading dock areas, which are not appropriate public entries and where conflicts are likely.

5.2.7 Parking

This section analyses the projected demand and supply of parking at CU-Boulder, presents information on the costs of new parking facilities, identifies potential sites for new parking, describes advancement in managing parking with new technology, and makes parking management recommendations.

5.2.7.1 Projected Parking Demand and Supply

To project parking demand, the mode share analysis in Chapter 2 was used along with the CU parking model to estimate parking demand by commuters to the CU campus. Parking supply was increased by 650 spaces which assumed that the underutilized spaces in the Research Park could be used by the commuting population. Comparison of 2010, 2020, and 2030 parking demand and supply is given in Table 5-24.

Table 5-24
Parking Demand/Supply Projections

	2010	2020	2030
Effective Supply			
Existing	9,576	9,576	9,576
With Research Park (650 spaces)		650	650
Total Effective Supply	**9,576**	**10,226**	**10,226**
Commuter Parking Demand (spaces)	9,125	10,203	10,400
Parking Surplus (Deficit)	**451**	**23**	**(174)**
Off-Campus Parking Demand	**2,304**	**2,369**	**2,399**

5.2.7.2 The Cost of Parking

Costs of recently-built parking structures in the Denver metro area averaged just over $15,000 in 2010, with soft costs (engineering, development costs, etc.) adding another 25%. Underground spaces are more costly due to excavation, shoring, and retaining walls. Table 5-25 displays the average space costs for various combinations of above and below grade structures. These costs doe not include land costs, which in Boulder may run more than $1 million per acre, which precludes the university building on non-owned land.

Since new parking structures will most likely be built on existing lots, it is important to consider the net space costs. Table 5-26 displays the costs of constructing a new 1,000-space parking structure over an existing lot and on vacant land. Also shown is the cost of a surface lot. The annualized costs (including operations, maintenance, and financing, assuming a 40-year life) are also shown.

Table 5-25
Parking Structure Costs

Type	2010 Construction Cost per Space[1]	Design, Constr. Mgmt., Contingency	Under-ground Factor[2]	2010 Total Cost per Space	Average Cost per Space: 1 up, 1 down	1 up, 2 down	1 up, 3 down	3 down
Parking Structure	$15,359	0.25	1	$19,199				
One Level Below	$15,359	0.25	1.8	$34,558	$26,878			
Two Levels Below Grade	$15,359	0.25	2.1	$40,317		$31,358		
Three Levels Below Grade	$15,359	0.25	2.9	$55,676			$37,438	$43,517
Surface[2]	$2,200	0.25	1	$2,750				

Notes:
1. Source: Carl Walker, May, 2010
2. Source: Parking Consultants, LLC

Table 5-26
Parking Cost Examples

	1 Underground Parking	2 Structured Parking	3 Structured Parking	4 Surface Parking
Spaces Built	1,000	1,000	1,000	1,000
Spaces Displaced	250	250	0	0
Net Spaces Gained	750	750	1,000	1,000
Original Construction Costs (1)	$34,813,733	$15,359,000	$15,359,000	$2,200,000
Soft Costs	25%	25%	25%	25%
Total Project Cost	$43,517,167	$19,198,750	$19,198,750	$2,750,000
Gross Cost per Space	$43,517	$19,199	$19,199	$2,750
Cost per Space Gained	**$58,023**	**$25,598**	**$19,199**	**$2,750**
Resulting Costs Per Space Per Year				
Annual Debt Service, per Space (2)	$4,269	$1,884	$1,413	$202
Operations & Maintenance, per Space	$250	$250	$250	$100
Total Annual Cost per Space per Year	**$4,519**	**$2,134**	**$1,663**	**$302**
Total Annual Cost per Space per Month	**$377**	**$178**	**$139**	**$25**
Total Annual Cost per Space per Workday (3)	**$17.34**	**$8.19**	**$6.38**	**$1.16**

Notes:
1. Source: Carl Walker, May, 2010
2. Assumes 20 year expected useful life of structure an 4% interest rate
3. Assumes 21.72 workdays per month

5.2.7.3 Potential Parking Expansion Sites

The recent Center for Community (C4C) project shows how difficult and costly it is to integrate underground parking in a building project. The project contains 376 underground spaces and 52 surface spaces built on lots which once contained 315 spaces, resulting in a net addition of 113 parking spaces. Due to the high cost of underground construction, the construction cost amounted to $44,124 spread over the 428 spaces. There were many benefits of the C4C project in this location, including convenience, event parking, and wise stewardship of limited land resources, but the cost of this parking structure will be a significant burden on PTS for years to come. Due to the high cost of construction, there will be few if any new spaces added to the Main Campus. New parking structures, however, may be needed to replace existing parking lots needed for new buildings. Several sites on the Main Campus have been identified for potential structures. These include:

- *Grandview* – Parking development in the Grandview area must be done in accord with the tenets of the Grandview Memorandum of Agreement (MOA) executed between the City of Boulder and the university in January 2001. The Grandview MOA limits the total number of spaces in the area to 470. There are currently 370 parking spaces in the Grandview area. Some parcels of land within the Grandview area are precluded from use as sites for parking development through the course of the "Grandview Preserve Covenant" addendum to the MOA, which will remain in effect through January, 2026. The proximity of this area to Mackey Auditorium makes it attractive, since Mackey attracts many visitors for lectures and concerts and nearby parking is difficult to find. Given the patchwork of buildings, streets and existing parking lots, however, it will be difficult to develop a site of sufficient size with reasonable access to be feasible.

- *Folsom Street/Stadium Drive* – this would be located south of Boulder Creek. A site study sponsored by the Department of Athletics projected that the facility could accommodate up to 1000 spaces and would serve as the foundation for a new Field House building[1]. Stadium Drive would be relocated north along Boulder Creek to connect to Folsom Street opposite Taft Drive. All the storage buildings and the Grounds Building would be removed. This opens up a rectangular site at the north end of Franklin Field that is very large and the grade difference allows for a four-level parking structure holding approximately 1,000 spaces. This site is located in a good location to intercept traffic coming from the north and is located relatively close to buildings located on the north end of campus. Its proximity to Folsom Stadium makes it very attractive for stadium events.

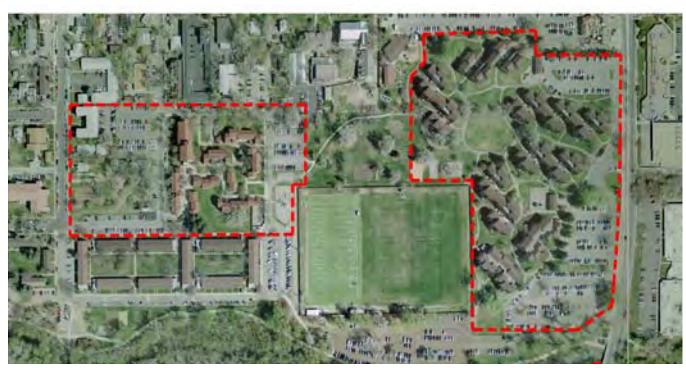
- *Euclid AutoPark* was design to allow the addition of an academic bulding containing two floors on top of the existing garage. Access in this area is an issue, especially at Broadway, where there is a skewed intersection. The planned improvements at Broadway/Euclid and 18th Street should improve this situation.

- *Regent AutoPark* could also be expanded into adjacent lots, but currently congestion on Regent Drive at the AutoPark and parking lot accesses is significant and dangerous for pedestrians, especially during afternoon periods. Adding traffic with more parking would only add to the problem. A *High Intensity Warning Signal* (HAWK) on Regent Drive was installed in the Spring of 2011 and it will be interesting to see how this affects traffic and vehicle/pedestrian conflicts.

- *Lot 304-308* has potential for under-building or underground parking in connection with the planned performing arts building if needed and financially feasible.

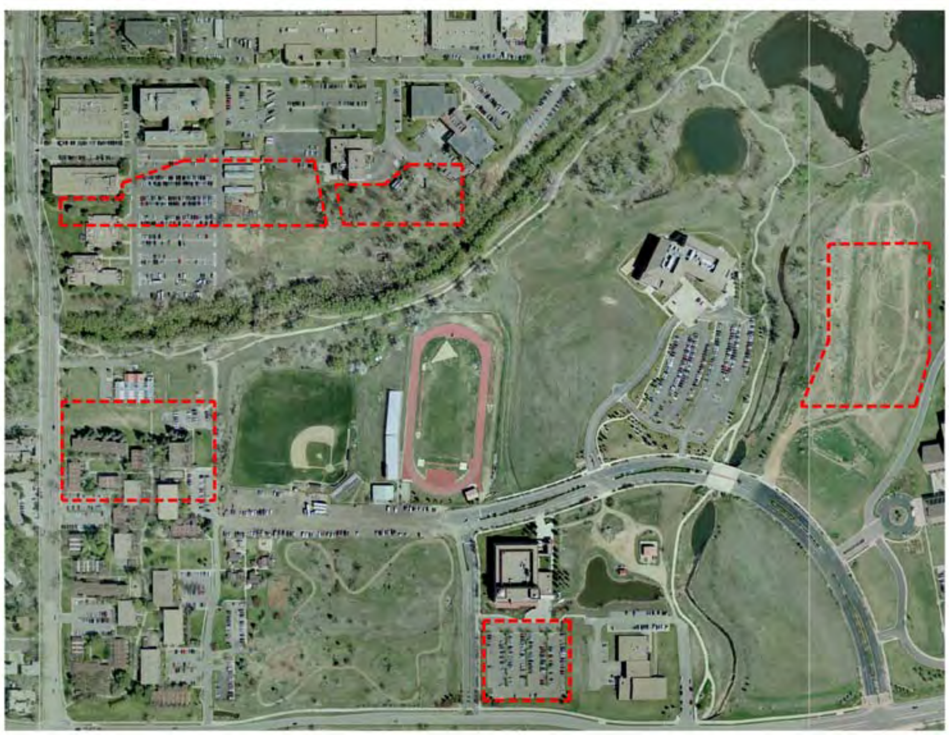
With the redevelopment of family housing north of Boulder Creek, additional housing on Williams Village, and the development of East Campus, potential other sites for structured parking include:

- *North of Boulder Creek* is currently being studied for replacement of outdated family housing. Since this area is located within walking/biking distance of the Main Campus, developing as many dwelling units as possible is desirable. In order to achieve higher densities, structured parking may be needed.



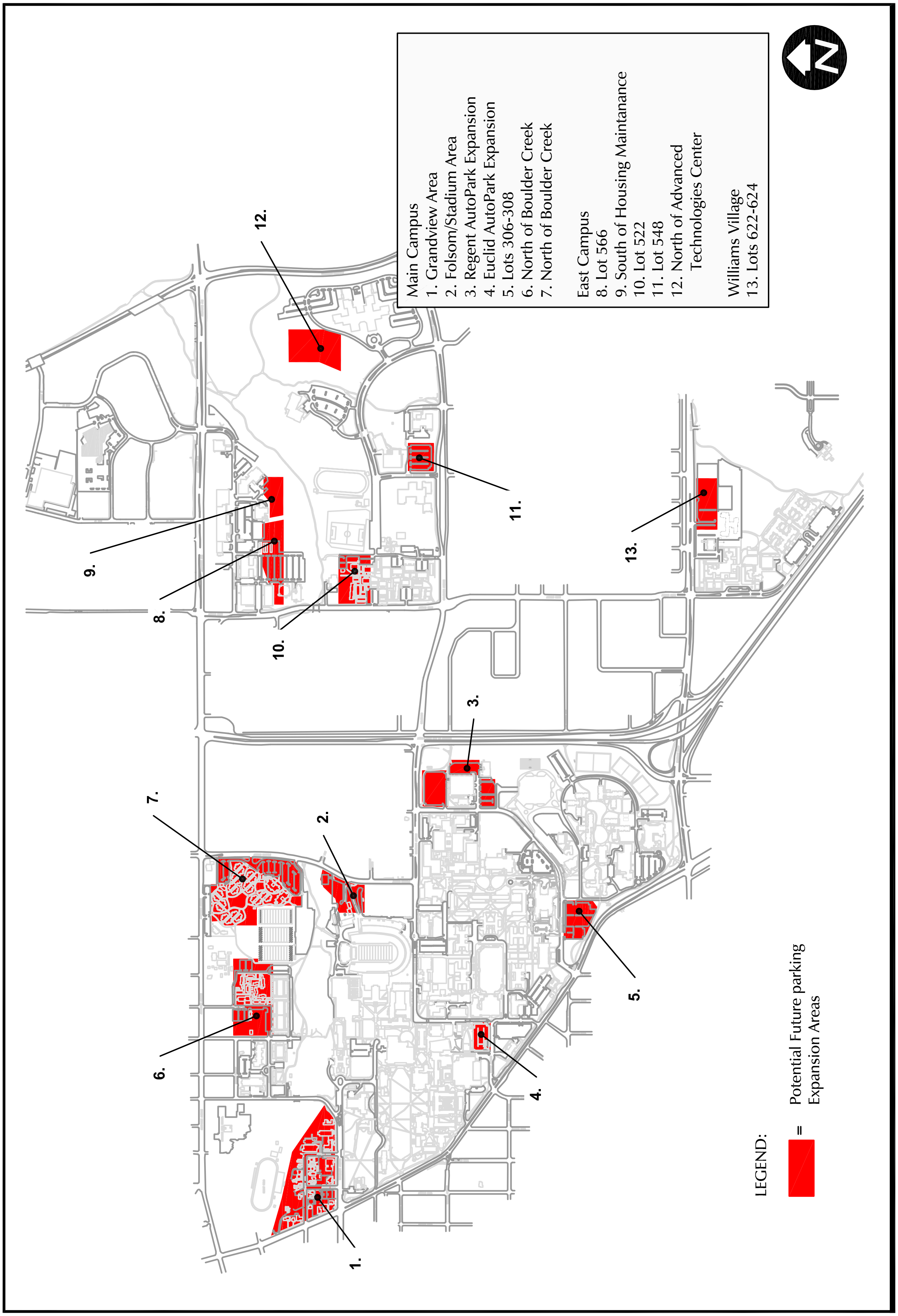
- *Williams Village* – the WV Micro-Master Plan Campus area plan includes structured parking in later phases, however, as indicated in Section 5.1.2.1, the Williams Village current parking supply of 1,400 spaces should be adequate to accommodate the projected under-graduate and graduate population. New parking should be added for any new family or faculty housing. Constructing structured parking on existing surface lots may be a long range option to provide commuter parking or to enhance the planned transit station. One site could be south of Baseline on Lots 622-24.

- *East Campus* – is being studied for development as a full campus with academic and residential uses. The Research Park will be fully integrated into the plan which may mean redevelopment over time from a suburban research park to more of a high density campus center. Currently, there is ample, underutilized



parking. Some of this parking could be used as remote parking in conjunction with increase frequency on the Stampede bus route or shuttle service. As the campus develops, some of the parking lots or other sites could be developed with structured parking.

Figure 5-12 shows potential future parking structure sites on campus, though no timeline has been identified for any of these facilities.



Potential Future Parking Expansion Areas

CU-Boulder Transportation Master Plan

Figure 5-12

5.2.7.4 Managing Parking with New Technology

Technology innovation in the parking industry has been slowly evolving and today there are numerous intelligent features that can enhance parking supply management in the field. Parking "pay on foot" stations have become more sophisticated, and CU-Boulder currently uses machines that provide flexible payment options and variable fees. CU-Boulder has investigated systems which will allow users to access specific gated lots on campus by means of a transponder tag carried in their vehicle. Over time, this system could be used to assess "real time" parking fees based on actual time of use, provide "gated access" by specific user to various lots on campus, and monitor important factors helping supply management, such as lot turnover, average duration, and peak time of day use.

Another technology being contemplated by CU-Boulder is a variable messaging sign system which can serve to direct visitors and commuters to specific parking areas and access routes. Another system used effectively in some new parking structures is an electronic space count system which can sense individual space availability and direct users to parking spaces through the use of signs located on each level. Social media could also play a role in communicating with parking users. The increase proliferation of "Apps" may someday lead to a CU Boulder App which may allow permit holders to reserve a space or be directed to the nearest free space closest to their destination. Or Apps could be developed for visitors, directing them to available short term parking. A combination of these systems and others can serve to greatly extend the effective availability and utilization of parking in today's market where structural costs have greatly increased.

5.2.7.5 Parking Management Recommendations

As discussed above, parking management is one of the most effective traffic reduction strategies and that underpriced, abundant and convenient parking can be a major deterrent to alternative mode use. From a land use perspective, devoting land to parking and access drives distracts from the pedestrian-oriented campus setting that is so important to a university environment. Parking needs to be priced appropriately and managed to get the highest possible utilization.

The following are recommendations for parking management at CU-Boulder:

1. Install access control (gates) at all larger lots and implement parking management technology (such as Smart Cards) which has the capability of monitoring parking use and charging demand-based parking rates.
2. Consider implementing a higher rate structure in the core of Main Campus (generally bounded by University and College Avenues on the north, Regent Drive on the east and south, and Broadway on the west). The differential between this area and other areas on campus should be at least 30%.
3. Provide more short term and visitor parking in the core area of Main Campus.
4. Using the new access control and parking management technology or other system, implement flexible permits which allow fewer than five days a week use to encourage alternate mode use.
5. Continue to provide low cost remote parking on East Campus for affiliates who lack alternative mode options and can't afford higher priced parking. Continue transit service to this parking and provide secure bicycle parking and bike share facilities.

6. The C4C project costs will increase PTS bond repayment costs by $1,232,000 for the next 25 years. This will be an additional cost for the next four years, but then other bonds are paid off. If the first four years costs of about $5 million are spread over 25 years, financed at an interest rate of 4%, the effective increase is about $320,000 per year or 8% of PTS expenses of $4 million per year. Effectively, this would increase the existing ~$17 million 25 year bonding for the C4C project to ~$22 million by adding a new $5 million bond for 25 years, to raise an extra $5 million to be used to cover the four years of double bond payments for both the C4C and EAP/RAP bonds. To offset these expenses, base permit fees (faculty/staff, student, business, gates and events) which currently bring in about $4 million in revenues, would have to be raised by 7 to 9% in addition to normal inflation.
7. Consider consolidation of all parking spaces under PTS management to administer all CU-Boulder parking spaces more equitably. In particular, the Research Park should come under PTS control, so the current underutilized parking can be used to meet CU-Boulder's parking needs.
8. Propose that costs associated with retirees and X permit holders should be borne by the appropriate departments and not PTS.
9. As redevelopment for family housing occurs, parking spaces should be unbundled from lease rates, with tenants required to purchase parking permits and encouraged to use alternate modes.
10. No net new parking spaces should be added to Main Campus. New parking structures may be needed to replace existing parking lots needed for new buildings. Since there is a great benefit to the university to utilize existing land with surface parking for campus buildings or other uses, and a great cost to replace this parking, alternative funding sources will be needed so the high costs of replacement structured parking doesn't overwhelm PTS's budget.

5.3 Influence Travel Choices

As discussed in Section 4.1 travel demand management initiatives which encourage alternative mode use are important for CU-Boulder for the following reasons:

- A coordinated approach to transportation – with priority given to walking, bicycling, and public transit trips – will help to develop a more sustainable land use pattern for the university and the Boulder Valley.
- Travel demand management projects help to make more efficient use of existing and future road infrastructure. Reducing the number of trips being made by car will free up road capacity for transit, high occupancy vehicles, commercial, freight, and other priority users.
- Travel demand management projects can increase public transit patronage and therefore increase the benefits from public transit investments.
- Increasing the proportion of trips made by walking and bicycling will have health, social and environmental benefits.
- Travel demand management projects are cheap for the transportation benefit they deliver – especially when compared to other transportation infrastructure construction costs including expensive parking structures.

This section will discuss options for influencing affiliate travel choices to encourage mode use which will help meet CU Boulder's sustainability goals.

5.3.1 Bus Pass Programs

The survey of peer institutions concluded that a key TDM strategy is providing bus passes to all affiliates at minimal cost to the users. CU-Boulder has been a leader in this approach and it has been shown that once a user has a bus pass, the zero-marginal cost of transit trips leads to increased transit usage.

Since its start in 1992, the student bus pass/faculty-staff EcoPass program has been the most important component of CU-Boulder's TDM program. The student bus pass program began with a 1991 student ballot where students voted 4 to 1 to impose a student fee of $10/semester to pay for a local bus pass. Additional student votes since that time have increased the fees and expanded the transit services available to students. The student fee is currently $71 per semester and also provides support for the bike program. This program is actually a group payment program where RTD counts the number of students that ride the buses and then the students pay RTD for that use through the student fee. The more usage, the more the students pay and the less it is used the less the students pay. The student fee can only go up by 10% without a student vote, thus when RTD raised fares by 12.5% in 2010, the students cut their support of transit programs (e.g. funding of increases service on the Stampede). The faculty-staff EcoPass program began in 1998 and allows CU- Boulder full and part time continuing employees to use their "BuffOneCard" to ride all regular RTD buses and light rail free of charge. These programs have contributed to a remarkable 30 percent student, 22 percent faculty/staff transit mode share for commuters to the CU Boulder campus. Continuation and increased marketing of these programs to gain greater use by existing Eco Pass holders are essential to CU Boulder's TDM program.

The effects of these programs are significant on parking demand. From the *2010 Commuter Survey* questions, information was obtained on what affiliates who use transit would do without their bus passes. Many said they would drive to campus. Table 5-27 calculates the number of parking spaces that might be needed if these programs were discontinued. CU-Boulder would have to provide almost 2,700 parking spaces at an annual cost of over $5.6 million to accommodate these affiliates.

Table 5-27
Parking Savings Due To Student Bus Pass and Faculty/Staff EcoPass Programs

	Affiliates	Transit Percent(1)	Transit Trips	Percent Not Riding Bus Without EcoPass(1)	Percent SOV Carpool/2(1)	+ Parked On-Campus(1)	Vehicles brought to campus	Presence Factor(2)	Parking Spaces Needed	Spaces Needed to Provide 90% Effective Parking Ratio(2)	Parking Spaces Saved	Capital Costs(3)	Annualized Capital Costs(4)
Faculty/Staff	7,260	21.7%	1,575	68.9%	76.4%	72.0%	597	97.0%	537	111.1%	597	$15,282,839	$1,146,775
Commuting Students	22,389	30.1%	6,739	71.3%	47.0%	71.0%	2,256	65.0%	1,896	111.1%	2,106	$53,913,739	$4,045,515
Resident Students	7,687	23.0%	1,768	71.3%	21.0%	79.0%	265	65.0%	222	111.1%	247	$6,326,546	$474,724
							3,118		2,656		2,950	$75,523,124	$5,667,014

Notes:
(1)Percentages taken from crosstabs of 2010 *Commuter Survey*
(2)Estimate developed by LSC based on PTS data
(3)Assumes 75% new parking and 100% above ground structured parking with a cost per space of $25,598- see Table 5-26
(4)Assumes annualized cost with 20 year useful life and a 4% interest rate plus operations and maintenance -see Table 5-26

5.3.2 Parking Based Options

5.3.2.1 Restructure Parking Fees to Reflect Costs, Best Utilize Available Supply and Encourage Alternate Mode Use

Long-term parking permits, including monthly and semester durations, are relatively inexpensive and priced lower than most other comparable universities (see Table 2-23). CU-Boulder permit prices range from $46.75/month for the most expensive parking to $31.00 for the least expensive parking (peripheral parking). Short-term parking, which costs $1.50/hour, is far more expensive than long-term which averages to $.20 to $.27 per hour.

Also, the current permit pricing structure is based on a proximity method – that is, the closer the parking is to where an individual works, the more expensive the permit regardless of where on campus an affiliate's parking is located. Peripheral rates are for parking that is more than 250 feet from a parker's place of work. This type of pricing system does not reflect demand for parking nor do the current permit prices for proximate and peripheral parking reflect the actual costs of providing that parking.

Students and employees who may drive only a few days a week will find it more cost effective to purchase a monthly or semester pass rather than pay day by day. Once these commuters purchase an annual or semester term pass they have little financial incentive to use alternative modes of transportation. To maximize the effective implementation of the TDM options presented in this report, it is essential that parking fees be structured in a way that most efficiently allocates the available parking supply, that reflects demand for parking and which encourages commuters to choose alternative modes of transportation for at least some days of their normal commute.

One option to encourage commuters to choose alternative modes of transportation would entail selling monthly and semester permits which allow fewer than 5 days a week use. For example, permits could be issued with a limited use varying from 1 to 3 times per week. The permits would be priced to reflect the reduced number of days a commuter chooses to park.

Another option would allow commuters to make choices about daily transportation behaviors and would in essence "reward" commuters based on the number of non-drive days per month they have. This could be accomplished with any number of parking technologies (such as the Smart Card) which have the capability of recording a commuter's daily use of the various facilities (parking, bike lock up, transit etc.) and is able to charge according to use. Under such a scenario, commuters could purchase a long term parking permit but would be reimbursed at the end of the month or semester according to how often they use parking facilities. For those commuters who only use parking facilities a few times per month, the fees would be substantially lower than those commuters who chose to travel to the campus everyday by SOV.

The flexibility of this program will depend upon the sophistication of the technology used. It may be only appropriate to offer this program to FTEs to ensure fairness and equity. If, however, a multi-mode transportation card is implemented, then it may be possible to expand this program to everyone, as each commuter would establish their own profile, and sensitivities could be developed to ensure that part-time commuters are assessed on a level playing field.

5.3.2.2 Price High-Demand Parking Spaces Appropriately

The CU-Boulder campus currently has adequate parking supply, but the available supply is not located in areas where there is the greatest demand. The parking lots in the core of Main Campus (generally bounded by University and Colorado Avenues on the north, Regent Drive on the east and south, and Broadway on the west) have the highest demand with well over 90% utilization during peak times and are most conveniently located to the majority of university services and facilities. However, these lots are priced under the same pricing methodology as all other CU-Boulder lots.

There are some inequities in the allocation of parking spaces as the permit cost for parking is not determined on high demand and preferred locations (i.e., core of Main Campus) but rather on proximity to an affiliate's place of work. Permits lots are designated as:

Closest Lot:	\$46.75/month (proximate parking)
Peripheral Lot:	\$39.25/month
Unpaved Lot:	\$31.00/month
Remote Lot:	\$11.75/month
Motorcycle:	\$15.50/month

Each permit is associated with a specific lot. Proximity is associated with distance from the parking to one's place of work. Metered spaces are priced to encourage turn-over so that spaces will be available for visitors and those desiring short term use. In reality, metered spaces are often used by students.

Although those who park on campus expressed no major concerns with the permit system, stating that the allocation method was very efficient, the current pricing system does not reflect the high cost of providing parking or encourage the use of underutilized lots.

A variable pricing approach would apply a market parking pricing system to more efficiently allocate parking supply, with higher prices charged at locations of peak demand.

One option is to establish a zone system with higher permit fees for the core area of Main Campus; medium fees for areas outside of the core on Main Campus and for the core areas on the East Campus, Research Park and Williams Village; and with the lowest fees for remote lots.

In addition to pricing parking to reflect the cost of providing that parking and to gain better use of existing supply, parking prices can be set to help encourage some shift in SOV use to alternative modes. Studies have shown that parking pricing can result in a 10-30% reduction in travel depending on the rate charged. Obviously, the closer to market rate or the cost of providing parking pricing is set, the greater the potential for reduction in automobile use. Such a reduction, however, may only be realized if there is a limited supply of available parking and there are other viable travel options. If not, increased rates might not reduce SOV use but push that parking to off-campus locations. There is some evidence that this is already happening with affiliates using the 29th Street Mall or spilling into adjacent neighborhoods near Williams Village or near the Main Campus.

The projected growth in CU-Boulder travel and parking demand by 2020 will result in a need for an additional 400 to 800 parking spaces (assuming current TDM programs stay funded at existing levels).

If CU-Boulder combines parking management, including parking fee increases, with more aggressive TDM programs it should be able to manage this increased demand without building new parking. Parking prices, however, will effectively change parking behavior. The *Nelson Nygaard 2005 Transportation Plan* estimated price elasticities for various campus segments:

Price Elasticities	
Undergraduate Students	-0.65
Graduate Students	-0.25
Faculty	-0.16
Staff	-0.35

The effects of various parking rate increases on 2020 parking demand are shown in Table 5-28.

Table 5-28
Price Elasticity and Parking Demand

	2020 Parking Demand	Price Elasticity	Change in Demand for Price Increase of: 10%	20%	30%
Undergraduate Students	3,443	-0.65	-224	-448	-671
Graduate Students	656	-0.25	-16	-33	-49
Faculty	3,470	-0.16	-56	-111	-167
Staff	343	-0.35	-12	-24	-36
	7,912		**-308**	**-615**	**-923**

If parking rates increase by 30% in real dollars, the above elasticities applied to the projected 2020 affiliate parking demand will reduce projected demand by over 900 spaces. The overall drop in demand will be 12% but revenues would still increase by almost 15%. This strategy, along with the recommended TDM program expansions, is capable of keeping pace with the planned campus population growth without major parking additions.

5.3.3 Marketing and Incentives

CU currently has undertaken several marketing programs aimed at informing affiliates of mode choices and encouraging the alternative mode use. These and other options include:

5.3.3.1 Commuter Surveys

CU Boulder periodically conducts surveys of affiliate commuting patterns with internet based survey instruments. These surveys have established mode share baseline line information as well as tracked changes in commuting habits over time. Questions are also asked about why affiliates choose their modes of travel so planners can attempt to make changes in services to respond to these concerns. The *2010 Commuting Survey* was conducted four times over the course of the year to ascertain the differences in seasonal travel choices.

5.3.3.2 Incentives

CU Boulder joins with local shops and vendors to offer incentives for alternative mode use. The bike station has been an excellent focal point for interaction with bicyclists to provide maps, helmets and bike accessories as part of promotional efforts.

5.3.3.3 Cash Back Programs

Other universities, notably Stanford, have set up commuting clubs or associations which provide cash back to affiliates who use alternate modes. As a public university, CU Boulder may be limited in such a program.

CHAPTER 6
Comprehensive TDM Strategies

This chapter identifies comprehensive TDM program packages, projects the impacts of various packages on CU-Boulder's sustainability goals and parking demand, and presents a least cost planning analysis which examines the costs of commuting by various modes.

6.1 Travel Demand Management Strategy Packages

The preceding sections outlined various options for TDM strategies that CU-Boulder may employ to promote alternate modes of travel. To achieve the University's sustainability goals, this section presents alternative packages for 1) continuing current TDM programs; 2) moderately expanding TDM programs and 3) aggressively expanding TDM programs. A comparison of these programs is given in Table 6-1.

6.1.1 Continue Existing TDM Programs

As discussed in Section 2.2, CU-Boulder provides a comprehensive package of TDM programs. For this package, these programs will be continued with additional services provided due to growth in affiliate population. Recommendations for this package include:

<u>Reduce Travel:</u>

1. Add 1,500 beds by 2030
2. Promote telecommuting, flexible work schedules & flexible start/end times

<u>Provide for Travel Choices:</u>

Bike/Pedestrian

1. Bike racks around most buildings
2. Regular surveys of bike parking
3. Bike station located near the UMC
4. Mobile Mechanics
5. Buff Bikes-bike sharing/semester rentals
6. Covered Parking near Arnett Hall

Transit

1. Regional Coverage
2. SkyRide
3. Late-night transit
4. CU Ski Bus
5. East Campus: Buy up of additional off-peak frequency on the Stampede route
6. Williams Village: Change the bus fleet from 2 articulated and 4 standard buses to 4 articulated and 2 standard buses on the Buff Bus

7. Main Campus: Transit service growth will be incremental and paid through EcoPass and Student Pass
8. Main Campus: Conduct traffic operations and simulation study of 18th/Colorado corridor.

<u>Influence Travel Choices:</u>

1. Continue Student Bus Pass Program
2. Continue Faculty/Staff EcoPasses
3. Guaranteed Ride Home with EcoPass
4. Find options to increase funding to monitoring programs
5. Periodic commuter surveys
6. Website "connection" programs to link individuals to various modes of travel.

Parking
1. Proximate permits 20% more than peripheral permits

Ridesharing
1. Ridematching through Zimride
2. Reserved priority carpool spaces at Wolf Law, Leeds Business, and C4C

Carsharing
1. Six carshare vehicles

Fleet Vehicles
1. Fleet vehicles available on East Campus

Table 6-1
TDM Program Options

	Continue Existing Programs	Moderate Expansion	Aggressive Expansion
Reduce Travel			
On-Campus Housing	* Add 1,500 beds by 2030	* Add 1,500 beds by 2030	* Add 1,500 beds by 2030
Integrated Trip Reduction	* Promote telecommuting, flexible work schedules & flexible start/end times	* Promote telecommuting, flexible work schedules & flexible start/end times	* Promote telecommuting, flexible work schedules & flexible start/end times * Implement staggered staggered class times
New Construction		* Propose reduced parking standards * Create & implement bike parking standards	* Propose reduced parking standards * Create & implement bike parking standards * Create & implement transit standards
Provide for Travel Choices			
Bicycle/Pedestrian	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Covered Parking near Arnett Hall	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Provide 100 more covered spaces * Provide additional bike racks as needed * Expand bike share programs * Add bike station at Williams Village * Add bike Station at Engineering Center * Add bike share Station at UMC * Add 2 secure bike parking locations * Add 2.4 miles of bike/pedestrian facilities around and through campus	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Provide 200 more covered spaces * Provide additional bike racks as needed * Expand bike share programs * Add bike station at Williams Village * Add bike Station at Engineering Center * Add bike share Station at UMC * Add bike share Station at Williams Village * Add two bike share stations on East Campus * Add 5 secure bike parking locations * Add 4.5 miles of bike/pedestrian facilities around and through campus
Transit	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * WV: change from 2-artic + 4-std buses to 4-artic + 2-std buses on the Buff Bus * EC: no change needed to STAMPEDE through 2020. 3-std buses * MC: transit service growth is incremental and paid through EcoPass and Student Pass. * MC: conduct traffic operation + simulation study of 18th/Colorado corridor.	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * Supplement Stampede with additional overlay/shuttle route between EC + MC * Buy up of additional service on one other route (Bolt) * WV: change from 2-artic + 4-std buses to 7-artic on the Buff Bus * EC: Add some capacity. Move from 3-std to 3-artic buses (RTD) * MC: transit service growth is incremental and paid through EcoPass and Student Pass. * MC: Modest improvements in marketing downtown Boulder - Main Campus transit option.	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * Supplement Stampede with additional overlay/shuttle route between EC + MC * Buy up of additional service or make service changes on two other routes (Bolt and HX or 205) * WV: change from 2-artic + 4-std buses to 10-artic on the Buff Bus * EC: Add significant capacity. Move from 3-std to 4-artic buses (RTD) * MC: Implement full traffic/bike/ped design changes on 18th/Colorado corridor. * MC: Modest improvements in marketing downtown Boulder - Main Campus transit option. * WV: Work with City to add US 36 slip ramp stop at south edge of the WV Campus. * Work with City & RTD to implement the Orbit bus route * Enhanced amenities at transit stops including real-time departure information at major stops.
Ridesharing	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C * Add 60 carpool spaces on Main Campus * Consider reduced carpool permit fees (50%)	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C * Add 60 carpool spaces on Main Campus * Add 30 carpool spaces on East Campus * Consider reduced carpool permit fees (50%)
Vanpooling		* Form 5 Vanpools	* Form 10 Vanpools
Carsharing	* Six CarShare vehicles	* Add 10 CarShare vehicles as funding becomes avaialble	* Add 20 CarShare vehicles as funding becomes avaialble
Fleet Vehicles	* Fleet vehicles available on East Campus	* Fleet vehicles available on East Campus * Provide pick-up location on Main Campus	* Fleet vehicles available on East Campus * Provide multiple pick-up locations on Main Campus
Influence Travel Choices			
Transit	* Continue Student Bus Pass Program * Continue Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs	* Student Bus Pass Program * Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs	* Student Bus Pass Program * Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs
Parking Management	* Proximate permits 20% more than peripheral permits	* Implement Zone permit structure with Core permits 30% more than peripheral permits * Implement Flexible Permit Program to allow fewer than 5 day use	* Implement Zone permit structure with Core permits 40% more than peripheral permits * Implement Flexible Permit Program to allow fewer than 5 day use * Install access control (gates) at larger lots and implement parking management technology with the capability of monitoring parking use and charging demand-based parking rates
Marketing and Incentives	* Periodic Commuter Surveys * Website "connection" programs to link individuals to various modes of travel	* Periodic Commuter Surveys * Enhanced Website "connection" programs to link individuals to various modes of travel * Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards) - FTE & incentives budget * Implement "Buddy" programs to show how to use transit, bike, etc., connect students to TDM - 1 Part-time student	* Periodic Commuter Surveys * Enhanced Website "connection" programs to link individuals to various modes of travel * Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards) - 2 FTEs & incentives budget * Implement "Buddy" programs to show how to use transit, bike, etc., connect students to TDM - 2 Part-time student * Develop social network apps for transit, bikesharing, carsharing, carpooling, etc.

Note: EC = East Campus; MC = Main Campus; WV = Williams Village

6.1.2 Moderate Expansion of TDM Programs

This package expands the existing TDM programs by adding or expanding the following programs. Table 6-2 provides the costs of these programs (excluding housing), the projected decrease in single-occupant vehicle use, and cost per diverted SOV.

<u>Reduce Travel:</u>

1. Promote telecommuting, flexible work schedules, and flexible start/end times

- Costs: This measure would be implemented with a part-time student at a cost of about $10,000 per year.
- Reduction in SOV's: Commuter survey indicated 6.2% of faculty/staff tele-worked/didn't come (7,260 x 0.062 = 450 F/S). Better promotion of tele-commuting and flexible work schedules could expand this by about 9% resulting in about 40 less SOV's. 5.6% of commuting students (22,389 x 0.056 = 1,254) were estimated to telecommute or not come. Since most students plan their commutes around their class schedules, only a small reduction of 10 SOV's was assumed.

