V. Land and Facilities Plan

A. Building Plan

This section begins by examining how much land remains developable or re-developable without irreversible harm to one of the nation’s most beautiful campuses. This look at potential development areas is from a long-term perspective, often termed a “build-out scenario.” The analysis shows that there are limited opportunities for new construction on the Main Campus and that many of them would require substantial investments in infrastructure that might make them financially infeasible. It also suggests that some of the facilities will be subject, at least in part, to redevelopment and that most major projects will need to evaluate the East Campus as an alternative to Main Campus locations.

This section also includes the master plan for capital construction. Capital construction is defined as building projects costing at least $2,000,000. Smaller projects usually do not appreciably change the utilization of space on campus, which is the focus of this master plan. The capital construction plan looks at potential projects in the next five years (through 2015) and in the six-to-ten-year time frame (through 2020).

The capital construction plan describes potential projects that will address the space deficits. It proposes specific facilities that would resolve existing limitations on space and cost. A location is proposed for some of these projects in the context of the long-range goals of the campus.

Finally, this section discusses the characteristics of building development. It describes the density goals of the students, the desired area for building safety, accessibility, and infrastructure necessary to support building development.

1. Potential Long-Term Development

Any discussion about the long-term development potential usually triggers people’s passion for the campus. Some are concerned that too much development of the Main Campus may degrade its beauty. Others are concerned that the growing programs of the university and its obligation to meet the needs of the state of Colorado may be unduly constrained in the future. The long-term development capacity of University of Colorado Boulder is largely in the flood plain and redevelopment would require careful consideration of the substantial risk.

For additional information about the development potential of the East Campus, refer to Section B of this chapter.

d. Williams Village Campus Potential

The Williams Village campus is perceived as a residential campus for both students and faculty and staff. The east side of Bear Canyon Creek remains largely undeveloped with approximately 19 acres that have been designated for future faculty and staff housing development. On the west side of Bear Canyon Creek, 8 acres remain to be developed for student housing, support facilities such as dining, residential college facilities, recreation, and parking.

For additional information about the development potential of the Williams Village campus, refer to Section B of this chapter.
e. CU-Boulder South Potential
A conceptual land use assessment conducted by the university that was published in January 2002 defined the potential development area of the CU-Boulder South property. Of the 310 acres owned by the university, 81.50 acres are in natural areas that are unsuitable for development (e.g., in wetlands or outside the berm and subject to flooding). Another 10.40 acres are in ponds for irrigation or exposed groundwater. Another 49.19 acres are needed for potential flood storage on site to protect any on-site development, but which might be developed for recreation or athletics facilities. This results in a net of 165.23 acres that could be developed of which 32 acres could be expanded flood control storage to protect the community downstream.

CU-Boulder South continues to be studied jointly by the City of Boulder, Boulder County, and the university regarding flood potential and mitigation. No development of CU-Boulder South is planned during the 10-year period. The university will work cooperatively with the other governmental agencies on any flood mitigation strategies that might be developed.

f. Mountain Research Station Potential
The Mountain Research Station is the arctic and alpine field research facility of the university. The campus is 192 acres located near Ward, Colorado, with study centers located on Niwot Ridge in the City of Boulder Municipal Watershed. Development at the station is constrained by the available utilities and a desire to minimize development in favor of environmental investigation.

For more information about the development potential of the Mountain Research Station, refer to Section B of this chapter.
2. New Buildings Envisioned within 10 Years

The long-range plans show where development would be occurring and where specific development is planned in the 10-year time frame. Exhibit V-A-3 indicates new buildings and major additions planned for the next 10 years on the three adjoining campus properties. The map shows:

- An illustration of the building footprint. The actual footprint is very basic with buildings designed but what is shown indicates the relative size of the proposed project.
- A list of projects that may be updated periodically based on new projects or programs and funding.
- Major renovation projects where the buildings may undergo capital renewal projects or where sizeable variations will require adaptation of the building to a new program.

The map does not indicate smaller renovation projects that may occur to enhance programs or to update and modernize existing space.

The map corresponds to the capital projects list included later in this section. Projects on the capital list may or may not come forward during the 15-year planning cycle since the capital list has a longer time window than the campus master plan. Appearance of a project on the campus map does not ensure that the project will be realized in the planning period. Campus projects are selected and advanced through the capital construction process discussed in Section VI.

a. Main Campus Projects

The Main Campus will continue to see new construction but at a slower pace than the previous planning period. There are 20 new projects, major additions, or parking structures proposed. Most of the new construction on the Main Campus is focused on auxiliary enterprise functions such as the utility generation, the Student Recreation Center, student housing, and family housing. Academic projects involve additions to the Engineering Center, Dushane Science Complex, and Norlin Library as well as a new Performing Arts Center.

In addition, 14 major renovations and capital renewal projects are planned, which highlights the university’s intention to modernize existing facilities. Capital renewal renovation to Ketchum Arts and Sciences, Heliem Arts and Sciences, Guggenheim Geography, Educa- tion, Clare Small Arts and Sciences, and McKenna Languages are proposed. Programmatic renovations of Ekelove Chemistry, Cristol Chemistry and Biochemistry, and the Fleming Building are likely to support change in mission for these facilities. Housing renovations will continue to be made to modernize facilities.

b. East Campus Projects

The East Campus will see new academic and research building development, primarily in the sciences. The existing campus is composed of four main users: family housing in Smiley Court; general university administrative and research space located north of Bear Creek; Intercollegiate Athletics facilities, primarily Potts Field and Prentup Field; and the CU Research Park. The Research Park is planned and funded, which are being re-planned into a new arrangement in alignment with new density requirements and the desire to make it one integrated science campus. Buildings that are proposed include the completion of the academic wing of the Garthurs Biotechnology Building, a Chemistry and Life Sciences Building, and the addition to the McAlistter Center, an addition to the LASP Space Technology Center, and several other new unspecified buildings for academic and research uses.

More detail about the new vision for the East Campus is included in Section B of this chapter.

c. Williams Village Projects

Additional student housing is planned for Williams Village. The final residence hall building may be constructed along with a new dining center that would be a scaled-down version of the Center for Community. Faculty, staff, and family housing may be constructed east of Bear Canyon Creek.

d. CU-Boulder South

The largest unmet needs for land are recreation fields to accommodate student demand, and intercollegiate athletics practice and competition spaces other than football. Development of the property for these uses may occur, depending on the outcome of ongoing studies of the South Boulder Creek project that is being conducted by the Boulder and Boulder County. Infrastructure development, including potentially a large-scale photovoltaic array, may lead recreation and athletic uses.

e. Mountain Research Station

The Mountain Research Station is the alpine and arctic field station of the university. Its primary focus on environmental research is likely to grow in the next 10 years as research into the world’s environmental problems accelerates. Development at the station will likely be increased research facilities and to weatherizing existing residential structures to increase the utilization of the station during winter months. For additional information about the Mountain Research Station, see Section B of this chapter.

3. Proposed Capital Projects List

Exhibit V-A-3 is a comprehensive list of all projects included in this plan. Each of these projects was discussed in the previous chapter within the land use categories—academic, service, athletics and recreation, or housing. Within these same categories, this exhibit indicates:

- Whether a program plan has been prepared.
- Whether a project has been funded.
- The approximate square footage (assignable and gross).
- Whether the project is planned to be completed in 5 to 6 years (through June 2022) or 6 to 10 years (June 2022) or beyond.
- The estimated cost in 2010 dollars.

The master plan catalogues all anticipated capital projects within the 10-year planning period. This list forms the pool of possibilities from which the five-year Capital Improvements Plan, the two-year cash-funded projects list, and the Five-Year Capital Improvements Plan is drawn. Exhibit V-A-3 should be interpreted as follows:

- This list reflects the need, not the financial resources. CU-Boulder is committed to accomplishing as many projects as possible, but recognizes that the need and plans may not exceed the likely resources. The actual projects to move forward from this list will depend on a project’s ability to raise funds.
- Only CU-Boulder projects are listed. Projects by the University System Administration, governmental agencies, and private tenants on campus may occur within developmental areas but are not listed on this exhibit.
- Projects may be added without amending the Campus Master Plan if there is a need identified in this plan and a site is available within the potential development areas.

The list of capital projects shown in Exhibit V-A-3 attempts to reconcile the space needs described in Section IVA with the potential funding stream to create a possible implementation plan. The needs far exceed the university’s ability to build them way out of the deficit. Still, the needs are so extensive that some building must occur if the institution is to maintain its strategic vision.

Exhibit V-A-3 can be compared to the anticipated space deficit found in Section IVA to determine how much of the deficit can be accommodated during the planning period. For Academic space, there is a current deficit of 953,343 assignable square feet that grows to 1,157,131 assignable square feet by the end of the planning pe- riod, primarily due to the growing demand for research space. This compares to the proposed 900,426 assign- able square feet that might be built during the planning period. Within the Academic category, there is also a great emphasis placed on renovating space through capital funding to improve and programmatic renova- tions. A total of 650,029 assignable square feet may be renovated under this plan to modernize existing facilities. While this does not add new square footage, the university intends to analyze these spaces to increase utilization and fit the right program into the right space, which will also help to offset the demand for space without actually constructing new space.

Some of the capital renewal projects appear beyond the current planning period, beyond 15 years. The univer- sity is currently reassessing the priorities of the capital renewal projects and these projects may accelerate if the new criteria rank them higher than they have been in the past.

A similar comparison can be made for each of the other categories listed in Exhibit V-A-3. In the Service and Administrative category, 200,250 ASF is proposed against a need of 243,633 ASF. The proposed projects in this category are primarily infrastructure projects that address deficiencies on the Main Campus and begin to lay the foundation for growth on the East Campus. Renovations to the Power House are part of the infra- structure improvement, and potential expansion of the potential expansion of the University Club would improve its usefulness, which has been underutilized since the university stopped providing overnight lodging.

In Athletics and Recreation, 247,750 ASF is proposed to meet a demand of 272,172 ASF. About one third of the added space will be for expansion and renovation of the Recreation Center. This project will likely impact the tennis courts, which will have to be replaced prior to and concurrent with the expansion. The remainder of the space will be added for athletics facilities. The new soccer/lacrosse stadium will facilitate East Campus development and the expansion of the Dail Ward Athletic Center is needed for Title IX compliance.

In Residential space, 1,162,150 ASF is proposed to meet a shortfall of 2,112,500 ASF. This largely reflects the condition of Family Housing, where the buildings are well beyond the useful life and should be replaced. It also reflects planned growth in undergraduate hous- ing where additional buildings may be built at Williams Village and the Quad may be redeveloped to increase density on the Main Campus.

Colorado Revised Statutes 24-1-136.5(6) requires that a five-year capital planning be submitted each year to the legislature’s Capital Development Committee. The exhibit and this Campus Master Plan go beyond that requirement to 10 years and beyond so that there is an understanding of what might be completed. The Five-Year Capital Improvements Plan is created from projects on the master plan list that are most timely. The CIP identifies proposed sources of funding and is revised annually as required by the state of Colorado.

Capital construction funding is allocated on an an- nual basis from fluctuating state of Colorado capital construction funding; inter-fund transfers such as indirect cost recovery, auxiliary revenues, student fees; other governmental units, and from gifts and grants through fundraising efforts. The five-year plan may be achievable but depends upon successful competition for limited resources. A feasibility study or program plan would normally be underway in order for a typical state- funded project to be realized in five years. With new flexibility legislation passed in 2009 and 2010, cash- funded projects can be realized in three years or fewer, but are also likely to have started planning. Within 10 years, about 67 percent of the entire list may be achievable, depending on assumptions about future revenues.
4. Renovations, Capital Renewal, and Demolition

The University of Colorado Boulder is one of the oldest public institutions in the state. More than 80 percent of the buildings on campus are more than 25 years old and 45 percent are more than 50 years old. By 2015, more than 62 percent of all buildings will be more than 50 years old. The oldest building, Old Main, is 134 years old. Yet the programs in these buildings are based on today’s educational mission and technological sophistication.

The age of the campus presents many renovation challenges. Buildings in the 25-to-40-year-old range have many systems that are at the end of their useful life. Studies by APPA, the federal government, and private entities indicate that maintenance and renewal requirements reach a peak during this period, suggesting that there will be a substantial need for reinvestment. CU-Boulder’s backlog of deferred maintenance is higher than peer institutions and its funding for maintenance has reached recommended target levels only twice in the past eight years. With these constrained resources, CU-Boulder has focused on resource conservation resulting in CU-Boulder having the lowest energy consumption of peers studied. The university will continue to make these types of investments and will make a greater effort in building renovation in the planning period.

There are three major types of renovation needs: those based on functional obsolescence, those based on regulatory changes, and those based on physical obsolescence. An analysis of the program requirements of the building occupants is used to determine functional obsolescence and whether an addition or replacement of buildings be removed in order to clear land for redevelopment. Most of these areas are in housing districts of the campus—north of Boulder Creek and the Kittredge Complex. The Long-Term Development Plan proposes removing Kittredge Commons (now rendered obsolete by the Center for Community) and replacing it with a residence hall and replacing the Dormitory Quad district (Aden, Brackett, Cockrell, Reed, and Crossman Halls) with higher density housing. These projects will require the removal of existing structures as a part of redevelopment.

Before a major building is demolished, a photographic record and basic information about the building are documented. The Ten-Year Capital Plan lists seven capital renewal projects that will proceed as funding becomes available. The Department of Housing & Dining Services executes a program that is between a typical maintenance renovation and a capital renewal. The Residential Annual Modernization Program (RAMP) is designed to update the appearance of residence halls without addressing either programmatic or major maintenance issues. A RAMP would typically address finishes and furnishings that are subject to greater abuse, such as carpet, wall paint, room furniture, and restroom facilities.

Major renovations occur when a building no longer meets the needs of its intended use. This could occur when a building has aged to the point where the programmatic arrangement is obsolete (e.g., Arnett Hall renovation, Eikeley Middle Wing renovation) or after a space has been vacated by a program (e.g., Fleming Building, Cristol Chemistry and Biochemistry). The scope of this type of renovation varies greatly depending on the extent of obsolescence or how closely the new occupant matches the vacated program.

The need to demolish Boulder campus buildings has traditionally been rare, with only two major buildings and six houses being removed in the previous 10-year period. This reflects the university’s philosophy of building with the long-term view in mind, where academic buildings will last for one hundred years or more and non-academic buildings may last 40 to 50 years. This strategy creates the lowest life-cycle costs. As the university moves towards its sesquicentennial, some areas of campus are poised for redevelopment, necessitating removal of existing building inventory.

This master plan proposes that a significant number of buildings be removed in order to clear land for redevelopment. Most of these areas are in housing districts of the campus—north of Boulder Creek, portions of Smiley Court, the Dormitory Quad district, and the Kittredge Complex. The Long-Term Development Plan also indicates that academic areas in the core of campus and the research buildings north of Boulder Creek on the East Campus could be removed at some point beyond the planning period. Family housing stock is largely 40 to 70 years old and must be replaced. Wholesale replacement is contemplated along with floodway improvements along Boulder Creek. The need to add undergraduate housing likely will mean greater housing density on the Main Campus. This plan proposes removing Kittredge Commons (now rendered obsolete by the Center for Community) and replacing it with a residence hall and replacing the Dormitory Quad district (Aden, Brackett, Cockrell, Reed, and Crossman Halls) with higher density housing. These projects will require the removal of existing structures as a part of redevelopment.

The campus regularly conducts renovations of buildings for functional, regulatory, and physical needs. Ongoing maintenance requirements and basic adaptations for new programs happen every year and are not specifically listed in this Campus Master Plan. In most cases, these types of projects fall outside threshold where they would meet the definition of major capital construction and are reported through other mechanisms.

Capital renewal is defined as a wholesale renovation of a building’s infrastructure and systems. These types of projects typically result in plumbing, heating, electrical, and telecommunication systems as well as upgrade life-safety systems, without making major programmatic changes to a building’s use. They are intended to make the building usable for another 50 to 75 years, although other renovations for programmatic uses could occur subsequent to the renewal. A greater emphasis is placed on these types of projects in this master plan. The Ten-Year Capital Plan lists seven capital renewal projects that will proceed as funding becomes available.

Most major renovations are designed to address several of these issues at one time.
5. Density

Density is defined as the ratio of building area to site area and is usually expressed as floor-area ratio (FAR). Density is an important consideration in campus planning because it describes the relationship of buildings, activities, and services to their surroundings. Higher density and proximate adjacencies are desirable as they facilitate movement between classes and other activities, and can support communication between academic disciplines. Density also allows efficient delivery of services such as transportation and can reduce the need for the automobile.

Exhibit V-A-5 shows the density for the developed Boulder Campus Properties. The average density for the three developed campuses in Boulder is 0.40 FAR. With the building types typical of CU-Boulder, some structured parking becomes necessary at density levels above 0.35 FAR if the same percentage of people need for the automobile.

The Main Campus is the densest of the three developed areas. Over time by larger institutional buildings. The planned density of CU-Boulder, nearly doubling its density in the past 10 years to 0.30 FAR. With the completion of Williams Village North, the density will be 0.34 FAR. The approved Master Site Development Plan calls for another residence hall and new support facilities that will raise the density to 0.42 FAR. Most of the density is located west of Bear Canyon Creek with a FAR of 0.48. The east side is undeveloped except for the University Residence and has a density of 0.01 FAR.

d. CU-Boulder South Density

The density of CU-Boulder South is near zero with one building sitting on more than 300 acres. No development is anticipated in the planning period, thus the density will remain near zero.

e. Mountain Research Station

The Mountain Research Station is another property that has a density near zero. This is reflective of its rural, mountain setting and its mission. Most of its development occurs within 41 acres of small buildings at the base camp. The density of this area is 0.02 FAR and may grow toward 0.04 in the planning period as laboratory additions and year-round facilities focused on environmental studies are constructed.

f. Other Properties

The university owns or leases other properties within the city of Boulder. These are typically developed to the density of the surrounding properties. The largest such area is the area north of the East Campus. The Distribution Center (owned by the CU Real Estate Foundation) and the Center for Innovation and Creativity have a combined density of 0.40 FAR.

Other properties owned by the university such as the Academy are not included in this analysis.
6. Architectural Character

Charles Z. Klauder, leading architect of his day for many university campuses, developed the “Tuscan Vernacular Revival” style for the University of Colorado Boulder, designing 15 buildings from 1919 through 1939. Klauder explained his concept of a university campus as follows:

[A campus] should be a homogeneous, clearly to be appraised entity in a studied and happy balance of things, of buildings located with regard to their functions, importance, and architectural effect at a fixed or variable elevation and topographical advantages skillfully exploited. Indeed, the develop- ment plan not only conserves views, it creates new ones in the form of delightful vistas projected between rows of buildings and ending at an imposing architectural mass embellished with entrance, tower...or else the view may be flung far into a magnificent distance or a lake, a river, or toward a distant mountain.

Functional arrangement of buildings, while preserving and creating views, is a defining characteristic of all of the CU-Boulder properties. One of the goals of CU-Boulder planning is to assure continuity of the Tuscan vernacular architectural style on the Main Campus. There is also the intent to assure contextual architectural quality on the other CU-Boulder properties. The quality of the University of Colorado Boulder as an institution of higher education is reflected in its buildings, in a uniform architectural style, and permanence. The Main Campus is known and admired for its uniform architectural style and building materials palette. Sandstone walls, red tile roofs, limestone trim, and black metal accents are set in a verdant landscape against the mountain backdrop, providing an appealing sense of place.

a. Architectural Style

Klauder tended to design buildings symmetrical in plan and elevation. Succeeding architects have often designed asymmetrical campus buildings, while retaining the characteristic composite assembly of forms, and the freedom of students to create buildings, respecting a human scale. Floor plates are narrow to capture cross ventilation and sunlight. Building wings often spread out from a central core, creating charming courtyards and forecourts. Recent buildings have built on the basic recipe for form, emulating some themes, courtyards and forecourts. Recent buildings have built on the basic recipe for form, emulating some themes, and continue the architectural distinctiveness of the Main Campus buildings pre-dating Klauder.

b. Historic Buildings

Norlin Quadrangle Historic District buildings are of importance to the state of Colorado, documented by their placement on the state and national registers of historic places. In the designated district are both new buildings designed by Klauder and those that pre-date Klauder. Newer additions to older buildings, such as Norlin Library, are included in the designation. Exterior alterations require advice and counsel from the State Historic Preservation Officer at the Division of the Building and Landmarks. Newer buildings in the district may be created by using the same materials, such as for telecommunication appurtenances. Checks are made to ensure the safety of historic buildings.

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Code compliant fire barriers.
Ignition prevention.
Fuel control.
Code compliant means of egress.
Exit signage.
Emergency lighting.
Smoke management system.
Fire suppression system.
Fire detection and alarm system.
Emergency notification system.
Identification and mitigation of special hazards.
Building services including emergency elevators and generators.
Fire prevention including routine inspection of means of egress, storage rooms, and mechanical rooms for fire hazards.

Exhibit V-A-9, Fire Safety Status, indicates the status of fire sprinkler protection for all campus buildings according to available records. Buildings in which inadequate emergency egress has been identified as an issue are also indicated on the drawing. The plans to address emergency apparatus access are covered in the Transportation Plan (Section VI E). The university as an entity of state government is not bound by local building height restrictions. When constructing high-rise university buildings, where the highest occupied floor is more than 75 feet above the level of fire department response, care should be taken to provide built-in fire and life safety protection systems to the extent feasible, but never less than that required by applicable codes, since the responding fire department (City of Boulder for most CU-Boulder properties) may not have proper equipment and adequate expertise or personnel for high-rise fires.

Large building complexes, such as the Engineering Center, also warrant especially careful review. A fire sprinkler system in these complexes is highly desirable. The building size and complexities increase both the potential hazards and response time. Renovations or new construction should be arranged to minimize response time and take advantage of modern fire detection and suppression technologies.

Bridges between buildings, and below-grade spaces, are also of concern. These building features have increasingly been used to increase campus density. There are two emergency access and fire protection issues with such features: (1) limitations on fire department access, and (2) potential fire spread from one building to another building. Some bridges are designed for fire department access underneath the bridge, which is usually preferable, while others are not. To address the fire and emergency access, new construction should be designed such that there is always an alternative fire apparatus access route around a bridge or below-grade space. To address the fire spread potential, there should be fire separation walls and doors between buildings.

A process is in place to ensure an adequate plan review. Architects and engineers submit written code reviews for construction projects. Campus authorities review construction documents and help ensure that code requirements are met. Compliance with code requirements includes interior building systems such as fire barriers, means of egress requirements, separation of buildings, emergency apparatus access, and adequate hydrants and water supply. New buildings are required to be fully code compliant. Renovation and remodeling activities are to meet the same standards to the extent practicable but normally exceed the code requirements for "existing" buildings.

A fire prevention and routine inspection program is established in order to reduce fire defense weaknesses attributable to misuse of the buildings and their systems, such as improper storage of combustibles or improper use of ignition sources. This fire prevention program provides occupant training as well as notification of code violations.

The Mountain Research Station (MRS) has distinctive fire protection issues, since it is somewhat remote, surrounded by forest, with buildings constructed largely of wood. The Facilities Management Department is undertaking efforts to upgrade utilities for this property, and the plan for the site (in Section VI B) proposes improvements to several structures, even though available resources are very limited for work at this site. In April 2010, a Fire Mitigation Plan was prepared for MRS. This Fire Mitigation Plan is to be implemented by Facilities Operations in coordination with the local fire protection district.

8. Accessibility

No otherwise qualified handicapped individual in the United States . . . shall, solely by reason of handicap, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving federal financial assistance.

The University of Colorado Boulder is committed to making all of its programs physically accessible for all persons. This requirement was extended to all branches of state and local government by Title II of the Federal Americans with Disabilities Act (ADA), which identifies:

Rights of accessibility, for which building design standards have been implemented. The University of Colorado Boulder recognizes the advantages of integrating disabled students into programs and facilities. Requirements of the ADA are often exceeded to assure integration.

Building accessibility. All new facilities on campus are designed to be accessible. Thanks largely to renovations funded in the 1990s, many of the academic buildings have received major ADA renovations. Many of the auxiliary enterprises of the university have been modernized since the last master plan, greatly improving access to students with disabilities.

Exhibit V-A-8 indicates the accessibility status of campus buildings on the three adjoining campuses (in 2010). Generally, there are four levels of accessibility on campus:

Fully Accessible. These are new buildings or buildings that have had all accessibility renovations to essentially comply with the accessibility standards, i.e., ADA Accessibility Guidelines (ADAAG) or the Uniform Federal Accessibility Standards (UFAS).

Functionally Accessible. Many of these buildings have had substantial renovations for accessibility but have some areas that remain inaccessible. These may be small tower rooms or mezzanine areas where full access is not possible, so functions or programs are duplicated in accessible areas.

Limited Accessibility. These are facilities where accessibility is provided to one or more floors but large portions of the building do not comply with ADAAG. In these cases, alternative programs, significant program accommodations are made to ensure that access is maintained under Title II.

Not Accessible. These buildings are not required to be accessible due to their function or because similar programs are provided in other buildings. For example, not all of the Family Housing units are accessible.

Analysis of the campus conducted in 2010 indicates that nearly 82 percent of the campus space falls into the fully accessible or functionally accessible categories. Family housing and smaller residence halls constitutes the largest block of inaccessible space on campus. This master plan intends to address these areas in the planning period.

