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MEMORANDUM

Date:	November 9, 2015
To:	David Trowbridge; Madison In Motion Committee
From:	Tom Huber; Kevin Luecke; Sonia Dubielzig
Re:	Madison In Motion Bicycle and Pedestrian Element

This memo presents draft text and maps for the Bicycle and Pedestrian Element of the *Madison In Motion, Sustainable Madison Transportation Master Plan*.
There are several placeholders for photographs and images.

I. Intro

Bicycle and Pedestrian Travel

Bicycling and walking are essential modes of transportation for residents of the City of Madison. Bicycling is efficient and convenient and also provides a high degree of flexibility for beginning and ending trips. Walking acts as a component to nearly every type of trip – transit and motor vehicle trips included. A viable transit system depends on a robust pedestrian network. From a travel time perspective, walking trips in Madison match any other mode of travel for trips under one mile. Travel times for bicycling are very comparable to driving for trips up to three miles, and sometimes farther. Walking and biking are especially attractive in the Isthmus and campus area where parking is in high demand and automobile travel times are considerably longer.

Gauging the level of bicycle and walking travel is easier in Madison than in many cities. In addition to having census data on work trip commuting, the city also has bicycle counting devices at over a dozen stations throughout the city, and there was a significant add-on to the *National Household Travel Survey* which provided statistically significant data for the city. The University of Wisconsin-Madison Transportation Services also conducts regular commuting surveys of its students, faculty, and staff and has historical data going back to 1979.

Clearly, walking and bicycling play a major role in transporting the city's population. The latest work commute data from the 2011-2013 American Community Survey (ACS) indicates that 9.5 percent of the workforce commuted by walking and 5.2 percent bicycled. These numbers are high compared to other U.S. Cities and metro areas nationally. The 2014 publication, *Bicycling and Walking in the United States*, by the Alliance for Biking and Walking, reported that an average of 5.0 percent of workforces in large U.S. cities commute by walking, and 1.0 percent commute by bicycle. Similarly the percentage of City of Madison residents who walk to work represents one of the highest percentages of any city its size or larger. Additionally, bicycling levels continue to rise in the city; bicycle commuting increased from 4.0 percent averaged over the 3-year period 2005-2007 to 5.2 percent in the latest 2011-2013 ACS. Bicycling and walking are also common forms of travel for other trips in addition to commuting. Unfortunately, current data for total bicycle and walking trips is not available.

The bicycle and pedestrian element of the Madison In Motion Plan was coordinated with the development of the *Bicycle Transportation Plan for the Madison Metropolitan Area and Dane County*. That plan is a comprehensive bicycle plan that serves as a blueprint for continuing to improve bicycling conditions and increase bicycling levels throughout Dane County. The planning horizon is 2050. It provides a framework for cooperation between state agencies, Dane County, and local governments in planning for and developing bicycle facilities and programs. It is intended to educate citizens and policy makers on bicycle transportation issues and the needs of bicyclists as well as present resources for planning, designing, and maintaining bicycle facilities. The plan is a component of the MPO's regional transportation plan.

More information on trends in bicycling and walking are provided later in this chapter.

The Case for Bicycling and Walking

Cities, counties and MPOs across the country are embracing bicycling and walking as viable transportation modes and a great form of recreation. Support for bicycling and walking was heard from a variety of stakeholders and the public during meetings and focus groups associated with this plan's development. Bicycling and walking support multiple objectives including: community development, improving public health, maximizing transportation investments, addressing transportation equity, and providing real transportation choices. These are elaborated on below. For these reasons, this element is supportive of a robust bicycling and walking environment and is in keeping with the overall objectives of the *Madison In Motion Plan*.

Community and Economic Development - For many businesses the competition for workers has a strong geographical aspect. Prospective employees are choosing employers not just on salary and traditional benefits, but on external criteria such as lifestyle and quality of life. In today's economy, the ability to attract business – and business's ability to attract employees – depends increasingly on the livability of the community. Cities that are making investments to support healthy lifestyles and to become more bikeable and walkable are seeing dividends in the form of attracting new residents and employers. Similarly, investments in bicycling and walking infrastructure are also a key community development strategy for revitalizing and improving neighborhoods. These investments improve access to businesses, make streets more attractive to a broader range of users, increase neighborhood livability by increasing social interaction and perceptions of personal safety, and reduce vehicle travel.

Health - The Centers for Disease Control and Prevention recommends two and a half hours of moderately-intense aerobic activity every week, which is equivalent to 10 minutes of brisk walking, three times per day, five days per week.[1] Adults who are physically active are healthier and less likely to develop many chronic diseases that are more common amongst inactive adults. In young people, there are nearly twice as many overweight children and almost three times as many overweight adolescents in the United States today as there were in 1980.[2] The number of children walking to school nationwide dropped substantially from the 1960's into the 2000's and has been a topic of concern in Madison over the past several decades. Expanded and improved bicycle facilities and support programs enable children, adolescents, and adults to get exercise as a part of their daily transportation routines. The health benefits of active transportation have also been shown to include increased labor productivity amongst adults and improved academic performance for youth.

Transportation Choice - Improving the bicycling and walking environment will expand transportation choices for the entire community. For those on low or fixed incomes, biking may provide a supplement to public transit. Over one third of the U.S. population do not drive because they are too young or too old, have a physical disability, do not have the economic resources to own and operate a car, or simply do not want to drive. However, many of these people can bicycle if safe and convenient bikeways are present. Biking may also be an option for the elderly who reach an age where driving is no longer an option. Older adults still need to travel to the grocery store, to medical appointments, to bus stops, and to access recreational opportunities. Improvements to bicycling conditions make it easier for Madison's residents to age-in-place, while also lowering transportation costs.

Providing safe and convenient bicycle and walking facilities also benefits people who rarely or never take advantage of them: for each person who bicycles to a particular destination, there is one less car on the street and one more parking space available for people who drive to the same destination. Using the bicycle to expand transportation choices in Madison also applies to people who may have temporary or limited access to an auto. By relying on bicycling for a small to moderate number of trips, the purchase of a second or even third motor vehicle may be averted.

1 Centers for Disease Control and Prevention, How Much Physical Activity do Adults Need? http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html accessed 8/7/13

[2] Childhood Obesity Facts. Centers for Disease Control and Prevention. Accessed November 25, 2013. http://www.cdc.gov/healthyyouth/obesity/facts.htm

Economic Benefits and Household Savings - Providing access and providing real transportation choices to households can also provide economic benefits to Madison residents. Bicycling is an affordable transportation mode that helps people save money and provides access for many people to jobs, shopping, and entertainment. People who can replace an automobile with a bicycle or delay the replacement of a car see the biggest benefit; however, just using a bike for some short trips saves money that would otherwise be spent on gas and maintenance. A motor vehicle is the second-highest household expense in the United States after housing according to the Bureau of Labor Statistics' *Consumer Price Index*. The American Automobile Association estimates that Americans spend on average approximately $9,122 each year to own and operate a car.[3] It is estimated that about $7,000 of this leaves the local economy (through fuel purchases, insurance fees, etc.) while the remainder stays in the community (through taxes, maintenance, registration, etc.). In a period of high-variability in the cost of fuel, bicycling offers a lower-cost transportation option. Bicycling has an annual operating cost of approximately $300. Providing transportation choices can give households the option of owning fewer cars, thus freeing up more household money that can be spent in the local economy.

Recreation - Creating a comprehensive network of bikeways and walkways with connectivity to neighboring communities increases the opportunities for close-to-home, affordable recreation for people of all ages. Bicycling and path networks are valuable ways to enhance access to the City's many public parks and other recreational venues, and to provide links into neighboring communities.

II. Bicycle Network—Facilities, Current Conditions, and Deficiencies

The City of Madison and the Madison area have an extensive network of bikeways that has been developed over the past 40 years. Within the city in 2015, there are approximately 55 miles of paths, 125 miles of bicycle lanes, and 120 miles of signed bicycle routes. The City's standards for new and reconstructed major streets include bicycle lanes. Sidepaths are sometimes considered in addition to bicycle lanes. In some cases, bicycle lanes have been added through re-striping efforts such as on Segoe Road or by reallocating lanes such as on West Washington Avenue which went from six travel lanes to four travel lanes with bicycle lanes and parking.

The city has invested millions of dollars over the past 20 years in the construction of paths within separate corridors. These include the Capital City Path (through the Isthmus), the Southwest Path (leading to the Badger State Trail), the Cannonball Path, University Avenue bikeways (including the Campus Drive Path, Black Hawk Path, expanded path segment west of Whitney Way), the Ice Age Junction Path, the Yahara River Path, the Starkweather Creek Path, the Wingra Creek Path, and other minor path segments.

Types of Bicycle Facilities

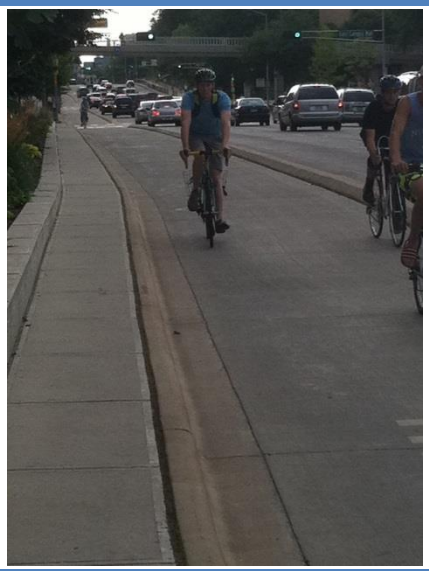
The City uses a variety of bicycle accommodations, with most described below and referred to throughout this chapter, to create a connected bicycle network. These accommodations have been established through precedent and practice in the City, as well as by well-accepted manuals such as, the American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, and the Wisconsin Bicycle Facility Design Handbook.

3 The American Automobile Association reports the average annual cost of owning a sedan to be $8,700 per year in 2014; an SUV is nearly $12,000. http://newsroom.aaa.com/2015/04/annual-cost-operate-vehicle-falls-8698-finds-aaa/

On-Street Bicycle Facilities and Treatments

Bicycle Lane: Conventional	
Conventional bike lanes are signed and marked with pavement markings to designate space for bicyclists outside of the travel lanes to minimize conflicts on busier streets. Bicycle lanes typically operate in the same direction as motor vehicle traffic. On one-way streets, they may be located on either the right or the left side of the roadway. The standard minimum width for bike lanes is four feet (not including the gutter pan) or five feet if adjacent to a parking lane or barrier. Photo Credit: Arthur Ross	
Typical use: medium to high volume streets where speeds range from 25 mph to 40mph.	