2. Propose reduced parking standards for new construction
3. Create and implement bike parking standards for new construction

<u>Provide for Travel Choices:</u>

Bike/Pedestrian

1. Provide 100 more covered spaces
2. Provide 2 secure bike parking locations
3. Monitor campus bike racks/Provide additional bike racks as needed where space is available
4. Expand bike sharing programs
5. Add bike station at Williams Village
6. Add bike station at Engineering Center
7. Add bike share station at UMC

- Costs: Based on CU's experience, covered spaces cost about $1,000 each with an annual maintenance cost of 5% or $50. Secure bike parking spaces were estimated to cost $5,000 each. Each bike station was estimated to cost $200,000 with annual operating and maintenance costs of $29,000 based on costs of the UMC station. Volunteers would staff the stations. The bike share station was estimated at $55,000 for 10 spaces with an outside vendor responsible for operating and maintenance costs. Bike share costs were estimated at $500 per bike and 10% per year annual maintenance. However, these projects would benefit all bike/ped users, not just new users. A reasonable share of these costs was estimated to be 10% for new users.

- Reduction in SOV's: The 2010 commuter survey estimated 14.9% of commuting students (14.9 x 22,389 = 3,338 students) biked to campus. These bike programs will serve those bicyclists but may increase bicyclists by 3.5% or reduce SOV's by 120 (3,338 x 0.035 = 120). The faculty/staff which had 7,260 x 8.4% = 608 bikers to campus could have a 4% increase in bicyclists or a reduction of about 25 SOV's.

8. Add 2.4 miles of bike/pedestrian facilities around and through campus (see Table 6-3)

- Costs: Completing 2.4 miles of ped/bike connections would cost $1,513,680 (see Table 6-3 for a prioritized list of projects and CU share of costs). However, these projects would benefit all bike/ped users, not just new users. A reasonable share of these costs was estimated to be 10% for new users.
- Reduction in SOV's: These connections may increase walking to campus by 1.5% and biking by 3% resulting in a reduction of ((22,389 x 20.4 x .015 = 70) + (22,389 x 0.149 x 0.03 = 100) = 170) 170 student SOV's and (7,260 x 0.059 x 0.015 = 6) + (7,260 x 0.084 x 0.03 = 18) = 20 faculty/staff SOV's.

Transit

1. Supplement Stampede route with additional overlay/shuttle route between East Campus and Main Campus

- Costs: The Stampede overlay service is estimated on a single vehicle operating at RTD's loaded peak costs of $138/hour, 12 hours per day, on weekdays during the regular school year. The existing Stampede is a cost-share agreement with RTD. Because this is a "buy up" of service, however, it was assumed that CU's share would be 85% of the total. (1 bus x 12 hrs/day x 190 days/year x $138/hr x 85% = $267,450, rounded to $300,000 reflect a 10% contingency on fuel and labor cost inflation).

2. Williams Village: Change the bus fleet from 2 articulated and 4 standard buses to 7 articulated buses on the Buff Bus
3. East Campus: Add some capacity. Change the bus fleet from 3 standard to 3 articulated buses
4. Main Campus: Implement first phase traffic/bike/ped design changes on 18th/Colorado corridor.
5. Main Campus: Modest improvements in marketing downtown Boulder – Main Campus transit option.
6. Enhance Broadway/Euclid Transit Stop

Ridesharing

1. Add 60 carpool spaces on Main Campus
2. Reduced carpool permit fees (50%)

- Costs: This assumed $200 per space to provide signing and striping for close-in spaces. The 50% discount assumed an annual rate of $700 (after rate increase described in Chapter 7) applied to 60 spaces multiplied by 50% to arrive at $21,000 in forgone revenue.

- Reduction in SOV's: This assumed each carpool would result in a reduction of 1 SOV or a total of 60 reduced SOV's.

Vanpools

1. Form 5 vanpools

- Costs: Assumed $27,000 cost per van with $3,500 annual operating costs. 50% of the cost would be borne by users or outside grants. Annualized costs are based on 7-year vehicle life.
- Reduction in SOV's: This assumed that each van would result in the reduction of 6 SOV's with faculty/staff taking up 2/3 of seats. Total reduction would be 30 SOV's.

Carsharing

1. Add 10 carshare vehicles as funding becomes available

- Costs: This assumes $2,000 per vehicle in administrative costs and foregone parking revenues.
- Reduction in SOV's: The primary benefit is for student personal use, encouraging students not to bring vehicles to campus. Two SOV's per car-share vehicle were assumed or a total of 10 reduced SOV's.

Fleet Vehicles

1. Provide pick-up location on Main Campus
2. Fleet vehicles available on East Campus. Provide pick-up locations on Main Campus.

- Costs: Assumes capital cost of $175,000 and annual operating costs of $21,000 for 5 vehicles, including hardware and software for automated dispatch system. Annualized costs are based on 7-year vehicle life. A reasonable share of these costs for those not commuting by SOV is 10%. Annual costs include forgone costs of $700 per space per year in parking revenue.
- Reduction in SOV's: The program would only be available to faculty/staff and 10 SOV's are estimated to be reduced.

<u>Influence Travel Choices:</u>

Parking

1. Consider a zone permit structure on Main Campus with Core permits 30% more than peripheral permits.
2. Propose a Flexible Permit Program to allow fewer than 5 days use.

- Costs: Access controls such as gates and readers plus software are estimated to cost $450,000 depending on the system chosen, with 10% annual maintenance costs (see Table 7-4 for calculation of revenues and allocation). Note, the current rate structure has a 20% differential between proximate and peripheral lots. This strategy would have a 30% differential between core zones and peripheral zones.

- SOV Reduction: CU's parking rate elasticity is estimated at 0.5. An increase in rates of 10% (changing from a 20% to 30% differential) is expected to result in 5% attrition. PTS estimates that 2,845 proximate permits will be reduced by 5% or by 142 permits. 25% or 36 permits will convert to flexible permits. The flexible permit holders will park on campus 3 days per week. SOV reduction will be (142 – 36 + 21) about 127.

Marketing/Incentives

1. Create an incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards)
2. Implement "Buddy" programs to show how to use transit, bike, etc. connect students to TDM.

- Costs: Purchase or develop software (estimated at $100,000) for enhanced web and mobile based access (e-services) to purchase parking, connect to TDM services, etc. Add FTE and part-time student at cost of $60,000 per year to staff marketing/incentives program.
- SOV Reduction is estimated at 110 students and 70 faculty/staff.

Table 6-2
Moderate Expansion of TDM Prgrams

		Description	Capital	Annual	Reduction of SOV's Students	Reduction of SOV's F/S	Annualized Cost		Total Diverted SOV	Cost Per Diverted SOV
Reduce Travel										
Integrated Trip Reduction	* Promote telecommuting, flexible work schedules & flexible start/end times	1 Part-time Student		$10,000	10	40	$10,000		50	$200
Provide for Travel Choices										
Bicycle/Pedestrian	* Provide 100 more covered spaces	100 Spaces	$100,000	$5,000	20	15	$3,707	(1)	35	$106
	* Provide 2 secure bike parking locations	2 Secure Locations	$200,000	$10,000						
	* Add Bike Station at Williams Village * Add Bike Station at Engineering Center	2 Bike Stations	$400,000	$60,000	100	10	$9,782	(1)	110	$89
	* Add Bike Share Station at UMC	1 Bike Share Station	$55,000							
	* Expand bike share programs	50 Bikes	$25,000	$2,500						
	* Pedestrian & Bike Connections	2.4 miles	1,513,680	75,684	160	20	$18,706	(1)	180	$104
Transit	* Supplement Stampede with additional overlay/shuttle route between EC + MC	Additional Bus on Short-turn Loop		$300,000	120	60	$300,000		180	$1,667
Ridesharing	* Add carpool spaces on Main Campus	60 Close-in Spaces	$12,000	$1,200	40	20	$23,083		60	$385
	* Reduced carpool permit fees	50% discount on Core Rate		$21,000						
Carsharing	* Expand Car Sharing (eGo)	Add 5 cars		$10,000	10		$10,000		10	$1,000
Vanpooling	* Vanpooling (50% Purchase Subsidy, Free Permit)	Purchase 5 vans	$67,500	$8,750	10	20	$19,996		30	$667
Fleet Vehicles	* Main Campus Fleet Vehicle Pick-up Station	Site and 5 Vehicles	$175,000	$24,500		10	$5,366	(1)	10	$537
Influence Travel Choices										
Parking Management	* Implement Zone permit structure on Main Campus with Core permits 30% more than peripheral permits	Access controls, technology & Software	$450,000	$45,000	50	75	$78,112			
		Core 30% more than Peripheral		-$94,300			($94,300)			
	* Implement Flexible Permit Program to allow fewer than 5 day use					25				
Marketing and Incentives	* Enhanced web and mobile based access (e-services) to purchase parking, connect to TDM services, etc.	Purchase/develop software	$100,000	$10,000	20	20	$17,358			
	* Incentive Programs (bike discounts, bike/pedestrian challenges & rewards, carpool/vanpool priority parking, discounts, etc.)	FTE plus rewards		$50,000	100	50	$50,000			
	* "Buddy" Programs - show how to use transit, bike, etc. Connect people to TDM.	1 Part-time Student		$10,000	10	20	$10,000			

Note: EC = East Campus; MC = Main Campus; WV = Williams Village
(1) Only 10% of CU costs allocated to new users)

Table 6-3
Moderate Expansion of TDM
Campus Bikeway/Pedestrian Projects

Project ID (1)	Prioritization Score (2)	Corridor	Facility Type	From	To	Length (miles)	Total Projected Cost	CU Cost	
4	5	Marine St	Shared Lane Marking	Arapahoe Ave	30th Street	0.42	$11,760	$11,760	
11	7	Leeds-Engineering	Bike Path	North-South Bikeway	Regent Drive	0.13	$97,500	$97,500	
13	5	Baker Dr	Bike Path/Shared Lane Marking	SE corner of Libby Hall	SW corner of Baker Hall	0.2	$41,700	$41,700	
14	5	UMC/Bike Station	Bike Route	18th Street	Broadway	0.12	$1,200	$1,200	
15	8	18th St/Colorado	Cycletrack	Euclid Avenue	Colorado Ave. Bike Lanes	0.2	$200,000	$200,000	
16	5	Marine – Boulder Creek Connector	Multi-use Path	Marine Street	Boulder Creek	0.05	$2,000,000	$400,000	(3)
17	6	Lot 169 Path	Multi-use Path	Lot 169	Rec. Center	0.2	$2,000,000	$400,000	(3)
18	8	Stadium Drive	Bike Path/Shared Lane Marking	Folsom Street	17th Street	0.53	$58,160	$58,160	
19	6	Libby Drive	Bike Path/Shared Lane Marking	Duane Physics/Colorado Connector	Cockerell Dr.	0.12	$3,360	$3,360	
20	9	North South Bikeway	Multi-use Path	Colorado Avenue	Broadway Bike Path	0.42	$600,000	$300,000	
						2.39	**$5,013,680**	**$1,513,680**	

Notes:
(1) See Figure 6-1 for project location.
(2) See Section 5.2.1.5 for prioritization analysis.
(3) CU share expected at 20% with the other 80% funded by federal and city funds.

6.1.3 Aggressive Expansion of TDM Programs

This package expands the existing TDM programs by adding or expanding the following programs. Table 6-4 provides the costs of these programs (excluding housing), the projected decrease in single-occupant vehicle use, and cost per diverted SOV.

Reduce Travel:

1. Promote telecommuting, flexible work schedules, and flexible start/end times

- Costs: This measure would be implemented with 2 part-time students at a cost of about $20,000 per year.
- Reduction in SOV's: Commuter survey indicated 6.2% of faculty/staff tele-worked/didn't come (7,260 x 0.062 = 450 F/S). Better promotion of tele-commuting and flexible work schedules could expand this by about 18% resulting in about 80 less SOV's. 5.6% of students (22,389 x 0.056 = 1,254) were estimated to telecommute or not come. Since most students plan their commutes around their class schedules, only a reduction of 50 SOV's was assumed.

2. Implement staggered class times
3. Propose reduced parking standards for new construction
4. Create and implement bike parking standards for new construction
5. Create and implement transit standards for new construction

Provide for Travel Choices:

1. Provide 200 more covered spaces
2. Provide 5 secure bike parking locations
3. Monitor campus bike racks/Provide additional bike racks as needed where space is available
4. Expand bike sharing programs
5. Add bike stations at Williams Village and Engineering Center
6. Add bike share stations at East Campus (2), Williams Village and at UMC

- Costs: Based on CU's experience, covered spaces cost about $1,000 each with an annual maintenance cost of 5% or $50. Secure bike parking spaces were estimated to cost $5,000 each. Each bike station was estimated to cost $200,000 with annual maintenance costs of 5% or $10,000. Volunteers would staff the stations. Bike share costs were estimated at $500 per bike and 10% per year annual maintenance.
- Reduction in SOV's: The 2010 commuter survey estimated 14.9% of students (14.9 x 22,389 = 3,338 students) biked to campus. These bike programs will serve those bicyclists but may increase commuting bicyclists by 7% or reduce SOV's by 240 (3,338 x 0.07 = 240). The faculty/staff which had (7,260 x 8.4% = 608) bikers to campus could have a 9% increase in bicyclists or a reduction of about 70 SOV's.

7. Add 4.9 miles of bike/pedestrian facilities around and through campus (see Table 6-5)

- Costs: Completing 4.9 miles of ped/bike connections would cost $2,806,540 (see Table 6-5 for a prioritized list of projects and CU share of costs). However, these projects would benefit all bike/ped users, not just new users. A reasonable share of these costs was estimated to be 10% for new users.
- Reduction in SOV's: These connections may increase student walking by 3% and biking by 5% resulting in a reduction of ((22,389 x 20.4 x 0.03 = 137) + (22,389 x 0.149 x 0.05 = 166) = 300) 300 student SOV's. Faculty/staff walking would increase by 2.5% and biking by 10%, resulting in a reduction of (7,260 x 0.059 0.025 = 10) + (7,260 x 0.084 x 0.10 = 60) = 70 faculty/staff SOV's.

Transit

1. Supplement Stampede with additional overlay/shuttle route between EC and MC

- Costs: The Stampede overlay service is estimated on a single vehicle operating at RTD's loaded peak costs of $138/hour, 12 hours per day, on weekdays during the regular school year. The existing Stampede is a cost-share agreement with RTD. Because this is a "buy up" of service, however, it was assumed that CU's share would be 85% of the total. (1 bus x 12 hrs/day x 190 days/year x $138/hr x 85% = $267,450, rounded to $300,000 reflect a 10% contingency on fuel and labor cost inflation).

2. Buy up additional service or make service changes on two other routes (BOLT and HX or 205)

- Costs: The extension of the BOLT from the Boulder Transit Center at 14th/Walnut was estimated on the premise that RTD would not be able to find operating efficiencies otherwise and that an additional bus would be added to the route. The cost was based on RTD's loaded peak costs of $138/hour, 10 hours per day, weekdays during the entire year (250 days). Because riders other than CU would benefit, a 25% cost share was assumed, with rounding to reflect contingencies on fuel and labor cost inflation. (1 bus x 10 hrs/day x 250 days/year x $138/hr x 25% = $86,250, rounded to $100,000 to reflect a 10% contingency on fuel and labor cost inflation). A second route extension's costs are estimated based on the same. ($100,000+$100,000 = $200,000).

3. Implement the Orbit bus route with the City of Boulder and RTD

- Costs: The Orbit costs are based on travel distance and average operating speeds for local streets, resulting in an estimated that 4 buses would be required to deliver 20-minute frequencies for this route. Operated 10 hours per day, weekdays (250 days/year), at RTD's loaded peak cost of $138/hr results in a total cost estimate of $1,380,000 annually, of which 15% is proposed to be CU's share, approximately $207,000, or with 10% contingency $230,000.

4. Enhanced amenities at transit stops including real-time departure information at major stops
5. Williams Village: Change the bus fleet from 2 articulated and 4 standard buses to 10 articulated buses on the Buff Bus
6. East Campus: Add significant capacity. Change from 3 standard to 4 articulated buses
7. Main Campus: Implement first and second phases of traffic/bike/ped design changes on 18th/Colorado corridor
8. Main Campus: Modest improvements in marketing downtown Boulder – Main Campus transit option
9. Williams Village: Work with the City of Boulder to add a US 36 slip ramp stop at south edge of the WV Campus

Ridesharing
1. Add 60 carpool spaces on Main Campus
2. Add 30 carpool spaces on East Campus
3. Consider reduced carpool permit fees (50%)

- Costs: This assumed $200 per space to provide signing and striping for close-in spaces. The 50% discount assumed an annual rate of $700 (after rate increase described in Chapter 7) applied to 60 spaces multiplied by 50% to arrive at $21,000 in forgone revenue.
- Reduction in SOV's: This assumed each carpool would result in a reduction of 1 SOV or a total of 90 reduced SOV's.

Vanpools
1. Form 10 vanpools

- Costs: Assumed $27,000 cost per van with $3,500 annual operating costs. 50% of the costs would be borne by users or outside grants.
- Reduction in SOV's: This assumed that each van would result in the reduction of 6 SOV's with faculty/staff taking up 2/3 of seats. Total reduction would be 60 SOV's.

Carsharing
1. Add 10 carshare vehicles as funding becomes available
- Costs: This assumes $2,000 per vehicle in administrative costs and foregone parking revenues.
- Reduction in SOV's: The primary benefit is for student personal use, encouraging students not to bring vehicles to campus. Two SOV's per car-share vehicle were assumed or a total of 20 reduced SOV's.

Fleet Vehicles
1. Provide pick-up locations on Main Campus

- Costs: Assumes capital cost of $175,000 and annual operating costs of $21,000 for 5 vehicles, including hardware and software for automated dispatch system. Annualized costs are based on 7-year vehicle life. A reasonable share of these costs for those not commuting by SOV is 10%. Annual costs include forgone costs of $700 per space per year in parking revenue.
- Reduction in SOV's: The program would only be available to faculty/staff and 10 SOV's are estimated to be reduced.

<u>Influence Travel Choices:</u>

Parking

1. Consider a zone permit structure on Main Campus with Core permits 40% more than peripheral permits
2. Propose a Flexible Permit Program to allow fewer than 5 days use.

- Costs: Access controls such as gates and readers plus software are estimated to cost $450,000 depending on the system chosen, with 10% annual maintenance costs (see Table 7-4 for calculation of revenues and allocation). Note, the current rate structure has a 20% differential between proximate and peripheral lots. This strategy would have a 40% differential between core zones and peripheral zones.
- SOV Reduction: CU's parking rate elasticity is estimated at 0.5. An increase in rates of 20% (changing from a 20% to 40% differential) is expected to result in 10% attrition. PTS estimates that 2,845 proximate permits will be reduced by 10% or by 284 permits. 25% or 72 permits will convert to flexible permits. The flexible permit holders will park on campus 3 days per week. SOV reduction will be (284 – 72 + 42) about 250.

3. Install access control (gates) at larger lots and implement parking management technology with the capability of monitoring parking use and charging demand-based parking rates.

Marketing and Incentives

1. Create an incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards)
2. Implement "Buddy" programs to show how to use transit, bike, etc. connect students to TDM.
3. Develop social network apps for transit, bikesharing, carpooling, etc.

- Costs: Purchase or develop software (estimated at $100,000) for enhanced web and mobile based access (e-services) to purchase parking, connect to TDM services, etc. Add one FTE and part-time student at cost of $60,000 per year to staff marketing/incentives program.
- SOV Reduction is estimated at 110 students and 70 faculty/staff.

Table 6-4
Aggressive Expansion of TDM Programs

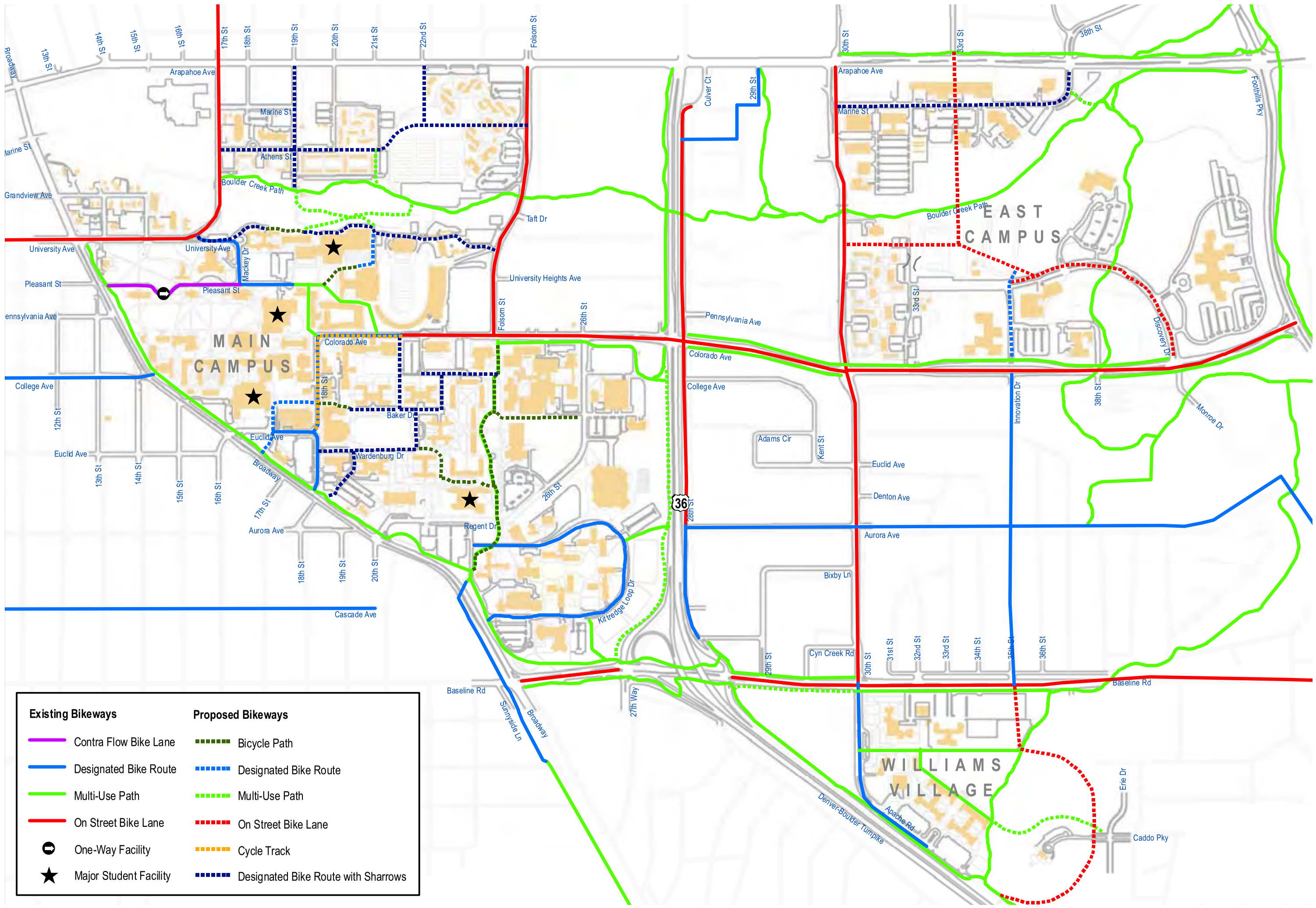
		Description	Capital	Annual	Reduction of SOV's Students	F/S	Annualized Cost		Total Diverted SOV	Cost Per Diverted SOV
Reduce Travel										
Integrated Trip Reduction	* Promote telecommuting, flexible work schedules & flexible start/end times	2 Part-time Students		$20,000	50	80	$20,000		130	$154
Provide for Travel Choices										
Bicycle/Pedestrian	* Provide 200 more covered spaces	200 Spaces	$200,000	10,000	40	30	$14,830	(1)	70	$212
	* Provide 5 secure bike parking locations	5 Secure Locations	$1,000,000	50,000						
	* Add bike station at Williams Village	2 Bike Stations	$400,000	$60,000						
	* Add bike Station at Engineering Center									
	* Add bike share Station at UMC				200	40	$10,996	(1)	240	$46
	* Add bike share Station at Williams Village	4 Bike Share Stations	$220,000							
	* Add two bike share stations on East Campus									
	* Expand bike share programs	50 Bikes	$25,000	$2,500						
	* Pedestrian & Bike Connections	4.5 miles	2,806,540	140,327	300	70	$34,684	(1)	370	$94
Transit	* Supplement Stampede with additional overlay/shuttle route between EC + MC	Additional Bus on Short-turn Loop		$300,000	120	60	$300,000		180	$1,667
	* Buy up of additional service or make service changes on two other routes (BOLT and HX or 205)	Route extension		$200,000	200	70	$200,000		270	$741
	* Work with City/RTD to implement Orbit route (15% share of costs)	Orbit Route		$230,000	130	60	$230,000		190	$1,211
	* Enhanced amenities at transit stops including real-time departure information at major stops.	Hardware/Software	$100,000	$10,000	50	25	$17,358		75	$231
Ridesharing	* Add carpool spaces on Main Campus	60 Close-in Spaces	$12,000	$1,200						
	* Add carpool spaces on East Campus	30 Close-in Spaces	$6,000	$600	50	40	$34,083		90	$379
	* Reduced carpool permit fees	50% discount on Core Rate		$32,000						
Carsharing	* Expand Car Sharing (eGo)	Add 10 cars		$20,000	20		$20,000		20	$1,000
Vanpooling	* Vanpooling (50% Purchase Subsidy, Free Permit)	Purchase 10 vans	$135,000	$17,500	20	40	$39,992		60	$667
Fleet Vehicles	* Main Campus Fleet Vehicle Pick-up	Site for 5 Vehicles	$175,000	$24,500		10	$5,366	(1)	10	$537
Influence Travel Choices										
Parking Management	* Implement Zone permit structure on Main Campus with Core permits 30% more than peripheral permits	Access controls, technology & Software	$450,000	$45,000	100	150	$78,112			
		Core 40% more than Peripheral		($165,400)			($165,400)			
	* Implement Flexible Permit Program to allow fewer than 5 day use					25				
Marketing and Incentives	* services) to purchase parking, connect to TDM services, etc.	Purchase/develop software	$100,000	$10,000	20	20	$17,358			
	* Incentive Programs (bike discounts, bike/pedestrian challenges & rewards, carpool/vanpool priority parking, discounts, etc.)	2 FTEs plus rewards		$100,000	200	100	$100,000			
	* "Buddy" Programs - show how to use transit, bike, etc. Connect people to TDM.	2 Part-time Student		$20,000	20	40	$20,000			

Notes:
(1) Only 10% of CU costs allocated to new users)

Table 6-5
Aggressive Expansion of TDM
Campus Bikeway/Pedestrian Projects

Project ID (1)	Prioritization Score (2)	Corridor	Facility Type	From	To	Length (miles)	Total Projected Cost	CU Cost	
1	4	19th Street	Shared Lane Marking	Arapahoe Ave	Grandview Ave	0.18	$5,040	$5,040	
2	3	22nd Street	Shared Lane Marking	Arapahoe Ave	Grandview Bike Path	0.08	$2,240	$2,240	
3	4	Marine Court	Multi-use Path	19th Street	Dal Ward	0.15	$112,500	$112,500	
4	5	Marine St	Shared Lane Marking	Arapahoe Ave	30th Street	0.42	$11,760	$11,760	
5	4	35th Street	Bike Lanes	Shadow Creek Drive	Arapahoe Ave.	0.16	$6,400	$6,400	
6	4	Shadow Creek Dr	Bike Lane	30th Street	Discovery Dr	0.4	$16,000	$16,000	
7	4	Innovation Drive	Bike Route	Colorado Avenue	Shadow Creek Drive	0.12	$1,200	$1,200	
8	2	Discovery Drive	Cycletrack	Colorado Avenue	Innovation Dr	0.36	$360,000	$360,000	
9	0	35th South	Cycletrack	Baseline Road	Bear Creek Apt. Path	0.5	$500,000	$500,000	
10	4	Williams Village	Bike Path	Bear Creek Apts.	Caddo Pkwy	0.2	$150,000	$150,000	
11	7	Leeds-Engineering	Bike Path	North-South Bikeway	Regent Drive	0.13	$97,500	$97,500	
12	3	Wardenburg Dr	Shared Lane Marking/Bike Path	18th Street	North-South Bikeway	0.34	$139,480	$139,480	
13	5	Baker Dr	Bike Path/Shared Lane Marking	SE corner of Libby Hall	SW corner of Baker Hall	0.2	$41,700	$41,700	
14	5	UMC/Bike Station	Bike Route	18th Street	Broadway	0.12	$1,200	$1,200	
15	8	18th St/Colorado	Cycletrack	Euclid Avenue	Colorado Ave. Bike Lanes	0.2	$200,000	$200,000	
16	5	Marine – Boulder Creek Connector	Multi-use Path	Marine Street	Boulder Creek	0.05	$2,000,000	$400,000	(3)
17	6	Lot 169 Path	Multi-use Path	Lot 169	Rec. Center	0.2	$2,000,000	$400,000	(3)
18	8	Stadium Drive	Bike Path/Shared Lane Marking	Folsom Street	17th Street	0.53	$58,160	$58,160	
19	6	Libby Drive	Bike Path/Shared Lane Marking	Duane Physics/Colorado Connector	Cockerell Dr.	0.12	$3,360	$3,360	
20	9	North South Bikeway	Multi-use Path	Colorado Avenue	Broadway Bike Path	0.42	$600,000	$300,000	
						4.88	**$6,306,540**	**$2,806,540**	

Note:
(1) See Figure 6-1 for project location.
(2) See Section 5.2.1.5 for prioritization analysis.
(3) CU share expected at 20% with the other 80% funded by federal and city funds.



Proposed Bicycle Network with Classifications

CU-Boulder Transportation Master Plan

Figure 6-1

6.2 TDM/Housing Scenarios

Based on the analysis of the expected reduction in SOV commuter trips shown in Tables 6-2 and 6-4, projections of vehicle miles of travel and parking demand were estimated along with fuel consumption and CO_2 emissions using the methodology described in Chapter 3. Table 6-6 is a summary of that analysis and shows that even if the university invests in the most aggressive TDM comprehensive strategy, it will fall short of achieving all of its goals (VMT reduction, parking space demand reduction, and carbon reduction by 20% by 2020 and carbon neutrality by 2030). Given this reality, scenarios that combined TDM strategies with additional housing on or near campus were also evaluated. The following are all of the scenarios considered. Please note that the university already plans on constructing 1,500 new beds by 2020 and that the housing identified in the various scenarios below are in addition to this base amount of additional housing:

1. **No Change in TDM:** Assumes no change in current TDM programs. This includes the expected growth in faculty/staff and student populations and the planned construction of approximately 1,500 new student beds. Since much of CU-Boulder's growth will occur on the East Campus, which now has a higher faculty/staff drive alone share, the overall faculty/staff drive alone share is expected to increase with continuation of current programs.

2. **Moderate TDM:** Assumes a moderate increase in TDM programs with the expected growth in faculty/staff and student populations and the planned construction of approximately 1,500 new student beds. Recommendations for a moderate expansion of TDM programs are given in Section 6.1.2.

3. **High TDM:** Assumes an aggressive increase in TDM programs with the expected growth in faculty/staff and student populations and the planned construction of approximately 1,500 new student beds. Recommendations for an aggressive expansion of TDM programs are given in Section 6.1.3.

4. **No Change in TDM – 2000 Additional Beds:** Assumes no change in current TDM programs with an additional 2,000 student beds constructed at East Campus and/or north of Boulder Creek, bringing the total new beds to 3,500. Faculty/staff mode split is assumed to remain unchanged from Alternative 1.

5. **Moderate TDM – 2000 Additional Beds:** Assumes a moderate increase in TDM programs with an additional 2,000 student beds constructed at East Campus and/or north of Boulder Creek, bringing the total new beds to 3,500.

6. **High TDM – 2000 Additional Beds:** Assumes an aggressive increase in TDM programs with an additional 2,000 student beds constructed at East Campus and/or north of Boulder Creek, bringing the total new beds to 3,500.

The mode share shift for each scenario was estimated based on several factors, including the number of additional on-campus housing beds (utilizing the data shown in Figure 2-2), the level of improvement to TDM programs (including improved transit services, and the projected growth in affiliates. The resulting mode share percentages anticipated to be achieved for each alternative mode and each scenario are shown in Table 6-6.

Table 6-6
Mode Split Scenarios

				2030 Alternatives				
			1	2	3	4	5	6
		No Change in TDM[1]						
Faculty/Staff	**2010**	**2020**	**2030**	**Moderate TDM[1]**	**High TDM[1]**	**3,500 New CU Beds Same TDM[2]**	**3,500 New CU Beds Moderate TDM[2]**	**3,500 New CU Beds High TDM[2]**
Bicycled	8.4%	8.0%	8.0%	8.5%	9.2%	8.0%	8.5%	9.2%
Carpooled/Vanpooled	7.7%	8.0%	8.0%	8.5%	9.0%	8.0%	8.5%	9.0%
Drove Alone	47.5%	49.6%	49.6%	46.8%	44.0%	49.6%	46.8%	44.0%
Transit	21.7%	20.2%	20.2%	21.5%	23.0%	20.2%	21.5%	23.0%
Walked	5.9%	5.4%	5.4%	5.4%	6.0%	5.4%	5.4%	6.0%
Worked at Home/Didn't Come/Other	8.8%	8.8%	8.8%	9.3%	8.8%	8.8%	9.3%	8.8%
Commuting Students								
Bicycled	14.9%	14.9%	14.9%	16.0%	16.0%	14.9%	16.0%	16.0%
Carpooled/Vanpooled	3.4%	3.4%	3.4%	3.6%	3.0%	3.4%	3.6%	3.0%
Drove Alone	22.9%	22.9%	22.9%	20.5%	18.9%	22.9%	20.5%	18.9%
Transit	30.1%	30.1%	30.1%	31.0%	33.0%	30.1%	31.0%	33.0%
Walked	20.4%	20.4%	20.4%	20.4%	20.4%	20.4%	20.4%	20.4%
Worked at Home/Didn't Come/Other	8.3%	8.3%	8.3%	8.5%	8.3%	8.3%	8.5%	8.3%
Weekday SOV VMT	**219,750**	**237,512**	**258,857**	**236,285**	**219,585**	**246,399**	**228,776**	**209,379**
Weekday HOV VMT	**33,009**	**35,040**	**38,097**	**40,157**	**40,971**	**36,355**	**37,210**	**39,134**
Total Vehicle-Miles Traveled[3]	**252,759**	**272,552**	**296,954**	**276,442**	**260,556**	**282,754**	**265,986**	**248,513**
Fuel Consumption (gal.)[4]	**13,414**	**12,346**	**11,778**	**11,146**	**10,712**	**11,210**	**10,716**	**10,210**
CO2 Emissions (mt. tons)	**118**	**109**	**104**	**98**	**94**	**99**	**94**	**90**
On-Campus Parking Demand	**9,125**	**10,203**	**10,826**	**10,400**	**10,043**	**12,678**	**11,820**	**11,433**
Off-Campus Parking Demand	**2,157**	**2,369**	**2,570**	**2,399**	**2,257**	**2,505**	**2,361**	**1,979**
Total Parking Demand	**11,281**	**12,572**	**13,396**	**12,799**	**12,300**	**15,182**	**14,181**	**13,412**

1. Assumes 1,500 student housing beds that are currently planned. Faculty/staff SOV split increases due to most new growth occuring at East Campus where the SOV split is higher than Main Campus.
2. Assumes 1,500 new beds on Main Campus/Williams Village and 2,000 new beds on East Campus/north of Boulder Creek.
3. Calculated using occupancy factors of 2.0 for faculty/staff and 2.0 for students and average one-way trip lengths of 11.0 miles for faculty/staff and 13.9 miles for students.
4. Year 2030 fuel consumption assumes a 25 percent reduction which is consistent with current EPA goals.

As shown, no change in TDM programs will result in a slight increase of the faculty/staff vehicular share due to the fact that most of the growth in faculty/staff will occur at East Campus where the vehicular mode split is significantly higher than at Main Campus. For Alternatives 2 through 6, various reductions in vehicular mode share are expected as a result of the increased TDM programs and additional on-campus housing.

The calculations for VMT include the calculation of total vehicles arriving to campus. These estimates were obtained by multiplying the commuting population by the vehicle mode split (both drive-alone and carpool/vanpool) and dividing by an average vehicle occupancy of 2.0 persons per vehicle. A similar method was used to calculate transit VMT, with the bus occupancy (except for Buff Buses) assumed to be approximately 8.9 persons per vehicle. The VMT was then obtained by multiplying the resulting vehicles by an average commuting trip length. A one-way trip distance of 11.0 miles for faculty/staff and 13.9 miles for students was used for vehicle commuter trips. For transit commuter trips, a one-way trip distance of 14.3 miles for faculty/staff and 6.8 miles for students was used. These distances were obtained from the *University of Colorado 2010 Commuter Spring Survey* (with the exception of the faculty/staff vehicle distance which was based on Fall 2010 PTS permit data). The results of the VMT calculation are shown in Table 6-6.

As shown, existing VMT associated with the university's commuting trips is approximately 252,759 miles per weekday. With no changes in the university's TDM programs, VMT is expected to grow to approximately 296,954 (Alternative 1) by the Year 2030 due to population growth and slight shifts in mode split due to growth at East Campus. For Alternatives 2 through 6, which incorporate different levels of TDM programs and on-campus housing, total VMT ranges from approximately 248,513 for the most aggressive TDM alternative to 282,754 for the least aggressive TDM alternative.

Table 6-6 also shows calculation of daily fuel consumption and metric tons of CO_2 emissions for each alternative. The fuel consumption was calculated using the VMT estimates, the current affiliate vehicle mix obtained from PTS, and the Environmental Protection Agency (EPA) fuel consumption estimates for each vehicle class. The specific mix used and miles-per-gallon (MPG) estimates for each class are shown in Table 6-7.

Table 6-7

Vehicle Type	Percent	MPG
2-Door Sedan	8%	28
3-Door Hatchback	1%	28
4-Door Sedan	42%	26
5-Door Hatchback	2%	26
Station Wagon	8%	22
Van	5%	21
Sport-Utility	19%	19
4-Wheel Drive Utility	4%	16
Truck	10%	16
Motorcycle/Moped	0%	50

The daily CO_2 emissions for each alternative were calculated assuming 19.4 pounds of CO_2 per gallon of fuel. A 20% reduction in carbon by 2020 from the 2010 baseline amount equates to 94 metric tons.

Please note that fuel consumption and emissions are expected to decrease from Year 2010 to Year 2030 even with a growth in VMT due to improvements in vehicle fuel consumption of 25 percent as set forth by recent federal standards. As shown in Table 6-5, fuel consumption and CO_2 emissions are expected to show similar trends between alternatives as the VMT. The federal fuel economy standards will reduce fuel consumption and CO_2 emissions by 12% in 2030 with no change in TDM programs. With a high TDM program, another 8% could be achieved. Alternatively, 3,500 new campus beds and a moderate TDM program could achieve CU-Boulder's 20% emissions reduction goal.