The university is committed to providing access to all programs on campus. Accessibility provisions are part of all new construction and renovation projects on campus. Further improvements within existing buildings will be made as a part of renovation projects.
B. Micro-Master Plans

Micro-master plans are sub-areas that have been the subject of further study, either as a part of this master plan or during previous planning efforts. Two micro-master plans proposed in the Campus Master Plan— the East Campus and the area north of Boulder Creek where family housing is located. Three micro-master plans are drawn from previous efforts—Williams Village Master Site Development Plan, Grandview Micro-Master Plan, and the Mountain Research Station Micro-Master Plan. A summary of the 2002 Conceptual Land Use Assessment for CU Boulder South is included as reference. This section concludes with a brief overview of other properties owned by the university.

Micro-master plans are a part of the university’s planning process. They describe the direction of the overall concept for university development and serve as a guiding document for further planning and design. In some instances, that planning may have already occurred. The Williams Village Master Site Development Plan and the accompanying Design Guidelines were adopted by the Board of Regents at their October 2001 meeting. Major land use changes cannot occur without an amendment to this board-approved document. Minor updates to plans that do not materially change the land use planning are included and adopted through this document. For example, a campus plan or during previous planning efforts. Two micro-master plans would be grouped in academic clusters that promote cross-disciplinary interactions. This micro-master plan embraces that vision and provides a basic framework by which it could be realized.

a. Existing Property

Largely undeveloped, the East Campus provides a clean slate in which to extend new and existing programs and an exciting opportunity to design for the future. The East Campus is generally bordered by Arapahoe Road on the north, Foothills Parkway on the east, the Colorado Avenue on the south, and 30th Street on the west. The original 220 acres was acquired by the university in 1957. It was reduced to 201 acres with conveyances of rights-of-way given to the for the construction of streets and Foothills Parkway. A 4.3-acre strip sitting on the east side of Foothills Parkway was granted by the university to the Open Space Program as a preserve and for flood control. The area is still open to the public.

The largely undeveloped land slopes gently to the north-east and benefits from the riparian landscape of Boulder Creek, Slurk Creek, Bear Canyon Creek, and retention ponds located on the north side of the Campus. Additional retention ponds were added during the development of the Research Park, removing most of the southern property from the 500-year flood plain. The most current flood planning map provided by the City of Boulder shows a large conveyance zone running from Arapahoe on the northeastern edge of the campus to the eastern edge of Boulder Creek. Recent mapping of the South Boulder Creek basin indicates that water flows down Foothills Parkway and may increase the flooding potential of the eastern edge.

The East Campus is composed of four general land uses—the CU Research Park; family housing apartments at Smiley Court; the athletics facilities of Fott Field, Prentup Field, associated outbuildings, and the Ski Shed; and the area north of Boulder Creek that has research and service functions. The Research Park is the largest of these areas and has the largest development potential. Originally planned in 1967, it was conceived as a suburban office park, where parcels of land would be leased to university or private companies. They would then build stand-alone buildings surrounding parking and landscaping. It was originally planned for 1.6 million gross square feet of which approximately 550,000 gross square feet was built prior to the construction of the first building. Smiley Court is approximately 230,000 gross square feet and there is approximately 564,000 GSF in 17 buildings north of Boulder Creek. Some of these buildings are not considered significant nor are the 6,400 GSF of miscellaneous athletics buildings.

b. Preliminary Planning

In 2005, university staff began investigating what the ultimate capacity of the site might be if exclusively dedicated for university use. Shapins Associates was retained to explore various options. They determined that the road and utilities systems would likely be able to support an increase to 3.2 million gross square feet north of Boulder Creek and that the north side of Boulder Creek might accommodate up to 800,000 gross square feet with flood mitigation. Their plan, called the “Shapins Plan,” retained the curvilinear street pattern but introduced quadrangles and courtyards similar to the Main Campus. Building heights and masses were three to six stories and parking was a major form determinant of building placement. It was the relationship of the open space areas and the natural drainage ways and wetlands. The Shapins Plan was determined not to be desirable because, among other things, it did not create a planning framework for implementation, and the orientation of many buildings created a walled edge condition along Foothills Parkway.

During the planning of the Caruthers Biotechnology Building, the design architect, Robert A. M. Stern & Associates, developed an alternative plan to test the building concept in light of the desire to increase density. The “Stern Plan” focused on creating a more traditional feel to the land planning of the campus. Two large quad-square spaces were proposed, around which the academic buildings would be arranged. The curvilinear roadway system would only be retained where it presently existed, and the entire urban grid would be extended into the campus. Unlike the Main Campus, the layout of the buildings was not strictly orthogonal, but it was proposed to be an area to construct market rate office space at a suitable rental price point to attract federal partners was added to the program requirements. During reviews and approvals, there was always strong support for the direction of the plan. Additional planning is necessary for the full concept to be developed. Working meetings with the university’s Design Review Board, there was significant discussion about the plans and some of its elements. This discussion is documented below and may lead to some modifications to the ultimate new plan.

1. The Stern Plan was supported extensively by a citizen that had land use and that athletic facilities could not be relocated to any other university projects.
2. The original task force report called for the fifth cluster to be social sciences, which was changed during subsequent discussions to computational sciences. Social sciences were not seen as an independent cluster but rather integrated into the other clusters as appropriate, much the way the Center for the American West is a part of the geosciences cluster.
4. The Plan

This plan integrates the quadrangle plans of the Stern Plan with the relationship to open space of the Shapins Plan. The plan is shown in Exhibit V-B-2. The Stern Plan established a new quadrangle as a part of the building project that is extended by this plan. The new quadrangle will be 290 feet across and 1,160 feet long, which will bring it to the edge of Boulder Creek. An extension of the center line of Shadow Creek Drive to the center line of this quadrangle creates an intersection point that becomes the relational center of the campus. This point becomes the origin from which the remainder of the campus is organized.

a. Pentagon/Pentacle Grid

The Main Campus uses a series of axial relationships between entrance elements to organize campus buildings and outdoor spaces (see Exhibit V-A-2). The Main Campus is strictly orthogonal and creates a unique sequence of experiences approaching buildings and entrances. The East Campus Micro-Master Plan proposes to impose a pentagon/pentacle grid on the property as the organizational element. From the origin point, grid lines are extended at 30°, 360°, 72°, and 90° on both sides of true north. Along the grid lines extending at 360° and 72°, secondary nodes are located in a phi relationship at 618 feet, 1,081 feet, and 2,518 feet. From each node of the grid lines can be established and the intersection of the radiating grid lines creates new nodes that become new starting points and on so on.

A pentagon/pentacle grid has several advantages:

- The radial nature of the grid allows more relationships to be developed, allowing the randomly placed existing buildings to be tied to new development.
- The grid intersects itself at phi ratio other grid lines. The phi ratio is the same ratio as is found in the “golden section.” By using this relationship, the spaces, distances, and features remain well proportioned.
- The grid is fractal and can be broken down or scaled up to any size, thus a relationship can be established between any two points.
- The grid’s 72° angle is a close to the angular relationship of the LASKP Business Park to the Discovery Drive at 70° and the McAllister Center (perpendicular to Foothills Parkway at 80°). Projected from the origin, the N72°E line passes near the former Sybase building creating a relationship that can be used to tie it to the rest of the campus.

The grid can be used then to set up development parcels for the rest of the campus and lay out circulation paths that will ultimately coordinate with the future development. The nodes, particularly at 1,000-foot intervals from the origin, are key points that should be celebrated with a prominent feature. The origin point should not have a memorable feature such as a large fountain or a courtyard. Secondary nodes would be suitable for fountains or public art.

b. Street System

Like the Stern Plan, the urban street grid is extended into the campus by continuing 33rd Street from Arapahoe Road south over Boulder Creek; a street opposite to Shadow Creek Drive can be extended into 33rd Street. For design, the grid outside the McAllister Center creates the origin point to create a street pattern that relates the urban grid to the new campus plan.1 Also, 33rd Street from Colorado Avenue is extended to the north along the quadrangle extension, and a loop road around the McAllister Center completes the main street system.

c. Academic / Research Clusters

The streets surround large parcels that become the blocks for buildings grouped in programmatic clusters. Two of these blocks have large quadrangles that, like the main quadrangle, have one end enclosed by the natural areas of the creek systems. The programmatic clusters are arranged thus:

- The Life Science Cluster is arranged around the main quadrangle. The Jennie Smoly Caruthers Biotechnology Building is located on the southeast corner of this block. The Chemistry and Life Sciences Building is proposed as a sister building with a similar footprint. Four more building sites extend north along the quadrangle for future programs as they are determined.
- The Space Sciences Cluster is the area of the Research Park Pod H and extends to the north, across Discovery Drive. Three more building sites exist before redevelopment is necessary.
- The Computational Cluster is the area of the Research Park Pod G, between Discovery Drive and Shunk Creek. Two building sites with parking are indicated.
- The Environmental Cluster is between Discovery Drive and Foothills Parkway. It includes the McAllister Center, which is being considered for lease by programs included in the geosciences proposal. This cluster has four large building sites available for development.
- The Energy Cluster is along both sides of Shunk Creek and adjacent to the Boulder Creek drainage way. This cluster includes the former Sybase building and four other potential clusters.

This distribution of clusters, site circulation, and potential building sites is proposed as the best suggestion based on the growth that is planned today. It should not be considered absolute. Programmatic needs, interdisciplinary opportunities, and existing uses may dictate that sites be utilized differently than indicated. This is allowed under this plan.

Other uses support the academic and research endeavors of the East Campus. Family housing for students, faculty, and staff should be redeveloped along the 30th Street line. City staff indicate that the 30th Street corridor will likely be redeveloping and that an urban edge is an appropriate response. This location is also more proximate to Scott Carpenter Park and within walking distance of retail services at Twenty Ninth Street Mall and the Sunrise Shopping Center at 30th Street and Arapahoe Road. Redevelopment of Smiley Court is needed since these buildings are near the end of their useful life. Increasing the density of the site should be an objective.

A public function space is reserved for the center of the campus near the origin point of the grid and at the intersection of Innovation Drive and Discovery Drive. This should be filled by a program that draws people to this part of the campus. An appropriate use might be a natural history museum, food service facility, theater or large auditorium, or recreation facility.

Administrative space continues to be located north of Boulder Creek, along with service space for the Department of Housing & Dining Services. The plan indicates that property that is owned presently by the university and is needed for the future may be necessary to purchase or swap land with owners along Arapahoe Road in order to right-of-way for 33rd Street and to create better commercial parcels along Arapahoe Road.

A site for a potential central utility plant is provided along the eastern edge. Utilities could be looped along the grid lines from the plant.

5. Transportation

The East Campus is a 10-minute walk from the eastern edge of Main Campus, a 30-minute walk from the western edge. Providing an efficient reliable connection between the campuses without dependence on single occupancy vehicles is paramount to the success of a large-scale development. Internally, major pedes- trian routes and bikeways should reinforce the grid system to link different building areas and promote separation should be provided between walkers and wheeled vehicles. Between campuses, some improvements have been made along Colorado Avenue but additional improvements would enhance pedestrian and bicycle flow. A connection should be planned from the underpass at 28th and Arapahoe to 30th and Colorado. Improvements could enhance the connection along the Boulder Creek Path; the south side of Arapahoe Road could connect family housing development to the academic functions, and improvements along 33rd Street could link the East Campus with the Boulder Transit Village and Williams Village.

Creating a robust transit system will be important if the East Campus is to reach its full development potential. As noted in the Transportation section (Section V-E), the East Campus is not connected to the Main Campus, resulting in a higher number of single occupant vehicle uses. CU-Boulder will need to work with RTD and the city to improve transit service from outlying areas to the East Campus.

The success of the East Campus will rely heavily on inter-campus transit service. Plans are underway to re-route the Stampede service to provide a 10-minute headway both directions on Colorado Avenue. As other lines are introduced into the, CU-Boulder should see if these lines can be adapted to economically increase service between the two campuses. The Biff Bus should be examined to see if it can be expanded to include the East Campus.

Parking will need to be built as the campus develops. The amount of parking will depend on the level of transportation demand management and alternative modes available. At present, parking on the East Campus is overbuilt and additional parking is only needed for convenience. An effective inter-campus transportation system could be supported by surplus spaces that can provide remote parking in surface lots for both the East Campus and the Main Campus. Sites on Exhibit V-B-1 are indicated for potential parking structures but these structures will not be needed until the density of the East Campus approaches 0.35 FAR, which will likely be 20 years or more.

Intervening years may make other sites more attractive and limited surface parking within development pods may further reduce the amount of structured parking needed to support the plan.

6. Building Plan

The originally adopted plan produced by Downing Thorpe and James in 1987 was modeled on a suburban business park with pods to be privately developed. A number of buildings including the McAllister Center for Astrophysics and Space Astronomy (CASA), LASP Space Technology Center, and Sybase were built within this plan and have interrelated development pods to this day. The pentagon/pentacle grid described above provides a guide for future building layouts. Building shapes should be aligned to reinforce the major open space and circulation paths. While the Main Campus is strictly orthogonal, buildings at angles of 360° and 72° should also be allowed.

The building plan reserves the center of the East Campus as a “Market Rate Overlay Zone.” This area of the campus is intended for development of buildings that are simple and economical to construct so as to be
planned with careful consideration to the micro-climate that will be created by the building being developed. Wherever possible, native and hardy adaptable plants should be used as appropriate to the micro-climate in which they are to be located.

7. Outdoor Areas and Landscape

The outdoor areas are divided into three main classifications: natural areas of the protected wetlands and the drainage areas, landscape buffers along the edges of the East Campus, and formal quadrangles that are surrounded by buildings. Each area has its own particular role.

The natural areas indicated in Exhibit V-B-1 are areas where development cannot occur, primarily due to the natural flooding hazard that is present. The northeast corner of the site is dedicated wetlands with no access. Surrounding this is the natural area used as a buffer from the riparian creek environments. Circulation paths, like the Boulder Creek Trail, are acceptable uses and are encouraged. These areas may be part of an overbank excavation to control flood. Use for formal recreation may be permitted if it does not impede the function of the overbank channel.

Landscape buffers are present along 30th Street and Colorado Avenue. These should be reinforced with similar plantings and treatments to create a unified edge to the campus and to set back development from the street.

Quadrangles are outdoor spaces for formal events and functions that might occur on the East Campus. As on the Main Campus, these serve as informal play areas, gathering sites, locations for student rallies and displays, and a place for graduation ceremonies. Because of this, the turf material must be durable and capable of handling programs. See Section V-C for materials that would be appropriate for use in these areas.

Tree canopies are encouraged in the quadrangles to provide shade. Consideration should be given to the type of environment that is currently present; that of a flat plain along a river valley, which suggests that the plantings should be more deciduous trees rather than conifers. Each building project that abuts an outdoor area, particularly the quadrangles, will be responsible for developing their section of that particular open space.

Landscape areas that are not part of the defined outdoor areas should be designed to reflect the programmatic requirements of the buildings to which they are associated. Buildings may require courtyards, lawns, plazas, contemplative gardens, gathering spaces, or other types of functions. Each of these should be
2. Main Campus, North of Boulder Creek

The University of Colorado has identified the area north of Boulder Creek as an area appropriate for redevelopment. The North of Boulder Creek Framework Plan sets an overall framework for the mixed-use redevelopment of this area. Goals for redevelopment of the area are designed to enhance the academic mission of the university by:

- Providing housing for graduate students, students with families, faculty, and staff.
- Providing academic space and academic support spaces.
- Providing space for athletics, recreation fields, and adequate open space.
- Developing stronger connections with the Boulder community by improving connections and providing floodway improvements.

a. Setting

The area is located along the northern edge of the Main Campus of the University of Colorado Boulder, separated by Boulder Creek and a rise south of the creek of approximately 60 feet to the Main Campus. The site, roughly 50 acres including the creek area, currently houses graduate and family housing apartments, athletics practice fields, and parking areas. The site is bounded on all sides with existing development ranging from the Main Campus to the south, Boulder High School to the west, mixed residential to the north, and regional retail to the east.

Topography north of the creek is generally flat, sloping slightly from west to east. The site is home to mature shade trees and unique riparian habitat along the Boulder Creek corridor. Views include the Front Range and Boulder Creek corridor. The site is intended to be a housing mix of students and other university affiliates. The concept is to provide a vibrant community that takes learning beyond the classroom, community shopping, and entertainment limit the regular need for cars. There are many modes of transportation that currently serve the north of Boulder Creek area. Downtown Boulder and most of the commercial shopping centers are located less than a mile from the center of the site. The area is a perfect example of a site that can accept transportation demand management (TDM) strategies.

b. Planning Process

The area north of Boulder Creek was identified early on as an area of concern. Family housing is deteriorating and in need of replacement; flood concerns after incidents in Fort Collins raised issues of safety, and the need to attract graduate and international students (the major demographic groups of family housing) all prompted this area for additional study. One of eight task forces was assigned to examine the area and make recommendations on how the area should develop (see online appendices: Task Force Reports).

Once the Task Force Report was adopted, Facilities Planning formed two working groups—one comprised of internal stakeholders and one of external stakeholders—to begin the process of developing a recommended plan. Each stakeholder group was interviewed separately and a list of goals and objectives was developed. This was combined with the desired outcomes from the task force report to become the working program for a design charrette.

The charrette was held at the Millennium Harvest House with both stakeholder groups present. The group was broken down into three subgroups and each was given a program and basic massing block that they were asked to place on a map of the area. The three groups developed low, medium, and high density scenarios and then the group discussed the strengths and weaknesses of each proposal. Facilities Planning then created the draft plan and circulated it back through stakeholder groups for comments. The final adjusted draft became the basis of the plan presented in this Campus Master Plan.

c. Building Plan

At full development, there is the potential for 1,500 apartment style living units, 270,000 GSF of academic or community space, and over 15 acres of recreation and athletics fields. The redevelopment of the site would utilize existing infrastructure systems and relieve pressure to develop CU-Boulder South in the foreseeable future.

The location, building mass, and land use will transition between the existing medium densities of adjacent housing north of the western half of the site, to higher density housing in the central portion of the site. The southeastern quadrant of the site is anticipated to be recreation and athletics fields that can also accommodate floodwater detention. The northeast corner of the site has the opportunity to be developed as university housing or to be reserved for a more public use, assuming that desired densities can be achieved on other parcels.

The site is intended to be a housing mix of students and other university affiliates. The concept is to provide a vibrant community that takes learning beyond the classroom and research lab and encourages interdisciplinary discussion amongst neighbors as described in the Flagship 2030 goals for university villages.

d. Transportation

An extension of the urban grid is proposed to provide a network of pedestrian, bicycle, and vehicle pathways. Marine Street will be extended through to Folsom Street, which will create a new “Main Street” and relieve traffic congestion on Arapahoe Avenue. Marine Street would accommodate bus shuttles to other parts of campus and the city. Improvements to the existing Boulder Creek Path and development of an accessible pedestrian route up the hill from the creek to the campus will be necessary for non-motorized access to Main Campus.

1 Initial studies indicated that the maximum carrying capacity of the site would be 1,900 apartment units if all underground parking was used and the first floor of each building contained non-residential uses. That was deemed too costly and a mix of parking options would be more likely, yielding a lower number of units.
3. Williams Village

After a 1998 study of alternative sites for student housing, the Board of Regents selected Williams Village as a preferred site for new student housing. The November 1999 Williams Village Micro-Master Plan sets the overall development framework for the site. The main land-use planning documents for the site were the August 2001 Master Site Development Plan and the Design Guidelines that were adopted by the Board of Regents in October 2001. The land-use and planning principles were examined as a part of this master planning process and deemed by and large to still be relevant and it was decided that the prior plan should be extended for the duration of this planning period. Where appropriate, minor adjustments to the adopted plan are identified in the text below.

a. Setting

The 66-acre site has two high-rise residence hall complexes, a commons facility, and two mid-rise apartment-style housing buildings. A new mid-rise residence hall is scheduled for occupancy in August 2011. Other amenities include surface parking areas, two soccer fields, four tennis courts, and other recreational facilities. Much of this relatively flat site east of Bear Canyon Creek is underdeveloped. The creek and the associated floodway bisect the site, with a multi-use path along its west bank. The University Residence (home of the CU-Boulder chancellor) is on the east side and is accessed from the Frasier Meadows neighborhood.

b. Building Plan

At full development of the site, there is the potential of about 500 additional undergraduate student beds in residence hall or apartment-style living units west of Bear Creek. This could accommodate a third of the projected growth in undergraduate housing during the next decade and provide relatively affordable, conveniently located housing. The housing proposed east of Bear Canyon Creek would help meet the backlog for family housing. East of the creek, there is the potential of about 200 units of graduate/family and faculty/staff housing. The goal is to maximize the family oriented housing while maintaining a lower profile compatible with the adjacent neighborhood and within the site capacities, keeping all residential buildings out of the floodway. Conference and Residential Academic Program (RAP) space is provided and used in conjunction with the undergraduate housing. Recreational facilities for all students will be maintained, although possibly relocated, including two soccer fields and four tennis courts, plus informal recreational fields and facilities provided for the on-site student population.

The location, mass, and demographics of housing development will transition between the existing tall towers and single-family housing to the east. Facilities housing undergraduates will be situated near the existing towers. Lower density faculty/staff housing will be next to the Frasier Meadows subdivision to the east. Between the two will be housing for graduate students and students with families. Exhibit V-B-3 shows the relative arrangement planned for the different housing types. In all, there is the potential for about an additional 330,000 additional interior gross square feet. Centrally located recreation fields and outdoor areas for more passive uses are to be maintained and expanded. Open space within the housing areas is based on a hierarchical system of courts and plazas, recalling elements of the Main Campus.

c. Transportation

An extensive network of walkways will serve pedestrians and bicyclists, including links to the Main Campus. Apache Drive will be looped back to the intersection of Baseline Road and 35th Street. The university will work with the City of Boulder to complete vacation of Apache Dr. (currently a city street) to facilitate development potential for the site. Minor streets will collect traffic onto this loop road. Faculty/staff housing will be accessed from this loop assuming new bridges over Bear Canyon Creek prove feasible. The loop road will accommodate a bus shuttle to other parts of the campus and city. Transportation linkages to adjacent neighborhoods will be limited to pedestrian and bicycle pathways. Roadway linkages are limited to discourage vehicle traffic between adjacent neighborhoods and the Williams Village campus.

To date, parking has largely been accommodated in surface lots. Ultimately, to accommodate the projected housing and to maximize open space, a combination of transportation demand management strategies and structured parking will be necessary. As noted in the Transportation plan (Section V.E) the parking ratio for the site can be reduced from 0.5 spaces per bed to 0.3 spaces per bed for the residence hall population. This reflects improvements in transit and the educational campaign by the university to reduce the number of cars brought by first-year students to campus.

d. Phasing

The goal is to continue development of the west side of Bear Canyon Creek and renovation or replacement of Darley Commons dining center within the first half of the planning period. More undergraduate student beds are possible within the planning period depending on student demand. Private development on university land is an approach being considered in order to minimize university debt incurred. The public/private funding model could be used to expedite development of the east side of the creek should there be developer interest.
Increasing the amount and types of teaching

Secondary goals for the MRS include:

- Completely surrounded by the City of Boulder Watershed, Indian Peaks Wilderness Area, and Roosevelt National Forest. Development consists of approximately 65 buildings, including laboratory and office space, housing (a lodge and detached bungalows), a dining hall, a bathhouse, field storage, facility shops, and a garage. The total gross square footage of these buildings totals only 31,200 gross square feet (23,800 assignable).

As one of the top five non-oceanographic research stations in the environmental sciences, the MRS is one of the premier alpine research centers in the world. The site is nationally unsurpassed for research and teaching about alpine ecosystems, and places CU-Boulder at the forefront of research into the impacts of global warming. Since the last master plan update, total grant support for research projects using the MRS as a base have quadrupled from $3.6 million to $14.5 million and in 2011, researchers at MRS received the largest single award to CU for environmental sciences of $5.9 million. The number of researchers has almost doubled from 31 to 56 in the same period. Undergraduate field courses are at capacity and will need additional classroom space if they are to grow.

To promote CU-Boulder’s leadership position in the area of environmental research science, the primary goals for the MRS are:

- Providing housing (detached bungalows) for senior researchers.
- Providing logistical support (dry labs) for research scientists.
- Upgrading the MRS infrastructure, both technological (in conjunction with new computational laboratories) to support research scientists, and physical (maintenance garage).
- Increasing the amount and types of teaching supported by the station through providing additional classrooms.
- Managing reduction of risk due to wild fire events by establishing and implementing a comprehensive fire mitigation plan that includes: personnel training; creating defensible spaces around buildings; fuel reduction zones; road widening to allow emergency vehicles; completion of a second emergency egress route from the MRS; the installation of a cistern for water storage; the creation of fire-resistive spaces to provide emergency shelter in the event evacuation is not possible; completion of a campaign to upgrade the fire resistance of existing structures; and, perhaps in conjunction with a new maintenance garage, provi- sions for a 1.6 wildland fire vehicle.

