MIAMI UNIVERSITY

MIAMI UNIVERSITY CIRCULATION MASTER PLAN REPORT

SEPTEMBER 2011

ACKNOWLEDGEMENTS

The recommendations presented in this report reflect the combined input of the planning team and numerous faculty, staff, student, and community representatives who participated in the effort. Their diligence and patience ensured that the Circulation Master Plan and its effects will exist for years, representing both university and community interests.

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1.0 INTRODUCTION

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High Street crosswalks

Miami University is a distinguished and renowned educational institution, steeped in a tradition of academic excellence and history. Often called the "Campus in the Woods," the University's main campus was developed in this location partially because of the area's natural beauty and idyllic setting. The University embraces its reputation as one of the nation's most picturesque campuses and strives to ensure a physical environment for learning that continues the tradition of distinction in academics and its physical setting.

The project team was hired by Miami University to develop a Circulation Master Plan to improve the transportation-related aspects of the physical campus's functionality while respecting its built and natural beauty. The Circulation Master Plan includes consideration of all forms of transportation, focusing mainly on non-passenger-vehicle traffic modes. Examination of campus transit and parking systems were added to the study in order to create an integrated Circulation Master Plan. This integrated approach provides:

- A holistic approach to campus mobility.
- Safer and more efficient bicycle and pedestrian travel.
- Enhanced bicycle and pedestrian facilities.
- Potential reduced vehicle congestion.
- Better operational safety for all modes.
- Better coordination between modes of travel.
- An understanding of the ripple effect of change on different modes.
- The ability to optimize resources and prioritize funding.

The project team consists of a consultant team and a Steering Committee appointed by University staff. The consultant team includes JJR, LLC; Michael Baker Jr., Inc.; and Vivian Llambi Associates. The Steering Committee includes University faculty and staff, University students, and City of Oxford staff.

1.1 PURPOSE

This report documents the process used and recommendations made to enhance the transportation elements of campus. It should be regularly updated as campus conditions and transportation modes and patterns change. Specific and broad-level physical and policy changes are recommended in this document with the hope that mode shifts can occur as campus acceptance of the changes grows.

One of the first steps of the study was the development of project goals, which helped create direction for the Circulation Master Plan.

The Circulation Master Plan strives to achieve the following goals:

- Improve safety and convenience for pedestrian and bicycle traffic on campus and to nearby housing, retail, dining, parks, recreation, etc.
- Consider all non-motorized travel modes as well as campus bus service and automobile traffic.
- Consider the interface between motorized and non-motorized modes of travel.
- Balance parking needs with all transportation modes.

1.2 PLANNING PRINCIPLES

In keeping with Miami University's tradition of purposeful planning of physical development and preservation, the project team endeavors to respect the "Campus Planning Goals" found in the "Campus Exterior Space and Landscape Master Plan" developed in 1999.

Campus Planning Principles Summary:

- Provide the best possible environment within which the academic mission of Miami University can be fulfilled.
- Provide the best possible environment within which residential, recreational, cultural and social functions can be served.
- Maintain and enhance the beauty and charm of the campus.
- Respect the campus in its context and history.

1.3 SUSTAINABILITY

In April of 2011, the campus community approved the "Sustainability Commitments and Goals" document, which includes goals for greening the campus transportation network. The approval of this document, conducted independently from, but during the development of the Circulation Master Plan, was timely. A number of the document's goals directly relate to concepts discussed in the Circulation Master Plan and helped shape recommendations and confirm the campus community's readiness for change in the transportation system.

The transportation-related commitments and goals from the "Sustainability Commitments and Goals" document are summarized below:

Goal: Reduce Miami University's transportation-related carbon footprint 20-30% by 2020

- Implement a holistic approach to circulation.
- Use urban design, parking policies, and incentives to make alternative modes preferable for short distance travel.
- Collaborate with the City of Oxford on planning/ implementation of a bicycle network and bicycle storage by 2012.
- Reduce vehicular use for short distance commutes.
- Increase the mode share for walking, bicycling, and transit.
- Develop parking policies to encourage sustainable transportation behaviors.
- Provide preferential parking/reduced permit costs for carpools, park-and-ride commuters, and low-emissions vehicles.
- Double carpooling by 2020.
- Offer to integrate Miami Metro service into a fully public, regional transportation system.

MIAMI UNIVERSITY SUSTAINABILITY COMMITMENTS AND GOALS

…create a culture in which responsible and sensible decisions will consistently contribute to a higher quality environment, reduce our carbon footprint, and lessen our dependence on carbon-based energy supplies...

We recognize that to be successful, we must engage the campus as widely as possible (including) the choices we make in travel.

2.0 ISSUES & OPPORTUNITIES

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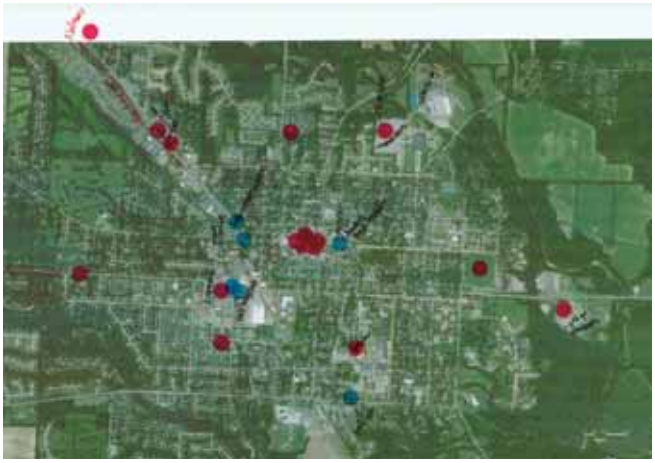


Regional popular destinations (red dots) and conflict locations (blue dots)

Campus popular destinations (red dots) and conflict locations (blue dots)

Discussions during a Steering Committee meeting

The project team utilized field observations, Steering Committee discussions, online and in-person surveys of the campus community, and focus group and general campus population discussions to determine existing problem areas and areas for improvement in the transportation network.

Questions that were explored included:

- What are the destinations for non-motorized travel?
- What are the destinations for all modes of travel?
- Where are the biggest gaps in pedestrian and bicycle networks?
- Where are pedestrian and bicycle conflicts with vehicular traffic?
- Where are conflicts between bicycles and pedestrians?
- Where are key bus interface opportunities?
- How is parking utilized on campus?
- How can parking (supply, location, and policy) support use of transit and non-motorized circulation?

Numerous campus and City of Oxford reports also contributed to the project team's understanding of the existing campus transportation network. Highlights and information themes found in those materials are summarized below:

University Material:

- 1999 Campus Exterior Space and Landscape Master Plan
- Miami University Master Plan Traffic Study
- Multi-Use Perimeter Path
- Miami University Campus Transportation Study
- Miami University Comprehensive Bicycle Pathway Plan
- Campus Parking Documents
- Miami Metro Documents
- Miami University Capital Improvement Report 2007
- 1997 Building Construction Standards
- 2003 Miami University Campus Planning

City Material:

- City of Oxford Transportation Task Force Goals and Long Range Plan
- Oxford Tomorrow Comprehensive Plan and Update
- 2004 Strategic Plan Priorities

- City of Oxford Off-Campus Bicycle Plan Student Report
- 2006 Oxford Thoroughfare Plan

Campus Documents Highlights:

Standards:
- Priority should be given to pedestrian paths.
- Pedestrian movements have priority over car movements.
- Bicycle traffic should have second priority after pedestrian traffic.
- Incorporate bicycle facilities into campus improvements.

Guidelines:
- Develop paths to connect:
  - » Residential quadrangle.
  - » Recreational sports spaces in Four Mile Creek Valley.
  - » Off-campus housing.
  - » Provide bicycle racks on paved surfaces near all major campus buildings.

Pattern Language:
- Build a system of designated bicycle paths that:
  - » Have recognizable surface.
  - » Run along local roads or major pedestrian paths where possible.
  - » Are separate from pedestrian paths.
  - » Reach within 100 feet of every building.
  - » Include bicycle racks near every building's main entrance.

City Documents Highlights:

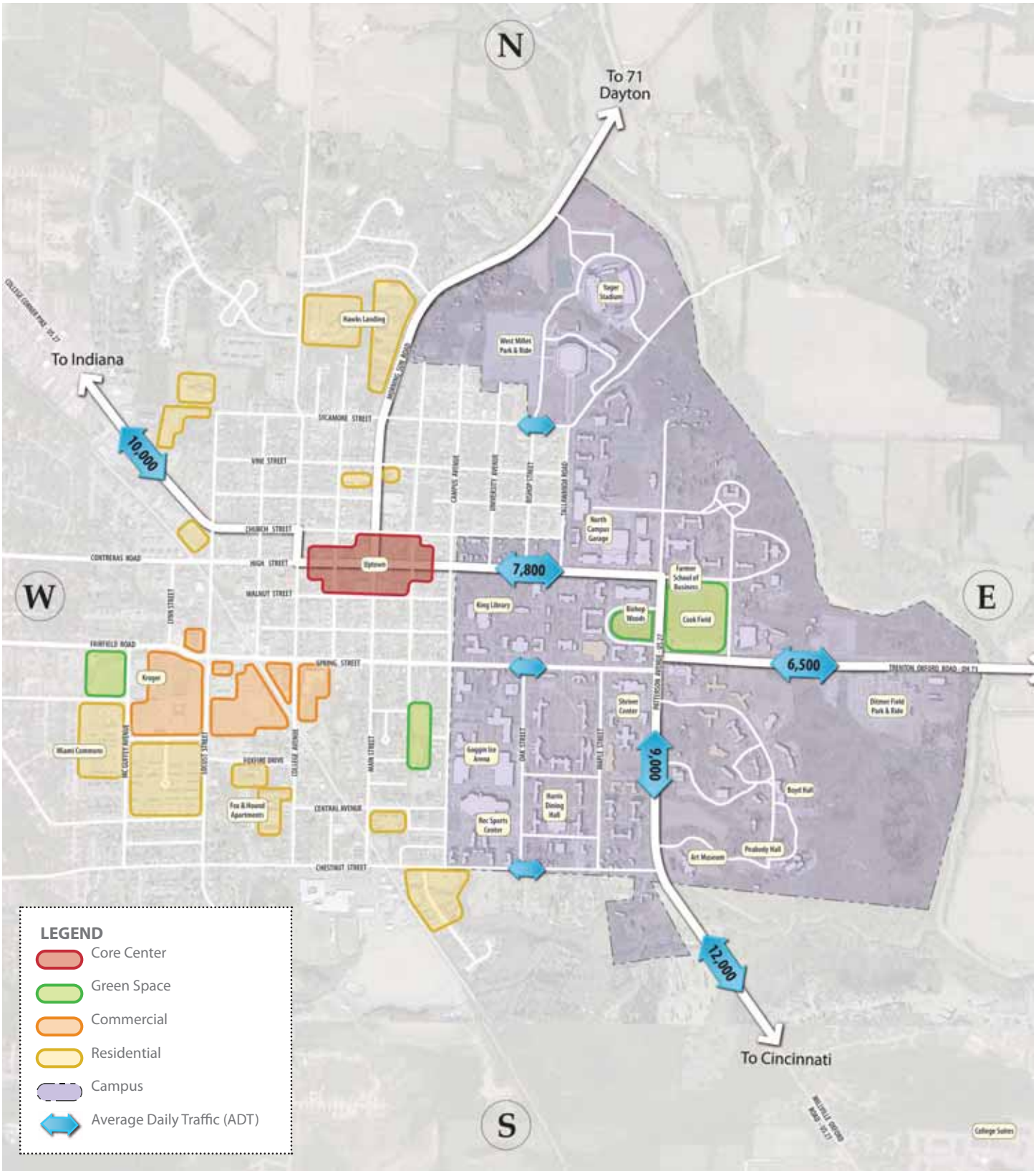
Priorities:
- Traffic calming
- Relocation of truck route
- Pedestrian management
- Mass transit

Goals:
- Develop a transportation system that encourages alternative forms of transportation.
- Explore expansion of bus service.
- Develop and implement a pedestrian and bicycle path master plan.
- Facilitate biking with bicycle facilities at public locations and private employers.
- Implement traffic calming in the Mile Square.
- Investigate commuter bus connections to regional hubs.
- Focus on multi-modal solutions to transportation planning.
- Integrate bicycle routes with roadways.

In addition to determining the current transportation network pattern on Miami University's campus, the project team researched other academic peer and aspirational institutions, as well as bicycle, pedestrian, and transit friendly campuses. This benchmarking data helped the Steering Committee understand how Miami University compares to peer institutions and provided ideas for potential physical and policy transportation improvements that have been successfully implemented on other campuses. Benchmarking data can be found in Appendix A and Appendix C.

Peer institutions that were studied included:

Ohio University, SUNY at Binghamton, The Ohio State University, University of Vermont, University of Notre Dame, University of Virginia, Wake Forest University, University of North Carolina, UC Davis, UC Berkeley, Portland State University, Michigan State University, Cornell University, University of New Hampshire, Virginia Commonwealth University, Virginia Tech, University of Colorado, and Princeton University, among others.



Existing land use and area destinations

2.1 NON-MOTORIZED

The project team spent a number of days walking the campus during peak and off-peak pedestrian hours, during spring and summer semester, and in various weather conditions. It is evident from these site walks that the pedestrian and, to a lesser extent, the bicycle modes of transportation are critical for faculty, staff, and students on and off campus. The University system of walks and paths is extensive and generally well-maintained, but pedestrian facilities often do not connect desired paths of travel, and bicyclists and pedestrians share narrow sidewalks in many locations.

The project team identified the current pedestrian pattern language as follows:

- Building placement, walks are highly symmetrical.
- There is a strong desire to create campus places and quads within the center of blocks.
- Pedestrian walks connecting interior quads create additional mid-block crossings at city streets.
- Buildings are often sited on the terminus of walks and roads–walks have to split around buildings, leading to offset connections across campus.
- Existing sidewalks are often not wide enough.

A list of analyses and observations from a broad level down to specific conflict locations and network gaps was developed, as shown below.

Analysis/Observations:

- Lack of adequate sidewalk width and quality
- Lack of continuity in pedestrian desire lines
- Lack of bicycle facilities
- Student drop-off/student drive to class rate
- Not enough nighttime campus lighting on Western Campus walks, at crosswalks on Spring Street and High Street
- Lack of clear pedestrian corridors lead to confusion for pedestrians, motorists and bicyclists
- Pedestrian/vehicular/bus conflicts
- Gaps in pedestrian network
- Too many/disorganized mid-block crossings
- Offset tee intersection (Spring Street/Patterson Avenue/State Route 73)
- Apparent issue with traffic speeds on Patterson Avenue south of campus
- New requirements for fire truck access
- Bus service: over-serving and under-serving
- Bus stop locations lead to mid-block crossings
- Vehicle cut-throughs

Pedestrian/Vehicular/Bus Conflicts:

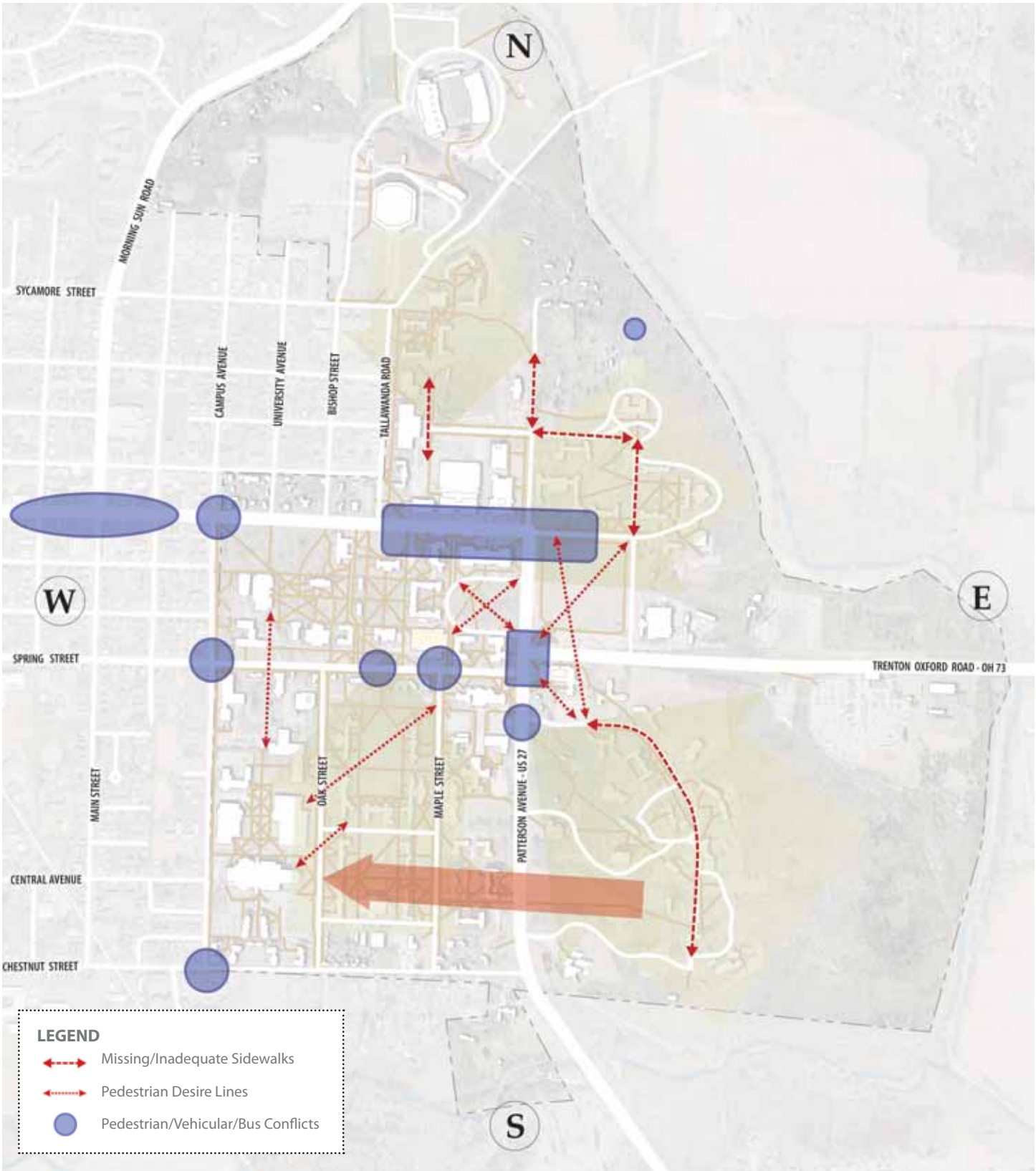
- High Street
- Spring Street/Patterson Avenue/State Route (SR) 73
- Sundial Crossing
- Shriver Center
- Patterson Avenue
- Kroger
- High Street
- Campus Avenue/Chestnut Street
- Church Street/College Corner Pike/Locust Street

Gaps in Pedestrian Network:

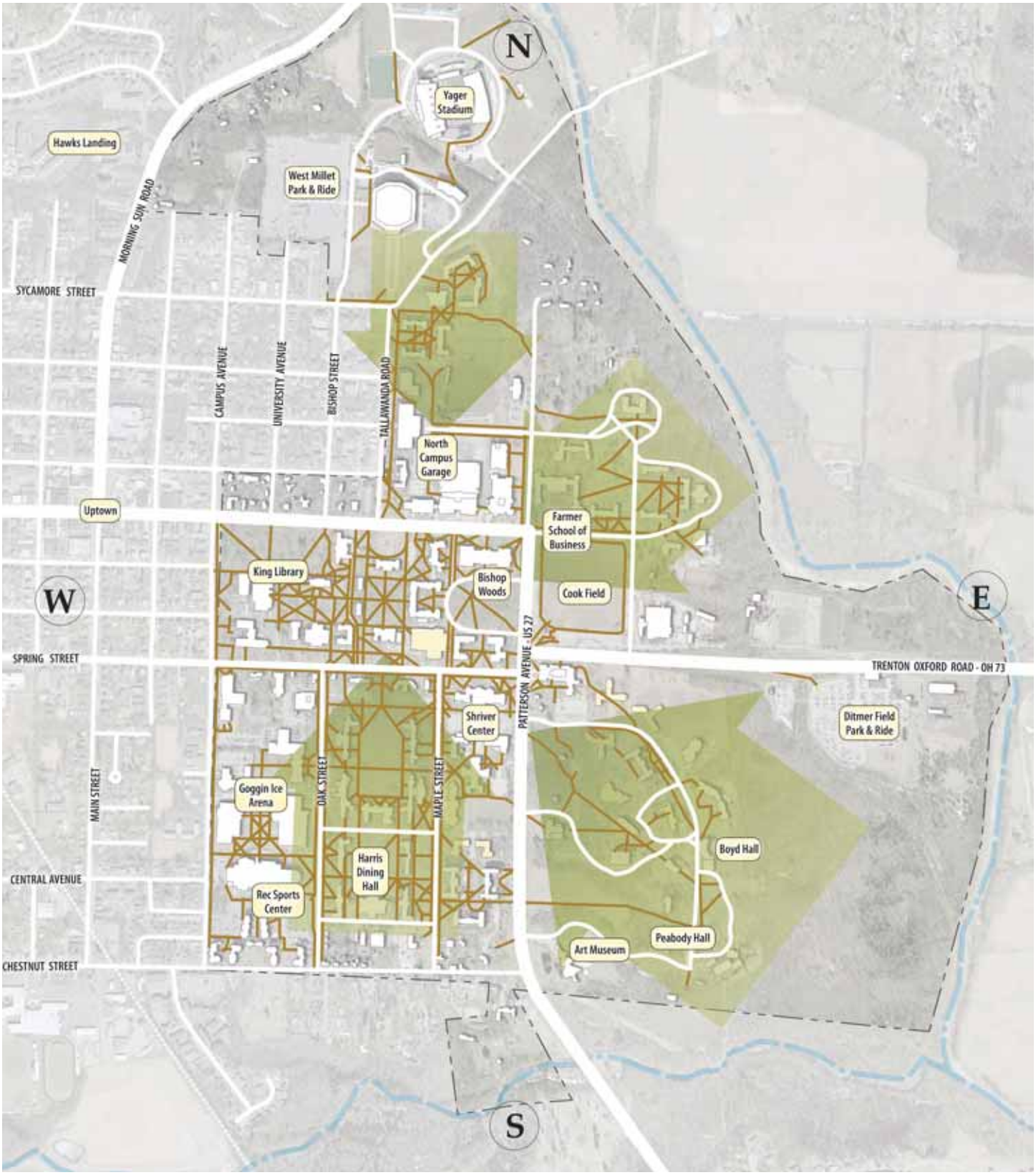
- Desire lines to recreation center
- Desire lines on Western Campus
- Northeast of Farmer Business School
- Adjacent to Miami Inn
- By Withrow Court

Pedestrian traffic on High Street

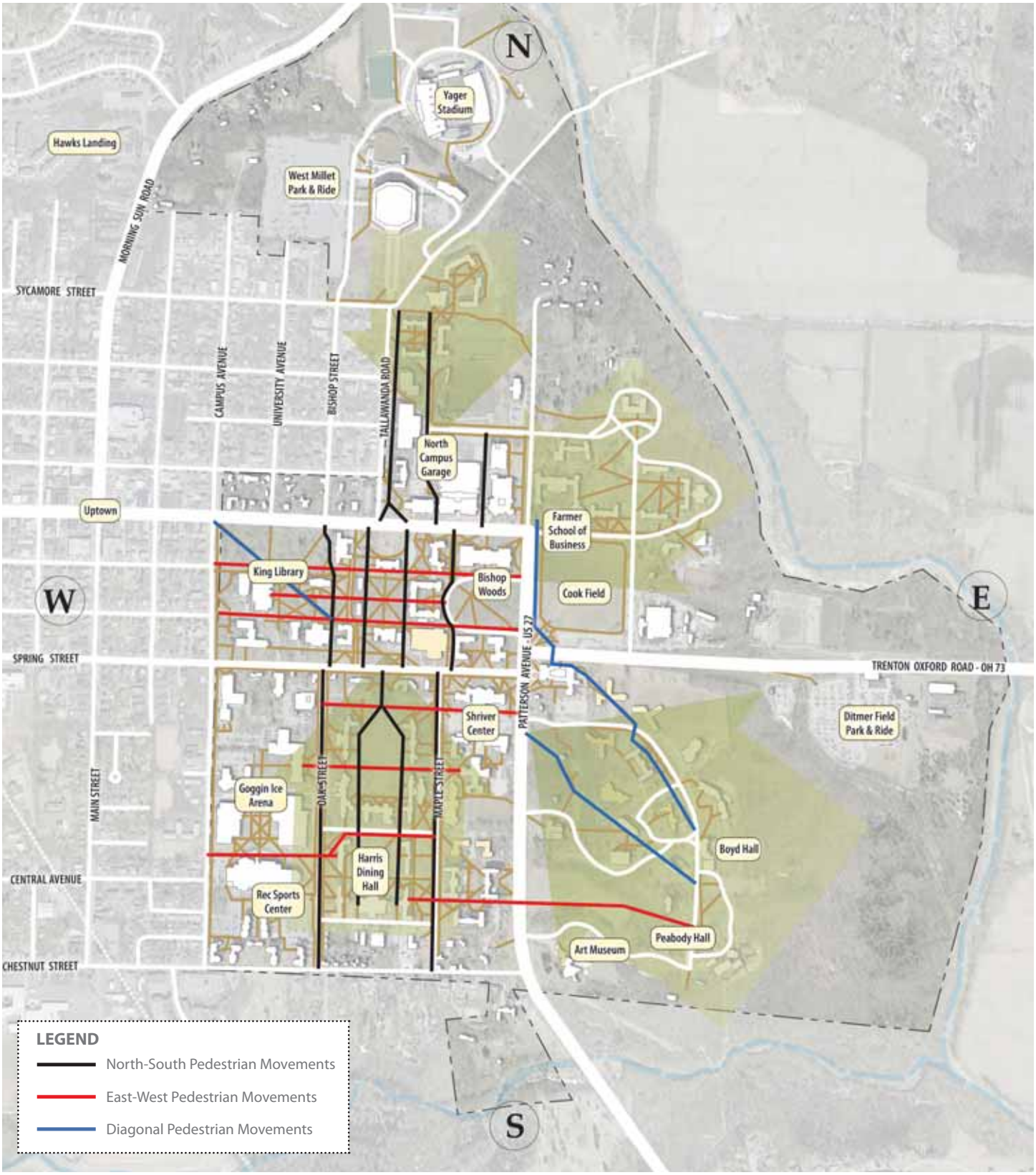
When mapping the existing pedestrian network from an overall perspective, it became obvious that one of the main reasons for pedestrian connectivity complaints, cut-through path development, and pedestrian/vehicular conflicts was discontinuity of pedestrian paths. The major pedestrian pathways and their connections, or lack thereof, are shown on the following three pedestrian diagrams.



Pedestrian movements



Existing campus pedestrian walkways and paths



Pedestrian movements

2.2 VEHICULAR & EMERGENCY ACCESS

A number of existing vehicular conflict points and gaps are listed in section 2.1 Non-Motorized. Locations of particular impact to vehicular campus transportation and its interaction with other modes include Spring Street through campus, High Street through campus and in Uptown, Patterson Avenue adjacent to and south of campus, Bishop Circle/Laws Drive, Irvin Drive, McGuffey Drive, and the Patterson Avenue/Spring Street/SR 73 offset intersection.

The University Fire Department uses existing roads, parking lots, and some paths as fire access routes. University fire officials are in the process of developing a more extensive network of fire access routes to accommodate recently purchased equipment. Further research into peer institution fire access treatments, as well as fire codes as they pertain to access location requirements should be completed on a per project design basis. In addition, due to the heavier dead load of the new equipment, potential structural load limit hazards are created where access routes cross over existing tunnel systems. Structural reinforcement or route modifications should also be considered on a per project basis.

2.3 PARKING

Parking on campuses is always a much-debated topic among the campus community. It is necessary to have parking on a campus to provide convenient access to campus destinations, but parking can directly or indirectly create additional pedestrian/bicycle/vehicular conflict points and encourage single-occupant vehicular use. For this reason, the number of parking spaces on campus, their location, and their current utilization were studied as part of the Circulation Master Plan. This analysis helped the project team understand how the existing parking system is utilized and develop parking concepts that integrate well with the rest of the transportation system, with the goal of balancing parking needs with all transportation modes.

To determine actual utilization of parking on campus, a two-day peak-period parking utilization study was completed on April 18 and 19, 2011. All campus-operated on-street parking and parking lots were surveyed during the peak parking period (between 10:00 AM and 2:00 PM) to determine peak parking occupancy. This two-day study, along with parking data provided by the University Police Department, produced the following results and observations:

West Cook Parking Lot

Results:

Total Parking Spaces on Count Day:	8,177
Total Parking Spaces Utilized in Peak Hour:	5,151
Percent of All Campus Spaces Utilized During Peak Hour:	63%

- Surface parking in campus core is highly utilized.
- Ditmer Field Park-and-Ride Lot has significantly higher occupancy than West Millett Park-and-Ride Lot.
- North Campus Garage is near capacity.
- Campus Avenue Garage is less than half full.
- On-street parking is not fully utilized.
- Boyd South Lot (Western Campus) - highly underutilized (15% occupancy).
- Gated Heritage Commons Lots – underutilized.
- Permit assignment to particular lots creates underutilized core lots (mainly South Cook Lot).
- Regional commuter pattern may contribute to underutilization of West Millett Park-and-Ride Lot.

Observations:

- Frequent drop-off activity
- Frequent parking space hunting
- Bishop Circle/Laws Drive has high drop-off activity

Future master-planned improvements on campus will affect the parking supply. The project team worked with

University staff to determine where parking was planned to be removed and added due to the Housing Master Plan and the Campus Master Plan recommendations. As part of the master-planned improvements, parking has already been added with the recent construction of the Campus Avenue Garage and the North Campus Garage. Major impacts to parking due to future master-planned improvements include parking modifications in the Campus Avenue Building/Spring Street area, the Bishop Circle/Gaskill Lot area, the Withrow Court Lot area, and Western Campus. Further discussion of the impacts of future master-planned improvements in coordination with Circulation Master Plan recommendations are included in the section 3.0 Recommendations.

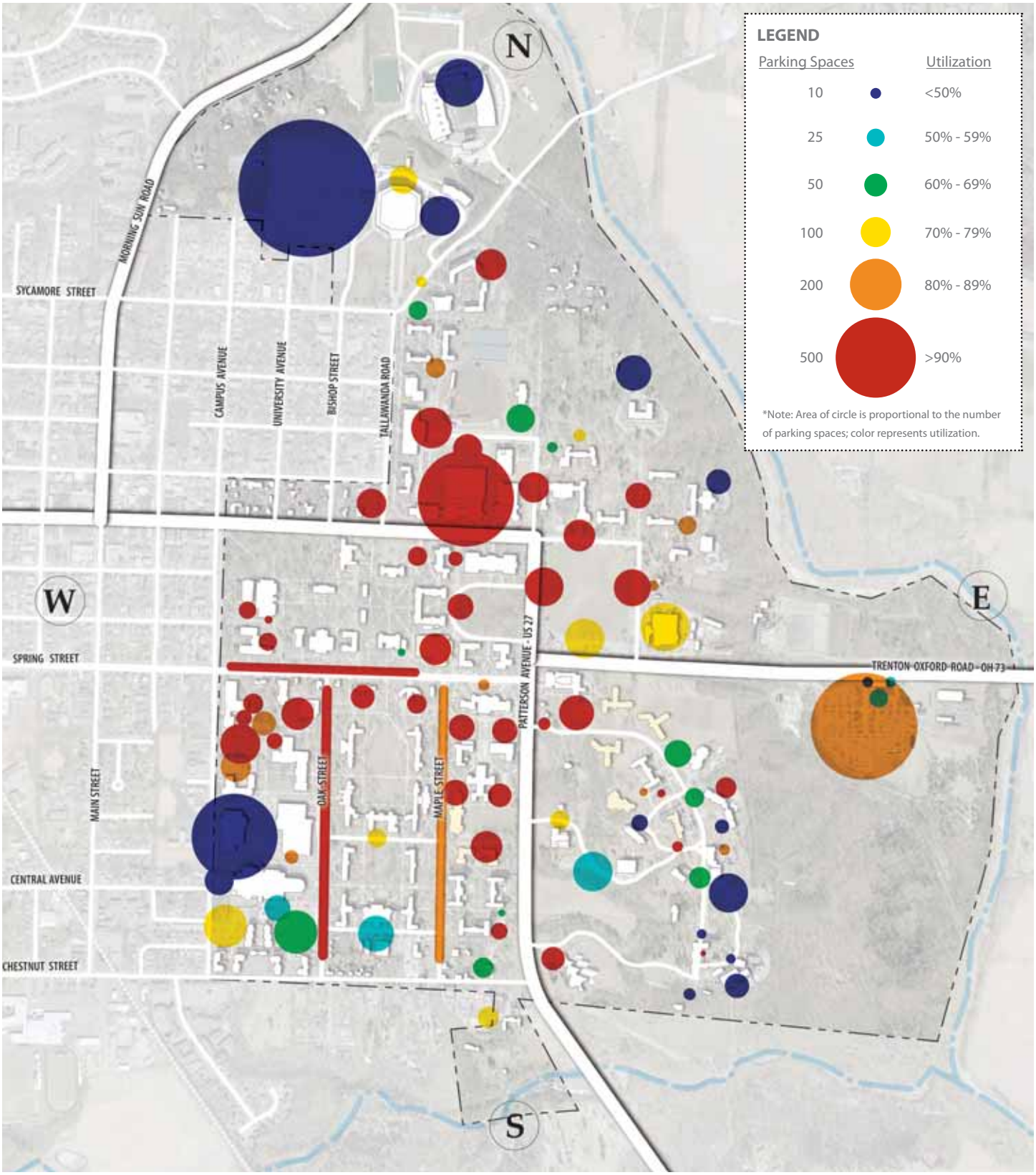
To determine how the parking ratio, defined as the ratio of campus population to number of parking spaces on campus, at the Miami University campus as currently configured compares with other universities, benchmarking data was collected, and is shown below.

Campus Avenue Garage

Institution	Population to Parking Space
University of Wisconsin - Milwaukee	13 to 1
Boston College	9.2 to 1
Portland State University*	6.0 to 1
University of California - Berkeley*	5.8 to 1
Carnegie Mellon University	4.2 to 1
University of Chicago	4.1 to 1
Old Dominion University	3.6 to 1
University of Vermont*	3.2 to 1
National Average	2.8 to 1
The University of Toledo	2.8 to 1
University of North Carolina*	2.7 to 1
Cornell University*	2.5 to 1
University of Virginia*	2.4 to 1
Miami University	2.27 to 1
Indiana University Bloomington*	2.2 to 1
Oklahoma State University	1.9 to 1
Grand Valley State University	1.7 to 1

*indicates academic, physical, or aspirational peer universities

Miami University's parking ratio is near the low end of many of its peer institutions and the overall national average, meaning that it has a higher than average number of parking spaces per person. This benchmarking exercise provided confirmation to the Steering Committee that, despite parking complaints that are so common on campuses, Miami University provides more parking spaces per person to its campus community than many comparable campuses in similar small town settings without public transit.



Peak parking utilization

2.4 TRANSIT

Miami Metro provides bus transit service for the Miami University campus. Despite changes to campus infrastructure, the bus routes have remained essentially unchanged for two decades. As part of the Miami University Circulation Master Plan, the University decided to investigate the development of new bus routes for the Miami Metro system. The sense was that the current routes were long, and perhaps the needs of potential riders were not being met. Miami University staff felt that bus service could be optimized to better serve the Miami University community and increase ridership, supporting the development of new bus routes. The new routes were to be based upon community engagement to assess service needs along with population density and land use, including the planned development of new residence halls on Western Campus.

Existing Transit System

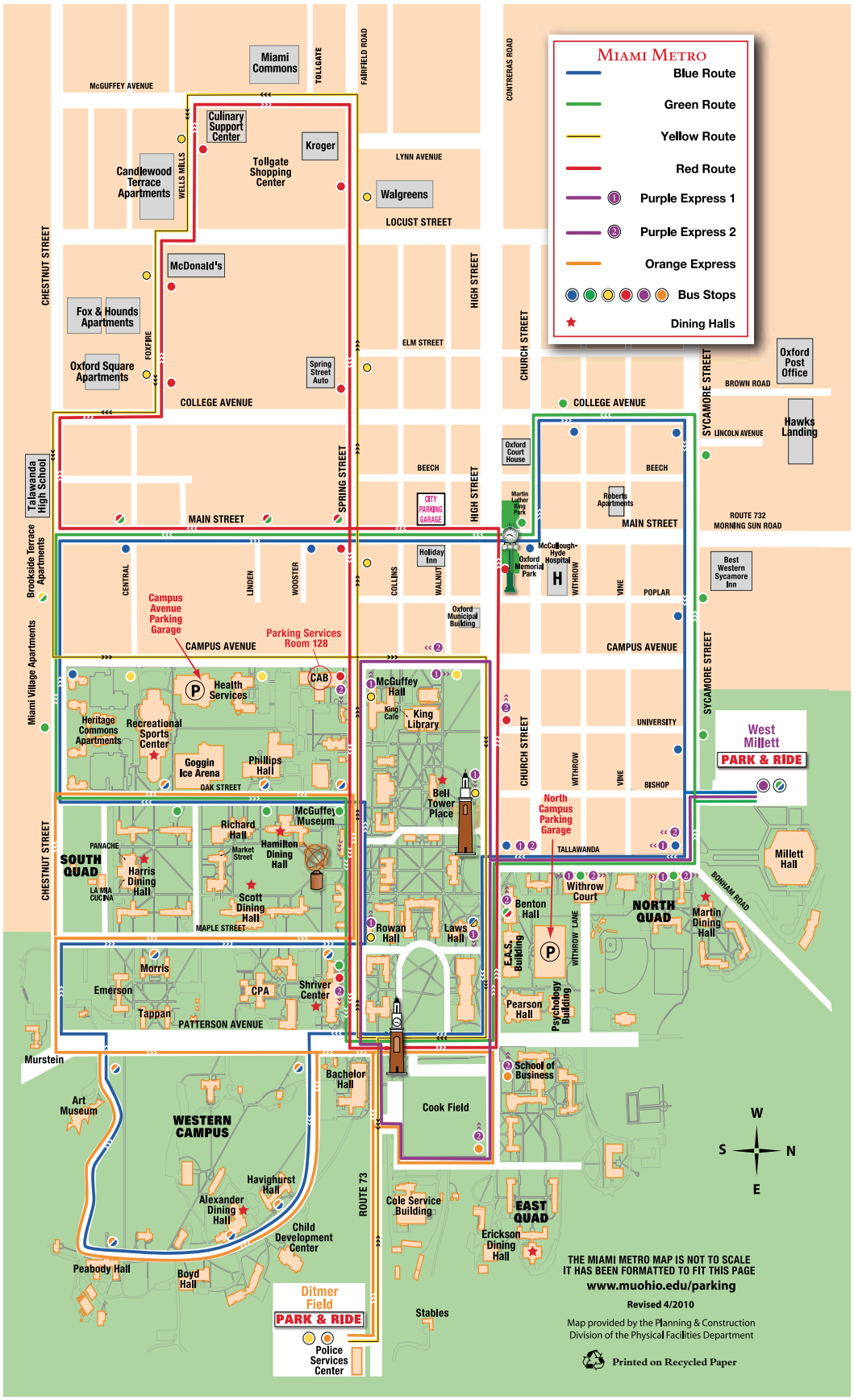
The Miami Metro system consists of seven bus routes that serve the Miami University campus and adjacent areas of the community, as shown on the Miami Metro route map. Together, the routes cover a total distance of approximately 27.7 miles. The bus routes are essentially looping routes, with six of the seven routes functioning in clockwise and counterclockwise pairs. Route timing is maintained by dwelling the buses at the stops located at Shriver Center, West Millett Park-and-Ride, and Ditmer Field Park-and-Ride. Depending on traffic and travel time, the dwell times can be fairly long, based on information received from the public outreach surveys and interviews.

Bus stop on campus with shelter

Bus stop on campus without shelter

Existing bus stops are located as shown on the Miami Metro route map. Some stops are marked with bus stop signs, while others provide shelters for waiting passengers. The wayfinding system provides route names and arrival times. Route maps are not illustrated at the stops.

Bus route information posted at Farmer Business School bus stop



Miami Metro routes

Benchmarking

The project team researched university transit systems with characteristics similar to Miami University to illustrate a variety of possibilities and glean ideas that could be applied to the Miami Metro transit system. The benchmarking results are presented in Appendix C. Potentially applicable ideas are presented below.