Bicycle Lane: Buffered	
Striped "buffers" may be painted next to bike lanes, to provide increased separation between a bike lane and a motor vehicle travel lane or a parking lane. A typical bike lane and buffer combination is a 5 foot bike lane and a 2-3 foot buffer. A buffer next to travel lane ensures that motorists give bicyclists the minimum 3-feet clearance when passing. A buffer next to parked cars helps to keep bicyclists from riding in an area where car doors may open into their paths.	
Typical use: medium to high volume streets to increase operating space and comfort for bicyclists	

Bicycle Lane: One-Way Protected	
Protected bike lanes, sometimes called "cycle tracks", provide a physical barrier such as curbs, bollards, pavement elevation, parked cars, or planters. Madison has a one-way protected counter-flow lane on University Avenue. While protected bike lanes increase bicyclists' sense of comfort, they still have conflict points at intersections and driveways, where turning traffic crosses them.	
Typical use: busier streets with few turning conflicts	

Bicycle Lane: Two-Way Protected	
Protected bike lanes, sometimes called "cycle tracks", use some kind of physical separation, such as curbs, bollards, pavement elevation, parked cars, or planters to separate the bicycle lane from the motor vehicle travel lane. Two-way protected bike lanes operate in both directions side by side. While protected bike lanes increase bicyclists' sense of comfort, they still have conflict points at intersections and driveways. These conflict points are most challenging for two-way protected bike lanes. Madison does not have any two-way protected bicycle lanes. Photo is of a protected bicycle lane in Washington D.C.	
Typical use: One-way streets and streets with few turning conflicts and high bicycle volumes	

Bicycle Lane: Counter-flow

Counter-flow bike lanes are signed and marked lanes that accommodate bicycle travel on one-way streets in the opposite direction of motor vehicle traffic. Counter-flow bike lanes may be separated by pavement markings or raised medians.

Typical use: Short segments of one-way streets or two-way streets that have entry restrictions for motor vehicles

Shared-Lane Marking ("Sharrow")

Shared Lane Markings remind bicyclists and motorists that they share street space on narrow or low-speed streets; they also indicate to bicyclists where they should position themselves in a lane, to prevent crashes with open car doors or turning vehicles.

Photo by Arthur Ross.

Typical use: low-speed and low-volume streets or streets that are too narrow for bicycle lanes

Advisory Bike Lanes

Advisory bicycle lanes are lanes into which motor vehicles may legally encroach. The line demarcating the lane is dashed instead of solid, and it is usually used on a street without a centerline. This is a more common bikeway type in Northern Europe on narrow, low volume roads, but has not been used in Wisconsin.

Typical use: low-volume streets that are not wide enough to support two full-width bicycle lanes and two travel lanes

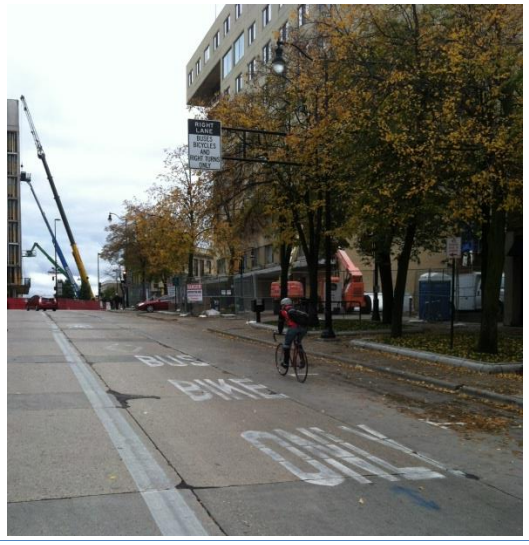
Bicycle Boulevard/Connected Low-Volume streets

Minor streets with low traffic volumes and speeds can provide an important piece of the bicycle network with limited or without any special pavement markings or accommodations because most bicyclists find them comfortable to ride on. When a street is designated a "Bicycle Boulevard", generally additional traffic calming devices are added to provide priority to bicyclists, such as speed tables, traffic circles, and barriers to through-traffic other than bicyclists.

Typical use: neighborhood streets with low volumes and speeds. In Madison, many of the local roads designated as Bicycle Boulevards run parallel to major roads and offer a more comfortable alternative to accessing land use destinations on those roads.

Bus, Bike, and Right Turn Lanes

Some arterial streets have designated marked bus lanes where bicyclists may also ride. These bus lanes often convert to right-turn lanes at intersections. If bus and right-turn volumes are relatively low, these lanes can provide a high level of service for most bicyclists. However, conflicts with buses and right-turning traffic may occur.



Typical use: arterial streets with marked bus lanes, bus rapid transit corridors.

Off-Street Bicycle Facilities

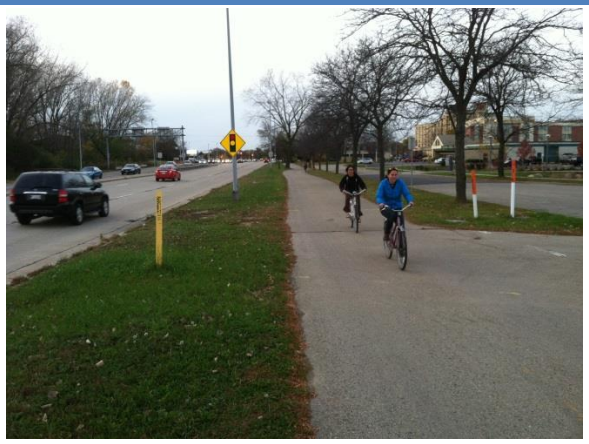
Shared Use Path

Shared-use paths are fully separated from a roadway and open only to bicyclists, pedestrians, and other non-motorized traffic. They are typically paved and are 10-12 feet wide.

Typical use: rail and utility corridors with available space, greenways, along lake shores and streams and in parks and in other linear corridors.

Sidepaths

Sidepaths are shared paths parallel to a street. They can either be paved with asphalt or concrete and are 8 to 10 feet wide. Sidepaths can pose safety and operational challenges at intersections and driveways so the consideration of where these are placed is important as well as their design at intersections and higher volume driveways. .



Typical use: adjacent to streets with no or very few intersections or driveways, or for short distance to connect two segments of the bicycle network.

Intersection Treatments and Bicycle Signage

Colored Pavement

Green colored pavement may be used to highlight bicycle lanes. This is especially useful at conflict areas with motor vehicle traffic. The City has used colored pavement to highlight some path crossings such as at the intersection of Monroe and Regent Streets.

Typical use: on bicycle lanes and sidepaths at intersections.

Bicycle Crossing

At a few intersections, the City has installed exclusive street crossings for bicycles, to reduce conflicts with pedestrians and motor vehicles. The bicycle crossings also typically use a bicycle signal to control bicycle and motor vehicle movements.

Photo by Arthur Ross.

Typical use: where popular bikeway crosses an intersection, such as Atwood Ave at Dunning Street.

Bicycle Signal	
Special traffic signals that indicate bicycle movements at an intersection may be used when bicycles, pedestrians, and motor vehicles have different movement cycles.	
Typical use: where paths cross streets at signalized intersections and it is important to distinguish the bicycle signal from the standard traffic and pedestrian signals.	

Wayfinding Signage	
Although technically not a bicycle facility type, wayfinding can be used to enhance bicycle facilities. Signs can help bicyclists navigate the bicycle network and can be placed at key intersections to guide users to specific destinations. They can include the distance to those locations and approximate travel time as well.	
Typical use: on most any bikeway, but especially on bicycle routes using neighborhood streets and paths	

Inventory of Existing Bikeway Network

The City of Madison has an extensive network of bikeways. Map 1 shows the bikeway facilities that are tracked by the City of Madison and the Madison Transportation Planning Board.

Some routes and streets used by bicyclists are not included on this map, due to inconsistencies in the bicycle facilities datasets used at the start of the study. For example, just west of Olbrich Park, the signed Monona Lake loop route continues through the Lowell/Atwood neighborhood on Lakeland Avenue and Rutledge Streets, but the existing facilities dataset used by the City of Madison did not include that route. As part of the work to develop the plan, the datasets used by the City, the Transportation Planning Board, and consultant staff were updated and reconciled to include a consistent set of bikeways, including commonly-used bicycle friendly streets and routes

Most of the City's designated bicycle network is provided by on-street accommodations as shown in blue on Map 1. As of 2015, the City has approximately 125 miles of streets with marked bicycle lanes or paved shoulders, and 52 miles of shared use paths. Overlaid on these and utilizing the local street network is a 120 mile network of signed bicycle route. This does not include an abundance of residential streets which are often used as informal "bikeways" by cyclists for making short connecting trips or for making longer trips by using them in combination with designated facilities and routes. The

inclusion of bicycle facilities on Madison's streets dates to at least 1972 when the Madison Common Council passed a resolution "directing the Director of Public Works, Director of Transportation and Planning Director to consider bicycle routes as part of all street construction or reconstruction projects." The on-street network, therefore, reflects over 40 years of this City policy.

Over the past 20 years, the City has placed emphasis on constructing shared-use paths that appeal to a larger segment of the bicycling public. These paths have two varieties - longer facilities in alignments where motorists have no access or shorter facilities that provide short-cuts between or within neighborhoods, such as a path connecting two culs-de-sac. Since 1995, the City has built the Cannonball Path, the Southwest Path, the Yahara River Path, the Beltline Path, the Starkweather Creek Path, the University Avenue Path, the Capital City Trail including the Isthmus Path, and the Greenbush Connector to the Southwest Path. Madison paths (displayed in brown on Map 1) provide some of the highest quality and most iconic bikeways in the network, and also provide many of the urban "escape routes" that can carry bicyclists out of the urban areas onto rural roads.

Current Conditions

Bicycle Level of Service

In recent years, as City leadership sought to encourage more bicyclists, there has been more interest in designing bikeways that appeal to a wide range of bicyclists. Many people do not feel comfortable riding close to busy traffic, even in bike lanes, and are looking for a riding environment that is low-stress. Bikeway planning needs to consider a range of bicyclists, including novice riders, children, seniors, and others who prioritize comfort in order to make bicycling more appealing to a larger segment of the population.

One way to measure the comfort of roadways for bicycling is to calculate the Bicycle Level of Service (BLOS) grade for the roadway segment. The BLOS methodology is outlined in the Transportation Research Board's Highway Capacity Manual 2010. Variables such as traffic volume and roadway geometry are input into the BLOS model, which then assigns a grade of A through F to the roadway, based on how likely bicyclists are to perceive their level of safety and comfort, with A representing the best bicycling conditions and F representing the worst conditions. Staff at the Madison Area Transportation Planning Board (MATPB) used BLOS methodology to measure existing conditions as part of their 2015 Bicycle Transportation Plan (which was conducted concurrently with the Madison in Motion plan). More information on how they adapted the BLOS methodology, as well as information about the weaknesses or limitations of the method, can be found in the MPO's plan.