Secondary goals for the MRS include:

- Increasing the public outreach programs of the station, particularly to K-12 institutions and organizations.
- Converting the station from a summer-only to a year-round facility.
- Improving the public image of the station commensurate with the educational experience.
- Enhancing the relationship between activities at the station and activities on the Main Campus, in part by integrating station research with Main Campus research.
- Considering the addition of off-site parking to accommodate future growth and restrict internal guest vehicular circulation.
- Developing stronger connections to the rest of CU-Boulder by diversifying the activities offered at the station.

a. Setting

The developed portion of the station sits on a south-fac- ing sub-ridge below Niwot Ridge. Exhibit V-B-5 shows the entire property and highlights the developed portion, which appears in more detail on the next exhibit. Most of the older buildings are sited along the 9,500-foot con- tour along the ridge, stretching the developed area out in an east-west line. The highest building is the water collection building at an elevation of 9,575 feet, and the lowest is the sewage treatment plant at an elevation of 9,390 feet.

The site slopes steeply to the south. Almost all areas ex- ceed a 1-to-8 slope. Many of the level areas are boggy and have springs, suggesting high ground water. Future development will likely occur in areas with a slope. Care must be taken to minimize site impacts relating to cut-and-fill, as well as proper drainage around structures.

Como Creek traverses the site from northwest to southeast near the developed portion of the site. This creek is part of Boulder’s water source and is home to the Greenback Cutthroat Trout (enochynchus clarki stomias). The creek has one of nine original populations for the trout, which is listed as a threatened species. The University of Colorado Boulder is committed to maintaining and improving the habitat for the Greenback trout. The station installed a new wastewater treatment plant in 1999 and has worked extensively with the U.S. Fish and Wildlife Service, Colorado Department of Game and Fish, Boulder County, and the City of Boulder on management strategies. The new treatment plant adds capacity for more intensive residential uses while main- taining protections for the Greenback Trout population in Como Creek.

New development must recognize the sensitive nature of Como Creek during design and construction. No new structures should be located within 50 feet of the creek and only limited improvements should be made to exist- ing structures within this zone. Construction techniques must minimize soil erosion and prevent deterioration of stream quality. Site improvements will be limited to the restoration of existing natural habitat, using native and natural materials found within the vicinity of the Moun- tain Research Station.

The soil characteristics of the station site vary across the site. In 1997, excavation for the new hostel revealed 10 to 14 feet of glacial till in the center portion of the campus. The eastern side of the site has a much thinner deposit of till, with large rock outcroppings, suggesting bedrock much closer to the surface. The western end of the campus has numerous springs and it is likely that glacial till in this area has a high water table.

The mountain campus remains vulnerable to natural wildfire events and has been studying various re- sponses. The mountain field station for Colorado State was destroyed by a wildfire in the mid-1990’s. Twenty trees have been recently removed which were too close to existing structures. The creation of firebreaks, how- ever, may cause more harm than good as sub-alpine crown fires will usually jump any fire breaks while allow- ing invasive species a foothold as they tend to flourish in cleared areas. Furthermore, the site’s steep topography makes tree removal very difficult. Fire breaks also increase wind-borne damage and worsen the effects of drifting snow.

Reducing wildfire risk by tree-culling (due to pine-beetle infestation) has been considered as well. However, as it is just as likely that a tree suffering mortal pine- beetle infestation is as flammable as a drought-ravaged green tree, culling beetle-infested trees should not be considered as a sole remedy for reducing risks from wildfires. Rather, all existing or proposed development areas should develop and maintain a plan of defensible spaces that considers trees of any kind as potential fuel sources.

b. Building Plan

The following table (Exhibit V-B-4) shows how space is used at the MRS and what additional space is required to meet programmatic aspirations. The usual space standards are not designed for such a unique site, so this table has been prepared based on the specific programs conducted at the station.

The existing utility infrastructure and topographic setting determine where development can occur. The proposed land use plan reinforces the existing land use pattern and corrects some land use anomalies. All future design and construction should consider at a campus-wide level both wildfire mitigation and accessibility (pas- senger loading zones, restroom facilities upgrades, and accessible routes within the site from public facilities to sleeping and/or dwelling units).

As shown on Exhibit V-B-6, six potential building sites are proposed within the year-round lower shelf area.
The Kiowa Lab Addition (currently under design) will add 1,000 GSF of flexible laboratory and teaching spaces. Should a new teaching/lab facility be built, it would be best located near the Kiowa and Marr Labs. There are also plans for a new telescope and observatory, adjacent to the existing observatory, paid for with private funds. The observatories remain unaffected by metropolitan levels of light pollution found on Main Campus.

The upper shelf area will remain intact as a housing zone, primarily for seasonal use. The area is populated by small cabins and the Moores Collins Family Lodge, which accommodates short-term guests and is the major outreach tool for K-12 groups and research conferences. Groups of 50 guests are typical during the summers, although the MRS can accommodate a maximum of 70. The capacity of the Dining Hall is limited only by the dining room size, as the kitchen remains underutilized. The main teaching space is in the Megaron Building, a timber structure constructed in 1928. Although no new seasonal housing projects have been added to the prioritized list of capital construction projects, a new lodge located near the S Cabins would be welcomed as it is feared that the campus’ lack of capacity in this regard has resulted in the loss of summer bookings. The lodge, in the form of a single-story bunkhouse (ski huts have even been suggested) could be expected to house not more than twenty short-term guests.

Nearly all the structures within the residential zone constitute the original camp settlement. Many of the structures are over 50 years old, some of which date back to the original camp. This creates a unique character to the buildings that adds to the experience of students and researchers. Capital development should consider the architectural richness of existing structures during planning and design of new and renovated structures. One of the greatest assets of the station is the experiential educational programs. Developing nature trails throughout the site could strengthen these programs. The trails could also be used to improve site circulation, separating pedestrian and vehicle circulation. Astronomers classes are increasing.

The buildings at the station are aging and small by institutional standards. Most of the needed renovation and additions can be done as small projects, falling below the $500,000 threshold for capital construction. Installation of ‘fire mesh’ at locations vulnerable to burn-through (i.e., vents and the undersides of elevated floor platforms) needs to be completed. Cabins used for long-term researcher housing should continue to be winterized as necessary.

Some capital construction projects have been identified for the latter years of the planning period (to 2018), if resources become available. All future projects should consider the inclusion of fire-proof shelters or areas of refuge in the building program. These include:

- **Priority #1:** Locate a housing cluster for senior research scientists at Building Sites A or B. The new cluster of four 715 GSF “duplex bungalows” each with two bedrooms (one as a lock-off) and a shared kitchen and dining area, estimated at a total of 2,900 GSF (2,600 ASF) for $1,300,000.
- **Priority #2:** A research laboratory, estimated at 3,000 GSF (2,400 ASF) for $1,800,000.
- **Priority #3:** A maintenance garage, 3,600 GSF (2,400 GSF)—estimated to cost $850,000.
- **Priority #4:** A computational lab, estimated at 900 GSF (600 ASF) for $550,000.

These four projects should be considered opportunities rather than as yet proposed capital projects. They would be added to project lists and the five-year CIP only after full programmatic review.

c. **Circulation**

The site is accessed almost exclusively by vehicles using Boulder County Road 116. Vehicles coming to the station park in one of four small parking areas. The preferred on-site circulation is for visitors to park remotely and walk about the campus. The increased number of visitors and automobiles during the summer overwhelms the campus, and is therefore discouraged. During the winter, the main road is closed at the Marr Lab and during the summer at the “brower pit.”

At the main station campus, pedestrians share the roads with automobiles. Currently, there is not enough vehicle traffic to warrant separating the flows. Other pedestrian flows are related directly to research operations. Researchers usually follow the power lines up the hillside until they come back to the road, then hike the road onto Niwot Ridge.

Future expansion of the MRS should consider keeping the campus a pedestrian campus only, except for service and research vehicles. All future plans for the MRS should account for the campus’ densely wooded forest location and life-safety requirements for rapid evacuations in the event of encroaching forest fires. A secondary road from the MRS leads to SOURDOUGH Trail only and does not provide a second means for evacuations. The campus maintains an evacuation plan that involves a cooperative agreement with the City of Nederland and the use of its school buses in the event of an emergency evacuation.

d. **Utilities Infrastructure**

The MRS is in a remote location thereby requiring it to provide many of its own utilities. The station has its own water and wastewater plants, and relies on Xcel Energy for its electrical power.

A wastewater treatment (tertiary) plant has been built and has a summertime capacity of 16,875 gallons per day (GPD) and a winter capacity of 1,688 GPD. After the water has been treated, it is held in a pond before being released into Como Creek. These two utilities create upper and lower boundaries to development at the station. In addition, agreements were necessary with the City of Boulder, Boulder County, and the National Forest Service regarding water use and discharge that essentially cap utilities at these levels. These factors must be considered in planning and design of new structures and ways of maximizing their potential must be used. Sustainable design techniques should be considered as development occurs on the campus, such as composting toilets, gray water systems, and raw water distribution systems for fire protection.

e. **Phasing**

Highest in priority at the MRS is construction of the four duplex bungalows for researcher housing, either partially or in their entirety. Next in priority for the MRS would be a research lab, followed by a computational laboratory. The research lab should be designed for flexibility and to accommodate possible classroom spaces. A new maintenance garage facility will be needed regardless as the MRS extends its operations.
5. CU-Boulder South

The purchase of the CU-Boulder South property in 1997 was a strategic acquisition to help ensure the long-term viability of CU-Boulder, which remains land-deficient in accommodating its projected institutional needs. The property acquisition was a part of ensuring Front Range locations for higher education services for the citizens of Colorado.

a. Setting

The CU-Boulder South property, previously known as the Flatirons or Gateway property, is a five-minute drive along U.S. 36 from the Main Campus, at the intersection of U.S. 36 and Colorado 157. See Exhibit V-B-5.

The property consists of 308 acres in unincorporated Boulder County, contiguous to the southeast boundary of the City of Boulder. CU-Boulder South is not far from other Boulder County cities and lies along the rapidly developing U.S. 36 corridor between Boulder and Denver. Louisville is two to three miles east. Urban services are nearby, including those of the City of Boulder and the city of Lafayette (which has part of its water system, Baseline Reservoir, one mile northeast).

Gravel mining occurred on the site prior to its purchase. Following acquisition, the property was re-vegetated under a Colorado Mined Land Reclamation Board permit, which is currently open. The mining eliminated much of the original natural character of the property, in contrast to the largely undisturbed adjoining City of Boulder open space east of the property. CU-Boulder South adjoins existing urban development to the north and west, and a good portion of the site is essentially flat. An existing on-site improvement remains today as a concrete warehouse (14,173 ASF) used for university departmental storage. Use of the building is 100 percent recharged back to Research Property Services. Athletics constructed further improvements in 2003, when the Kittredge Tennis Courts (Varsity Courts) were moved to CU-Boulder South. Twelve tennis courts, spectator seating, and parking for 125 cars covers approximately 525,000 square feet. The tennis court complex is supported by portable restrooms only as no permanent restroom facilities have been constructed to date due to restrictions by the City of Boulder.

South Boulder Creek adjoins the property. Most of the property is outside of the South Boulder Creek floodplain according to FEMA (Federal Emergency Management Agency) mapping. The portion of the property south of an existing berm is likely to remain in the 100-year floodplain of South Boulder Creek. Cooperative efforts are underway with the City of Boulder, Boulder County, and the Urban Drainage and Flood Control District on a consultant’s study to update flood hazard mapping and develop a new floodplain management plan for the South Boulder Creek watershed. A master plan for South Boulder Creek will include the hydrologic information and other facilities and appurtenances needed to provide mitigation of flood hazards within the South Boulder Creek study area. A local drainage-way, Viele Channel, also crosses the property and should be studied further.

b. Building Plan

A 2002 conceptual land use assessment for CU-Boulder South identified site opportunities and constraints for the purpose of strategically locating facilities that have been developed.

In the short-term, CU-Boulder expects to continue use of the property for outdoor tennis facilities, pedestrian and bicycle trails, grazing, storage, and a cross-country running course. Outdoor research projects may also occur at CU-Boulder South, for example those related to plant ecology and environmental biology. Minor spectator facilities associated with the tennis courts have been built, but development of additional athletics fields and support facilities are not planned at this time.

c. Transportation

The site has one developed vehicular access, at a traffic signal on Table Mesa Drive just west of U.S. Highway 36. Local and regional bus routes serve this access location, with nearly direct access to Main Campus. There is a developed open space trail crossing the south portion of the property. Additional options for access will be evaluated prior to significant additional development.

d. Phasing

No development of facilities is anticipated within the planning period. Environmental, flood, wetland, and species mitigation issues continue to evolve. Studies will help identify any limitations that should be addressed, respected, or mitigated.

This property can play a significant role in providing land for CU-Boulder needs for the future, but additional development is not anticipated during the term of this Campus Master Plan. The property is an increasingly important strategic asset to help ensure that CU-Boulder can continue to provide quality education for the citizens of the state of Colorado. Improvements could be considered should outside agencies approach CU-Boulder with requests related to flood protection, drainage improvements, wetlands management, or related community infrastructure improvements on the property for the benefit of the surrounding community.
6. Grandview

The University of Colorado Boulder identified the Grandview Terrace area north of University Avenue as a logical area for expansion of the Main Campus and began acquiring the properties in the early 1960s. In 1980, the Long-Range Facilities Master Plan for the campus suggested that most of the acquired buildings in Grandview should be demolised and replaced with new, larger buildings in order to provide needed academic and research spaces. In 2000, a micro-master plan was prepared by Shipmans & Associates and used to form a basic understanding about the development potential of the site. In 2001, the university and City of Boulder signed an agreement that was later overturned by the courts; however, both the city and university have continued to abide by the terms of the agreement when discussing land use issues in the area. The 2000 plan has been reconsidered in this Campus Master Plan.

Although specific development plans for the area are flexible, a plan has evolved preserving some of the 1910 to 1930s era bungalows in the area, retaining useful buildings for institutional use, and identifying sites for the needed new buildings. For these reasons, the basic Grandview plan is being extended for the length of this planning period.

a. Setting

The Grandview area, located on the northwest edge of the Main Campus, is bordered by Broadway to the west, University Avenue to the south, and 17th Street to the east. To the north are the Andrew Arborboretum, Boulder High School's football and track facility (Recht Field), and an enclave of single-family homes along Hillside Drive. Grandview is perched above the bluff rising from the Boulder Creek floodplain.

The university owns 26 buildings totaling approximately 193,000 square feet of building space in Grandview, including approximately 60,000 in the new Institute for Behavioral Science building. Structures are generally of modest size, including a few mid-sized buildings (a sorority, and others used as office space) and two dozen smaller 1910 to 1930s era bungalows (most of which have been used for various university offices). The bungalows generally are in poor condition and not easily accessible to mobility-impaired persons.

Although the Grandview area comprises less than 11 acres, not a large portion of the total campus, it is of strategic long-term importance to the university because of its proximity to the campus core. Grandview is within a reasonable walking distance from the existing academic buildings on campus, and much of Grandview is within the “ten minute class change area.” Future growth of hard science areas is planned to be directed to the East Campus, but the Grandview area is important for growth of social sciences academic and research spaces located in the Main Campus core and within a reasonable walk.

b. Building Plan

Exhibit V-B-6 is the Micro-Master Plan map for Grandview. The Grandview long-term potential development area (as shown on Exhibit V-A-1) has been divided into two sub-areas: an area generally to be preserved and an area generally to be redeveloped.

In recognition of historic preservation concerns and pursuant to its understanding with the City of Boulder, the university maintains an agreement with the city creating a 25-year preserve for bungalows it owns facing Grandview Avenue between 13th and 15th Streets as a part of the 2001 Campus Master Plan. Under the agreement, which will extend through 2025 as it pertains to the preserve, the university will not demolish or relocate bungalows within the preserve except as specified, during the term of the agreement. The bungalows in the preserve may be used in a number of ways, including university academic/research uses and housing rentals.

The rest of the university-owned property in Grandview is a redeveloping area. This includes both new and renovated buildings to provide needed academic space, including research. Incidental non-academic space uses are also possible, including day care, food services, housing, and transportation facilities such as structured parking.

Three of the university buildings on the perimeter of Grandview will continue to be used as university office space during this planning period: 1055 University Avenue (Continuing Education), 1511 University Avenue (the Armory, housing the School of Journalism and Mass Communication), and 1546 Broadway.

Ultimately, the Grandview area could accommodate over half a million gross square feet of buildings if it were to be fully developed, but that is not planned during this planning period. The Proposed Capital Projects List (Exhibit V-A-3) lists a potential building project within the Grandview area totaling 100,000 square feet. Uses for the proposed development have not been specified but the site is considered suitable for several potential campus needs. Taking into account buildings removed, the net change in space will be less.

Suitable transitions between the campus and the surrounding city will be included in future building plans. Redevelopment at the corner of Broadway and University Avenue is desirable to help create a more appropriate corner and entrance to the campus. Any new development in Grandview will reference but not re-create the Tuscan vernacular architectural style of the Main Campus, which helps define CU-Boulder, much as the new IBS building does. In summary, the building plan retains aspects of Grandview’s historical development, proposes an increasing synergy with the Main Campus north of University Avenue, and provides for new, more functional university spaces.

c. Transportation

Many modes of transportation serve the Grandview area. Pedestrian access is safer due to improved crossings of University Avenue developed during 2000 in a joint city and university effort. In the future, a new pedestrian overpass of 17th Street is envisioned to provide an improved link to Macky Auditorium and the Main Campus. As part of the Grandview Agreement, the city has vacated 13th Street from its intersection with University Avenue north to the southern boundary of Grandview Avenue and from the northern boundary of Grandview Avenue north to the northern boundary of the Grandview area. Certain public alleyways in the Grandview area have also been vacated. This permits an increase in the size of building footprints and facilitates the conversion of some land from vehicular-oriented use to pedestrian-oriented use. Where there is now an unsightly alley between Grandview and University Avenues, a new west-to-east landscaped pedestrian spine is envisioned.

There have been a maximum of 470 parking spaces in the Grandview area between Broadway and the Armory, including non-university spaces, but not including spaces along University Avenue. With the vacation of portions of 13th Street and adjacent alleys, along with demolition of smaller structures, it may be advantageous to reconfigure some surface parking and roadway areas to provide better utilization of the land and increase availability of parking in the area. Long-range development plans indicate that some of the parking will need to be in structures as parking demand grows and as surface parking is eliminated by development. Parking will be integrated into academic or housing development where feasible to minimize its visual impact.

d. Phasing

Some structures will be removed. Where buildings are removed, there may be interim land uses such as parking lots and/or landscaped spaces. The university likely will continue to acquire some of the remaining privately owned buildings shown in Exhibit V-B-6. The pace of redevelopment will depend on many things: acquisition of land, usage of existing buildings, timing of demolitions, identification of space needs, consideration of site suitability for identified needs, and availability of funding.
7. Other Micro-Master Plans
Periodically, other micro-master plans are prepared for campus areas, such as the five discussed in this section, and campus topics, such as outdoor lighting. Micro-master plans have a narrower focus and greater level of detail. Micro-master plans are usually adopted by CU-Boulder rather than by the Regents representing the entire university, but some have been approved by the Regents.

Some of the following micro-master plans are reference in this plan, and have links to the existing plans.

Other still applicable micro-master plans as of this writing include:
- Fischer Field Physical Sciences Micro-Master Plan, 1989, by Peter Heinz Architects
- The Norlin Quadrangle Historic Area Micro-Master Plan, May 1999, by Design Concepts Landscape Architects

C. Open Space Development Plan
1. Overview and Background
The University of Colorado Boulder rests against the Foothills of the Rocky Mountains, which created the inspiration for the architectural style and the backdrop for today's campus landscape; a set of spaces and places carefully designed to unify the surrounding buildings in a subtle manner creating psychological and sociological connections. These design and planning processes help shape institutional image and play a role in student recruitment and retention; create safe and welcoming environments, and provide a consistent framework for the buildings to sit. This portion of the Campus Master Plan is meant to guide the preservation, creation, and management of the campus landscape and open space.

a. Correlation to Other Plans
Previous master plans provided primary focus for the 313 acres that make up the Main Campus; this open space development plan is set within a broader framework to include land use issues for north of Boulder Creek, the East Campus, and Williams Village. It will augment but not replace the Williams Village Master Site Development Plan created in 2006 by Design Workshop. The plan is meant to build upon the work started by William R. Deno FASA, Campus Architect Emeritus, as guided by Hideo Sasaki of Sasaki Associates, Inc. in the Campus Open Space Development Plan (final revision, 1998). The plan also derives information from the report of the Task Force on Recreation, Open Space, and Athletics, and the University of Colorado Research Park Design Guidelines prepared by Downing/Thorp/James & Associates, January 29, 1988.

b. Purpose of the Open Space Development Plan
This plan is meant to provide a framework for determining appropriate levels of development, management of the existing landscape, and guidance for land protection efforts in the future. It is thought that the additions to the landscape are part of a consistent whole; and will allow for flexibility, growth, and expansion while protecting current natural resources. Finally, the plan will outline landscape guidelines and standards for those that will be maintaining the existing and new improvements.

c. Guiding Principles
- Preserve and maintain existing open spaces, including recreational fields, from development and detrimental activities.
- Identify the appropriate amount of passive and active open space to correspond with total campus population and building ratios.
- Strengthen connections between the Main Campus and other developing areas, including North of Boulder Creek, East Campus, and Williams Village.
- Promote and restore historic landscapes within the Main Campus.
- Promote sustainable design for existing and new developments that complement the architecture. Create safe and accessible spaces for everyone.
- Designate safe and understandable circulation routes of all modes of travel, including service vehicles.
- Apply universal accessibility standards in all exterior design.
- Provide adequate wayfinding and lighting.

2. The Campus Landscape: A Sense of Place
It has been said that "walking across a campus landscape is one of the most memorable experiences of a place that people ever encounter." The University of Colorado, fortunate with the architectural richness of the Klauder buildings, makes use of the landscape as a final detail to ground each building knitting the exterior space together. Students, visitors, and alumni have fond memories of their experiences on campus. Not all will mention the landscape in particular, but almost all will have mentioned the landscape combined with a favorite space they recall providing quiet study or fond memories of their experiences on campus. Not all will mention the landscape in particular, but almost all will have mentioned the landscape combined with a favorite space they recall providing quiet study or gathering to meet friends.

a. Regional Influences
Colorado enjoys over 300 days of sunshine per year, creating a desirable destination for many. Boulder sits at the base of the foothills, at an elevation of 5,430 feet. One can walk from the campus and be hiking a trail in the foothills within 20 minutes, making the Boulder campus a very popular place for outdoor enthusiasts. These same foothills reveal a harsher side, bringing wind gusts up to 100 miles per hour which can uproot trees and create challenges for landscape engineers. The beauty of this region is the waterways that supply the campus landscape can also cause flash flooding during the spring and summer, making it tough to understand that water is one of the state’s greatest resources. Boulder receives only 19 to 21 inches of rain per year, requiring careful selection of vegetation. These same foothills provide a backdrop against which the landscape is set today. The historical landscape layout is informal, providing a simple contrast to the modernist campus stating that "an effective environment for education cannot permit through-traffic in the campus." The University of Colorado Boulder is a rare example assisting the effort. The separation allows for slight development, creating one of the most popular spots in the city for Audubon Club members to visit.

b. Historical Background
Old Man was the first building on a barren landscape consisting of dryland grasses and cactus. Ann Siewali, the wife of the first president, is credited for planting the lawn in the infancy of the University. Armed with bed sheets and grass seed, she elicited assistance from a janitor and two students to spread 50 wagon loads of topsoil and plant the seeds which was covered with the bed sheets anchored by rocks. In the spring they were rewarded with a "lawn of matchless green." The campus held annual celebrations in the spring the first few decades of the 20th Century which included digging of weeds and planting of trees by students.

The Colorado legislature supported an increase in student population from 1,200 to 3,000 students prompting the Board of Regents to instruct President George H. Weeks to appoint an architect to do a master plan for the development of the campuses. This resulted in the commissioning of the firm of Day & Klauder, Philadelphia. Charles Klauder’s use of natural materials in his "Rural Italian" style provides the rich backdrop against which the landscape is set today.

The landscape against the Klauder buildings includes high quality plantings and informal foundation plantings that soften the stone edges and frame entrances. The landscape layout is informal, providing a simple contrast to the modernist campus stating that "an effective environment for education cannot permit through-traffic in the campus." The landscape is set today. The landscape against the Klauder buildings includes high quality plantings and informal foundation plantings that soften the stone edges and frame entrances. The landscape layout is informal, providing a simple contrast to the modernist campus stating that "an effective environment for education cannot permit through-traffic in the campus." The University of Colorado Boulder is a rare example assisting the effort. The separation allows for slight development, creating one of the most popular spots in the city for Audubon Club members to visit.