Virginia Tech
Blacksburg, Virginia
Blacksburg Transit

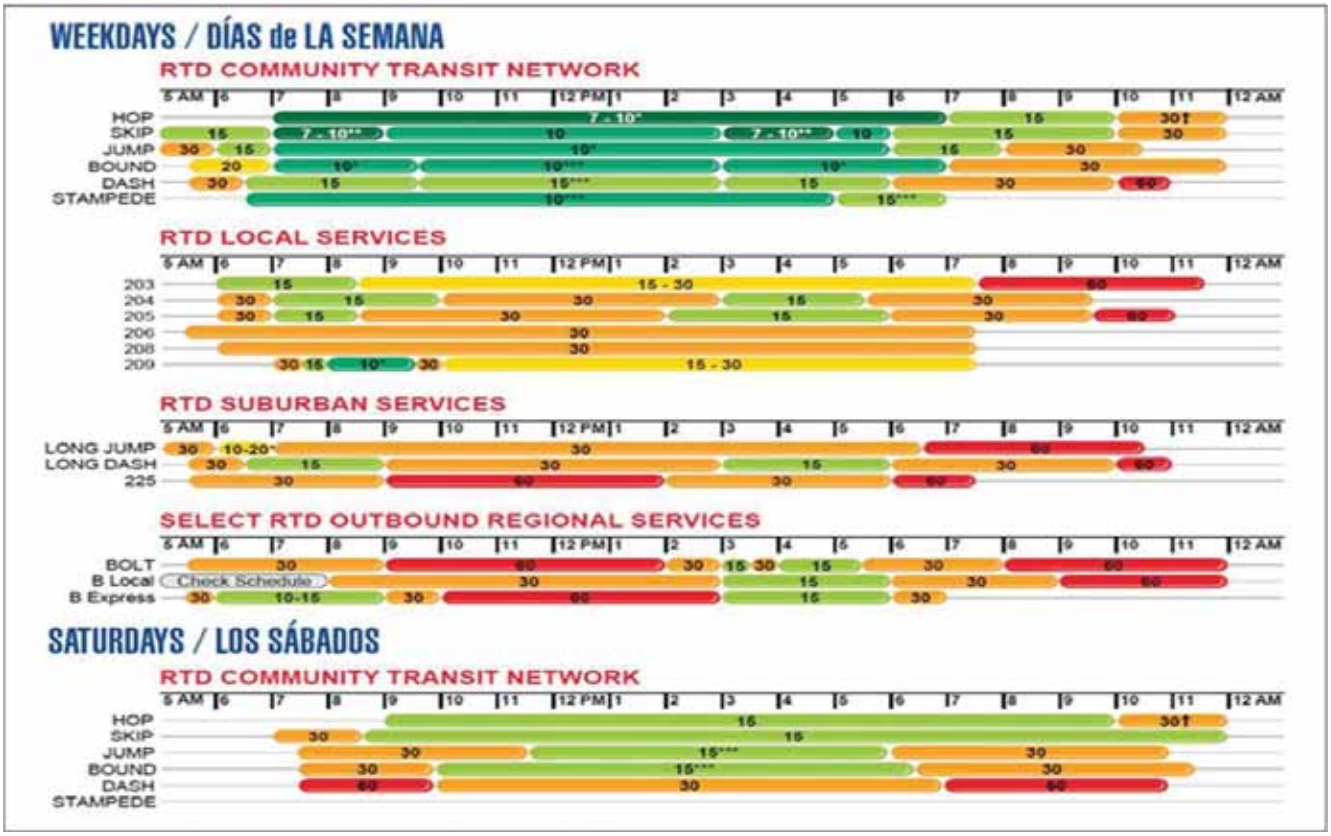
Blacksburg Transit provides fixed route bus service within the campus and surrounding community with multiple bus lines using radial and circulator routes and multiple schedules. The schedule is maintained through the use of "time checks" where departure times are set at identified bus stops, with the understanding that the stops in between will occur within the defined range of the adjacent time check stops. Ridership on the Blacksburg Transit is 90% students, 5% faculty, and 5% Blacksburg citizens. The project team anticipates a similar ridership breakdown for Miami Metro.

The Ohio State University
Columbus, Ohio
CABS (Campus Area Bus Service)

CABS provides bus services on campus and in the surrounding community with multiple routes and schedules, with short headways and interfacing with COTA (Central Ohio Transit Authority). This system pioneered the use of a GIS-based system providing information on expected arrival time of the next bus.

University of Colorado
Boulder, Colorado
GO BOULDER

The university and the Boulder community are served by multiple circulator routes (Hop, Skip, Jump, Bound, Dash, Stampede). These routes interface with the regional transit system, providing transit access for students to destinations along the entire Front Range. The buses run on fixed headways based on a time of day schedule. This information is portrayed in an easily understandable graphical image.



GO BOULDER bus schedule

Virginia Commonwealth University
Richmond, Virginia
2BNB (Bottom & Back)

2BNB provides bus service between the campus and the downtown entertainment district during evening entertainment hours with a series of bus route loops. This 501(c)(3) organization is supported by local donations and private donors who contribute through their on-line web page "piggy bank."

Princeton University
Princeton, New Jersey
Tiger Transit

Transit service is provided on campus and in the surrounding community with a bus fleet of low-floor, fully accessible buses that run on B20 biodiesel fuel and carry bicycle racks.

Bus Route Development

The recommended changes to the bus routes were developed through a process grounded in community engagement. The project Steering Committee provided general oversight and guidance as the concepts were developed and refined.

Additionally, the project team held open house events and interviewed interested individuals from the University (students, faculty and staff) as well as the Oxford community. The information and feedback obtained through outreach was invaluable in determining the needs of today's bus riders and potential riders.

Community Engagement

The project team held outreach events to obtain feedback on the existing bus system and ideas for changes to the system to better meet the needs of riders and potential riders. These outreach events were held on April 18, 2011, at the following locations:

- On the sidewalk outside the Engineering Building
- In the downstairs level of the Shriver Center
- In an advertised open house at MacMillan Hall

Expanded input was obtained by posting a survey on-line from April 18-May 6, 2011, at the end of the spring semester. There were 376 respondents to the survey, with 51% students (28% on-campus, 23% off-campus), 35% staff, 9% faculty, 4% residents, and 2% other. This distribution presents a good cross-section of potential riders. The survey is included in Appendix B.

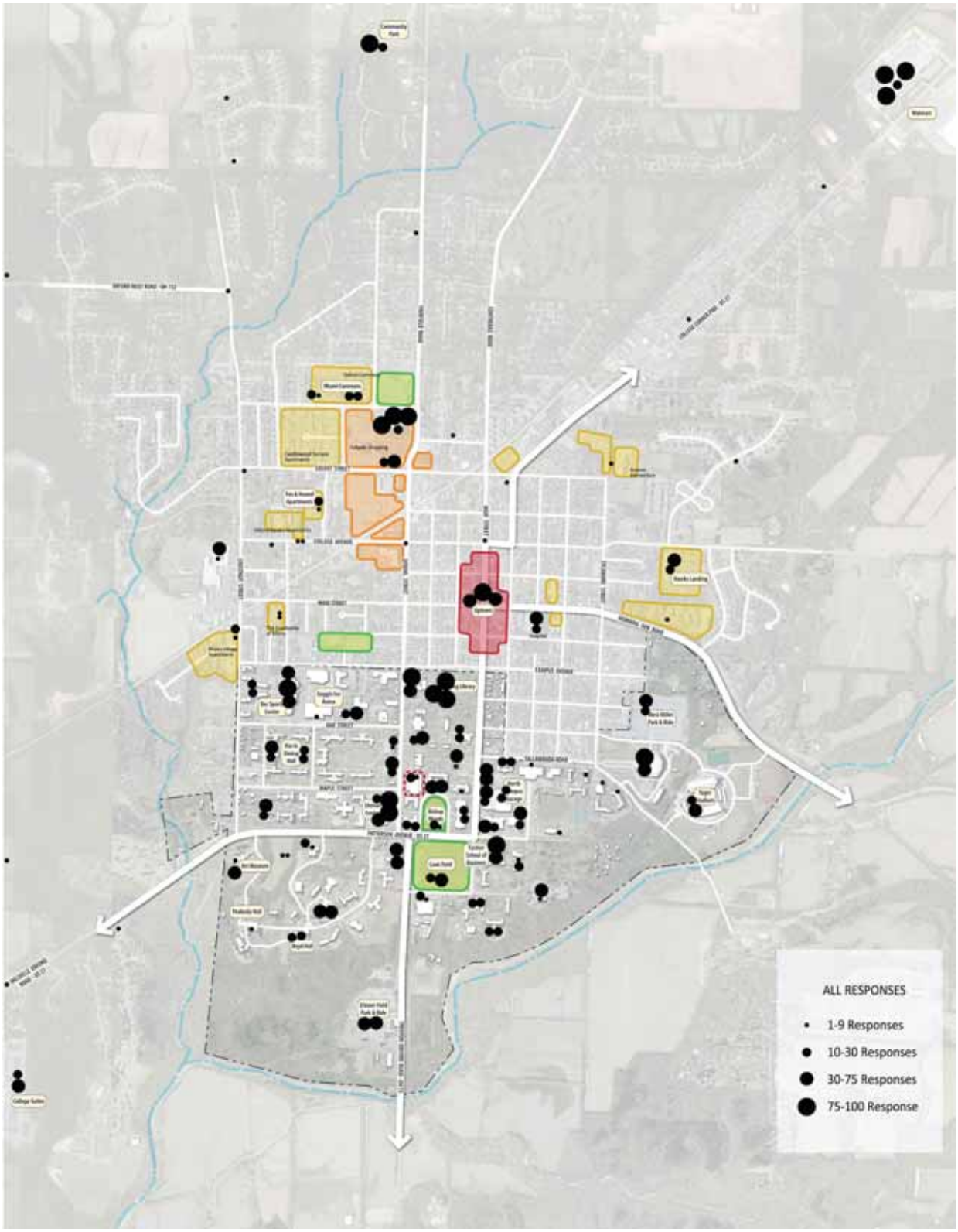
The survey results indicated that students ride the bus most often, with more than 50% riding the bus two or more times per week. Not surprisingly, faculty and staff reported riding the bus least often, with approximately 75% of respondents reporting that they never ride the bus.

The reasons people reported they choose not to ride the bus are listed below in order of priority, with the most common reasons at the top.

- More convenient to drive.
- More convenient to walk.
- Commute is too long/does not serve needs.
- Bus does not go where I need it to go.
- Wait at bus stop is too long.
- Travel time is too long.
- More convenient to ride my bicycle.

The survey asked respondents to identify destinations they would like to be served by Miami Metro. The responses are illustrated in the graphic on the facing page, where the dot size corresponds to the number of responses.

Outreach event in Shriver Center



Desired destinations for Miami Metro bus service

This information was used, in conjunction with population densities and land use, to develop the conceptual new routes for Miami Metro's bus service.

The conceptual routes were presented to Miami Metro and the Miami University project team on May 23, 2011. (The presentation is provided in Appendix C.) A variety of concepts and routes were presented and discussed, along with benchmarking from similar universities and an overview of their policies and operations that Miami University might choose to adopt.

The project team made a number of recommendations, which were incorporated into revisions to the conceptual routes. Those updated routes were subsequently presented to the Steering Committee whose members were asked to provide feedback. The Steering Committee studied the routes and provided comments to the project team, who then refined the bus routes based on the Steering Committee suggestions. (The Disposition of Comments is provided in Appendix D.) The recommended bus routes are presented in section 3.0 Recommendations.

3.0 RECOMMENDATIONS

3.0 RECOMMENDATIONS

Many studies have been completed that investigate and identify the need for bicycle, roadway, and, to a lesser extent, pedestrian facilities in the Oxford area and on campus. Most of these previous studies, however, do not give direction for improvements necessary to accommodate that need. Recognizing this, the Steering Committee requested that the project team develop specific project recommendations to be implemented as funding becomes available as well as broad-level recommendations to be used during construction of other campus projects. The following section outlines these recommendations.

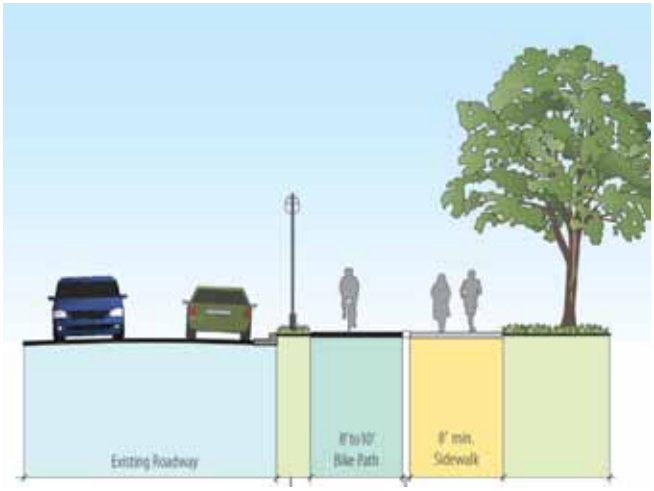
3.1.1 NON-MOTORIZED (BICYCLE)

Bicycle travel on and to campus is not a prevalent form of transportation, but campus sustainability goals state a need to increase usage of alternative modes of transportation, emphasizing the desire to create a viable bicycle network. A great volume of input was received on proposed bicycle facilities from faculty, staff, students, and Oxford community members. Of particular importance is that, although views differed on the specific location and exact type of bicycle facility that would best serve the campus community, nearly all of the input received encouraged the creation of some type of bicycle facilities.

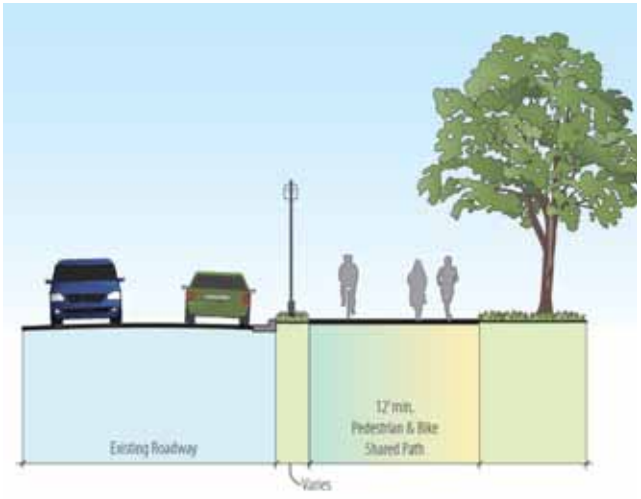
As the city and campus have a combined total of less than a mile of existing bicycle facilities, nearly all recommended bicycle improvements are new facilities. As confirmed by input received from the campus and city communities as well as numerous prior reports, the creation of a continuous bicycle network was considered by the project team to be paramount to successful adoption by the campus and surrounding community. With only random, disconnected facilities in place, transition from single-occupancy vehicular commuting to commuting by bicycle would face significant challenges, as it has in the past with this approach. With that in mind, the project team worked with the City of Oxford and University to develop a bicycle network with three main classifications of bicycle facilities that would serve the campus community and reach broader Oxford destinations.

Class I

Off-Street Bicycle Paths are facilities that are separated from vehicular traffic by a physical barrier (curb, curb lawn, etc). In locations where there are high volumes of pedestrians and bicycle traffic, the bicycle path is separated from the pedestrian path using a visual divider, often a row of bricks or prominent striping (Class IA). In locations where low volumes of pedestrian and bicycle traffic are anticipated, pedestrian and bicycle traffic share a widened pathway (Class IB). Both levels of off-street bicycle paths can also be used as emergency access routes (with additional clearance and lawn stabilization where required) and accommodate maintenance Gator vehicles that are no longer allowed on area roadways. Because the installation of Class I bicycle paths of any width can increase impervious surface area on campus, use of pervious concrete or asphalt and integration of alternative stormwater collection techniques should be considered, and projects should be coordinated with the stormwater master plan.



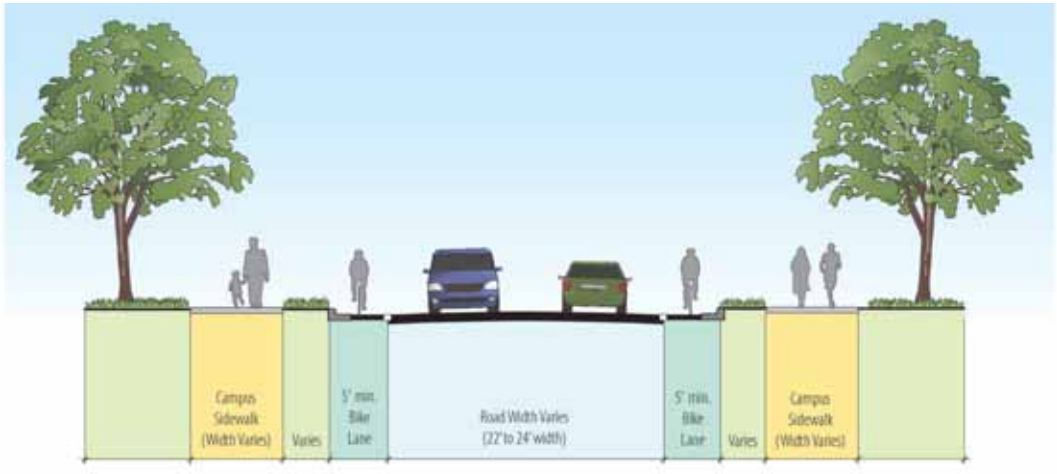
Class IA: off-street bicycle paths, high volume



Class IB : off-street bicycle paths, low volume

Class II

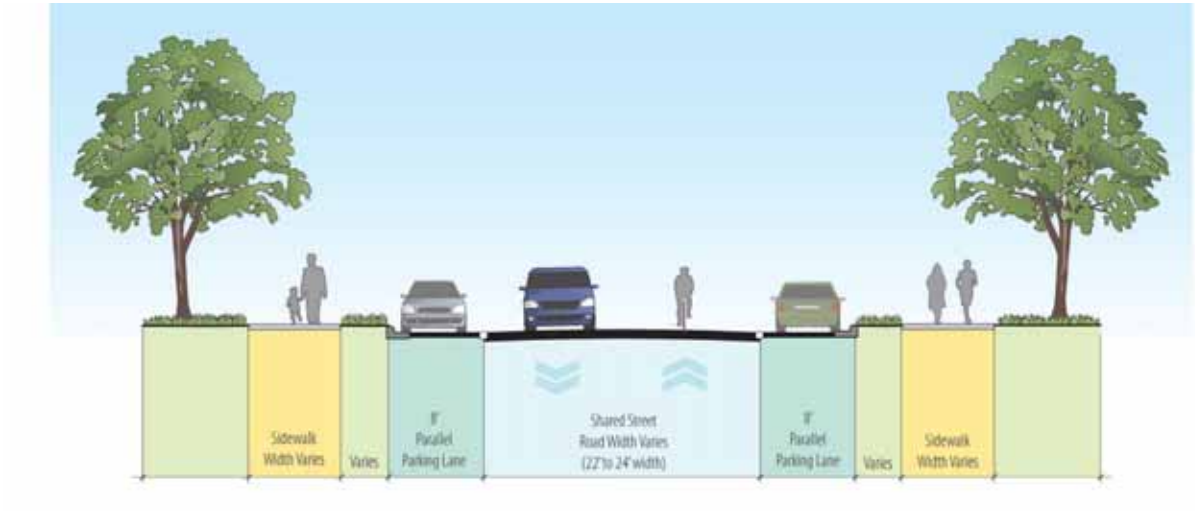
On-Street Bicycle Lanes are striped lanes designated for the sole use of bicycles on a roadway. They are marked with bicycle lane specific marking and signage. As budget and maintenance requirements allow, consideration should be given to providing alternate bicycle lane identification such as a colored surface treatment of the lane itself or brick installation adjacent to the lane striping, provided such treatment is high-contrast and meets engineering design standards.