The MATCP's analysis of BLOS on the roadways in Madison can be seen on Map 2. Most of the rated roadways measured in the City received a grade of C or above. Neighborhood streets were not rated and uniformly provide relatively high levels of service for the range of bicyclists. Lower-volume roads or roads with bicycle lanes received grades of A and B, while high-volume roads without bicycle lanes received grades of E and F. Usually the C, D, E, and F scores are on high speed and/or highvolume arterials that do not have bike lanes, such as Atwood Avenue, Mineral Point Road (partial), and Park Street (partial).

Demand for Bicycling

The bicycle heat map analysis shown on Map 3 broadly illustrates the demand for bicycle trips (both existing and latent demand). The demand for bicycling was estimated by taking into account land uses such as population density and major activity centers such as employers and shopping areas. This map does have some limitations and is dependent on what criteria are selected to gauge demand and what weights the different criteria are given. For instance, different weighing of the criteria would likely lead to more demand being shown in the east Isthmus area and along north Sherman Avenue. The map does reflect where significant biking already occurs (downtown/campus) because of the density of destinations and the high population density in those areas. The map also highlights areas along University Avenue, Regent Street, Monroe

Street, Park Street, Commercial Avenue, and Northport Drive that should have high demand for biking trips, even if there are not currently high-quality bicycle accommodations on those streets.

Bicycle Crashes

The City of Madison and Wisconsin Department of Transportation keep detailed records for all reported crashes in the City, including those involving bicyclists. Various studies have shown that only a small minority of crashes, generally less than 20 percent, are the result of bicycle-motor vehicle collisions. By far the most common crash type, accounting for at least one-half of all crashes, involves a solo bicyclist who falls as a result of a road surface condition, wet or icy surfaces, an object getting caught in moving parts, bicyclist error, or other causes. However, many bicycle crashes resulting in severe injuries and almost all fatal bicycle crashes involve motor vehicles. Therefore, this summary will focus on bicycle-motor vehicle crashes.

The numbers of reported bicycle crashes, injuries, and fatalities have decreased from the peak years in the mid-1970's, but most recently have not continued the downward progression. From 2002 to 2006, reported crashes between motorists and bicyclists in Madison which resulted in injuries, numbered 92 per year on average. That increased significantly to 115 on average per year for the years 2007 to 2012. Bicyclist fatalities remained relatively low during the past two decades. From 1990 to 2012 there were nine bicyclist fatalities in the city involving crashes with motorists. Unfortunately, in 2012 and 2013, there were three bicyclist fatalities followed by two more in the first half of 2015.

A more in-depth study of bicyclist-motorist crashes was conducted for the 5-year period 2008 to the end of 2012. Of the 535 reported bicyclist-motorist crashes, just 19 of the crashes involved bicyclists under the age of 18. The median age of a bicyclist involved in a crash was 34. With so few child crashes, analyzing crashes in Madison quickly becomes an evaluation of adult crashes, which is important to know since the characteristics and types of crashes differ considerably between adults and children.

Approximately 58 percent of bicyclists involved in crashes were males and 42 percent were females. Approximately 79 percent of crashes were reported as angle crashes (orientation of the bicyclist and motorist at the time of collision), the exact same percent as being reported occurring at intersections. Another 17 percent were reported as rear-end and side-swipe crashes. Crashes were reported on city streets and state highways (151, 51, 113, 12, etc. which are high traffic and sometimes limited access routes); just under 17 percent were reported on state highways with a considerable percentage involving the crossing of state highways. Light conditions (dark or sunlight conditions) were indicated for only 150 of all 535 reported crashes. Of those crashes, 26 percent occurred at night, dawn, or dusk and 74 percent during day light conditions. Just thirty of the crashes were listed as having "snow/ice/wet" as possible "highway contributing circumstances".

The Madison Area Transportation Planning Board, an MPO (MATPB), mapped five years of bicycle crashes in the Madison area using data compiled by the University of Wisconsin Traffic Operations and Safety (TOPS) laboratory and Wisconsin Department of Transportation supplemented with the City of Madison's more detailed records. Map 4 displays the approximate location of these crashes.

A concentration of crashes was evident in the Isthmus and near the UW-Madison campus where bicycle use is the heaviest (see Map 4). Crashes were most common along busier streets where exposure is higher including Gorham, Johnson, University Avenue, Dayton, Regent, Williamson, Park, and sections of East Washington. Many of these crashes occurred at intersections where bicyclists were crossing these streets. Outside of central Madison, crashes tend to occur at high-volume intersections of arterial streets, and at pinch-points such as interchanges with the beltline and interstate. There were very few crashes involving bicyclists crossing the Beltline and Stoughton Road (Highway 51), which in part is a reflection of lower bicycle usage. In earlier City of Madison crash studies, the bike-motorist crash typology was analyzed which produced a much clearer picture of how crashes occurred and who was most responsible for the critical error. The results of a more recent bicyclist crash analysis by the Wisconsin Department of Transportation supported those results

and indicated that of the top five crash types, four involved motorists turning in front of bicyclists at intersections or moving through or out into an intersection in front of a bicyclist who should have been yielded to.

An expanded household travel survey in 2001 provided important information on overall bicycle usage of people living in the city. Although this is now somewhat dated, it still is useful when examining crash rates. When looking at per capita crash rates, Madison's rate is 2.5 times that of the state of Wisconsin. However, when bicycle usage is factored in, which is four times greater per capita in Madison than the state, the crash rate per bicycle mile traveled is considerably lower.

Bicycle System Deficiencies

During the past 40 years the City of Madison has been able to incorporate or retrofit bikeways unto most major streets in the city. At the same time, over 50 miles of path have been constructed. Most of the gaps in the Madison bikeway network are a result of barriers or streets that have very restricted rights-of-ways. The gaps can be summarized as the following:

- *Gaps in the Path System.* There are several key segments of paths that are lacking continuity and require key connections. The most pressing examples include: the continuation of the Capital City Trail from Madison's Cottage Grove Road to the beginning of the Glacial Drumlin Trail in Cottage Grove, the continuation of the Cannonball Trail to the north to connect beyond Fish Hatchery Road to the Wingra Path, the Sherman Flyer (to the east of and paralleling North Sherman Avenue), the Goodman Path (east and northeast sides), and the Good Neighbor Path into Middleton.

- *Gaps in Bicycle Service.* Despite considerable efforts to include bicycle lanes on all major streets, several key segments of major streets have no bike lanes. (Most of these streets have not been reconstructed and/or are in constrained rights-of-ways). Several examples include: Mineral Point Road (partial), Speedway Road, Odana Road (partial), Monroe Street, Regent Street, Monona Drive (partial) and Cottage Grove Road (partial). This has plagued some neighborhoods more than others; where other bikeways or a more complete neighborhood street system serves an area the bicycle service gaps may represent less of a serious problem.

- *Low Bicycle Level of Service on Bikeways.* There are a number of arterial streets that have been reconstructed with bicycle lanes. Since the time they were built with bicycle lanes, traffic has increased and conditions have become more stressful for bicyclists. The MATPB bicycle level of service analysis explains this in more detail. Examples of streets with low bicycle level of service but having bicycle lanes include: Johnson/Gorham Streets, Fish Hatchery Road (near the Beltline Crossing), and part of Mineral Point Road near West Towne.

- *Crossings of Limited Access Highways*. The Beltline, Stoughton Road (Highway 51), and Interstates 90/94/39 have very few crossings that are considered bicycle friendly. The Beltline and the Interstate act as major bicycle barriers in Madison, partly owing to the lack of non-interchange street crossings of these freeways. In many cases, bike lanes have been provided through the interchanges, but given high traffic volumes and the numerous ramps that bicyclists encounter, they are rated moderately low for overall bicycle level of service.

- *Peak Travel Lane Streets*. Several streets including Monroe, Williamson, and a portion of Regent, lose a parking lane during peak travel times to become a travel lane. This requires that bicyclists use the travel lane during peak traffic periods. Generally conditions are far better during off-peak times, when the bicyclists share the lane with parked autos.

When the gaps as outlined above are considered and mapped, deficiencies are easier to identify. The arterials that do not have any bicycle accommodations and the collectors that have BLOS scores of less than B are displayed on Map 5. It is important to note that the identification of arterials lacking bicycle accommodations was treated strictly as an inventory of

what does and what does not exist. Some of the arterials are in constrained settings and may have limited potential for including bikeways. It is the city's policy, supported by this plan, that these major streets receive bike lanes. Consideration of bike lanes should occur at the time of reconstruction even if there are apparent challenges. Additionally, several of the streets shown on Map 5 as not having bicycle accommodations on the street itself are served with a path that is either immediately adjacent to it or very nearby.

Comparing the bicycle deficient streets shown on Map 5 to the Bicycle Level of Service ratings shown on Map 2 as developed by the MATPB, several additional observations emerge:

- For the arterials (shown in red on Map 3), most of the arterials that do not have bicycle facilities scored a "D" or lower on the BLOS score. These arterials, like Mineral Point Road, Atwood Avenue, and a section of E Johnson Street, have moderate to high traffic volumes and speeds. Stoughton Road is included in the analysis because even though it functions as a freeway in places, bicycles are not prohibited from riding on the shoulder. John Nolen Drive also appears as bicycle facility deficient, even though it has a popular shared-use path that runs parallel to it for much of its length. Other arterials that rated a "C" or lower on the BLOS score, such as Park Street or Northport Drive through Cherokee Marsh, do not appear on the "Bike Deficient streets" map because they have bicycle accommodation, even if it is simply a wide outside lane or paved shoulder.

- Many of the collectors that were ranked in the BLOS map do not have explicit bicycle accommodation, but due to their low traffic volumes, lower speeds, or wide outside lanes, they had high scores in the BLOS analysis and are therefore not shown on Map 3 as "bicycle deficient". The collectors that do appear likely scored low because they have higher traffic volumes and/or speeds or are narrow.

III. Pedestrian Network – Facilities, Current Conditions and Deficiencies

Sidewalks were a common pedestrian facility in areas of cities built before the 1950 to 1960 time period. As cities grew so did the distances between destinations and cities were often more willing to waive sidewalks for new developments. Additionally, street crossings became more difficult with bigger intersections. This was the case with Madison as some new developments were built without sidewalks or were annexed to the City without sidewalks. Fortunately, the support for pedestrian facilities and pedestrian mobility in Madison has swung back to pre-1960 ideals. Pedestrian mobility and how it is affected by the closeness of destinations, its association with transit, and the presence and quality of pedestrian facilities is much better understood in Madison today than even 20 years ago. However, there are still significant gaps in the sidewalk system and street crossings are still a challenge. This section is focused on the range of pedestrian facilities available for use in Madison and an inventory of pedestrian facility needs, especially sidewalks.