One of the goals of the university in the current Master Plan is to reduce VMT growth to zero. Based on the alternatives evaluated in Table 6-6, it is clear that significant changes in mode share will be required to achieve goals to maintain existing VMT levels and provide reductions in fuel consumption and CO_2 emissions. To achieve this shift in mode share, some combination of increased TDM programs (including improved transit service) and additional student housing near or on campus will be needed.

If the university just wants to achieve the goal of reducing parking demand and not having to build new parking over the next ten years, it can achieve this by investing moderately to aggressively in TDM. As is shown in Table 6-6, Scenario 3, a "high" TDM program, will result in a total parking demand of 10,043 spaces in 2030 – a 783 parking space decrease from estimated 2030 parking demand that will occur with no change to current TDM programs (Scenario 1 – an anticipated parking demand of 10,826 spaces by 2030). Scenario 2, Moderate TDM, shows an estimated reduction in parking space demand of 426 spaces (2030 parking demand of 10,400).

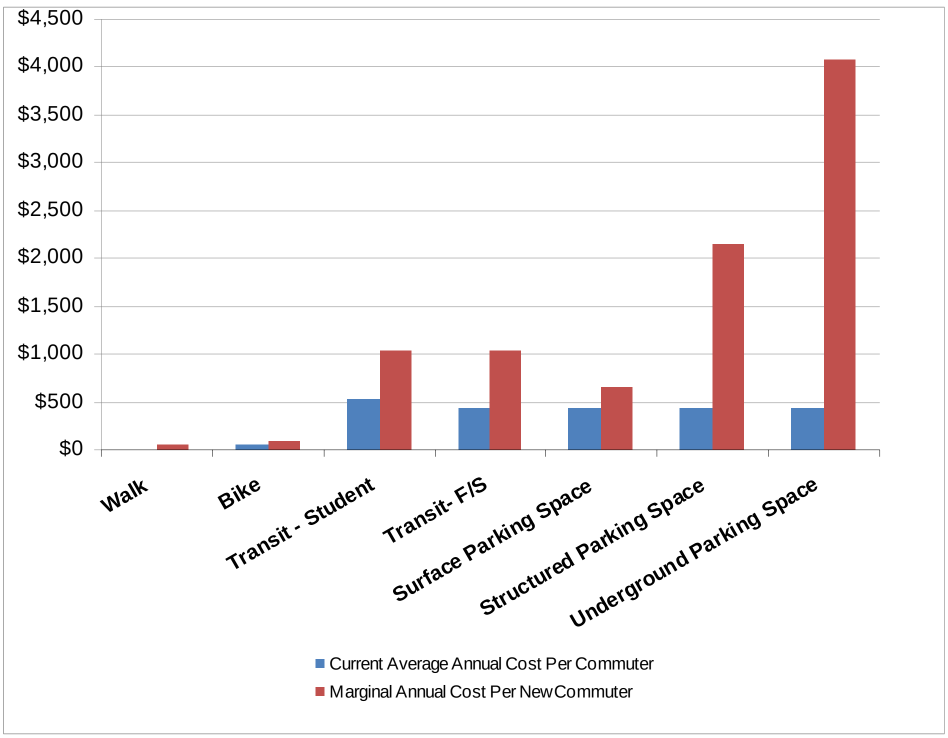
If the university wants to achieve its 2020 and 2030 carbon reduction goals and commitments in addition to not having to build new parking, then it will need to look at a combination of TDM investments and the construction of housing on or near campus.

The university will need to decide if it wants to set the policy direction and dedicate the funding needed to achieve all of its goals.

6.3 Annual CU-Boulder Costs of Commuting by Various Modes

It is important to compare CU's relative costs to accommodate trips in different modes because this will be one of several key determinants for future parking and transportation development planning. Figure 6-1 summarizes an analysis of the average and marginal cost per trip for various modes at CU-Boulder. The current average cost per trip reflects actual costs to the University of providing this mode per commuter per year. The marginal cost per new trip is an estimate of what it could cost the university per commuter per year to provide this service in the future and reflects the cost of capital improvements, programs and services needed to provide this new trip. The discussion following Figure 6-1 explains how each of these costs was determined.

Figure 6-2
Annual Cost Per Commuter



Current average costs per mode were derived from the *FY11 Sustainable Transportation Partnership Financial Plan*[1] which summarizes budgeted amounts broken down into various categories for both the PTS Transportation Options program and the Environmental Center Transportation program. Many of the budgeted items are mode specific. It was assumed that one-third of the PTS salaries and benefits and one-half of the Environmental Center salaries and benefits were devoted to the bike program. Other non-specific costs were allocated among modes based on their share of the mode specific costs. The resulting model costs are summarized in Table 6-8.

[1] See Appendix D

Table 6-8
Sustainable Transportation Partnership
FY11 Budget

Mode	Student Fee	PTS	Total
Transit	$4,610,683	$956,688	$5,567,371
Bike	$173,727	$79,777	$253,504
Rideshare	$4,996	$4,744	$9,740
Total	$4,789,406	$1,041,210	$5,830,616

Walking and Bicycling
No breakdown was available for existing pedestrian costs. For biking, CU spends $253,524 per year but has revenues of $23,950 per year. The net cost of $229,554 is spread over 4,926 bike commuters, or an average of $46 per bike commuter per year. The marginal annual cost to add a new bike commuter was based on data from Table 6-4, Aggressive TDM Programs, by taking the total costs of the bike programs and dividing by the expected new bike trips ($60,510 / 680 = $89).

Faculty/Staff EcoPass Program Cost Per New Commuter Accommodated
From Table 6-1, the $956,688 spent on the Faculty/Staff EcoPass program is offset by $298,309 in auxiliary reimbursements, resulting in $658,379 divided by 1,575 F/S users (21.7% of commuting Faculty/Staff), yielding a F/S transit cost per trip of $416.

Student Bus Pass Program Cost Per New Commuter Accommodated
From Table 6-1, the student transit cost of $4,610,683 divided by 6,730 student commuting transit riders (30.1% of student commuters) yields a student transit cost per trip of $685. The marginal cost for a new transit trip was based on data from Table 6-4, Aggressive TDM Programs. Students, faculty and staff were combined with projected costs ($747,358) divided by projected trips (715), yielding an annual cost of $1,045.

Parking Cost Per New Commuter Accommodated
Total PTS FY10 parking expenses (excluding costs for the Sustainable Transportation Partnership Budget) were $3,967,322. As indicated in Table 5-24, the parking demand in 2010 was estimated at 9,057 spaces for students, faculty and staff. In addition, visitor and other trips were also accommodated with parking. Daily numbers of visitor and service vehicles parking on campus were not available to add to the total; this added parking demand is offset to some degree by the fact that all students, faculty and staff do not come to campus at the same time or even on the same day. The annual parking cost divided by the parking demand works out to be $438 per trip.

The annual marginal cost per new vehicle commuter is related to the costs of constructing and maintaining new parking. Examples of parking space costs are contained in Table 5-26. Most of CU-Boulder's parking is surface parking which, at an estimated annualized cost of $302, is relatively inexpensive. Given the high value of land in Boulder and the need to construct academic, research and housing space on the Boulder campus, surface parking may not be an option for new parking except on the East Campus Park in the short term. Most likely, new parking will be structured parking and constructed on existing parking lots where streets and access drives already exist. The annual net cost per new parking space using the example illustrated in Table 5-26, which assumes a 1,000-space parking structure built on an existing 250-space lot, is estimated to be $2,134, including operation and maintenance costs. On the Main Campus, land is at such a premium, that underground parking (like the recently completed parking structure built for the Center for Community project) will be even more expensive. For a 1,000 space underground structure with three levels built on an existing 250-space lot, the annualized cost per net new space is estimated at $4,519. Added to these costs are estimated costs of connecting streets and access drives, which would easily add $500 per space. Since more permits are sold than spaces available, these costs are divided by an overall rate of 1.23 (average of students, faculty and staff) to yield costs of $652 ((302 + 500)/1.23) per surface space, $2,141 per above grade structured space ((2,134 + 500) / 1.23) and $4,080 per underground space ((4,519 + 500) / 1.23).

CHAPTER 7
Financing Strategies

This chapter identifies and discusses existing and potential funding sources for transportation facilities and programs serving CU-Boulder. The first part discusses local and regional funding sources while the second part discusses university funding sources.

7.1 Local and Regional Funding

Funding for CU-Boulder transportation facilities, programs, and activities comes from many sources controlled by many agencies and departments with their own specific missions, goals, and objectives. Fortunately, from a transportation perspective, these missions are often aligned in encouraging the use of efficient transportation modes which minimize energy consumption and reduce carbon emissions. The City of Boulder and CU-Boulder both share the same goals of reducing single-occupant vehicle use and encouraging transit, bicycle, and pedestrian travel. This consensus has allowed the City and CU-Boulder to compete well for regional funding for bike/ped facilities, alternate mode programs, and transit funding. While the prospect of increased federal and state funding in the short term is bleak, recent emphasis on transit and alternative modes funding bodes well for CU-Boulder and City of Boulder joint projects if federal and state funding are put on a stable, sounder basis. It is thus assumed that many of the transit recommendations, especially commuting services which transport riders from home to campus, will be funded by RTD, the City, Boulder County and DRCOG. Likewise, bicycle and pedestrian connections to nearby neighborhoods, other city areas and Boulder County will be funded by city, county, state, and federal sources. As it has done in the past, CU-Boulder should work closely with its local and regional partners to plan these programs and facilities, providing limited funding when demonstration projects may be necessary or when federal/state/private sources can be leveraged.

7.1.1 County-Wide EcoPass Funding

At a recent US-36 TMP Steering Committee meeting, Boulder County staff shared some exploratory thinking on the possibility of county-wide EcoPasses. Decisions would need to be made about how the money for a program of this type would be collected. Possibilities include sales tax, property tax, head tax, employment tax, or other. Additional discussion would be needed to understand how it might change the student fee structure, faculty/staff EcoPass program, and how out-of-county residents or employees would be affected. A county-wide program of this type could be beneficial in increasing transit service in areas beyond CU's geographic area of influence.

7.1.1.1 City of Boulder/Boulder County EcoPass Rebates

CU-Boulder's student bus pass and faculty/staff EcoPass programs not only have saved the cost of parking spaces on the CU-Boulder campuses, but also have reduced auto travel in and around the City of Boulder, putting off the need for expensive street capacity improvements. As indicated in Section 2.5.2, traffic volumes on state highways in the Boulder Valley have decreased by 13% from 2001 to 2009. While there are many reasons for this decrease, including significant increases in fuel prices, the implementation of TDM programs by the city, county, and CU-Boulder greatly contributed to this decrease. The city and the county should encourage CU-Boulder to continue these programs through matching funds or rebates as it does with other employees and neighborhood groups. For example, a 10% rebate of student bus pass costs ($4,670,000) and faculty/staff EcoPass costs ($660,000) would amount to $533,000 per year. Rather than rebate these funds, the city and county could fund projects or programs costing a like amount on or near CU-Boulder that would encourage alternate mode use.

7.2 Local CU-Boulder Departments and Revenues

Most of the Transportation Funding and Programs fall under the purview of the Vice-Chancellor of Administration, which oversees the Parking and Transportation Services Department and the Facilities Management Department; or the Vice-Chancellor of Students Affairs which oversees Housing and the Environmental Center. Responsibilities and potential funding sources are discussed below.

7.2.1 Facilities Management

This department plans, designs, constructs and maintains CU-Boulder sites, buildings and infrastructure. FM receives both General Fund and project-related revenue, but these sources typically come with stringent restrictions on use. FM will be responsible for implementing many of the infrastructure recommendations of this plan that occur on the CU-Boulder campus. Some of these recommendations, especially bicycle and pedestrian connections, can be implemented as part of specific building projects (as was done with the C4C and Business School projects). However, campus-wide projects, which go beyond the projects limits of buildings, should be identified and submitted through the legislative and University budget process. These could include:

- Pedestrian Plan Main Campus Upgrades
- Bikeway Network Main Campus Upgrades
- North of Boulder Creek Connection
- East Campus Street Improvements
    - i. 33rd Street, Arapahoe and Discovery Drive (Boulder Creek Bridge)
    - ii. Discovery Drive, 33rd extension to 30th Street
    - iii. East Campus Traffic Signals
- Williams Village
    - i. 35th Street Connector
- 18th/Colorado Multi-Modal Improvements

7.2.2 Housing

Expanding On or Near Campus Housing

CU projects an expansion in enrollment by 4,875 students over the next 20 years. This will place additional demands on transportation and parking infrastructure, and would likely add new vehicle trips to the Campus' impact. Expanding student housing on and near campus could reduce parking demand and shift travel demand to walking, bicycling, and transit use.

The housing market in Boulder is undersupplied, with high costs for rental and for-sale housing and low rental vacancy rates. Student housing demand is primarily for rental housing, and Boulder has some of the lowest rental vacancies in the metro area. Due to the low vacancy rates and desirability of living in Boulder, student demand contributes to the City's affordable housing problem. Five percent vacancy is considered a stabilized or healthy vacancy rate. The citywide vacancy rate, excluding the University area submarket, is currently 4.5 percent and has dropped below 5.0 percent three times since 2005, as shown in Table 7-1. The University submarket has an even lower vacancy rate, currently at 1.9 percent and averaging 3.4 percent over the past six years. Rents are high enough to support new development, but there are few centrally located sites available. Average rents for a two-bedroom apartment range from $1,000 to $1,200 per month.

Table 7-1
Boulder Apartment Vacancy Rates, 2005 – 2010

Year	Boulder – Except University	Boulder – University
2005	7.1%	5.1%
2006	6.6%	2.9%
2007	3.0%	3.1%
2008	3.0%	2.5%
2009	5.8%	4.8%
2010	4.5%	1.9%
2005 – 2010 Avg.	**5.0%**	**3.4%**

Source: Denver Metro Apartment Vacancy % Rent Survey

Student Housing Examples

There are several examples of recent public-private student housing developments at public institutions in Colorado. This shows that there is a market for this type of housing and it can be developed successfully.

William's Village North is a new residence hall at CU Boulder opening in August 2011. The dormitory will house 500 students. Room and board is paid each semester. Rates, which include meals, range from $5,526 to $6,649 per student per semester, or about $1,381 to $1,622 per month. Parking is extra and can be purchased through the University. It is owned by CU and managed by Housing and Dining Services.

Bear Creek Apartments were originally developed in 2003 as a partnership between CU-Boulder and American Campus Communities, a private developer. American Campus Communities managed the property until 2006 at which point the university terminated the management contract. The original financing and management assumptions for the project assumed that students would enter into 12-month leases, which are not desirable to most students. Occupancies at the property were well below similar properties. Bear Creek Apartments' occupancy rate has increased since being purchased by the University. The apartments can house approximately 1,000 students. Residents must be at least 18 years of age or have sophomore standing.

Leases are issued for nine or twelve months. Rents for a nine-month lease range from $502 to $1,335 per month. Twelve-month leases are slightly less expensive per month, ranging $446 to $1,272. Parking costs an additional $40 to $50 per month. The initial difficulties CU faced with this project were not due to a lack of market demand but to a development concept unresponsive to the student market.

Campus at Auraria Village is a student housing complex serving the University of Colorado Denver, Metro State College, and Denver Community College. The complex has 690 beds and rates range from $689 to $949 per student per month. Parking is extra and ranges from $80 to $90 per month. The land is owned by the University of Colorado and the building is owned and managed by Education Realty Trust.

Regency Hotel is a private student housing complex located in a former hotel near the Auraria Campus. The Regency provides housing for students from UCD, Metro, and CCD. The cost is approximately $450 to $750 per student per month. Parking is free. The building and land are privately owned and managed by Regency Realty Investors.

The Inn at Auraria provides student housing for UCD, Metro, and CCD. It is located in a high rise building attached to the Curtis Hotel in Downtown Denver. Rents for furnished apartments range from $624-$834 per student per month. Parking is located in the Curtis Hotel garage and costs $140 per month. The property is owned and operated by American Campus Communities and is not affiliated with any public college.

The Grove at Fort Collins is a proposed student housing project that will serve CSU students. It is slated to open in Fall 2011, but it has not yet gained approval from the Planning and Zoning Board. The project will have 624 beds. Information on rental rates is not yet available. The Land is owned by the CSU Research Foundation (CSURF). If approved, the project will be developed under a long term land lease between CSURF and Campus Crest, the developer.

Housing Development Costs and Parking Standards

It has been suggested that reducing the parking standards for new student housing and academic or administrative facilities could result in construction cost savings that could be re-directed to TMD investments. The following example illustrates the cost savings associated with reduced parking standards.

Housing

The approximate costs to build student housing at different parking standards are shown in Table 7-2. The hypothetical project shown is a 500-unit apartment style development. Half of the parking is assumed to be in a podium structure and half is assumed to be surface parking. A building with podium parking typically has a two-story parking structure with residential units stacked on top of the structure and surrounding most of the structure. Total building height including the two-level parking structure could be up to seven or eight stories using lower cost engineered wood frame construction, as opposed to higher cost steel and concrete high-rise construction. Two examples are shown, one with a parking standard of 0.30 spaces per unit, or 0.15 spaces per bed with an average unit size of two bedrooms. The other example has 1.25 spaces per unit, which is more typical of traditional market rate multifamily housing.

Construction costs for the housing units are constant at $110,000 per unit not including land costs. A 500-unit project, a fairly large development, would cost $55 million for the housing component. Podium parking spaces cost approximately $12,000 to construct, and surface spaces cost about $2,750 per space. At 0.30 spaces per unit, 150 spaces are needed for the project, which is an aggressive reduction in parking that must be met with an equally aggressive TDM program. The cost for 150 spaces is $1.1 million. At 1.25 spaces per unit, 313 spaces are needed at a cost of $4.6 million, or $3.5 million more than the 0.30 space per unit scenario. The reduced parking standard would reduce the per-unit cost of the project from $119,219 to $112,213, a savings of $7,000 per housing unit.

Table 7-2
Approximate Student Housing Development Costs

		Multi-Family @0.30 Spaces/Unit	Multi-Family @1.25 Spaces/Unit
Housing			
	Units	500	500
	Per Unit Cost[1]	$110,000	$110,000
	Total Housing Cost	**$55,000,000**	**$55,000,000**
Parking			
	Parking Space per Unit[2]	0.30	1.25
	Parking Spaces	150	625
	% Podium Spaces	50%	50%
	Podium Spaces	75	313
	Podium Parking Space Cost	$12,000	$12,000
	Podium Cost	**$900,000**	**$3,756,000**
	% Surface Spaces	50%	50%
	Surface Spaces	75	313
	Surface Parking Space Cost	$2,750	$2,750
	Surface Cost	**$206,250**	**$859,375**
	Total Parking Costs	**$1,106,250**	**$4,609,375**
Total Cost		**$56,106,250**	**$59,609,375**
Cost Per Unit		$112,213	$119,219

1. Does not include land cost
2. These two parking ratios represent the Dormitory Standards of 0.15 per bed or 0.30 per unit, and a typical market standard of 1.25 per unit.
Source: Economic & Planning Systems

7.2.3 Parking and Transportation Services

This department plans, operates and maintains CU-Boulder parking facilities and plans and staffs alternate mode programs. As an auxiliary, PTS is primarily self-funded with little General Fund revenue. It faces the dilemma of trying to achieve the

University's goals of reducing vehicle miles of travel and reducing SOV use, while maintaining its revenue base which relies on parking fees. It also faces a short term funding crisis, with four years of overlapping bond payments which will exhaust its fund balances unless the debt is restructured. With land on the Main Campus in short supply and eyed for many uses, structured parking is the only viable solution, but prohibitively expensive. No net new spaces are recommended for the Main Campus, with new parking structures recommended to replace existing parking lots needed for other uses. PTS has increasingly funded TDM programs through parking revenues. The General Funds share of TDM programs has declined from 49% in 2002 to 7% in 2010.

Going forward, CU-Boulder should base its decisions about transportation programs on the cost to accommodate each annual new commuter trip and on the effectiveness in meeting sustainability goals. Investments in TDM programs may well be less costly and more effective than investing in parking facilities, but new sources of funds will be needed if the parking inventory (and hence permit revenues) doesn't grow. The following are potential sources of funds.

7.2.3.1 Growth in Existing Funding Sources

As the student population and faculty/staff grows, there will be a growth in revenues due to higher demand. Table 7-3 illustrates the growth in PTS revenues over the last four years, with total revenues increasing by 3.6% per year. Most of this is due to inflation, as PTS has attempted to keep its permit fees, or other rates tied to inflation. The last two columns show the predicted annual revenues (before inflation) in 2020 and 2030 for each line due to expected growth in the student population and faculty/staff. Each revenue line item was assessed for growth based on its dependence on student population growth or faculty/staff growth and this growth rate is shown in the 3rd to last column. For example, faculty/staff permit revenues were tied to half the expected faculty/staff growth rate of 0.86% while student permit revenues had half the growth rate as the student population growth rate. Of course, these revenue increases would only be realized if supply keeps pace with demand.

Table 7-3
CU-Boulder
Parking and Transportation Services
Historic and Projected Revenues

Population Group		2010 Estimates[1]		Annual Growth Rate	2020 Forecast[1]	2030 Forecast[1]
Students		30,076		0.87%	32,797	34,951
Faculty/Staff		7,260		0.86%	7,907	8,605
Years					10	20

PARKING REVENUE[2]	2007	2008	2009	2010	2007-2010	Annual Growth Rate[3]	2020 Revenue Forecast[4]	2030 Revenue Forecast[4]
Faculty/Staff Permits	$1,247,274	$1,301,086	$1,314,905	$1,402,271	3.98%	0.43%	$1,463,749	$1,527,922
Student Permits	$1,153,282	$1,201,638	$1,106,025	$1,300,629	4.09%	0.38%	$1,350,907	$1,403,128
Business Permits	$259,016	$259,590	$293,428	$280,684	2.71%	0.30%	$289,219	$298,014
Citation	$1,132,991	$954,026	$937,477	$949,105	-5.73%	0.50%	$997,642	$1,048,662
Visitor Permits	$187,584	$276,243	$312,754	$359,030	24.16%	1.00%	$396,592	$438,085
Meter Fees	$801,288	$871,941	$919,083	$886,969	3.44%	0.50%	$932,329	$980,008
Euclid Auto Park	$952,900	$920,486	$1,002,782	$1,096,751	4.80%	0.30%	$1,130,101	$1,164,466
Gates	$104,702	$122,378	$123,106	$129,329	7.30%	0.50%	$135,943	$142,895
Events	$710,740	$843,866	$873,402	$895,256	8.00%	0.50%	$941,040	$989,164
Bicycle	$23,960	$26,180	$24,152	$22,460	-2.13%	0.80%	$24,323	$26,340
Refunds	-$4,432	-$3,348	-$4,328	-$10,029	31.29%	0.80%	-$10,861	-$11,762
Misc.	$95,220	$204,037	$122,474	$111,097	5.28%	0.80%	$120,312	$130,291
Total Revenue	**$6,664,524**	**$6,978,124**	**$7,025,259**	**$7,423,552**	**3.66%**		$7,771,296	$8,137,213

Notes:
1. Provided by CU-Boulder Planning and Budgeting
2. Source: Parking & Transportation Services
3. LSC Estimate
4. 2020 & 2030 Forecasts are before inflation

7.2.3.2 Faculty/Staff EcoPass Funding

When this program began in 1998-99, the General Fund picked up about half its costs. By 2002, when City of Boulder subsidy ended, combined General Fund/ Auxiliary Fund picked up about 70% of the PTS TDM costs. This has declined to less than 30% in 2010, with PTS revenues (mostly parking revenues) picking up over 70%. While arguments can be made for using parking revenues for EcoPass and other TDM programs, faculty/staff EcoPass holders enjoy significant benefits in transit use with zero cost, unless they also purchase a parking permit. Passing some of the EcoPass costs onto the user or funding more of its costs with other sources are potential revenue sources. It is recommended that at least half of PTS TDM costs be funded by non-parking revenue. Possible options include:

- Faculty/staff EcoPass co-pay fee (calculated at 50% of per capita cost) or $97.25/0.5 = $48.63 in 2011. If this is optional (i.e. needs to be paid at time of pick-up) up to 30% of faculty/staff may decline, so revenues are estimated at 7,260 faculty/staff x $48.63 x 0.7 = $247,138 per year.

- Faculty/staff EcoPass co-pay fee = $50.

- The advantages of such fees are that those that directly benefit from their EcoPass share in the costs of the program. The drawbacks are the administrative tasks of collecting the fee, the potential of faculty/staff not picking up the pass, and the potential drop in transit ridership by these affiliates.

- Increase General Fund/Auxiliary Funding of PTS TDM budget to 50% or $463,903 in 2011 (an increase of $194,256).

7.2.3.3 Transportation Fee

All faculty/staff and students at CU Boulder will benefit by implementation of the recommendations of the TMP, either through facilitating access to campus, traveling between the three campuses or traveling within one of the three campuses. In the past, parking fees and citations funded the majority of parking and transportation programs. With the implementation of the student bus programs, students were assessed fees for the program after a vote and have expanded the program several times with positive votes. In recent years, student fees have also paid for bicycle programs and other TDM programs. Transportation fees could be expanded for students and a new transportation fee implemented for faculty/staff. Potential revenues could be

Students	30,076 students x $12 Semester Fee x 2.15 semesters	=	$775,961
Faculty/staff	7,260 x $7 Monthly Fee x 12	=	$609,840
			$1,385,881

One big advantage of this fee is that all affiliates share in the costs of transportation programs, no matter what mode they use to get to or around campus. Expenditures would be geared to reducing SOV use and facilitating travel which would meet the university's sustainability goals. The drawbacks include obtaining student approval of a fee increase when fees are already being criticized as too high; and the administration, legal and equity hurdles of implementing a faculty/staff fee.

7.2.3.4 Zone-Based /Flexible Parking Rate Structure

As discussed in previous chapters, a market-based rate system, where higher rates are charged for high demand spaces, coupled with a flexible rate system which encourages alternate mode use, could lead to lower SOV use, higher utilization of valuable parking spaces, and higher parking revenues. Table 7-4 provides calculations and assumptions for two rate structures compared with the current rate structure. The first option (low) would establish a high demand (core) zone (Zone 1) that is 10% higher (after a 3% inflation increase) than current proximate rates. This core zone would be 30% higher than the peripheral zones (2 and 3). The second (medium) rate structure would have a 40% difference between the core (1) and peripheral (2 and 3) zones. Table 7-4 also assumes that 3-day permits would be sold at 60% of the 5-day permits. In calculating revenues, it assumes that the rate increase results in some attraction (price elasticity of 0.5%) with some of this (25%) converting to flex permits. The low scenario results in about $94,300 in additional revenues, with the medium scenario generating $165,400.

Table 7-4
Flexible Permit Revenue Projections with Zone Pricing and Attrition

Level of Overall Price Increase	Zone	% Price Increase	Permit Rate: Proximate	Permit Rate: Peripheral	Permit Rate: Remote	Permit Rate: Flex	5-Day Permit Revenue	# Peripheral to Proximate	$ Peripheral to Proximate (Zone, Opt 2)	Elasticity/Attrition: 0.50% per 1% incr	Elasticity/Attrition: # of permits	Attrition Revenue Loss	% Attrition Convert to Flex	# Attrition Convert to Flex Permit	Flex Permit Revenue	Net Revenue	Net Revenue Gain/(Loss)
FY2012 Plan	1	3%	48.25				$ 1,542,557			0.0%	-	$ -	0%	0		$ 1,542,557	
	2,3	3%		40.50	32.00		$ 886,119			0.0%	-	$ -				$ 886,119	
Total							$ 2,428,676					$ -				$ 2,428,676	
Low	1	13%	52.75			31.75	$ 1,686,423	181	$ 114,573	5.0%	(142)	$ (89,886)	25%	36	$ 13,716	$ 1,724,826	$ 182,268
	2,3	3%		40.50	32.00		$ 886,119	(181)	$ (87,966)	0.0%	-	$ -				$ 798,153	$ (87,966)
Total							$ 2,572,541					$ (89,886)				$ 2,522,978	$ 94,302
Medium	1	23%	57.50			34.50	$ 1,838,281	181	$ 124,890	10.0%	(285)	$ (196,650)	25%	71	$ 29,394	$ 1,795,915	$ 253,357
	2,3	3%		40.50	32.00		$ 886,119	(181)	$ (87,966)	0.0%	-	$ -				$ 798,153	$ (87,966)
Total							$ 2,724,399					$ (196,650)				$ 2,594,067	$ 165,391

Assumptions

	Proximate	Peripheral	Remote
FY2011 Permit Price	46.75	39.25	31.00
# of FS Permits	1,823	529	97
# of Student Permits	1,344	1,709	194
% Student Reduction, EcoPass	96%	95%	94%
% of a calendar year, Students	65%	65%	65%
# of permits per rate	2,664	1,646	224

2010 Permit Revenues
$ 2,353,338

Flex Permit Percentage 60% (reduction from proximate rate)

7.2.3.5 Parking Rate Increase

CU charges $46.75 per month for its most expensive parking lots. The City of Boulder Downtown University Hill Management Division controls the majority of Downtown parking and sets pricing in its garages and lots. The City sells quarterly parking permits at a cost of $88 per month for a garage space, or roughly twice what CU-Boulder charges for its centrally located parking spaces. There are waiting lists for City parking permits, indicating that the City is underpricing its parking. The CU campuses and Downtown Boulder are both large employment districts within the City, suggesting that CU could increase its parking rates by 25 to 75 percent and still be within the market price for parking in Boulder, as shown in Table 7-5. If parking fees are increased, CU should ensure that there is lower cost remote parking available with shuttle bus service available for those employees that cannot afford to pay the higher parking rates.

Table 7-5
Potential Parking Rates vs. City of Boulder Rates

Parking Fees ($/Month)	$/Month	% Increase: 25%	% Increase: 50%	% Increase: 75%
CU Close-In Parking	$46.75	$58.44	$70.13	$81.81
CU Peripheral Parking	$39.25	$38.75	$46.50	$54.25
Downtown Boulder City Garage	$88.00	---	---	---

Source: City of Boulder, CU-Boulder, Economc & Planning Systems

The C4C project costs will increase PTS bound repayment costs by $1,232,000 for the next 25 years. This will be an additional cost for the next four years, but then other bonds are paid off. If the first four years costs of about $5 million are spread over 25 years, financed at an interest rate of 4%, the effective increase is about $320,000 per year or 8% of PTS expenses of $4 million per year. Effectively, this would increase the existing ~$17 million 25 year bonding for the C4C project to ~$22 million by adding a new $5 million bond for 25 years, to raise an extra $5 million to be used to cover the four years of double bond payments for both the C4C and EAP/RAP bonds. To offset these expenses, base permit fees (faculty/staff, student, business, gates and events) which currently bring in about $4 million in revenues, would have to be raised by 7 to 9% in addition to normal inflation. An 8% increase in base parking rates would generate about $320,000 per year.

7.2.3.6 PTS Management of East Campus Parking

As indicated in Chapter 5, existing parking on the East Campus (particularly on the Research Park) is underutilized. As leases expire or agreements can be made with existing tenants, PTS could bring many of these spaces into the campus permit system, allowing PTS to sell both permit parking and short term parking in all of these locations at prices commensurate with Main Campus parking.

The potential for this to yield a net revenue gain or loss for PTS will depend on the interplay of several factors:

- the initial and future parking pricing levels adopted for these locations,
- any related construction and financing costs,
- the operations, maintenance and enforcement costs for these new parking areas,
- the existence of any remaining free parking easily accessible by foot or bus pass,
- whether or not revenue sharing is required in any of these locations; the % shares implemented, and
- the mix of existing and additional parkers utilizing these locations.

7.2.3.7 Additional TDM Funding to Support Reduced Parking Requirements

Where parking requirements are reduced at new or existing campus facilities, additional, ongoing funding will be required for PTS to support the aggressive TDM programming needed to make and keep the reduced parking supply workable for facility users.

7.3 Summary of Revenue and Program Expansion Recommendations

Recognizing the difficulties of implementing new sources of funds, three different programs were developed which correspond to the three TDM programs discussed in previous chapters. Three programs, depicted in Tables 7-6 (a to c), include projections of PTS revenues for 2020 and 2030 summarizing recommendations for new funding programs. In addition, projections of expenses for 2020 and 2030 are also shown along with the costs of TDM program recommendations from previous chapters. These programs include:

7.3.1 Minimal New Funding/Continued TDM Programs – Table 7-6(a)

a. New funding recommendations include:

- Increase of base parking permit rates by 8% to fund the additional bond payments for the C4C project.

b. TDM Program expansions include:

- Stampede Route Changes & Overlay Service

Table 7-6 (a)
CU-Boulder
Parking and Transportation Services
Projected Revenues & Expenses
With Minimal New Funding and Continued TDM Programs

Population Group	2010 Estimates[1]	Annual Growth Rate	2020 Forecast[1]	2030 Forecast[1]
Students	30,076	0.87%	32,797	34,951
Faculty/Staff	7,260	0.86%	7,907	8,605

PARKING REVENUE[2]	2010	Annual Growth Rate[3]	2020 Revenue Forecast[4]	2030 Revenue Forecast[4]
Faculty/Staff Permits	$1,402,271	0.43%	$1,463,749	$1,527,922
Student Permits	$1,300,629	0.38%	$1,350,907	$1,403,128
Business Permits	$280,684	0.30%	$289,219	$298,014
Citation	$949,105	0.50%	$997,642	$1,048,662
Visitor Permits	$359,030	1.00%	$396,592	$438,085
Meter Fees	$886,969	0.50%	$932,329	$980,008
Euclid Auto Park	$1,096,751	0.30%	$1,130,101	$1,164,466
Gates	$129,329	0.50%	$135,943	$142,895
Events	$895,256	0.50%	$941,040	$989,164
Bicycle	$22,460	0.80%	$24,323	$26,340
Refunds	($10,029)	0.80%	($10,861)	($11,762)
Misc.	$111,097	0.80%	$120,312	$130,291
Total Revenue from Existing Sources	**$7,423,552**		**$7,771,296**	**$8,137,213**
Recommended Funding Programs				
Increase to Base Rates (F/S,Student, Business Permits,Gates& Events) by 8% for C4C	$320,000	0.10%	$323,214	$326,461
Total New Revenues	**$320,000**		**$323,214**	**$326,461**
Total Existing & Additional Revenues	**$7,743,552**		**$8,094,510**	**$8,463,674**

PARKING EXPENSE[2]	2010	Annual Growth Rate[3]	2020 Expense Forecast[4]	2030 Expense Forecast[4]
Salaries & Benefits	$2,761,189	1.00%	$3,050,070	$3,369,175
Operating Expense	$767,087	1.00%	$847,341	$935,992
Utilities	$186,174	0.50%	$195,695	$205,703
Admin & Police Recharge	$608,233	1.00%	$671,868	$742,160
RTD Expense[5]	$685,849	2.00%	$836,046	$1,019,136
Debt Service[6]	$1,204,217	0.00%	$1,554,000	$1,434,000
Change in Fund Balance Fund Balance[7]	$1,210,803	0.10%	$389,490	$207,509
Renewal & Replacement			$250,000	$250,000
Total Expenses from Existing Programs	**$7,423,551**		**$7,794,510**	**$8,163,674**
Recommended Program Expansions				
Stampede Overlay Service	$300,000		$300,000	$300,000
Total New Expenses	**$300,000**		**$300,000**	**$300,000**
Total Existing & Additional Expenses	**$7,723,551**		**$8,094,510**	**$8,463,674**

Notes:
1. Provided by CU-Boulder Planning and Budgeting
2. Source: Parking & Transportation Services
3. LSC Estimate
4. 2020 & 2030 Forecasts are before inflation
5. CU-Boulder Campus only
6. Assumes Additional bond payment costs in 2011-14 are financed over 25 years at 4% increaseing debt service payments by $320,000
7. Difference between Revenues and Expenses

7.3.2 Moderate New Funding/Moderate TDM Program Expansions – Table 7-6(b)

a. New funding recommendations include:

- Increase of base parking permit rates by 8% to fund the additional bond payments for the C4C project.
- Consider implementing a Zone-based/Flexible Parking Rate Structure (with core zone rates 30% more than peripheral zone rates. This could raise about $95,700 in 2020.
- Consider implementing a Faculty/Staff EcoPass co-pay fee of $50. This could raise about $275,000 in 2020.

b. TDM Program expansions include:

- Covered/Secured Bike Parking
- Bike station/bikeshare programs
- Pedestrian & Bike Connections (2.4 miles)
- Stampede Route Changes & Overlay Service
- Carpooling spaces/discount rates
- Expanded car sharing
- Vanpools
- Fleet vehicle pick-up station on Main Campus
- Marketing & Incentives
- Access Controls for Market-based Parking Permit Program

Table 7-6(b)
CU-Boulder
Parking and Transportation Services
Projected Revenues & Expenses
With Moderate New Funding and Moderate TDM Program Expansions

Population Group	2010 Estimates[1]	Annual Growth Rate	2020 Forecast[1]	2030 Forecast[1]
Students	30,076	0.87%	32,797	34,951
Faculty/Staff	7,260	0.86%	7,907	8,605

PARKING REVENUE[2]	2010	Annual Growth Rate[3]	2020 Revenue Forecast[4]	2030 Revenue Forecast[4]
Faculty/Staff Permits	$1,402,271	0.43%	$1,463,749	$1,527,922
Student Permits	$1,300,629	0.38%	$1,350,907	$1,403,128
Business Permits	$280,684	0.30%	$289,219	$298,014
Citation	$949,105	0.50%	$997,642	$1,048,662
Visitor Permits	$359,030	1.00%	$396,592	$438,085
Meter Fees	$886,969	0.50%	$932,329	$980,008
Euclid Auto Park	$1,096,751	0.30%	$1,130,101	$1,164,466
Gates	$129,329	0.50%	$135,943	$142,895
Events	$895,256	0.50%	$941,040	$989,164
Bicycle	$22,460	0.80%	$24,323	$26,340
Refunds	($10,029)	0.80%	($10,861)	($11,762)
Misc.	$111,097	0.80%	$120,312	$130,291
Total Revenue from Existing Sources	**$7,423,552**		**$7,771,296**	**$8,137,213**
Recommended Funding Programs				
Increase to Base Rates (F/S,Student, Business Permits,Gates& Events) by 8% for C4C	$320,000	0.10%	$323,214	$326,461
Zone-Based/Flexible Parking Rate Structure (Zone 1=1.3 x Zone 2)	$94,300	0.15%	$95,724	$97,170
New Faculty/Staff EcoPass Pick-up Fee (@$50 x 70% for those not picking up)	$254,100	0.86%	$276,745	$301,175
Total New Revenues	**$668,400**		**$695,684**	**$724,806**
Total Existing & Additional Revenues	**$8,091,952**		**$8,466,979**	**$8,862,019**