Class II: on-street bicycle lanes

Class III

Shared Use Roadways are roadways that have been specifically designated as bicycle-friendly roadways using appropriate signing ("Share the Road" and "Bicycle Route" signs) and sometimes markings ("Sharrows"), but without designated bicycle lanes. Shared use roadways often have insufficient width to stripe bicycle lanes but provide important links in the bicycle network. Although designating a roadway as a shared use facility provides riders with a preferred route in areas where other options may not be available, less experienced riders can be uncomfortable with "taking a lane" when traffic is present. Therefore, ideally the more heavily-travelled Class III facilities would be on-street bicycle lanes, but in some locations there is not enough roadway width for travel lanes and bicycle lanes (and parking, in some cases) as recommended by engineering standards. Some cities have successfully implemented narrower striped shoulders that are used as bicycle lanes in lieu of Class III facilities where there is insufficient width for a full-width bicycle lane.



Class III: shared use roadways

Bicycle Master Plan

The Bicycle Master Plan incorporates these three classifications of bicycle facilities to create a continuous bicycle network, providing access to the highest demand on- and off-campus destinations and housing areas. Alternative routes are shown for some routes that may be more difficult to implement because of more restrictive physical barriers such as constrained right-of-way, higher traffic volumes, or unique existing configurations.

Locust Street is a preferred route noted on the Bicycle Master Plan as having a shared use path in the future. Implementation of full width for this shared use path for the entire length of Locust Street will most likely not be possible due to physical constraints. The project team felt this connection was critical as a part of the larger system, and recommends the development of the shared use path along Locust Street to the extent possible, despite potential narrow locations. Lynn Street, McGuffey Avenue, and North College Avenue are shown as alternatives to locust.

High Street in uptown is an example of an alternative route where bicycle lanes would be ideal, but implementing the concept would be challenging. Because of this, Church Street is shown as the primary route and High Street is shown as an additional alternative. Potential High Street improvements and cross-section are shown on page 36. In the long term, High Street improvements such as those shown would benefit the city and campus communities by providing better access to all transportation modes.

The project team and Steering Committee chose the routes shown on the Bicycle Master Plan (facing page) in an effort to create a continuous network that serves the most rider types possible, focusing on the average rider (inexperienced to experienced). There are a number of locations in the area where multiple other viable routes exist. As such, roadways that are not shown as part of the Bicycle Master Plan are not to be excluded from bicycle use.

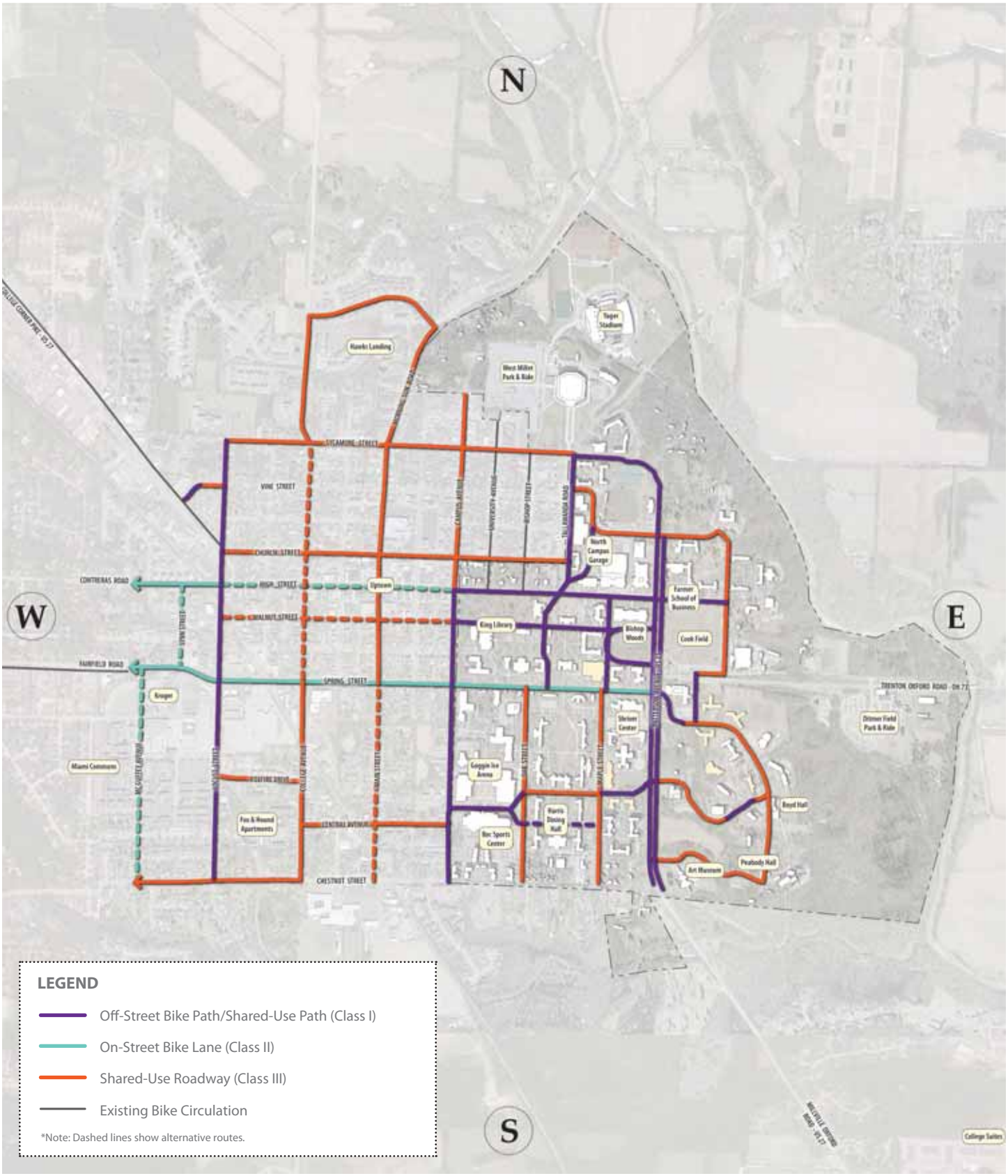
The recreation fields east of campus beyond Four Mile Creek and the stables just to the west have been identified as a potential draw for campus bicyclists. If increased activity to the east of campus creates a demand for bicycle travel along State Route 73, there is the potential to add bicycle lanes along this section of roadway to accommodate the demand. As the roadway is an ODOT facility, minimum bicycle lane design standards apply for the entire length of the bicycle lanes, resulting in required roadway widening in any area where the width requirements can't be met (such as the Ditmer driveway intersection). Further study of the geometry and characteristics of this roadway would be required prior to installation of bicycle lanes.

In addition, future connections to the Oxford Area Trail System (OATS) regional trail, planned to travel through the University's campus, should be studied once future details on the exact OATS connection locations are determined.

All modifications to city roadways, including signing, striping, or removal of parking (notably on Spring Street) will require review and approval by City of Oxford staff.

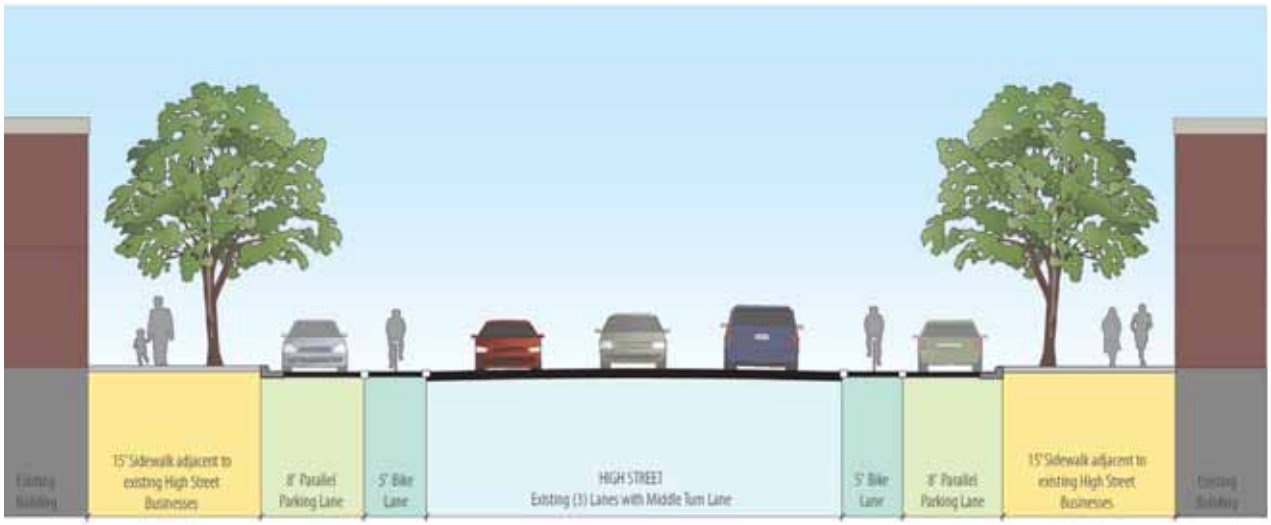
Bicycle ownership on campus varies greatly by students' academic year, residence location, and biking experience. In addition, 33% of the student body is from outside of Ohio, with a growing international population, making bicycle ownership less likely, as transporting a bicycle longer distances at points throughout the school year is difficult. Other campuses, such as Cornell and North Carolina State University, have developed bicycle share and bicycle rental programs that allow free or low-cost rental by the hour, day, or semester to students and the campus community. Bicycle rental programs are also available to international students on a semester basis on a number of campuses. As such, other programs that should be further studied for possible implementation on Miami University's campus include bicycle share or rental, bicycle maintenance clinics, and bicycle awareness and campus safety bicycle tours.

Example of bike share program



Bicycle Master Plan

Potential long-term High Street improvements



Potential long-term High Street cross-section

Bicycle Parking

Providing bicycle parking on campus is essential to the successful implementation of the Bicycle Master Plan. Without appropriate bicycle parking facilities on campus, bicycle facilities put in place to bring people to campus will be underutilized, especially by more experienced riders who often hesitate to park more expensive bicycles in unsecured, unlit, or uncovered areas. The recommendation stated in the campus pattern language that bicycle parking should be provided at every residence hall and every academic building should be implemented with, at a minimum, standard outdoor bicycle racks on a hard surface near a main door. Indoor and/or covered bicycle racks should be installed wherever possible. Covered bicycle parking is recommended at residence halls and popular, centralized campus destinations such as the new Student Center. Parking garages provide ideal locations where indoor/covered parking can be provided easily without major modification. The North Campus Parking Garage, with its central location and high parking turnover rate, would be an ideal location for an indoor bicycle parking facility. Where possible, residence halls should have secure storage for bicycles inside to provide protection for bicycles on a day-to-day basis, as well as over winter months when out-of-town students cannot take their bicycles home for storage. Bicycle parking lockers for rental have garnered success on a number of other campuses and should be further considered.

Covered bicycle parking at North Carolina State University (proposed bicycle parking)

Miami University bicycle parking at Shriver Center

Miami University bicycle parking near Morris Hall

3.1.2 NON-MOTORIZED (PEDESTRIAN)

Pedestrian facilities are the single most heavily utilized transportation facilities on college campuses, as nearly everyone, staff and students alike, walk through a portion of campus on a daily, if not hourly, basis. As a result, the project team has placed considerable emphasis on improving the connectivity, safety, and usability of the pedestrian network. Improvements and design principles for pedestrian facilities at their interface with vehicular facilities as well as internal to campus are recommended below.

Miami University example of pedestrian desire line

In response to gaps and conflict points in the pedestrian network described in section 2.0 Issues & Opportunities, the project team developed a "Pedestrian Bill of Rights" used to spur discussion within the Steering Committee on what aspects of a pedestrian network create the best functionality and safety. The Steering Committee generally agreed that, despite the fact that following some of these principles could create asymmetric or non-rectangular paths in particular locations on campus, catering to pedestrians where practical is critical for the safety and convenience of the campus community.

The Miami University "Pedestrian Bill of Rights":

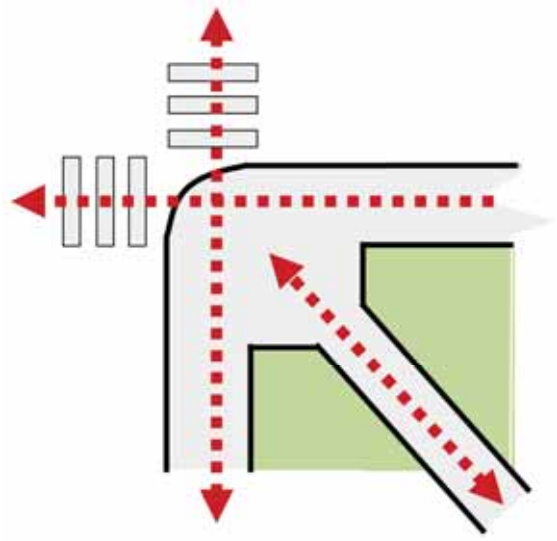
- Recognize larger cross-campus pedestrian flows and routes.
- Design routes and walks to accommodate cross-campus travel to destinations.
- Identify barrier-free route network across campus.
- Align mid-block crossings to larger cross-campus walks (not to individual building entrances).
- Locate building entries and entry walks to major intersections and cross-campus walks, not just to the sidewalk.
- Consolidate the number of sidewalks and crosswalks to where pedestrians actually use them.
- Minimize the use of post and chain/pedestrian barriers to areas of actual safety concern.
- Can we let pedestrians walk where they want to … even if it means non-symmetry?

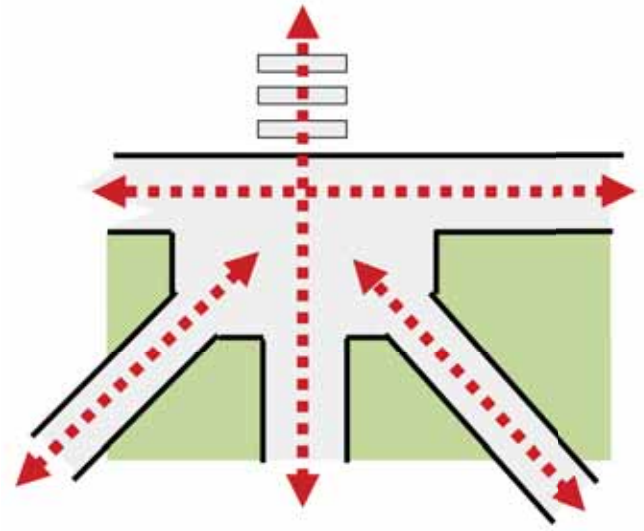
The following general design principles for pedestrian facilities were developed to provide examples of pedestrian-friendly design in various locations on campus. They should be used when designing new pedestrian facilities and when modifying existing pedestrian facilities.

Miami University example of pedestrian desire line

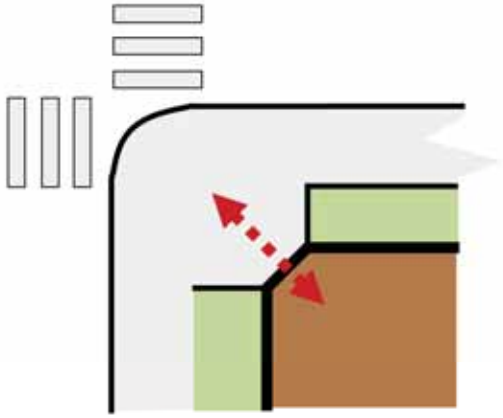
Pedestrian Design Principles:

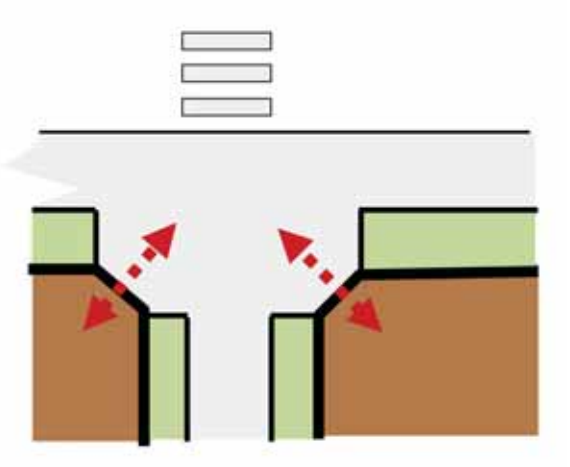
1. ***Align Major Walks and Crossings***
   - Align crossings with sidewalks at intersections.
   - Align intersections.
   - Create mid-block crossings at major corridors only.
   - Provide accessible features at every crossing.
   - Orient ramps to crosswalks.
   - Reduce number of crosswalks crossing one roadway in a particular area.



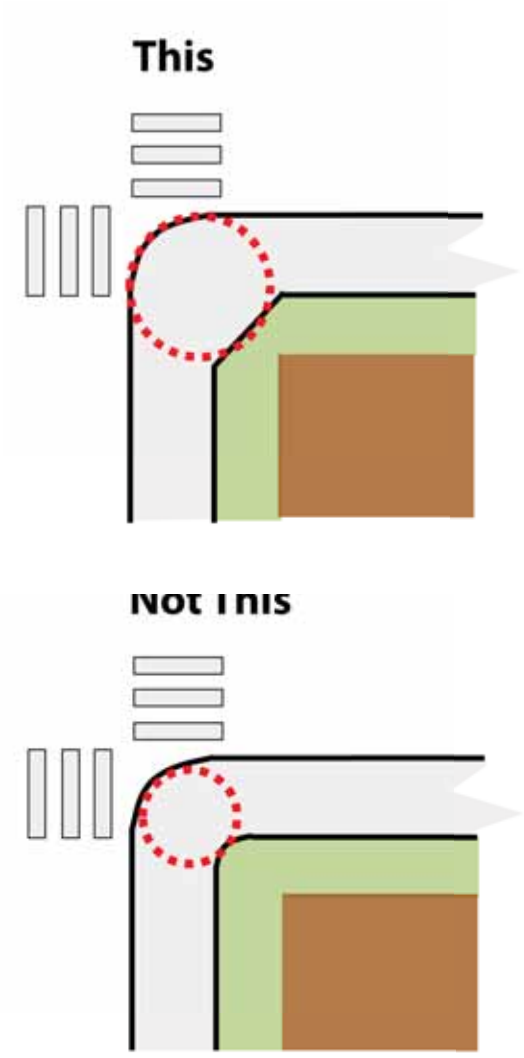


2. ***Orient Building Entrances to Major Walks***
   - Bring building entry walks to major crosswalks and intersections.
   - Bring major and minor sidewalks in alignment with consolidated mid-block crossings .
   - Orient new buildings entrances to major pedestrian corridors and intersections.

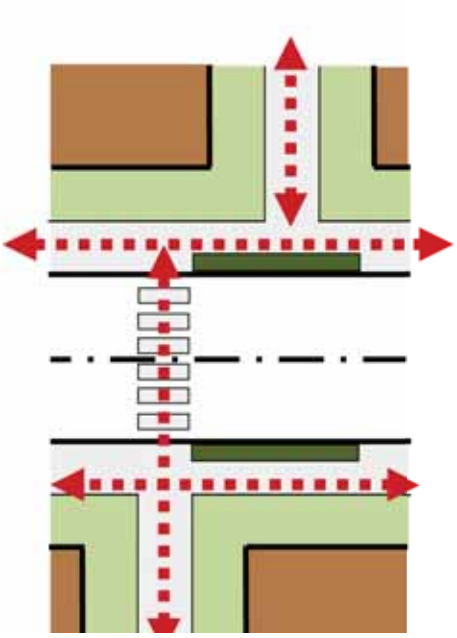




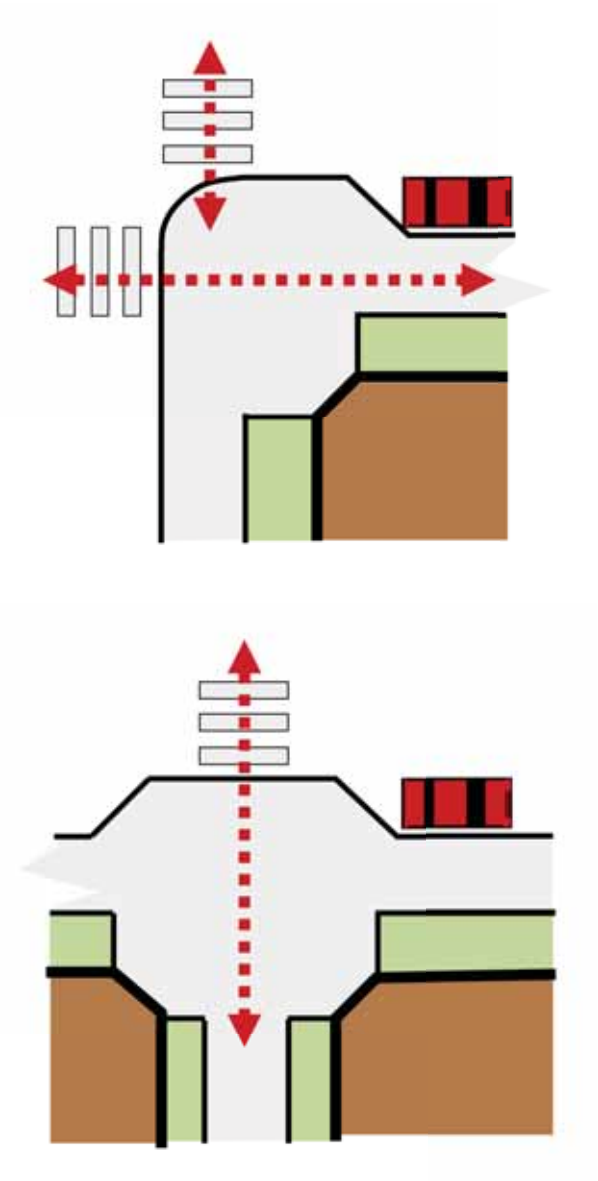
3. ***Ample Platooning at Intersections***
   - Provide ample "platooning" area at intersections for pedestrians.
   - Widen walks at intersections.
   - Remove unnecessary clutter from corners.