Types of Pedestrian Facilities

The City of Madison Zoning Code has required sidewalks to be constructed as part of new developments for a long time. The City also has a long-standing policy to include sidewalks when streets are reconstructed. The City's Standard Specifications for Public Works Construction outlines many guidelines related to sidewalk design. In addition, there are several state and national publications that the City can use for guidance on designing sidewalks: the Wisconsin Department of Transportation's guide on *Designing Pedestrian Facilities* (Chapter 5), the U.S. Access *Board's Proposed Accessibility Guidelines for Pedestrian facilities in the Public Right-of-Way* (known as PROWAG), the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, and the FHWA's *Designing Sidewalks and Trails for Access*. Most of the treatments and facilities described below are used by the City to enable pedestrians to walk along and across streets in a safe and comfortable manner. There is a detailed section on recommended crossing improvements provided at the end of this chapter.

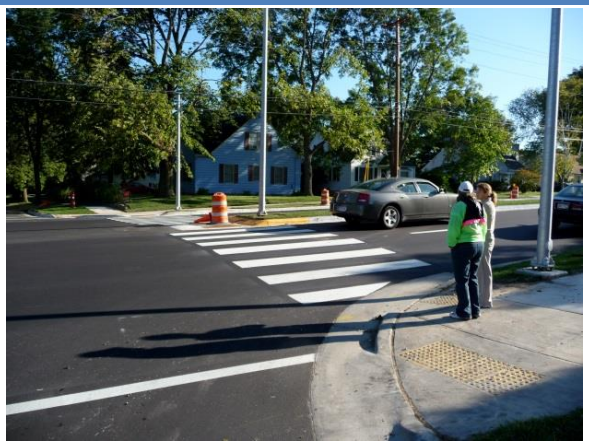
Sidewalk	
Most streets in Madison have sidewalks. A 5-foot sidewalk is typical in residential neighborhoods; in commercial and downtown areas, sidewalks can be much wider than 5 feet to accommodate additional pedestrian traffic and street furniture.	

Shared Use Path

Shared-use paths are fully separated from a roadway and open only to bicyclists, pedestrians, and other non-motorized traffic. They are typically paved and are 10-12 feet wide. In Madison they are often located along former rail corridors, lake shores and streams.

Crosswalk: Marked

Marked crosswalks emphasize and designate the part of an intersection where drivers can expect pedestrians to cross. They also define the pedestrian crossing area where they otherwise would not exist such as a mid-block crossing. Motorists must always yield the right of way to pedestrians in any crosswalk except at a signalized intersection where pedestrians follow the appropriate signal. The City of Madison uses standard variety of crosswalk markings including the "international" or continental crosswalk. Crosswalks are automatically marked at most intersections with traffic signals. Madison marks crosswalks on busier arterial and collector streets. Mid-block crosswalks are sometimes used under a variety of circumstances to aid pedestrian crossings, Where mid-block crossings are used at special locations, they are often supplemented with median islands, warning signs, and/or overhead flashers.



Crosswalk: Unmarked

In Wisconsin, unmarked crosswalks are the continuation from a sidewalk on one side of the street to the other side of the street. Motorist must always yield the right of way to pedestrians in any unmarked or marked crosswalk except at a signalized intersection where pedestrians follow the appropriate signal.

Grade-Separated Crossings

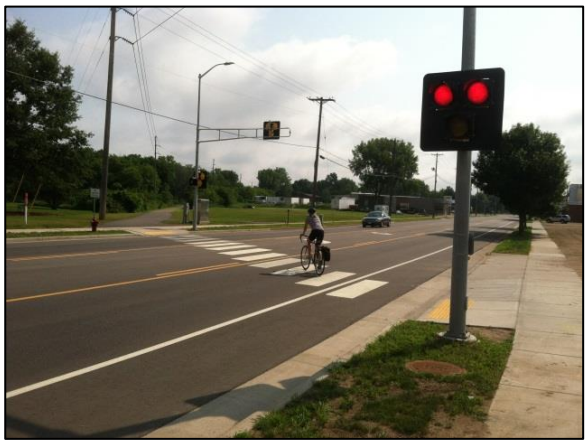
Grade-separated crossings are considered in situations where pedestrian and/or bicyclist crossings are essential, street crossing at-grade is not feasible for these users, and no other measures are considered to be appropriate. These crossings are often expensive and carefully considered, but can provide a critical crossing point for both pedestrians and bicyclists.

Low Speed Streets

One of the first low speed streets – called a "Woonerf" – was pioneered in the Netherlands. As with other low speed street designs it is designed primarily for very slow use by giving pedestrians and bicyclists priority while limiting motor vehicle speeds and use. The streets are generally at sidewalk level, without curbs. Motor vehicles are allowed to use the street to gain access to homes, but at very low speeds. Often the street is designed with chicanes or street furniture that forces vehicles to meander and move at a very slow pace. Many European countries have turned other lower volume residential streets into slower streets using a variety of treatments. Sections of UW-Madison's malls are the closest thing to low speed streets in Madison. It is important to note that, compared with a typical local street in Madison, construction and maintenance is significantly more costly. They also are more costly and challenging for placement and management of parking, snow maintenance and other services, such as street cleaning and refuse/recycling collection. As such, these types of treatments may only be appropriate in limited parts of the City, such as near the UW Campus, State Street and the Capitol Square.

Pedestrian Hybrid Beacon ("HAWK")

A pedestrian hybrid beacon is an overhead warning device, used at locations that are unusually hazardous or where pedestrians or bicyclists should be expected to cross throughout the day or where pedestrian crossing activity would not be readily apparent. The beacon is dark until activated by a pedestrian or bicyclist. When activated, the beacon displays a yellow signal followed by a red signal to drivers and a "walk "signal to pedestrians. Criteria for installation are from the MUTCD.



Rectangular Rapid Flashing Beacon

These beacons are attached to pedestrian crossing warning signs (mounted street-side as shown), or are overhead, and are pedestrian activated. This means the beacon is dark until activated by a pedestrian. When activated the beacon flashes yellow strobe lights to indicate to drivers that a pedestrian is present.

Median Refuge Island

A median refuge island is a protected area in the center of a street that allows pedestrians to cross one direction of traffic at a time. This makes finding gaps in traffic easier on busy two-way streets.

Pedestrian Bump-out/Curb Extension	
Curb extensions can reduce the effective street crossing distance for pedestrians by narrowing the streets. They also have a minor impact on reducing traffic speeds by narrowing the street.	

Wayfinding Signage	
Maps of downtown areas can help pedestrians navigate areas with lots of major activity centers. They can be placed at key intersections and decision points.	Insert Photo

Inventory of Existing Sidewalk Network

The City of Madison generally has a well-connected pedestrian network comprised of sidewalks and shared use paths, although there are areas of the city that are not well-served by these pedestrian facilities. Sidewalks, and to some extent shared use paths, provide important connections for pedestrians throughout the city to residences, schools, retail areas, and other attractions such as libraries and parks. Most City streets have sidewalks on both sides of the street, as shown in Map 6.

Streets that are missing sidewalks on both sides are displayed as gray; streets that have sidewalks on only one side are displayed in blue, and streets without sidewalks are shown as thin grey lines. Sidewalks, and to some extent shared use paths, provide important connections for pedestrians throughout the city between residences, schools, retail areas, and other attractions such as libraries and parks. Overall, about 72 percent of all Madison streets (excluding Interstates and freeways) have a sidewalk on at least one side of the street, and the vast majority of those streets have sidewalks on both sides.

Table 1 displays the approximate miles of streets in the city with sidewalks on both sides, one side, or no sidewalk.

Table 1: Miles and percent of streets in Madison with sidewalks

Sidewalk Status	Miles	% of Total
Both Sides	573	60%
One Side	110	12%
None	267	28%

Source: City of Madison

The lack of sidewalks is a significant barrier to walking, particularly for people with disabilities and children. This is especially true for streets that carry moderate to high volumes of traffic, which represent a more immediate need. When sidewalks are not available, pedestrians, must walk in the street, walk on unpaved surfaces, or use another form of transportation, such as driving, to reach their destination.

Overall, sidewalk coverage is nearly complete on the Isthmus and near-east and near-west sides of the city – areas that were generally developed before World War II. Most arterials and collector streets in Madison currently have sidewalks, although there are notable exceptions, including Tompkins Drive by Glendale Elementary on the south east side; portions of Packers Avenue on the north side, gaps along University Avenue on the west side, and much of Hammersley Road on the southwest side. Areas of the city that have been annexed from adjoining towns, some post-war developments, and some newer subdivisions often lack comprehensive sidewalk coverage.

Pedestrian Crashes

The City of Madison keeps detailed records about pedestrian crashes as well. In Traffic Engineering's 2011 Crash Report, there were 87 reported crashes involving pedestrians. In 45% of the crashes, auto drivers failed to yield the right of way. Pedestrians failed to yield in 10% of the crashes. Pedestrians were in the crosswalk for 56% of the crashes and in the roadway 30% of the crashes. Forty-seven percent of the crashes occurred at signalized intersections, 23% occurred at stop controlled intersections, and 29% did not occur at an intersection

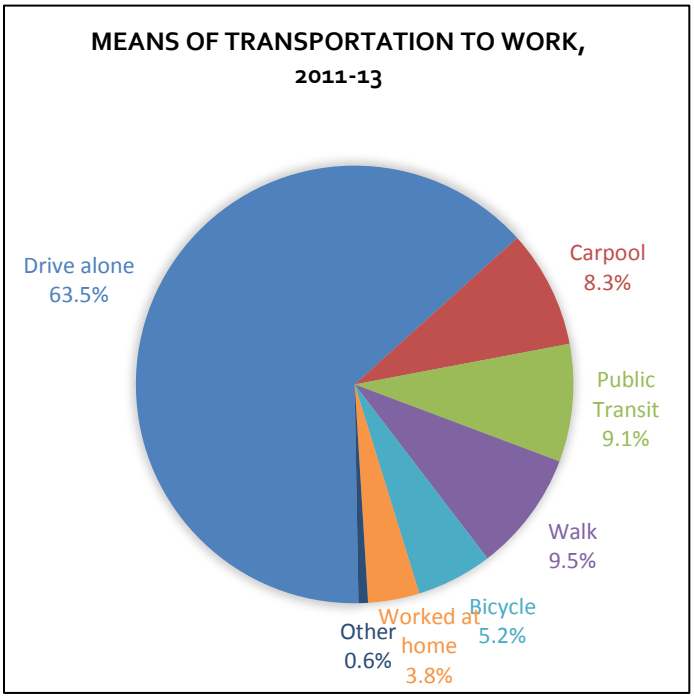
Pedestrian Demand Heat Map

Map 7 is a "heat map" that broadly illustrates the latent demand for pedestrian trips. The demand for walking was estimated by taking into account the presence of population density, activity centers such as employers and shopping areas, and transit facilities. The map shows where significant walking and biking already occur (downtown/campus) because of the density of destinations and the high population density in those areas. The map also highlights areas along the University Avenue, Park Street, and Northport Drive corridors that should have high demand for walking trips, even if there are not currently high-quality pedestrian crossings along those corridors. This type of analysis does have some limitations. For instance, if different weights were placed on certain criteria, more demand would have appeared on the map for sections of Williamson Street and Monroe Street showing more pedestrian demand.