PARKING EXPENSE[2]	2010	Annual Growth Rate[3]	2020 Expense Forecast[4]	2030 Expense Forecast[4]
Salaries & Benefits	$2,761,189	1.00%	$3,050,070	$3,369,175
Operating Expense	$767,087	1.00%	$847,341	$935,992
Utilities	$186,174	0.50%	$195,695	$205,703
Admin & Police Recharge	$608,233	1.00%	$671,868	$742,160
RTD Expense[5]	$685,849	2.00%	$836,046	$1,019,136
Debt Service[6]	$1,204,217	0.00%	$1,554,000	$1,434,000
Fund Balance[7]	$1,210,803	0.10%	$176,086	$19,980
Renewal & Replacement			$300,000	$300,000
Total Expenses from Existing Programs	**$7,423,551**		**$7,631,106**	**$8,026,146**
Recommended Program Expansions				
Covered/Secured Parking	$37,075		$37,075	$37,075
Bike Station/Bikeshare Programs	$97,820		$97,820	$97,820
Pedestrian & Bike Connections	$187,063		$187,063	$187,063
Stampede overlay Service	$300,000		$300,000	$300,000
Carpooling spaces/discount rates	$23,083		$23,083	$23,083
Expand Car Sharing	$10,000		$10,000	$10,000
Vanpools	$19,996		$19,996	$19,996
Fleet Vehicle Pick-up Station	$5,366		$5,366	$5,366
Marketing & Incentives	$77,358		$77,358	$77,358
Access Controls for Market/Flex Parking Structure	$78,112		$78,112	$78,112
Total New Expenses	**$835,873**		**$835,873**	**$835,873**
Total Existing & Additional Expenses	**$8,259,425**		**$8,466,979**	**$8,862,019**

Notes:
1. Provided by CU-Boulder Planning and Budgeting
2. Source: Parking & Transportation Services
3. LSC Estimate
4. 2020 & 2030 Forecasts are before inflation
5. CU-Boulder Campus only
6. Assumes Additional bond payment costs in 2011-14 are financed over 25 years at 4% increaseing debt service payments by $320,000
7. Difference between Revenues and Expenses

7.3.3 New Funding/Aggressive TDM Program Expansions – Table 7-6(c)

This program is intended to fund an aggressive TDM program designed to meet CU-Boulder's sustainability goals. In addition, it funds many key transportation infrastructure projects which will allow the university to complete the bike/ pedestrian plan on Main Campus; complete the Williams Village Micro-Masterplan; provide access connections for the redevelopment of the area north of Boulder Creek; and undertake access/bike/pedestrian connections necessary for the development of the East Campus.

a. New funding recommendations include:
   - Increase of base parking permit rates by 8% to fund the additional bond payments for the C4C project.
   - Consider implementing a Zone-based/Flexible Parking Rate Structure (with core zone rates 40% more than peripheral zone rates. This is could raise about $168,000 in 2020.
   - Consider implementing a new Faculty/Staff transportation fee (proposed at $7 per month per employee). This could raise $664,000 per year in 2020.
   - Consider increasing the Student Transportation (TDM) fee by 17% ($12 per semester). This could raise $846,000 per year in 2020.

b. TDM Program expansions include:
   - Covered/Secured Bike Parking
   - Bike station/bikeshare programs
   - Pedestrian & Bike Connections (4.5 miles)
   - Stampede Route Changes & Overlay Service
   - Buy up additional service or make service changes on two other routes (Bolt and HX or 205)
   - Fund 15% of new Orbit route (28^{th}/Folsom)
   - Carpooling spaces/discount rates
   - Expanded car sharing
   - Vanpools
   - Fleet vehicle pick-up station on Main Campus
   - Marketing & Incentives

c. Transportation Infrastructure Projects include:

   - North of Boulder Creek Connections at $1,000,000
   - Stadium Drive at $300,000
   - North Service Road at $600,000
   - East Campus Boulder Creek Bridge at $2,000,000
   - East Campus Road Connections at $3,500,000
   - East Campus Traffic Signals at $1,200,000
   - Williams Village Connections at $1,500,000

Table 7-6(c)
CU-Boulder
Parking and Transportation Services
Projected Revenues & Expenses
With Comprehensive New Funding and Aggressive TDM Program Expansions

Population Group	2010 Estimates[1]	Annual Growth Rate	2020 Forecast[1]	2030 Forecast[1]
Students	30,076	0.87%	32,797	34,951
Faculty/Staff	7,260	0.86%	7,907	8,605

PARKING REVENUE[2]	2010	Annual Growth Rate[3]	2020 Revenue Forecast[4]	2030 Revenue Forecast[4]
Faculty/Staff Permits	$1,402,271	0.43%	$1,463,749	$1,527,922
Student Permits	$1,300,629	0.38%	$1,350,907	$1,403,128
Business Permits	$280,684	0.30%	$289,219	$298,014
Citation	$949,105	0.50%	$997,642	$1,048,662
Visitor Permits	$359,030	1.00%	$396,592	$438,085
Meter Fees	$886,969	0.50%	$932,329	$980,008
Euclid Auto Park	$1,096,751	0.30%	$1,130,101	$1,164,466
Gates	$129,329	0.50%	$135,943	$142,895
Events	$895,256	0.50%	$941,040	$989,164
Bicycle	$22,460	0.80%	$24,323	$26,340
Refunds	($10,029)	0.80%	($10,861)	($11,762)
Misc.	$111,097	0.80%	$120,312	$130,291
Total Revenue from Existing Sources	**$7,423,552**		**$7,771,296**	**$8,137,213**
Recommended Funding Programs				
Increase to Base Rates (F/S,Student, Business Permits,Gates& Events) by 8% for C4C	$320,000	0.10%	$323,214	$326,461
Zone-Based/Flexible Parking Rate Structure (Zone 1=1.4 x Zone 2)	$165,400	0.15%	$167,898	$170,433
New Faculty/Staff Transportation Fee ($7 per month per employee)	$609,840	0.86%	$664,188	$722,820
Increased Student Transportation Fee ($12 per semester)	$775,961	0.87%	$846,163	$901,736
Total New Revenues	**$1,551,201**		**$1,678,248**	**$1,794,989**
Total Existing & Additional Revenues	**$8,974,753**		**$9,449,544**	**$9,932,202**

PARKING EXPENSE[2]	2010	Annual Growth Rate[3]	2020 Expense Forecast[4]	2030 Expense Forecast[4]
Salaries & Benefits	$2,761,189	1.00%	$3,050,070	$3,369,175
Operating Expense	$767,087	1.00%	$847,341	$935,992
Utilities	$186,174	0.50%	$195,695	$205,703
Admin & Police Recharge	$608,233	1.00%	$671,868	$742,160
RTD Expense[5]	$685,849	2.00%	$836,046	$1,019,136
Debt Service[6]	$1,204,217	0.00%	$1,554,000	$1,434,000
Fund Balance[7]	$1,210,803	0.10%	($3,958)	($184,503)
Renewal & Replacement			$300,000	$0
Total Expenses from Existing Programs	**$7,423,551**		**$7,451,062**	**$7,521,662**
Recommended TDM Program Expansions				
Covered/Secured Parking	$148,298		$148,298	$148,298
Bike Station/Bikeshare Programs	$109,960		$109,960	$109,960
Pedestrian & Bike Connections	$346,837		$346,837	$346,837
Stampede overlay Service	$300,000		$300,000	$300,000
Buy up of additional off-peak frequency or make service changes on two other routes	$200,000		$200,000	$200,000
Work with City/RTD to implement Orbit route (15% share of costs)	$230,000		$230,000	$230,000
Enhanced amenities at transit stops including real-time departure information at major stops.	$17,358		$17,358	$17,358
Carpooling spaces/discount rates	$34,083		$34,083	$34,083
Expand Car Sharing	$20,000		$20,000	$20,000
Vanpools	$39,992		$39,992	$39,992
Fleet Vehicle Pick-up Station	$5,366		$5,366	$5,366
Marketing & Incentives	$137,358		$137,358	$137,358
Access Controls for Market/Flex Parking Structure	$78,112		$78,112	$78,112
Transportation Infrastructure Projects				
North of Boulder Creek Connections ($1,000,000 @ 4% for 20 Years)			$73,582	$73,582
Stadium Drive ($300,000 @ 4% for 20 Years)				$22,075
North Service Road ($600,000 @ 4% for 20 Years)				$44,149
East Campus Boulder Creek Bridge ($2,000,000 @ 4% for 20 Years)			$147,164	$147,164
East Campus Road Connections ($3,500,000 @ 4% for 20 Years)				$257,536
East Campus Traffic Signals ($1,200,000 @ 4% for 20 Years)				$88,298
Williams Village Connections ($1,500,000 @ 4% for 20 Years)			$110,373	$110,373
Total New Expenses	**$1,667,364**		**$1,998,482**	**$2,410,540**
Total Existing & Additional Expenses	**$9,090,916**		**$9,449,544**	**$9,932,202**

Notes:
1. Provided by CU-Boulder Planning and Budgeting
2. Source: Parking & Transportation Services
3. LSC Estimate
4. 2020 & 2030 Forecasts are before inflation
5. CU-Boulder Campus only
6. Assumes Additional bond payment costs in 2011-14 are financed over 25 years at 4% increaseing debt service payments by $320,000
7. Difference between Revenues and Expenses

7.4 Advantages and Disadvantages of Various Funding Models

Throughout the development of the Transportation Master Plan, ideas and concepts for increasing revenues for transportation improvements were presented and considered for inclusion in the final document. Most of these concepts could be classified as falling into one of two groups: those that increase revenues to the university and those that transfer existing revenues between departments that provide transportation improvements. Each of these broad categories has their advantages and disadvantages that generally apply across the board to those financing options within the category. There may be minor deviations such as how fees might be enacted or implemented but overall ramifications are similar. An in-depth analysis of each method is not included in the scope of this document but should be considered as transportation funding options move forward.

7.4.1 Options That Increase Revenues

Options that increase the overall revenue to the university are the preferred method by which transportation improvements and TDM programs should be funded. In essence, many of the transfer options listed below are also funded through these sources because much of the costs are passed along to the end users. Sources of funds that are new revenues are:

- Student fee increases
- Tuition increases
- Room and board increases
- Transportation fees paid directly by employees (head tax, co-pay, monthly fee)
- Parking fees
- Government grants
- Donations

All of these are advantageous because they represent true increases in funding that can be applied to transportation measures. Revenues derived from these sources can be applied to the programs described in this Transportation Master Plan without negatively impacting other programs or the academic mission of the institution. With the exception of donations, most of these sources have predictable funding patterns and are largely stable, allowing long-term planning for TDM improvements and capital investment in infrastructure once they are implemented. Parking fees are well established and are an expected part of university employment. Assuming that the rate increase balances cost with demand (elasticity), raising parking fees would serve two purposes described earlier in this master plan – reducing parking demand while increasing parking revenue.

The political process of implementing these revenue sources is the most difficult aspect to overcome. The first three sources – student fees, tuition and room and board increases – are all considered as the cost of education. With declining support from the state, the university has increasingly had to rely on student fees and tuition to fund the educational mission of the institution and room and board has had to increase to cover the cost addressing deferred maintenance and enrollment growth in housing. There is political pressure to contain the total cost so that higher education is affordable to middle and lower income Coloradans. Thus, fees for transportation infrastructure may be seen limiting student access by increasing costs unnecessarily. Transportation fees for faculty and staff would raise issues of equity and may elicit debate about parking and TDM practices. By state statute, benefits and costs paid to or by one state employee must be the same as all other employees. Thus, all employees would need to pay the transportation fee. This has been seen as a burden to low income employees that often work shifts where alternative transportation modes are not available. Faculty and staff might be resistive to implementing a fee where one has not existed before, particularly if they do not use parking or transit. Such fee would likely have to start small and be phased in gradually over time.

In much the same way, parking fees impact students, faculty and staff and would raise many of the issue above. Parking fees would be considers part of a student's cost of education. Faculty and staff have consistently voiced concern over parking fee increases with regards to equity and impacts to the cost of living. This has become more acute as employees have been asked to shoulder more of the burden of health care, retirement and other traditional benefits without pay increases in order to help balance the state budget.

Donations and government grants are less certain than the other sources. Grants must be sought on a regular basis and funding for traditional programs has become more competitive in recent years. Donations require an active fundraising organization and transportation improvements have not been solicited in the past. A dedicated staff person would be required, donors identified and then pursued. This may be seen as competing against academic programs since the potential donor pool is well known and largely finite.

7.4.2 Options That Transfer Funds to Transportation

Options that do not increase the overall revenue of the university but instead transfer existing revenue to transportation providers include:

- General Administrative and Infrastructure Recharge (GAIR)
- Direct subsidies
- Annual budget requests
- Indirect Cost Recovery (ICR) fees
- Departmental transportation fees
- Capital construction fees

CU-Boulder's FY 2010-11 budget was $1.4 billion. If the institution was truly committed to making transportation a priority, funds could be reprioritized to fund the infrastructure and programs proposed in this document without increasing revenues. The funding mechanisms listed in this category are largely in place and can be adapted readily to achieve the goals and programs without being subject to the political debates and scrutiny that fee increases would receive.

The primary funding mechanism that exists today is GAIR (also known as GAR/GIR), which is like a tax placed on groups that benefit from university services and support but would not otherwise pay for them. GAR and GIR are calculated separately as a percentage of the monthly expenditures of auxiliaries and self-funded activities. It is used to fund the maintenance and construction of grounds, roads, sidewalks, etc. in support of the auxiliaries and self-funded activities to which it is charged. An increase in GIR would be one logical source of funds for transportation improvements, particularly those that support auxiliaries..

ICR is similar to GAIR and is charged to federal research grants awarded to the university. While the amount received from ICR is tremendous (approaching nearly 50% of a grant), there are equivalent restrictions that dictate how ICR revenues can be spent. Additional investigation is needed to determine whether any revenue from ICR can be used to support transportation initiatives proposed in this master plan.

Likewise a direct subsidy from the General Fund would cover costs to support the transportation needs of the academic units. The most likely way that this would occur, would be through annual budget requests submitted by PTS and Facilities Management for transportation improvements.

The biggest obstacle to implementing these types of fees is the lack of stability in the funding stream. Because each year is independent and must be requested, funding is subject to competing interests. For example, a failure in a pipe serving an auxiliary might require a disproportionate expenditure for utility improvements that would limit the amount of money that could be applied to TDM funding. Similarly, an academic or research initiative my gain priority over a General Fund subsidy of transportation causing a one-time or permanent reduction to the subsidy. This type of instability would make long-term transportation funding difficult to plan, implement and maintain.

Departmental fees would be a new extension of the concept of GAIR to academic and General Funded units. A fee could be based on the number of employees (departmental head tax) on expenditures like GIR, or on the amount of space occupied by a unit. This would avoid having employees paying directly for transportation infrastructure and programs but would have a direct impact on academic units and their mission.

Capital construction represents another area where revenue could be transferred to transportation infrastructure providers. CU-Boulder frequently constructs and renovates buildings on campus, averaging close to $120 million per year over the past four years. Municipalities frequently require “growth to pay its own way” and tax new developments in the form of development excise taxes, use taxes, plant investment fees, permit fees and other charges. To some extent, the university is similar and assesses some plant investment fees, lost parking fees and permit fees on its projects. Unlike a municipality, fees charged a capital project are coming ultimately from the institution and if passed through contractor, will be marked up, costing the institution more than a direct transfer.

University capital construction suffers from the perception that it is too expensive. There is constant pressure to keep costs down and maximize the amount of construction put in place. Transportation fees on capital projects have been rejected in the past because of their impact to a project’s bottom line. It would be difficult to do long-term transportation planning to account for this type of funding since it would vary greatly depending on the number of projects being built.

Within all the transfer options, there are state laws and fiscal rules that apply differently to each source. As noted, ICR may not be able to be applied to transportation. State funds are prohibited by law from being applied to internal university charges such as plant investment fees. Other rules likely exist meaning that much additional study is required before all the ramifications of fee transfers are known.

7.4.3 Funding Options Summary

It is clear from this discussion that there is no easy solution to funding transportation infrastructure and programs. It is likely that a variety of funding sources will be needed to accomplish the various TDM programs outlined above. New revenue sources are desirable since they do not adversely affect existing programs. Issues of equity and fairness must be addressed in any solution. Existing methods for transferring funds must be understood to avoid running afoul of laws and fiscal rules. This section of the Transportation Master Plan presents ideas and concepts about several possible transportation futures. One can only conclude that additional investigation is needed to develop a viable proposal that ensures financial viability of transportation providers like PTS at a price that is fair to those that use the transportation system.

CHAPTER 8
Summary of Recommendations

The Transportation Master Plan is an element of the *2011 Campus Master Plan* which fulfills CU-Boulder's obligation under CRS 23-1-106 for higher education institutions to have an approved master plan for facilities prior to the submission of capital construction requests. It also continues CU-Boulder's tradition of academic excellence and its distinction as one of the "Most Eco-Enlightened U.S. Universities."

The Transportation Master Plan must also meet the goals of the *Flagship 2030 Strategic Plan* which will increase enrollment by 5,300 students and tenure-track faculty by 300 positions. At the same time as growth is forecast, broad sustainability goals set high aspirations for the University:

- Reduce greenhouse gas (GHG) emissions 20% by 2020, and
- Become carbon-neutral by 2050.

The master plan adopts the goals listed in the Sustainability Task Force document, which are to:

- Move toward a higher proportion of transportation fuels derived from renewable resources;
- Increase vehicle occupancy;
- Reverse the growth in the average length of trips taken; and,
- Work to reduce the growth in the number of trips taken while retaining the current modal hierarchy of pedestrians, bicycles and skateboards, transit, car share/carpool and single occupancy vehicles (SOV).

8.1 Accomplishments and Future Challenges

8.1.1 Accomplishments

The Transportation Master Plan is completed on the 20th Anniversary of the first comprehensive transportation demand management program for CU-Boulder. Those efforts were initiated in Fall 1991 and today this document continues the commitment. The following summarizes what it has taken to accomplish today's celebrated successes:

- Collaborative transportation demand management actions, including those of CU-Boulder have meant that traffic volumes in Boulder have decreased approximately 13% from 2001 to 2009 while at the same time metropolitan Denver traffic volumes are up 12%. The result is a total 25% difference in traffic volumes had CU's programs not been in place.

- 2010 survey data of student and faculty/staff suggest that if both the faculty/staff EcoPass program and the Student Bus Pass Program were to end, then CU-Boulder would need an additional 2,950 parking spaces today.

- CU-Boulder has one of the lowest single-occupant vehicle (SOV) modal splits among major universities.

- CU-Boulder is in the top 9% of universities in the nation with regard to campus transit service, with over 28 transit routes now providing access to campus and CU student transit ridership having increased over 974% since 1991.

- CU-Boulder compares favorably with its peer universities and "excellent" rated universities with regard to bicycle and pedestrian facilities.

8.1.2 Future Challenges

As CU-Boulder embarks on planning for the next 20 years, if faces many issues that will challenge its ability to both physically and financially meet its projected growth and its sustainability goals, including:

- Parking and Transportation Services' (PTS) revenue streams are currently strained to offset its existing operating costs, which include the new debt service for the recently completed Center for Community parking structure.

- CU-Boulder's Travel Demand Management (TDM) programs have been very successful, but unless these programs continue to expand the university will need to build additional parking to address future parking demand. Building new parking is significantly more expensive than TDM. The university will need to off-set projected growth in travel demand as well as to reduce green house gas emissions to achieve its sustainability commitments.

- The university's parking system currently has limited supply in the high demand areas of Main Campus and an under-utilized supply at East Campus and the current price of parking does not reflect the cost of providing that parking. Excess supply and under-priced parking are major deterrents to successful TDM programs.

- The Main Campus of the university is nearing build-out. Although there are a variety of viable alternative transportation options offered on Main Campus, there is still a need for enhanced and new pedestrian, bicycle and transit infrastructure and services.

- Approximately 36% of the university's total parking supply is not within the management and control of PTS (over 4,000 parking spaces). Much of this parking is provided with no direct permit or other fee charged to users. Without centralized oversight of the parking supply, the university will not have consistency in its approach to parking management and will not be as successful as it can be in achieving a change in travel behaviors and in reducing parking demand.

- If no improvements are made to current travel demand management programs, rather than reducing GHG's by the 2020 campus goal of 20%, CU-Boulder's GHG's will be reduced by only 8% by 2020 (primarily due to the federally mandated increase in vehicle fuel economy standards) and commuting vehicle miles traveled will increase by 8%.

- If no improvements are made to current travel demand management programs, parking demand will increase by 1,700 spaces by 2030.

8.1.3 Travel Demand Management Response to Future Challenges

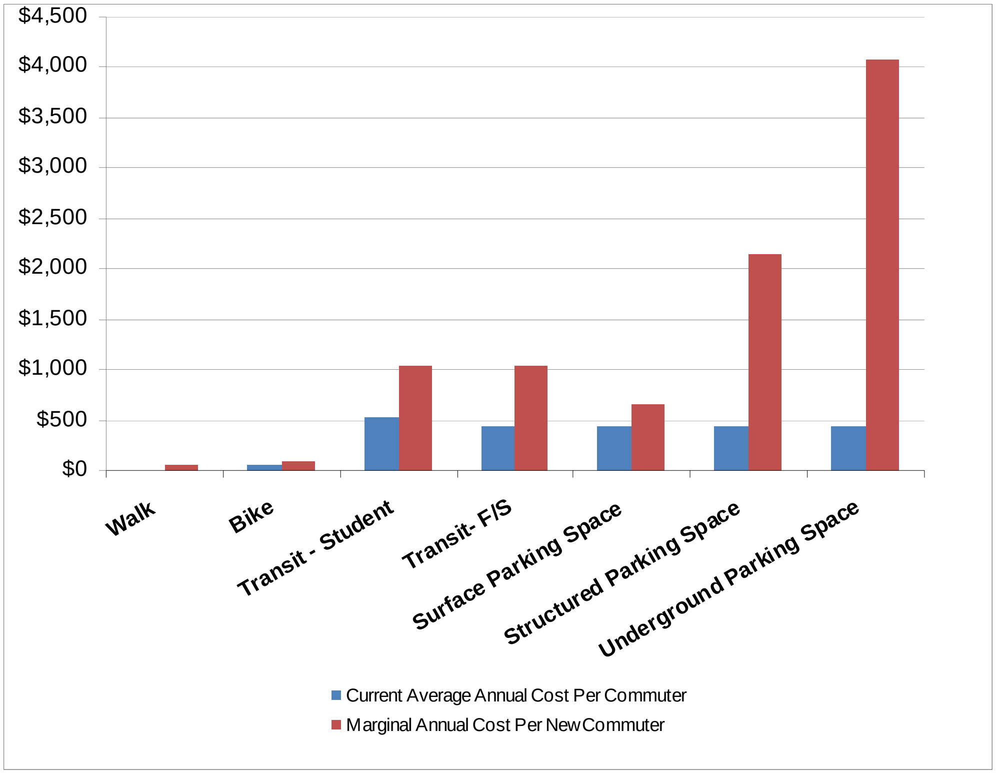
The CU-Boulder response to these future challenges is to manage parking, improve pedestrian, bicycle, and transit access to campus, and to thereby achieve VMT and GHG goals. The tools and techniques which will be applied and expanded include the following:

Reduce the need to travel	• Land use – intensification • University villages with housing, academic, retail, and service facilities • Tele-working, video conferencing
Provide for travel choices	• Allocation of street space (to public transit, walking, bicycling, high occupancy vehicles) • Improved public transit services • Construction of walking and bicycling networks
Influence travel choices	• School, Business, and Community Travel TDM Plans • Improved Travel Information • Pricing of parking and roads (i.e., US 36)

CU-Boulder's experience shows that TDM costs approximately four times less than building additional parking. This *least-cost* planning approach is the best approach to help the university address the challenges it is facing.

Chart 8-1 summarizes an analysis of the average and marginal cost per trip for various modes at CU-Boulder. The current average cost per trip reflects actual costs to the University of providing this mode per commuter per year. The marginal cost per new trip is an estimate of what it could cost the university per commuter per year to provide this service in the future and reflects the cost of needed capital improvements, programs and services needed to provide this new trip.

Chart 8-1
Annual Cost Per Commuter



Therefore it is recommended that the following should be considered in all future transportation decision-making:

- TDM should be implemented first before considering street capacity improvements and adding parking;

- Land is a scarce and valuable asset at CU-Boulder, planned land uses should aim to minimize induced travel demand and encourage the use of alternative modes;

- The supply and price of parking are two key factors in choice of travel mode and the university should use these variables to achieve financial sustainability and to encourage use of alternative modes of transportation;

- Consistent parking management and pricing throughout CU-Boulder can address inequities that currently exist; and

- Transportation investments to improve commuting to campus by affiliates should consider the costs of accommodating each type of trip to campus (i.e., bike, pedestrian, transit, carpool/vanpool, etc.).

8.2. Transportation Master Plan Vision and Goals

8.2.1 Transportation Vision Statement

During the Campus Master Plan process, a vision emerged for the Transportation Master Plan that describes the aspirations of the Boulder Campus. The vision is one where:

- Mobility and accessibility are ensured for all CU-Boulder faculty, staff, students, visitors and vendors regardless of race, age, income or disability; and

- CU-Boulder bicycle and pedestrian facilities, public transit systems, campus streets and surrounding community streets are all safe and well-maintained and take users when and where they need to go; and

- An integrated, market-based pricing system for the parking supply helps to not only manage the demand on the transportation and parking system but also helps to pay for its improvements and for programs and services to reduce travel demand; and

- The impacts of travel activities are recognized and CU-Boulder functions as a good neighbor to mitigate the negative impacts on surrounding communities; and

- The CU-Boulder campuses are transformed by a growth pattern that creates complete campus communities with ready, safe and close access to classrooms, research and laboratories, jobs, shopping and services and are connected by reliable and cost-effective transit and alternative travel mode facilities; and

- Technology is implemented including:
  - clean fuels and vehicles;
  - traffic operation systems that manage traffic flow and reduce delay and congestion on nearby roadways;
  - advanced and accessible traveler information that allows for informed travel choices; and
  - transit systems and strategies that synchronize schedules and routes to speed travelers to desired destinations; and

- There is a viable choice to leave autos at home and take advantage of a seam-less network of accessible pedestrian and bicycle paths that connect to nearby bus, rail and other alternative travel modes that can carry users to school, work, shopping, recreation and services; and

- CU-Boulder works with regional and local agencies and stakeholders to take effective action to protect the earth's climate and to serve as a model for national and international action; and

- CU-Boulder's transportation investments and travel behaviors are driven by the need to reduce the impact on the earth's natural habitats; and

- All who work, learn, and teach at CU-Boulder and those who visit enjoy a higher quality of life.

8.2.2 Transportation Goals

The Transportation Master Plan, as an element of the CU-Boulder Master Plan, will work in conjunction with the *Flagship 2030 Strategic Plan* and provides guidance on how to address these challenges and recommendations to:

- Provide a framework and guidance for transportation planning and management over the next 20 years in order to help the university achieve a sustainable transportation future;
- Reduce congestion in and around the campuses and to reduce the total number of motor vehicles driven to campus, which will result in reduced parking and travel demand;
- Provide convenient and viable alternative mode options to the campus community in order to encourage the use of transportation modes other than the single-occupant vehicle;
- Better manage the available parking supply and to price it to ensure financial sustainability and to encourage alternative mode use;
- Ensure TDM and parking management strategies are considered and incorporated into projects as the campuses develop and to use other methods, such as providing more on-campus housing and building university villages (which integrate student, faculty, and staff housing along with education, retail, sustainable transportation, and service facilities), to minimize or eliminate the need to build new parking;
- Achieve greenhouse gas emission (GHG) reductions in campus transportation by 2020 in comparable proportion (about 20%) that the transportation sector contributes locally to campus GHG;
- Develop viable financial strategies to address current financial deficits of Parking and Transportation Services as well as to identify funding for new and expanded efforts to achieve a reduction in travel and parking demand;
- Develop both long-range and short-term strategies to move people between the various properties that compose CU-Boulder; and
- Continue to coordinate the university's transportation planning goals with regional efforts.
- Analysis of CU-Boulder mode share scenarios demonstrates that zero growth in campus-related travel (vehicle miles of travel) is possible even with projected growth in student enrollment and faculty/staff. It is recommended that TDM

programs and services be implemented that will achieve zero growth in vehicle mile of travel and CU-Boulder's GHG reduction goals.

8.3 TDM Program Improvements and Recommendations

This Transportation Master Plan used least-cost planning analysis tools to examine the costs of commuting by various modes and analyzed alternative TDM program packages as shown in Table 8-1. The "aggressive" package is recommended to meet the stated objectives of the *Flagship 2030 Strategic Plan* and its greenhouse gas emissions goals.

Table 8-1
TDM Program Options

	Continue Existing Programs	Moderate Expansion	Aggressive Expansion
Reduce Travel			
On-Campus Housing	* Add 1,500 beds by 2030	* Add 1,500 beds by 2030	* Add 1,500 beds by 2030
Integrated Trip Reduction	* Promote telecommuting, flexible work schedules & flexible start/end times	* Promote telecommuting, flexible work schedules & flexible start/end times	* Promote telecommuting, flexible work schedules & flexible start/end times * Implement staggered staggered class times
New Construction		* Propose reduced parking standards * Create & implement bike parking standards	* Propose reduced parking standards * Create & implement bike parking standards * Create & implement transit standards
Provide for Travel Choices			
Bicycle/Pedestrian	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Covered Parking near Arnett Hall	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Provide 100 more covered spaces * Provide additional bike racks as needed * Expand bike share programs * Add bike station at Williams Village * Add bike Station at Engineering Center * Add bike share Station at UMC * Add 2 secure bike parking locations * Add 2.4 miles of bike/pedestrian facilities around and through campus	* Bike racks around most buildings * Regular surveys of bike parking * Bike Station located near the UMC * Mobile Mechanic * Buff Bikes–bike sharing/semester rentals * Provide 200 more covered spaces * Provide additional bike racks as needed * Expand bike share programs * Add bike station at Williams Village * Add bike Station at Engineering Center * Add bike share Station at UMC * Add bike share Station at Williams Village * Add two bike share stations on East Campus * Add 5 secure bike parking locations * Add 4.5 miles of bike/pedestrian facilities around and through campus
Transit	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * WV: change from 2-artic + 4-std buses to 4-artic + 2-std buses on the Buff Bus * EC: no change needed to STAMPEDE through 2020. 3-std buses * MC: transit service growth is incremental and paid through EcoPass and Student Pass. * MC: conduct traffic operation + simulation study of 18th/Colorado corridor.	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * Supplement Stampede with additional overlay/shuttle route between EC + MC * Buy up of additional service on one other route (Bolt) * WV: change from 2-artic + 4-std buses to 7-artic on the Buff Bus * EC: Add some capacity. Move from 3-std to 3-artic buses (RTD) * MC: transit service growth is incremental and paid through EcoPass and Student Pass. * MC: Modest improvements in marketing downtown Boulder - Main Campus transit option.	* Regional Coverage * SkyRide * Late-night transit * CU Ski Bus * Buy up of additional off-peak frequency on the Stampede route * Supplement Stampede with additional overlay/shuttle route between EC + MC * Buy up of additional service or make service changes on two other routes (Bolt and HX or 205) * WV: change from 2-artic + 4-std buses to 10-artic on the Buff Bus * EC: Add significant capacity. Move from 3-std to 4-artic buses (RTD) * MC: Implement full traffic/bike/ped design changes on 18th/Colorado corridor. * MC: Modest improvements in marketing downtown Boulder - Main Campus transit option. * WV: Work with City to add US 36 slip ramp stop at south edge of the WV Campus. * Work with City & RTD to implement the Orbit bus route * Enhanced amenities at transit stops including real-time departure information at major stops.
Ridesharing	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C * Add 60 carpool spaces on Main Campus * Consider reduced carpool permit fees (50%)	* Ridematching through Zimride * Reserved priority carpool spaces at Wolf Law, Leeds Business & C4C * Add 60 carpool spaces on Main Campus * Add 30 carpool spaces on East Campus * Consider reduced carpool permit fees (50%)
Vanpooling		* Form 5 Vanpools	* Form 10 Vanpools
Carsharing	* Six CarShare vehicles	* Add 10 CarShare vehicles as funding becomes avaialble	* Add 20 CarShare vehicles as funding becomes avaialble
Fleet Vehicles	* Fleet vehicles available on East Campus	* Fleet vehicles available on East Campus * Provide pick-up location on Main Campus	* Fleet vehicles available on East Campus * Provide multiple pick-up locations on Main Campus
Influence Travel Choices			
Transit	* Continue Student Bus Pass Program * Continue Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs	* Student Bus Pass Program * Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs	* Student Bus Pass Program * Faculty/Staff EcoPasses * Guaranteed Ride Home with EcoPass * Find options to increase funding to monitoring programs
Parking Management	* Proximate permits 20% more than peripheral permits	* Implement Zone permit structure with Core permits 30% more than peripheral permits * Implement Flexible Permit Program to allow fewer than 5 day use	* Implement Zone permit structure with Core permits 40% more than peripheral permits * Implement Flexible Permit Program to allow fewer than 5 day use * Install access control (gates) at larger lots and implement parking management technology with the capability of monitoring parking use and charging demand-based parking rates
Marketing and Incentives	* Periodic Commuter Surveys * Website "connection" programs to link individuals to various modes of travel	* Periodic Commuter Surveys * Enhanced Website "connection" programs to link individuals to various modes of travel * Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards) - FTE & incentives budget * Implement "Buddy" programs to show how to use transit, bike, etc., connect students to TDM - 1 Part-time student	* Periodic Commuter Surveys * Enhanced Website "connection" programs to link individuals to various modes of travel * Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards) - 2 FTEs & incentives budget * Implement "Buddy" programs to show how to use transit, bike, etc., connect students to TDM - 2 Part-time student * Develop social network apps for transit, bikesharing, carsharing, carpooling, etc.

Note: EC = East Campus; MC = Main Campus; WV = Williams Village

Reduce Travel

- Add 1,500 beds by 2030
- Promote telecommuting, flexible work schedules & flexible start/end times
- Implement staggered class times.
- Propose reduced parking standards for new construction
- Create and implement bike parking standards for new construction
- Create and implement transit standards for new construction

Provide for Travel Choices

Bike/Pedestrian

- Monitor campus bike racks/Provide additional bike racks as needed where space is available
- Maintain the bike station located near the UMC
- Provide 200 more covered spaces
- Expand bike sharing programs
- Add bike stations at Williams Village and Engineering Center
- Add bike share stations at East Campus, Williams Village and at UMC
- Add 4.5 miles of bike/pedestrian facilities around and through campus
- Develop secure bike parking at two to five sites listed in Figure 8-3.

Transit

- Regional Coverage
- SkyRide
- Late-night transit
- CU Ski Bus
- Supplement Stampede with additional overlay/shuttle route between East Campus and Main Campus
- Buy up additional off-peak frequency or make service changes on two other routes
- Implement the Orbit bus route
- Enhanced amenities at transit stops including real-time departure information at major stops
- Williams Village: Change from 2 articulated and 4 standard buses to 10 articulated buses on the Buff Bus
- East Campus: Add significant frequency of service and passenger capacity. Provide added frequency of service as demand warrants. Move from standard to articulated buses as demand warrants.
- Main Campus: Implement first phase traffic/bike/ped design changes on 18^{th}/Colorado corridor
- Main Campus: Modest improvements in marketing downtown Boulder – Main Campus transit option
- Williams Village: Work with the City to add a US 36 slip ramp stop at south edge of the WV Campus

Ridesharing

- Add 60 carpool spaces on Main Campus
- Add 30 carpool spaces on East Campus
- Reduced carpool permit fees (50%)

Vanpools

- Form 10 vanpools

Carsharing

- Add 20 carshare vehicles as funding becomes available

Fleet Vehicles

- Provide pick-up locations on Main Campus and East Campus

Influence Travel Choices

Transit

- Continue Student Bus Pass Program
- Continue Faculty/Staff EcoPasses
- Guaranteed Ride Home with EcoPass

Marketing and Incentives

- Find options to increase funding to monitoring programs
- Conduct periodic commuter surveys
- Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards) – 2 FTEs and incentives budget
- Implement “Buddy” programs to show how to use transit, bike, etc. connect students to TDM. 2 part-time students.
- Develop social network apps for transit, bikesharing, carpooling, etc.

Parking

- Consider zone permit structure with core permits 40% more than peripheral permits.
- Propose a Flexible Permit Program to allow fewer than 5 days use.
- Install access control (gates) at larger lots and implement parking management technology with the capability of monitoring parking use and charging demand-based parking rates.

Costs for the Aggressive TDM program are given in Table 8-2.