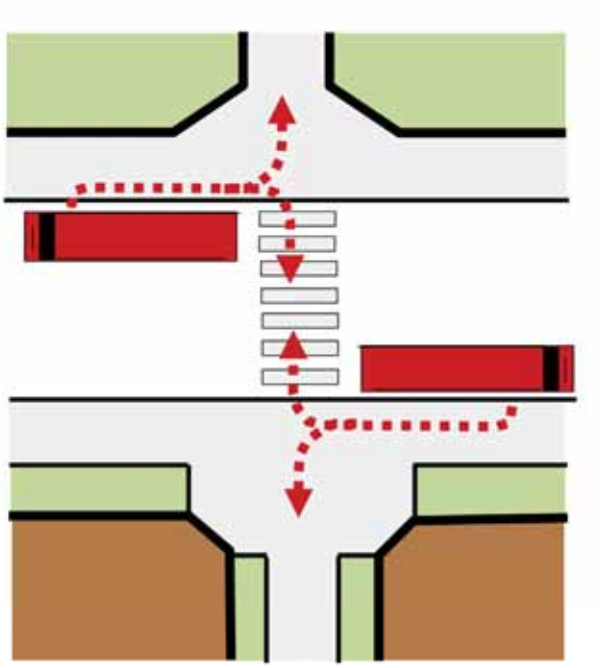
4. ***Avoid Offset Corridors***
   - When corridors on opposite sides of a street can't be aligned, use directional measures to guide pedestrian movements.



5. ***Curb Extensions***
   - Create curb extensions to shorten the roadway crossing for pedestrians and slow traffic when on-street parking exists.



6. ***Bus Stop Locations***
   - Load and unload buses adjacent to intersections and mid-block crossings to put pedestrians where they want to be.
   - Consolidate bus stops to locations where common crossings can be used.
   - Explore locating crosswalks behind stops for greater pedestrian visibility.

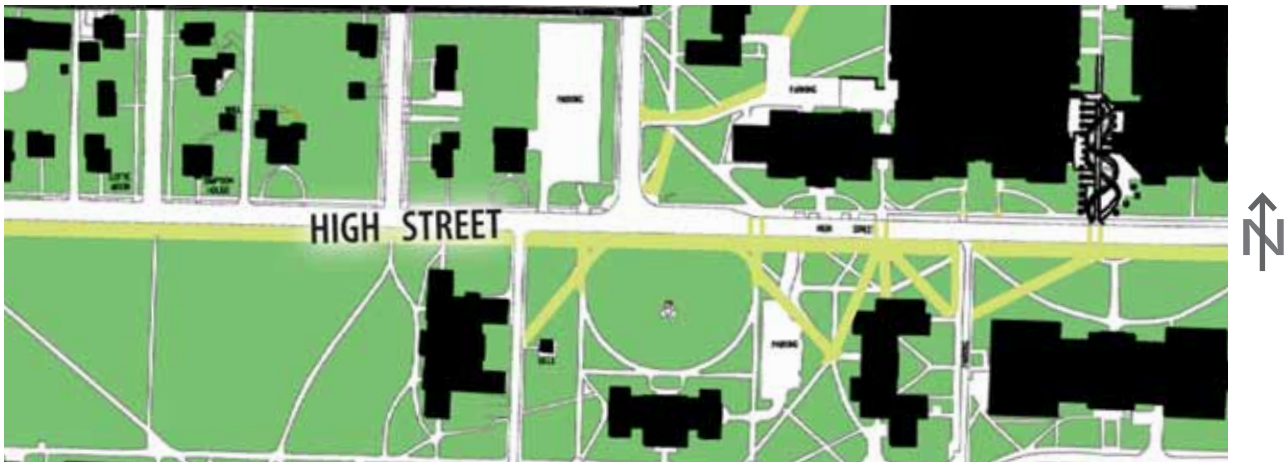


In combination with traffic calming measures discussed in section 3.2 Vehicular and Emergency Access, following these principles will increase safety, reduce pedestrian cut-through, and increase pedestrian connectivity. The Pedestrian Master Plan incorporates the design principles discussed above and master-planned campus improvements to improve pedestrian connectivity and safety on campus, while respecting the existing symmetrical quad-based pedestrian language to the extent possible.

Pedestrian Master Plan

The project team also studied the following locations in detail, providing recommendations for removing and consolidating crosswalks in the locations shown to improve safety for each area.

Spring Street crosswalks



High Street crosswalks

Patterson Avenue crosswalks

A public awareness campaign on the dangers of texting while crossing busy streets could reduce scenes like these found on Miami University's campus during one project team visit.

3.2 VEHICULAR & EMERGENCY ACCESS

Although the project charge was to address primarily non-motorized transportation modes, the project team felt it was necessary to consider vehicular transportation modes in particular locations in order to improve pedestrian safety and provide a truly integrated Circulation Master Plan. The following are particular roadway treatments recommended for the University's campus.

Traffic Calming

Traffic calming measures are physical features implemented at problem locations to control traffic speed and encourage driving behavior appropriate to the environment.

- Patterson Avenue/US 27 has a 45 mile per hour speed limit until it is adjacent to campus where it changes to a 35 mile per hour speed limit. Anecdotal evidence shows that vehicles are often travelling faster than 35 miles per hour when approaching campus crosswalks. Installation of pedestrian refuge islands at crosswalks with an intermittent raised median between Chestnut Street and Spring Street is recommended. Patterson Avenue is a state route, and therefore ODOT approval, in addition to City of Oxford approval, will be required for any roadway configuration changes.

Examples of pedestrian refuge islands and median traffic calming measures

- A south campus gateway should be installed near the intersection of Chestnut Street and Patterson Avenue. Gateways calm traffic by providing a visual signal of a change in pedestrian environment, and are particularly useful for this at campus edges.

Example of campus gateway in median

- Spring Street speeds are generally within the 25 mile per hour speed limit (according to anecdotal evidence) through campus, but driver behavior is often not appropriate for the heavily-travelled pedestrian environment. A speed table with special intersection paving and curb bump-outs is recommended at the intersection of Maple Street and Spring Street as part of the new Student Center construction. Conversion of this intersection to an all-way stop is an additional recommendation that should be further studied.

Example of a speed table at a campus intersection

- High Street through campus has a speed limit of 35 miles per hour and, like Spring Street, driver behavior does not always reflect the heavily-travelled pedestrian environment. In addition, High Street is the main east-west connection through the City of Oxford, bringing heavy local and through traffic through the core of campus. Because High Street is currently a truck route and state highway, less invasive traffic calming treatments such as painted medians with "yield to pedestrian in crosswalk" paddles are recommended at crosswalks. These signs provide highly visual objects within the roadway and the driver's primary line of sight. They alert drivers of the potential for pedestrians crossing the road, as well as provide a physical obstacle that discourages the use of the two-way-left-turn lane as a passing lane when buses are stopped in the through lane. Reduction of the speed limit to 25 miles per hour should also be further studied, as there is potential for the University and City of Oxford joining forces to petition ODOT to reduce the speed limit on High Street and Patterson Avenue through campus.

Example of a painted median with "yield paddles"

Naked Streets

Naked streets are streets with no signs, traffic markings, curbs, etc., and are often paved in materials similar to those of a sidewalk or pedestrian environment.

On naked streets, pedestrians, bicycles, and vehicles share the roadway equally. Naked streets have been successful in areas of low traffic volume in reducing vehicular speeds and encouraging drivers to pay more attention to the pedestrian environment.

- Conversion of Irvin Drive and Bishop Circle to naked streets and limiting access to only emergency vehicles, service vehicles/buses, those vehicles needing ADA access to adjacent buildings, and bicycle and pedestrian usage is recommended in order to enhance the pedestrian core of campus and increase connectivity.

- Conversion of the King Library/Spring Street connector to a naked street, limiting access to only emergency vehicles, deliveries, bicycle and pedestrian usage is recommended. Additionally, full closure of the roadway segment between the King Cafe and Bishop Hall delivery areas is recommended to accommodate the proposed diagonal walk from McGuffey Hall into the core of campus.

Examples of naked streets on campuses

Complete Streets

Complete streets are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users. Roadway uses that benefit from complete streets include: passenger vehicles, bus transit, bicycles, pedestrians, and disabled persons. Complete streets respond to their community context, and are actually required by some agencies.

- Traffic calming treatments listed above for Spring Street and High Street, along with sidewalk widening and the addition of bicycle lanes or paths would make Spring Street and High Street safer and more attractive for all users. Additional complete street treatments in locations other than those discussed above, such as High Street in uptown or Spring Street west of campus, should be implemented when the opportunity arises.

Green Streets

Green streets are designed to reduce stormwater runoff, bring natural elements into streets, and improve access for pedestrians and bicyclists. Many cities and campuses are designing green streets to meet sustainability goals, reduce runoff, and enhance user experience.

- Green street measures such as stormwater collection facilities or pervious pavers could be implemented on the naked streets discussed above, on Western Campus roadways, or on nearly any campus roadway.

Additional Roadway Improvements

- Modification of traffic operations on Center Drive (currently one-way eastbound) is recommended to accommodate westbound bus travel on the recommended Residence Hall Loop Route. Options are: (1) remove parking and convert to two-way street, or (2) reverse direction of one-way flow. Option 1 provides better system flexibility. The curb-to-curb distance is approximately 26 feet, which could accommodate either option without adjusting the roadway edges.

- The bollard and raised concrete island in the Billings-McFarland driveway should be removed to better facilitate bus access.

- Removal of parallel parking along Western Drive (as shown in section 3.3 Parking) is recommended to allow two-way traffic extending to just north (or south, if width allows) of Peabody Hall. Conversion to two-way traffic to Peabody Hall allows for greater flexibility in transit routing and turnaround and accommodates bicycle traffic on Western Drive northbound from Peabody Hall.

- Additionally, minor modifications to the High Street/ Patterson Avenue and High Street/Tallawanda Street intersections that have the potential to improve pedestrian convenience and connectivity should be studied to determine their impact on intersection operations:

  - » Include pedestrian recall and all-red pedestrian phase during class hours.
  - » Implement minor geometry modifications including removal of or modifications to turn lanes.
  - » Close north entrance to West Cook Parking Lot.

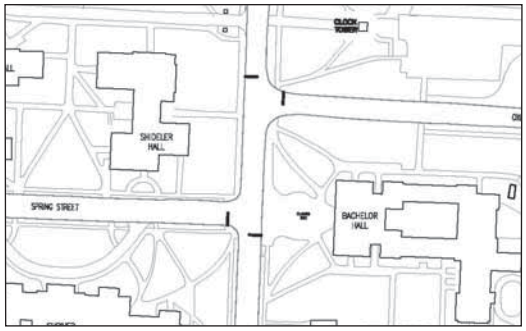
- The Spring Street/Patterson Avenue/State Route 73 intersection operates poorly. Its offset tee configuration creates additional vehicular and pedestrian conflict points, produces queues that block the adjacent legs of the offset tee, and increases pedestrian and motorist tendency to travel through the intersection on a yellow or red light. Intersection operations often result in gridlock generated by both bicycle and pedestrian queues. The existing configuration is not pedestrian-friendly and does not adequately accommodate car and truck traffic. Further study and coordination with ODOT of potential pedestrian treatments and intersection improvements is recommended.

  A number of improvements to the Spring Street/ Patterson Avenue/State Route 73 intersection varying in complexity of implementation and effectiveness are possible, including:

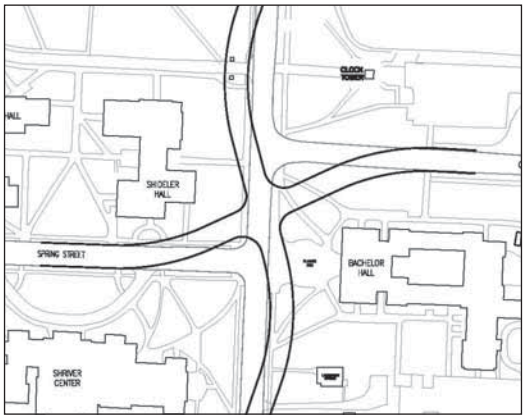
  - » Recommended with all solutions: Pedestrian recall and countdown timers for pedestrian phase
  - » Recommended as preliminary solution: Signalize full offset tee as one intersection.
  - » Recommended as long-term solution: Remove Bachelor Hall and realign Spring Street through building footprint.
  - » Study for effect on intersection operation: All-red pedestrian phase.
  - » Realign intersection to be a four-way intersection without removal of Bachelor Hall.
  - » Install roundabout at intersection.

Emergency Access

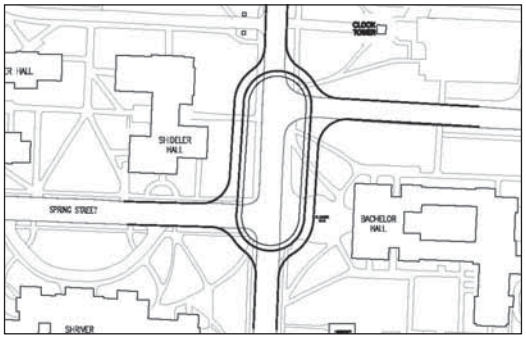
Due to recent acquisition of larger fire trucks, the University Fire Department has increased its requirements for emergency access path width and number of access locations. Although facility modification for all necessary emergency access routes is outside of the scope of this project, the project team has attempted to provide adequate width for the new fire trucks in locations where sidewalk or roadway improvements are already being recommended in other portions of the Circulation Master Plan. A minimum width of 20 feet is required to accommodate the new equipment. This width can be accommodated with all pavement or a minimum of 10 feet of reinforced hard surface and 10 feet of geotextile grid reinforced lawn. Due to the extent of the requested fire access route modifications and additions, further research on a per project design basis will need to occur.



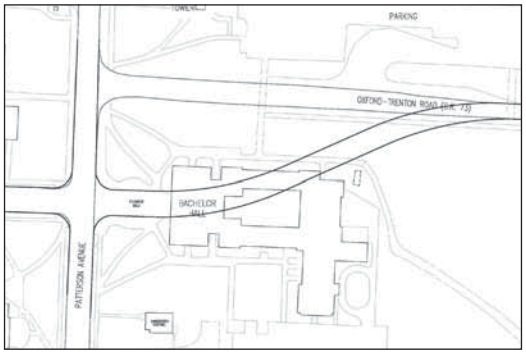
Signalize as one intersection
(Recommended as preliminary solution)



Realign intersection to be four-way (no Bachelor Hall removal)



Install roundabout



Realign intersection to be four-way (with Bachelor Hall removal)
(Recommended as long-term solution)

3.3 PARKING

Parking on Miami University's campus is currently utilized 63% during the peak parking period, as discussed in section 2.3 Parking. As illustrated by this overall campus parking utilization percentage, the addition of the Campus Avenue Garage and North Campus Garage increased the overall number of parking spaces on campus beyond total demand. To accommodate improved pedestrian, bicycle, and transit facilities and to aid in balancing parking demand with supply, modifications to parking in a number of locations is recommended.

In addition to the spaces already added with the construction of the Campus Avenue Garage and North Campus Garage, modifications to campus parking due to master-planned improvements and Circulation Master Plan recommendations include:

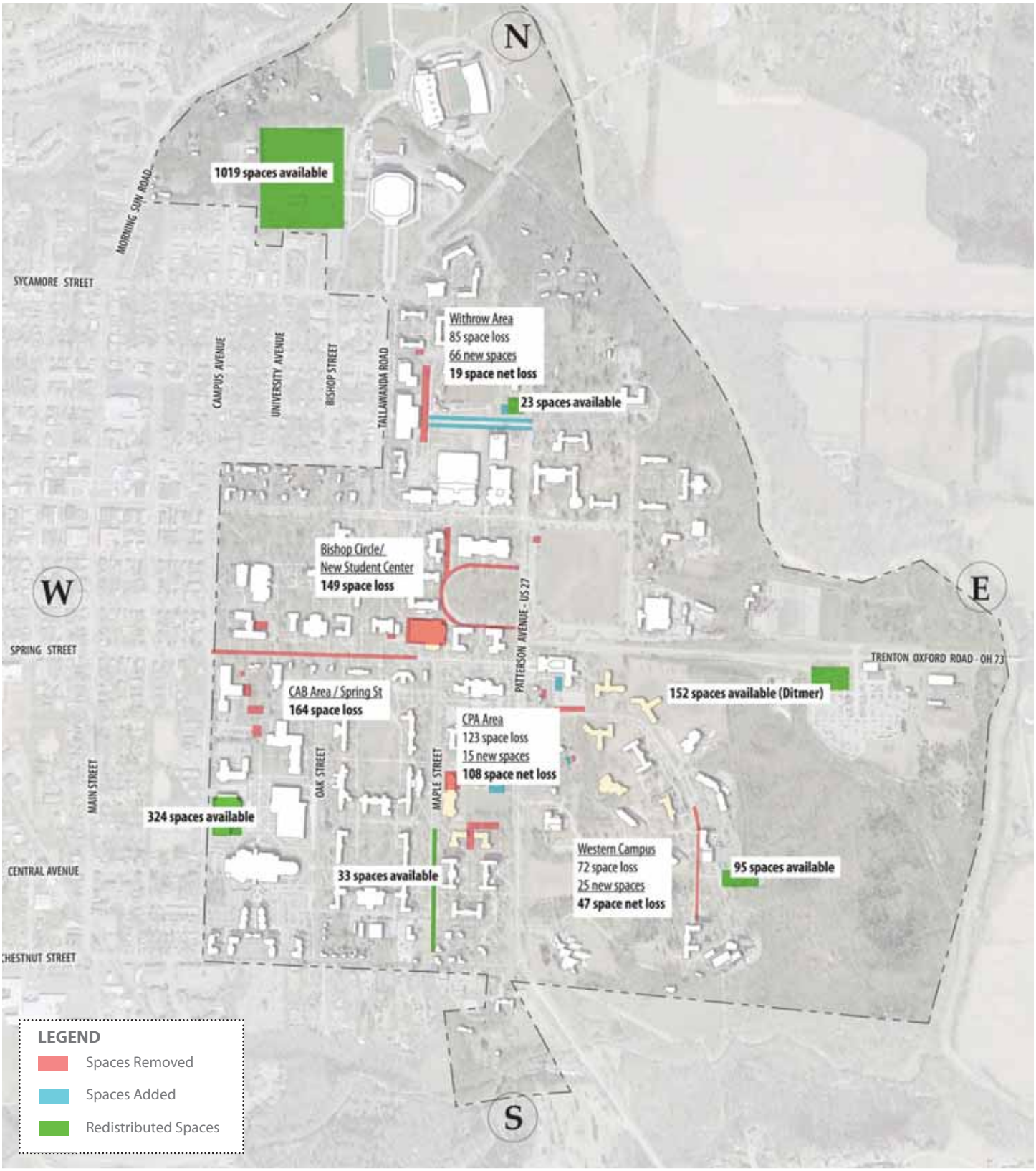
- Removal of parking along Spring Street to accommodate bicycle lanes on each side of the street.
- Modification of parking lots in the Campus Avenue Building area to accommodate an axial walkway from the Recreational Sports Center to King Library.
- Removal of lots adjacent to Gaskill, Robertson, and Rowan Halls as part of construction of the new Student Center.
- Removal of two lots in the Center for the Performing Arts quad resulting from future dining and residence hall construction, and addition of spaces to one lot.
- Removal of parallel parking along Bishop Circle and Laws Drive to allow for restricted access naked street concept and emphasis as a major bicycle and pedestrian corridor.
- Reconfiguration of lots in the Withrow Court area to create cleaner, more standard configuration of the Withrow Court roadway and enhance pedestrian facilities.
- Addition of parallel parking spaces along Withrow Court to reduce number of spaces removed in Withrow Court Lot reconfiguration and calm traffic along Withrow Court.
- Removal of a limited number of spaces at the north end of the West Cook Lot to allow for closure of the northern access to this parking lot.
- Reconfiguration of Bachelor Lot to accommodate new pedestrian pathway and accommodate spaces lost in Western Campus master-planned improvements.
- Reconfiguration of Patterson Place Lot to accommodate bicycle and pedestrian improvements.
- Removal of parallel parking along Western Drive to allow for two-way traffic extension to near Peabody Hall, including two-way transit traffic.