IV. Trends in Bicycle and Pedestrian Travel, Successes, and Challenges

Trends in Bicycling and Walking in Madison

According to the 2013 American Community Survey (ACS) "journey to work" data compiled by the U.S. Census, about 5.2% of people in the city biked to work for the 2010 to 2013 period, which is high compared to other U.S. cities and metro areas. The City has continuously led other cities of its size in bicycle trip-making. Bicycling levels continue to rise in the city. Bicycle commuting increased from 4.5 percent in the 2007-09 period to 5.2 percent in the 2011-13 period. According to the same data and 2011-2013 period, 9.5 percent of workers in the City walked to work. This also represents one of the highest percentages of any city its size or larger.



Other Bicycle and Pedestrian Travel Usage trends.

Other than the ACS "journey to work" data, there are limited sources of information to measure bicycle and pedestrian travel trends over time.

The University of Wisconsin-Madison conducts biennial surveys of the transportation choices of students, faculty, and UW Hospital employees. Historical data from 30 years of UW transportation surveys shows that the number of students biking to campus in good weather has remained between 20 and 30 percent. Since 1995, the number of students choosing to walk or take transit has increased, and auto/carpool modes have decreased.

Source: 2013American Community Survey Table B08006 Sex of Workers by Means of Transportation to Work.

Madison Metro's ridership has also been growing and breaking ridership records. In 2014, the transit system recorded 15.2 million rides, compared to 12.0 million boardings in 2006. Each trip taken on transit has two walking trips on either side, so the growth in ridership also means more people are also walking to and from bus stops along the transit corridors.

These local figures reflect current national trends. Over the past seven years, Americans are driving less and using other modes of transportation more. Between 2005 and 2012, the total number of miles that Americans drove stayed constant, while the vehicle miles traveled per capita dropped by 7 percent. More specifically, over this same period, young Americans have been driving less and empty nesters are moving to more walkable neighborhoods. Many of these trips made by these two groups are being made by transit, walking, and bicycling. A variety of studies have documented that Millennials (the generation born between 1983 and 2000) are driving less. Many Millennials prefer living in walkable communities, and have less interest in car ownership than previous generations. However, it is important to note that a number of economic factors could explain this trend - including a relatively poor job market for recent college graduates, high levels of student debt and unstable home ownership markets. Whether young adults continue to drive less as they age remains to be seen, but it is clear that recent generations of adults are more amenable to non-auto transportation than has occurred previously.

Successes and Challenges

Bicycling Successes

The City's path and street bikeway network has grown extensively in the past 20 years, and innovative infrastructure like bike boxes, green lanes, bike signals, buffered bike lanes, and bicycle boulevards have made biking more appealing to a wider range of users. This has resulted in many more people bicycling in the City, as documented above. The League of American Bicyclists has designated the City of Madison a Gold-level Bicycle Friendly Community and new rankings should be announced shortly.

Other initiatives seek to improve biking and build a "bike culture" in the City. The MPO's Bicycle Transportation Plan 2015 for the Madison Metropolitan Area and Dane County has more detail about all of existing education, encouragement, and enforcement activities to promote bicycling and "bike culture" in the Madison area, and includes recommendations for improving and expanding on those efforts. Some of the highlights are below:

- Madison hosted its first Ride the Drive event in 2009 and now holds two events per year allowing citizens to bike down some of Madison's signature streets free of motor vehicle traffic.
- In 2011 Trek launched BCycle to start offering bike share services, and made Madison one if its first bike share systems. BCycle provides short term bicycle rentals at locations scattered throughout central Madison. Madison BCycle currently has 39 stations and 350 bikes.
- Madison citizens are engaged and supportive of initiatives to improve bicycling in the City. The Bicycle Federation of Wisconsin has a Madison office which has traditionally been involved in events to encourage biking among adults, including Bike to Work Week. The Bicycle Federation also runs the "Share and Be Aware" campaign to raise awareness among all road users regarding safety and the responsibilities of motorists, bicyclists, and pedestrians.

- The City employs three positions dedicated to bicycling related issues: a full-time Pedestrian/Bicycle Coordinator who focuses on planning and traffic engineering activities related to bicycle and pedestrian facilities in the city; a full-time Pedestrian and Bicycle Safety Educator who teaches bicycle and pedestrian safety at schools and neighborhood organizations, and a Bicycle Registration Coordinator who oversees the City's Bicycle Registration program. The City's engineering and traffic engineering staff have "institutionalized" the way they consider and implement street, bicycle and pedestrian projects. The University of Wisconsin-Madison also employs a full time Bicycle/Pedestrian Coordinator.

Bicycling Challenges

Despite this great progress, the City faces some significant hurdles to implementing the recommended bicycle facilities and growing the number of people who choose to bicycle for transportation. Locally and nationally, planning for bicycle travel has also undergone an attitude shift. Previous bicycle planning efforts primarily focused on establishing bicycle routes and major shared use paths. Although the City can attest to success in this regard since bikeways have been greatly expanded during the past 25 years, challenges continue into the present day. In the preceding section, challenges for the bicycle system were identified which included filling in gaps in the networks that do exist, and making bikeways that feel safe for a wider variety of users, including children, new riders, and older adults. In addition to the listing of those system gaps, here is a summary of the major barriers.

When the Beltline (U.S. Hwy 12/14/18), Stoughton Road (U.S. Hwy 51) and I-90/39 were first constructed, they were surrounded by rural farmland. Now that the city has grown beyond them, there are streets on both sides of the highways that need to be connected via non-interchange crossings that are compatible with bike routes. The I-39/90 corridor also poses a barrier for bikeways. Many of the crossings are non-interchange crossings, but they carry high traffic volumes which deter many bicyclists. <<insert aerial photo of beltline/interstate?>>

The City has routinely provided bicycle accommodations on arterial streets as they were reconstructed. However, in some cases, fitting in accommodations proved to be too difficult because of constrained street rights-of-ways. These street segments are identified as "bikeway deficiencies" as reported earlier in this chapter. Including bikeways on some arterial streets when they are reconstructed will continue to be a challenge for the city when space is at a premium. Narrowing lanes and doing road diets (i.e. 4-lane to 3-lane conversion) will be an option on some streets, but not all. <<insert photo of Willy Street bicyclist?>>

Funding is also a concern. The 2012 Moving Ahead for Progress in the 21st Century Act (MAP-21) Federal transportation spending bill significantly reduced the sources of funding for bicycle and pedestrian projects. MAP-21 combined three previous funding programs (Safe Routes to School, Transportation Enhancements, and Recreational Trails programs) into the Transportation Alternatives Program (TAP), and reduced the total amount of money appropriated to the State for projects that would be eligible for those previous programs. Wisconsin State law also restricts the City's ability to raise money by increasing its tax levy. The levy limits have placed great pressure on the City's budget.

Although the share of travel by bicycle has been growing, it still only accounts for approximately 6 percent of commutes in Madison. In order to continue that growth, travel by bicycle needs to be more convenient than driving. High-density, mixed land use development can make walking and biking more convenient by bringing residential areas closer to job and commercial destinations. The City will need to continue to support the development of bicycle lanes and shared use paths, the creation of attractive bicycle routes with wayfinding, and grade separations of major barriers.

Pedestrian Successes

Madison is ahead of most communities in the level of pedestrian facilities it provides. The City requires sidewalks on all new or reconstructed streets, and has worked hard to improve pedestrian crossings, especially near schools. The City has successfully lobbied for overpasses and underpasses as part of major state and federally-funded roadway reconstruction projects such as along the Beltline, East Washington Avenue, and on University Avenue.

In 1997, the City launched a Neighborhood Traffic Management Program to provide a mechanism for neighborhood groups to work with the City to install traffic calming features such as curb extensions, median refuge islands, speed tables, and traffic islands for neighborhood streets. This popular program has successfully been used on local and collector streets across the city.

The City's Sidewalk Repair and Rehabilitation Program has kept the City's sidewalks under excellent condition. Each aldermanic district is scheduled for sidewalk repair and replacement every six to nine years. Individuals can also use the "report a problem" tool on the City's website to alert the City of a sidewalk concern.

Day to day maintenance of sidewalks, including snow removal, is required of adjacent property owners in Madison.

Pedestrian Challenges

The City requires that developers install sidewalks in new development. For already-developed areas that don't have sidewalks, adding sidewalks along streets is a more complicated issue. There are three types of situations in which sidewalks would be added to already-developed areas: 1) as part of site redevelopment projects; 2) as part of street reconstruction projects; or 3) as stand-alone retrofit projects where just sidewalks are constructed. These situations are discussed below.

- ***As part of site redevelopment.*** Many times, when sites are redeveloped, the developers are required to get certain permits or approvals from the City. In these cases, the City may require the developer to install sidewalks on the site if they do not currently exist.
- ***As part of street reconstruction projects.*** When the City proposes to reconstruct a street, it also proposes to add sidewalks to streets that do not currently have them. In some cases, the City encounters opposition. Many property owners object to sidewalks because they have to pay the total cost of installing new sidewalks and must shovel them in the winter. City elected officials are often reluctant to support the installation of the sidewalk if they face opposition from the neighborhood or the affected property owners. Debates about whether to install or not to install the sidewalk can get emotional. The City of Madison recently launched a pilot program where the City shares the cost of adding sidewalks under certain conditions. This program helped reduce opposition to installing sidewalks on two reconstruction projects in 2015, and may make it easier for property owners and local Alders to support the inclusion of sidewalks on future street reconstruction projects.
- ***As stand-alone retrofit projects.*** Because of costs and the opposition to sidewalk installation in general, the City has been reluctant to fill sidewalk gaps as part of stand-alone retrofit projects. The City has installed short segments of sidewalk as part of stand-alone retrofits in some critical areas, but has not implemented a program to aggressively build the miles of sidewalk that are needed along collectors and arterials and near schools. If the city waits to install sidewalks on streets until they are being reconstructed, some high-priority street segments will not be slated to have them added for another 20-30 years.

Madison's central business district benefits from wide sidewalks along State Street and around the Capitol Square. These sidewalks get lots of use by pedestrians all day and evening and also provide space for restaurants to offer outdoor seating that uses valuable sidewalk space. The booming downtown restaurant business has resulted in many sidewalk cafes that can sometimes impede pedestrian travel.