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The 1979 Master Plan addressed pedestrian connectivity and improved definition of campus edges and entrances to define the campus and upgrade its image. This plan was the first to address natural resources including flood water, irrigation and energy conservation. In 2001, the Campus Master Plan continued to address improvements to be made to the open space, exterior lighting, signage, and wayfinding. Looking towards the future, the Main Campus will soon reach build out with development spreading to East Campus, areas north of Boulder Creek, East Campus, and Williams Village. Continued growth requires a persistent management of existing resources and protection of existing assets.

c. Landscape Management
The campus landscape affects not only aesthetics but also the health and vigor of the ecosystem. Careful attention to design details, plant species, and material selection will assist those in charge of caring for the outdoor spaces. Advance-ment of the current Turf Task Force (TTF) and Integrated Pest Management (IPM) plans will support programs to increase soil health and plant health while reducing the amount of synthetic chemicals applied to the turf and landscape beds. Proper site design of new capital projects must include Low Impact Development (LID) techniques to control storm water runoff at each site instead of removing the water by piping directly to the storm sewer system. These best management prac-tices (BMPs) include reducing the amount of impervious surfaces, using bio-swales, retention, detention and the landscape and wet storm water basins. The campus enjoys an abundant variety of wildlife from red squirrels to deer, foxes, and an occasional bear that also cause flash flooding during the spring and summer, requiring careful selection of vegetation. The physical separation of the Main Campus, the East Campus, and Williams Village is part of the open space design to avoid through traffic (TTFs). The Pinion Pine ecosystem, one of the six ecosystems found within the Boulder Campus, sits with its visual prox-imity to the Foothills. The transition to the East Campus and Williams Village provides a different topography with larger open spaces, riparian landscapes, and varied views to the back range of the Rocky Mountains. While it is important to maintain a integrated campus feel, it is also important to acknowledge the special differences that make up each individual campus. As CU-Boulder moves into the 21st Century, stewardship for the exist-
ing landscape is paramount while developing land-
scapes for the future.

a. Main Campus

Today’s Main Campus has changed quite dramatically from
the open spaces and walking paths of the past. The broad
landscape is paramount while developing land-
scapes. The University of Colorado Boulder
has transformed from a rural setting into a vibrant,
campus

Campus is now a valuable asset to the University, and
for water conservation and the reduction of chemical
furnishings, wayfinding, lighting, and the use of pervious
incorporate additional bike lanes and bike parking while
Campus, there is the potential to close streets and

ways.  Aging infrastructure and lack of coordination
without compromising other open spaces and while
lots, creating challenges to replace the loss of parking
Campus are primarily located within existing parking
areas of Boulder Creek and attached ponds.  Additional
connection to future development north of Boulder
Creek. Any additional work to the riparian area should be
consistent with the riparian guidelines and native plant
species with native plantings and protection of
the CCC era stone walls and fireplace at the foot of the
plant species that are adapted to the environment and
be limited to the replacement of non-native invasive
non-irrigated state with improvements limited to issues
related to safety.  Currently, there are three bridges
crossing Boulder Creek, allowing access to the campus
from the northern properties and the city of Boulder.
These are the Stadium Bridge, the 21st Street Bridge, and
the 19th Street Bridge.  Built in the 1970’s, it is rated for 36
ton gross vehicle weight (GVW). It has recently been evaluated by structural engineers to
have 10-20 more years of service life.  The bridges at
19th and 21st Streets are in disrepair and need replace-
ment. A recent design has been completed to renovate the
19th and 21st Street trails allowing for an accessible
path to the stadium. When finished, this path will be
the only ADA accessible path from the city of Boulder
to the campus and will allow for pedestrian and bicycle
connection to future development north of Boulder
Creek. Any additional work to the riparian area should be
consistent with the riparian guidelines and native plant
species with native plantings and protection of
the CCC era stone walls and fireplace at the foot of the
19th Street trail.  Consideration should be given to the
relocation of the Outdoor Services bone yard located at
Folsom with restoration back to native habitat.

The property north of Boulder Creek is not as heavily
inhabited as the rest of Main Campus, although it
is home to a variety of mature trees that need evalu-
ation prior to development efforts. Aside from the
mature trees, the parcel of land is a blank slate for
future development. Care should be taken to meld
the landscape north of Boulder Creek into one that
complements the Main Campus while adding an urban
feel that respects the surrounding neighborhoods and
maintaining the Open space development guidelines
applied to development within each building pod. All
of this property lies within the floodplain of Boulder
Creek. Framework plans show an increase of recreation
fields located within a 100 foot buffer of residential neighborhoods. One should not ignore
the natural beauty of the hillside and the creek to the
south by designing with this in mind. The property
North should be made to capitalize on the opportunity to use
biophilic design principals to include the ecosystem into
any new development. The integration of the property
north of Boulder Creek to the hillside trails will provide a
connectedness and strengthen the University image. Additional
planning considerations with the City of Boulder should look toward increasing the width of the Boulder Creek
Path from the current 10 feet to a size that can accom-
modate the large volume of users in the multi-use path and
encourage alternative modes of transportation to the East Campus by campus affiliates.

b. Boulder Creek and North of Boulder
Creek

The northern edge of the academic Main Campus is a bluff, dropping 60 feet down to Boulder Creek, bisect-
ing the Main Campus and separating the 50 acres to the
north. The bluff and creek provide a unique riparian area for
animals and wildlife. A large area has been set aside from the 19th Street Bridge to Folsom Street has been designated as a Zone 1 natural area protected by LEED requirements that the area will remain in a natural,

non-irrigated state with improvements limited to issues
related to safety. Currently, there are three bridges
crossing Boulder Creek, allowing access to the campus
from the northern properties and the city of Boulder.
These are the Stadium Bridge, the 21st Street Bridge, and
the 19th Street Bridge. Built in the 1970’s, it is rated for 36	on gross vehicle weight (GVW). It has recently been evaluated by structural engineers to
have 10-20 more years of service life. The bridges at
19th and 21st Streets are in disrepair and need replace-
ment. A recent design has been completed to renovate the
19th and 21st Street trails allowing for an accessible
path to the stadium. When finished, this path will be
the only ADA accessible path from the city of Boulder
to the campus and will allow for pedestrian and bicycle
connection to future development north of Boulder
Creek. Any additional work to the riparian area should be
consistent with the riparian guidelines and native plant
species with native plantings and protection of
the CCC era stone walls and fireplace at the foot of the
19th Street trail. Consideration should be given to the
relocation of the Outdoor Services bone yard located at
Folsom with restoration back to native habitat.

The property north of Boulder Creek is not as heavily
inhabited as the rest of Main Campus, although it
is home to a variety of mature trees that need evalu-
ation prior to development efforts. Aside from the
mature trees, the parcel of land is a blank slate for
future development. Care should be taken to meld
the landscape north of Boulder Creek into one that
complements the Main Campus while adding an urban
feel that respects the surrounding neighborhoods and
maintaining the Open space development guidelines
applied to development within each building pod. All
of this property lies within the floodplain of Boulder
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Path from the current 10 feet to a size that can accom-
modate the large volume of users in the multi-use path and
encourage alternative modes of transportation to the East Campus by campus affiliates.

c. East Campus

The CU-Boulder East Campus is an easy 10-20 minute walk from the Main Campus and adds to the
area featuring abundant wildlife and birds. A large area from the 19th Street Bridge to Folsom Street has been designated as a Zone 1 natural area protected by LEED requirements that the area will remain in a natural,
non-irrigated state with improvements limited to issues
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Path from the current 10 feet to a size that can accom-
modate the large volume of users in the multi-use path and
encourage alternative modes of transportation to the East Campus by campus affiliates.

d. Mountain Research Station

The Mountain Research Station is located in the moun-
tains west of Boulder. The 192 acre property sits at an

elevation of 9,900 feet and is largely undeveloped. The
landscape is native to the rocky mountain region. Any
plans for development in the area will include restoration
to the native habitat.

e. CU-Boulder South

CU Boulder South is 910 developed acres in unincor-
porated Boulder County, south and east of the city of
Boulder. The property is currently land banked by the
university with no plans for development in the near
future and is not considered within this master plan
process.

4. Landscape Typologies

a. Built Systems

Within each part of campus there exists a series of
built systems that interact with the open space:
courtyards, terraces and plazas, fields, emergency
streetscapes, and edges. Each system is identified
below with suggested guidelines for the creation and
new areas, and direction for future development. Additional
information can be found in the Landscape Guidelines.

b. Quadrangles and Lawns

The large open green spaces around which the buildings
are arranged create a sense of place like setting that gives the
campus its unique and memorable character. These
areas include formal quadrangles, malls and lawns
which are associated with the more private spaces for
students and staff to observe and maintain new
areas. Additional information can be found in the Landscape Guidelines.

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areas. Additional information can be found in the Landscape Guidelines.
increasing the quality of turf and landscape, although it continues to be used for construction staging and other campus activities. The Norlin Quadrangle is part of the Norlin Quadrangle Historic District (NQHD) and should continue to be upgraded using the NQHD guidelines as well as have the protection afforded to this type of area with stronger written policy.

Other important open spaces in the historic district include the quadrangle cross axis between Macky and Helmcken Buildings, and the liturgical axis between the Administration Building, the Sterling Planetarium, and the Mills Library, along with pedestrian access to the Folsom Field, the fields on the West Bank of the City of Boulder Creek, and the Friday evening field. These open spaces need to be preserved in their location or replaced in close proximity to retain the spaces needed for passive and active recreational use.

Additional campus quadrangles and lawns include the newly installed Engebretson Quadrangle located on the west side of the Leeds School of Business, the Recreation Center Lawn, and the Housing Quadrangle located between Brackett, Hallett, Reid, and Farrand Halls. Both the Recreation Center Lawn and the Housing Quadrangle will be in the center of green space redeveloped as these properties are renovated or replaced.

New quads proposed for the East Campus will be similar in scale and developed with the same traditional feel as the Norlin Quadrangle, with large expanses of lawn and tree canopies that allow protection from wind and sun while allowing visibility across the campus. New quads will relate to surrounding architecture that helps define and enclose the space. Pedestrians need to be accommodated within these large expanses while keeping in mind the high levels of use, correct climatic plantings and innovative ways to address storm water management. New quadrangles and lawns can be found in Exhibit V-C-1.

Several significant areas have been improved since the last master plan. The Dalton Trumbo Fountain Court has received a major upgrade to the fountain. Additional improvements to the surrounding planted areas are still needed. Herbst Plaza was created as part of the Discovery Learning Center in 2002. Overlook Plaza was created between McKenna and Macky, thanks to the Class of 1950. Library Circle, east of Norlin, has been renovated to include upgrades to the sundial area, previous paving, water features, an outdoor classroom, and site furniture with electrical accommodations for exterior study opportunities. The construction of the pedestrian underpass at Regent Drive included an upgrade to the area west of Fiske Planetarium. The Diana Family Plaza on the west side of the Center for Community provides another large paved plaza for public gatherings and the Dirks Courtyard provides a quiet, enclosed courtyard to enjoy a meal and the beauty of the Flatirons backdrop. The restoration of the Lilac Garden originally designed by Irvin McCrary of Denver in 1949 will feature the addition of large expanses of new plantings while keeping in mind the high levels of use, correct climatic plantings and innovative ways to address storm water management. Additional improvements to the surrounding planted areas are still needed. Herbst Plaza was created as part of the Discovery Learning Center in 2002. Overlook Plaza was created between McKenna and Macky, thanks to the Class of 1950. Library Circle, east of Norlin, has been renovated to include upgrades to the sundial area, previous paving, water features, an outdoor classroom, and site furniture with electrical accommodations for exterior study opportunities. The construction of the pedestrian underpass at Regent Drive included an upgrade to the area west of Fiske Planetarium. The Diana Family Plaza on the west side of the Center for Community provides another large paved plaza for public gatherings and the Dirks Courtyard provides a quiet, enclosed courtyard to enjoy a meal and the beauty of the Flatirons backdrop. The restoration of the Lilac Garden originally designed by Irvin McCrary of Denver in 1949 will feature the addition of large expanses of new plantings while keeping in mind the high levels of use, correct climatic plantings and innovative ways to address storm water management.

c. Terraces, Plazas, Courtyards and Gardens

Terraces, plazas, and courtyards create the social spaces between the buildings and the landscape. They are meeting places, gathering spots, and destinations for quiet study. The sizes range from those large enough for a public gathering to intimate gardens with a bench under a shady tree. If designed with care, they become vibrant memorable places on campus that build community feelings. They can be unfenced open air voids that are hardly inhabited. Designs for these social spaces need to address the desired function for the space. Is the area a large gathering spot or a quiet study area? How many activities will be or can be accommodated in the space? Successful social spaces will require design to be somewhat flexible to allow for a variety of activities. They need to include adequate paving and seating using a variety of materials placed around the edges, as well as adequate lighting and accessible pathways. Designers should address today’s student, allowing for laptop accommodations to plug in and connect to wireless networks. Design should be scaled appropriately for pedestrian use, which may require providing horizontal enclosure using trellis or tree canopy elements. Plant materials can create a micro-climate that is created by the building orientation allowing for special plantings to occur within a plaza or courtyard. Water features or scenic vistas need to create a focal point and add identity to the space.

d. Recreation and Athletic Fields

Recreational fields provide a much needed release to the stresses of campus life. The Task Force Report on Recreation, Open Space, and Athletics documented the health benefits of active and passive recreation while listing a concern for the amount of recreational space on campus. The flooding and drainage system allowing for high use without damage to the playing fields and lawns. Points at the edges should reflect the surrounding area, yet be consistent with the overall campus landscape. In some instances there are opportunities to use plant materials as an educational opportunity, showcasing adaptable plant species in new arrangements.

Circulation

The circulation network of a campus lies the campus community to their daily activities. Routes for pedestrians, bicyclists, skateboarders, and service vehicles need to be safe, direct, and well maintained. As campus population continues to increase, the challenge becomes greater to maintain safe travel routes for all who travel through the campus. The topic of transportation demand is more fully addressed in the Transportation section (Section V.E) and in the more detailed Transportation Master Plan (Appendix VII.B). The information in this section will give guidance to circulation patterns and recommendations as it relates to the landscape.

Pedestrian Routes

Master planning efforts make reference to enhanced the pedestrian feel of the campus. The Boulder campuses are challenged with a growing campus population traveling in limited spaces. Major walkways on the Main Campus are not wide enough, causing travel along the edges to damage the landscape. The current mix of pedestrians, cyclists, and skateboarders within the same travel routes is causing conflict and accidents. Main pedestrian routes need to be re-examined allowing for separation of travel routes, introduction of more perennial materials, and widths adjusted to accommodate traffic as well as a 12-24" landscape buffer on the edges as walkways are replaced. The Campus Open Space Development Plan in 1990 stated: “Designers and planners need to keep in mind that pedestrians follow the shortest path, are often preoccupied, and do not always follow vehicular traffic rules when on a sidewalk (that is they tend to walk on the right, but will still walk in the middle to talk).” A large amount of effort has been initiated to create better ADA access through the campus, although more can be done to make travel for all an improved experience.

Multi-Modal Travel

Today’s students are as likely to jump on a skateboard or bicycle as they are to walk. The Boulder campus was recognized by the Sierra Club in 2009 as one of the most sustainable campuses in the nation. When students came to visit, they had many positive remarks about the number of bicycles on the Boulder campus, which
Section V: Land and Facilities Plan

1. Definition of the Campus Landscape

The University of Colorado Boulder is a century old landscape that makes up CU-Boulder. It is a compilation of the Campus Master Plan, Research Park Design Guidelines, and the Department of Housing Landscape Master Plan. The information listed in this document is fluid and adaptable to change.

2. Purpose of the Landscape Design

a. Introduction/Correlation to the Campus Master Plan

This document is meant to work in conjunction with the Campus Master Plan, providing details for the design and character of the campus landscape. It is a compilation of the Campus Open Space Development Plan written by Campus Architect Emeritus William R. Deno, FAIA, in consultation with Hideo Sasaki (final revision June 1990), the Williams Village Master Site Development Plan, Research Park Design Guidelines, and the Department of Housing Landscape Master Plan. The policy to protect landscape from construction impacts should be formalized for the campus.

b. Landscape Design Guidelines

Buildings on the Boulder campus are aligned along the edges of open spaces forming architectural walls to create a series of outdoor rooms that include quadrangles, plazas, and courts. These rooms, along with the circulation pathways, supporting amenities, and planted landscape, create the whole that becomes the park like setting in which the university community resides. Changes to the landscape will work within the framework established by past master plans, with guidance from the current plans and an eye toward the future.

The goal of the landscape guidelines is to provide direction for design consultants, university staff, and maintenance personnel working within campus architectural and associated exterior spaces. These guidelines will focus on the elements that make the University of Colorado Boulder a special and unique place, including site planning, vegetation, and sustainable practices.

The most critical component in the wayfinding program is directional signage. Directional signage should be added to identify routes to key campus locations, as well as the identification of bike/service routes through campus, which will further pedestrian safety efforts. Campus wayfinding is a critical component of the campus landscape. A consistent, clear signage program that includes appropriate lighting is part of the overall image of the institution.

The current wayfinding system on the Boulder campus includes campus directory maps in various locations and building identification signage. A missing component in the wayfinding program is directional signage. Directional signage should be added to identify routes to key campus locations, as well as the identification of bike/service routes through campus, which will further pedestrian safety efforts. Any additions to the system should be designed in tandem with the existing graphics program. The signage system needs to be addressed with a way to remain consistent projecting a positive institutional image.

4. Landscape Design Guidelines

a. Arboretum status should be pursued and obtained for the Main Campus.

b. Development sites on the East Campus, Williams Village, and the area north of Boulder Creek should include site evaluations during initial design phases to map important landscape and natural features.

c. Policy to protect landscape from construction impacts should be formalized for the campus.

5. Formal guidelines to protect natural areas should be written and followed by all who maintain these areas.

i. View Corridors

a. Goal. Views of the Flatirons, Boulder Creek, and the Continental Divide are amenities that need consideration when siting buildings and other open spaces.

b. Guidelines.

- View corridors should be protected or enhanced during the planning process for buildings, open greens, roads, and walkways.
- Show view corridors on landscape plans and design landscape to take advantage of long range views.

ii. Floor Area Ratios

The ratio of building gross floor area as established in the Campus Master Plan for each campus will monitor overall density and protect open spaces.

a. Goal. Maintain and create open spaces identified in the Campus Master Plan.

b. Guidelines.

- Total building floor area ratio to overall land area for Main Campus should be no more than 0.60 with new projected development including north of Boulder Creek.
- The overall East Campus FAR will be .46 at buildout. The goal will be to match the Main Campus FAR of .60 in areas not subjected to flooding. Areas subject to flooding will have an FAR of 0.25.
- Williams Village: The maximum floor areas for each developable pod are found in the Williams Village Master Site Development Plan.

6. Outdoor Places

a. Quadrangles and Lawns

Large open greens on campus become symbolic places that the buildings surround, creating space for social gatherings and passive recreation.

b. Goal. Preserve and protect campus quadrangles and open lawns, renovating as needed to make certain surfaces can withstand high pedestrian use.

c. Guidelines.

- Scale plant materials to the size and scale of the space, while maintaining diversity.
- Locate the appropriate open space adjacent to residence halls for maximum health benefits.

1. Overview

V. Land and Facilities Plan

• Vehicular Travel. Vehicular travel on campus is made up of campus commuters and those that travel the campus as part of their workday including staff, service vehicles, vendors, and emergency vehicles. Emergency routes have been designated and can be found on Exhibit V-E-18. Vendors and service vehicles are required to attend to various needs on campus and can often be found traveling on the sidewalks. In the last ten years, an attempt has been made to limit the number of vehicles that travel on sidewalks. Service stalls have been added and permits changed for vendors allowing them time to load and unload without parking privileges. Construction access is limited, allowing 1-2 vehicles onsite; the remainder of the construction crews park in remote areas. Facilities Management has mandated no travel on sidewalks by campus vehicles during class changes, providing alternate routes. The practice, however, has not been universally accepted by the campus community and external vendors, leaving room for improvement. Despite requests to outside vendors to curb driving and parking activities on the sidewalks, there is not a class change that does not include a Pepsi, FedEx, or UPS truck travelling on the busiest of walks alongside the students. If the campus is to increase pedestrian safety, stronger rules and enforcement need to apply to all who travel the walkways. In the most congested areas, hours of operation should be instituted similar to large cities that allow early morning and evening deliveries only. Vehicle fleets should be evaluated to determine if smaller vehicles or electric carts could be used for service. A bicycle messenger service could be implemented for small deliveries during all but a few inclement months. Construction access can be further limited to no onsite parking, instead providing these 1-2 spaces in a nearby lot, thereby reducing sidewalk trips.

• Parking Lots. Surface parking lots are necessary for daily campus business and require attention within the campus landscape. There are a few good examples of landscaped parking lots completed with newer buildings. The remainder of the lots are often barren, usually consisting of asphalt paving and character of the campus landscape. It is a compilation of the Campus Open Space Development Plan written by Campus Architect Emeritus William R. Deno, FAIA, in consultation with Hideo Sasaki (final revision June 1990), the Williams Village Master Site Development Plan, Research Park Design Guidelines, and the Department of Housing Landscape Master Plan. The policy to protect landscape from construction impacts should be formalized for the campus.

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- Williams Village: The maximum floor areas for each developable pod are found in the Williams Village Master Site Development Plan.

6. Outdoor Places

a. Quadrangles and Lawns

Large open greens on campus become symbolic places that the buildings surround, creating space for social gatherings and passive recreation.

- Preserve and protect campus quadrangles and open lawns, renovating as needed to make certain surfaces can withstand high pedestrian use.
- Scale plant materials to the size and scale of the space, while maintaining diversity.
- Locate the appropriate open space adjacent to residence halls for maximum health benefits.
• Use plant materials to assist in creating windbreaks and shade, locating large canopy trees around the edges.
• Large-scale renovations of fields should include drainage systems and turf design for high use.
• Sixty years is appropriate for current and future pedestrian use, snow removal, and service traffic requirements.
• Design for snow storage areas to take advantage of storm water drainage into landscape or permeable plaza areas.

II. TERRACES, PLAZAS, COURTYARDS, AND GARDENS
The intermediate exterior rooms of the campus are the terraces, plazas, courtyards, and gardens. These areas define building entrances and exits, providing a transition from public to private using architectural and landscape elements.

• Goal. Plan exterior building spaces to take advantage of Colorado’s climate and design for a variety of activities.

• Guidelines.
  • Design these outdoor rooms focusing on the programs within the buildings, adding the appropriate amount of site furnishings, amenities, and landscape.
  • Plazas, terraces, and courtyards are pedestrian spaces. Limit access to vehicles by the use of bolards, site walls, and landscaping. Bicycle storage is not an appropriate use for these spaces.
  • Each area should incorporate unique design character and focal points from other areas, i.e., fountains, sculpture, study spaces, food vendors.
  • Larger plazas and terraces should have flexibility to accommodate different types of events.
  • Enclosed courtyards can consider movable furniture creating flexibility. Moveable furniture has not been acceptable for open campus areas.
  • Paving should be permeable whenever possible and include snow storage areas if appropriate.
  • Provide structural soil systems within hardscape surfaces for plant materials to avoid planting in native compacted soils.
  • Use tree grates for trees planted in terraces and courtyards.
  • Design areas to be sheltered from northwest and west winds and hot southern sun, while taking advantage of gentle southeast and southwest winds.
  • Provide adequate lighting without creating light pollution, and limit landscape that could become overgrown providing security concerns.
  • Make note of micro climates created by buildings when choosing plant palette.
  • Use landscaping to enhance transitions between exterior spaces.

III. RECREATION AND ATHLETICS FIELDS
Outdoor recreation is essential to maintain physical and mental well-being. Recreation fields are interspersed within the campus, contributing to productive use of leisure time and lower stress levels in students.

• Goal. Continue to provide adequate space for recreation fields within close proximity of student population centers for student access, student zones, and central locations.

• Guidelines.
  • Planning of new fields and facilities will be done with a commitment to sustainability goals, including the latest design technologies to reduce turf stress, lower water usage, encourage recycling and composting, and reduce pesticide applications.
  • Protect prime play fields from detrimental activities that add to soil compaction, such as event parking.
  • Provide amenities for spectators including adequate seating, shade trees, and structures as well as trash receptacles.
  • Design equipment storage space into campus-approved accessory structures to eliminate renegade storage boxes.

IV. NATURAL AREAS
The Boulder campus properties include two types of natural areas. Natural areas in Zone 1 include areas that can contain fragile or endangered species and are to be left in a native state, providing maintenance only as needed for removal of dangerous tree limbs and refuse clean up. Zone 2 natural areas are defined as spaces on campus where landscape is planned as a park, inclusive of adaptive plantings, ponds, and waterways. A map of each zone is located in Section V.C.

• Goal. Preserve and protect natural areas from disturbance and development, and restore and renew as directed by the following guidelines.

• Guidelines.
  • Management criteria for these zones will account for the rare or unique attributes of each zone, allowing for specific enhancements deemed appropriate.
  • Restoration of Zone 1 areas will include replacement of non-native invasive species and plantings at the end of their lifespan with native plantings suited to their biotic zone.
  • Plantings will encourage wildlife within Zone 1 natural areas.
  • Maintenance within Zone 1 areas will include the removal of dead and dangerous tree limbs, trash removal, and limited clearing for safety (Boulder Creek).
  • Restoration of Zone 2 areas will include enhancement of the natural area using native and adaptive plantings and removal of invasive species.

V. PLAZAS, TERRACES, COURTYARDS, AND GARDENS
These include historic patches on the Main Campus that were used to flood irrigate the campus, ponds that were built to enhance the landscape or mitigate storm water, and natural creeks.

• Goal. Protect and enhance natural ponds and waterways.

• Guidelines.
  • Provide regular maintenance to established ponds on campus—Varsity Lake, Kittredge Ponds, and the 28th Street Ponds to keep them healthy, safe, and aesthetically pleasing.
  • Monitor bank erosion around ponds, planting grasses and trees to stabilize soils.
  • Maintain the ditches used for flood irrigating that are located within the historic district.
  • Enhance existing storm water retention areas with landscape to create amenities rather than detractions from the landscape. Consider restoring, retaining, and maintaining the natural streams and ponds when adding new storm drainage and detention/retention areas.