Total Parking Spaces on Count Day:	8,177
Total Parking Spaces Utilized in Peak Hour:	5,151 (63%)
Total Parking Spaces Available in Peak Hour:	3,026
Total Parking Spaces Removed Due to Proposed Housing and Circulation Master Plans:	593
Total New Spaces Added:	106
Total Net Reduction:	487
Parking Ratio without Replacing 487 Spaces:	2.41 to 1

The recommended net reduction in parking spaces can easily be accommodated by the existing parking supply creating a parking ratio of 2.41 people to one parking spot, which is lower than the national average of 2.8 and lower than that of many comparable universities such as Cornell (2.5) and University of North Carolina (2.7). This parking reduction should be considered a continuation of "right sizing" the additional capacity that was created as a result of the construction of the two parking decks on campus.

As the parking utilization rates, shown by study data, and turnover rates, shown by staff-collected data and anecdotal evidence, are higher in the core of campus, policy changes should be implemented to encourage students to utilize alternative forms of transportation to campus or, at the least, while on campus. Policies such as providing a special free or reduced-cost temporary permit that allows for a limited number of days (possibly 10 days per semester) of close proximity parking for students, faculty or staff who don't purchase a standard permit, and preferential parking for carpools and low-emissions vehicles have been successfully implemented on other campuses.

Specific lots that should be considered for policy changes include the North Campus Garage, the Campus Avenue Garage, the West Millett and Ditmer Field Park-and-Ride Lots, the South Cook Lot and the Heritage Lots. Modifications to permit colors in the South Cook and Heritage lots should be explored in order to create better utilization of those lots. Implementation of policies encouraging commuter parking in the Campus Avenue Garage and subsequent transit usage would be ideal because of the garage's low utilization and its proximity to US 27 South, which serves a high percentage of commuter trips.



Parking Recommendations

3.4 TRANSIT

The purpose of the revisions to the Miami Metro transit system is to better serve the Miami University community and to increase ridership. To do this, the routes focused on serving the three target markets listed below. Conceptual bus routes were developed to address the needs of these groups based on surveys, personal interviews, markets, population densities, and desired destinations. The three target markets include:

1. Students who need mobility (locally) and do not need to utilize parking areas.
2. Commuters (faculty, staff, off-campus students) who park in the remote lots and parking structures and need rides in.
3. Choice riders, those who drive now, but could take the bus if the service meets their needs.

Recommended Bus Routes

The routes listed below were developed based on the criteria identified above and refined based on feedback from the Steering Committee. The recommended bus routes are described and illustrated on the subsequent pages in this section.

- Core to Core
- Residence Hall Loop with Walmart Flyer
- North Loop
- North-South Core
- Park-and-Ride Express
- Sprint Street Connector
- Tollgate Loop and Westside Express
- Western Express

The intent of the bus routes is to serve the identified markets in an efficient and effective manner. Shorter routes were preferred over longer routes to reduce overall travel times. Additionally, loop routes were generally preferred to out and back link connections because of the expanded pedestrian capture area. A basis of ¼ mile was used as an acceptable pedestrian walking distance to get to a bus, which is shown as the approximate bus route capture area. Recommended station locations are based on the ¼ mile walking distance, as well as an effort to maintain use of as many existing bus stops as possible.

Bus Route Distances

Miami University would like to maintain the current operational levels in terms of commitment of resources. As such, it is important to consider bus route travel distances, along with headways, in assessing the allocation of resources. The approximate distances of the current and recommended bus routes are presented below. The recommended bus routes cover more total miles than the current routes due to the addition of the Walmart Flyer and the Westside Express routes. Without those two routes, the resulting total mileage for the recommended routes is slightly less than the current bus routes.

Current Bus Routes	Estimated Distance
Blue Route	5.3 mi
Green Route	3.8 mi
Orange Route	4.7 mi
Purple Express 1	2.7 mi
Purple Express 2	2.7 mi
Red Route	3.7 mi
Yellow Route	4.8 mi
Total Current Travel Distance (sum of all routes)	**27.7 mi**

Recommended Bus Routes	Estimated Distance
Core to Core	2.9 mi
Residence Hall Loop	3.8 mi
-Walmart Flyer (extension spur only)	5.5 mi
North Loop	3.6 mi
North-South Core	2.9 mi
Spring Street Connector	3.5 mi
Tollgate Loop	4.2 mi
Westside Express	6.6 mi
Park-and-Ride Express	3.9 mi
Western Express	2.6 mi
Total Recommended Travel Distance (sum of all routes)	**39.5 mi**
Travel Distance Without Walmart Flyer and Westside Express	**27.4 mi**

Proposed Bus Stop Locations

The proposed bus stops are shown on the combined route map following the route descriptions. The stop locations are proposed in places that serve the routes and desired destinations and where they integrate well with the Pedestrian Circulation Plan. For example, if a bus stop is located near a crosswalk, it should be placed so that the bus stops beyond the crosswalk, requiring the pedestrian to cross behind the bus. This will enhance the visibility of pedestrians to drivers behind the buses, an important consideration since vehicles are permitted to pass stopped Miami Metro buses.

The proposed bus stop locations should be verified in the field to ensure optimal placement of the stops and avoidance of conflicts with existing elements in the area such as utilities, trees and other physical features. Some existing bus stops will better serve the new routes if they are shifted, as feasible. For example, student feedback indicated a preference for the stop by the King Library to be located as close to the doors as possible.

Transit waiting environment improvements may be required at the proposed bus stop locations to accommodate the riders, such as provision of sidewalks and paved waiting areas, benches, shelters, route information, wayfinding, etc. Pleasant and accommodating transit waiting environments with good information will attract more riders than bus stops with bare minimum facilities, like a sidewalk with a sign.

The project team reviewed a representative sample of boarding information for the current bus routes, as provided by the Miami University staff. The sample data indicates that the bus stops with the most boardings are located near the major university buildings and at the campus Park-and-Ride Lots, as well as at central retail and high-density residential nodes off campus. The bus stops with the fewest boardings are those that fall between major university buildings, high-density retail/ residential nodes, and major road intersections. This information validates the premise of this effort to focus on providing bus service and locating stops adjacent to major university buildings and in areas of high density. Note that a ridership survey would be required to determine peak hourly use and to assess origination/destination patterns. The data also points out that a very large number of riders sit on the buses through layovers at the Shriver Center. This is not an effective use of their time and likely discourages some potential riders from taking the bus. Restructuring the routes to use a system that does not have extended dwell times at specific locations may result in increased ridership.

Hours of Operation

Suggested periods of operation are shown in the table below. Specific hours of operation should be developed in collaboration with University staff based on University class schedules and hours of operations, and with an understanding of current service hours and ridership, and desired levels of service. The periods and hours of operation should be validated after the three-month transit system performance test (or after one semester) with evaluation of ridership data and possibly rider surveys. A three-month trial period would allow sufficient time to notify potential riders of the new bus routes and to allow the riders to change their bus riding habits.

Recommended Bus Routes	Daytime	Evening	Weekend
Core to Core	•	o	o
Residence Hall Loop - Walmart Flyer	•	•	• •
North Loop	•	o	o
North-South Core	o	o	o
Park-and-Ride Express	o		
Spring Street Connector	o	•	•
Tollgate Loop	•	•	•
Westside Express	o		
Western Express	•	•	•

- • Priority route
- o Desired route but not as high priority

Roadway Improvements

Performance of the bus routes, along with pedestrian access and safety, would be enhanced with the following modifications to the roadway network. It may be desirable to perform traffic studies to support these changes.

- Improve operational efficiency at Patterson Avenue (US 27)/Spring Street/State Route 73 intersection.
- Convert Spring Street/Maple Avenue to an all-way stop intersection. This will have the added benefit of enhancing operational safety for pedestrians and improving access for vehicles travelling to and from Maple Avenue.
- Modify traffic operations on Center Drive (currently one-way eastbound) to accommodate westbound buses. Options are: (1) remove parking and convert to two-way street, or (2) reverse direction of one-way flow. Option 1 provides better system flexibility. The curb-to-curb width is approximately 26 feet, which could accommodate either option without adjusting the roadway edges. This conversion should be coordinated with the parking and bikeway elements of the plan.
- Remove the bollard and raised concrete island in the Billings-McFarland driveway to facilitate bus access.

Prioritization of Routes

The routes are divided into three levels of prioritization (A, B, C) with A being the highest priority. The prioritization of the routes is based on how each route accommodates the purpose of Miami Metro's bus service, the perceived level of need for the potential riders, and the potential for ridership based on land uses, population densities served, and need. The prioritization levels should be reviewed by the Steering Committee and adjusted as appropriate. They should then be used to assist with allocation of resources.

Recommended Bus Routes	Level
Core to Core	A
Residence Hall Loop	A
-Walmart Flyer	B
North Loop	B
North-South Core	C
Park-and-Ride Express	A
Spring Street Connector	B
Tollgate Loop	A
Westside Express	C
Western Express	A

Bus Route Timed Runs

It is important that Miami Metro conduct timed runs using their buses and pausing at the bus stop locations to effectively simulate the time it will take to complete the route. This information should then be used to determine resource allocation with respect to the numbers of buses that will be assigned to each route for the various hours of operation and the approximate headways between buses. Note that if bus headways are 15 minutes or less, it is not necessary to post arrival/departure times because the wait for a bus will not be long or perceived as inconvenient. If the waits are longer, specific departure times should be developed. Once the new routes have been implemented, they should be allowed to run for approximately three months. Then they should be evaluated for ridership and to determine if route adjustments (i.e., route path, direction of travel, hours of operation) should be adjusted.

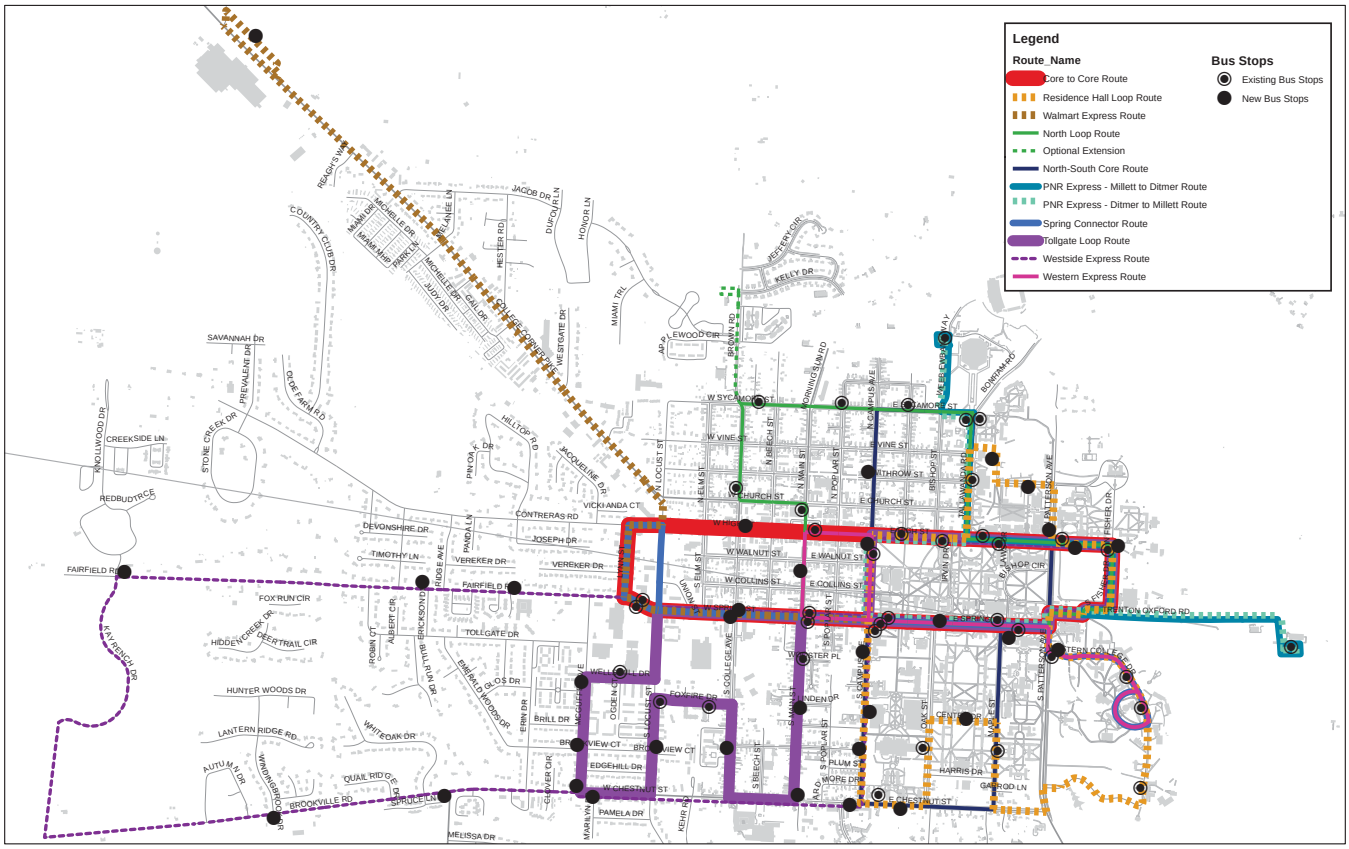
Miami University and Miami Metro staff conducted timed runs of the proposed routes using Miami Metro buses with stops at the proposed bus stop locations. The timed runs were conducted in July 2011, so the student/pedestrian population was significantly less than during the academic year. However, the travel times shown may be used as a relative comparison between the routes.

Proposed Bus Routes	Travel Time Estimate (min.)
Core to Core	18:00
Residence Hall Loop	22:00
-Walmart Flyer	route not tested
North Loop	20:00
North-South Core	route not tested
Park-and-Ride Express	
-Millett to Ditmer	19:00
-Ditmer to Millett	21:00
Spring Street Connector	19:00
Tollgate Loop	23:00
Westside Express	route not tested
Western Express	route not tested

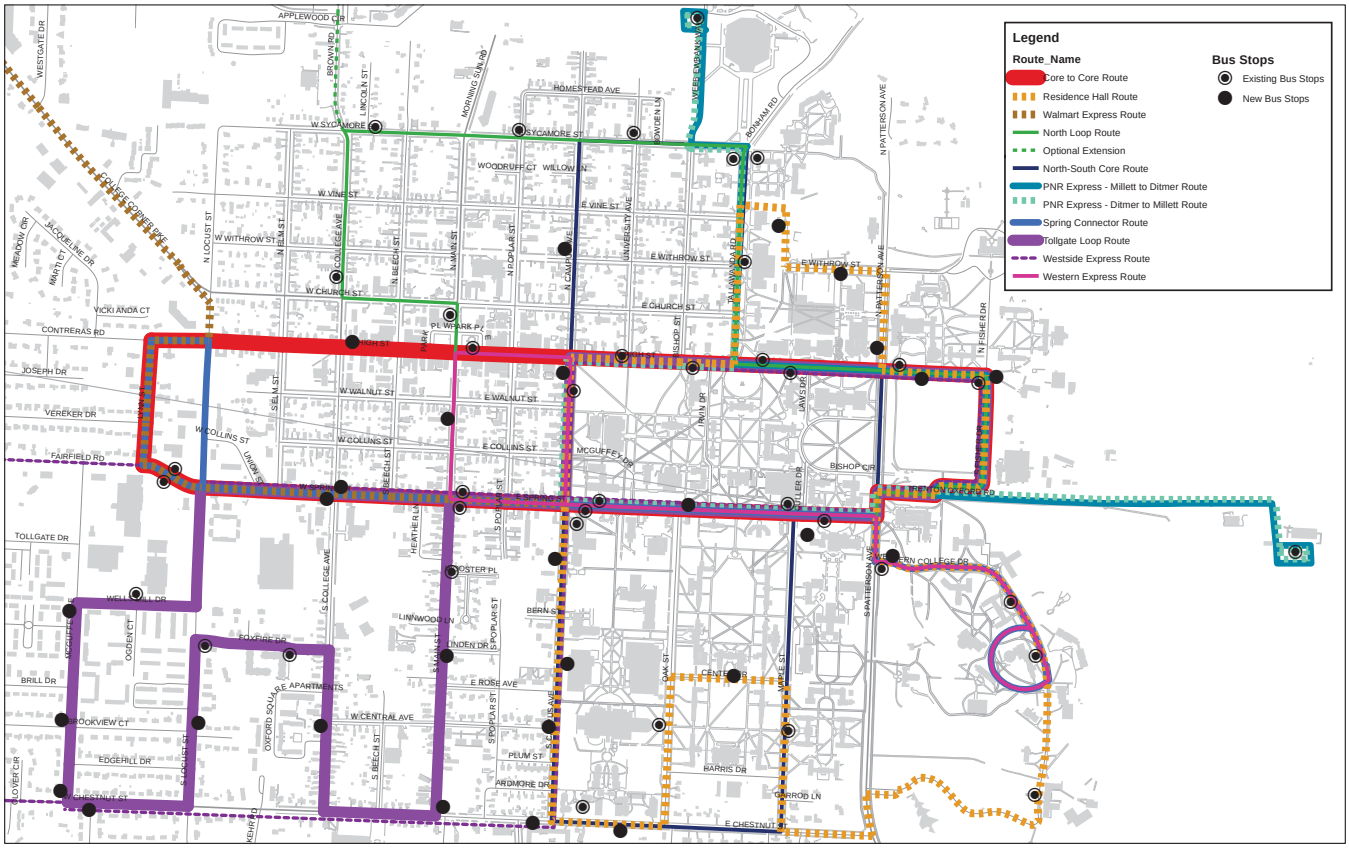
Note: Travel time estimates are based on timed runs conducted using Miami Metro buses, with stops at the originally proposed bus stop locations.

Bus Route Illustrations

A map showing all of the bus routes as they relate to each other is shown below. Each bus route individually is illustrated on the following pages.