Table 8-2
Aggressive Expansion of TDM Programs

Category	Program	Description	Capital	Annual	Reduction of SOV's Students	Reduction of SOV's F/S	Annualized Cost		Total Diverted SOV	Cost Per Diverted SOV
Reduce Travel										
Integrated Trip Reduction	* Promote telecommuting, flexible work schedules & flexible start/end times	2 Part-time Students		$20,000	50	80	$20,000		130	$154
Provide for Travel Choices										
Bicycle/Pedestrian	* Provide 200 more covered spaces * Provide 5 secure bike parking locations	200 Spaces 5 Secure Locations	$200,000 $1,000,000	10,000 50,000	40	30	$14,830	(1)	70	$212
	* Add bike station at Williams Village * Add bike Station at Engineering Center	2 Bike Stations	$400,000	$60,000						
	* Add bike share Station at UMC * Add bike share Station at Williams Village * Add two bike share stations on East Campus	4 Bike Share Stations	$220,000		200	40	$10,996	(1)	240	$46
	* Expand bike share programs * Pedestrian & Bike Connections	50 Bikes 4.5 miles	$25,000 2,806,540	$2,500 140,327	300	70	$34,684	(1)	370	$94
Transit	* Supplement Stampede with additional overlay/shuttle route between EC + MC	Additional Bus on Short-turn Loop		$300,000	120	60	$300,000		180	$1,667
	* Buy up of additional service or make service changes on two other routes (BOLT and HX or 205)	Route extension		$200,000	200	70	$200,000		270	$741
	* Work with City/RTD to implement Orbit route (15% share of costs)	Orbit Route		$230,000	130	60	$230,000		190	$1,211
	* Enhanced amenities at transit stops including real-time departure information at major stops.	Hardware/Software	$100,000	$10,000	50	25	$17,358		75	$231
Ridesharing	* Add carpool spaces on Main Campus * Add carpool spaces on East Campus * Reduced carpool permit fees	60 Close-in Spaces 30 Close-in Spaces 50% discount on Core Rate	$12,000 $6,000	$1,200 $600 $32,000	50	40	$34,083		90	$379
Carsharing	* Expand Car Sharing (eGo)	Add 10 cars		$20,000	20		$20,000		20	$1,000
Vanpooling	* Vanpooling (50% Purchase Subsidy, Free Permit)	Purchase 10 vans	$135,000	$17,500	20	40	$39,992		60	$667
Fleet Vehicles	* Main Campus Fleet Vehicle Pick-up	Site for 5 Vehicles	$175,000	$24,500		10	$5,366	(1)	10	$537
Influence Travel Choices										
Parking Management	* Implement Zone permit structure on Main Campus with Core permits 30% more than peripheral permits	Access controls, technology & Software	$450,000	$45,000	100	150	$78,112			
		Core 40% more than Peripheral		($165,400)			($165,400)			
	* Implement Flexible Permit Program to allow fewer than 5 day use					25				
Marketing and Incentives	* services) to purchase parking, connect to TDM services, etc.	Purchase/develop software	$100,000	$10,000	20	20	$17,358			
	* Incentive Programs (bike discounts, bike/pedestrian challenges & rewards, carpool/vanpool priority parking, discounts, etc.)	2 FTEs plus rewards		$100,000	200	100	$100,000			
	* "Buddy" Programs - show how to use transit, bike, etc. Connect people to TDM.	2 Part-time Student		$20,000	20	40	$20,000			

Notes:
(1) Only 10% of CU costs allocated to new users)

8.4 Pedestrian Improvements and Recommendations

The recommended Campus Pedestrian Corridors are shown in Figure 8-1. There are two types of pedestrian-oriented designations on the CU-Boulder Campus. *Major Pedestrian Corridors*, and *Pedestrian Only Corridors*. Together, these facilities comprise the pedestrian network on campus and lay the groundwork for CU-Boulder's attractive and safe pedestrian environment.

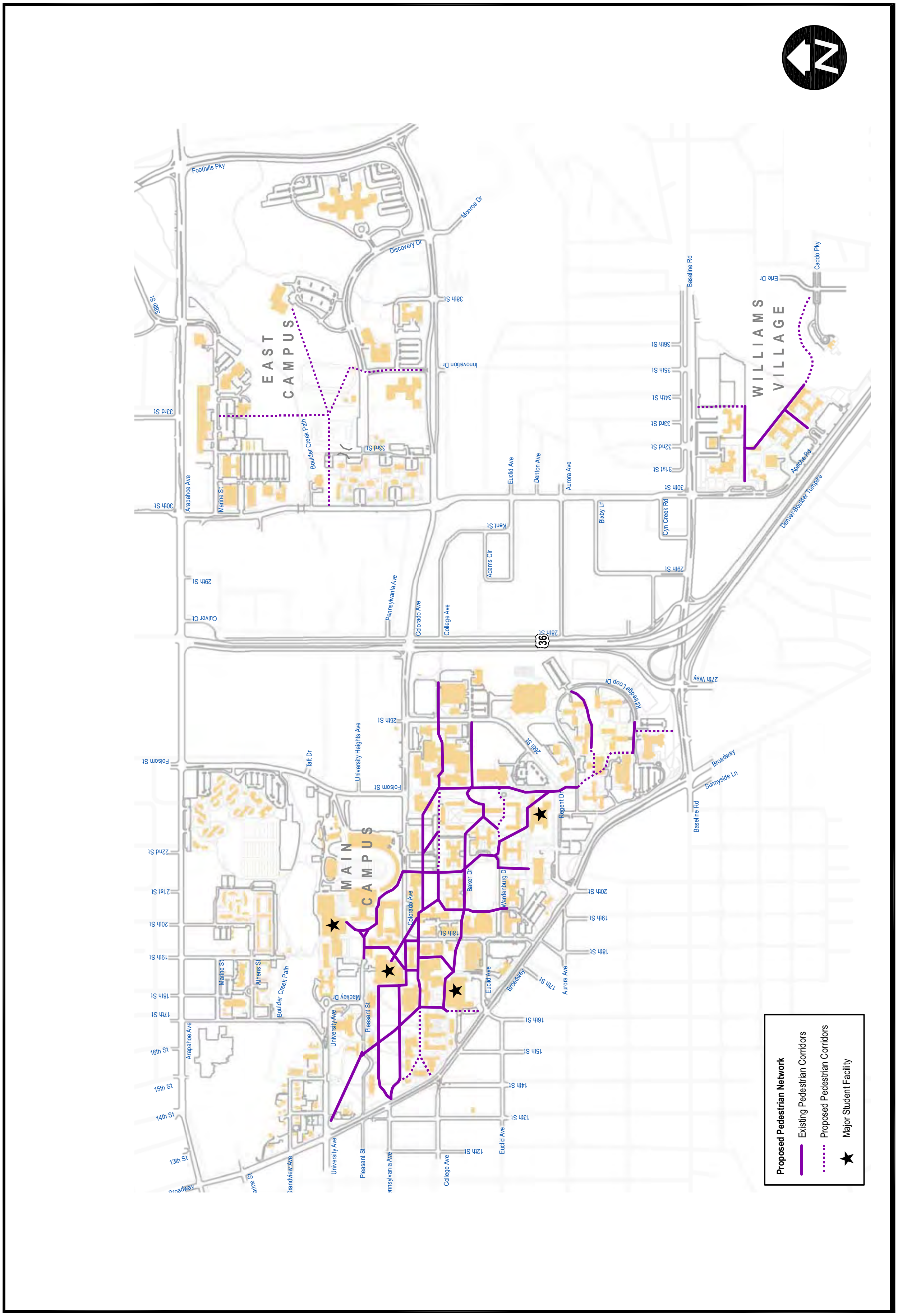


Figure 8-1

Proposed Pedestrian Network

CU-Boulder Transportation Master Plan

The purpose of identifying a pedestrian network on campus is to prioritize current/future improvements, maintenance, and other issues that face the pedestrian environment on campus. There are many paths, rights of way and sidewalks that are used every day on campus, but are not major corridors. The purpose of this discussion is to identify *key* pedestrian corridors on campus and acknowledge them for planning and development purposes.

8.4.1 Major Pedestrian Corridors

Major pedestrian corridors are thoroughfares heavily used throughout the day, and support large volumes of pedestrian traffic during peak-travel times. Because of their significance to the greater pedestrian network, service vehicles, bicycles and skate-boards would ideally refrain from using these parts of campus during peak travel times. For planning purposes and future development, Major Pedestrian Corridors (MPCs) should take priority with respect to maintenance and snow removal. As Main Campus develops and East Campus continues to grow, designating additional MPCs will ensure that CU-Boulder continues to be a pleasant place to walk.

8.4.2 Pedestrian Only Corridors

Pedestrian Only Corridors (POCs) are special areas on campus. These areas combine thematic and physical design that prioritizes pedestrian movement and enhances the overall beauty of the campus. There are currently two POCs in development stages. The Central Campus Walkway and the University Memorial east pathway through Fine Arts Green are scheduled to be the first POCs on campus. POCs will be designated and designed for pedestrian use only. Service vehicles and bicycles will be discouraged from utilizing these areas of campus. In the future, CU-Boulder may want to designate other areas of campus as POCs as growth and need warrant.

8.5 Bicycle Improvements and Recommendations

8.5.1 On-Campus Bicycle Improvements

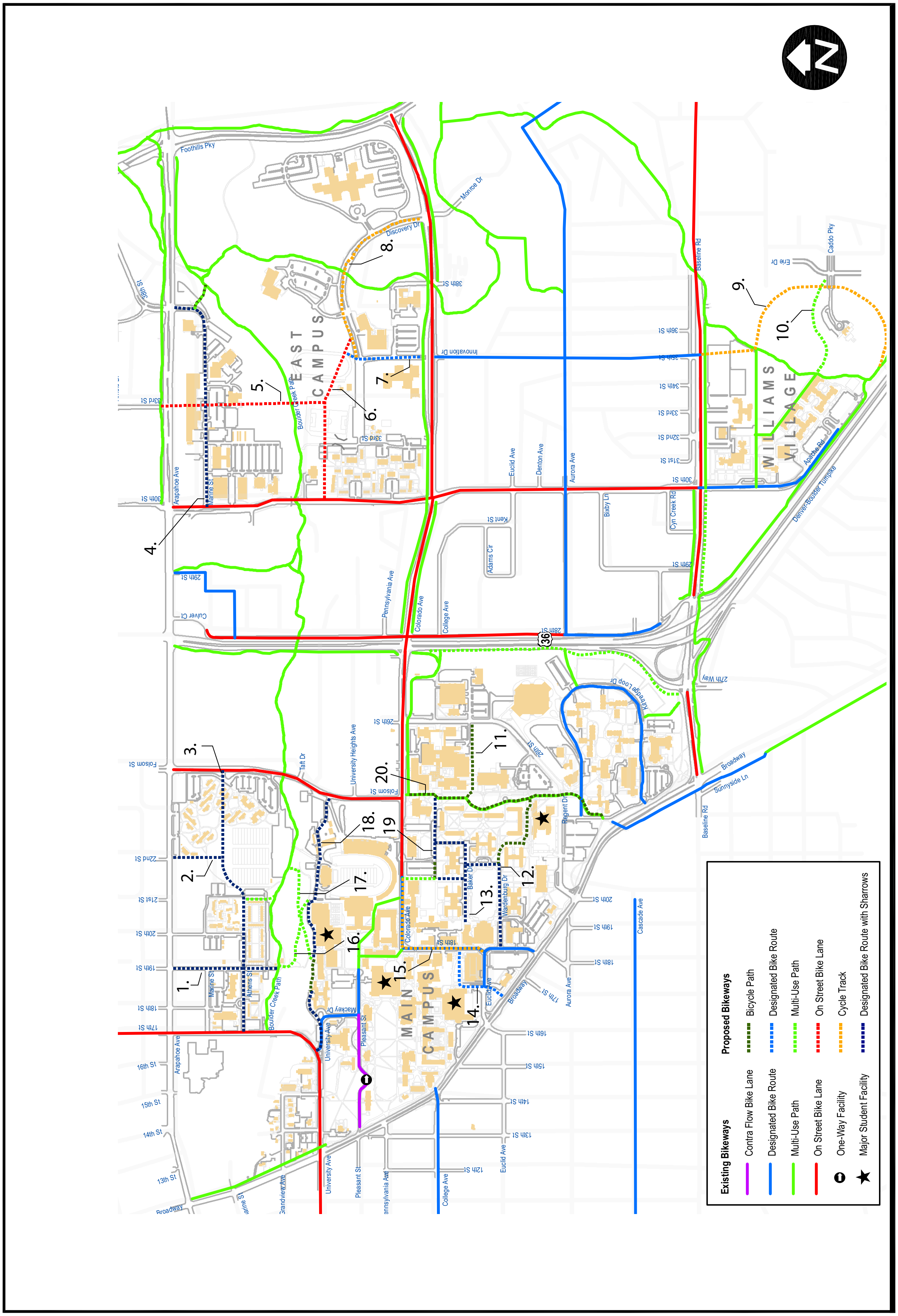
To encourage bicycle/skateboard use off Major Pedestrian Corridors and restrict their use on Pedestrian Only Corridors, a connected, viable network must be implemented for bicyclists and skateboards to travel throughout campus. The recommendations in this plan establish a network of varying facilities to provide enhanced convenience and connectivity for non-motorized travel to, from and between campuses. The recommendations are listed in Table 8-3.

Figure 8-2 outlines the additions to the existing bike network. It is important to note that some of these projects will take longer to fund and build. This network is designed to provide bicyclists a viable, uninterrupted system of routes to get through campus. *A primary component to improving the bikeway network will require that off-street facilities provide separation from pedestrian use if/when space permits*. In areas of new development/facilities, all off-street bicycle and pedestrian facilities should be separated.

Separation can be provided via elevation changes, landscaping, fencing, bollards and other design features. This is most relevant to the East-West Bikeway and to the path that runs north and south from the Engineering Complex towards the Kittredge Loop.

Table 8-3
Proposed Campus Bikeways

Project ID	Corridor	Facility Type	Limit 1	Limit 2	Length (miles)
1	19th St	Shared Lane Marking	Arapahoe Ave	Grandview Ave	0.18
2	22nd St	Shared Lane Marking	Arapahoe Ave	Grandview Bike Path	0.08
3	Marine Court	Multi-use Path	19th St	Dal Ward	0.15
4	Marine St	Shared Lane Marking	Arapahoe Ave	30th St	0.42
5	35th St	Bike Lanes	Shadow Creek Dr	Arapahoe Ave	0.16
6	Shadow Creek Dr	Bike Lane	30th St	Discovery Dr	0.4
7	Innovation Dr	Bike Route	Colorado Ave	Shadow Creek Dr	0.12
8	Discovery Dr	Cycletrack	Colorado Ave	Innovation Dr	0.36
9	35th South	Cycletrack	Baseline Road	Bear Creek Apartment Path	0.5
10	Williams Village	Bike Path	Bear Creek Apartments	Caddo Pkwy	0.2
11	Leeds-Engineering	Multi-Use Path	North-South Bikeway	Regent Dr	0.13
12	Wardenburg Dr	Shared Lane Marking/ Multi-Use Path	18th St	North-South Bikeway	0.34
13	Baker Dr	Shared Lane Marking	SE corner of Libby Hall	SW corner of Baker Hall	0.2
14	UMC/Bike Station	Bike Route	18th St	Broadway	0.12
15	18th St/Colorado	Cycletrack	Euclid Ave	Colorado Ave Bike Lanes	0.2
16	Marine – Boulder Creek Connector	Multi-use Path	Marine St	Boulder Creek	0.05
17	Lot 169 Path	Multi-use Path	Lot 169	Rec Center	0.2
18	Stadium Drive	Shared Lane Marking	Folsom Street	17th St	0.53
19	Libby Drive	Shared Lane Marking	Duane Physics/ Colorado Connector	Cockerell Dr	0.12
20	North-South Bikeway	Multi-Use Path	Colorado Ave	Broadway Multi-Use Path	0.42



Proposed Bicycle Network with Classifications

CU-Boulder Transportation Master Plan

Figure 8-2

8.5.2 Off-Campus Bicycle Connections

An important facet of the recommended network is it how it synthesizes with the greater City of Boulder network. To maximize the convenience of bicycle travel to campus, it is important that the Campus network provides multiple, convenient connections to bikeways in the City of Boulder. In the development of the proposed CU bikeway network, connections to the City of Boulder's bikeway network were examined to ensure that the CU bikeways were integrated with Boulder. Table 8-4 lists the proposed CU bikeways and their connections to the Boulder bikeway network.

Table 8-4
Proposed Bikeways Connecting to Boulder Bikeways

Proposed CU Facility	Proposed Facility Type	Connecting Boulder Facility	Connecting Boulder Facility Type
University Ave	Shared Lane Marking	University Ave	Bike Lane
Stadium Dr	Shared Lane Marking	Folsom St	Bike Lane
Athens Ct	Multi-use Path	Boulder Creek	Multi-use Path
Lot 169 Path	Multi-use Path	Boulder Creek	Multi-use Path
Regent Dr	Shared Lane Marking	Broadway Path	Multi-use Path
Regent Dr	Shared Lane Marking	Colorado Ave	Bike Lane
Libby Dr	Shared Lane Marking	Colorado Ave	Bike Lane
Discovery Dr	Cycletrack	Boulder Creek	Multi-use Path
Innovation Dr	Bike Route	Colorado Ave	Multi-use Path/ Bike Lane
Innovation Dr Extension	Bike Path	30th St	Bike Lane
Marine St Connector	Multi-use Path	Boulder Creek	Multi-use Path
Marine St	Shared Lane Marking	30th St	Bike Lane
Marine St	Shared Lane Marking	Arapahoe Ave	Multi-use Path
35th St	Bike Route	Boulder Creek	Multi-use Path

The proposed CU bikeway network seeks to increase bikeway connections to the existing and proposed City of Boulder bikeway network. The completion of the CU bikeway network will greatly increase the convenience of biking in and through campus.

8.5.3 Special Non-Motorized Network Locations

In the development of this plan, two campus locations received specific attention because of their importance to the movement of non-motorized users connecting with the City of Boulder network, and moving within the greater campus network. The 18th Street/Colorado Avenue corridor and the College Avenue underpass beneath Broad-way were examined to heighten the safety of pedestrians, bicyclists and skateboards and minimize any conflict that may exist between the various user groups. Out of several concepts which evolved, specific recommendations are made for each site.

18th Street & Colorado Avenue

The 18th/Colorado corridor is the primary artery for transit and motorized traffic within Main Campus. As such, it is the point of convergence for pedestrians, bicyclists, service vehicles and others who use the corridor on a daily basis. During passing periods, the corridor supports heavy amounts of pedestrian activity as students cross 18th and Colorado. Passing periods substantially impact bus operations and time tables and bicyclists are left to operate in the same space as buses and pedestrians crossing at other places than the crosswalk. The fundamental ideals behind the following design options were to provide designs that increased the utility of the corridor for bicyclists, minimized transit conflicts, and prioritized pedestrian crossings.

The recommended concept is called the "Hybrid", acknowledging that at this point completely restricting transit access through the corridor is not an option, but providing a transformative environment that emphasized bicyclist and pedestrian safety was a top priority.

A dedicated and separated cycle track is located on the west side of 18th and north side of Colorado is it runs east towards Folsom. The median separates the dedicated traffic lane with green space, permeable surface for rainwater collection, and additional bike parking facilities. This concept would substantially increase the convenience of intra-campus bicycle travel, by separating it from bus/vehicle traffic. It would also allow transit vehicles to have their own lane(s) and enhance safety by channeling pedestrian crossings at officially designated points along the corridor. At present, the open "feel" of the corridor permits crossing at any point of convenience for pedestrians.

Hybrid Design Concept

The hybrid concept also addresses vehicular access/travel, as well as transit routing. The hybrid model recommends limiting vehicular access to only transit vehicles, and private ADA access. All other private use/service vehicles would be restricted from this corridor. The transit lane of the hybrid model is currently recommended with three scenarios for further study:

1. Transit access can travel in both directions, with "pull out" areas located within the median to allow buses to yield to each other when traveling within the corridor.
2. Peak-hour model, wherein transit flow is reversible along the one lane corridor, depending on the time of day.
3. Transit access limited to north on 18th, east on Colorado via a one-way travel lane.

College Avenue/Broadway Underpass

The College Avenue/Broadway underpass is one of the major access points for pedestrians and bicyclists coming from "the Hill" and western Boulder and travelling to the CU campus and the Broadway Bike Path. It is the convergence of bicyclists and pedestrians coming from the underpass and crossing through or utilizing the Broadway Bike Path. Because of the design of the underpass, it can present a challenge for bicyclists traveling on the Broadway bike path to see individuals coming out from the underpass. The Broadway bike path slopes down towards this point on campus, increasing speeds of bicyclists and pedestrians. This location was the only count location that experienced a decrease in pedestrian and bicycle activity. Designs to improve sight lines and safety were considered to help the large numbers of bicyclists, pedestrians and skateboarders accessing/leaving campus at this location. Two designs are recommended for further consideration and subsequent implementation.

8.5.4 Bicycle Parking Recommendations

Based upon a comprehensive review of conditions at CU-Boulder and a consideration of bicycle parking standards at peer universities, it is recommended that CU-Boulder consider both existing facility standards and new facility standards:

- **Campus Core Bicycle Parking Standard** – it is recommended that CU-Boulder develop and adopt bicycle parking standards for the core campus area.

- **New Development Bicycle Parking Standard** – it is recommended that CU-Boulder develop and adopt a bicycle parking standard for new development on campus to ensure that adequate bicycle parking is provided.

Covered Bicycle Parking

Due to inclement weather in Colorado, it is recommended that CU develop and adopt a standard for providing covered bicycle parking to encourage bicycling year round – even on rainy or snowy days. CU-Boulder's initial covered bicycle parking installation has been well received by the cycling community. Utilization of this covered bicycle parking suggests that additional covered bicycle parking installations are warranted. Over time as funding is available, CU-Boulder should strive to provide 8 - 10% of total bicycle parking as covered bicycle parking.

Secure Bicycle Parking

As a means of providing a safer, more secure bicycle parking option on campus, it is recommended that CU begin providing more secure bicycle parking options, such as the following:

- Bicycle Lockers
- Indoor bicycle storage rooms
- Bicycle cages in parking structures
- Bicycle Garages (see photo from PSU)
- Consider design changes to allow bicycle parking within offices and residence halls

Secure Bike Parking/Bike Station/Bike Share Locations

Figure 8-3 illustrates proposed locations for new bike stations, secure bike parking, and bike sharing facilities.

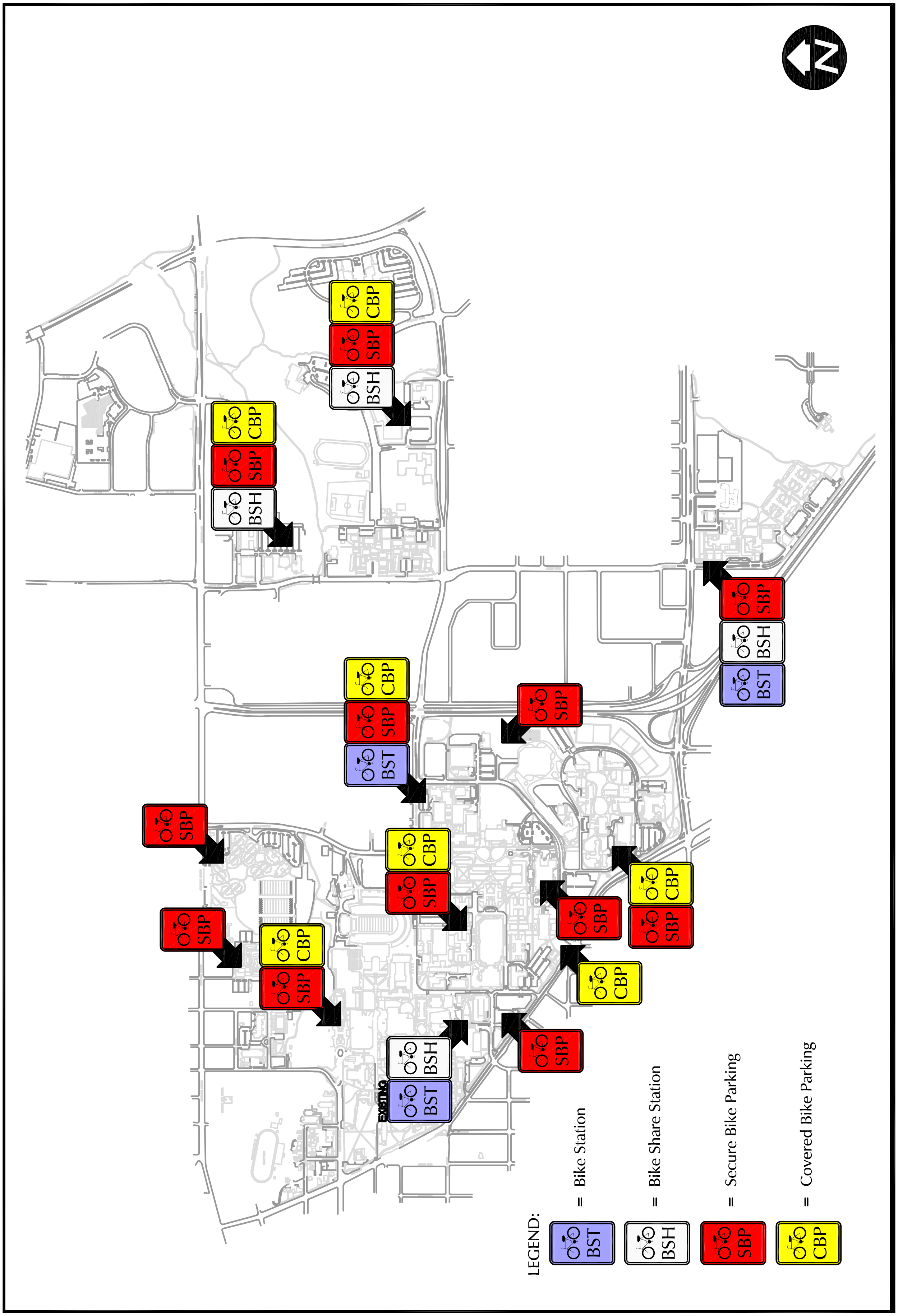


Figure 8-3

Proposed Secure Bike Parking/Bike Sharing/Bike Stations

CU-Boulder Transportation Master Plan

8.6 Transit Improvements and Recommendations

8.6.1 Main Campus Transit Service Recommendations

- The Orbit (see Figure 8-6) is identified in this analysis as having a high priority among CTN recommendations for implementation, to increase connectivity to Main Campus with convenient transfers, for routes like the Bolt and 205. Two-way (bi-directional) service is recommended.

Broadway Corridor

- The Broadway corridor has well-established local and regional bus routes with well-established transit infrastructure including pedestrian underpasses and the under-construction Broadway/Euclid project.

- Transit services will primarily expand based on RTD service standards for loading and frequency. CU's funding share will expand with Student Pass and Eco Pass pricing for students and faculty/ staff, respectively.

- Transit services are expected to expand incrementally based on load standards and overall ridership for the next ten years. FasTracks plans over the longer-term may provide additional increases, but will be beyond the ten-year horizon of this plan.

- Market, educate, and otherwise increase the level of understanding about the existing services between the Boulder Transit Center and the CU Main Campus.

- Extension of routes from the BTC to CU Main Campus should pursued only after the marketing/education actions and CTN actions above, and then only done selectively with additional data collection to support it.

Euclid/18th Street/Colorado Avenue Corridor

- Based on transit alternatives, both baseline and aggressive, bus volumes in this corridor are expected to increase 4 to 14 buses per hour by 2020 and 14 to 22 buses per hour by 2030. This is on top of 42 buses per hour currently. More buses means that more people will be using transit and meeting the goals of the plan (VMT, carbon emission reductions), and that there will be more opportunity for motorized and non-motorized conflicts. Safety and incident monitoring in this corridor is recommended to document trends and identify the appropriate phasing for more comprehensive actions and solutions.[1]

- Through iterative development and evaluation of design alternatives, the preferred option is to increase overall safety in this corridor by reducing the transit-way to one lane in a significant segment of 18th Street and Colorado Avenue, likely between Euclid and the guard house near Folsom Field. A more thorough traffic operations evaluation, possibly simulation, is recommended to complete the evaluation of this preferred concept.

[1] A combination of Public Safety (actual accidents) and PTS (operational observations from drivers or by PTS staff) is recommended.

- Traffic analysis and simulation will need to consider three locations for bus queuing: Euclid/18th, 18th/Colorado (Engine Alley), and the Folsom Field guard station. Two of those, Euclid/18th and Folsom Field guard station, should also be considered for turn-around locations.

28th Street Corridor

- CU and RTD should jointly monitor the HX and S services to ensure there is alignment between funding increases, especially student and faculty/staff pass sales, and service enhancements.

- CU and RTD should verify that services in this corridor continue to meet customer expectations as connecting services, like the Stampede, are modified.

- Incrementally increases in the span of service and frequency of service on both the HX and S over the course of the decade.

8.6.2 East Campus Transit Service Recommendations

- Monitor East Campus growth in terms of both campus population and transit utilization. Ensure that transit utilization and mode split are at least keeping pace with transit growth.

- Reconfigure the current Stampede route to provide two-way service along the full length of Colorado Avenue along the south edge of East Campus, and maintain the service along Arapahoe and Marine Streets. Two-way service along Arapahoe will also benefit the Center for Innovation and Creativity (CINC) to the north by providing a closer stop.

- Plan for demand on the Stampede to grow between 6% per year as a base forecast in the near term. By 2012 or 2013 supply additional capacity by either providing articulated buses or increasing the frequencies of service. Increased frequency will do more to attract ridership. A short-turn route pattern of the Stampede is recommended to achieve this objective. See Figure 8-4.

- With RTD, plan to extend the Bound along Iris to provide a direct connection to more of North Boulder, and a one-transfer connection with the Skip.

- If a Boulder Creek crossing allows north-south vehicular access through East Campus, re-align the regional route J to make the most of this opportunity to provide direct transit access. See Figure 8-5.

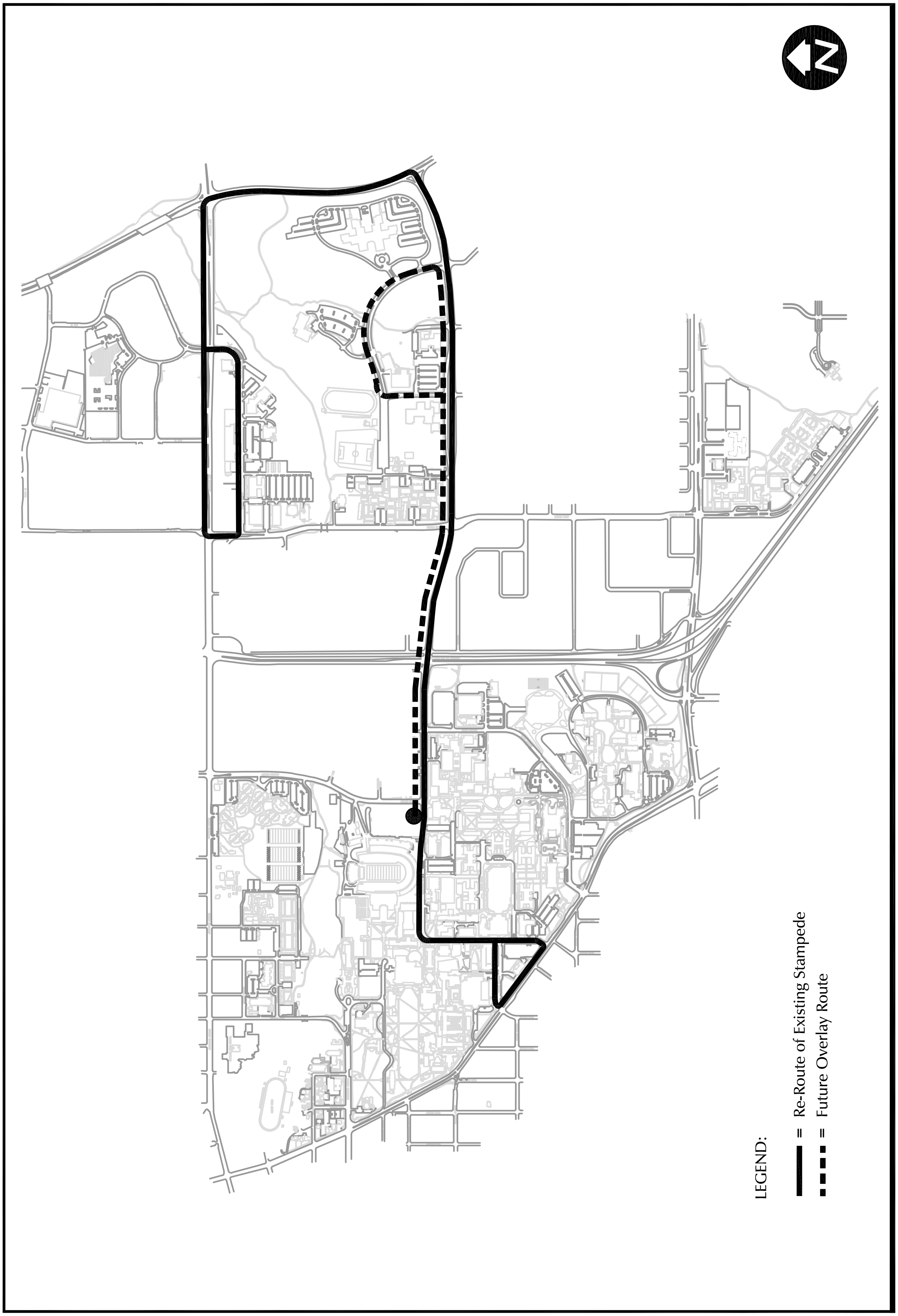
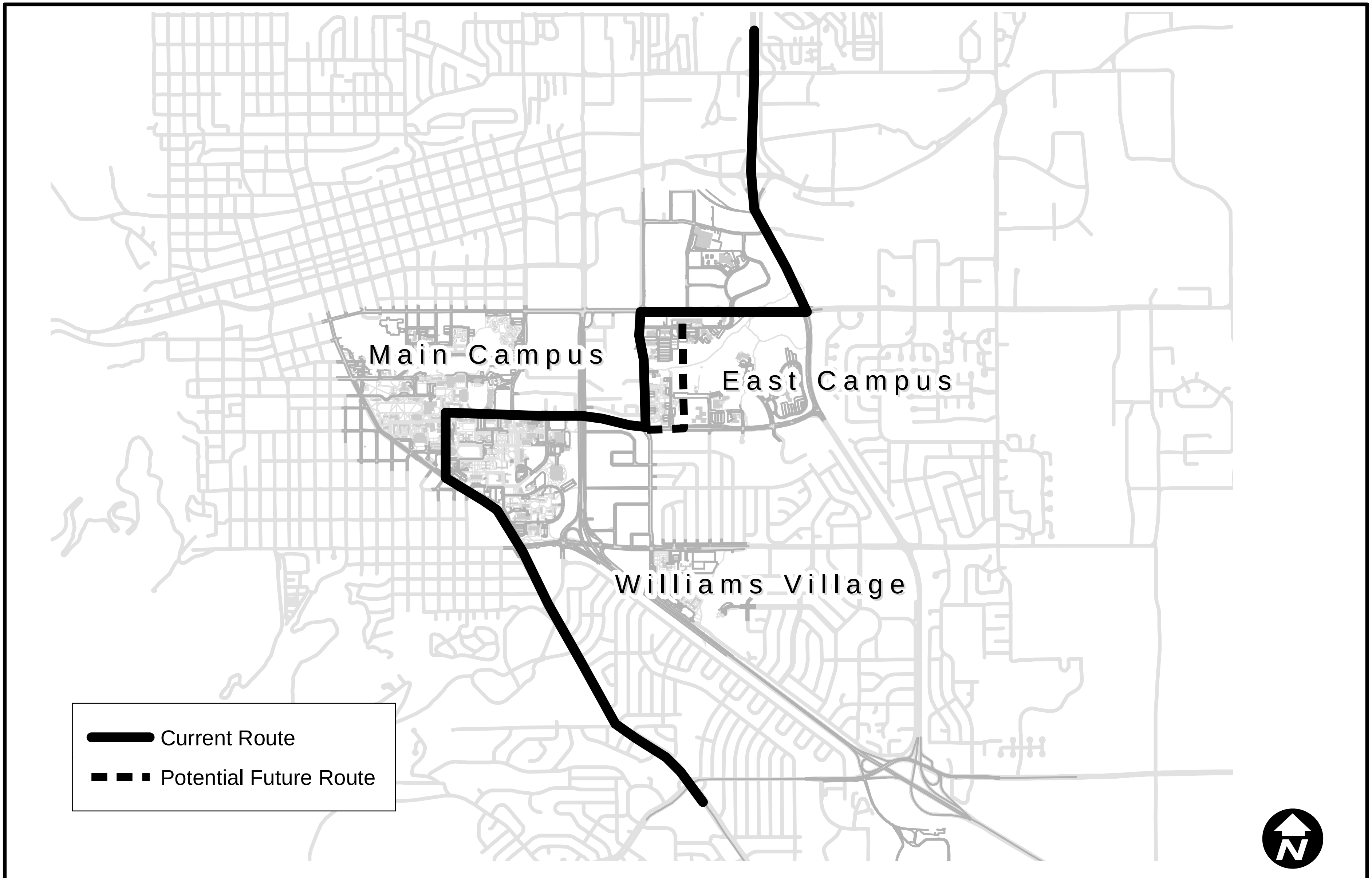


Figure 8-4

Preferred Stampede Route

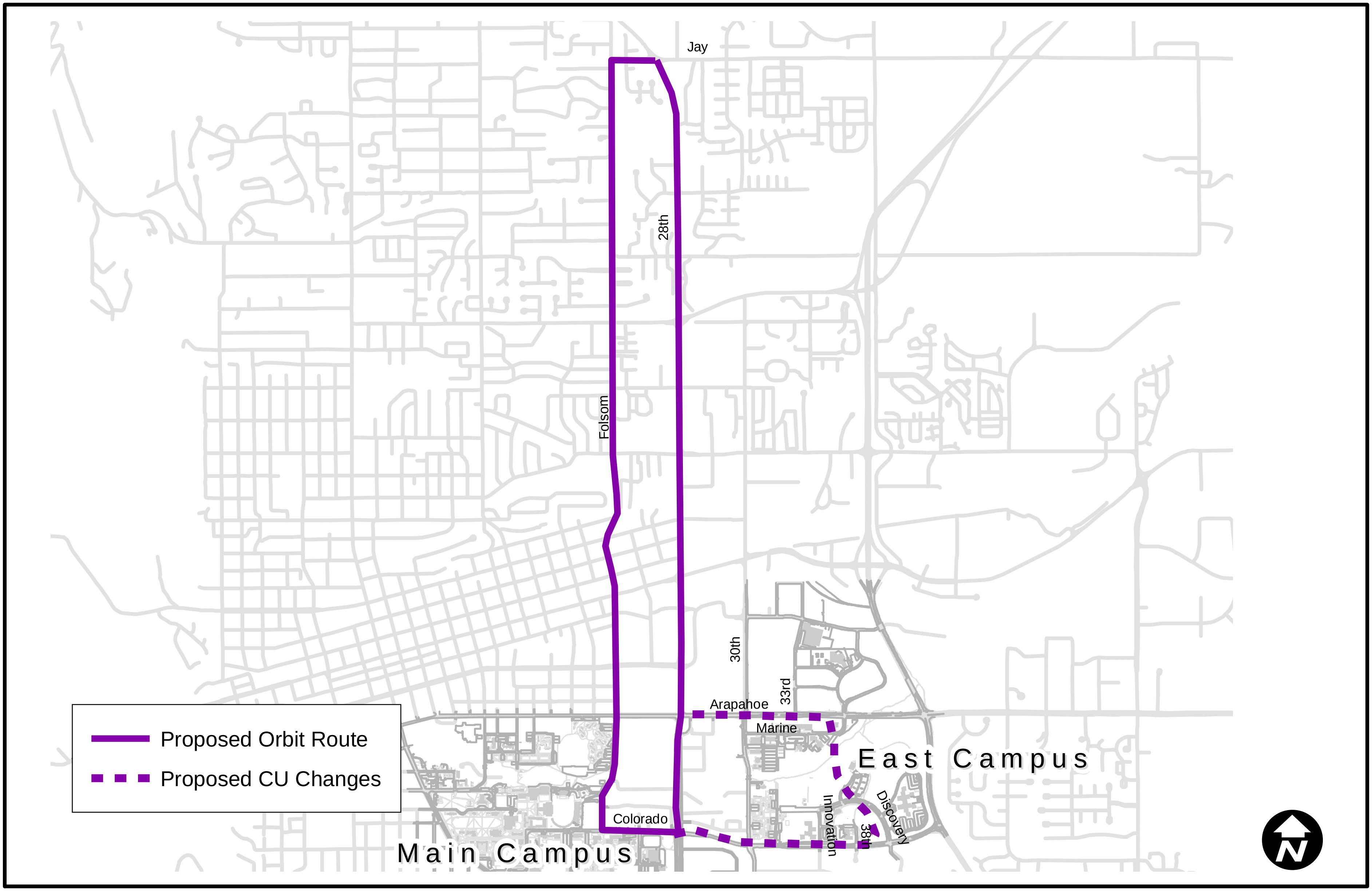
CU-Boulder Transportation Master Plan



Route J Options

CU-Boulder Transportation Master Plan

Figure 8-5



Proposed Orbit Route

CU-Boulder Transportation Master Plan

Figure 8-6

8.6.3 Williams Village Transit Service Recommendations

- Monitor demand and utilization carefully with the opening of Williams Village North which will take the student and faculty/staff population from 2,400 to 3,600.