VI. CAMPUS EDGES AND GATEWAYS
The edge of the campus creates a boundary between the university “city” and the surrounding community. These spaces help to define image while reinforcing entrance. The boundaries of the Boulder campuses are somewhat amorphous depending on location, due in part to campus growth or lack thereof. As the Main Campus reaches build-out and other campuses begin to develop, it is important to define and enhance the image of the Boulder campus.

• Goal. Use landscape and wayfinding to clearly define the extent of the Boulder campus properties.

• Guidelines.
  • Gateway approaches should enhance the image of the university while providing a welcoming entrance and feel for all students, staff, faculty, and visitors. Entrance design should be the proper scale for the type of entrance.
  • Designs should follow established gateway “kit of parts” provided for the initial location at Baseline and Broadway including low masonry walls, limestone panels with engraved signage, and lighting.
  • Use mass plantings at campus entrances, limiting the plant palette to a few varieties taking advantage of adaptive plant species where appropriate.
  • High maintenance specialty gardens are not appropriate for gateway entrances.

• Maintenance within Zone 2 will be dictated by location of the zone within campus.

• Guidelines for federally protected wetlands located in Williams Village will be followed.

VI. Types of Space
I. NATURAL PONDS AND WATERWAYS
There are a variety of waterways on the Boulder campus properties. These include historic patches on the Main Campus that were used to flood irrigate the campus, ponds that were built to enhance the landscape or mitigate storm water, and natural creeks.

• Goal. Protect and enhance natural ponds and waterways.

• Guidelines.
  • Provide regular maintenance to established ponds on campus—Varsity Lake, Kittredge Ponds, and the 28th Street Ponds to keep them healthy, safe, and aesthetically pleasing.
  • Monitor bank erosion around ponds, planting grasses and trees to stabilize soils.
  • Maintain the ditches used for flood irrigating that are located within the historic district.
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  • Use mass plantings at campus entrances, limiting the plant palette to a few varieties taking advantage of adaptive plant species where appropriate.
  • High maintenance specialty gardens are not appropriate for gateway entrances.

• Consider low masonry site walls to accent the entrances and define the edge between the campus and the city, maintaining the appropriate scale for the type of entrance.

• Entry walls and landscaping should be placed so that there are unobstructed sight lines for safe entrance and exit.

• A formal street tree plan using approved street and canopy tree species should be developed for new campus expansions. Existing street tree plans for the East Campus should be adjusted to minimize monoliths.

• Planning of new fields and facilities will be done with a commitment to sustainability goals, including the latest design technologies to reduce turf stress, lower water usage, encourage recycling and composting, and reduce pesticide applications.

• Protect prime play fields from detrimental activities that add to soil compaction, such as event parking.

• Provide amenities for spectators including adequate seating, shade trees, and structures as well as trash receptacles.

• Design equipment storage space into campus-approved accessory structures to eliminate renegade storage boxes.

• Use pervious paving and bioswales for water quality, snow storage, and supplemental irrigation to landscape.

• Guidelines.
  • Use grading, sitework, and site walls with landscaping to buffer and screen parking from off-site views.
  • Parking lots should be considered as exterior rooms. Add internal landscaping to provide shade and break up large lots, using shade trees for entrances, exits and perimeter plantings. Avoid messy trees.
  • Use pervious paving and bioswales for water quality, snow storage, and supplemental irrigation to landscape.

• Parking spaces will be 8’-6” minimum width by 19’-0” long.

• Include spaces in each lot for car share programs.

• Bicycle parking should be considered along one edge of a lot if the lot is close proximity to buildings.

• Interior landscaped islands should be at least five feet wide with one shade tree planted every 40 feet in a structural soil system that includes a root barrier.

IV. SERVICE, DELIVERY AND STORAGE AREAS
Areas defined for service include loading docks, waste storage areas, and snow storage.

• Goal. Plan for service and storage areas away from major entrances or social areas, allowing accessibility without compromising views.

• Guidelines.
  • Use site walls, green walls, and plant materials to ...
I. WATER QUALITY, STORM WATER MANAGEMENT/DRAINAGE DESIGN GUIDELINES

The university strives to improve water quality of storm water by reducing pollutant loads to protect existing streams and creeks. Improve drainage, and maintain ground water recharge.

II. WATER RESOURCES AND WATER

• Consider using green roof technology in appropriate conditions.
• Improve water quality of storm water by using bio-ground water recharge.

• Guidelines.
  • Locate underground utility corridors in streets or through the center of large quadrangles whenever possible to reduce future landscape conflicts.
  • Locate underground utility corridors at ground level away from major social spaces and building entrances.
  • All grates are to be spaced one-half inch apart or less to allow bicycle and wheelchair accessibility.

III. UTILITIES

Utilities include underground lines and aboveground support structures. Both can have a detrimental effect on the landscape.

• Goal. Minimize visual impacts of aboveground utility structures and long range impacts of belowground utility lines.

• Guidelines.
  • Locate underground utility corridors in streets or through the center of large quadrangles whenever possible to reduce future landscape conflicts.
  • All grates are to be spaced one-half inch apart or less to allow bicycle and wheelchair accessibility.
  • Consider using green roof technology in appropriate locations to minimize runoff and reduce heat island effect.

IV. LIGHTING

Campus activities—including classes, performances, and evening sporting events—occur at all hours. Lighting is a critical component of the landscape creating ambiance as well as a safe environment for all to travel in.

• Goal. Suitable lighting will create a welcoming nighttime landscape while providing a safe, secure environment.

• Guidelines.
  • Evaluate campuses routinely to verify that the exterior lighting is continuous without dark areas.
  • Use sustainable fixtures that cast a warm white, instead of orange or bright white, light.
  • Highlight campus gateways and entrance signage.
  • Provide accent lighting on significant building façades.
  • Design lighting to accommodate light sensitive areas, keeping the night sky from being over-lit.

V. CIRCULATION DESIGN GUIDELINES

• Goal. Design new streets to accommodate travel through campus in a safe, efficient manner while accommodating all modes of travel.

• Guidelines.
  • Primary streets considered as the main thoroughfares through campus should be designed to accommodate all modes of travel, incorporating separate bikeways (cycle track) when spatially possible.
  • Secondary streets may be targeted as intercampus bike routes, and should incorporate bike lanes if design of travel connects through campus.
  • Eliminate on street parking where practical, using additional space for bike lane or pavement width reduction.
  • Many campus sidewalks serve as emergency access routes. Design of sidewalks should be of adequate width to accommodate their intended use, including a 1–2’ buffer at the edges for landscape.
  • Policies regarding vehicle traffic on sidewalks should be written and enforced.
  • All street design should include a landscape plan that contains appropriate street tree planting, lighting, and associated landscape including furniture, fixtures, and equipment.
  • Design a pedestrian friendly circulation system that accommodates all forms of transportation in a safe, efficient way.

VI. PEDESTRIAN CIRCULATION DESIGN GUIDELINES

The 1979 Campus Master Plan reaffirmed the notion that the campus is ”first and foremost a pedestrian environment.” As the population increases within the Boulder campus, it is paramount to design for the future providing separate, accessible routes. Planning efforts must include retrofitting to the Main Campus walkways along with new planning ideas for properties yet to be developed.

• Goal. The campus should be designed for pedestrians creating a safe, identifiable, walkable campus with safe connections through.

• Guidelines.
  • All pedestrian routes must meet and/or exceed the current Americans with Disabilities Act (ADA) design criteria for safety and accessibility.
  • Identify major pedestrian corridors with changes in width, pavement design, lighting, and wayfinding along with site furniture.
  • Provide pedestrian linkage to all parts of campus, with enhancement of aging trails becoming a priority as funding is available.
  • Provide clear, well lit, safe routes through parking lots to building entrances.
  • Delinate pedestrian crosswalks with a consistent paver design, raised in areas of high vehicle traffic.
  • Provide lighting for safety on all walkways and add wayfinding and site furniture where necessary. Use of permeable paving surfaces is encouraged.
  • Use railings as a last resort when landscape or site furnishings will not be sufficient to deter cross cutting.
  • Railings tend to be used as unauthorized bike rails requiring enforcement.

I. W ATER, QUALITY, STORM WATER

f. Outdoor Systems

• Co-locate waste collection sites with building uses.
• Co-locate temporary construction staging in selected locations on campus periphery zones, allowing for storage of materials and equipment to be removed from central areas of campus.
• Co-locate construction staging with building uses and collection times.
• All waste collection sites must be screened with standard materials and closures.
• Site planning will include snow storage sites using permeable materials.

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the business day.
• Consider the use of alternative modes for delivery of small packages during peak travel times on dry weather days.
• Develop service ring roads around each campus, helping to eliminate vehicles from the core of campus.

II. SIGNAGE AND WAYFINDING

Signage systems include a hierarchy of information and if well designed can add a visual connection to the ex-
terior spaces, providing direction and creating a positive campus image. Signage is informational, directional, and regulatory and a necessary component to the campus landscape. The way information is portrayed can either be a positive or negative experience. Too many signs cause information overload, resulting in “message 
ignore.” Campus wayfinding should be expanded from the current campus maps to include markers that direct the visitor to main buildings and areas. Types of signage addressed in this section include campus gateways, primary identification, and wayfinding.

• Goal. Reinforce a positive campus image by creat-
ing a consistent signage program to include campus gateways, primary identification, wayfinding, and regulatory signs.

I. GATEWAY

• Guidelines.
• Main campus entry points should be identified with the “kit of parts” created for the monument signage at Baseline and Broadway. Materials will include masonry walls with limestone panels to identify the campus.
• Wood is not a suitable material to be used for signage.

II PRIMARY IDENTIFICATION

• Guidelines.
• Primary building identification will be consistent on all campuses, located at main building entrances.
• Larger buildings with multiple entry points may require multiple signs.
• Building identification will follow Building Identifica-
• Background colors will remain consistent on all campuses.
• Individual logos will not be applied to building signage.
• Signage height will be sufficient to clear moderate snowfall without creating a safety obstruction.

III. WAYFINDING

• Guidelines.
• Expand campus wayfinding from campus maps to
intermediate directional signage with appropriate lighting at key points on campuses to identify note-
worthy buildings or areas.
• Update campus maps as new buildings are built.

I. SITE FURNISHINGS DESIGN GUIDELINES

Site furnishings for the campus provide design consis-
tency in the relationship between the exterior spaces and architecture, acting as a functional accent to the landscape. The campus has chosen site furnishings and accessories that are listed in current campus standards. Any changes to the existing site furnishings will be reviewed and approved by facilities planning. Materials should consider safety, durability and maintenance, and economy. The furnishing group includes shelters and kiosks, seating, and miscellaneous site accessories. Signage and wayfinding are discussed in the Signage section.

II. SHELTERS AND KIOSKS

Shelters include those that are used for weather protec-
tion on recreational fields, bus stops, and covered bike parking. Kiosks include the small structures used for ATMs and parking equipment protection, as well as informational kiosks for posting of campus events.
• Guidelines. Shelters and kiosks shall be placed in areas with high pedestrian activity, with careful consider-
ation of open space use, and protection of views.
• Guidelines. All shelters and kiosks will be consistent in design, materials, and forms that relate to current site fur-
ishing family.

III. SEATING

• Guidelines.
• Goal. All site furnishings should be consistent and complementary to the building style and surrounding landscape.
• Guidelines. Include a variety of seating options in plazas and ter-
races to accommodate different uses and groupings.
• Guidelines. The extension of campus-wide Wi-Fi has created additional opportunities for outdoor study. Additional tables should be added for this use. Exterior study spaces should include a few exterior outlets for laptops.
• Guidelines. Provide adequate number of furnishings for the anticipated use for all outdoor areas including plazas, pathways, and recreation fields.
• Guidelines. Congregate seating for conversational purposes, adding space for wheelchair parking in bench lay-
outs.
• Guidelines. Consider space for feet to rest when placing benches along walkways.
• Guidelines. Maintain consistency of furnishings within individual building sites, using established campus standard selections.
• Guidelines. Black metal furnishings will be used to maintain campus consistency.

• Wood is not a reliable material in the Colorado climate and should be avoided.
• Masonry seat walls provide alternatives to individual benches along borders and edges. Masonry should match campus buildings and include skateboard detail engraved in the capstone.

IV. MISCELLANEOUS SITE FURNISHINGS

Accessory site furnishings provide additional amenities to the outdoor space.

IV. TRASH RECEPCTALES AND ASH URNS

Trash receptacles, including recycling stations, are located in tandem in select areas around campus. Ash urns are necessary for the safe disposal of cigarettes.
• Guidelines. Trash and co-mingled recycling stations are located by the Outdoor Services staff in high traffic areas. Two cans are located together on a concrete slab out of view of sidewalks for ease of disposal, ease of collection, and out of snow removal routes.
• Guidelines. Trash collection should be located away from build-
ing entrances to eliminate access for pests to enter the building.
• Guidelines. Locate ash urns using current state statutes for health and welfare. Current statutes require ash urns to be 25 feet from any building entrance.
• Guidelines. Do not locate ash urns in front of air intakes. Plan the locations carefully to avoid ash urns next to mulched garden beds.

j. Site Amenities

i. Planters

Planters can help direct pedestrian traffic and ac-
centuate buildings and plazas while providing a spot for seasonal color.
• Guidelines. Materials chosen for planters should complement the surrounding architecture, be durable, and be sized to withstand Colorado’s harsh climate.

II. BICYCLE RACKS

Bicycle racks are an important feature to the campus landscape that enhances multi-modal transportation.
• Guidelines. Integrate layout and configuration with campus circu-
lation system, plaza design, and building entrances.
• Guidelines. Provide adequate lighting and place racks in loca-
tions where they can be viewed from buildings.
• Guidelines. Areas that are more removed from main entrances should be covered to encourage use.
• Guidelines. Maintain consistent installation standards.

III. TREE GRATES

• Guidelines. Tree grates are to be provided for all trees that are located within paved areas to ease soil compaction and provide protection from equipment.
• Guidelines. Newspaper Vending Machines
• Guidelines. Congregate newspapers in select approved locations on campus to reduce the visual clutter of numerous boxes.
• Guidelines. Provide three-sided screening using appropriate campus building materials.
• Guidelines. Materials and finishes should be consistent with sur-
rounding site furnishings.
• Guidelines. Outdoor boxes must meet current ADA standards.

k. Fencing and Screening

Fences placed on campus are used as a pedestrian in-
tervention or for screening purposes. The placement of a fence is carefully guided by facilities planning. Fencing will not obstruct quads or separate recreational spaces from public use unless approved. The fencing appropri-
ate for campus includes steel picket, metal screening, and vinyl coated chain link with privacy panels.
• Guidelines. Use fencing judiciously for screening and barri-
ers if necessary for protection of athletics fields.

I. STEEL PICKET

• Guidelines. Steel picket fencing is found around Franklin Field and Farrand Field. This type of fence has been installed to modulate pedestrian traffic around and through these venues. A 42-inch pedestrian scale height is preferred. This type of fencing is also used as crowd control for large events at the stadium instead of less permanent jersey barriers. All steel fencing is black in color.

II. VINYL COATED CHAIN LINK

• Guidelines. Vinyl coated chain link fencing has been approved for screening of less visible areas such as utility areas or trash enclosures. This type of fencing must include black privacy slats to create a completely opaque screen. Non vinyl coated chain link is not an ap-
proved material.

III METAL SCREENING

• Guidelines. Metal posts with two panels of metal screening are appropriate for screening of transformers, and trash enclosures in visible areas on campus. Metal for screening should be chosen for its opaque nature. All metal screening is black in color.

j. Site Design Guidelines

The landscape concept for the Boulder campuses will enhance and add to the existing park-like setting created for the Main Campus a century ago without creating major shifts in design. New landscapes for buildings will be required to become part of the “consis-
tent whole” while applying technology to preserve and conser-
serve materials.
• Guidelines. Plant selection for the campus is to be diverse and appropriate to the climate of Colorado. Native
plants are to be used when possible and where appropriate. Avoid plants that require excessive maintenance.

- **Guidelines.**
  - Plant pallets should be chosen with consideration of micro climates created by masonry buildings.
  - Plants should be massed in general to avoid creating high maintenance bed requirements, and of proper scale to match the setting. For example, the mature canopy trees in the Norlin Quadrangle lend a sense of history, permanence, and tradition. Smaller ornamental trees in bordering courtyard entrances help bring the scale to a pedestrian level.
  - Plant pallets should be selected with the idea that the main “season” for the majority of university population is August through May.
  - Spacing for plant materials should be determined on individual growth habits of each species within the Colorado climate.
  - Existing beds should be evaluated to remove plants at the end of their lifespan, replacing them with materials that are climatically appropriate, and do not increase maintenance or pest infestations.
  - Mulch beds should be filled with shrubs or ground cover to reduce constant yearly cycle of mulch replacement.
  - Group plantings with similar water requirements allowing for efficient irrigation design.
  - Planting within historic districts should maintain existing historic patterns.

See Appendix B for Plant Material List

### m. Design Guidelines for Construction Sites and Temporary Facilities

Construction is an ongoing activity on campus, causing detours for pedestrians and detriment to the campus landscape. The following guidelines apply to all construction sites and temporary facilities installed during construction.

- **Guidelines.**
  - Locate construction staging away from landscaped areas whenever alternatives are present.
  - A site survey is required to list all plant material, site furnishings, or accessories that may be impacted by construction. Plant materials may be subject to an outside appraisal prior to start of construction.
  - Access, traffic control, and storm water management plans will be approved by authorized campus personnel prior to start of construction.
  - Staging areas will include limited parking. Crew parking will be found in nearby parking lots or off-site with the use of shuttles for larger capital projects.
  - Chain link fencing will be used for all construction perimeters.

### n. Campus Standards

Campus Standards can be found on the Facilities Management web site. These materials include all site amenities and planting requirements for the Boulder campus to be used for all projects affecting the landscape.
D. Environmental Management Plan

1. Outdoor Air Quality

- **Actions taken by CU-Boulder can impact outdoor air quality to some degree. Among CU-Boulder’s existing and ongoing efforts to help assure air quality:**
  - Leading-edge research conducted regarding air quality, including studies at the Mountain Research Station, which affords a unique opportunity to assess atmospheric conditions.
  - Cogeneration of electricity and steam (used for heating and cooling buildings), in a natural-gas-fueled power plant. The use of natural gas is cleaner but more expensive than coal, which is used as a fuel source at many Colorado power plants.
  - Initiatives to encourage the use of varied transportation modes, including the non-motorized modes of walking and bicycling when these are feasible, reducing vehicular emissions.
  - In winter road and walkway ice abatement operations, the shift from use of a sand/salt mixture to a magnesium chloride liquid de-icer. Sand application has been reduced by approximately 70 percent in the five years prior to writing this plan, helping limit suspended airborne particles, a significant component of visible air pollution.
  - CU-Boulder should establish guidelines to minimize pollutants that degrade air quality or that contribute to widespread environmental concerns such as the "greenhouse effect."

- **Goal.** CU-Boulder will identify and implement institutional actions that help address air quality concerns.

- **Guidelines.**
  - Add air pollution control devices at Williams Village and Main Campus, which helps limit the need for vehicular trips.
  - Improve pedestrian routes, bicycle routes, transit service, and transit vehicles.
  - Mitigate congestion and idling in traffic through roadway construction and improvements, improved directional signage, and parking management.
  - Reduce hazardous waste generation (avoiding the need for waste disposal companies to incinerate it).
  - Upgrade institutional fleet vehicles with newer cleaner-burning diesel and natural gas engines and (where feasible) with vehicles using hydrogen fuel technologies for propulsion such as electric and hybrid-electric.
  - Environmental Health and Safety and Facilities Management will continue to coordinate efforts to comply with new EPA Greenhouse Gas Rules issued in 2009.

2. Indoor Air Quality

Indoor air quality is affected by many factors in building design, site design, and location of air intakes. Concentrations of potentially toxic materials in the air tend to be much higher indoors than outdoors, in part due to the use of paints, sealants, adhesives, and other modern building materials. One way to lower these concentrations is through the use of materials that do not off-gas as much formaldehyde, volatile organic compounds (VOCs), or other potentially hazardous chemicals. CU-Boulder has successfully built with the LEED for New Construction requirements of using low VOC materials. This practice will continue in all new buildings and major renovations.

- **Goal.** CU-Boulder will continue to implement practices and procedures that help assure indoor air quality.

- **Guidelines.**
  - Continue to implement processes to identify and mitigate the potential for mold growth.
  - Continue to locate vehicular loading areas and air intakes at separate locations in new building design.
  - Continue to respond to concerns regarding smoking near entryways and air intakes and to support a culture of smoking courtesy.
  - Use low- or no-VOCs materials in construction and maintenance activities.
  - Continue to utilize a "purging" time to ventilate a new building with outside air for a reasonable time before people move in. This will help remove airborne contaminants left over from the construction process, and it will better accommodate the initial off-gassing of VOCs. LEED requires an approximately two-week flush-out process.
  - Continue to balance adequate indoor air quality measures with energy efficiency.
  - Provide IAQ monitoring devices in new buildings and retrofit devices into existing buildings during renovations.

3. Water Quality

Potable water originates in the mountains and is treated by the city of Boulder treatment plants before distribution to the campus. The city of Boulder is responsible for the quality of this potable water. Water leaving the campus in sanitary sewers is delivered to the city of Boulder wastewater treatment plant. The city of Boulder regulates CU-Boulder wastewater discharge to comply with Colorado Department of Public Health and Environment, and Federal EPAs regulations. CU-Boulder’s wastewater discharge permit limits allowable discharges of organic pollutants, arsenic, cadmium, chromium, copper, lead, mercury, molybde- num, nickel, silver, and zinc, and limits allowable levels of biological oxygen demand. Wastewater discharges are periodically sampled from several sampling stations on campus.

- **Goal.** CU-Boulder will meet or exceed water quality requirements in campus discharges to streams and to storm and sanitary sewer systems.

- **Guidelines.**
  - Continue to maintain the City wells which accommodate flood protection, nature study, and cleansing of drainage runoff.
  - The Department of Environmental Health and Safety will continue to oversee the campus community to avoid accidental discharges of illicit materials into storm and sanitary waste systems.
  - New campus construction guidelines include design criteria that incorporate best management practices and structures that work to improve overall campus water quality. Also identified in LEED SSIC 6.1 & 6.2.
  - Continue utilizing the integrated pest management system, which helps reduce the use of pesticides in landscaping and drainage runoff. CU-Boulder is finalizing a plan to significantly reduce pesticide use with a goal of chemical free turf within the next few years.
  - Continue to locate and appropriately label storm drains to help avoid accidental spills into creeks.

4. Flood Mitigation

The University of Colorado Boulder has approximately 30 percent of its land assets located within the 500-year floodplain. Reducing the likelihood of flood damage through appropriate land-use planning, building design, and siting are important components of planning, design, and construction on the campus. The campus has had consultants study the impacts of a major flood event to the campus to assess areas of vulnerability and provide recommendations to improve the flood risk. The city of Boulder has also placed flood-warning sirens on and near the campus, which will alert people in the vicinity of an impending flood so they may move to higher ground.

- **Goals.**
  - Ensure flood evacuation plans are in place for all facilities located within the 500-year floodplain. These evacuation plans should be periodically reviewed by Facilities Management staff and distributed to the building occupants annually before each flood season.
  - Continue to perform building modifications that reduce the risk of flood damage within the building.
  - Continue planning to mitigate the flood hazard for the existing campus residential units north of Boulder Creek.
  - Remove the overhead steam line crossing Boulder Creek, which feeds the residential properties on the north side of the creek.
  - Continue to work with the city of Boulder and the Urban Drainage and Flood Control District to address floodplain concerns on the campus. This includes the possible replacement of existing bridges over Boulder Creek with "breakaway" type bridges.
  - Continue to minimize the flood risk to areas on the campus that may be subject to localized flooding.

- **Guidelines.**
  - Do not locate critical facilities (as defined by the Colorado Water Conservation Board) in the 500-year floodplain, unless the requirements of the CWCB’s Floodplain Rules and Regulations are met.
  - Elevate the first-floor elevation of new buildings to be located in floodplains to 2.0 feet above the FEMA regulatory floodplain.
  - Athletics playing fields and recreational facilities, e.g., soccer fields, are preferably located in floodplains and floodways.

5. Hazardous Materials

The Department of Environmental Health and Safety administers the policies for radiation safety, biocellular materials, biological hazards, radioactive materials, indoor air quality, water quality, industrial hygiene, and asbestos/lead abatement. Campus safety remains a responsibility shared
by every member of the university community. Program areas within EH&S are designed to focus on preventative, remedial, and emergency response measures to hazardous materials used on campus.

The Environmental Health and Safety Center (EHSC) was completed in 2000. The facility houses all EH&S staff and facilitates services and waste methodologies intended to reduce the amount and costs of hazardous wastes for disposal for the Main Campus. A waste treatment facility was incorporated into the EHSC and became operational in 2001. The treatment facility allows EH&S to treat certain hazardous wastes, thereby reducing costs and liabilities associated with their disposal. Research continues within the treatment facility to find ways of expanding opportunities for waste treatment.

The continued growth in research activities at CU-Boulder has produced a corresponding growth in activities performed by EH&S related to hazardous materials management. The additional research space that is currently under construction, especially the expansion of research facilities on the East Campus, will result in an even greater need of these activities performed by EH&S to safely manage the hazardous materials used and generated.