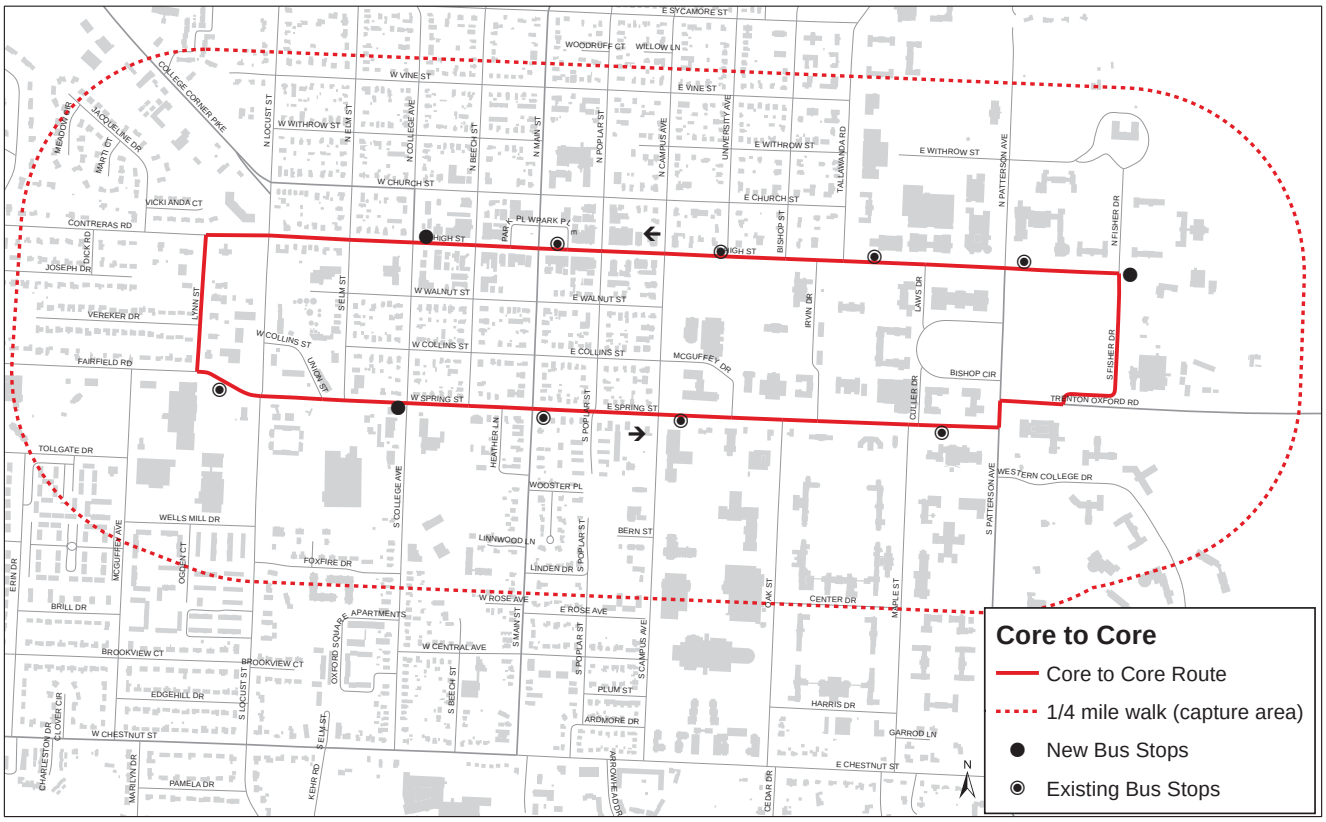


Overall On-Campus Route Map



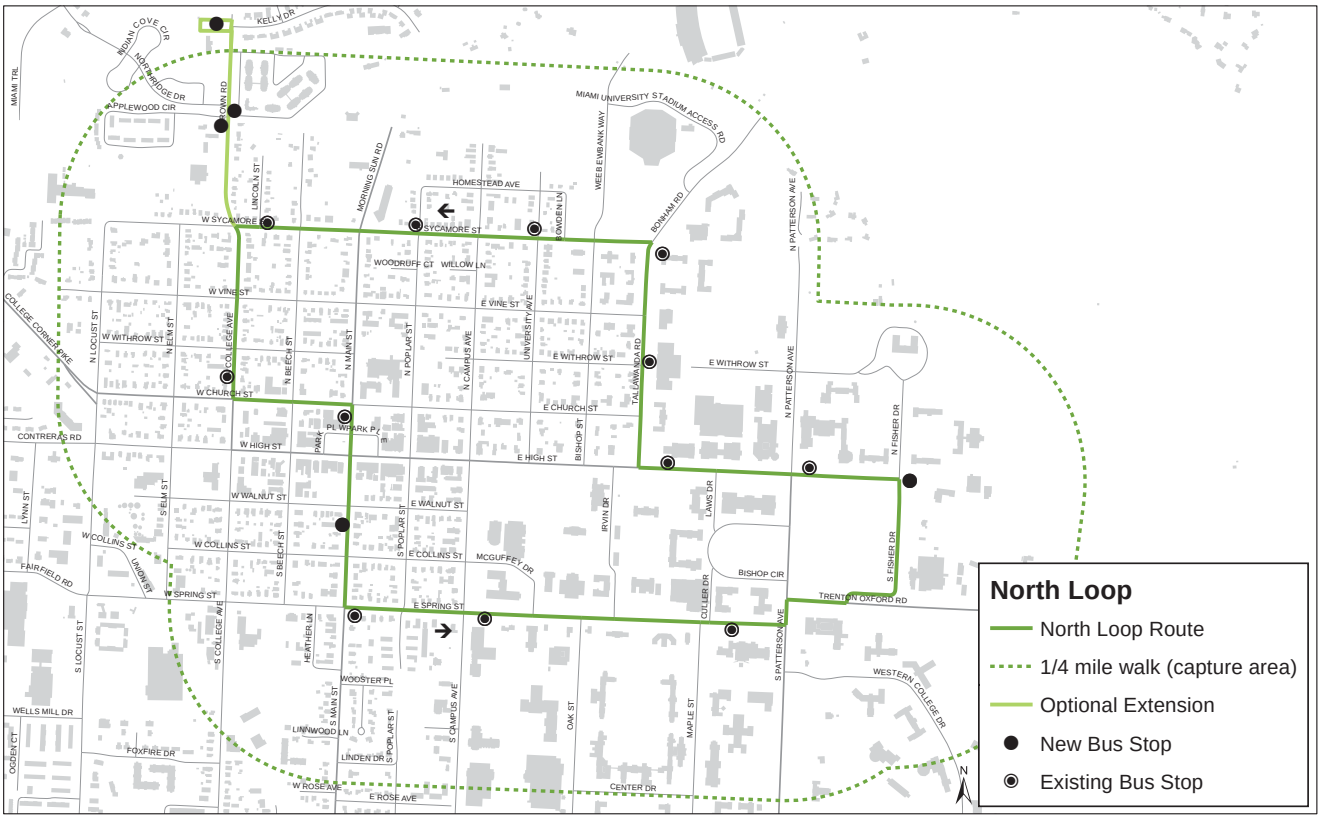
Core to Core

The Core to Core route provides access and mobility between the Miami University campus core and the core of uptown Oxford. This route was adjusted from the original proposal, extending the north end to Lynn Avenue and the south end to encompass Cook Field and Farmer School of Business. Given the functionality of this route, it would be beneficial to run this route during daytime/business hours, as well as evenings and weekends.



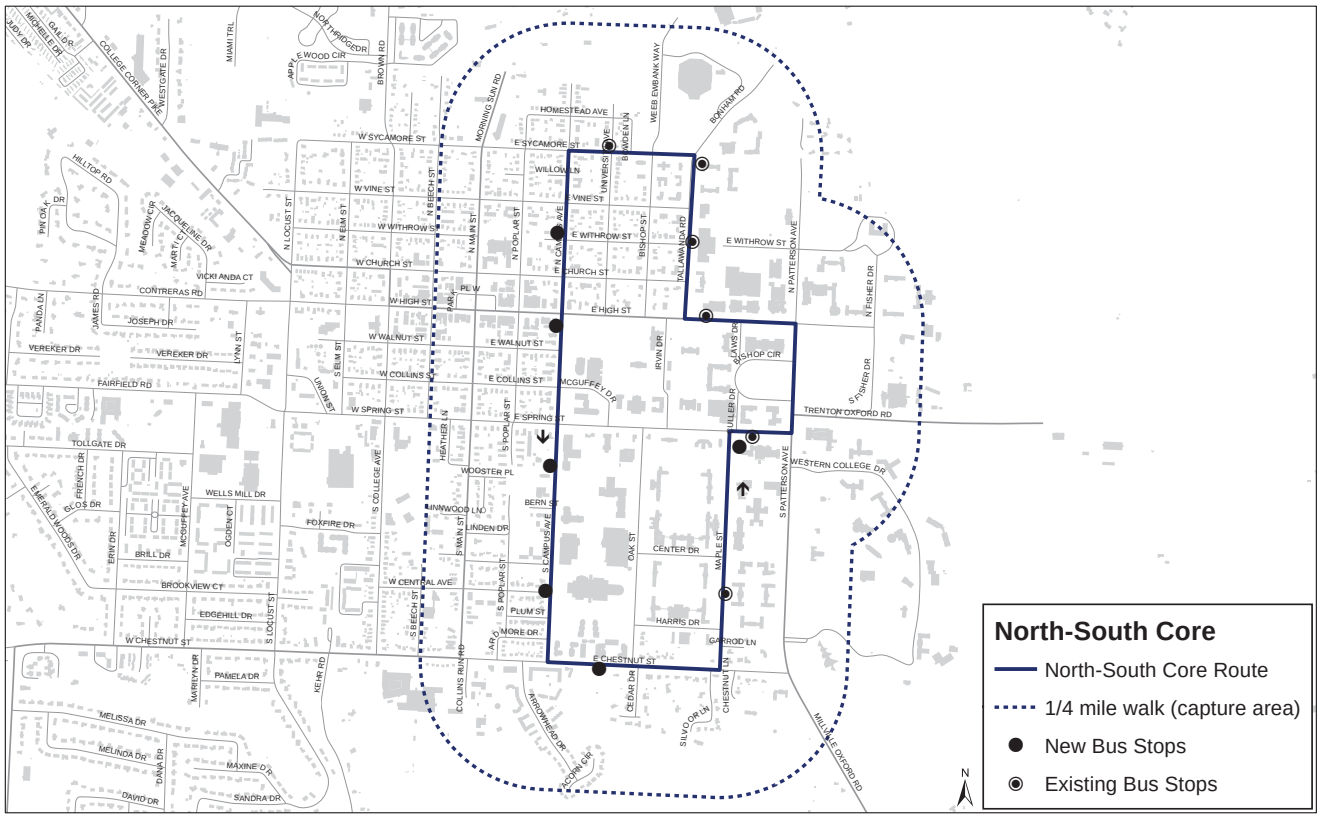
North Loop

The North Loop connects off-campus housing areas to the north and west of the University with the campus core. This route was adjusted from the originally recommended route, with the Brown Road turnaround moved from the Hawk's Landing entrance drive to the University property across from Kelly Drive. This adjustment will require construction of a second driveway access into the existing parking lot to facilitate bus turnaround. Until modification to the parking lot can be made, the route could left turn from Sycamore Street (westbound) to College Avenue (southbound). The extension to the north on College Avenue would be added when the bus turn can be accommodated in the parking lot. This route should be run during daytime/business hours, with possible extension into evenings and weekends, if it is supported by ridership and/or additional survey data.



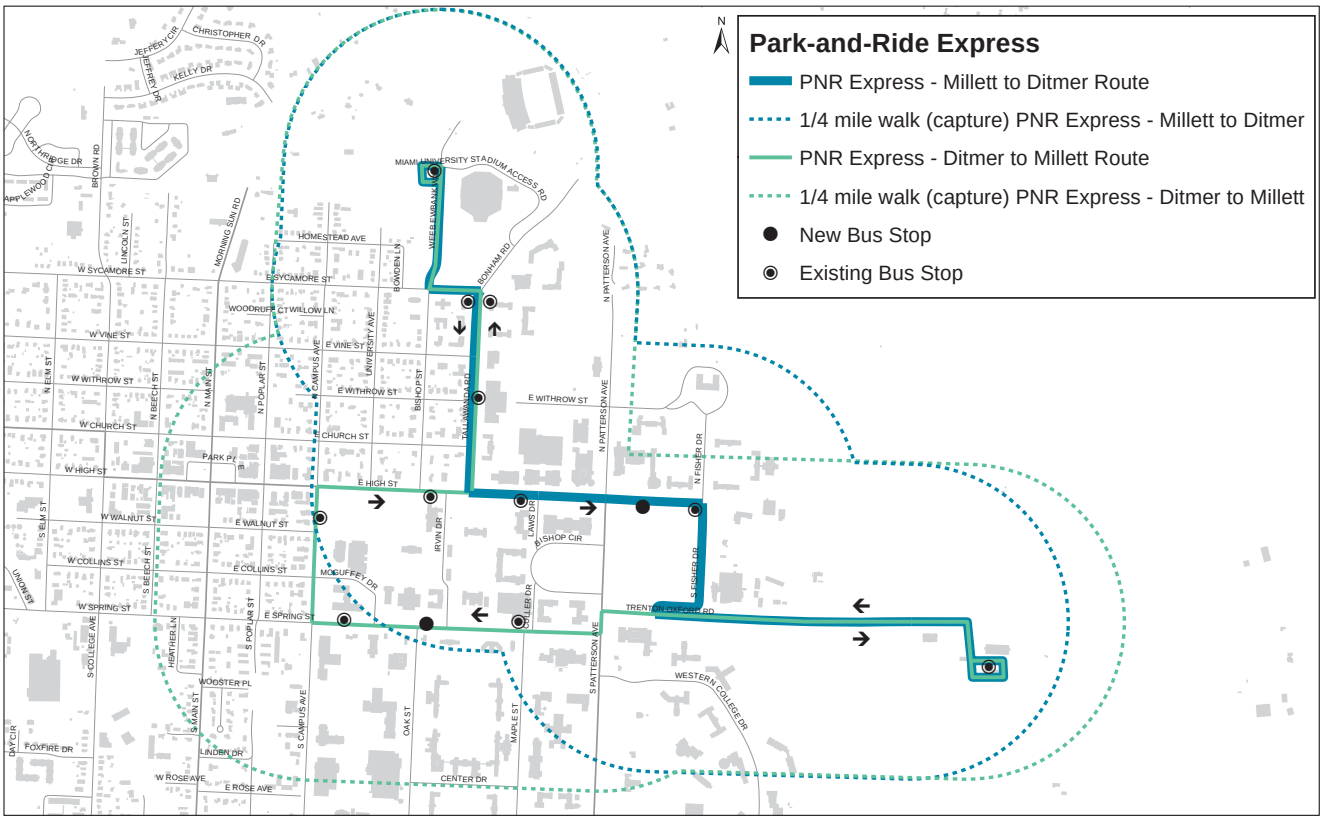
North-South Core

The North-South Core provides bus service that traverses the campus core and reaches the off-campus housing areas to the north and south of the University property. Bus service and pedestrian safety would be enhanced with the conversion of the Spring Street/Maple Avenue intersection to an all-way stop. Although the route is shown operating in one direction, it could easily operate in either direction, given the lack of physical constraints. The North-South Core route is somewhat redundant because it is covered by other recommended routes. As such, it provides for operational flexibility if resources are constrained and the level of bus service needs to be reduced.



Park-and-Ride Express

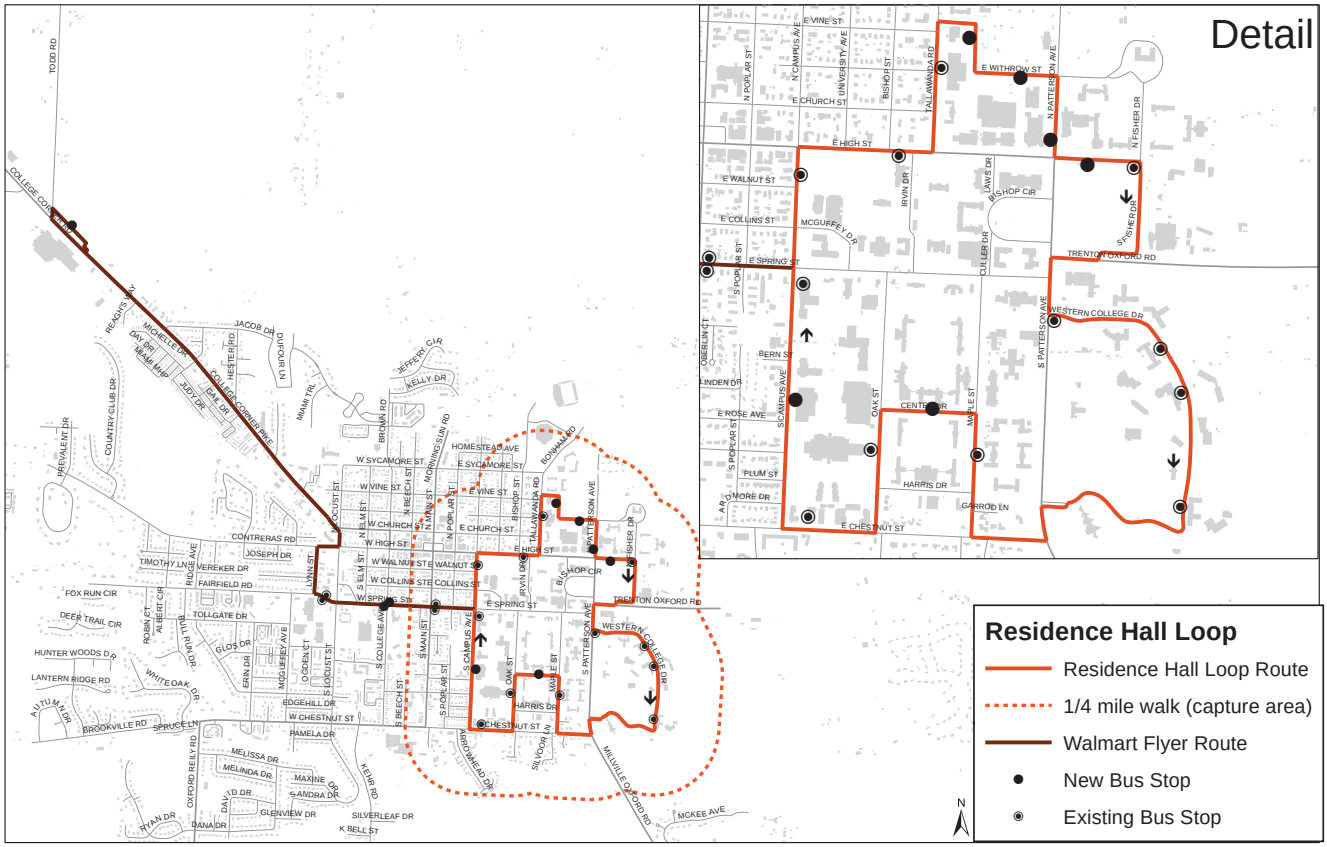
The Park-and-Ride Express, as shown, is a circulator that connects the remote parking areas (West Millett and Ditmer Field) with the campus core. This route is expected to be an efficient and effective way to connect commuters with their desired destinations. The Millett to Ditmer leg includes a stop at the North Campus Garage, thereby expanding the route's capture area. Service to and from the Park-and-Ride Lots is expected to be in highest demand during hours of school operation. If resources are available, it would be feasible to divide this recommended route into two routes, one from each Park-and-Ride Lot with each route making the loop around the campus academic core, as shown.



Residence Hall Loop with Walmart Flyer

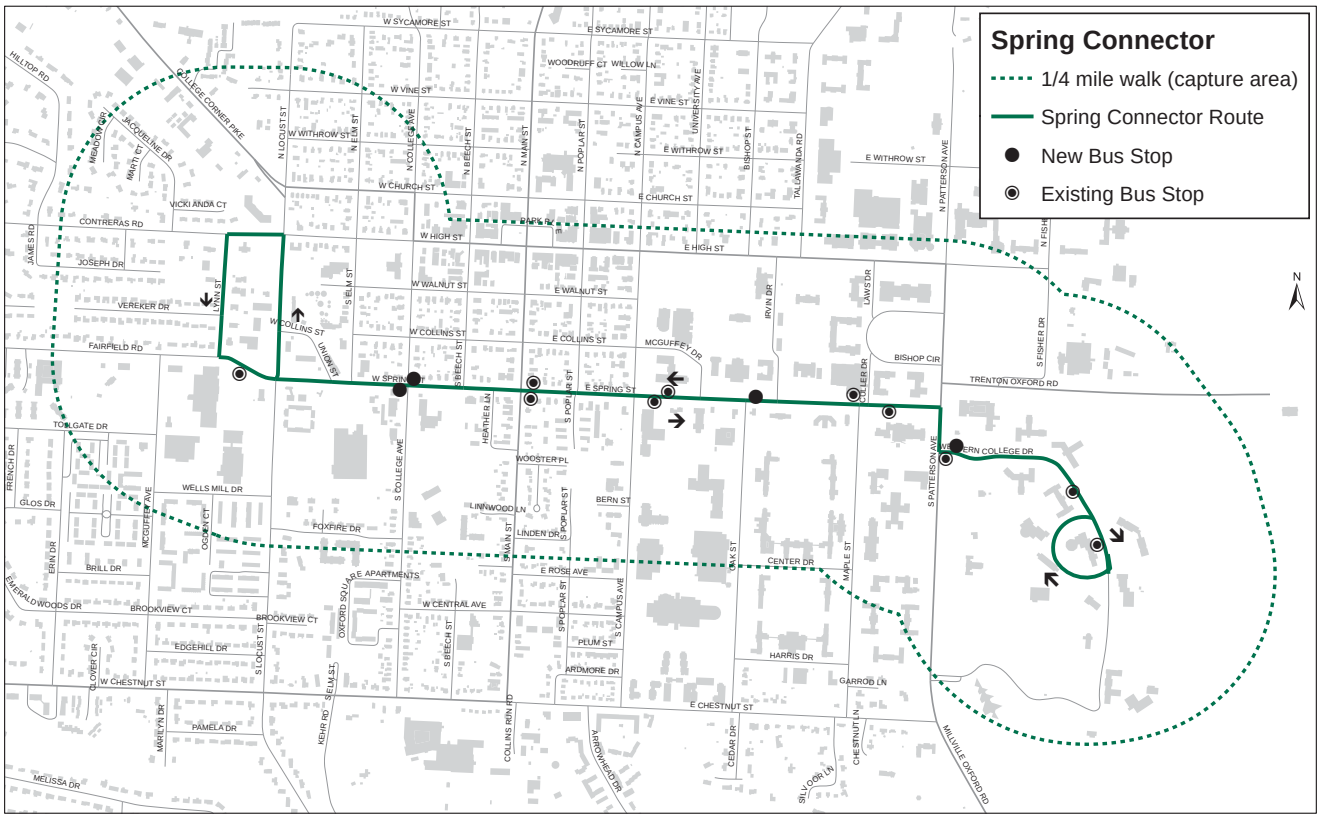
The Residence Hall Loop provides circulation between the campus residence halls and includes a stop at the King Library. The need for this route was clearly stated in the surveys and personal interviews. Respondents also expressed a desire for such a route to provide late night service, particularly to the library. As such, it would be beneficial to run this route from morning well into the evening or past midnight on weekdays and weekends.