V. Recommended Bikeway Network

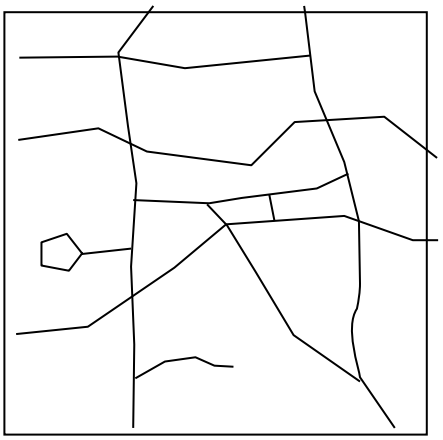
Bikeway Functional Classification

Over the past decade, there has been increased interest in applying a functional classification system to bikeways in order to prioritize improvements, identify gaps, and make recommendations about appropriate bikeway types. Traditionally, bikeways are simply classified by their location (shared road, bike lane, and off-street path). Users of the bikeway network intuitively understand that the long, direct, shared-use paths like the Southwest Path and the Capital City Trail serve as primary bikeways for travel between different parts of the city. Local and collector streets and neighborhood paths serve as secondary bikeways that connect neighborhoods and connect to the primary bikeways.

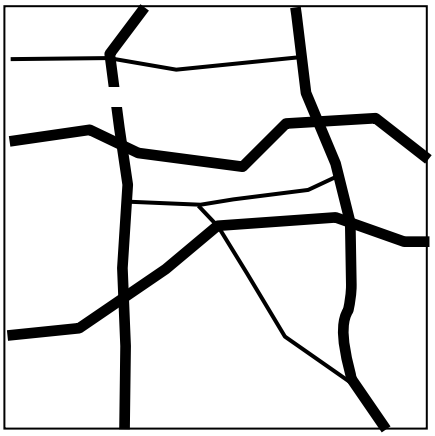
As part of the *Bicycle Transportation Plan for the Madison Metropolitan Area and Dane County 2015*, the future bicycle network was mapped and planners decided which of the network segments would form the "primary" and "secondary" network. The functional classification system is only meant to aid or guide planners — it is not meant to tell users where they should or should not be riding, nor does it relate to State or Federal roadway funding eligibility. Some of the expected uses of the bikeway classification are for funding and system prioritization, as well as locally-adopted facility design standards, maintenance priorities, and wayfinding tools like maps, signs, and trip planning. The process is shown graphically in Figure 2.

The classification scheme for primary and secondary bikeways is summarized in Table 2.

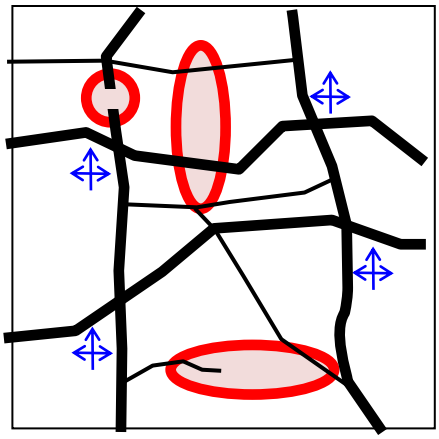
Figure 2, Role of Bikeway Functional Classification



Hypothetical bikeway network of on-street and off-street facilities



Routes on the network are given a functional classification based on connectivity, function, and use



Gaps are identified and improvements are prioritized; wayfinding is added

Table 2: Characteristics of Primary and Secondary Bikeways in the Recommended Bikeway Network

Characteristics	Primary Bikeway	Secondary Bikeway
Basic Characteristics	• Appealing to cyclists of varying skills and comfort levels • Likely to attract and carry high bicycle volumes • Relatively direct; longer distances	• May not appeal to all cyclists' comfort levels • Carry moderate volumes of bicycle traffic • Moderately direct (or most direct in the case of higher volume, higher speed motor vehicle routes); short to moderate distances
Spacing	• ½ to 1 mile apart	• ¼ to ½ mile apart
Facility Types	• Shared-use paths, protected, buffered, or conventional bicycle lanes, or bicycle boulevards • Likely to be on lower-volume, lower-speed streets such as bicycle boulevards or wayfinding routes (sometimes parallel to a Secondary bikeway on a busier street)	• Shared-use paths and bike lanes or connecting local streets • May include higher-volume, higher-speed motor vehicle routes with bike lanes •
Intersection Treatments	• Minimize delay (fewer stops, high-quality intersection crossings) • Overcome barriers (for example, crossing a freeway with an overpass)	• Moderate number of intersections • Provide bicycle accommodation with traffic signal treatments and/or pavement markings • Connect to primary path to overcome freeways or barriers
Wayfinding	• Include wayfinding signage	• Often includes wayfinding signage.
Madison Examples	• Southwest Path • Isthmus Path • Capital City Trail	• Marshview Path • E. Washington Avenue • Vilas Park Drive

In addition to the primary and secondary bikeways, there are local neighborhood streets and short local paths that serve to connect streets within neighborhoods, or connect a cul-de-sac to a primary or secondary bikeway. These are useful for access at the very fine-grained level and serve an important function for access to homes and businesses. They were left out of the classification which focused on longer-distance routes that support a significant function in the larger bicycle network. Another important role of local streets occurs when short path connections elongate a street or combination of streets into a much longer stretch of bicycle route. When this occurs or when this is identified as an opportunity, the classification of this local street(s) can sometimes be elevated to a secondary bikeway.

As part of the functional classification process, some streets that had not been formally classified as "bicycle routes" by the City were classified in the bikeway network as secondary routes. In most cases, these streets are not signed and do not have any specific bicycle facilities, but they are bicycle-friendly streets that are already used by many cyclists. These streets will likely become a part of the new wayfinding route network once that is in place. For example, on the west side, South Hill Drive is an important parallel route next to Mineral Point Road. On the east side, Dempsey Road is a critical connection between the Capital City Trail, the bridge over Stoughton road, and Milwaukee Street. Classifying these streets as "secondary" bikeways recognizes the role that they play and can help city staff identify where bicycle accommodations should be added, where they cross intersections, and identify where additional wayfinding signage is needed.

Map 7 shows the vision of a future bicycle functional classification system, taking into account planned facilities and needed improvements. The planned future bicycle system would add bicycle facilities to arterials that currently lack them. The future bikeway system shows a larger, more connected network with a higher reliance on a variety of bikeways, especially in developing areas at the City's edge.

Recommended Bikeway Network—On-street component

Map 8 shows just the on-street component of the recommended bikeway network. Map 3 identified arterial and collector streets which lacked bikeways. Arterial streets that have poor BLOS scores and lacked bikeways are recommended to have bikeways. These arterial streets provide access to many commercial and employment destinations such as Mineral Point Road/Speedway Road and Atwood Avenue. In a few cases, some bikeway-deficient arterial streets are not included in the network because they are limited access arterial streets and have or are recommended to have high-quality parallel bike paths, such as John Nolen Drive and Stoughton Road.,

The City should continue its policy of providing bicycle accommodations on all collector and arterial streets whenever possible. When these streets are scheduled for reconstruction or resurfacing, bicycle facilities need to be considered at that time. However, not all of the deficient streets identified on Map 3 will be fitted with bike lanes due to physical constraints of the right-of-way and the close proximity of adjacent buildings. Along limited access highways a sidepath may be a workable solution which will often supplement the on-street bikeway.

The types of bicycle facilities that can be considered for different roadway types in the recommended bikeway network are shown in more detail in Table 3.

Table 3: Recommended Bicycle Accommodations on Collectors and Arterial Streets in the Bikeway Network

Treatment Type	Bicycle Accommodation on Low-Volume Local and Collector Streets	Bicycle Accommodation on High-Volume Arterial Streets
Roadway Treatments	• Buffered bike lanes • Bicycle boulevards • Shared Lane Marking ("Sharrow") • Advisory bike lanes • Traffic calming devices such as speed tables •	• Conventional bike lanes • Buffered bike lanes • Protected bike lanes •
Intersection Treatments	• Restricted access to through-traffic • Traffic calming devices such as traffic circles • Median refuge islands may be appropriate where the bikeway crosses a busy arterial • Bicycle signal • Bike boxes (where appropriate) • Bicycle crossing with green colored pavement	• Bike lane continuity (Green colored pavement in bike lane through intersection conflict area, or bike lane marked as dashed lines through intersection) • Bike boxes • Pavement markings that indicate bicycle position to the left of right turn lanes/through complex intersections • Eliminate free-flow right turn lanes where possible
Wayfinding	• Include wayfinding signage when part of the "Primary or Secondary Bikeway" network • Use pavement markings such as sharrows to help position cyclists correctly at jog points	• Usually would not include wayfinding signage unless part of a primary or secondary bike route.

Recommended Bikeway Network—Off-street component

Map 9 shows just the off-street component of the recommended bikeway network. Many of the planned shared use paths at the City's developing edge are shorter and could be built as neighborhoods are developed, perhaps as a requirement of the development permitting process. Many of the long segments span municipal boundaries and are critical links in the priority bikeway network. Many of these paths would act as priority bikeways in a regional bikeway network. They are likely to use public funding sources, particularly county, state, and Federal grant programs. Some of the longest segments are not even available for development yet because they are still on an active railroad corridor and would need to wait for railroad abandonment, railbanking, or an agreement with the rail operator for a rail-with-trail opportunity to occur. Another option, although very challenging, would be to build parallel shared use paths within these corridors. Many of these projects have a long-range planning horizon for implementation.

Many of the long segments of off-street paths will form part of the priority bikeway network due to the level of comfort they provide for riders of all abilities. As the paths are designed and constructed, planners and engineers should consider the path's importance within the overall network to determine the path width, intersection treatments, and wayfinding signage. (See Table 4).

Table 4: Recommended Characteristics of Paths in the Priority and Secondary Bicycle Network

Treatment Type	Paths in PrimaryNetwork	Paths in Secondary Network
Path type/width	• At least 10' wide, but often to be considered at 12' or greater because of usage • May have designated lanes for pedestrian and bicycle traffic	• At least 10' wide
Intersection Treatments	• Overcome significant barriers with grade-separated crossings (underpasses/overpasses) • Bicycle signal • Ensure good visibility and sightlines where side paths cross intersections and where paths cross streets in independent corridors	• Mark crossings with crosswalks and/or green paint (some may require grade separation depending on site-specific conditions) • Ensure good visibility and sightlines where side paths cross intersections and where paths cross streets in independent corridors
Wayfinding	• Include wayfinding signage showing major destinations. • Use pavement markings such as sharrows to help position cyclists correctly when connecting to/from on-street connection	• When paths cross streets, sign intersections with street names • In some situations, wayfinding signage may be necessary
Lighting	• Add lighting that is appropriate for bicyclist and pedestrians	•

Recommended Bikeway Network –On-Street and Off-Street Combined

The existing and proposed bikeway network is shown as one complete network on Map 10. This will help readers comprehend what is recommended for the entire system. To most bicyclists, having a continuous bikeway, whether it is on-road, off-road, or a combination of the two, is what matters most. The existing and proposed bikeways often go from being off-street to on-street facilities, which makes wayfinding important.