- **Goal.** EH&S will help the campus community continue to nurture an environmental and safety consciousness and maintain compliance with local, state, and federal environmental standards and regulations.
- **Guidelines.**
  - Minimize the production of hazardous waste through education, inventory management, and waste treatment efforts.
  - Conduct on-site inspections, training and program reviews, and investigations of incidents.
  - Oversee safe use of radiation producing machines and the safe use and disposal of radioactive materials.
  - Handle, transport, and appropriately dispose of hazardous waste materials.
  - Oversee safe use and disposal of biohazardous materials.
  - Test, detect, abate, and dispose of materials containing asbestos or lead.
  - Develop contingency plans and procedures.
  - Develop appropriately scaled waste handling facilities on the East Campus as the campus develops and more waste is generated.
E. Transportation Plan

1. Overview

This section summarizes the efforts of a larger document that is to be appended to the Master Plan once complete. The Campus Master Plan Transportation Element addresses the policy and direction by which transportation planning will be developed. The larger Transportation Master Plan will address these issues as well as implementation strategies, financial considerations, and operational opportunities and constraints.1 The Transportation Master Plan of the 2011 Campus Master Plan must 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 percent by 2030.
- 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.
- Work to reduce the growth in the number of trips taken while retaining the current modal hierarchy of pedestrian, bicycle, transit, car, share/carpool (SOV) and single occupancy vehicles (SOV).

2. Transportation Accomplishments and Future Challenges

a. Accomplishments

The Transportation Master Plan is being 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 at CU-Boulder, have meant that traffic volumes in Boulder decreased approximately 13 percent from 2001 to 2009 while metropolitan Denver traffic volumes increased 12 percent over the same time period. The result is a total 25 percent reduction in traffic volumes because of these actions.
- Survey data of students and faculty/staff suggest that CU-Boulder has one of the lowest single-occupant vehicle (SOV) modal splits among major universities.
- CU-Boulder is in the top 9 percent of universities in the nation with regard to campus transit service, with over 28 transit routes now providing access to campus and an increase in CU-Boulder student transit trips of over 300 percent since 1991.
- CU-Boulder compares favorably with its peer universities and is rated “excellent” with regard to bicycle and pedestrian facilities.

b. Future Challenges

As CU-Boulder plans for the next 20 years, it faces many issues that will challenge its ability to both physically and financially meet its projected growth and its sustainability goals, including:

- Parking & 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 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 reduce greenhouse 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 are still enhanced and new pedestrian, bicycle, and transit infrastructure and services needed.
- Approximately 35 percent 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 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 vehicle miles traveled and GHGs by 20 percent, CU-Boulder’s VMT will increase by 17 percent by 2030.
- If no improvements are made to current travel demand management programs, campus parking demand will increase by 1,700 spaces by 2030.

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c. 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 thereby achieve VMT and GHG goals. The tools and techniques that will be applied and expanded include the following:

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<th>Reduce the need to travel</th>
<th>Provide for travel choices</th>
<th>Influence travel choices</th>
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<tbody>
<tr>
<td>Land use – intensification</td>
<td>Allocation of street space (to public transit, walking, bicycling, high occupancy vehicles)</td>
<td>School, business, and community travel TDM plans</td>
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<tr>
<td>University villages with housing, academic, retail, and service facilities</td>
<td>Improved public transit services</td>
<td>Improved travel information</td>
</tr>
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<td>Tele-working, video conferencing</td>
<td>Construction of walking and bicycling networks</td>
<td>Pricing of parking and roads (i.e., US 36)</td>
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<td>University villages with housing, academic, retail, and service facilities</td>
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Figure 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 would 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.
Goal

- Encourage the expansion of TDM programs to increase the use of alternative transportation modes and reduce the use of single-occupancy vehicles.

Guidelines

- 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.
- 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.).
- Transportation options should consider the needs of people with disabilities during the planning and implementation of TDM strategies.

3. Transportation Master Plan Vision and Goals

a. Transportation Vision Statement

During the Campus Master Plan process, a vision emerged for the Transportation Master Plan that describes the features 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.
- CU-Boulder bicycle and pedestrian facilities, public transit systems, campus streets, and surrounding communities are all safe and well-maintained and take users when and where they need to go.
- 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.
- The impacts of travel activities are recognized and CU-Boulder functions as a good neighbor to mitigate the negative impacts on surrounding communities.
- 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.
- 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 systems and strategies that synchronize schedules and routes to speed travelers to desired destinations.
- 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.
- 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.
- CU-Boulder's transportation investments and travel behaviors are driven by the need to reduce the impact on the earth's natural habitats.
- All who work, learn, and teach at CU-Boulder and those who visit enjoy a higher quality of life.

b. Flagship 2030 Strategic Plan Long Range Goals

This plan continues themes from the previous plan, including the modal hierarchy, density, and mixed land uses as key components that support efficient transportation and conveniently locate campus services. In addition, 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 learning environment.
- Increasing the number of non-freshman residents in residence halls from 2 percent (2008) to 20 percent by 2020.
- Redeveloping 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).
- Internationalizing the institution as a part of the global economy, including seeking more international students.

As noted above and in Section 3 of the Campus Master Plan, the state of Colorado and the University of Colorado Boulder have adopted broad sustainability goals to:

- Reduce greenhouse gas (GHG) emissions by 20 percent by 2020.
- Become carbon neutral by 2050.

4. Current Conditions

a. 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 6,284 affiliate participants. Existing mode share was obtained from a weighted average of the four. The results of the 2010 survey are shown in Table 1 along with the results from the University of Colorado 2008 Commuter Survey.

As shown in Table 1, the 2010 drive alone share is approximately 47 percent for faculty/staff and 19 percent for students. Carpooling is the major source of single-occupancy vehicle account for another 7 percent of faculty/staff trips and 4 percent of student trips. Compared to 2008, the faculty/staff vehicular use has increased slightly while student use of single-occupancy vehicles (SOV) is about the same.

In addition to looking at overall mode share, the 2010 data were 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 shows the results of the analysis.
Finally, an additional analysis was performed on the 2010 data to determine mode share by commuting distance. As shown in Figure 2, vehicle use is very low (less than 10 percent) for affiliates who live within a mile of campus and increases to almost 60 percent for affiliates who live more than five miles from campus. As a result, significant shifts away from vehicle use can be obtained by providing additional housing near campus.

Table 2
CU-Boulder Mode Share

<table>
<thead>
<tr>
<th>Faculty/Staff</th>
<th>Main Campus</th>
<th>East Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telework/Didn’t Come</td>
<td>6.1%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Walk</td>
<td>5.9%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Bike</td>
<td>8.4%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Skateboard</td>
<td>0.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Bus</td>
<td>21.7%</td>
<td>24.0%</td>
</tr>
<tr>
<td>Car/Vanpool</td>
<td>7.7%</td>
<td>7.6%</td>
</tr>
<tr>
<td>Motor cycle/scooter</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Drive alone</td>
<td>47.3%</td>
<td>44.0%</td>
</tr>
<tr>
<td>Other</td>
<td>2.7%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

As shown, vehicular use is significantly higher for faculty and staff working at the East Campus. This is most likely due to a combination of the lower level of transit service and bicycle/pedestrian facilities at the East Campus and more widely available parking. 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.

b. Existing TDM Programs
CU-Boulder has developed and funded a comprehensive package of TDM programs since 1992. These programs are jointly managed by Parking & Transportation Services (PTS) and the Student Environmental Center through a Sustainable Transportation Partnership (STP) agreement. PTS has two 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.

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 – available to full and part-time continuing employees working at a 20 percent or greater full-time equivalent appointment.
- Late-night transit.
- CU Ski Bus.
- Buy up of additional off-peak frequency on the STAMPEDE 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 edo 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. A comparison of cordon counts on the Main Campus indicates an increase of 62 percent in faculty and staff working at the East Campus. This is most likely due to a combination of the lower level of transit service and bicycle/pedestrian facilities at the East Campus and increases to almost 60 percent for affiliates who live within a mile of campus.

**Existing Non-Motorized Travel and Facilities**
Non-motorized modes will always be the preferred forms of travel to campus and on campus due to zero energy use and zero carbon emissions. The Main Campus is a walking environment because of its modest size; efficient land use encouragement; extensive system of pedestrian walkways; and pleasant, park-like atmosphere. As East Campus and Williams Village build out, similar pedestrian and bicycle-oriented environments will be developed.

i. Non-Motorized Demand
As previously indicated in Table 1, over 15 percent of faculty and staff and over 42 percent of students use a non-motorized mode of travel to reach campus. The closer affiliates live to campus, the higher the non-motorized mode share.

Quantifying non-motorized travel to Main Campus, a cordon count was conducted in 2010. In total 11,417 individuals were counted walking, biking, or skateboarding to campus on Wednesday October 6, when the weather was clear/party cloudy with temperatures in the low to mid 50s. 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 3.

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

The 2010 counts were a thorough, but not exhaustive, summary of all non-motorized travel to campus. There are individuals who access campus at numerous places, whether at an officially designated crossing or at an informal crossing of convenience, who 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 people were included in the counts who use the CU-Boulder network to get to their destination, though CU-Boulder might not be their destination.

Despite these factors, the counts still allow some general interpretations to be made about non-motorized...
traffic in and around campus. As shown in Table 3, from the 2010 counts it was estimated that nearly a quarter of all individuals coming to campus do so by foot. Additionally, about 12 percent came to campus by bicycle. The results also tell us where more bicyclists, pedestrians, and skateboarders are accessing campus. Understanding these 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 tabulated. Campus-wide, the busiest times for non-motorized activity were between 10:00 and 11:00 a.m., with the highest 15-minute peak beginning at 10:45 a.m. 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. The count results in Table 4 break out the count totals by aggregated skateboard, bicycle, and pedestrian activity.

The 2010 results show high levels of walking and bicycling. Skateboarding was not recorded in significant levels and represented approximately 2 percent 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 utility 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 Boulder Creek should be re-examined to strengthen its connection to campus and its utility as a bikeway.

### Table 4

<table>
<thead>
<tr>
<th>Location</th>
<th>Skates</th>
<th>Bikes</th>
<th>Peds</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folsom &amp; Colorado</td>
<td>26</td>
<td>738</td>
<td>977</td>
<td>1,741</td>
</tr>
<tr>
<td>16th &amp; Broadway</td>
<td>19</td>
<td>405</td>
<td>1,030</td>
<td>1,454</td>
</tr>
<tr>
<td>Broadway &amp; College</td>
<td>40</td>
<td>199</td>
<td>1,123</td>
<td>1,362</td>
</tr>
<tr>
<td>Broadway &amp; University</td>
<td>28</td>
<td>403</td>
<td>711</td>
<td>1,362</td>
</tr>
<tr>
<td>26th &amp; College</td>
<td>21</td>
<td>500</td>
<td>492</td>
<td>1,013</td>
</tr>
<tr>
<td>Lot 169 &amp; Stadium</td>
<td>0</td>
<td>151</td>
<td>493</td>
<td>644</td>
</tr>
<tr>
<td>17th &amp; University</td>
<td>8</td>
<td>217</td>
<td>478</td>
<td>733</td>
</tr>
<tr>
<td>Broadway &amp; Pennsylvania</td>
<td>12</td>
<td>80</td>
<td>568</td>
<td>660</td>
</tr>
<tr>
<td>Athens Court</td>
<td>7</td>
<td>49</td>
<td>481</td>
<td>537</td>
</tr>
<tr>
<td>16th &amp; Broadway</td>
<td>33</td>
<td>96</td>
<td>379</td>
<td>508</td>
</tr>
<tr>
<td>Baseline &amp; Broadway</td>
<td>2</td>
<td>366</td>
<td>105</td>
<td>473</td>
</tr>
<tr>
<td>26th &amp; Aurora</td>
<td>4</td>
<td>213</td>
<td>295</td>
<td>521</td>
</tr>
<tr>
<td>South Broadway Tunnel</td>
<td>7</td>
<td>296</td>
<td>54</td>
<td>357</td>
</tr>
<tr>
<td>Broadway &amp; Regent</td>
<td>20</td>
<td>51</td>
<td>240</td>
<td>311</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>277</td>
<td>3,764</td>
<td>7,426</td>
<td>11,417</td>
</tr>
</tbody>
</table>

### ii. Non-Motorized Supply

Discussion and analysis of non-motorized facilities were broken into pedestrian and bicycle components. This distinction is made due to the relative difference in travel speeds between the two modes. There are also some multi-use facilities.

#### (1) PEDESTRIAN FACILITIES

Pedestrian facilities on the CU-Boulder campus are divided into three sub-categories: corridors, crosswalks, and sidewalks.

Pedestrian corridors are areas of campus where pedestrian movement is prioritized and given preference to other forms of transportation.

Crosswalks are found where pedestrian facilities intersect streets. The major crosswalks on campus are located along Broadway, University Avenue, the 18th/Colorado Avenue corridor and Regent Drive.

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 suitable only 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.

#### (2) BICYCLE FACILITIES

According to the Pedestrian Safety Committee Final Report from April 2010, there are currently two on-street 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 contra-flow bike lane, meaning that it runs against the one-way traffic. The existing bike lanes connecting or near to campus are designated in Exhibit V-E-1.

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 an extensive bicycle parking system, though there is no dedicated funding source for bike parking and localized parking shortages exist.

According to the 2009 Bicycle Parking Assessment, conducted by the university, there are 9,433 parking spaces in 1,159 racks across campus. Roughly half of this parking is available to the full campus community of 37,334 (30,074 students and 7,260 faculty/staff), or enough parking to serve 13 percent of potential users versus 14 percent of estimated demand. The other half of existing bike parking is provided for on-campus residents at their residential locations on Main Campus, and at Family Housing, Williams Village, and Bear Creek.

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mile distance with regional service. The intermediate distance will need to be a focus to capture the dispersal of trips and housing locations unless housing location trends change.

The mode share data also indicated strength in service to Main Campus and Williams Village. As the East Campus is built out, transit service to this location will need to be a future area of focus.

ii. Demand for Transit Service

Compared to the 740,000 CU-Boulder student boardings on RTD buses recorded in 1992, student boardings had almost doubled to 1,427,000 in 2002, and had tripled to 2,328,000 by 2009. Of the 2.3 million student trips made in 2009, 74 percent were served by local routes, 24 percent by regional routes, and 2 percent by SkyRide routes.

Additional analysis was conducted to understand the share of riders who board routes that directly serve one of the CU-Boulder campus locations. This gave an indication of the preference for one-seat rides versus rides requiring a transfer. The data show that 83 percent of CU-Boulder student boardings are on routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth of CU-Boulder student boardings. On routes with direct service (one seat ride) to campus, while 7 percent are on routes requiring a transfer to reach campus. Direct-service routes average 30 percent student boardings requiring the indirect routes. 6 percent average annual growth ofCU-Boulder students. Separate demand estimates for the three campuses of CU-Boulder were prepared. These were prepared using a variety of estimates and methods including trend line growth, population and employment forecasts by local government, University, and regional government (DRCOG), and forecasts by CU-Boulder of student, faculty, staff, and facilities growth (buildings and classroom space). The actual, historical, and average growth rate are presented for the baseline growth. The lower end of the range represents a continuation of existing mode split. The upper end of the range represents some progression in shifting travel from other modes to transit. An aggressive growth rate is also presented, reflective of more robust growth and policy choices which might more strongly favor transit. Demand estimates are shown here, existing and forecast transit supply follows, and then recommendations are made to address identified gaps between demand for and supply of transit service.

Williamson Village Transit Demand

- Base Demand: Average of 2.6 percent per year base growth (Range: 1.7 to 3.5 percent per year).
- Aggressive Demand: 5.0 percent per year.

East Campus Transit Demand

- Base Demand: Average of 2.5 percent per year base growth (Range: 1.3 percent to 3.6 percent per year).
- Aggressive Demand: 6.0 percent per year.

Main Campus Transit Demand

- Base Demand: Average of 1.7 percent per year base growth (Range: 1.1 percent to 2.4 percent per year).
- Aggressive Demand: 4.8 percent per year.

ii. Supply of Transit Service

CU-Boulder is served by 28 different routes, with different combinations of those routes serving one of the three campus locations: Main, East, or Williams Village. The bus routes are provided by RTD, Special Transit, and CU-Boulder, and are funded by many sources.

Main Campus

The CU-Boulder Main Campus is directly served by 16 RTD routes, the HOP, and the Buff Bus. Of the 16 RTD routes, eight are local routes and eight are regional/ SkyRide. Of the eight RTD routes serving Main Campus, five serve the west edge of the Main Campus and are oriented south along the Broadway corridor (203, 204, 225, Dash, and 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 RTD 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-Boulder 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-Boulder campus. Those seven routes are: 203, 204, 225, 226, 238, 291, and 352. These routes provide important connections to the Boulder County locations of Gunbarrel, East Boulder, Valmont/50th/ East Arapahoe, Lafayette and Louisville, Longmont, Nederland, and Lyons, respectively.

Of the eight regional/skyRide routes serving Main Campus, five are oriented north-south along the Broadway corridor (All, B/SX, 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).

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 four edges 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-only service, 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 that come within several blocks of East Campus. These routes pass through the Arapahoe/28th (Regional Route 106) and Canyon/28th Street intersection (205, 206, B3).

Williams Village

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 Bus to Boulder 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.

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

e. Existing Vehicular Travel and Facilities

The CU-Boulder campuses are located within the City
of Boulder and served by the city's street network which is
displayed in V-E-3. 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 surround-
ning properties.

I. 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, and
SH 157 was compared to 2009 traffic data. The results
are shown in Figure 7. Data for a total of 14 locations
were 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 De-
mand 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
in the last couple of years, a volume comparison was
overall reduction in traffic volumes that has occurred
and City of Boulder have implemented, or due to the
Management (TDM) practices that the university
To determine if this reduction is due to the Travel De-
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 surround-
ning properties.

II. 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 intersec-
tions in 2000. Levels of Service for the intersections
surrounding CU-Boulder are illustrated in Exhibits V-E-5
and V-E-6 for the morning and evening peak hours,
respectively. In general, operations are better during the
morning peak hour, with all nearby intersections operat-
ing 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 intersec-
tions in recent years. Improvements are planned at
Broadway/Baseline, Baseline/30th, and Baseline/Foot-
hills Parkway.
f. Existing Parking Management, Supply, and Demand

(1) EXISTING PARKING SYSTEMS OPERATION

Parking & Transportation Services (PTS) is an auxiliary (i.e., self-sustaining) 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 & 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 percent of the Main Campus, East Campus, and Williams Village Campus parking supply. The remaining 35 percent of this supply is controlled by Housing and Family Housing (19 percent), the Research Property System on East Campus (13 percent), the Athletics Department (2 percent), and a variety of other departments (2 percent). 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.

(1) EXISTING PARKING SUPPLY

PTS-managed parking facilities are located throughout the Main, East, and Williams Village Campuses as shown in Exhibits V-E-7, V-E-8 and V-E-9. 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 located around the stadium. This distributed 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 percent 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 percent 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.

There are a total of 10,355 parking spaces on Main Campus, East Campus, and Williams Village. In addition, there are 1,292 spaces at the Research Park for a combined total of 11,647 spaces. Of the Research Park spaces, 1,027 are leased and used by Sybase and the Advanced Technologies Center. The remaining 265 are used 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 departments other than PTS manage at least 4,042 spaces, comprising about 35 percent 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.

(2) EXISTING PARKING DEMAND

Previous parking studies conducted for CU-Boulder estimated parking demand by multiplying the percent age of each user group expected to be traveling to campus each day by the percentage of drive alone (SOV) users and carpool drivers. 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 5. The faculty/staff driving ratio is the drive alone plus motorcycle percentage (47.5 percent) plus the carpool percentage (7.67 percent) 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.

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 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

---

Table 5

<table>
<thead>
<tr>
<th>Population</th>
<th>Driving Ratio (^1)</th>
<th>Parking On-Campus (^2)</th>
<th>Presence Factor</th>
<th>Parking Demand Ratio</th>
<th>Campus Total Space</th>
<th>Campus Parking Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty/Staff</td>
<td>0.72</td>
<td>0.97</td>
<td>0.128</td>
<td>2.086</td>
<td>8.015</td>
<td></td>
</tr>
<tr>
<td>Commuter Students</td>
<td>0.71</td>
<td>0.65</td>
<td>0.114</td>
<td>2.552</td>
<td>1.638</td>
<td></td>
</tr>
<tr>
<td>Resident Students Driving to Campus</td>
<td>0.79</td>
<td>0.65</td>
<td>0.052</td>
<td>365</td>
<td>20</td>
<td></td>
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<tr>
<td>Family Housing Students Driving to Campus</td>
<td>0.76</td>
<td>0.65</td>
<td>0.052</td>
<td>35</td>
<td>2</td>
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</tr>
<tr>
<td>Subtotal</td>
<td>37.336</td>
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<td>5.558</td>
<td>2.197</td>
<td></td>
</tr>
<tr>
<td>Resident Students</td>
<td>0.70</td>
<td>0.97</td>
<td>0.238</td>
<td>1.888</td>
<td>10</td>
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<tr>
<td>Family Housing Students</td>
<td>0.25</td>
<td>0.97</td>
<td>0.238</td>
<td>158</td>
<td>9</td>
<td></td>
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<tr>
<td>Faculty/Staff in Family Housing</td>
<td>1.5</td>
<td>225</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td></td>
<td>2.092</td>
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<td>Retreats Parking on Campus</td>
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<td></td>
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<tr>
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<tr>
<td>Visitors &amp; Contractors</td>
<td>29</td>
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<tr>
<td>Daily Lot Parking Passes</td>
<td>96</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>University Vehicles</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitors &amp; Contractors</td>
<td>376</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitors</td>
<td>1,526</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty/Staff in Family Housing</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty/Staff</td>
<td>5.558</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Driving ratio is a weighted combination of drive-alone (SOV) users and car/van pool users (HOV)
2. Obtained from 2010 Spring/Fall Commuter Survey

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2. Acquired by CU-Boulder in 2011, the parking is now a part of the Research Properties.
for shorter periods than faculty/staff.

In addition, PTS provided estimates of daily parking by retirees, vendors and contractors, university vehicles, and visitors. Table 5 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 are shown in Table 6. 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 percent.

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 7: Student Enrollment Projections

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>4,854</td>
<td>5,013</td>
<td>5,175</td>
<td>5,338</td>
<td>5,503</td>
<td>5,671</td>
<td>5,840</td>
<td>5,947</td>
<td>6,056</td>
<td>6,168</td>
<td>6,281</td>
<td>7,550</td>
</tr>
<tr>
<td>Total</td>
<td>31,040</td>
<td>31,359</td>
<td>31,680</td>
<td>32,198</td>
<td>32,797</td>
<td>32,987</td>
<td>33,198</td>
<td>33,410</td>
<td>33,638</td>
<td>33,870</td>
<td>34,113</td>
<td>42,972</td>
</tr>
</tbody>
</table>

### Table 6: Effective Parking Supply

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Effective Factor</th>
<th>Reserved</th>
<th>Faculty Housing</th>
<th>ADA</th>
<th>Disabled</th>
<th>Motorcycle</th>
<th>Short Term (1)</th>
<th>Resident Hall (2)</th>
<th>Family Housing (2)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>60%</td>
<td>60%</td>
<td>95%</td>
<td>90%</td>
<td>90%</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>Commuters</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>60%</td>
<td>60%</td>
<td>95%</td>
<td>90%</td>
<td>90%</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>Effective Spaces</td>
<td>3,020</td>
<td>2,298</td>
<td>334</td>
<td>634</td>
<td>134</td>
<td>98</td>
<td>467</td>
<td>233</td>
<td>776</td>
<td>517</td>
</tr>
</tbody>
</table>

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

5. Assessment of Data and Demand Projections

This section 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.

a. Campus Population Projections

The office of Planning, Budgeting, and Analysis (PBA) provided projections of student enrollment through 2030 as shown in Table 7. PBA also provided projections of faculty/staff through 2030 as shown in Table 8. Using PBA’s mid estimate and carrying the same growth rate of approximately 0.86 percent per year through 2030 yields the affiliate population projections shown in Figure 14.
b. Existing 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 Survey and Table 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 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 9. As shown, existing VMT associated with the university’s commuting trips is approximately 252,760 miles per weekday.