Provision of bus service to Walmart was also expressed. An extension could be provided on the Residence Hall Loop to connect with Walmart and other businesses along the route. The Walmart Flyer should be connected to the Residence Hall Loop because of the anticipated desired travel patterns of on-campus students who expressed the need for the route: they want to travel from where they live to shopping opportunities, without having to walk a long distance carrying packages on their return trip. This service should run on a limited basis; Miami Metro staff indicated that a biweekly run on a weekend day would be supported, based on their research.



Spring Street Connector

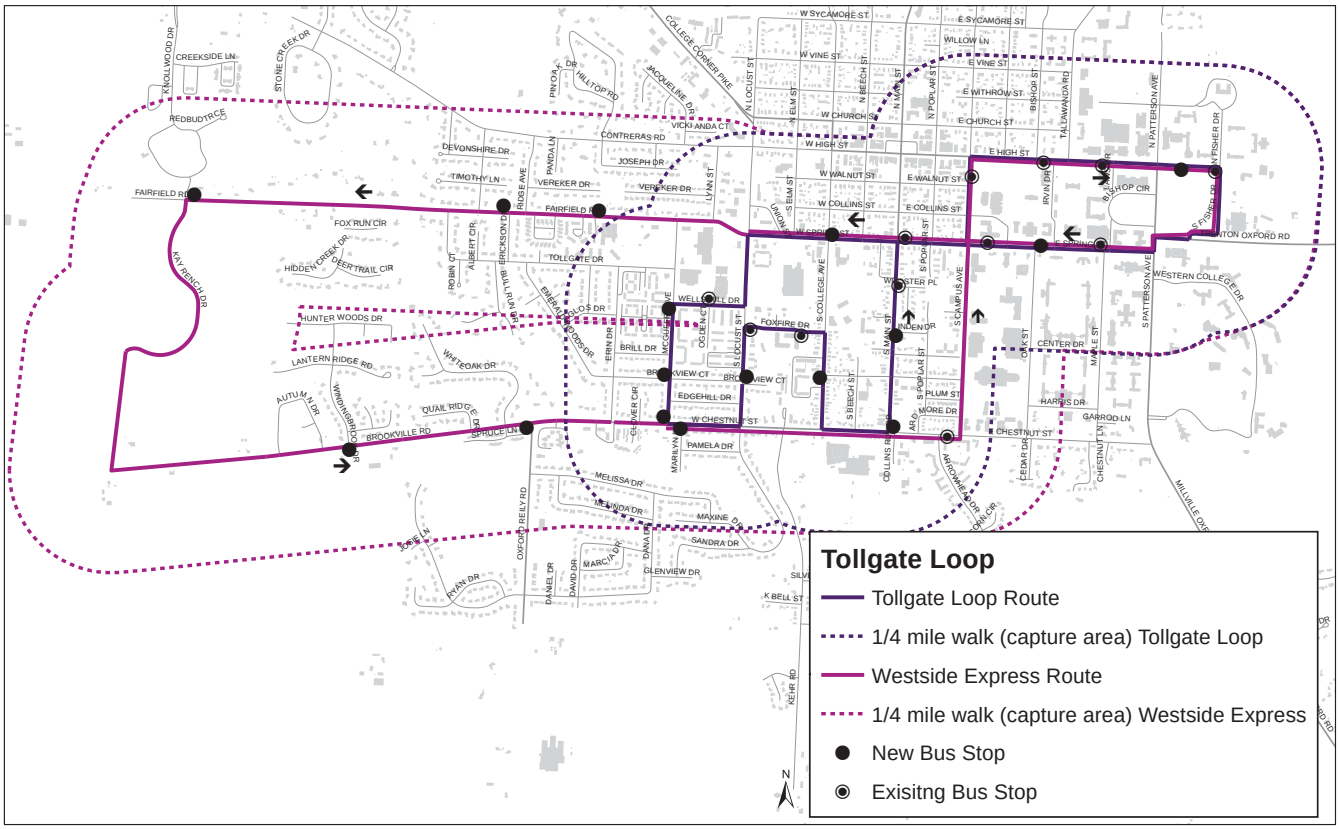
The Spring Street Connector was developed in response to a comment from the Steering Committee. This route provides service along Spring Street, from Western Campus to Kroger and back. It is a linear route that travels predominantly along Spring Street, a roadway that is proposed as a complete street in the Miami University Circulation Master Plan. The greatest demand for this route may be in the evenings and on weekends, although it also provides a very direct connection between Western Campus and the campus core. As such, this route will likely be in demand during the school day as well. However, the Western Express also connects Western Campus with the campus core, so evening and weekend service may be sufficient. Routing and turnaround location on Western Drive may be modified after the Circulation Master Plan-recommended extension of two-way traffic and Housing Master Plan-recommended driveway modifications are completed.



Tollgate Loop and Westside Express

The Tollgate Loop and the Westside Express are two routes that travel similar paths. The Tollgate Loop connects the higher density off-campus residential areas to the west and south with the campus core and points in between.

Provision of the Westside Express was requested by the Steering Committee and the public for transit access to the University from the residential areas on the western edge of town. The route would stop at locations west of Locust Street only, with no additional stops until the bus reaches the campus area. Pending conversations with The Knolls, the route could be modified to provide a stop at their front door. The ridership demand for this route is unknown and should be tested. The Westside Express could be modified to run back and forth along Fairfield Road with a turnaround at The Knolls and if Brookville Road is not desired as a transit corridor. In either case, this route should be tested on a trial basis to assess ridership demand. A three-month trial period would allow sufficient time to notify the community of the new route and the opportunity to travel to and from the University by bus, and to allow the riders to demonstrate a change in mode choice from autos to the bus.



Western Express

The Western Express provides direct service between Western Campus and the campus core. With the new residence halls that will be constructed in this part of campus, this route is expected to be in demand. This route would be most beneficial during school hours. Evening operations would be beneficial, since it provides a more direct connection to King Library than the Residence Hall Loop. Note: To avoid potential confusion with the Westside Express, this route could be named the Western Campus Express. This would only be necessary if the Westside Express is tested and found to have sufficient ridership to support continued operation. Routing and turnaround location on Western Drive may be modified after the Circulation Master Plan-recommended extension of two-way traffic and Housing Master Plan-recommended driveway modifications are completed.

ADDITIONAL RECOMMENDATIONS

Transit Waiting Environment

As previously mentioned, comfortable, safe, and informative transit waiting environments (bus stops) will enhance ridership. Wayfinding and signage at the bus stops should be improved to clearly indicate bus routes, hours of operation, departure times as appropriate, and other relevant information. In general, the greater the amenities and information that are provided at bus stops, the more people will ride the bus.

Bus Shelters

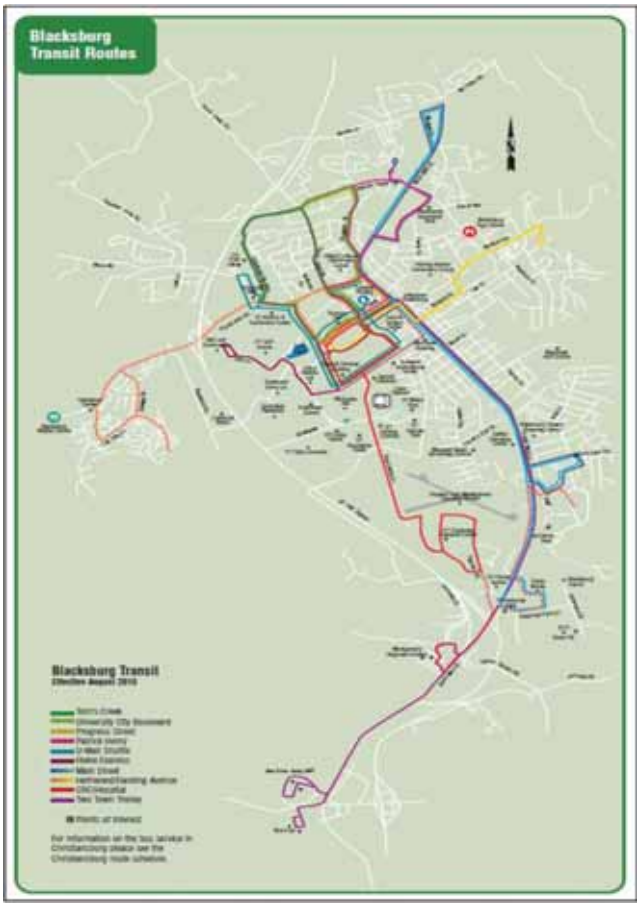
Bus shelters should be provided at busier bus stops and at bus stops where riders may have to wait for what feels like a long time for a bus to arrive. Benches would be beneficial at bus stops without shelters. Provision of the bare minimum bus stop sign will inform potential riders of the bus stop location, but will do very little to encourage ridership.

Example route map

Bus Route Maps

Bus route maps should be posted at all bus stops and inside the buses. Additionally, it would be beneficial to post complete bus system information (all routes) within bus shelters. The use of graphical images is clearly preferred over lists or other text-oriented information. Illustrated maps are more easily comprehensible to riders, including those to whom English is a second language.

The survey results indicated a preference for bus route names that "mean something." As a result, the recommended routes have been named to indicate the destinations or general service area for each route.



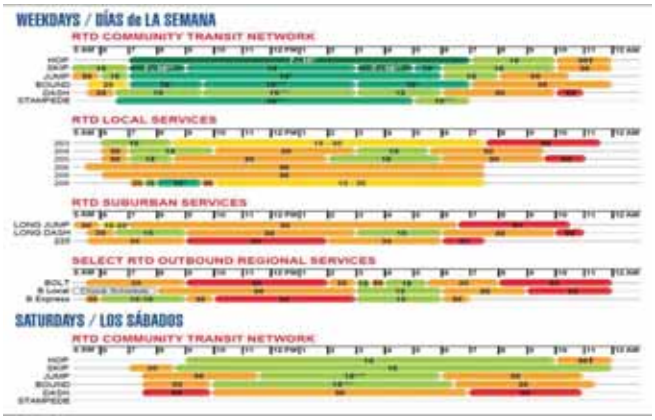
Example route map

Bus Schedules

Bus schedules, hours of operation, and departure times should be posted at the bus stops, along with any smart phone applications that may be implemented and any other applicable technology enhancements.

Miami Metro should have as a goal to operate at minimal headways to support and encourage bus ridership. Short headways (10-15 minutes between buses) foster ridership and eliminate the need for exact, time-specific schedules, operating on the understanding that if the buses come frequently, the riders do not mind a 10-15 minute wait. An example of route information for this type of service is the GO BOULDER local circulator in Boulder, Colorado.

For hours of operation where short headways are not feasible, the schedule could be maintained through the use of "time checks" where departure times are set at identified bus stops, with the understanding that the stops in between will occur within the defined range of the adjacent time check stops. These time checks should be at regular intervals, located at every two to three stops. This system could also be used for hours of operation with short headways, if desired, for operational predictability. Virginia Tech's Blacksburg Transit presents a good example. (http://www.blacksburg.gov/Index.aspx?page=791)



GO BOULDER bus schedule (see enlargement, section 2.4 Transit)

Public Awareness

A critically important element in increasing ridership is increasing public awareness and understanding of the Miami Metro transit service. This can be accomplished through inclusion of Miami Metro routes, bus stop locations, hours of operation, and related information on campus maps, the University's website, in fliers provided in information kiosks, and other sources of University information. Again, the use of illustrated route maps is important, as they are the most easily comprehended method of understanding the bus routes.

It would be most helpful to introduce new students to the Miami Metro services during summer orientation and in the fall as all students arrive for the new school year. The University and Miami Metro may want to devise a game or competition that introduces students to the Miami Metro bus system and gets them to actually ride the bus. Students are much more likely to ride the bus when they have taken their first bus ride and have an understanding of how the system works. If Miami University develops innovative ideas and ways to get students to take that first bus ride, it is likely that such efforts would generate an increase in ridership.

Bus Fleet

It is understood that Miami University will need to update the bus fleet in the near future with Americans with Disabilities Act (ADA) accessible vehicles. When that changeover occurs, the University should consider the use of alternative fuel buses and installation of bicycle racks that can carry two or more bicycles on the fronts of the buses. Such efforts would be consistent with Miami University's focus on sustainability.

4.0 IMPLEMENTATION

4.0 IMPLEMENTATION

The project team was asked to look at potential phasing and broad-level cost estimates for projects developed from the Circulation Master Plan recommendations. The following list of projects and costs are listed in implementation timeframes developed by University staff with the project team.

Planning-level costs were developed for the short term, medium term, and long term projects to aid the University in planning the implementation of these projects. The costs listed below were developed using information from comparable projects of similar nature and adjusted for the Miami University campus. They are intended to be general order of magnitude costs, and are based on assumptions listed under "notes" at the end of this section.

In progress

- Implementation of transit routes, new bus stops, roadway improvements, etc.
- Reconfiguration of pedestrian facilities adjacent to new Student Center.

Ongoing

- Widening walks in areas shown and installing new walks.
- Continuing implementation of emergency access requirements.

Short Term (0-2 years)

- High Street pedestrian crossings with sidewalk reconfiguration adjacent to the crossings – $170,000 for 3 crossings
  - » Includes 1300 LF of sidewalk leading up to crossings
  - » Includes ramp reconstruction
- Spring Street pedestrian crossings with sidewalk reconfiguration adjacent to the crossings – $440,000 for 4 crossings
  - » Includes 2800 LF of sidewalk leading up to crossings
  - » Includes ramp reconstruction
- Patterson Avenue pedestrian crossings with sidewalk reconfiguration adjacent to the crossings – $95,000 for 2 crossings
  - » Includes 660 LF of sidewalk leading up to crossings
  - » Includes ramp reconstruction
- Installation of bicycle lanes on Spring Street (upon City of Oxford approval) – $9,000 on campus and $16,000 off campus
  - » Includes removal and reinstallation of centerline striping
  - » Assumes modification of striping at four nodes/ terminations
- Speed table, bump-outs and potential 3-way stop at Spring/Maple as part of Student Center construction – $140,000
  - » Includes ramp reconstruction
  - » Includes brick unit pavers in intersection
- Shared use bicycle facilities installation (sharrows, signs) – $700 per block ($25,000 on campus and $42,000 off campus)
- Modifications for signalization as one intersection at Patterson/Spring/73 with pedestrian recall and countdown timers –$175,000 LS
  - » Assumes signal reconstruction (mast arm structure)
  - » Note: Further investigation into controller hardware and software as well as mast arm loadings, etc., would be necessary to determine whether it is possible that this signal could be modified with striping and timing modifications alone, reducing cost

Medium Term (2-5 years)

- Additional bicycle plan implementation (on campus) – $130 per LF 12' path, $200 per LF 20' path
- Covered bicycle parking on campus – $90,000 per location
- Installation of new walks in Bishop Woods – $425,000 LS
- Pedestrian route modifications near Bachelor – $255,000 LS
  - » Includes 900 LF of sidewalk
  - » Includes parking lot reconfiguration
- Western Campus pedestrian walks – $130 per LF of 10' walk, $150 per LF of 12' walk, $230 per LF of 20' walk, $7,000 per mid-block crossing
  - » Mid-block crossings include ramp construction
- Patterson crosswalk islands – $9,000 per island
- Bus shelters – $35,000 per new shelter, $6,000 per relocated shelter
- Install modifications to make Irvin Drive naked street – $300,000 LS
  - » Assumed surface equivalent to brick unit pavers
- Install modifications to make Center Drive naked street – $275,000
  - » Assumed surface equivalent to brick unit pavers
- Install modifications to make Bishop Circle/Laws Drive naked street – $375,000 LS
  - » Assumed surface equivalent to brick unit pavers

Long Term (5+ years)

- Finish walk improvements and installation – $115 per LF of 10' walk, $130 per LF of 12' walk

- Patterson/Spring/73 long-term improvements – $2,240,000 for rotated 90 degree intersection, $1,535,000 for straight 90 degree intersection (removal of Bachelor Hall)
  - » Does not include removal of and restoration around Bachelor Hall
  - » Assumes concrete pavement in intersection and roadway

- Closure of parking in CAB area – $570,000 LS
  - » Includes 2200 LF of sidewalk (axis walk and 90 degree crossing walk)
  - » Includes parking lot reconfiguration

- Modification of parking in Withrow area – $280,000 LS
  - » Includes 910 LF of sidewalk
  - » Includes parking lot reconfiguration

- Final links of bicycle plan implementation – $130 per LF of 12' path, $200 per LF of 20' path

- King Library drive reconfiguration – $280,000 LS
  - » Includes 1050 LF of sidewalk
  - » Includes parking lot reconfiguration
  - » Includes plain concrete plazas
  - » Includes 2 benches and 1 trash receptacle in each plaza

Estimate Notes:

- All estimates include:
  - » 2% for mobilization, staking, fencing, traffic control (except at Patterson/Spring/73, where ODOT requisite mobility cost was used).
  - » 10% allowance for miscellaneous utility work
  - » 15% for design (design fee, traffic studies, design contingency).
  - » 30% for construction (estimate contingency, construction contingency, construction administration).
- Assumes existing survey will be provided by the University.
- Assumes University will act as project manager and owner's representative during construction.
- Assumes 4" plain concrete on 6" aggregate base for walks/plazas (except where noted otherwise).
- Assumes 3" HMA with 8" aggregate base for parking lots/asphalt areas.
- Lighting (pedestrian or vehicular) is not included.
- The removal of contaminated/hazardous soils and materials, underground obstructions, and other unknown conditions are not included.
- The construction costs are based upon master plan-level recommended improvements. The opinion of probable construction costs reflects this current level of design detail, and the estimate reflects a general magnitude of cost in 2011 dollars.
- The costs associated with land acquisition, easement/lease procurement, and other land rights, where required, have not been included.

Potential Funding Sources

Potential funding sources for the Circulation Master Plan components are listed below. To maximize funding opportunities and eligibility, it is important for Miami University and the City of Oxford staffs to work together in partnership.

- NHS (National Highway System) funding for pedestrian systems
- STP (Surface Transportation Program) funding
  - » Pedestrian and bicycle facilities on Federal Aid Highways
  - » Includes ADA (Americans with Disabilities Act) /PROWAG (Public Rights-of-Way Accessibility Guidelines) design standard
- Clean Ohio fund
  - » Recreational trails and commuter access in urban areas
- ODOT discretionary funding
  - » Highway safety improvements
- State Transportation Enhancement (TE) funding
  - » Bicycle and pedestrian facilities
  - » Safety and education activities
- CMAQ (Congestion Mitigation Air Quality) funding
  - » Metropolitan Planning Organizations (MPOs) that are non-attainment areas (Ohio Kentucky, Indiana Regional council of Governments - OKI)
- Potential OKI funding sources (regional MPO)

5.0 APPENDIX