Map 12 identifies the major highways that act as barriers to bicycle travel. The map also illustrates where crossing improvements need to be made. The major barriers are either freeways or limited access highways and include Interstates 94, 90/39, and 90/94/39. Stoughton Road (Highway 51), Highway 14 south of the Beltline, Campus Drive, Aberg Avenue/Highway 30, and Highway 151 south of the Beltline and east of Interstate 90/94/39. The Wisconsin Department of

Transportation is conducting major studies of the Beltline, Stoughton Road, and Interstate 39/90. These studies have been structured to include the consideration of bicyclists and pedestrians in the following ways:

- Evaluation of the suitability of existing crossings for bicyclists and pedestrians has been a major consideration for these studies.
- Consideration of the spacing of bicycle and pedestrian crossings for possible new crossings.
- Providing recommendations for new crossings – primarily as new and independent crossings, but may also include bikeway recommendations to be built as part of new streets crossings.
- Providing bikeway enhancements at existing interchanges; these may include separated sidepaths, bike lanes, paved shoulders or a combination of these bicycle facility types.
- Evaluating potential bikeways that can run adjacent to the Beltline that enhance crossings (enable bicyclists and pedestrians to get to an adequate crossing) or make important bikeway connections along the limited access highways

Work has been coordinated between these studies and this plan. The crossings on Map 12 represent the City's recommendations for new and enhanced crossings, but they are largely consistent with early results of the studies. In summary, as part of these major roadway projects, seven new bicycle and pedestrian crossings are recommended for Interstate 39/90, seven for the Beltline (including several with new streets), eleven for Stoughton Road (including several with streets), and two for Highway 151.

Other Bicycle Facility Recommendations

Consistent with the bicycle network plan, there are a number of general recommendations that are tied to the successful implementation of the plan:

- The City should continue to work with the MATCP and Dane County to implement a bicycle wayfinding system that is consistent on bikeways throughout the county, with special priority given to bikeways that have been identified as primary routes. The City should also gradually remove outdated bicycle wayfinding infrastructure as new signs are put in place (such as the old generic "bike route" signs without wayfinding elements) that are not being maintained or updated.
- The City's bicycle boulevard program has gotten a good start and is evolving. Many of the new boulevards are lightly treated with devices that could potentially slow automobile traffic or even divert non-neighborhood-based trips by motorists. Although this will take strong neighborhood and alderperson support, it is recommended that additional treatments be provided for current bicycle boulevards, while future boulevards be conceptualized with an increased level of treatments to encourage bicycle traffic while reducing or eliminating cut-through traffic. Alternatively, another option is to shift the focus to establishing new wayfinding routes which would include many of the same elements of bicycle boulevards without being called bicycle boulevards.
- Develop a set of street typologies as part of the City's complete streets efforts. Bikeways should be prominently featured for collector and arterial streets.
- Continue to work closely with Dane County, Wisconsin Department of Transportation, and the Federal Highway Administration to ensure improvements to existing crossings of highways, as well as the creation of new crossings.

VI. Plan for Pedestrian Facilities

Madison generally has a good pedestrian infrastructure. The strategies recommended below would make Madison an even better place to walk by filling in gaps in the sidewalk network and improving street crossings to make them safer and more comfortable.

Sidewalks

Sidewalks should be included as an integral part of all new developments and retrofitted to existing, built-up areas when opportunities arise. The city already requires sidewalks as part of new subdivisions and developments. The following are recommendations for sidewalk installations for new developments, site redevelopments, when streets are reconstructed, and as sidewalks are considered as independent or retrofitted projects.

Sidewalk Installation Policy in New Developments and Site Redevelopment

- **Recommendation for New Developments:** The City should continue to enforce its ordinance requiring developers to install sidewalks along both sides of the street in all new developments at their own expense.
- **Recommendation for Site Redevelopment:** When sites are redeveloped along existing roadways without sidewalks, require the developer to install sidewalks on the site if they do not currently exist.

Sidewalk Priorities for Already-Developed Areas

Sidewalks are recommended for installation along both sides of all Madison streets. Any time a roadway without sidewalks is reconstructed, or there is another major construction project near a short gap in the sidewalk system, sidewalks should be added. Including sidewalks as part of a street reconstruction project is generally more cost effective than as a stand-alone project because the mobilization of equipment, materials, and construction workers needed to install the sidewalk are already at the site. Typically a street reconstruction involves the entire right-of-way of a street providing a better and less costly opportunity to do grading work necessary to add sidewalks.

Some streets represent higher priorities for sidewalks than others. As part of this plan, streets were categorized based on the presence of sidewalks and those without sidewalks were placed into two tiers of priority:

- **Tier 1 Sidewalk Priority:** arterial or collector streets, local streets with bus routes, or streets near a school that lack sidewalks on one or both sides. The streets assigned Tier 1 sidewalk priority are displayed in Map 11. For the Tier 1 Sidewalks that are located on still-rural roadways (roads without curb and gutter or storm sewer), the City should still require developers to install sidewalks along both sides of the street at their own expense for both new development and redevelopment projects.
- **Tier 2 Sidewalk Priority:** all other streets without sidewalks on one or both sides. When the street is reconstructed sidewalks should be installed on both sides of the street. Property owners would still be required to pay the cost of the sidewalk.

The City requires that developers install sidewalks in new development. For already-developed areas that don't have sidewalks, adding sidewalks along streets is a more complicated issue. There are three types of situations in which sidewalks are recommended be added to already-developed areas: 1) as part of site redevelopment projects; 2) as part of street reconstruction projects; or 3) as stand-alone retrofit projects. These situations are distinguished in more detail under the pedestrian challenges section of this element and in Table 5. The recommendations are summarized below.

- **As part of site redevelopment.** The City should require the developer to install sidewalks on the site if they do not currently exist.
- **As part of street reconstruction projects.** This plan supports current city policy that sidewalks be added at the time of street reconstruction to both priority 1 and 2 situations. Madison recently launched a pilot program where

the City splits the cost of initial sidewalk construction with the property owners at approximately 50%/50% under certain conditions. This program should help reduce opposition to installing sidewalks. The program should continue and will make it easier for property owners and Alders to support the inclusion of sidewalks on reconstruction projects.

- **As stand-alone retrofit projects.** The City should install short segments of sidewalk as part of other nearby street projects or when repairing sidewalks in the neighborhood. The City should take that one step further and developed significant (multi-block) sidewalk projects. This plan recommends including more Tier 1 sidewalk priorities with other nearby street projects similar to the current practice. Additionally, Tier 1 sidewalk projects are important enough that this plan is recommending a program similar to the current pilot program (which provides approximately a 50/50 funding arrangement with the city) for the construction of sidewalks for more significant gaps. This is detailed below.

Table 5: Existing Sidewalk Installation Criteria and Funding

Type of Location	Sidewalks required?	How paid for	When occurs
Sidewalk installation in new developments	Required on both sides of new streets, unless the plan Commission determines they are not required.	Developers install sidewalks at own expense	When new development occurs
Sidewalk installation in Already-Developed Areas:			
As part of site redevelopment	City may require developer to install sidewalks on site as part of permitting process	Developers install sidewalks at own expense	When new development occurs
As part of street reconstruction	Sidewalks are included as part of the overall street reconstruction	Property owners pay for initial sidewalk construction; Pilot program allows the City to share the cost 50/50 with property owners in certain situations	When street is reconstructed
As stand-alone retrofit projects	Sidewalks are sometimes considered along with nearby projects	Property owners pay for; Pilot program allows property owners to pay for 50% of cost.	Pilot program recommended to increase frequency. Small missing sections of sidewalk can also be added when nearby sidewalks are replaced as part of the City's 10 year cycle of repair and replacement

Funding Programs to Reduce the Burden of Installing Sidewalks

The city's current policy is that adjacent property owners pay 100% of the cost of initial sidewalk installation and 50% of the cost of sidewalk replacement. The City has begun a pilot program to reduce the costs of new sidewalks for homeowners when streets are reconstructed. There are certain conditions that apply for eligibility. The percentage contribution of the cost of new sidewalks is brought down to costs comparable to that of sidewalk replacement. This plan supports the continuation of that program which will reduce the financial burden on property owners when streets are reconstructed. The plan also calls for establishing a similar program to support more retrofitting of Tier 1 sidewalk gaps instead of waiting for streets to be reconstructed in order for sidewalks to be added. Excluding streets in undeveloped areas, the City still has about 800,000 linear feet, or 150 miles, of street frontage in developed areas that lacks sidewalks. A summary of possible options to finance sidewalk in already-developed areas are summarized below and are supported by this plan:

- In 2015 the City of Madison recently launched a pilot program called "Safe Routes" to reduce the financial burden of retrofitting sidewalks. In addition to cutting the property owner's share of the cost of retrofitting sidewalks in the pilot area to approximately 50%, the pilot allows property owners to pay the cost over 15 years, and for eligible low-income homeowners to pay when their property is sold. This program helped property owners on Tompkins Drive and Turner Avenue agree to installing sidewalks when the street was reconstructed in 2015. In 2015, the City spent $150,000 on this program to install 3.75 miles of sidewalk. The City has allocated $150,000 for this program in the 2016 budget.
- A similar pilot program should be instituted that will retrofit short, but critical gaps in the sidewalk system identified as Tier 1 priorities.
- The City can seek grant funding to install some sidewalks near elementary and middle schools by applying to use Transportation Alternatives Program (TAP) funding. TAP provides funding for a variety of pedestrian and bicycle infrastructure, including infrastructure projects such as adding sidewalks near schools.

Table 6: Costs for Installing Sidewalks

	Cost per linear foot	Cost for 1 mile of sidewalk
Cost of installing concrete sidewalk	$20 to $30	$100,000 to $160,000

Source: City of Madison and Costs for Pedestrian and Bicyclist Infrastructure Improvements, UNC Highway Safety Research Center (2013)

Challenging Street Crossings

Along with challenges presented by gaps in the sidewalk system, the other significant barrier to pedestrian mobility is crossing major streets. Many of the public comments highlighted the need for better crossings on some of Madison's busiest streets. Transit corridors, in particular, need to be designed with easier street crossings in mind, because transit riders will board the bus on one side of the street in the morning, but will get off the bus on the opposite side in the afternoon.

Map 14 shows major streets that are likely to present crossing challenges and thus are more likely candidates for the crossing treatments included in Table 7. Map 14 displays streets with successively higher gradients of traffic. Motorized traffic is a component of exposure – the higher the volume of traffic, the more potential conflicts exist for pedestrians while having to cross more travel lanes. The map illustrates where there are longer stretches of major streets that are not signalized. Different treatments are called for depending on whether an intersection is signalized or unsignalized.