Table 8
Projections of Faculty/Staff

<table>
<thead>
<tr>
<th>Year</th>
<th>Instructional</th>
<th>Research/Non-Instructional</th>
<th>Classified/Unclassified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2,207</td>
<td>1,787</td>
<td>3,280</td>
<td>7,260</td>
</tr>
<tr>
<td>2012</td>
<td>2,279</td>
<td>1,877</td>
<td>3,414</td>
<td>7,326</td>
</tr>
<tr>
<td>2013</td>
<td>2,315</td>
<td>1,947</td>
<td>3,715</td>
<td>7,392</td>
</tr>
<tr>
<td>2014</td>
<td>2,351</td>
<td>2,016</td>
<td>3,931</td>
<td>7,524</td>
</tr>
<tr>
<td>2015</td>
<td>2,387</td>
<td>2,083</td>
<td>4,061</td>
<td>7,590</td>
</tr>
<tr>
<td>2016</td>
<td>2,413</td>
<td>2,148</td>
<td>4,094</td>
<td>7,656</td>
</tr>
<tr>
<td>2017</td>
<td>2,439</td>
<td>2,214</td>
<td>4,128</td>
<td>7,722</td>
</tr>
<tr>
<td>2018</td>
<td>2,465</td>
<td>2,280</td>
<td>4,161</td>
<td>7,788</td>
</tr>
<tr>
<td>2019</td>
<td>2,491</td>
<td>2,346</td>
<td>4,194</td>
<td>7,854</td>
</tr>
<tr>
<td>2020</td>
<td>2,517</td>
<td>2,412</td>
<td>4,227</td>
<td>7,907</td>
</tr>
</tbody>
</table>

* Actual employment

Figure 14

Table 9
2010 Vehicle-Miles Traveled Calculations

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Mode Share</th>
<th>Average Trip Length</th>
<th>Miles Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commuting Students</td>
<td>Bike</td>
<td>14.9%</td>
<td>11.0</td>
<td>190</td>
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<td></td>
<td>Transit</td>
<td>30.1%</td>
<td>14.3</td>
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<tr>
<td></td>
<td>Drive Alone</td>
<td>22.2%</td>
<td>11.0</td>
<td>25,482</td>
</tr>
<tr>
<td></td>
<td>Car/Van Pool</td>
<td>3.4%</td>
<td>11.0</td>
<td>276</td>
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<tr>
<td></td>
<td>MC/Scooter</td>
<td>0.7%</td>
<td>11.0</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>20.4%</td>
<td>11.0</td>
<td>23,974</td>
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<tr>
<td></td>
<td>Other</td>
<td>8.3%</td>
<td>11.0</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Mode Share</th>
<th>Average Trip Length</th>
<th>Miles Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident Students</td>
<td>Bike</td>
<td>12.8%</td>
<td>6.8</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Transit</td>
<td>23.0%</td>
<td>6.8</td>
<td>326</td>
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<tr>
<td></td>
<td>Drive Alone</td>
<td>6.8%</td>
<td>6.8</td>
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<tr>
<td></td>
<td>Car/Van Pool</td>
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<td>6.8</td>
<td>390</td>
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<tr>
<td></td>
<td>MC/Scooter</td>
<td>0.8%</td>
<td>6.8</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>43.3%</td>
<td>6.8</td>
<td>13,330</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>8.3%</td>
<td>6.8</td>
<td>6,637</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Mode Share</th>
<th>Average Trip Length</th>
<th>Miles Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty/Staff</td>
<td>Bike</td>
<td>8.4%</td>
<td>11.0</td>
<td>1,575</td>
</tr>
<tr>
<td></td>
<td>Transit</td>
<td>21.7%</td>
<td>11.0</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>Drive Alone</td>
<td>47.3%</td>
<td>11.0</td>
<td>75,482</td>
</tr>
<tr>
<td></td>
<td>Car/Van Pool</td>
<td>7.7%</td>
<td>11.0</td>
<td>22,127</td>
</tr>
<tr>
<td></td>
<td>MC/Scooter</td>
<td>0.3%</td>
<td>11.0</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>5.9%</td>
<td>11.0</td>
<td>4,282</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>8.8%</td>
<td>11.0</td>
<td>6,411</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Mode Share</th>
<th>Average Trip Length</th>
<th>Miles Traveled</th>
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<tbody>
<tr>
<td>Total Campus Population</td>
<td>Bike</td>
<td>8.4%</td>
<td>11.0</td>
<td>1,575</td>
</tr>
<tr>
<td></td>
<td>Transit</td>
<td>21.7%</td>
<td>11.0</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>Drive Alone</td>
<td>47.3%</td>
<td>11.0</td>
<td>75,482</td>
</tr>
<tr>
<td></td>
<td>Car/Van Pool</td>
<td>7.7%</td>
<td>11.0</td>
<td>22,127</td>
</tr>
<tr>
<td></td>
<td>MC/Scooter</td>
<td>0.3%</td>
<td>11.0</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>5.9%</td>
<td>11.0</td>
<td>4,282</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>8.8%</td>
<td>11.0</td>
<td>6,411</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Mode Share</th>
<th>Average Trip Length</th>
<th>Miles Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Bike</td>
<td>8.4%</td>
<td>11.0</td>
<td>1,575</td>
</tr>
<tr>
<td></td>
<td>Transit</td>
<td>21.7%</td>
<td>11.0</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>Drive Alone</td>
<td>47.3%</td>
<td>11.0</td>
<td>75,482</td>
</tr>
<tr>
<td></td>
<td>Car/Van Pool</td>
<td>7.7%</td>
<td>11.0</td>
<td>22,127</td>
</tr>
<tr>
<td></td>
<td>MC/Scooter</td>
<td>0.3%</td>
<td>11.0</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td>Walk</td>
<td>5.9%</td>
<td>11.0</td>
<td>4,282</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>8.8%</td>
<td>11.0</td>
<td>6,411</td>
</tr>
</tbody>
</table>

**Notes:**
(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 of 8.9 based on RTD data.
(4) Calculated based on average trip distance. Trip distance for commuting students is based on Spring 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 5 months of service, 5.04 days per month, and 5.6 days per week (expected per year based on the existing schedule and design assumptions).
c. 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 4-a (see Table 3), 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 5-b, VMT was estimated for 2020 and 2030 using the affiliate population estimates discussed for 2020 and 2030. The results are shown in Table 10 along with estimates for 2010. As shown, existing VMT associated with the university’s commuting trips is approximately 252,780 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.

Using the same methodology as Section 5-b, VMT was estimated for 2020 and 2030 using the affiliate population estimates discussed for 2020 and 2030. The results are shown in Table 10 along with estimates for 2010. As shown, existing VMT associated with the university’s commuting trips is approximately 252,780 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 10 also shows calculation of daily fuel consumption and metric tons of CO2 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 11.

The daily CO2 emissions for each alternative were calculated assuming 19.4 pounds of CO2 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.
6. Transportation Master Plan Goals

a. Mode Share Goals

Analysis of CU-Boulder mode share scenarios demonstrates that zero growth in campus-related travel (vehicle miles of travel) is possible even with a projected 18 percent growth in student enrollment and faculty/staff. If TDM programs and services are implemented, they can achieve the following target mode shares by 2030 as shown in Table 12:

<table>
<thead>
<tr>
<th>Mode of Travel</th>
<th>Goal for 2030</th>
<th>Existing 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students</td>
<td>Faculty/Staff</td>
</tr>
<tr>
<td>Biking/Walking</td>
<td>15.1%</td>
<td>8.4%</td>
</tr>
<tr>
<td>biking/Driving</td>
<td>27.3%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Transit</td>
<td>19.1%</td>
<td>44.7%</td>
</tr>
<tr>
<td>Work at Boulder</td>
<td>39.3%</td>
<td>38.5%</td>
</tr>
<tr>
<td>Work at Boulder EC</td>
<td>38.3%</td>
<td>39.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Mode Share Goal

- **Implement Zone permit structure with Core permits and peripheral permits.**
- **Continue Faculty/Staff EcoPasses.**
- **Add 30 carpool spaces on East Campus.**
- **Consider reduced carpool permit fees (50 percent).**
- **Expand bike share programs.**
- **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.**
- **Find options to increase funding to monitor programs.**
- **Conduct periodic commuter surveys.**
- **Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards).**
- **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.**
- **Consider a zone permit structure with core permits 40 percent more than peripheral permits.**

b. Transit Goals

- **Reduce Travel**
  - Add 1,550 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**
  - 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 and Williams Village, and at UMC
  - Add 4.5 miles of bike/pedestrian facilities around and through campus

- **Transit**
  - Regional Coverage
  - SkyRide
  - Late-night transit
  - CU Ski Bus
  - Supplement Stampede with additional overlay/shuttle route between EC and MC
  - 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: Move from 2 articulated and 4 standard buses to 10 articulated buses on the Buff Bus
  - East Campus: Add significant capacity. Move from 3 standard to 4 articulated buses
  - Main Campus: Implement first phase traffic/bike/ped design changes on 18th/Colorado corridor
  - Main Campus: Modest improvements in marketing downtown Boulder – Main Campus transit option

- **Carpooling**
  - Consider reduced carpool permit fees (50 percent)
  - Form 10 vanpools
  - Add 20 carshare vehicles as funding becomes available
  - Guaranteed Ride Home with EcoPass

- **Marketing and Incentives**
  - Find options to increase funding to monitor programs
  - Conduct periodic commuter surveys
  - Create an Incentives Program (bike discounts, bike/ped challenges & rewards, carpool incentives/rewards)
  - 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 a zone permit structure with core permits 40 percent 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

- **C. Pedestrian Improvements and Goals**

The suggested Campus Pedestrian Corridors are shown in V-E-10. 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.
I. 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 skateboards 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.

II. 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.

d. Bicycle Improvements and Goals

I. 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 guidelines 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 14.

Exhibit V-E-11 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 whenever 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>
<thead>
<tr>
<th>Project</th>
<th>Corridor</th>
<th>Facility Type</th>
<th>Limit 1</th>
<th>Limit 2</th>
<th>Length (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19th St. Path</td>
<td>Multi-Use Path</td>
<td>Boulder Creek</td>
<td>Rec Center Colorado Ave, Bike Lanes</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>18th St./Colorado</td>
<td>Cyletrack</td>
<td>Euclid Ave.</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>UMC/Bike Station</td>
<td>Bike Route</td>
<td>18th St.</td>
<td>Broadway</td>
<td>0.12</td>
</tr>
<tr>
<td>4</td>
<td>Baker Drive</td>
<td>Shared Lane Marking</td>
<td>SE Corner of Libby Hall</td>
<td>SW Corner of Baker Hall</td>
<td>0.2</td>
</tr>
<tr>
<td>5</td>
<td>Wardenburg Dr.</td>
<td>Shared Lane Marking/ Multi-Use Path</td>
<td>18th St.</td>
<td>North-South Bikeway</td>
<td>0.34</td>
</tr>
<tr>
<td>6</td>
<td>Leeds-Engineering</td>
<td>Multi-Use Path</td>
<td>North-South Bikeway</td>
<td>Regent Dr.</td>
<td>0.13</td>
</tr>
<tr>
<td>7</td>
<td>Williams Village</td>
<td>Bike Path</td>
<td>Bear Creek</td>
<td>Apartments</td>
<td>0.2</td>
</tr>
<tr>
<td>8</td>
<td>35th South</td>
<td>Cyletrack/Multi-Use Path</td>
<td>Baseline Road</td>
<td>Bear Creek</td>
<td>0.5</td>
</tr>
<tr>
<td>9</td>
<td>Discovery Dr.</td>
<td>Cyletrack</td>
<td>Colorado Ave.</td>
<td>Innovation Dr</td>
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<tr>
<td>10</td>
<td>Innovation Dr.</td>
<td>Bike Route</td>
<td>Colorado Ave.</td>
<td>Shadow Creek Dr.</td>
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<tr>
<td>11</td>
<td>33rd St.</td>
<td>Bike Lanes</td>
<td>Shadow Creek Dr.</td>
<td>Arapahoe Ave.</td>
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</tr>
<tr>
<td>12</td>
<td>Shadow Creek Dr.</td>
<td>Bike Lane</td>
<td>30th St.</td>
<td>Discovery Drive</td>
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</tr>
<tr>
<td>13</td>
<td>North-South Bikeway</td>
<td>Multi-Use Path</td>
<td>Colorado Ave.</td>
<td>Broadway Multi-Use Path</td>
<td>0.42</td>
</tr>
<tr>
<td>14</td>
<td>Libby Drive</td>
<td>Shared Lane Marking</td>
<td>Duane Physics/ Colorado Connector</td>
<td>Cockrell Dr.</td>
<td>0.12</td>
</tr>
<tr>
<td>15</td>
<td>Stadium Dr.</td>
<td>Shared Lane Marking/ Multi-Use Path</td>
<td>Folsom St.</td>
<td>17th St.</td>
<td>0.53</td>
</tr>
<tr>
<td>16</td>
<td>Lot 169 Path</td>
<td>Multi-Use Path</td>
<td>Lot 169</td>
<td>Stadium Dr.</td>
<td>Multi-Use Path</td>
</tr>
<tr>
<td>17</td>
<td>22nd St.</td>
<td>Shared Lane Marking</td>
<td>Arapahoe Ave</td>
<td>Alvord St, Bike Path</td>
<td>0.08</td>
</tr>
<tr>
<td>18</td>
<td>Athens St.</td>
<td>Shared Lane Marking</td>
<td>17th St.</td>
<td>Folsom</td>
<td>0.42</td>
</tr>
<tr>
<td>19</td>
<td>19th St.</td>
<td>Shared Lane Marking/ Multi-Use Path</td>
<td>Arapahoe Ave, Boulder Creek Path</td>
<td>0.18</td>
<td></td>
</tr>
</tbody>
</table>
II. OFF-CAMPUS BICYCLE CONNECTIONS

An important facet of the guideline network is 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-Boulder bikeway network, connections to the City of Boulder’s bikeway network were examined to ensure that the CU-Boulder bikeways were integrated with Boulder. Table 15 lists the proposed CU-Boulder bikeways and their connections to the Boulder bikeway network.

III. 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 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 Street/Colorado Avenue 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.

The recommended concept is called the “Hybrid” (following page), 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. 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.

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 traveling to the CU-Boulder 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

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

iv. Bicycle Parking

Goal

Bicycle parking will be improved through a tiered investment strategy which considers both existing facility standards and new facility standards.

Guidelines

- **Campus Core Bicycle Parking Standard** – Develop and adopt bicycle parking standards for the core campus area.
- **New Development Bicycle Parking Standard** – Develop and adopt a bicycle parking standard for new development on campus to ensure that adequate bicycle parking is provided.
- **Covered Bicycle Parking** - 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 1-2 percent of total bicycle parking as covered bicycle parking.
- **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**

Exhibit V-E-12 illustrates proposed locations for new bike stations, bike sharing stations, secure bike parking, and covered parking.

Secure Bicycle Parking

Goal

Provide more secure bicycle parking options as a means of providing a safer, bicycle parking option on campus.

Guidelines

CU-Boulder should begin providing more secure bicycle parking options, such as the following:

- **Bicycle Lockers**
e. Transit Improvements Goals & Guidelines

Goal
Provide public transit systems that are safe, well maintained and take users when and where they want to go.

I. MAIN CAMPUS TRANSIT SERVICE GUIDELINES

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-Boulder’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. FastTracks 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 Main Campus.
- The Orbit (see Exhibit V-E-13) 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 Main Campus should be 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 mean 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.
- 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-Boulder 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-Boulder and RTD should verify that services in this corridor continue to meet customer expectations as connecting services, like the Stampede, are modified.

II. EAST CAMPUS TRANSIT SERVICE

Guidelines
- 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.
- Plan for demand on the Stampede to grow between 1.3 percent and 3.6 percent per year as a base forecast. By 2020 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 Exhibit V-E-14).
- 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 (see Figure 20).

III. WILLIAMS VILLAGE TRANSIT SERVICE

Guidelines
- 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 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 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.

¹ Combination of PMHS safety (actual accidents) and PTS (operational observations from drives or by PTS staff) is recommended.
### Roadway Improvement Development Plan

With the Main Campus almost built out, street improvements will focus on improving bike, pedestrian, and transit access, as well as reducing modal conflicts. Exhibit V-E-16 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 safe vehicular access for heavily congested Arapahoe Avenue.

**MAIN CAMPUS**
3. Stadium Drive: realign if new parking structure or fieldhouse is built.
4. North Service Road: construct service road connecting 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: convert 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 33rd Street southeast across Bear Creek loop back to the Williams Village parking south of the Bear Creek apartments.
13. Baseline Road/30th 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.

### Service and Emergency Access

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

**i. 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 have been tried, but 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 to the need to retains 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 policies. 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.

**ii. 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 alleys, and wide sidewalks serving as fire lanes. Exhibit V-E-18 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 day 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 approval is granted with regard to width, height, and turning radius 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.

### Table 16: Street Connection Costs

<table>
<thead>
<tr>
<th>Key</th>
<th>Street/Project</th>
<th>From</th>
<th>To</th>
<th>Description of Services/Street</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28th St.</td>
<td>27th St.</td>
<td>Arapahoe Ave.</td>
<td>Connect 27th and 28th to Arap. Ave.</td>
<td>$337,000</td>
</tr>
<tr>
<td>2</td>
<td>32nd St.</td>
<td>33rd St.</td>
<td>Arapahoe Ave.</td>
<td>Construct two-lane low-speed street</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>3</td>
<td>23rd St.</td>
<td>22nd St.</td>
<td>Discovery Dr.</td>
<td>Connect a six-lane street</td>
<td>$95,000</td>
</tr>
<tr>
<td>4</td>
<td>35th St.</td>
<td>34th St.</td>
<td>Folsom St.</td>
<td>Construct two-lane low-speed street</td>
<td>$300,000</td>
</tr>
<tr>
<td>5</td>
<td>33rd St.</td>
<td>32nd St.</td>
<td>30th St.</td>
<td>Construct two-lane collector street</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>6</td>
<td>31st St.</td>
<td>Discovery Dr.</td>
<td>Colorado Ave.</td>
<td>Construct two-lane collector street</td>
<td>$495,000</td>
</tr>
<tr>
<td>7</td>
<td>Discovery Dr.</td>
<td>30th St.</td>
<td>31st St.</td>
<td>Construct two-lane collector street</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>8</td>
<td>Traffic Signal</td>
<td>Colorado Ave.</td>
<td>Blackhawk Dr.</td>
<td>Install Traffic Signal/Pipe Ditch/Add Turn Lane</td>
<td>$600,000</td>
</tr>
<tr>
<td>9</td>
<td>30th St.</td>
<td>Discovery Dr.</td>
<td>3rd St.</td>
<td>Install Traffic Signal</td>
<td>$300,000</td>
</tr>
<tr>
<td>10</td>
<td>3rd St.</td>
<td>2nd St.</td>
<td>4th St.</td>
<td>Install Traffic Signal</td>
<td>$300,000</td>
</tr>
<tr>
<td>11</td>
<td>Baseline Rd.</td>
<td>35th St.</td>
<td>Bear Creek</td>
<td>Construct two-lane low-speed street</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>12</td>
<td>Williams Village Micro-Master Plan</td>
<td></td>
<td></td>
<td></td>
<td>$2,000,000</td>
</tr>
</tbody>
</table>

Costs for these connectors are given in Table 16.
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.

h. Parking Management

I. PROJECTED PARKING DEMAND AND SUPPLY

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.

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.

To project parking demand, the mode share analysis in Chapter 3 was used along with the CU-Boulder parking model to estimate parking demand by commuters to the CU-Boulder 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 17.

Table 17
Parking Demand/Supply Projections

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective Supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing</td>
<td>9,576</td>
<td>9,576</td>
<td>9,576</td>
</tr>
<tr>
<td>With Research Park (650 spaces)</td>
<td>650</td>
<td>650</td>
<td></td>
</tr>
<tr>
<td><strong>Total Effective Supply</strong></td>
<td>9,576</td>
<td>10,226</td>
<td>10,226</td>
</tr>
<tr>
<td>Commuter Parking Demand (spaces)</td>
<td>9,125</td>
<td>10,203</td>
<td>10,400</td>
</tr>
<tr>
<td><strong>Parking Surplus (Deficit)</strong></td>
<td>451</td>
<td>23</td>
<td>(174)</td>
</tr>
<tr>
<td>Off-Campus Parking Demand</td>
<td>2,304</td>
<td>2,369</td>
<td>2,399</td>
</tr>
</tbody>
</table>
II. 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 sites along with other sites on Williams Village and East Campus are shown in Exhibit V-E-17.

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 1,000 spaces and would serve as the foundation for a new Field House building. Stadium Drive would be relocated north along Boulder Creek to connect to Folsom 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 designed to allow the addition of an academic building 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. In addition, Lot 204, located south of Euclid, could be built on with structured parking, but potential expansion of the University Club for Admissions may likely remove this from consideration.

Regent AutoPark could also be expanded into adjacent lots, but currently congestion on Regent Drive at the AutoPark and parking lot access 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 funded for Spring 2011 and will be used as a test pilot for the following year to see how traffic and vehicle/pedestrian conflicts are affected.

4 The Grandview agreement expired in July 2011 however both the university and City of Boulder continue to abide by the general terms until such time as a new agreement can be negotiated.
Lot 304-308 has potential for under-building or under-ground parking in connection with the planned perform-
ing arts building if needed and financially feasible.

With the redevelopment of family housing north of Boul-
der 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 pos-
sible 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 Chapter 4 of the Transportation
Master Plan, the Williams Village current parking supply
of 1,400 spaces should be adequate to accommodate
the projected undergraduate 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.

III. PARKING MANAGEMENT GOALS &
GUIDELINES

Parking management is one of the most effective traffic
reduction strategies and that underpriced, abundant and
convenient parking can be a major deterrent to alterna-
tive 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.

Goal
Parking needs to be priced appropriately and managed
to get the highest possible utilization.

Guidelines

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 Univer-
sity 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 percent.

3. Provide more short term and visitor parking in the
core area of Main Campus.

4. Using the new access control and parking manage-
ment 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 op-
tions 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 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 percent, the
effective increase is about $320,000 per year or 8
percent of PTS expenses of $4 million per year. Ef-
ectively, 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 percent
in addition to normal inflation.

7. Consider consolidation of all parking spaces under
PTS management, to administer all CU-Boulder park-
ing spaces more equitably In particular, the Research
Park should come under PTS control, so the current
underutilized parking can be used to meet CU-Boul-
der’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 park-
ing, alternative funding sources will be needed so the
high costs of replacement structured parking doesn’t
overwhelm PTS’s budget.
I. Transportation Program Financing

Funding for CU-Boulder transportation facilities, programs, and activities comes from many sources, controlled by agencies and departments with their own specific missions and objectives. Fortunately, from a transportation perspective, these missions are often aligned in encouraging the use of efficient transportation modes to 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-Boulder 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.

TDM Program expansions include:

- Covered/Secured Bike Parking
- Bike station/bikeshare programs
- Pedestrian Improvements (4.5 miles)
- Stampede Route Changes & Overlay Service
- Buy up additional off-peak frequency or make service more flexible in other routes
- Fund 25 percent of new Orbit route (28th/Folsom)
- Carpools/spacing/discount rates
- Expanded bike sharing
- Vanpools
- Fleet vehicle pick-up station on Main Campus
- Marketing & Incentives
- North of Boulder Creek Connections
- Stadium Drive
- North Service Road
- East Campus Boulder Creek Bridge
- East Campus Road Connections
- East Campus Traffic Signals
- Williams Village Connections

a. 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 its 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.

I. 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 exceptions 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 increases balance costs 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 as limiting student access to those 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 burdensome low-wage 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 issues above. Parking fees would be considered part of a student’s cost of education. Faculty and staff have consistently expressed concern over parking fees 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 categories. 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 and TDM 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.

II. 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 (GAR) fees
- 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 reprogrammed 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 GAR (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 expenditure of auxiliaries from self-funded activities. It is used to fund the maintenance and construction of grounds, sidewalks, etc. in support of the auxiliaries and self-funded activities. An increase in GIR would be one logical source of funds for transportation improvements, particularly those that support auxiliaries.

ICR is similar to GAR and is charged to federal research grants awarded to the university. While the amount received from ICR is tremendous (approaching nearly 50 percent 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 in funding 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 may 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 GAR/GIR 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 the way in which they are funded. 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.

III. 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.
F. Utilities Infrastructure Plan

The University of Colorado Boulder is served by a variety of utilities that are essential to campus operations. This infrastructure plan identifies the various utility systems, their current status, and the issues that should be addressed. The campus is currently embarked on a utility system upgrade that will replace much of the utility generation and distribution systems on the Main Campus. Much of the material contained in this section summarizes more than 10 years of analysis regarding the power utilities of the campus and outlines the plan to improve campus service. During calendar year 2012, following the scheduled adoption of this Campus Master Plan, the East Campus will be studied to better serve the building needs identified by this plan.

References to “city” in this section mean the city of Boulder, particularly its Public Works Department. Campus properties outside of the city of Boulder are also discussed in this section. Utilities at the Mountain Research Station are addressed separately in the Moun-

1. Utility Systems Overview

a. Fuel

Central campus heating, power, cooling, and compressed air are produced by a cogeneration facility fueled by natural gas, with fuel oil backup. Williams Village also uses natural gas with fuel oil backup. Natural gas is the primary fuel source for heating buildings on the East Campus and CU-Boulder South.

b. Heating

Most Main Campus and Williams Village buildings are heated through district steam heating systems radiating from central plants on the two campus properties. Buildings on the north periphery of the Main Campus, and buildings on the East Campus, have individual building heating systems.

c. Power (Electricity)

Most electricity used by the CU-Boulder campus can be produced at the campus Power House, which also produces steam for heating. Xcel Energy, Inc. currently provides the majority of electricity for the CU-Boulder campus. Utility power is not available to Grandview, Williams Village, leased buildings on the East Campus, and CU-Boulder South, all of which are supplied by Xcel. A major reconstruction of the Power House is planned for 2012-14 that will change the way in which power is generated and purchased (see section below).

d. Natural Gas

A high-pressure natural gas line provides service to the Power House for turbine operation, intermediate pressure gas lines serve other campus buildings. With few exceptions, Xcel owns and maintains the natural gas distribution systems on campus.

e. Cooling

Fourteen buildings comprising approximately 40 percent of the Main Campus building space are cooled by chilled water from the Power House. Other buildings are cooled with individual systems such as building chillers, evaporative cooling systems, or unit air conditioners. A number of buildings, including most residence halls, have no space cooling systems, although the Kittredge Complex is ready for chilled water when it is available from the new cooling plant and all residence halls will be added during the planning period.

f. Compressed Air

The Main Campus is served by a central compressed air system. This system is used for both building temperature control systems and laboratory use. However, some buildings utilize this system only as a backup supply and new laboratory usage is currently not permitted due to limited capacity. The demand for compressed air has decreased and will continue to decrease over the planning horizon for the control systems for the campus are converted to digital systems.

g. Water Supply

Domestic (potable) water is distributed from two city of Boulder water treatment plants to the campus edge. On-campus water distribution is primarily through university-owned and maintained water lines with some city lines. On the East Campus, city water is provided directly to each building.

h. Irrigation

Nearly all grounds are irrigated by sprinkler systems using raw water from irrigation ditches. Areas being converted to raw water use are Grandview, west of Bear Canyon Creek; the new Grandview North campus; and portions north of Boulder Creek on the Main Campus.

i. Sanitary Sewers

On campus, sewage is collected primarily by university sanitary sewer lines and by some city lines. All sewage is conveyed through city sewer lines from the campus edge to the city treatment plants at 75th Street.

j. Storm Sewers

Storm water is collected by a system of on-campus facilities, including retention ponds and university storm sewer lines. Most storm-water runoff is routed to Boulder Creek or other drainage ways.

k. Metering

All campus buildings are metered for electricity use. Most buildings on the Main Campus, East Campus, and Williams Village are metered for domestic water, chilled water and steam usage. Buildings served with natural gas are also metered.

l. Communications and Networking

The campus has its own telephone system and data communications network, connected to worldwide networks. The campus currently has fiber-optic cabling in selected buildings. A few peripheral buildings, including some in the Grandview area and some housing, have direct phone service provided by Qwest Communications. Communications and networking are covered in the following section (Section V-G).