- Make short-term, incremental shifts in fleet mix to increase the proportion of service delivered with articulated buses (two have been ordered for 2011-12).

- Make long-term Buff Bus fleet mix decisions after Main Campus design decisions have been made <u>and</u> implemented, i.e. 18th/Colorado. There is expected to be a 2-year lead time between any such decision and actual implementation.

- Make design decisions at Williams Village which are aligned with Buff Bus operating investments.
  - If the choice favors RTD service supplying some of the needed transit capacity, Williams Village North building and site design should improve upon recommendations in this report for a traffic and pedestrian signal at 35th street and collaborate with the City of Boulder, Boulder County, and RTD to implement transit hub/superstop/FastConnect facilities along Baseline Road.

- Adjust Buff Bus operating budgets and/or RTD service buy-up budgets according to the above decisions.

- Complete a design study to more fully evaluate the potential for a US-36 slip ramp stop at the south edge of the Williams Village/Bear Creek Campus and its concomitant site impacts.

8.7 Roadway Improvements and Recommendations

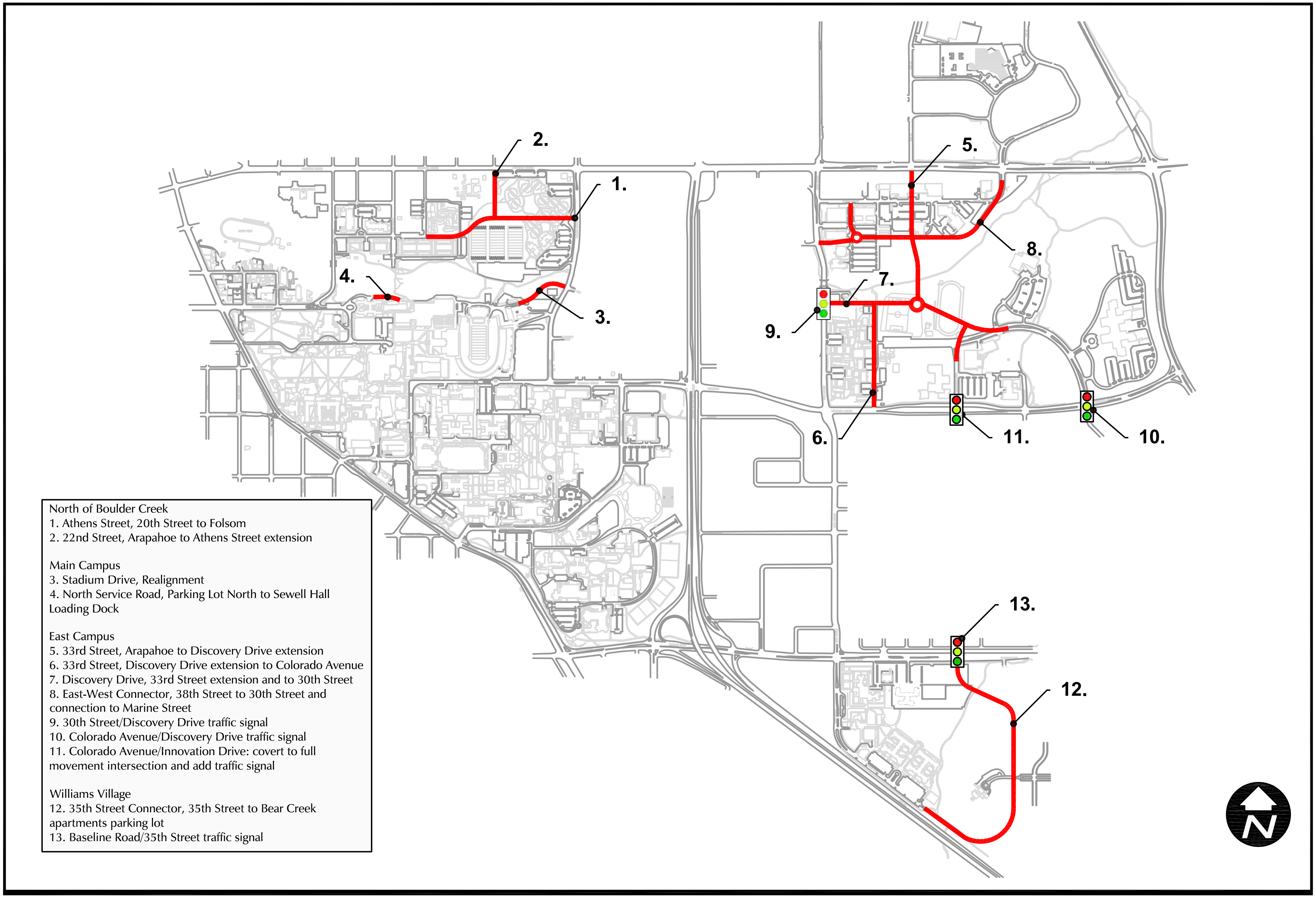
With the Main Campus almost built out, street improvements will focus on improving bike, pedestrian and transit access, as well as reducing modal conflicts.

Figure 8-7 displays the recommended street improvements for the CU-Boulder campus. These include:

North of Boulder Creek

1. Athens Street: construct connection between 20th and Folsom Streets as a low speed local street.
2. 22nd Street: construct connection between Arapahoe and Athens Street extension as a low speed local street.

These connections will improve connectivity in this area for vehicles, bikes and pedestrians. Athens Street will have continuity between 17th and Folsom Streets, thus providing some relief for heavily congested Arapahoe Ave.



LSC TRANSPORTATION CONSULTANTS, INC.

Proposed Street Improvements

CU-Boulder Transportation Master Plan

Figure 8-7

alta PLANNING + DESIGN

Main Campus

3. Stadium Drive: realign if new parking structure is built.
4. North Service Road: construct service road connection from parking lot north of the Recreation Center to the loading dock behind Sewell Hall.

East Campus

5. 33rd Street: construct connection from Arapahoe south over Boulder Creek to Discovery Drive extension.
6. 31st Street: improve connection between Discovery Drive extension and Colorado Avenue.
7. Discovery Drive: construct extension west to the 33rd Street extension and to 30th Street opposing Shadow Creek Drive.
8. East-west connector: construct local street connecting 38th Street with 30th Street opposing the south access to Scott Carpenter Park. Includes connection to Marine Street.
9. 30th Street/Discovery Drive traffic signal.
10. Colorado Avenue/Discovery Drive traffic signal.
11. Colorado Avenue/Innovation Drive: covert to full movement intersection.

These connections will improve connectivity for vehicles, bikes and pedestrians. The bridge over Boulder creek will provide an internal connection between the East Campus and the Research Park. This will allow rerouting of some bus routes as described above. It will provide another vehicular route from the Research Park to Arapahoe which may provide some relief to the Colorado/Foothills Parkway intersection.

Williams Village

12. 35th Street Connector: construct low-speed street from 35th Street southeast across Bear Creek looping back to the Williams Village parking south of the Bear Creek apartments.
13. Baseline Road/35th Street traffic signal when traffic volumes warrant.

This connection will provide access to the faculty/staff housing planned east of Bear Creek as part of the Williams Village Micro-Master Plan. The connection of this road to Caddo Parkway will be designed for emergency vehicles and non-motorized users.

Costs for these connectors are given in Table 8-5.

Table 8-5
Street Connection Costs

Map Key	Street/Project	From	To	Description	Units	Unit Cost	Cost
1	Athens Street	20th St.	Folsom St.	Construct two-lane low speed street	1,700 ft.	$450 per ft.	$765,000
2	22nd St.	Arapahoe Ave.	Athens St.	Construct two-lane low speed street	520 ft.	$450 per ft.	$234,000
3	Stadium Drive	Stadium	Folsom St.	Construct two-lane low speed street	600 ft.	$500 per ft.	$300,000
4	North Service Rd.	Rec Center Parking Lot	Sewell Hall	Construct service drive	300 ft.	$2,000 per ft.	$600,000
5	33rd St.	Araphaoe Ave.	Discovery Dr.	Construct two-lane collector street	1,200 ft.	$500 per ft.	$600,000
				Boulder Creek Bridge	10,000 sq. ft.	$200 per sq. ft.	$2,000,000
6	31st St.	Discovery Dr.	Colorado Ave.	Construct two-lane collector street	1,100 ft.	$450 per ft.	$495,000
7	Discovery Dr. Extension	Discovery Dr.	30th St.	Construct two-lane collector street	2,000 ft.	$500 per ft.	$1,000,000
8	East-west Connector	38th St.	30th St.	Construct two-lane collector street	2,800 ft.	$500 per ft.	$1,400,000
9	Traffic Signal	30th St.	Discovery Dr.	Install Traffic Signal	1	$300,000 each	$300,000
10	Traffic Signal	Colorado Ave.	Discovery Dr.	Install Traffic Signal	1	$300,000 each	$300,000
11	Traffic Signal	Colorado Ave.	Innovation Dr.	Install Traffic Signal/Pipe Ditch/Add Turn Lane	1	$600,000 each	$600,000
12	35th St. Connector	Bear Creek Apartments	35th St.	Construct two-lane low speed street	3,000 ft.	$400 per ft.	$1,200,000
13	Traffic Signal	Baseline Rd.	35th St.	Install Traffic Signal	1	$300,000 each	$300,000
							$10,094,000

8.7.1 Service and Emergency Access

Access to buildings needs to be provided for essential services and in emergency situations.

8.7.1.1 Service Access

Service access and parking should be better managed to avoid the conflicts between pedestrians and vehicles that are currently too prevalent on campus sidewalks. The maintenance and delivery requirements for nine million square feet of building space, and the equipment contained therein, generate a constant influx of service vehicle traffic to the campus. Consistent with planning tenets, many roadways that previously transected the campus have been eliminated in favor of a more contiguous, pedestrian-oriented environment. Given the absence of proximate roadway access to many campus buildings, service vehicles must drive, and park, on campus sidewalks. Fortunately, pedestrian/vehicle collisions that lead to injury have been extremely rare, although pedestrians often complain of sidewalks obstructed by service vehicles. Vehicles associated with new construction, and those associated with projects maintaining or replacing aging facilities, add to the problem. Service vehicles and emergency vehicles sometimes find their paths blocked by other service vehicles parked along sidewalks.

A variety of regulatory strategies has been tried, but has proven ineffective at significantly reducing sidewalk traffic and parking. In fact, most of the vehicles now driving and parking along campus sidewalks are in compliance with CU-Boulder parking regulations, which include the issuance of permits to park on sidewalks.

The Department of Facilities Management has installed some physical barriers to close off vehicular access to the plazas and other pedestrian areas on which vehicles are inappropriate, but many areas cannot be blocked off due the need to retain emergency access. The campus is also too large for physical barriers to be the principal solution. Permitted sidewalk parking should be reduced. Instead, most maintenance and delivery vehicles could be directed to designated service parking areas. Designating more service parking could help to alleviate the pressure to park on sidewalks along with stronger campus policy. Minimal construction vehicles should be accommodated within staging areas, designating an access point/path for construction sites connecting to the nearest service drive, while encouraging construction employee vehicles to be largely accommodated at remote locations.

8.7.1.2 Emergency Access

Based on the Uniform Fire Code, as adopted by the State of Colorado and CU-Boulder, fire apparatus access routes need to be added where any part of buildings are located more than 150 feet from existing fire apparatus access. Access routes are reviewed by the CU-Boulder Fire Marshall, the Boulder Fire Department, and facility planners. Campus emergency access is along a variety of routes: state highways, city streets, university streets, service alleyways, and wide sidewalks serving as fire lanes. Figure 8-8 is a map of the existing and proposed fire lanes, which need to have at least 12 feet in width of clear access.

Non-fire emergencies such as a flood, chemical release, hazardous material spill, or gas leakage are also important concerns on campus. Especially in light of the many laboratory science facilities on campus, the need for adequate access and evacuation routes is pronounced.

Some portions of the Main Campus need to be made more accessible for emergency apparatus. According to the Boulder Fire Department, an existing area with problematic fire apparatus access is "Engine Alley," the central east-west walkway in the academic core of campus, where many service vehicles are parked each day. This has been addressed by prohibition of service vehicle parking in this or any other fire lane, as specified in the Uniform Fire Code, although vehicle travel still remains an issue.

Also of concern is access around large building complexes such as the Engineering Center, high-rise structures, building bridges, and below-grade spaces. These concerns should be addressed through upgrade of building fire protection systems, access improvements and regulation, parking restriction, and by careful design of future development.

Trees can limit emergency access if placed improperly. Trees along emergency routes should be trimmed as not to interfere with access. Placement of new plantings should consider emergency routes and future growth so that Fire Department vehicle access is not adversely affected in the future.

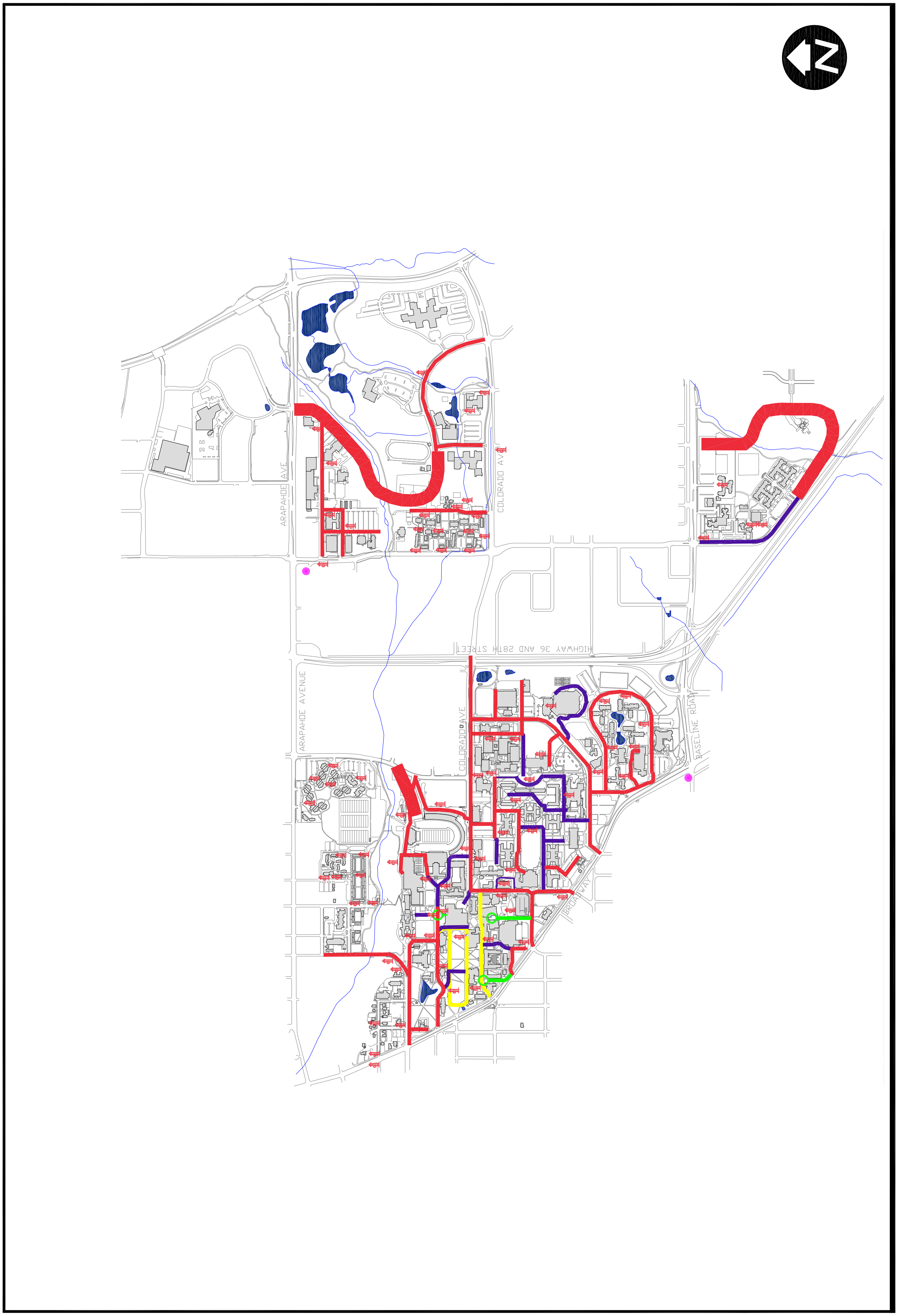
Adequate access by Fire Department vehicles will continue to be included during all phases of new construction and site development. It is the campus practice for the Boulder Fire Department to be invited to provide input for all site and building developments. Boulder Fire Department apparatus requirements with regard to width, height, and turning radius are to be addressed for necessary access in site and building designs.

As the campus continues to grow in density and size, the safety and welfare of all persons and property can be assured by the following: attention to access during design, construction, and operations; provision of an adequate and accessible supply of water; and compliance with adopted building codes.

Figure 8-8

Fire Lanes

CU-Boulder Transportation Master Plan



8.7.1.3 Service and Emergency Access Goals & Guidelines

Goal
Necessary access will be ensured to service buildings and to provide emergency services.

Guidelines
- Provide more adequate service vehicle parking.
- Evaluate current service and delivery parking and add additional sites for drop-off and pick-up of materials if space allows within reasonable proximity of each building.
- Keep emergency access routes and walkways in general, unobstructed by parked vehicles through better enforcement.
- Continue review of all development proposals to ensure access for building services and for emergencies.
- Coordinate the routes and close-in parking with overlapping requirements to meet needs of handicapped persons. Avoid placing handicapped parking in loading dock areas, which are not appropriate public entries and where conflicts are likely.

8.8 Parking Management Recommendations
Parking is a major land use on campus. Parking competes with building sites, open space, and athletic and recreational uses for the valuable and limited campus land resource. Approximately 75 acres of campus land are occupied by parking spaces. Of the total 11,647 parking spaces 7,152 are on the Main Campus; 3,081 are on the East Campus, including the Research Park; and 1,414 are at Williams Village.

8.8.1 Existing Parking Demand and Supply
Previous parking studies conducted for CU-Boulder estimated parking demand by multiplying the percentage of each user group expected to be traveling to campus each day by the percentage of drive alone (SOV) users and carpool drives. For this analysis, the percentages derived from the *2010 CU-Boulder Commuting Spring and Fall Survey* and the current population estimates were used and are shown in Table 8-6. The faculty/staff driving ratio is the drive alone plus motorcycle percentage (47.5%) plus the carpool percentage (7.67%) divided by two (assuming two-person carpools) which results in a 51.4% driving ratio. The Commuter Survey also had a question asking those who drive where they parked. This percentage was used in the analysis. The presence factor takes into account varying schedules of faculty/staff.

Because resident hall demand is based on students who want to park their cars on campus (not how much they drive them), the parking demand ratio for this group is based on the ratio of the number of permits sold, divided by the number of students. This was then multiplied by a presence factor estimated by PTS.

For commuting students, the driving ratio was derived from the *2010 Commuting Survey* drive alone/motorcycle/carpool mode shares as was the percentage parking on-campus. The presence factor was taken from the previous parking studies. It is lower than the faculty staff presence factor since students tend to be on campus for shorter periods than faculty/staff.

In addition, PTS provided estimates of daily parking by retirees, vendors and contractors, University vehicles, and visitors. Table 8-6 indicates that the 2010 affiliate population generates an average daily parking demand of about 9,136 spaces.

Table 8-6
Parking Demand

	Population	Driving Ratio(1)	Percent Parking On-Campus(2)	Presence Factor	Parking Demand Ratio	On-Campus Total Space Demand	Off-Campus Parking Demand
Faculty/Staff	7,260	0.514	0.72	0.97	0.359	**2,606**	**1,013**
Commuter Students	22,389	0.246	0.71	0.65	0.114	**2,552**	**1,038**
Resident Students Driving to Campus	7,021	0.101	0.79	0.65	0.052	**365**	**97**
Family Housing Students Driving to Campus	666	0.101	0.79	0.65	0.052	**35**	**9**
Subtotal	**37,336**					**5,558**	**2,157**
Resident Students	7,021		0.25	0.97	0.238	**1,669**	
Family Housing Students	666		0.25	0.97	0.238	**158**	
Faculty/Staff in Family Housing	150				1.5	**225**	
Total						**2,052**	
Retirees Parking on Campus						**150**	
Vendors & Contractors						**89**	
Daily Lot Parking Passes						**46**	
University Vehicles						**465**	
Visitors						**776**	
						1,526	
						9,136	

Notes:
(1) Driving ratio is a weighted combination of drive-alone (SOV) users and car/van pool users (HOV) assuming an occupancy rate per HOV vehicle of 2.0 for faculty/staff and students
(2) Obtained from *2010 Spring/Fall Commuter Survey*

To compare this with CU Boulder's parking supply, current parking data is shown in Table 8-7. PTS provided the number of regular, short-term, disabled, and reserved spaces available for faculty/staff and student parking on the Main Campus, East Campus (including the Research Park) and Williams Village. To reduce time and energy spent on finding a parking space, it is good practice to provide a supply that is somewhat more than the projected demand. The effective factors take this into account. These factors are the same as used in previous studies. For short-term spaces, the effective supply was assumed to be the current utilization, which was estimated by PTS to be 70%. The effective parking supply for the resident and commuter population is estimated at 9,576 spaces.

Table 8-7
Effective Parking Supply

	Faculty/Staff Commuter	Student Commuter	Resident Hall	Family Housing	ADA	Reserved	Other(1)	Motorcycle	Short Term(2)	Research Park(3)	Service(4)	Total
Total Spaces	3,359	2,553	980	983	223	103	519	259	1,108	1,292	268	**11,647**
Effective Factor	90%	90%	95%	90%	60%	95%	90%	90%	70%	40%	80%	
Effective Spaces	**3,023**	**2,298**	**931**	**885**	**134**	**98**	**467**	**233**	**776**	**517**	**214**	**9,576**

Notes:
1. "Other" - includes Alumni, Athletics, Facilities, Foundation, Jila, Transportation Center & President's office
2. Short Term - includes 664 spaces that would be generally at $1.50/hr, 398 spaces at Euclid AutoPark at $1.75/hr (first 3 hours) and $3/hr (additional hrs till 5pm M-F), and 46 other spaces
3. Effective Factor calculated based on current use by CU affiliates
4. Service spaces are not available for commuter parking

Based on a comparison of the estimated demand and supply, it appears that CU-Boulder has a surplus of about 438 spaces. However, most of the surplus is on the East Campus and Williams Village, with Main Campus lots having a high utilization rate. The tight Main Campus supply results in many vehicles being parked off-campus. Over 2,100 vehicles are estimated to be parked off-campus.

8.8.2 Projected Parking Demand and Supply

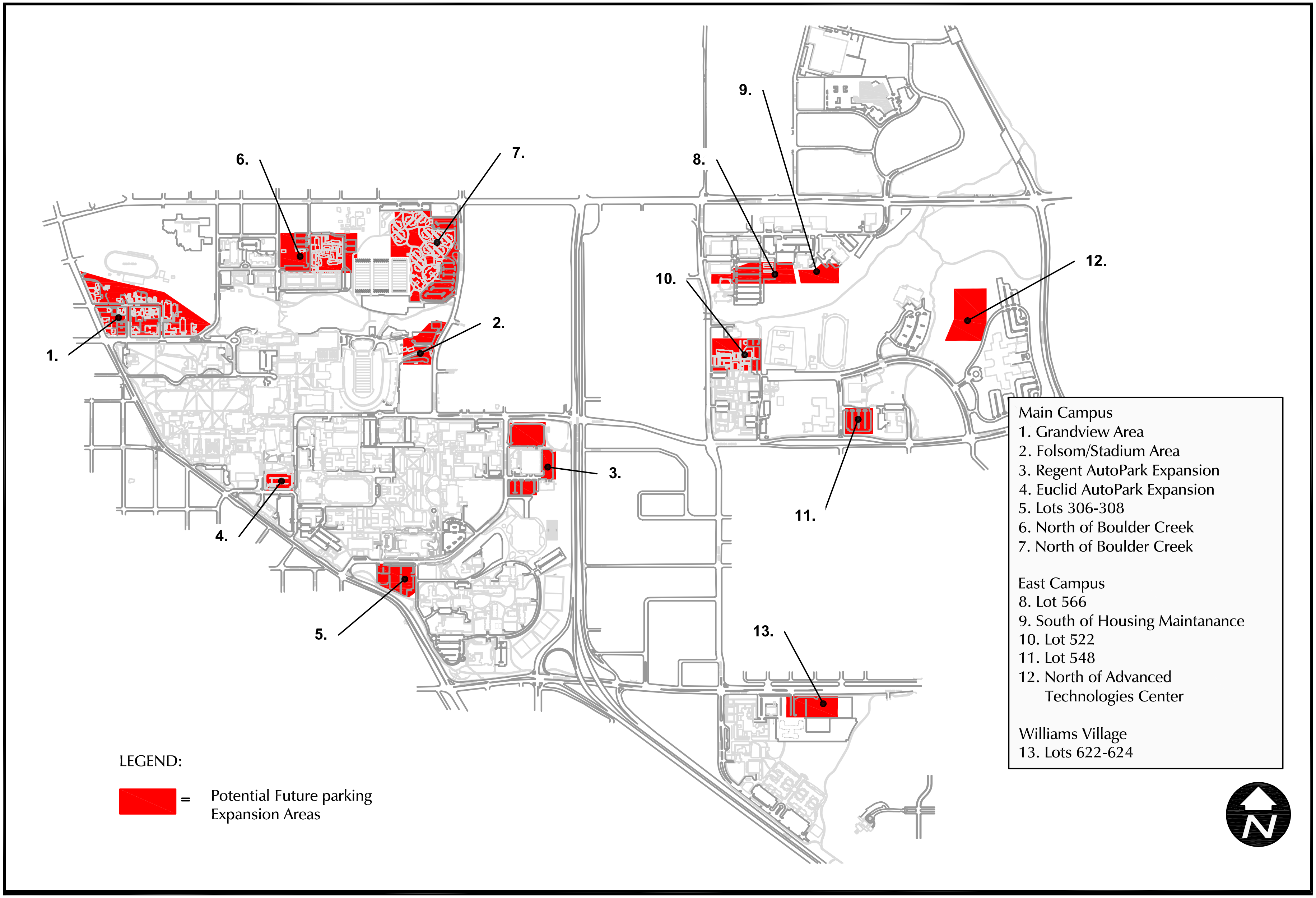
To project parking demand, the mode share analysis in Chapter 2 was used along with the CU parking model to estimate parking demand by commuters to the CU campus. Parking supply was increased by 650 spaces which assumed that the underutilized spaces in the Research Park could be used by the commuting population. Comparison of 2010, 2020, and 2030 parking demand and supply is given in Table 8-8.

Table 8-8
Parking Demand/Supply Projections

	2010	2020	2030
Effective Supply			
Existing	9,576	9,576	9,576
With Research Park (650 spaces)		650	650
Total Effective Supply	**9,576**	**10,226**	**10,226**
Commuter Parking Demand (spaces)	9,125	10,203	10,400
Parking Surplus (Deficit)	**451**	**23**	**(174)**
Off-Campus Parking Demand	**2,304**	**2,369**	**2,399**

8.8.3. Potential Parking Expansion Sites

The recent Center for Community (C4C) project shows how difficult and costly it is to integrate underground parking in a building project. The project contains 376 underground spaces and 52 surface spaces built on lots which once contained 315 spaces, resulting in a net addition of 113 parking spaces. Due to the high cost of underground construction, the construction cost was $44,124 per space or a total of $18,883,360. There were many benefits of the C4C project in this location, including convenience, event parking, and wise stewardship of limited land resources, but the cost of this parking structure will be a significant burden on PTS for years to come. Due to the high cost of construction, there will be few if any new spaces added to the Main Campus. New parking structures, however, may be needed to replace existing parking lots needed for new buildings. Several sites on the Main Campus have been identified for potential structures, keeping in mind the guideline that TDM should be implemented first before considering street capacity improvements and added parking. These sites along with other sites on Williams Village and East Campus are shown in Figure 8-9.



LSC TRANSPORTATION CONSULTANTS, INC.

Potential Future Parking Expansion Areas

CU-Boulder Transportation Master Plan

Figure 8-9

alta PLANNING + DESIGN

8.8.3.1 Parking Management Recommendations

Parking management is one of the most effective traffic reduction strategies and underpriced and abundant parking can be a major deterrent to alternative mode use. From a land use perspective, devoting land to parking, alleys, and driveways distracts from the pedestrian-oriented campus setting that is so important to a university environment. Parking needs to be priced appropriately and managed to get the highest possible utilization.

The following are recommendations for parking management at CU-Boulder:

1. Install access control (gates) at all larger lots and implement parking management technology (such as Smart Cards) which has the capability of monitoring parking use and charging demand-based parking rates.
2. Consider implementing a higher rate structure in the core of Main Campus (generally bounded by University and College Avenues on the north, Regent Drive on the east and south, and Broadway on the west). The differential between this area and other areas on campus should be at least 30%.
3. Provide more short term and visitor parking in the core area of Main Campus.
4. Using the new access control and parking management technology or other system, implement flexible permits which allow fewer than five days a week use to encourage alternate mode use.
5. Continue to provide low cost remote parking on East Campus for affiliates who lack alternative mode options and can't afford higher priced parking. Continue transit service to this parking and provide secure bicycle parking and bike share facilities.
6. The C4C project costs will result in PTS bond repayment costs of $1,232,000 for the next 25 years. For the next four years, total PTS bond repayment costs will go up by this amount but then other bonds are paid off. If the first four years costs of about $5 million are spread over 25 years, financed at an interest rate of 4%, the effective increase is about $320,000 per year or 8% of PTS expenses of $4 million per year. Effectively, this would increase the existing ~$17 million, 25-year bonding for the C4C project to ~$22 million by adding a new $5 million bond for 25 years, to raise an extra $5 million to be used to cover the four years of double bond payments for both the C4C and EAP/RAP bonds. To offset these expenses, base permit fees (faculty/staff, student, business, gates and events) which currently bring in about $4 million in revenues, would have to be raised by 7 to 9% in addition to normal inflation.
7. Consider consolidation of all parking spaces under PTS management to administer all CU-Boulder parking spaces more equitably. In particular, the Research Park should come under PTS control, so the current underutilized parking can be used to meet CU-Boulder's parking needs.
8. Propose that costs associated with retirees and X permit holders should be borne by the appropriate departments and not PTS.
9. As redevelopment for family housing occurs, parking spaces should be unbundled from lease rates, with tenants required to purchase parking permits and encouraged to use alternate modes.

No net new parking spaces should be added to Main Campus. New parking structures may be needed to replace existing parking lots needed for new buildings. Since there is a great benefit to the university to utilize existing land with surface parking for campus buildings or other uses, and a great cost to replace this parking, alternative funding sources will be needed so the high costs of replacement structured parking doesn't overwhelm PTS's budget.

8.9 Transportation Program Financing

Funding for CU-Boulder transportation facilities, programs, and activities comes from many sources, controlled by many agencies and departments with their own specific missions, goals, and objectives. Fortunately, from a transportation perspective, these missions are often aligned in encouraging the use of efficient transportation modes which minimize energy consumption and reduce carbon emissions. While the prospect of increased federal and state funding in the short term is bleak, recent emphasis on transit and alternative modes funding bodes well for joint projects. It is assumed that many of the transit recommendations, especially commuting services, will be cooperatively funded by RTD, the City, Boulder County, and DRCOG. Likewise, bicycle and pedestrian connections to nearby neighborhoods, other City areas and Boulder County will be funded by City, County, State, and federal sources. As it has done in the past, CU-Boulder should work closely with its local and regional partners to plan these programs, services, and facilities, with CU providing funding for campus-only projects, and providing limited participation in joint funding for demonstration projects or when federal/state/private sources can be leveraged.

8.9.1 Recommended Transportation Program Financing Plan

The financing plan shown in Table 8-9 is intended to fund an aggressive TDM program designed to meet CU-Boulder's sustainability goals. In addition, it funds many key transportation infrastructure projects which will allow the university to complete the bike/pedestrian plan on Main Campus; complete the Williams Village Micro-Master-plan; provide access connections for the redevelopment of the area north of Boulder Creek; and undertake access/bike/pedestrian connections necessary for the development of the East Campus.

a. New funding recommendations include:
    - Increase of base parking permit rates by 8% to fund the additional bond payments for the C4C project.
    - Bring Research Park parking spaces under PTS control, allowing PTS to sell 200 additional permits to manage these spaces with same permit structure as the rest of the campus.
    - Consider implementing a Zone-based/Flexible Parking Rate Structure (with core zone rates 40% more than peripheral zone rates. This is could raise about $168,000 in 2020.
    - Consider implementing a new Faculty/Staff transportation fee (proposed at $7 per month per employee). This could raise $664,000 per year in 2020.
    - Consider increasing the Student Transportation (TDM) fee by 17% ($12 per semester). This could raise $846,000 per year in 2020.

b. TDM Program expansions include:
    - Covered/Secured Bike Parking
    - Bike station/bikeshare programs
    - Pedestrian & Bike Connections (4.9 miles)
    - Stampede Route Changes & Overlay Service
    - Buy up additional service or make service changes on two other routes (Bolt and HX or 205)
    - Fund 15% of new Orbit route (28^{th}/Folsom)
    - Carpooling spaces/discount rates
    - Expanded car sharing
    - Vanpools
    - Fleet vehicle pick-up station on Main Campus
    - Marketing & Incentives

c. Transportation Infrastructure Projects include:
    - North of Boulder Creek Connections at $1,000,000
    - Stadium Drive at $300,000
    - North Service Road at $600,000
    - East Campus Boulder Creek Bridge at $2,000,000
    - East Campus Road Connections at $3,500,000
    - East Campus Traffic Signals at $1,200,000
    - Williams Village Connections at $1,500,000

Table 8-9
CU-Boulder
Parking and Transportation Services
Projected Revenues & Expenses
With Comprehensive New Funding and Aggressive TDM Program Expansions

Population Group	2010 Estimates[(1)]	Annual Growth Rate	2020 Forecast[(1)]	2030 Forecast[(1)]
Students	30,076	0.87%	32,797	34,951
Faculty/Staff	7,260	0.86%	7,907	8,605

PARKING REVENUE[(2)]	2010	Annual Growth Rate[(3)]	2020 Revenue Forecast[(4)]	2030 Revenue Forecast[(4)]
Faculty/Staff Permits	$1,402,271	0.43%	$1,463,749	$1,527,922
Student Permits	$1,300,629	0.38%	$1,350,907	$1,403,128
Business Permits	$280,684	0.30%	$289,219	$298,014
Citation	$949,105	0.50%	$997,642	$1,048,662
Visitor Permits	$359,030	1.00%	$396,592	$438,085
Meter Fees	$886,969	0.50%	$932,329	$980,008
Euclid Auto Park	$1,096,751	0.30%	$1,130,101	$1,164,466
Gates	$129,329	0.50%	$135,943	$142,895
Events	$895,256	0.50%	$941,040	$989,164
Bicycle	$22,460	0.80%	$24,323	$26,340
Refunds	($10,029)	0.80%	($10,861)	($11,762)
Misc.	$111,097	0.80%	$120,312	$130,291
Total Revenue from Existing Sources	**$7,423,552**		**$7,771,296**	**$8,137,213**
Recommended Funding Programs				
Increase to Base Rates (F/S,Student, Business Permits,Gates& Events) by 8% for C4C	$320,000	0.10%	$323,214	$326,461
Zone-Based/Flexible Parking Rate Structure (Zone 1=1.4 x Zone 2)	$165,400	0.15%	$167,898	$170,433
New Faculty/Staff Transportation Fee ($7 per month per employee)	$609,840	0.86%	$664,188	$722,820
Increased Student Transportation Fee ($12 per semester)	$775,961	0.87%	$846,163	$901,736
Total New Revenues	**$1,551,201**		**$1,678,248**	**$1,794,989**
Total Existing & Additional Revenues	**$8,974,753**		**$9,449,544**	**$9,932,202**

PARKING EXPENSE[(2)]	2010	Annual Growth Rate[(3)]	2020 Expense Forecast[(4)]	2030 Expense Forecast[(4)]
Salaries & Benefits	$2,761,189	1.00%	$3,050,070	$3,369,175
Operating Expense	$767,087	1.00%	$847,341	$935,992
Utilities	$186,174	0.50%	$195,695	$205,703
Admin & Police Recharge	$608,233	1.00%	$671,868	$742,160
RTD Expense[(5)]	$685,849	2.00%	$836,046	$1,019,136
Debt Service[(6)]	$1,204,217	0.00%	$1,554,000	$1,434,000
Fund Balance[(7)]	$1,210,803	0.10%	$137,672	($42,872)
Renewal & Replacement			$300,000	$0
Total Expenses from Existing Programs	**$7,423,551**		**$7,592,693**	**$7,663,293**
Recommended TDM Program Expansions				
Covered/Secured Parking	$24,716		$24,716	$24,716
Bike Station/Bikeshare Programs	$152,638		$152,638	$152,638
Pedestrian & Bike Connections	$346,837		$346,837	$346,837
Stampede overlay Service	$300,000		$300,000	$300,000
Buy up of additional off-peak frequency or make service changes on two other routes	$200,000		$200,000	$200,000
Work with City/RTD to implement Orbit route (15% share of costs)	$230,000		$230,000	$230,000
Enhanced amenities at transit stops including real-time departure information at major stops.	$17,358		$17,358	$17,358
Carpooling spaces/discount rates	$34,083		$34,083	$34,083
Expand Car Sharing	$20,000		$20,000	$20,000
Vanpools	$21,716		$21,716	$21,716
Fleet Vehicle Pick-up Station	$4,236		$4,236	$4,236
Marketing & Incentives	$77,358		$77,358	$77,358
Access Controls for Market/Flex Parking Structure	$96,791		$96,791	$96,791
Transportation Infrastructure Projects				
North of Boulder Creek Connections ($1,000,000 @ 4% for 20 Years)			$73,582	$73,582
Stadium Drive ($300,000 @ 4% for 20 Years)				$22,075
North Service Road ($600,000 @ 4% for 20 Years)				$44,149
East Campus Boulder Creek Bridge ($2,000,000 @ 4% for 20 Years)			$147,164	$147,164
East Campus Road Connections ($3,500,000 @ 4% for 20 Years)				$257,536
East Campus Traffic Signals ($1,200,000 @ 4% for 20 Years)				$88,298
Williams Village Connections ($1,500,000 @ 4% for 20 Years)			$110,373	$110,373
Total New Expenses	**$1,525,733**		**$1,856,851**	**$2,268,909**
Total Existing & Additional Expenses	**$8,949,285**		**$9,449,544**	**$9,932,202**

Notes:
1. Provided by CU-Boulder Planning and Budgeting
2. Source: Parking & Transportation Services
3. LSC Estimate
4. 2020 & 2030 Forecasts are before inflation
5. CU-Boulder Campus only
6. Assumes Additional bond payment costs in 2011-14 are financed over 25 years at 4% increaseing debt service payments by $320,000
7. Difference between Revenues and Expenses

8.9.2 Advantages and Disadvantages of Various Funding Models

Throughout the development of the Transportation Master Plan, ideas and concepts for increasing revenues for transportation improvements were presented and considered for inclusion in the final document. Most of these concepts could be classified as falling into one of two groups: those that increase revenues to the university and those that transfer existing revenues between departments that provide transportation improvements. Each of these broad categories has their advantages and disadvantages that generally apply across the board to those financing options within the category. There may be minor deviations such as how fees might be enacted or implemented but overall ramifications are similar. An in-depth analysis of each method is not included in the scope of this document but should be considered as transportation funding options move forward.