Table 7 shows some common types of interventions to make street crossings easier for pedestrians. They are divided into crosswalk treatments (for all intersections), traffic signal treatments, and traffic calming. Many of the interventions, like median refuge islands and flashing beacons, are helpful for arterials with high traffic volumes. These crossing treatments should be used in conjunction with many other measures to improve walking and crossing conditions along city streets. Traffic calming measures such as traffic circles, speed humps, and chicanes slow traffic and discourage drivers from cutting through neighborhood streets and are often used on lower speed and lower volume residential streets.

Table 7: Treatments to Make Street Crossings Easier

Street Crossing Treatment Type	Notes and assumptions	Cost	Crash Reduction Effectiveness
Crosswalk Treatments			
Crosswalk striping (standard and continental)	Painting and maintaining crosswalk markings is less expensive than more durable treatments such as thermoplastic and epoxy striping. However, longevity for durable markings vastly improves over paint.	$5-17/linear foot	Medium
Median Crossing Island	Costs increase as size of island and landscaping costs increase.	$2,100-$30,000 each	High
Raised crossing	This is a relatively new treatment to have tested results	$5,000-$20,000 per crosswalk	Medium
Pedestrian Signal and Beacon Treatments			
Flashing beacon	Flashers may be at road sign height or overhead. Rapid flashing beacons likely to be more effective.	$2,000-$8,000 each	Varies considerably
Pedestrian Hybrid Beacon (HAWK)	Used to stop traffic at midblock crossings.	$45,000-$130,000 each	High
Rectangular Rapid Flashing Beacon		$5,000-$20,000	Still being tested. Early results good.
Traffic Calming on Street Corridor			
Chicanes	A chicane is a series of curb extensions that make vehicles have to follow a curving path.	$5000-$11,000 per chicane	High
Curb extensions	Costs include 2 wheelchair ramps and detectable warnings. Costs can increase with special pavement or landscaping.	$7,000-$15,000 per corner	High
Speedhumps/Speed Tables		$2,000-$5,000	High
Stop Signs		$200-$500	Medium
Traffic Circles	Small landscaped circle, usually used in neighborhood streets	$15,000-$25,000	High

Source: Costs for Pedestrian and Bicyclist Infrastructure Improvements database, Pedestrian and Bicycle Information Center, 2013; Crash Modification Factors Clearinghouse: and Toole Design Group.

Crosswalk Treatments

Crosswalks marked with continental, ladder, or zebra patterns have been found to be significantly more visible to motorists[4] and to reduce crashes by a statistically significant percentage.[5] High-visibility crosswalks are especially beneficial on multi-lane streets, but are much more effective in conjunction with additional countermeasures, such as median crossing islands and rectangular rapid-flash beacons (described below).

[4] *K. Fitzpatrick, S. Chrysler, V. Iragavarapu, and E.S. Park. Detection Distances to Crosswalk Markings: Transverse Lines, Continental Markings, and Bar Pairs. Transportation Research Record: Journal of the Transportation Research Board, No. 2250. Transportation Research Board of the National Academies, Washington, DC, 2011.*

[5] L. *Chen, C. Chen, R. Ewing, C. McKnight, R. Srinivasan, and M. Roe. Safety Countermeasures and Crash Reduction in New York City—Experience and Lessons Learned. Accident Analysis and Prevention. In print, 2012. Retrieved August 14, 2015. http://dx.doi.org/10.1016/j.aap.2012.05.009*

In Madison, crosswalks are typically marked with waterborne paint or epoxy. Waterborne paint is less expensive and is done by the City's own crews and will last about a year. Epoxy costs more than waterborne paint but is substantially more durable, lasting two to four years. The most expensive and durable option is preformed cold tape, but it should be inlaid in the pavement in order to avoid damage from snowplows.

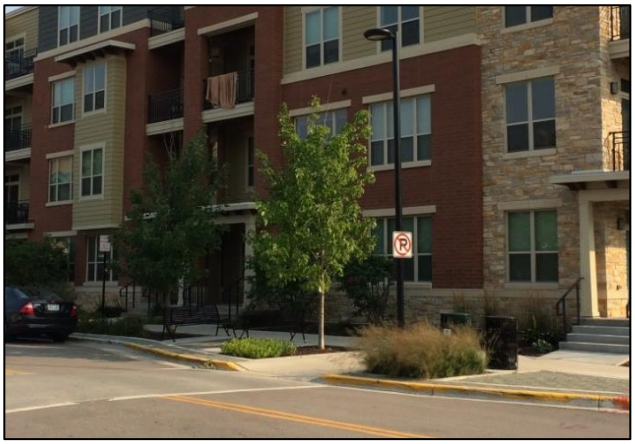
Marked crosswalks do have limitations and in many situations should only be used in conjunction with other crossing treatments. This is especially true for marking them when posted speeds are greater than 40 miles per hour. The Federal Highway Administration's *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations* provides direction and guidance on crosswalk placement. For additional information on marked crosswalks, as well as standards and guidance for various crosswalk improvements (including signs, signals, and other devices), the MUTCD guidelines for marked crosswalks need to be used.

Crossing or pedestrian islands (minimum of 6 feet wide, ideally 8 feet wide or wider to accommodate strollers, bicycles, etc.) located along the centerline of a street provide refuge for pedestrians and allow multi-stage crossings of wider streets. They have recently been added to the list of countermeasures that provide a significant crash reduction factor for pedestrians. These features also have minor traffic calming effects and improve crossings at unsignalized locations including locations with Rectangular Rapid Flash Beacons (RRFBs), since pedestrians are only required to negotiate one direction of traffic at a time. The raised median provides a safe place for the pedestrian to check for traffic before crossing the second half of the street. They also significantly reduce wait times for pedestrians, improving the level of service while making the crossings safer.

While crossing islands have a high safety factor relative to construction cost, adding them at key intersections of major streets is often difficult because of space limitations. Even when streets are reconstructed, finding space can be challenging in constrained areas. Often the best opportunities for incorporating crossings islands are on streets which have parking or when streets are "repurposed" and the number of travel lanes is reduced. The City has incorporated crossing islands at key crossings throughout the city including at some path crossings.

There are other devices that can effectively shorten the crossings of streets including curb extensions or curb bump-outs. By reducing crossing distances for pedestrians, exposure to conflicts with motor vehicles is reduced and pedestrian visibility is increased. They also have a traffic

calming effect and are listed under that section of Table 7. Curb extensions can also be used to reduce excessive corner radii at intersections (as shown in the photo).



Pedestrian Signal Treatments

Pedestrian signals are located at signalized intersections in Madison and at the pedestrian/bicyclist hybrid beacon at Blair and Mifflin Streets. Pedestrian signal devices provide walk and don't walk phases. While pedestrian signals appeal to many pedestrians since they create a "gap" in traffic (although there is still turning traffic), they often create longer waits for pedestrians. Furthermore, signalized intersections with pedestrian signals are not an absolute guarantee for pedestrian safety. Conflicts still exist at most intersections with turning motorists and inattentive drivers. Nevertheless, there are ways to enhance pedestrian signals and more innovative pedestrian hybrid beacons have been approved for use in the past 10 years.

As a standard treatment for pedestrian signals, countdown timers have been added to inform pedestrians of the amount of time remaining before the solid "DON'T WALK" phase of the signal cycle. This tool increases compliance by discouraging pedestrians from beginning to cross after the WALK cycle has ended. Reduced crash rates and delays can be realized through the installation of such signals. The City has been well on its way to incorporating these signal heads.

Traditional signal timing often results in pedestrians entering the "WALK" phase at the same time left-turning and right-turning traffic is given the green. Turning traffic must still yield for pedestrians. This creates conflicts between pedestrians in the crosswalk and turning motorists who either do not see the pedestrian, are confused by who has to yield, or believe they can pass through the intersection before the pedestrian arrives at the conflict point. Leading pedestrian intervals start the "WALK" phase 3 to 10 seconds before any motor vehicle traffic is allowed to proceed. This allows pedestrians to enter the crosswalk before turning motor vehicles begin moving through the intersection, thereby reducing crashes by as much as 60 percent.[6] The City of Madison has been using this technology for the past 15 years especially at signalized "T" intersections.

[6] *A.C. Fayish and Frank Gross. Safety effectiveness of leading pedestrian intervals evaluated by a before–after study with comparison groups. Transportation Research Record No. 2198 (2010): 15–22.*

One technology the City has used sparingly compared to peer communities is the Pedestrian Hybrid Beacon (HAWK). The purpose of a HAWK is to create a signal-directed break in traffic to improve the safety of pedestrian crossings, but stopping road traffic only as needed. Where standard traffic signal 'warrants' prevent the installation of standard three-color traffic signals, the HAWK beacon provides an alternative. HAWK beacons can work at either mid-block or at intersections, although the MUTCD currently recommends their treatment at mid-block locations. The City has one set of HAWKs that are intended for both bicyclist and pedestrian use at the intersection of Mifflin and Blair Streets. Other possible applications are where neighborhood streets intersect major streets. While the HAWK beacon could attract more pedestrians to cross at that location, it would not have the same attraction to motorists who would be unable to activate the beacon. This would likely be more acceptable to residents of the neighborhood street.

Flashing yellow warning beacons have been a common device in Madison at key pedestrian crossings. Many of these are activated during a certain period of the day, such as school travel hours. A new warning device that has proven much more effective is Rectangular Rapid Flash Beacons (RRFBs) which consist of a crosswalk warning sign and orange high-intensity flashing LED lights. RRFBs are activated by users (using push buttons) or automatically (using video, microwave, or infrared detection). RRFBs increase the visibility of crosswalks and increase motorist compliance with state laws regarding yielding to pedestrians in crosswalks. When installed, push buttons should ideally be positioned within the reach of pedestrians on the sidewalk and bicyclists in the roadway. Alternatively, separate pedestrian and bicyclist push buttons can be provided.

Lastly, technology has also been improving for pedestrians with disabilities who experience additional challenges at signalized intersections to allow them to access all of the available crossing information. Accessible pedestrian signals (APS) are pedestrian devices that benefit pedestrians since they enhance crossing information through visual, audible or vibrotactile devices. New signals should be APS compliant.

Traffic Calming/Traffic Management

Table 7 also includes traffic calming devices as a pedestrian facility treatment. There is a fundamental difference between these treatments and those listed as enhancing crossings of busy streets. The intent of traffic calming is to slow traffic on neighborhood streets to at or below the speed limit and to redirect cut-through to nearby collector or arterial streets. A direct side benefit of these treatments is the enhancement of the pedestrian environment for both walking along and across neighborhood streets. Of the listed devices in Table 7 the city has used speed tables the most and these have been effective in the two metrics stated above. There is growing interest in Madison in two broad uses of traffic calming devices: with potential wayfinding routes and on bicycle boulevards. Both of these will require a combination of the listed traffic calming devices to be effective, more so than what is being done today for bicycle boulevards.