2. Infrastructure Principles

Because 2008 and 2011, the university began planning and designing a new heating and cooling system for the Main Campus. The current concept is one that balances convenience and cost with efficient utilization of energy. The plan is to renovate the existing Power House, to be renamed the West District Energy Plant (WDEP), and construct a second plant near the Coors Events Center, to be named the East District Energy Plant (EDEP). This plan best balances the conservation, carbon, and cost goals with the investment in the existing infrastructure. Analyses confirm that centralizing steam and chilled water production in two interconnected district plants provides more diversity, redundancy, and lower life cycle costs than using distributed heating and cooling, which involves production of utilities in many smaller plants scattered throughout the campus.

Likewise, there has been a substantial investment at Williams Village in the existing system. Sustainability enhancements will be made during the planning period on an incremental basis as new buildings are brought on-line.

Developing areas north of Boulder Creek and on the East Campus offer opportunities to plan new types of central utility systems. The university will investigate lower exergy® systems in conjunction with traditional carbon-based systems. These types of systems could achieve energy conservation and allow the campus to transfer heat between buildings as well as integrate renewable sources such as thermal solar and geothermal energy into the supply, furthering the goal of near net zero energy use in buildings.

The following principles should be used as utility systems are upgraded and expanded:

a. Safety

Of primary concern is safety of the students, faculty, and staff. Utility systems must ensure the safety of the entire campus community.

b. Reliability

Utility systems must be reliable. For many systems, this suggests backup and redundant systems allowing for downtime for equipment failures, maintenance and repair, and peak-load accommodation.

c. Environmental Protection

Environmental impacts associated with the acquisition, production, and distribution of campus utilities should be minimized. Renewable sources should be examined and integrated wherever possible.

d. Minimization

Utilities operating costs should be minimized, with life-cycle costing that includes capital improvements. System demands should be controlled and, peak-load avoided, through energy management tools. New buildings and major renovations should be properly commissioned. Integral to this is the accurate metering of utilities for each building.

e. Sustainability

All new and renovated facilities shall strive to be near net-zero carbon facilities, defined as: “A net-zero energy facility collects as much energy from renewable sources as the facility uses on an annual basis while maintaining an acceptable level of service and functionality.” Buildings can exchange energy with the power grid as long as the net energy balance is zero on an annual basis. Integral to this is the accurate metering of utilities for each building.

f. Reliability on Utilities Providers

The university will need to rely on the city for the provision of most potable water service and sewer treatment and conveyance. Natural gas will be provided either by Xcel or third-party suppliers. Most campus buildings will continue to receive electricity from Xcel.

g. Longer Demand Periods

Summer occupancy of campus is increasing, creating higher peak demands, and increased cooling demand. Nighttime and weekend use is also increasing.

h. Information Technology

System demands should be controlled where possible through the use of building automation and information technology. The university plans to invest in information technology and Data Acquisition (SCADA) system. Optimization of communications, networking, computer, and building control technologies are increasingly integral to higher education endeavors. The development of a central Operations Control Center (OCC), along with a CU-Boulder campus smart grid, are key components to real-time building optimization and energy management. Utility and building systems planning must account for these emerging technologies. (See also Section V.G.)

i. Utility Development Costs

These costs should be recovered through assessments to the various users based on their proportional demands upon the system as allowed by state law.

3. Fuel Use

a. Power House

The central plant on the Main Campus, the “Power House,” provides electricity, steam, chilled water, and compressed air. Electricity and steam are both produced (cogenerated) through the combustion of natural gas in two industrial gas turbines. Production of electricity
b. Natural Gas

Natural gas is the primary fuel for the Power House. Gas commodity purchases are managed through a combination of fixed price contracts and spot market purchases to provide CU-Boulder fuel delivery and pricing stability. In fiscal year 2009–10, the Main Campus Power House used approximately 1.9 billion cubic feet of natural gas. Natural gas is the fuel of choice for several reasons, including its relatively clean burning characteristics, lack of storage requirements, and cost.

The natural gas is transported to the campus through a high pressure pipeline owned by Xcel Energy, Inc. (Xcel). A transportation fee is paid monthly to Xcel for this service.

The Williams Village complex is served by a central steam and chilled water plant. Gas commodity purchases are managed under the same contracts as the Power House on the Main Campus north of University Avenue, and some of the larger projects are managed under the same contracts as the Power House on the Main Campus.

The campus also has 22 diesel emergency generators for 96 hours before oil deliveries would need to occur to allow year-round operation of the cogeneration system to further optimize the process and reduce carbon.

Additionally, the electricity produced will offset the power and demand requirements of the projected new steam turbine-electric generating plant. This power will be produced by Xcel Electric and will be sold to meet the electricity needs of the campus.

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installed in a new utility tunnel. The other, a direct-buried line serving the Stadium, Grounds Building, and Dal Ward Athletic Facility, yet to be replaced. This should be considered when the new Fieldhouse is constructed north of Franklin Field.

Steam velocities in the pipes are increasing as more loads are added, placing increasing demands on the maintenance staff. The radial pattern of the steam distribution piping also adds complexity to maintenance activities, as taking any one piping system out of service affects all buildings downstream from the shutoff point. While improvements have been made, additional work is needed to ensure that pressure drops are minimized, particularly if the full build-out potential of the system is to be realized.

For the past 40 years there has been a recognized need to rehabilitate the utility tunnels on the Main Campus. Two sources of rehabilitation funds are used on campus—controlled maintenance funds from the state of Colorado and renewal and replacement funds generated as a part of the utility rates. Controlled maintenance has been the preferred method of rehabilitation over the years, but has dropped off dramatically as the state has had to curtail spending to meet its budget. This means that going forward more of the cost of maintenance will have to be borne on the users through utility rates.

While providing access for maintenance workers and, thus, extending the life of equipment for many years, new utility tunnels are relatively capital-intensive at $2,000 a foot. Only short sections have been constructed on campus in recent years. In order to provide service to new buildings, the construction of less expensive short tunnels or the burying of steam lines directly in the ground are being considered as options to full-size service tunnels. The cost to extend steam utility service in a main in the tunnel of a new building is borne by the project. The extension of steam mains is also under consideration with that of increasing production capacity.

c. Heating Systems within Buildings

Older buildings such as Old Main and the Administration Building have been retrofitted with steam in cast-iron radiant systems. However, the majority of buildings utilize heat exchangers to heat water to steam to vaporize water for the heating system and then condense the steam back to water to be reused by the heating system. Generally, buildings not supplied with district steam, which is then used to condition the building with steam in cast-iron radiators. However, the majority of buildings on campus are heated with hot water, with the exception of the Jennie Smoly Caruthers Biotechnology Building that was constructed as part of the Jennie Smoly Caruthers Biotechnology Building Project. The Power House produces chilled water to air-condition approximately 1.4 million square feet of Main Campus buildings. These buildings are generally located near the core of campus. There are three existing steam absorption chillers in Norlin Library that can provide the campus demand for chilled water. The campus demand for chilled water is estimated to be approximately 400 tons. Eight hundred tons of the 1,400 tons capacity is from an absorption chiller that is only dispatched when an electric chiller is unavailable.

The East Campus is presently served by individual plants in each building. This is expected to change in the case of the former Research Park, which is being redeveloped as the Jennie Smoly Caruthers Biotechnology Building. The Power House is the sole source for CU-Boulder South at this time.

6. Cooling

a. Chilled Water Production

The Power House converts excess steam water to air-condition at approximately 1.4 million square feet of Main Campus buildings. These buildings are generally located near the core of campus. There are three existing steam absorption chillers in Norlin Library. The plant layout can also accommodate 6,500 tons. The plant is designed to meet the various buildings but some additional work may be required to ensure redundancy is provided.

b. Electrical Distribution

The university owns and maintains the electrical distribution system running through most of campus, although the university owns some electric lines. The system is distributed at 13.2 kilovolts (kv) and looped to allow power to be back fed to any particular building in the event of failure in any one distribution cable. The capacity of the distribution system should serve planned campus expansion for the next 10 to 20 years.

On the Main Campus, the electrical distribution system is constantly being improved. Replacing aging transformers and switches is an ongoing process. Upgrading of cables in tunnels may occur in parallel with tunnel work associated with the steam and chilled water distribution system.

Two basic loops are routed around parts of campus to provide service. These loops are largely reaching their load capacity and改造 was run to the Center for Community.

On the East Campus, a new electrical station is being constructed to supply the Jennie Smoly Caruthers Biotechnology Building that will facilitate electrical service to the entire campus. The replacement gear will be located near Greenhouse No. 3 and a new duct bank will run to the Caruthers building. From here, it will be able to loop to other buildings as the campus develops.

The Williams Village campus is served by a radial 13.2KV feeder from Xcel. With development, looped systems have been constructed from the entrance to the various buildings but some additional work may be required to ensure redundancy is provided.

Xcel is the sole source for BU Boulder South at this time.

b. Other Cooling Production and Conservation Efforts

Most university buildings have internally determined cooling loads, that is, heat produced from the equipment, lighting, people, and other heat generating appliances are a greater factor in design than the heating loads from the external climate. Building design has not been influenced by the fact that the annual cycle of heating load is far greater than the annual cycle of cooling load. As a result, cooling systems are sized to accommodate the maximum cooling load, which in many cases is far greater than the actual cooling load. This results in a strategy of overdesigning the building to accommodate the largest possible cooling load. This strategy is not economically sound and results in the waste of energy. The Power House and the DEEP will be interconnected in such a way that only one of them will be used at any one time.
responsible to this dynamic throughout the history of the campus. Early buildings like Hellmans had narrow floor plates, high ceilings, and transom windows that facilitated ventilation through the building. The Engineering Center was constructed with few externally facing windows and those that were provided were surrounded by a hood to increase the shading coefficient and keep the heat associated with natural light out. New building technologies and windows for the space minimize heat gain through the use of high-performance glass. In this way, additional external heat gain can be minimized.

Evaporative cooling is increasingly used to provide the initial cooling for campus buildings. The first stage is direct evaporative cooling where water is added to the air stream to cool the interior environment. This is achieved by cold water from a 750-ton water-side economizer heat exchanger to conserve water while providing cooling. The second stage is indirect evaporative cooling where water is run through a cooling tower, then through a heat exchanger in an air handling unit to cool the interior environment. The third stage of cooling would be to cool using chilled water. In some buildings like laboratories, the tight temperature controls and humidity requirements require chilled water, while in others direct/indirect evaporative cooling can provide most if not all of the cooling for a building. This is the case in the Center for Community where building is exclusively cooled with direct/indirect evaporative cooling. This is likely to be the way of the future for all new campus development.

Beyond normal building cooling, there is a line dedicated to providing cooling for process loads from equipment. Many experiments use heat producing equipment that rejects heat to water systems. In many scientific buildings, process chilled water loops have been installed to conserve water while providing cooling. Processed chilled water loads exist year-round and are served by the existing system. In some buildings like scientific buildings, process chilled water loops have been installed to conserve water while providing cooling. Processed chilled water loads exist year-round and are served by the existing system. Processed chilled water loops have been installed to conserve water while providing cooling. Processed chilled water loads exist year-round and are served by the existing system.

The system serving the Smiley Court area is likely dete-riorated over time requiring that equipment and plan for future development. The automated sprinkler system that uses untreated (raw) Boulder Creek water has proven to be a cost-effective system to irrigate the campus. This system was the topic of a 1983 Campus Irrigation Master Plan. The purchase of over 100 million gallons annually of more costly, treated city water is currently avoided by using this system. This system utilizes a portion of the university’s decreed water rights. Water is diverted from Boulder Creek and rediverted into the campus where it is stored in retention ponds. From there, it is pumped through distribution piping to its point of use. Compressed air is also used in many laboratories, although the demand for pursed chilled water means that many of these systems are standalone. Compressed air usage was on the rise for many years; however, with the affordability of direct digital control (DDC) systems, the need for compressed air has flattened. It will likely reduce some in the planning period although it will not go away since many systems have DDC controllers with pneumatic actuators and devices.

Buildings at Williams Village and the East Campus have individual air compressors. The automated sprinkler system that uses untreated (raw) Boulder Creek water has proven to be a cost-effective system to irrigate the campus. This system was the topic of a 1983 Campus Irrigation Master Plan. The purchase of over 100 million gallons annually of more costly, treated city water is currently avoided by using this system. This system utilizes a portion of the university’s decreed water rights. Water is diverted from Boulder Creek and rediverted into the campus where it is stored in retention ponds. From there, it is pumped through distribution piping to its point of use. Compressed air is also used in many laboratories, although the demand for pursed chilled water means that many of these systems are standalone. Compressed air usage was on the rise for many years; however, with the affordability of direct digital control (DDC) systems, the need for compressed air has flattened. It will likely reduce some in the planning period although it will not go away since many systems have DDC controllers with pneumatic actuators and devices.

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11. Storm Sewers

The University of Colorado owns approximately 17.1 miles of storm drainage sewers and open channels on the Boulder campus. These systems have largely been installed as development continues to grow on the campus. Storm water systems are generally designed to accommodate five-year storm events in campus streets and parking lots. From the 2003 Campus Master Plan, many of the suggested storm drainage improvements have been completed, including but not limited to: Mary Rippon Outdoor Theater, the UMC, and the Visual Arts Complex.

The storm sewer system is largely in good shape in terms of capacity and life expectancy. However, the focus for the next 10 years should be on sustainability and storm water quality, concentrating on upgrades that affect large areas of campus. For sustainability, new projects should focus on ensuring storm water runoff by means of porous pavements, infiltration trenches, bio-swales, and soil augmentation.

For new projects with existing imperviousness less than or equal to 50 percent, the university should insure that post-development storm water discharge rate and quantity don’t exceed pre-development discharge rate and quantity for the one- and two-year 24-hour design storms. For new projects with existing imperviousness over 50 percent, the university should seek to reduce the average runoff 25 percent or more. Existing pre-storm water conditions should be utilized in order to help reduce construction related contamination.

Projects for the next 10 years should include: Campus Storm Basin Outfall Improvements, Business Building Storm Sewer Upgrade, and 18th and Colorado Site Drainage Improvements.

G. Information Technology (IT)

1. Background

Information Technology (IT) at CU-Boulder is facilitated through a centralized organization and numerous decentralized services and offices throughout campus. Information Technology Services (ITS) operates many of the centralized IT services and environmental computing resources, including the development of sustainable computing resources, including the development of sustainable computing models that require large amounts of power for high-performance computing, dissipate large amounts of heat into the air, are prone to higher than expected ongoing service and maintenance costs, and consume valuable square footage. Consolidating those resources into an energy-efficient data center for a "green" style or "micro" cluster model (where faculty obtain shares of a centrally maintained computing resource) will increase both energy efficiency and resource utilization. The campus already maintains a centralized data center, located in the Computing Center. Originally built in 1973 on the East Campus and located in the floodplain, the Computing Center is a 150 kW secure facility with back-up power and redundant chillers.

Advanced research computing has become essential to the success of faculty research, and has a direct effect on faculty recruitment and retention. Funding agencies now recognize the importance of computing in successful research and tend to assess this component more rigorously when evaluating grant proposals. For instance, the NSF now requires that all proposals include a data management plan, a move that other funding agencies are likely to follow. Participation in national cyberinfrastructure initiatives such as TeraGrid and can also greatly enhance the prospects for outstanding research, which increasingly requires collaboration on a national and international level.

The network to maintain, access, and integrate these resources is called "cyber-infrastructure", which according to EDUCAUSE, consists of "computational resources, data and information management, advanced systems, data and information management, advanced systems, space requirements, nor the technical knowledge necessary just to get started. Some research areas cannot overcome these barriers, nor provide the specialized support skills, and thus may lag behind.

A committee of research faculty, the Boulder Campus Cyberinfrastructure Board, has been created by the VCR to oversee the development of computing resources, including the development of sustainable computing models to support centralized research computing. It will also give priority to Research Computing, which will develop, maintain and promote the campus’ research computing capabilities while supporting our research community in the use of these resources.
3. Current and Ongoing Projects

The campus continues to ensure that all classrooms in capital construction projects are technology-enhanced. All new buildings completed with distance learning capabilities. By fall 2011, 100% of centrally-scheduled classrooms will be technology-enhanced. Additionally, Flagship 2030 calls for a marked increase in the number of Residential Academic Programs, which will add several dozen technology-enhanced classrooms to the current pool. The campus's physical plant will be deployed across the campus. In turn, those four areas yielded sixteen extensive reports—the culmination of focus groups, participant surveys, and the dedicated efforts of more than 200 student, staff, and faculty participants.

The ITS Strategic Plan (http://www.colorado.edu/itplanv) recommends an IT framework to help enhance learning and expand access while meeting cost and quality concerns expressed by the campus community. The plan identifies the physical systems and user support systems necessary to provide convenient and reliable IT tools to all campus users. It also recommends ways to provide the leadership, funding, and management necessary to properly support a versatile and flexible IT environment. Rapid growth and change in IT means that the campus must not only respond to that change, but responsibly guide and lead it. The vision for it is driven by how it’s goals serve the goals of CU-Boulder’s vision.

The strategic recommendations of the 2010 IT Strategic Plan are intended to help campus leaders effectively implement rapidly emerging information technologies to effectively support CU-Boulder’s mission. The key recommendations in this plan follow.

Teaching/Learning:
- Ensure usability of centrally provided tools, systems, and spaces.
- Align central support with local and changing needs.
- Provide backup support for students, staff, and faculty.
- Facilitate effective support across campus through partnering.
- Invest adequate funds to support centurally adopted new technologies. Likewise, establish a phasing-out process for out-of-date technologies.
- Formally integrate usability guidelines into centrally adopted tools or spaces.
- Invest in teaching/support resources equal or greater to the investments in those spaces and tools.
- Create a collaborative support environment on campus.
- Target support on cross-unit needs rather than discrete organizational needs.

Research computing:
- Develop capabilities to support computing, visualization, and simulation-heavy research in the humanities and social sciences, including the capability to analyze non-numerical types of data, including visual, textual, geographic, and audio.
- Develop a funding model to continue to provide efficient, centralized computing and data centers for research and academic departments.
- Create a Center for Research Computing to promote the campus’s research computing capabilities.
- Create a central research computing data center that meets the research community’s unique requirements for capacity, flexibility, efficiency, and security; accommodates central and independent control systems; and provides requisite staffing for primary support functions.
- Improve the reliability of the campus network and its inbound and outbound capacity.
- Ensure archival data can be preserved in usable form in perpetuity.
- Further integrate the research network with the national cyber-infrastructure such as TeraGrid.

Mobile technology:
- Convene a group of current cloud innovators and experts to develop a roadmap for cloud computing on campus.
- Locate and mobilize cloud collaborators such as NIST, Google, etc.
- Expand wireless coverage so that it is ubiquitous, including outdoor areas and assessing use of a university-owned spectrum in the 2.5GHz band for WiMAX coverage and 4.9GHz for public safety use.
- Start development of a basic set of CU-Boulder-branded mobile apps based on the MIT Mobile Web project within the framework of the iMobileU Initiative. Expand the use of SMS text messaging to provide information beyond emergency notifications.
- Adopt a convergence strategy for all current and future web applications.
- Re-evaluate procurement regulations regarding use of mobile devices.
- Continue to provide wireless networking services (for all devices, all locations) to all spaces in a building where flexibility and mobility for data access are required and when this is the most cost effective alternative.
- Supplement over time the existing voice telecommunication systems. Voice Over Internet Protocol (VOIP) wireless communications will expedite emergency responder issues. Install emergency back-up generators, as UPS in data closets to maintain VOIP communications for emergency responders.

Rich Collaboration Tools:
- Develop a content and media repository.
- Develop shared (“CU-cloud”) tools. Create centrally stored/collaborative/shared/converged learning tools for teams across campus.
- Develop a cohesive video-conferencing service model that eliminates difficulties in supporting multiple technologies, lack of interoperability, and inability to aggregate equipment purchases.
- Develop unified communications technologies combining all of the ways individuals communicate, tightly integrated with voice, electronic messaging, calendaring, and LDAP directories.

Increase Staff Effectiveness:
- Develop a better understanding of present and future business needs.
- Develop and promote a common understanding of staff effectiveness.
- Develop a better IT service environment.
- Better utilize current technology.

Other:
- Update web infrastructure.
- Improve the IT service model.
- Libraries and IT should partner appropriately on the Norlin Renaissance plan especially as East Campus develops.
- Continued collaborations between IT and Libraries regarding iTunesU, audio/video streaming services, and digital repository platforms.
- Pursue technology initiatives to achieve effective ISIS utilization and resource efficiencies.
- Make meaningful data available in ISIS through data services standards and approaches.
- Establish ISIS service and governance initiatives to provide direction, clarity, and opportunity.
- Encourage primary reliance on university-wide reporting tools and the data warehouse.
- Develop an IT infrastructure master plan.
- Collaborate with Facilities Management to improve the understanding between the two departments, including mutual agreement on campus standards for construction.
- Implement a program for energy conservation and sustainability for campus data centers.
- Explore the “virtualization” of computing and instructional labs, which decreases the reliance on lab staff and recover assignable square footage for other uses.
- Support end-of-life management of electronics, including working with Procurement Services for placing responsibility of the reuse or recycling of electronics on vendors.
- Increase coordination with Facilities Management to reduce duplication in backup power infrastructure.
- Establish a set of core principles shared between IT and Housing & Dining Services (HDS).
- Identify administrative computing services that can be shared between IT and HDS.
- Create a monthly service review meeting between IT and HDS.
- Develop mutually acceptable funding models between IT and HDS.
- Troublem the Tier 2 Customer Support Represen- tative (CSR) program.

8. Capital Expenditures for IT Infrastructure

CU-Boulder spends more than $500,000 annually on the increasing quantities of small classrooms. All centrally-scheduled classrooms will have size-appropriate tech-
ology enhancements by fall 2011. The campus should then embark on strategic technology enhancements to departmentally-controlled classrooms, approximately half of which have no technology enhancements. One estimate puts the costs of build-out of departmental classrooms somewhere between $300K and $450K; once build-outs are complete, the campus should continue to evolve teaching and learning spaces, adding new technologies as needs and pedagogical uses dictate.

In addition to classroom and learning spaces enhancements, the initial, but not ongoing support, costs of some of which will be borne by individual building projects, there are other infrastructure costs associated with information technology. Again, some of the costs for these infrastructure enhancements will be included in individual building projects; the rest will be covered by controlled and deferred maintenance, CU-Boulder operating funds, and expenditures by non-university utility providers. These costs are not included in capital estimates in this plan. As detailed utility planning is done in the year following this plan, a clearer picture will emerge as to both costs and revenue sources. The capital needs in the next 10 years for improvements discussed in this chapter are approximately $10 - $13 million.

The Computing Center (built in 1973) is located at 3645 Marine Street and contains 17,233 ASF. It is located in the 100-year floodplain. As it is the backbone for the campus’s core data services such as CULearn, e-mail, and CULink, the Computing Center should be relocated to an area not prone to catastrophic failure due to flooding events associated with Boulder Creek. Resources needed for the Computing Center include redundant chillers, a minimum 150 kW of back-up power, and security. Therefore, top priority should be given to moving the Computing Center to the Sybase Building, which has a robust IT infrastructure, contains 285 kW of back-up power, and is located out of the 100-year floodplain. The cost for relocating the Computing Center to the Sybase Building is estimated to be approximately $3.4 million to $3.8 million.

To support ever growing wired and wireless network demands across campus, the network core will need to be enhanced to support additional bandwidth and improved reliability. In addition, the legacy telephone system will soon be at end of life and will need to be replaced, possibly with a VoIP solution. To provide higher network availability Uninterruptible Power Supply (UPS) units are being added at each network closet. The cost to upgrade the backbone and distribution layers, upgrade to the latest wireless standards and to support increased demands from research is estimated to be $7-9M.