8.9.2.1 Options That Increase Revenues

Options that increase the overall revenue to the university are the preferred method by which transportation improvements and TDM programs should be funded. In essence, many of the transfer options listed below are also funded through these sources because much of the costs are passed along to the end users. Sources of funds that are new revenues are:

- Student fee increases
- Tuition increases
- Room and board increases
- Transportation fees paid directly by employees (head tax, co-pay, monthly fee)
- Parking fees
- Government grants
- Donations

All of these are advantageous because they represent true increases in funding that can be applied to transportation measures. Revenues derived from these sources can be applied to the programs described in this Transportation Master Plan without negatively impacting other programs or the academic mission of the institution. With the exception of donations, most of these sources have predictable funding patterns and are largely stable, allowing long-term planning for TDM improvements and capital investment in infrastructure once they are implemented. Parking fees are well established and are an expected part of university employment. Assuming that the rate increase balances cost with demand (elasticity), raising parking fees would serve two purposes described earlier in this master plan – reducing parking demand while increasing parking revenue.

The political process of implementing these revenue sources is the most difficult aspect to overcome. The first three sources – student fees, tuition and room and board increases – are all considered as the cost of education. With declining support from the state, the university has increasingly had to rely on student fees and tuition to fund the educational mission of the institution and room and board has had to increase to cover the cost addressing deferred maintenance and enrollment growth in housing. There is political pressure to contain the total cost so that higher education is affordable to middle and lower income Coloradans. Thus, fees for transportation infrastructure may be seen limiting student access by increasing costs unnecessarily. Transportation fees for faculty and staff would raise issues of equity and may elicit debate about parking and TDM practices. By state statute, benefits and costs paid to or by one state employee must be the same as all other employees. Thus, all employees would need to pay the transportation fee. This has been seen as a burden to low income employees that often work shifts where alternative transportation modes are not available. Faculty and staff might be resistive to implementing a fee where one has not existed before, particularly if they do not use parking or transit. Such fee would likely have to start small and be phased in gradually over time.

In much the same way, parking fees impact students, faculty and staff and would raise many of the issue above. Parking fees would be considered part of a student's cost of education. Faculty and staff have consistently voiced concern over parking fee increases with regards to equity and impacts to the cost of living. This has become more acute as employees have been asked to shoulder more of the burden of health care, retirement and other traditional benefits without pay increases in order to help balance the state budget.

Donations and government grants are less certain than the other sources. Grants must be sought on a regular basis and funding for traditional programs has become more competitive in recent years. Donations require an active fundraising organization and transportation improvements have not been solicited in the past. A dedicated staff person would be required, donors identified and then pursued. This may be seen as competing against academic programs since the potential donor pool is well known and largely finite.

8.9.2.2 Options That Transfer Funds to Transportation

Options that do not increase the overall revenue of the university but instead transfer existing revenue to transportation providers include:

- General Administrative and Infrastructure Recharge (GAIR)
- Direct subsidies
- Annual budget requests
- Indirect Cost Recovery (ICR) fees
- Departmental transportation fees
- Capital construction fees

CU-Boulder's FY 2010-11 budget was $1.4 billion. If the institution was truly committed to making transportation a priority, funds could be reprioritized to fund the infrastructure and programs proposed in this document without increasing revenues. The funding mechanisms listed in this category are largely in place and can be adapted readily to achieve the goals and programs without being subject to the political debates and scrutiny that fee increases would receive.

The primary funding mechanism that exists today is GAIR (also known as GAR/GIR), which is like a tax placed on groups that benefit from university services and support but would not otherwise pay for them. GAR and GIR are calculated separately as a percentage of the monthly expenditures of auxiliaries and self-funded activities. It is used to fund the maintenance and construction of grounds, roads, sidewalks, etc. in support of the auxiliaries and self-funded activities to which it is charged. An increase in GIR would be one logical source of funds for transportation improvements, particularly those that support auxiliaries.

ICR is similar to GAIR and is charged to federal research grants awarded to the university. While the amount received from ICR is tremendous (approaching nearly 50% of a grant), there are equivalent restrictions that dictate how ICR revenues can be spent. Additional investigation is needed to determine whether any revenue from ICR can be used to support transportation initiatives proposed in this master plan.

Likewise a direct subsidy from the General Fund would cover costs to support the transportation needs of the academic units. The most likely way that this would occur would be through annual budget requests submitted by PTS and Facilities Management for transportation improvements.

The biggest obstacle to implementing these types of fees is the lack of stability in the funding stream. Because each year is independent and must be requested, funding is subject to competing interests. For example, a failure in a pipe serving an auxiliary might require a disproportionate expenditure for utility improvements that would limit the amount of money that could be applied to TDM funding. Similarly, an academic or research initiative my gain priority over a General Fund subsidy of transportation causing a one-time or permanent reduction to the subsidy. This type of instability would make long-term transportation funding difficult to plan, implement and maintain.

Departmental fees would be a new extension of the concept of GAIR to academic and General Funded units. A fee could be based on the number of employees (departmental head tax) on expenditures like GIR, or on the amount of space occupied by a unit. This would avoid having employees paying directly for transportation infrastructure and programs but would have a direct impact on academic units and their mission.

Capital construction represents another area where revenue could be transferred to transportation infrastructure providers. CU-Boulder frequently constructs and renovates buildings on campus, averaging close to $120 million per year over the past four years. Municipalities frequently require “growth to pay its own way” and tax new developments in the form of development excise taxes, use taxes, plant investment fees, permit fees and other charges. To some extent, the university is similar and assesses some plant investment fees, lost parking fees and permit fees on its projects. Unlike a municipality, fees charged to a capital project are coming ultimately from the institution and if passed through a contractor, will be marked up, costing the institution more than a direct transfer.

University capital construction suffers from the perception that it is too expensive. There is constant pressure to keep costs down and maximize the amount of construction put in place. Transportation fees on capital projects have been rejected in the past because of their impact to a project’s bottom line. It would be difficult to do long-term transportation planning to account for this type of funding since it would vary greatly depending on the number of projects being built.

Within all the transfer options, there are state laws and fiscal rules that apply differently to each source. As noted, ICR may not be able to be applied to transportation. State funds are prohibited by law from being applied to internal university charges such as plant investment fees. Other rules likely exist meaning that much additional study is required before all the ramifications of fee transfers are known.

8.9.2.3 Funding Options Summary

It is clear from this discussion that there is no easy solution to funding transportation infrastructure and programs. It is likely that a variety of funding sources will be needed to accomplish the various TDM programs outlined above. New revenue sources are desirable since they do not adversely affect existing programs. Issues of equity and fairness must be addressed in any solution. Existing methods for transferring funds must be understood to avoid running afoul of laws and fiscal rules. This section of the Transportation Master Plan has presented ideas and concepts about several possible transportation futures. One can only conclude that additional investigation is needed to develop a viable proposal that ensures financial viability of transportation providers like PTS at a price that is fair to those that use the transportation system.

APPENDIX A

Related Planning Efforts

Draft 2010-2020 Campus Master Plan

A capital facilities master plan is a comprehensive, long-range, high-level summary of expected development. It provides broad planning information to support decision making by the campus. The data and analyses contained therein are used to guide development and bring about a highly functioning, aesthetically pleasing environment. It is based on input from the campus, the state and the community. It incorporates information from surveys, building audits, regional, state and local planning initiatives, micro-master plans, maps and financial reports, and many other data sources. Facility master plans, which are in conformance with educational plans, are required for all institutions of higher education by CRS 23-1-106. By necessity, facility solutions for the *2010-2020 Campus Master Plan* will be driven by the institutional and academic goals defined in the *Flagship 2030 Strategic Plan.*

The Process

In November 2007, the Board of Regent approval of CU-Boulder's *Flagship 2030 Strategic Plan* ushered in a new era of physical planning for the campus and is providing a refreshing context for the new campus master plan. Subsequently, constituents of the campus volunteered in large numbers to participate first in a 2030 Facilities Task Force in 2008, and then in each of eight, more subject-area focused, master plan task forces in 2009.

The following outlines a timetable for the entire process.

Board approves *Flagship 2030 Strategic Plan*	November 2007
City Council Discussion – *Flagship 2030*/Introduction to Master Plan	March 2009
Master Plan Preliminary Research • Interview administrators, deans, directors • Research trends, demographics, existing conditions	Summer 2009
Task Force discussions began	September 2009
Goal Setting • Strategic Plan alignment • Task Force Reports	January 2010
City Council Discussion–Task Force Reports/Input to date	February 2010
In-depth Study • Infrastructure Planning (Utility, Flood, Transportation) • Micro – Master Plan Areas (East Campus, Family Housing) • Space Needs Analysis	Spring/Summer 2010
City Council Discussion – Planning Scenarios	December 2010
Draft Plan	Fall-Winter 2010
Public Input	Spring/Summer 2011
Approvals and adoption	Summer/Fall 2011

Conceptual Modeling the "New Flagship University" of the 21st Century

In considering both core and flagship initiatives detailed in the strategic plan, the 2008-2030 Facilities Task Force provided nine "big ideas" that helped to shed light on the challenges that CU-Boulder faces in the provision of a supportive learning and research environment over the master planning period of ten years and beyond. Discussion spanned a wide range of topics, including how to garner financial support and budget for renewal of aging buildings and infrastructure, while increasing facilities utilization, designing for efficient transportation modes, reducing congestion and carbon emissions, and enhancing the graduate student experience. Special facilities, such as those needed for increased public engagement, satellite library access, teleconferencing, and collaborative, region-wide research were also discussed. The group not only debated what to build, but also, when and where development should occur. The next step carefully examined technologies capable of moderating the need for additional facilities in Boulder. Mixed-use, smart growth development concepts from forward-thinking campus towns were sought out and village models compared for constructing residential complexes with technology-rich seminar rooms, dining, retail and childcare. Creative minds envisioned East Campus facilities carefully arranged in Main Campus scale, with low-water use, but still green quadrangles. After the 2030 task force work was complete, the facilities planning office began an information gathering stage which included many on-campus interviews and developed key issues to be addressed in the master plan. In 2009, the next stage of task force work was organized around eight subject areas:

Academic Needs & Space	East Campus
Transportation & Parking	Sustainability
Recreation, Open Space & Athletics	North of Boulder Creek
Living/Learning Environments	Community Partnerships

Representatives from the local community, including the City and County participated in this work and final reports were delivered early in 2010.

After further vetting by campus leadership, the *2010-2020 Campus Master Plan* will detail proposed facilities solutions intended in this summary.

CU Master Plan Elements

A campus master plan is the ten-year, highest-level summary of physical improvements tailored to meet the programmatic demands of the campus. The plan will provide an overall development framework that will bused and cited in regent actions and state budget documents to justify each facilities decision made by the campus for the ten-year planning period. Subsequent to the production of the master plan document, the campus proceeds with the development of area plans, sometimes called "framework plans" or "area micro-master plans." In addition, the campus annually produces the state required, five-year capital improvement program (CIP) spreadsheet, which provides a prioritized list of projects with details on square footage and financial planning for each of the projects. This spreadsheet is submitted annually through the Board of Regents in June, then to the Colorado Commission on Higher Education (CCHE) and Governor's Office of Planning and Budget (OSPB).

Conceptual ideas for building projects that are included in the master plan capital list are first detailed in an internal feasibility study. If plans remain viable throughout the campus vetting process, program plans are developed and proceed through the formal approval process which starts with the appropriate department head or dean, then the appropriate vice chancellor, senior vice chancellor and chancellor, president's office, Board of Regents and CCHE. Program plans provide details on program spaces, estimated costs, phasing, and project sites. The Boulder Campus Planning Commission, made up of students, faculty and staff, discusses land use decisions for the campus and provides recommendations to the chancellor regarding specific projects. Plans receiving state funding or legislative cash spending authority proceed to the University Design Review Board during design.

Previous Campus Transportation Planning Efforts

This section summarizes the previous planning efforts to ensure that the 2010 plan is in harmony with successes of the past and continues to build upon them.

- ***University of Colorado Master Plan Transportation Plan*, 1999, Felsburg Holt & Ullevig.**

  The 1999 Transportation Element focused largely on vehicle movement and its impact on Campus and City of Boulder circulation patterns. This report conducted bicycle and pedestrian counts and estimated mode split, assessed pedestrian/bicycle operations and transit operations. It also evaluated the feasibility of a parking structure in the Grandview area of the Main Campus. The 1999 plan lightly addresses the concerns surrounding the 18th Street/ Colorado Avenue corridor, specifically cut-through traffic. This corridor is still a major concern for CU's transportation issues, as it is *the* transit corridor for campus, as well as a bikeway route and supports several high-volume pedestrian crossing points.

- ***University of Colorado at Boulder Campus Master Plan*, 2001**

  Section E, Transportation Plan, contains a transportation vision and goals which established preferred modes of on-campus transportation, in order : (1) walking, (2) bicycling, (3) transit, and lastly (4) driving. This encourages "environmentally friendly" transportation, meaning best use of land, minimizing air pollutants, and maximizing safety. A pedestrian-oriented environment for the heart of the campus enhances the total learning experience. Vehicular trips may be necessary for longer distances, time-urgent needs, and movement of materials. Various transportation improvements were envisioned including a "circulator bus route" which was implemented as the "Stampede" bus route.

- ***Transplan 2005, Transportation Master Plan,* 2005, Nelson\Nygaard**

  This Plan was developed to serve as a "roadmap" of comprehensive strategies and implementation programs designed to meet the diverse transportation needs of university affiliates and visitors as they move to, from, and around the CU Boulder Campus. It was developed over a 24-month period with broad input from community stakeholders including university faculty, staff, students, visitors, as well as policymakers, staff and citizens of the City of Boulder. Existing conditions were measured and compiled in a detailed Existing Conditions Report that informs this plan. Specifically, Transplan 2005 offers short, medium, and long-term strategies to address the numerous issues that may arise as the campus grows and develops, surface parking is consumed by new buildings, and daily commuting needs evolve.

- ***Bicycle & Safety Committee Final Report*, 2010**

  The report addresses the major concern of pedestrian and bicycle conflict. This conflict was historically addressed through the installation and enforcement of "dismount zones." At present, CU has moved away from enforcing "dismount zones." In the wake of significant and repeated conflicts between cars, skateboards, bicycles and pedestrians, a committee was formed by the Vice Chancellor's office and executed by the CU Police department to examine pedestrian safety on campus. The report analyzed peer university approaches to bicycle and pedestrian safety to see how CU's practices and policies compared. The report produced several sets of recommendations designed to enhance safety. Among them include:

- "Engine Alley" pedestrian corridor pilot project
- Evaluate the main campus in terms of non-motorized accessibility
- Restrict vehicle access on 18th and Colorado
- Develop list of pedestrian-oriented projects

In addition to the report, the committee created a messaging campaign to be implemented campus wide. The safety campaign is intended to reinforce safe behaviors as well as alert all users of campus to the hazards for bicyclists and pedestrians on campus.

- ***2008 University of Colorado at Boulder Commuter Survey***
  In the spring of 2008 3,078 faculty, staff and students participated in the online survey, hosted by SurveyMonkey.com. This study was to determine the "modal split" (the proportion of commute trips made using each method of transportation) of trips made to and from the University of Colorado at Boulder by faculty, staff, and students. The significant modes among student respondents were riding a bus (32%), walking (22%), driving (19%), and biking (15%), whereas, faculty/staff preferred driving (45%) and riding a bus (26%). A similar survey was conducted during 2010, at four time intervals, to ascertain differences during the seasons and semesters.

- **Other Campus Documents**
  Williams Village Micro Master Plan, 1999
  Williams Village Transportation Analysis – Survey Results, 2002
  Research Park Master Site Development Plan, 1987

Local and Regional Transportation Planning Efforts

City of Boulder

Since the University of Colorado is located in the core of the City of Boulder and is the City's largest employer, their transportation planning efforts need to be coordinated. The two entities have had a long history of working together on various transportation projects and providing funding for important TDM programs.

- **1989 Transportation Master Plan**
  First adopted in 1989, the Transportation Master Plan (TMP) is the city's long range blueprint for travel and mobility. It has been updated several times by City Council with advice from the Transportation Advisory Board. The TMP helps serve a variety of broad community goals, under the umbrella of the Boulder Valley Comprehensive Plan. The original TMP called for shifting away from single occupant vehicle trips. It recognized the need to reconcile two sometimes conflicting goals: "to provide mobility and access in the Boulder Valley in a way that is safe and convenient" and "to preserve what makes Boulder a good place to live by minimizing auto congestion, air pollution, and noise."

- **1996 Update**
  Set an objective of "no long term growth in vehicle traffic" to limit the environmental and community impacts. The document committed to enhancing the community's ten major arterial streets to make them work for buses, bikes, and pedestrians as well as cars, making Boulder a pioneer in building "complete streets."

- **2003 Update**
  Created three investment programs: what could be built with current funding, an action plan for a logical increment of improvements, and a vision plan which described full build-out of the system. Four policy focus areas were identified:

  - Enhancing Regional connections;
  - Expanding Transportation Demand Management (TDM) efforts, especially via public private partnerships;
  - Completing the multimodal corridors with 28th Street as the top priority;
  - Identifying the funding necessary to achieve the goals of the plan.

- **2008 Update**
  Recognized the planned FasTracks regional transit services, and outlined the funding challenges for transportation. The Complete Streets Investment Program identifies a strategic set of the highest priority investments for the community through 2025.

Boulder County

Boulder County adopted its first multi-modal Transportation Plan in 1977 and has updated the plan several times. The County has initiated a process to revise its Transportation Master Plan with completion scheduled for 2011. The County is compiling demographic, economic, and land use data, analyzing projected travel for 2035, addressing bikeway and transit connections and TDM programs. Related studies include:

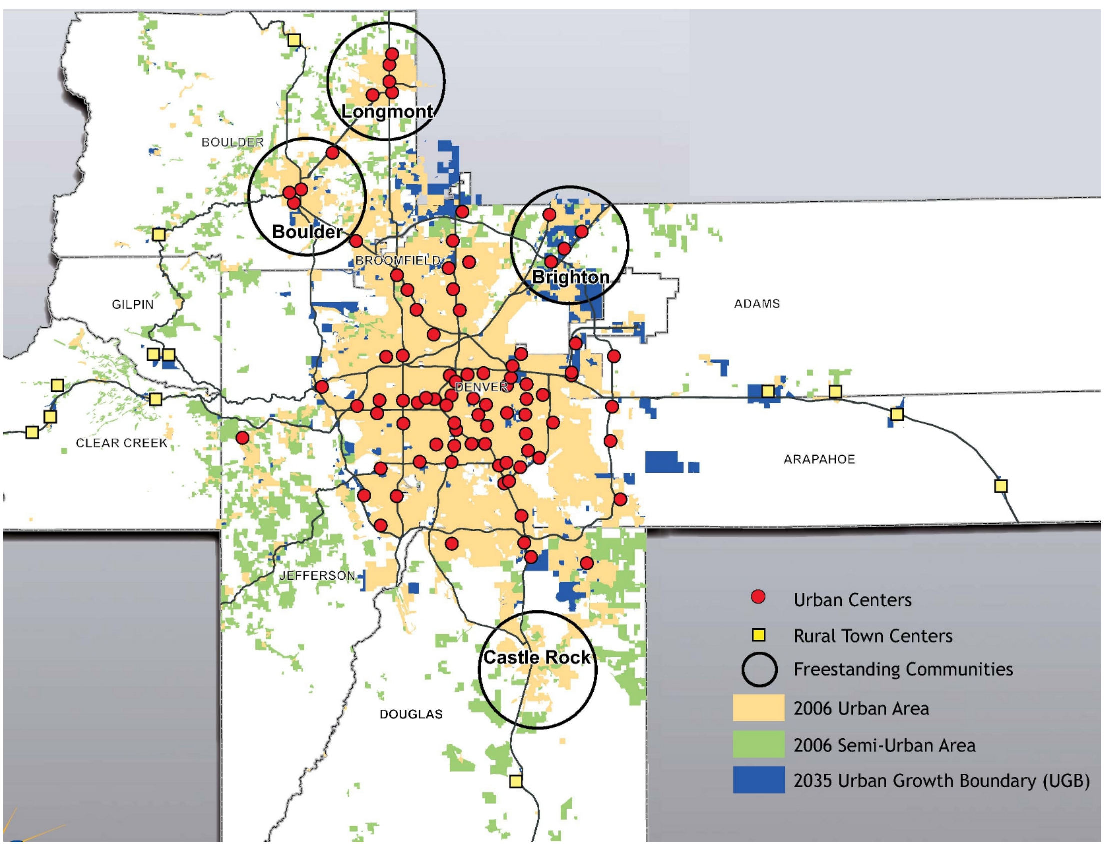
- *Boulder County Travel Patterns and VMT Memo*, 2007
- Boulder County Transportation CIP Plan, 2009 – 2015
- *Boulder County Multimodal Transportation Standards*
- *State of Boulder County Transit System*, 2010.

Denver Regional Council of Governments

DRCOG is the regional planning agency and designated metropolitan planning organization (MPO) for the nine-county (Adams, Arapahoe, Broomfield, Boulder, Clear Creek, Denver, Douglas, Gilpin, and Jefferson) Denver metro area. It is DRCOG's responsibility as MPO to plan, program, and coordinate federal transportation funds. DRCOG works with the Colorado Department of Transportation (CDOT) and the Regional Transportation District (RTD) and others to prepare transportation plans and programs. In addition, DRCOG provides services such as traffic signal coordination, carpool and vanpool matching, telework assistance, and alternative transportation promotion.

2035 Metro Vision Regional Transportation Plan, 2007

This plan addresses the challenges and guides the development of a multimodal transportation system over the next three decades. It reflects a transportation system that closely interacts with the growth, development, and environmental elements of the Metro Vision, which is the Denver region's plan for future growth and development. One of the key plan elements is to encourage development in higher-density, mixed use, transit- and pedestrian-oriented urban centers. CU-Boulder is recognized as one of these urban centers.



APPENDIX B

Full Non-Motorized Cordon Count Data by Location

17th Street & University Avenue

LOCATION #1		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** 17th Street at University	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30							9	19		**28**
7:45		5	2				15	41		**63**
Subtotal		5	2	0	7	0	24	60	84	**91**
8:00		3	3			1	6	12		**25**
8:15		1	1				8	22		**32**
8:30		4	2			1	18	36		**61**
8:45		18	9	1			39	94		**161**
SubTotal		26	15	1	42	2	71	164	237	**279**
9:00		6	8				15	27		**56**
9:15		9					10	11		**30**
9:30		8	2				11	28		**49**
9:45		26	11	4			30	68		**139**
SubTotal		49	21	4	74	0	66	134	200	**274**
10:00		8		1		1	3	11		**24**
10:15		7					4	21		**32**
10:30		23	10			1	16	18		**68**
10:45		47	15	3		4	33	70		**172**
SubTotal		85	25	4	114	6	56	120	182	**296**
Grand Totals		165	63	9		8	217	478		**940**

Count Location 1 - University Ave & 17th

Athens Court

LOCATION #2		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location Athens Court at Boulder Creek**	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		3					1	24		**28**
7:45		2	1				6	44		**53**
Subtotal		5	1	0	6	0	7	68	75	**81**
8:00		3		1			3	13		**20**
8:15		2					1	17		**20**
8:30		2	1				6	56		**65**
8:45		8	1	1		1	6	64		**81**
SubTotal		15	2	2	19	1	16	150	167	**186**
9:00		17	1			1		20		**39**
9:15		3					1	21		**25**
9:30		1				2	4	41		**48**
9:45		24	1	1			12	56		**94**
SubTotal		45	2	1	48	3	17	138	158	**206**
10:00		14				2		19		**35**
10:15		8					1	13		**22**
10:30		7	1			1	4	53		**66**
10:45		26	3				4	40		**73**
SubTotal		55	4	0	59	3	9	125	137	**196**
Grand Totals		120	9	3		7	49	481		**669**

Count Location 2 - Athens Court

Lot 169 & Stadium Drive

LOCATION #3	Wednesday (10/6/10) 7:30 AM - 11:00 AM									
Intervals	**Location Lot #169 Stadium Drive**	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		22	1				5	18		**46**
7:45		114					8	33		**155**
Subtotal		136	1	0	137	0	13	51	64	**201**
8:00		12					9	16		**37**
8:15		3					10	18		**31**
8:30		8	4				6	34		**52**
8:45		16	6				25	54		**101**
SubTotal		39	10	0	49	0	50	122	172	**221**
9:00		9	6				6	25		**46**
9:15		5					8	21		**34**
9:30		6	1				9	33		**49**
9:45		13	4				14	51		**82**
SubTotal		33	11	0	44	0	37	130	167	**211**
10:00		6	4				34	107		**151**
10:15		27	4				5	46		**82**
10:30		18	3				4	21		**46**
10:45		13	5				8	16		**42**
SubTotal		64	16	0	80	0	51	190	241	**321**
Grand Totals		**272**	**38**	**0**		**0**	**151**	**493**		**954**

Count Location 3 - Lot 169 & Stadium Dr

Folsom Field & Colorado Avenue

LOCATION #4	Wednesday (10/6/10) 7:30 AM - 11:00 AM									
Intervals	**Location** Folsom Field and Colorado Avenue	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		14	6				21	35		**76**
7:45		5	11	2		1	65	90		**174**
Subtotal		19	17	2	38	1	86	125	212	**250**
8:00		4	9			3	44	39		**99**
8:15		2	10				13	28		**53**
8:30		8	10				52	65		**135**
8:45		63	48	3		4	162	200		**480**
SubTotal		77	77	3	157	7	271	332	610	**767**
9:00		14	10	2		2	42	72		**142**
9:15		7	9	1			20	26		**63**
9:30		14	9	1		2	47	49		**122**
9:45		125	111	11		2	125	148		**522**
SubTotal		160	139	15	314	6	234	295	535	**849**
10:00		23	16				24	40		**103**
10:15		19	15	1		1	17	26		**79**
10:30		29	23	2		3	22	33		**112**
10:45		148	128	11		8	84	126		**505**
SubTotal		219	182	14	415	12	147	225	384	**799**
Grand Totals		475	415	34		26	738	977		**2,665**

Figure 1: Count Location 4 - Folsom Field at Colorado Ave

28th Street & College Avenue

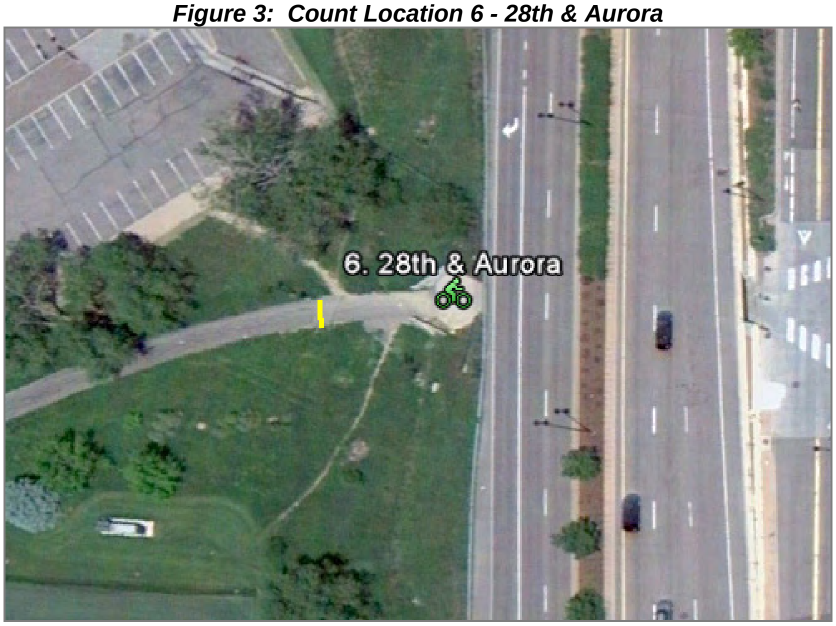
LOCATION #5		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** 28th and College Avenue	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30			2			3	14	36		**55**
7:45			2			2	60	41		**105**
Subtotal		0	4	0	4	5	74	77	156	**160**
8:00			4			2	12	16		**34**
8:15			3			1	16	24		**44**
8:30		1	5			1	45	70		**122**
8:45		6	13	1		5	108	71		**204**
SubTotal		7	25	1	33	9	181	181	371	**404**
9:00		2	3	1		2	30	22		**60**
9:15		2	1			1	21	26		**51**
9:30		2	1			1	35	50		**89**
9:45		13	20	3			53	50		**139**
SubTotal		19	25	4	48	4	139	148	291	**339**
10:00		13	9	1		1	20	16		**60**
10:15		3	8	2		1	12	19		**45**
10:30		5	5				23	24		**57**
10:45		18	29	3		1	51	27		**129**
SubTotal		39	51	6	96	3	106	86	195	**291**
Grand Totals		65	105	11		21	500	492		**1,194**

Figure 2: Count Location 5 - 28th & College Ave

28th Street & Aurora Avenue

LOCATION #6		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** 28th and Aurora Avenue	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		2	2				13	20		**37**
7:45		2	2			1	21	24		**50**
Subtotal		4	4	0	8	1	34	44	79	**87**
8:00							11	9		**20**
8:15		1	3				4	24		**32**
8:30		2				1	23	44		**70**
8:45			4	1			43	47		**95**
SubTotal		3	7	1	11	1	81	124	206	**217**
9:00		2	2				9	7		**20**
9:15		1	1				12	12		**26**
9:30		2	2				15	49		**68**
9:45		8	6	1		2	22	19		**58**
SubTotal		13	11	1	25	2	58	87	147	**172**
10:00		11	1				7	6		**25**
10:15		7	2				7	8		**24**
10:30		2	1				10	17		**30**
10:45		4	15	1			16	9		**45**
SubTotal		24	19	1	44	0	40	40	80	**124**
Grand Totals		44	41	3		4	213	295		**600**

Figure 3: Count Location 6 - 28th & Aurora



Baseline & Broadway

LOCATION #7	Wednesday (10/6/10) 7:30 AM - 11:00 AM									
Intervals	**Location** Baseline Road and Broadway	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30			1				17	4		**22**
7:45		2	6				42	14		**64**
Subtotal		2	7	0	9	0	59	18	77	**86**
8:00		2	2				13			**17**
8:15			2				15	13		**30**
8:30			3				32	13		**48**
8:45		1	3				63	5		**72**
SubTotal		3	10	0	13	0	123	31	154	**167**
9:00		2	2				17	8		**29**
9:15		2	4	2			15	16		**39**
9:30		3	7			1	30	11		**52**
9:45		2	14				55	1		**72**
SubTotal		9	27	2	38	1	117	36	154	**192**
10:00		5	7				13	2		**27**
10:15		1	2				5	8		**16**
10:30		1	5				16	6		**28**
10:45		12	34	1		1	33	4		**85**
SubTotal		19	48	1	68	1	67	20	88	**156**
Grand Totals		33	92	3		2	366	105		**601**

Figure 4: Count Location 7 - Baseline & Broadway

South Broadway Tunnel

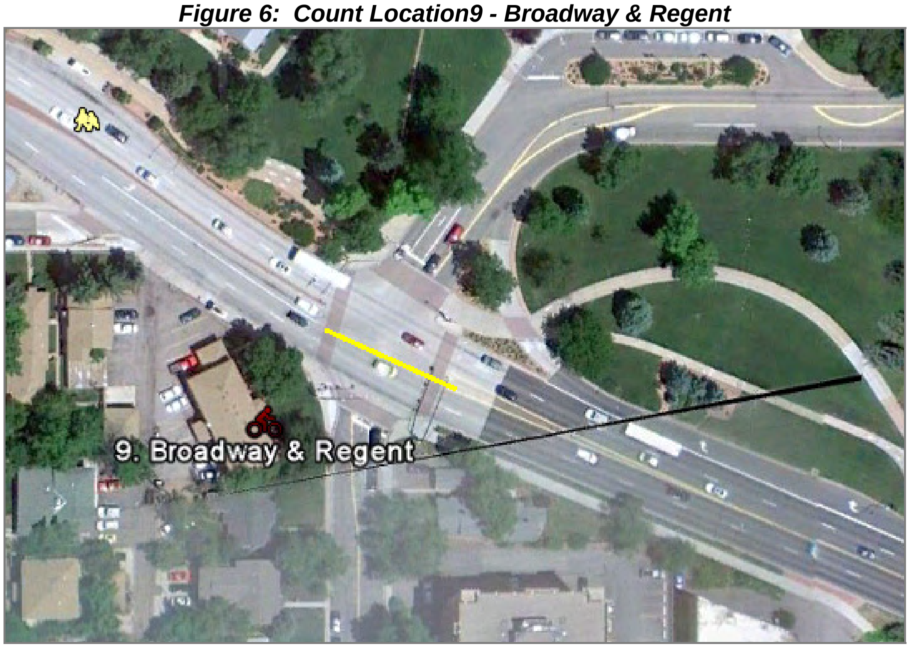
LOCATION #8		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** South Broadway Tunnel	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		1	4				13	1		**19**
7:45			6				31			**37**
Subtotal		1	10	0	11	0	44	1	45	**56**
8:00			4				22	1		**27**
8:15			36			1	30	2		**69**
8:30		1	2				16	6		**25**
8:45		2	8				61	9		**80**
SubTotal		3	50	0	53	1	129	18	148	**201**
9:00		2	3			1	27	2		**35**
9:15		1	3				12	3		**19**
9:30			2				15	4		**21**
9:45		3	9	1		2	18	13		**46**
SubTotal		6	17	1	24	3	72	22	97	**121**
10:00		5	11			1	14	2		**33**
10:15			6	1			10	1		**18**
10:30			3			1	7	3		**14**
10:45		2	11			1	20	7		**41**
SubTotal		7	31	1	39	3	51	13	67	**106**
Grand Totals		17	108	2		7	296	54		**484**

Figure 5: Count Location 8 - South Broadway Tunnel

Broadway & Regent Drive

LOCATION #9		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** Broadway and Regent Drive	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		1	2				3	16		**22**
7:45			1			1	3	35		**40**
Subtotal		1	3	0	4	1	6	51	58	**62**
8:00							5	17		**22**
8:15		9	1				3	12		**25**
8:30		1		1		1	4	16		**23**
8:45		7	2	1		1	8	21		**40**
SubTotal		17	3	2	22	2	20	66	88	**110**
9:00		3	2				2	16		**23**
9:15		1					4	3		**8**
9:30		5	1			2	2	18		**28**
9:45		10	3			7	6	31		**57**
SubTotal		19	6	0	25	9	14	68	91	**116**
10:00		6		1		1	1	15		**24**
10:15		6	2				1	3		**12**
10:30		8	1			1		17		**27**
10:45		17	4	2		6	9	20		**58**
SubTotal		37	7	3	47	8	11	55	74	**121**
Grand Totals		74	19	5		20	51	240		**409**

Figure 6: Count Location9 - Broadway & Regent



Broadway & 18th Street

LOCATION #10		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	Location 18th Street and Broadway	Outbound				Inbound				
		Peds	Bikes	Skates	Total	Skates	Bikes	Peds	Total	Int. Total
7:30		1				2		22		**25**
7:45		1				6	11	43		**61**
Subtotal		2	0	0	2	8	11	65	84	**86**
8:00							4	13		**17**
8:15		2	1				6	13		**22**
8:30		6				1	2	29		**38**
8:45		12	3			10	26	69		**120**
SubTotal		20	4	0	24	11	38	124	173	**197**
9:00		3	3	1			6	25		**38**
9:15		7	1			1		6		**15**
9:30		7	1				3	15		**26**
9:45		31	2	4		2	11	57		**107**
SubTotal		48	7	5	60	3	20	103	126	**186**
10:00		8		1			5	13		**27**
10:15		2	3	1		3	2	12		**23**
10:30		7	1				3	8		**19**
10:45		35	8	2		8	17	54		**124**
SubTotal		52	12	4	68	11	27	87	125	**193**
Grand Totals		122	23	9		33	96	379		**662**

Figure 7: Broadway & 18th

Broadway & 16th Street

LOCATION #11 — **Wednesday (10/6/10) 7:30 AM - 11:00 AM**

Intervals	Location 16th and Broadway	Outbound Peds	Outbound Bikes	Outbound Skates	Total	Inbound Skates	Inbound Bikes	Inbound Peds	Total	Int. Total
7:30		12	6			1	16	35		**70**
7:45		10	7			2	39	99		**157**
Subtotal		22	13	0	35	3	55	134	192	**227**
8:00		15	12			1	20	34		**82**
8:15		13	12			2	48	36		**111**
8:30		19	9				14	41		**83**
8:45		20	22			3	26	90		**161**
SubTotal		67	55	0	122	6	108	201	315	**437**
9:00		26	19			4	17	99		**165**
9:15		29	12	1			63	156		**261**
9:30		44	13			2	29	59		**147**
9:45		73	9				19	79		**180**
SubTotal		172	53	1	226	6	128	393	527	**753**
10:00		44	14			1	22	70		**151**
10:15		43	10	1			27	76		**157**
10:30		51	8			1	21	74		**155**
10:45		88	6			2	44	82		**222**
SubTotal		226	38	1	265	4	114	302	420	**685**
Grand Totals		487	159	2		19	405	1,030		**2,102**

Figure 8: Count Location 11 - Broadway & 16th

Broadway & College Avenue

LOCATION #12	Wednesday (10/6/10) 7:30 AM - 11:00 AM									
Intervals	Location	Outbound				Inbound				
	Broadway and College	Peds	Bikes	Skates	Total	Skates	Bikes	Peds	Total	Int. Total
7:30		3	1			1	8	30		**43**
7:45		7	3			2	23	75		**110**
Subtotal		10	4	0	14	3	31	105	139	**153**
8:00		6	1			2	7	48		**64**
8:15		11	8				8	30		**57**
8:30		12	5			1	8	87		**113**
8:45		38	9	1		9	28	193		**278**
SubTotal		67	23	1	91	12	51	358	421	**512**
9:00		22	3			2	15	35		**77**
9:15		19	4				8	36		**67**
9:30		32	6	1		1	6	57		**103**
9:45		122	11	4		6	31	209		**383**
SubTotal		195	24	5	224	9	60	337	406	**630**
10:00		52	7	3		1	14	65		**142**
10:15		25	3	2		1	11	27		**69**
10:30		35	4			1	9	53		**102**
10:45		180	22	4		13	23	178		**420**
SubTotal		292	36	9	337	16	57	323	396	**733**
Grand Totals		564	87	15		40	199	1,123		**2,028**

Figure 9: Count Location 12 - Broadway & College

Broadway & Pennsylvania

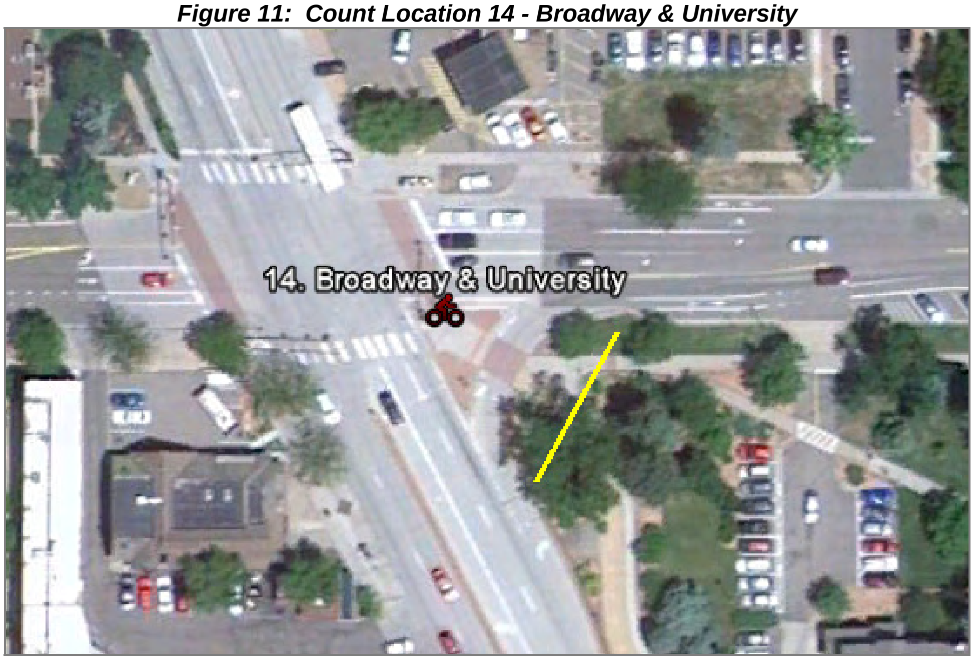
LOCATION #13		Wednesday (10/6/10) 7:30 AM - 11:00 AM								
Intervals	**Location** Broadway and Pennsylvania	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		1	1				2	14		**18**
7:45		4				1	13	45		**63**
Subtotal		5	1	0	6	1	15	59	75	**81**
8:00		2					2	18		**22**
8:15		2					2	14		**18**
8:30		3		1		2	1	33		**40**
8:45		27	5			1	19	102		**154**
SubTotal		34	5	1	40	3	24	167	194	**234**
9:00		10	3			1	3	12		**29**
9:15		8	1				3	13		**25**
9:30		8	3			1	2	30		**44**
9:45		48	7			3	11	112		**181**
SubTotal		74	14	0	88	5	19	167	191	**279**
10:00		20	6			3	2	32		**63**
10:15		6	2				2	17		**27**
10:30		13	1	1			2	34		**51**
10:45		74	5				16	92		**187**
SubTotal		113	14	1	128	3	22	175	200	**328**
Grand Totals		226	34	2		12	80	568		**922**

Figure 10: Count Location 13 - Broadway & Pennsylvania

Broadway & University Ave

LOCATION #14	Wednesday (10/6/10) 7:30 AM - 11:00 AM									
Intervals	**Location** Broadway and University	**Outbound**				**Inbound**				
		Peds	**Bikes**	**Skates**	**Total**	**Skates**	**Bikes**	**Peds**	**Total**	**Int. Total**
7:30		6	10	1		1	13	25		**56**
7:45		3	17			3	42	50		**115**
Subtotal		9	27	1	37	4	55	75	134	**171**
8:00		10	12	1			24	18		**65**
8:15		6	18				20	14		**58**
8:30		4	18	1		1	22	63		**109**
8:45		19	20			4	68	102		**213**
SubTotal		39	68	2	109	5	134	197	336	**445**
9:00		9	17			2	25	30		**83**
9:15		8	11			2	20	31		**72**
9:30		14	12				15	49		**90**
9:45		32	25	1		5	51	125		**239**
SubTotal		63	65	1	129	9	111	235	355	**484**
10:00		41	22	1		2	18	22		**106**
10:15		15	10	1			13	28		**67**
10:30		12	17	1			23	57		**110**
10:45		61	37	7		8	49	97		**259**
SubTotal		129	86	10	225	10	103	204	317	**542**
Grand Totals		240	246	14		28	403	711		**1,642**

Figure 11: Count Location 14 - Broadway & University



APPENDIX C
Advanced Transit Evaluation

Introduction

This section presents a discussion of conceptual advanced transit options for the CU Boulder campus. Work done to date has indicated that transit demand can be expected to grow to the level where advanced technologies may be an option. This document presents a comparison and advantages/disadvantages of three advanced public transportation modes: gondola, streetcar, and advanced bus systems.

The following presents a comparison of the attributes, advantages, and disadvantages of three new public transportation modes in the corridor. The reader is encouraged to keep in mind that much greater analysis could well be conducted on each of these individual factors discussed below. These studies (such as engineering studies and environmental studies) would be warranted in light of the substantial costs that would be incurred and indeed would be a requirement for any federal funding programs. The purpose of this discussion is to provide a planning-level review of the various transit options, in order to identify any “fatal flaws” that can reduce options to be brought forward for a more detailed evaluation, as well as to identify those factors that should be the focus of further evaluation. Table C-1 presents a generic summary of these three travel modes.

Discussion of Transit Options

Streetcar

The streetcar is a transit mode that was very prevalent prior to World War II, and has recently been making a “comeback”. The vehicle travels along a track (typically buried in the street pavement, but sometimes in a median or separate alignment). Where tracks are provided in travel lanes, the streetcar operates much like a large bus. Power is supplied by a single overhead catenary wire connected to the vehicle via a trolley arm. Examples of systems implemented in recent years can be found in Portland, Oregon; Seattle, Washington; Kenosha, Wisconsin; and Tampa, Florida. Characteristics of modern streetcar systems are as follows:

Table C-1
Comparison of Advanced Public Transit Technologies

	Enhanced Transit Bus	Gondolas	Streetcar
Physical Data			
Length	35 to 42 ft	5.6 to 7.8 ft	30 to 60 ft
Width	8 to 8.5 ft	4.2 to 7.4 ft	7 to 9 ft
Height	10 to 12 ft	5.8 to 8 ft	8 to 12.5 ft (vehicle only) 10 to 20 ft (w/overhead wire)
Rear Axle Weight	26,000 lbs	NA	NA
Right of Way	NA	32 - 38 ft (horizontal), 8 ft (vertical)	Operates within existing roadway right of way. Standard track gauge is 4', 8.5".
Power Source	Diesel, CNG, battery, hybrid	Cable propulsion	Overhead electric
Low Floor	Generally available	Available by design	Available by design
Cost Characteristics			
Operating Cost for Equivalent Capacity (2,000 pass/hr)	$525 per hour (7 buses)	$550 per hour	$500 per hour (5 streetcars)
Annual Operating Cost (18 hrs x 365 days)	$3,449,250	$3,613,500	$3,285,000
Vehicle Cost - each	$500,000 per bus	$25,000 to $40,000 per cabin	$2,000,000 - $2,500,000 (new modern)
Vehicle Cost - system	$3,500,000	$665,000	$11,250,000
Vehicle Life	12 to 15 years 500,000 to 1,000,000 miles	30 years	25 to 30 years
Vehicle Lifecycle Cost	$7,000,000	$665,000	$11,250,000
Infrastructure Capital Cost	$4,000,000	$22,000,000	$75,000,000
Total Capital Cost	$11,000,000	$22,665,000	$86,250,000
Operating Characteristics			
Max Operating Speed	60 mph	11 to 14 mph	30 to 40 mph
Max Grade	15%	31% to 46%	9%
Turn Radius	28 to 40 ft	Tangent only	34 to 50 ft (minimum)
Passengers per Unit:			
Seated	35 to 48	4 to 24	Approximately one third of total capacity.
Standees	15 to 30	0	Approximately two thirds of total capacity.
Total	65 to 78	4 to 24	48 to 140
Per Train Set	NA	NA	Typically single-unit vehicles
Fuel Consumption	3 to 5 mpg	200 - 1,750 kW	TBD
Technology Characteristics			
Maneuverability	Requires 11 to 12 foot lanes	Ideal for steep slopes. Difficult to change routes and stops. Straight line travel only, unless multiple terminals are used.	Difficult to change routes and stops. Can only travel on fixed track.
Ability to Adjust Service to Match Ridership Levels	Very Good -- Buses can easily be added or removed. Costs can be relatively high at highest ridership levels.	Poor -- Little ability to scale back service during low ridership periods.	Good -- Streetcars can be added so long as necessary passing opportunities are available.
Noise	Internal combustion engine models generate noise.	Low noise level	Low noise level (similar to cars) Steel wheels may cause a squealing noise to occur on turns.
Visual Impact	Typically minor	Can be substantial, particularly on flat terrain where more towers are required. Residential neighbors can strongly oppose gondolas that allow passengers to view backyards and balconies.	Catenary lines can have substantial impact, particularly at corners.
Operator, Service, and Vehicle Availability	Ready supply of operators, mechanics and manufacturers. Ready supply of lease, rent and charter opportunities.	Relatively simple maintenance, with skills available in region. Ready availability of suppliers, but few domestic suppliers. Requires special operator training. Operators relatively less available than buses.	Operators relatively less available. Requires special operator training. Requires specific maintenance skills (track, catenary)
Vehicle Features	Designed for frequent stops. Ready availability of equipment for ADA service.	Limited system lengths. Terminal facilities are complicated.	Multiple doors for easy boarding and alighting. Can be ADA compliant. Fewer vehicles needed for heavy demand.
Maintenance Facility	Flexible Location	At station, but modest in size. Cabins can be trucked offsite for major maintenance	Must be on line, substantial in size
Examples			
	Eugene, OR	Telluride, CO	Portland, OR; Kenosha, WI

Source: LSC, 2010

- Vehicles range in capacity around roughly 110 passengers (compared with a typical bus capacity of 50-64 passengers), and are typically operated as single units. With driver controls at either end, as there is no need to turn the vehicle at the end of the line.

- The key design strategy of streetcar systems is a focus on local (as opposed to regional) trips, and keeping the system simple.

- As it essentially functions as a “bus on steel wheels,” it is not generally regulated as a rail system.

- Streetcars operate at the speed of vehicular traffic, and drivers obey the same traffic regulations (such as signals).

- Stops are very similar to those provided for typical bus service, and often are only a sign and shelter. Depending on the specific vehicle, a wheelchair ramp may also be necessary.

- Additional land may be required for one or two electrical substations to supply power to the catenary.

- Some systems (such as those found in Kenosha, San Francisco, Memphis or New Orleans) use historic streetcars. The newer Portland and Seattle systems use vehicles of modern design.

It should be noted that “streetcar” differs substantially from “Light Rail Transit” (or LRT), in that it typically runs all or in part in regular travel lanes, sharing road space with autos, pedestrians, and bicyclists. LRT is appropriate for longer routes than would be needed to connect the portions of the CU Boulder campus, and is therefore not included in this analysis.

In the CU Boulder campus area, one possible streetcar alignment is shown in Figure C-1. It would connect Willams Village, the Main Campus, and the East Campus via Baseline Road, Broadway, 18th Street, and Colorado Boulevard. This alignment would be roughly 3.1 miles in length. The majority would be double tracks, though single track sections could be provided off of public roadways where the lack of passing opportunities does not result in delays (such as at the ends).

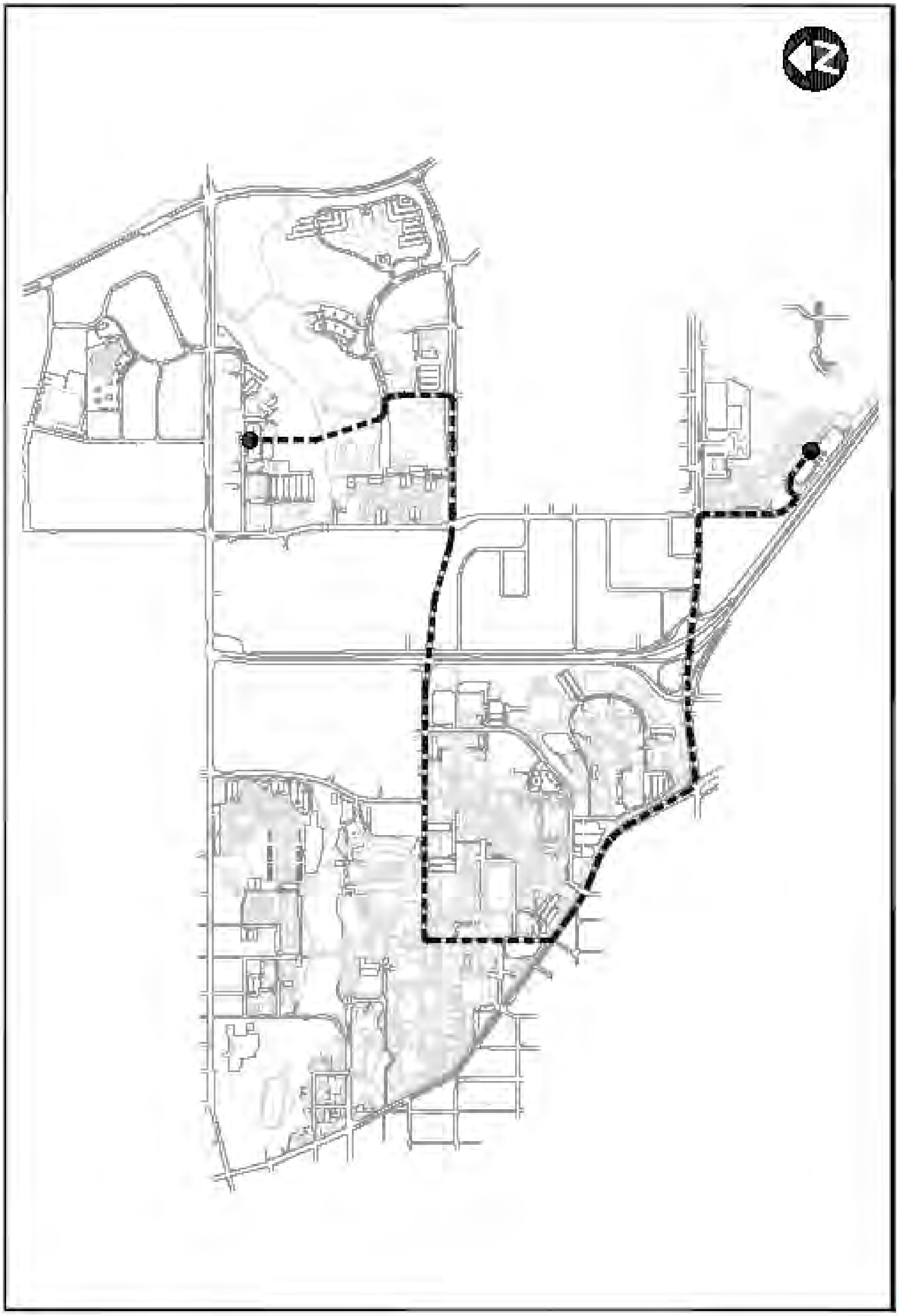


Figure C-1

Streetcar Alignment Concept

CU-Boulder Transportation Master Plan

Advanced Bus

Advanced bus transit is also a mode that is gaining popularity in recent years. The concept is to use some of the characteristics of light rail transit (faster running speeds, limited stops, higher quality vehicles, and possibly dedicated right-of-way) to gain increased ridership. A direct "match" with LRT is the various Bus Rapid Transit (BRT) systems. Perhaps the best example is the "Emerald Express" BRT line provided in Eugene, Oregon. This 4-mile long line was opened in 2007, and connects downtown Eugene, the University of Oregon campus, and downtown Springfield. Much of it operates along the median of a major roadway.

For the Boulder campus area, an advanced bus strategy could include the following elements:

- An alignment essentially identical to that presented for the streetcar option above.
- Hybrid diesel-electric or gas-electric vehicles, in a unique color scheme to make it stand out from the other buses.
- "Queue jump" lanes or "right turn only buses excepted" lanes to reduce travel times.
- Signal pre-emption at traffic signals to provide a travel time savings to bus service.
- Relatively limited transit stops, such as every 1,200 feet.
- Enhanced amenities as transit stops, including real-time departure information at major stations.
- Can be designed to take advantage of multiple-door boarding, especially if combined with radio-frequency fare (RFID), pre-boarding pay stations, or fare-free zones.
- Short sections of bus only roadways (or bus/bike only) could be provided, such as across Boulder Creek in the East Campus).

Gondola

A gondola system consists of cabins fixed along a moving cable (or "rope"). It differs from a tram system whereby two counterweight cabins are pulled along fixed cables. With detachable grips to allow slow speed operation at stations, gondolas typically have an operating speed of 17 miles per hour (slightly faster than typical bus operating speeds in mixed traffic). The gondola, of course, would be immune from traffic congestion delays. Typically however, the gondola would not attract ridership simply due to reduced travel times.

An important distinction between gondola service and the other options is that it only serves those passengers traveling within a convenient walking distance of both terminals. For an area as expansive as the CU Boulder Main Campus, much of the area would not be convenient to the terminal. A single gondola terminal at 18th and Colorado, for example, would be beyond a convenient quarter-mile walk of Farrand Hall on one side and Hale Scientific Building on the other.

One of the most crucial issues with regard to a new gondola in Colorado is state laws regarding right-of-way that are enforced by the Colorado Tramway Board. Specifically, Section 2.1.1.3.2.1 Code of Colorado Regulations states:

> "*No passenger tramway installation shall be permitted to operate when a structure encroaches into the air space of the passenger tramway, defined as the area bounded by vertical planes commencing at a point thirty-five (35) feet from the intersection of the vertical planes of the ropes or cables and ground surface.*"

In other words, a 70-foot corridor clear of structures must be provided beneath the gondola line. This would be virtually impossible to provide on the CU Boulder Campus, except directly over major roadways (such as Colorado Boulevard). "Turning stations" needed to change the direction of a gondola line are substantial and expensive structures (in order to accommodate the tension of the rope lines). Providing a 70-foot corridor would be particularly difficult along the Main Campus – Williams Village corridor, without the removal of a substantial number of existing major structures.

Factors For Consideration

The following presents a discussion of a variety of individual factors that warrant consideration, consisting of environmental factors, ridership factors, operational factors, impacts on other travel modes, and impacts on development patterns.

Environmental Factors

- The right-of-way requirements of the gondola would be greater than those of the streetcar or advanced bus options. Both of the latter two options could effectively use existing travel lanes to avoid any right-of-way requirements, while the gondola would require a 70-foot-wide clear zone. The towers required for the gondola (which would be numerous, particularly on relatively flat terrain) would require careful placement or redesign of roadways.

- Roadway noise is an issue for streetcars and advanced buses. The noise impact of a streetcar is generally reduced due to the lack of an onboard engine. However, a streetcar can generate a low vibration from the wheels (which can be addressed through careful design and maintenance). In addition, there is a potential for a particularly annoying steel-on-steel "squeal" as a streetcar makes a sharp turn (such as may be necessary at 18th and Colorado), though this could be reduced or possibly eliminated through careful design and the use of specialized rail wheels with rubber insets.

- Both streetcar and gondola modes can be effectively zero emissions with regard to power-related air emissions, to the degree that the electricity in the local power grid is generated by sources (such as wind or hydropower) that do not generate air emissions. This can be beneficial both at the local level (avoidance of particulate and carbon monoxide emissions along the right-of-way) as well as at the global level (reduction in greenhouse gas emissions). It should be noted, however, that a modern hybrid-electric bus has a much lower emission level than the old "diesel belching" buses. Both buses and streetcars would add to airborne particulate matter ("re-entrained road dust") along the route as their passage would kick up road sand materials. The advanced bus mode would marginally add to re-entrained road dust as rubber wheels would pulverize more road sand than steel wheels.[1]

- Perhaps one of the environmental effects associated with a gondola that is of greatest concern is the loss of privacy to homeowners within sight of gondola passengers. This has been a vehement criticism of gondola projects in other communities, as homeowners resent the fact that passengers can observe them in their backyards, on their balconies, or through their windows.

- The visual impacts of a gondola can be substantial, particularly as the relatively flat terrain along the corridor would require a greater number of towers than

[1] To the extent that advanced transit technologies increase the modal shift from single-occupant autos to transit, total airborne particulates may be reduced due to a higher ratio of passenger miles traveled per vehicle mile.

would a gondola of similar length over varied terrain. A streetcar system would also have the visual impact associated with the catenary wire, which can be particularly unattractive at corners where guy wires are needed to stretch the catenary to follow the curve of the tracks. While there are design techniques to minimize the web of wires that can be seen in some older streetcar or trolley systems, a streetcar system would inevitably result in visitors and residents perceiving the corridor as more "urban."

- Construction impacts (noise, street closures, dust, etc.) would be the least under the advanced bus option. Both the gondola and streetcar options would have substantial impacts, though the need to remove pavement and effectively build a new rail track/sub-grade structure indicates that the greatest impacts would be generated by the streetcar option. For both the streetcar and gondola options, some relocation of overhead wires would be needed.[2] The requirement to relocate underground utilities for the streetcar option would depend on their existing location and the weight requirements of the selected vehicle type, while relocation of underground utilities for the gondola option would depend on tower location.

Ridership Factors

- A gondola has the advantage of effectively eliminating the wait for a vehicle (at least during periods when passengers arrive at a station at a rate lower than the capacity of the gondola), while both the streetcar and advanced bus options would require passengers to wait. During a peak special event (such as at the end of a sporting event or concert), however, the gondola could require long waits.

- Both the streetcar and advanced bus options could have faster travel times than existing transit bus services, due to signal priority and potential jump-queue lanes. Typical travel times on the three modes would be very comparable. However, the gondola would have the advantage of not being impacted by traffic delays during busy traffic or pedestrian activity periods.

- By serving additional stops, both the streetcar and advanced bus option would increase the proportion of the campus destinations within a convenient walk distance of the nearest stop.

- Some potential passengers will avoid a gondola due to acrophobia (fear of heights), or fear of being stranded. It is generally reported that 5 percent of the US population has acrophobia.

- In comparison with a bus, rail can provide a smoother ride, and has been proven to generate additional ridership (all other factors being equal). Transportation modelers in urban areas typically give rail service a "credit"

[2] "Cordless light rail" technology with super-charging batteries or in-street power supply systems are under development, but not available commercially for direct comparison at this time.

equal to a reduction in travel time of 12 minutes in comparison with local bus service, in order to reflect this additional ridership factor.

- While options are available to generate limited electricity for lighting in a gondola (such as through batteries and solar cells), gondolas are typically not heated.

Operational Factors

- Capital (right-of-way, station and vehicle) can be roughly estimated as follows:
  - The costs associated with constructing a streetcar system vary widely depending on the existing corridor, the need for reconstruction of existing streets and underground utilities, and the need for relocation of overhead utilities. On one hand, the recent Kenosha, Wisconsin streetcar system along an existing parkway median cost only $2 million per mile (including vehicles). On the other hand, the double-track San Francisco "F line" streetcar system cost about $30 million per mile (though this included extensive streetscaping and roadway reconstruction). A reasonable unit cost for Boulder (assuming that streetscape amenities are modest) would be $25 million per mile, or a total cost of roughly $37.5 million for a 1.5 mile system connecting Williams Village and Main Campuses and $75 million for a 3 mile system connecting all three
  - A recent study of a gondola in similar relatively flat terrain (the Sun Valley – Ketchum Gondola Feasibility Study) indicated a capital cost of approximately $20 million per mile – essentially equal (at this rough level of cost estimation) with the streetcar option. This does not include costs associated with removal of structures beneath the ropeway, or redesign of roadways to allow tower placement. Absent removal costs, capital costs would be $22 million for a 1.1 mile system connecting Williams Village and $60 million for a 3 mile system connecting all three.
  - The advanced bus option would require estimated capital costs as shown:

Vehicles (7 hybrid buses @ $500,000 each)	$3.5 million
Street improvements (signal pre-emption, queue lanes)	$2 million
Enhanced transit stops	$2 million
Total	$7.5 million

- As shown, an enhanced bus system would be substantially less expensive than the other two alternatives.

- The one-way passenger-trips per hour capacity of the various modes can vary significantly depending on design. A streetcar system operating four vehicles at a time and an advanced bus system operating six vehicles at a time could both serve up to roughly 1,100 passengers per hour in the peak direction. In comparison, a gondola system could serve roughly 1,200 passengers per hour in the peak direction.

- The greater capacity of a streetcar compared to a bus means that the driver cost per passenger-trip for a streetcar can be lower than for buses, though only for the periods in which the capacity of a single bus is exceeded. Given the limited number of peak periods that would generate such high ridership levels, this potential cost savings associated with the streetcar option is expected to be modest.

- An advanced bus system has greater flexibility to adjust to changes in passenger demand levels over the course of the day or the year. It also provides the opportunity for buses to use the advanced bus corridor, and then branch to serve other areas. The capacity of a streetcar system is dependent on the location of passing opportunities, while it is relatively easy to schedule additional peak buses to handle transportation for special events. On the other hand, it is difficult to reduce the capacity of a gondola system during low patronage times.

- With regard to staffing, gondolas are typically operated with a minimum of two staffers at each station/loading location. This would require a total of 8 persons on duty for a two-leg gondola system at all times the service is in operation. In comparison, at low demand times, the streetcar or advanced bus system could conceivably be operated with only a few persons on staff (such as two drivers providing service roughly every 20 minutes). Given the high minimum cost to operate gondola service, there is a tendency to operate gondola service only when passenger levels warrant the cost, resulting in fewer hours per day (or fewer days per year) than a bus or streetcar option would be operated. (The issue of operating hours for the Telluride gondola system has long been a point of contention.)

- A streetcar would require a maintenance/vehicle storage facility somewhere along the rail line. In addition to the land requirements for this facility (which could easily total a half acre or more), there would be noise impacts associated with maintenance activities. In comparison, buses can be maintained anywhere in the region, while gondolas can also be refurbished or maintained elsewhere.

- A streetcar requires maintenance skills not currently available from CU-Boulder PTS Staff , including track maintenance and catenary maintenance expertise. While it is certainly possible for CU-Boulder PTS staff to gain these skills or for CU to contract with RTD maintenance staff, providing training (and ensuring some redundancy in staff) increases costs.

- A streetcar cannot maneuver around an obstacle (such as a stalled car), unlike a transit bus.

- Put simply, an advanced bus option avoids having maintenance costs for the right-of-way falling on the transit service (with the possible exception of new bus-only sections). Bus service essentially is only responsible for maintenance of the vehicles and relatively minimal bus stop maintenance, while both the streetcar and gondola options also incur substantial ongoing costs associated with upkeep of the right-of-way.

- A streetcar operating on an exclusive right-of-way (such as the railroad grade) would need to address snow removal. Other systems in similar winter weather conditions have found that simply operating the system throughout a snow storm typically can keep the line operating, avoiding the need for specific snow removal operations except during the worst of storms.

- The advanced bus approach has the distinct advantage of allowing a more gradual phasing in of improvements. Rather than a major project requiring tens of millions of dollars, relatively simple steps such as signal prioritization and bus stop improvements can be implemented, with a long-term goal of a fully realized advanced bus corridor.

Impacts on Other Transportation Modes

- The gondola has the benefit of avoiding any impacts on auto traffic along 28th Street (US 36), 30th Street, Baseline Road and Colorado Avenue. The impacts of streetcars and advanced transit services on traffic due to signal pre-emption is modest: numerous studies have shown substantial travel time savings (on the order of 20-25 percent reduction in signal delay) for transit vehicles, with only roughly a 2 percent increase in delay for general traffic.

- The streetcar would result in metal tracks and flange grooves in public roadways also used by bicyclists, pedestrians, and users of wheelchairs and other personal mobility devices. In particular, the tendency of bicycle and wheelchair wheels to be caught by the flange grooves can increase accidents.

Advanced Transit Technology Conclusions

Advanced bus strategies have the greatest overall potential to improve transit accessibility and ridership in the CU Boulder campus, with a maximum level of flexibility and implementability, and a minimum of environmental impacts and financial requirements.

APPENDIX D

FY2011 Sustained Transportation Partnership Financial Plan

FY2011 DRAFT PARTNERSHIP FINANCIAL PLAN	FY11	*[DRAFT]*		TOTAL BUDGET	STUDENT FUND BUDGET	PTS FUND BUDGET
SUBTOTAL REVENUE				-$5,042,494	-$4,739,766	-$302,728
SUBTOTAL EXPENSE				$5,830,617	$4,789,406	$1,041,211
ANNUAL BALANCE				-$10,873,111	$49,640	-$1,343,939
PRIOR FY BALANCE				$0	-$430,447	$0
CURRENT BALANCE				-$10,873,111	-$380,807	-$1,343,939
CURRENT BALANCE % OF EXPENSES					8%	
CURRENT BALANCE % OF REVENUES					8%	
Program	**[CAT]**	**Sub-Program**	**[SUBCAT]**	**TOTAL BUDGET**	**STUDENT FEE BUDGET**	**PTS GENERAL BUDGET**
Revenue	REV					
		mandatory student fee revenue	*MFEE*	-$4,669,766	-$4,669,766	$0
		optional student fee revenue	*OFEE*	-$70,000	-$70,000	$0
		general fund eco pass revenue	*GFUR*	-$55,000	$0	-$55,000
		aux recharge revenue	*AUXR*	-$173,723	$0	-$173,723
		system eco pass revenue	*SYSR*	-$70,309	$0	-$70,309
		transportation services salary & benefits	*TSSB*	-$3,696	$0	-$3,696
Subtotal Revenue				**-$5,042,494**	**-$4,739,766**	**-$302,728**
Administration	ADM					
		professional exempt salary	*PESA*	$16,532	$16,532	$0
		classified staff salary	*CLSA*	$174,079	$65,199	$108,880
		student hourly wages	*STWA*	$40,000	$40,000	$0
		professional exempt benefits	*PEBE*	$4,827	$4,827	$0
		classified staff benefits	*CLBE*	$50,831	$19,038	$31,793
		student hourly benefits	*STBE*	$480	$480	$0
		operating expenses	*OPER*	$17,330	$8,000	$9,330
		travel	*TRAV*	$4,000	$2,000	$2,000
Subtotal Administration				**$308,079**	**$156,076**	**$152,003**
Advertising	ADV					
		administration/other/project management	*ADWZ*	$2,400	$1,200	$1,200
		campaign: bicycle culture	*ADBC*	$6,000	$3,000	$3,000
		campaign: bicycle registration	*ADBR*	$3,500	$1,750	$1,750
		campaign: bike station	*ADBS*	$3,050	$1,525	$1,525
		campaign: buff bikes	*ADBB*	$100	$50	$50
		campaign: carshare (SOV)	*ADCS*	$1,000	$500	$500
		campaign: general transportation	*ADGT*	$6,676	$3,338	$3,338
		campaign: late night transit	*ADLT*	$6,700	$3,350	$3,350
		campaign: mobile mechanic	*ADMM*	$1,000	$500	$500
		campaign: ski bus	*ADSB*	$5,700	$5,700	$0
		campaign: sky ride	*ADSR*	$2,000	$1,000	$1,000

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CURRENT BALANCE % OF EXPENSES					8%	
CURRENT BALANCE % OF REVENUES					8%	
Program	**[CAT]**	**Sub-Program**	**[SUBCAT]**	**TOTAL BUDGET**	**STUDENT FEE BUDGET**	**PTS GENERAL BUDGET**
		campaign: intermodal safety	*ADIS*	$7,500	$3,750	$3,750
		campaign: transit advocacy	*ADTA*	$1,500	$750	$750
		campaign: vanpool/carpool (HOV)	*ADVC*	$500	$250	$250
Subtotal Advertising				**$47,626**	**$26,663**	**$20,963**
Business Ops						
		bicycle registration	*BKRE*	-$17,452	$0	-$17,452
		bicycle station	*STAT*	$31,440	$3,985	$27,455
		buff bikes	*BUFF*	$3,814	$3,814	$0
		lock cutting service	*LCTS*	-$2	-$2	$0
		used bike sales	*USED*	$115	$6,844	-$6,730
		mobile mechanic	*MECH*	$1,683	$343	$1,340
		semester rentals	*SEMR*	$9,389	$9,389	$0
		ski bus	*SKIB*	$19,529	$19,529	$0
Subtotal Business Ops				**$48,516**	**$43,903**	**$4,614**
Bicycle Programs (Non-Business Ops)	BKE					
		folsom park bike station	*FPBS*	$50,000	$50,000	$0
		bike parking	*PARK*	$75,000	$0	$75,000
Subtotal Bicycle Programs				**$125,000**	**$50,000**	**$75,000**
Development (Non-Business Ops)	DEV					
		intersection painting	*REPA*	$5,000	$5,000	$0
Subtotal Development				**$5,000**	**$5,000**	**$0**
HOV Programs	HOV					
		ride sharing (zimride)	*ZIMM*	$7,000	$4,000	$3,000
Subtotal HOV Programs				**$7,000**	**$4,000**	**$3,000**
Research	RES					
		campus bike census	*CENS*	$500	$250	$250
		commuter study	*COMM*	$1,500[1]	$750	$750

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CURRENT BALANCE % OF EXPENSES					8%	
CURRENT BALANCE % OF REVENUES					8%	
Program	**[CAT]**	**Sub-Program**	**[SUBCAT]**	**TOTAL BUDGET**	**STUDENT FEE BUDGET**	**PTS GENERAL BUDGET**
		cultural assessment	*CULT*	$500	$250	$250
		price elasticity study	*ELAS*	$3,000	$1,500	$1,500
Subtotal Research				**$5,500**	**$2,750**	**$2,750**
Transit Programs	BUS					
		student bus pass ("College Pass")	*SBUS*	$4,117,972	$4,117,972	$0
		employee bus pass ("Eco Pass")[2]	*EBUS*	$744,934[3]	$0	$744,934
		late night transit	*LNTR*	$191,958	$191,958	$0
		bus stop operations & maintenance	*BSOM*	$5,000	$5,000	$0
		transit service buy-ups	*STMP*	$41,692	$37,149	$4,543
Subtotal Transit Programs				**$5,101,556**	**$4,352,079**	**$749,477**
Recharge	GAR					
		general administrative recharge	*GADR*	$158,333	$129,327	$29,006
		general infrastructure recharge	*GINR*	$24,007	$19,609	$4,398
Subtotal Recharge				**$182,340**	**$148,936**	**$33,404**