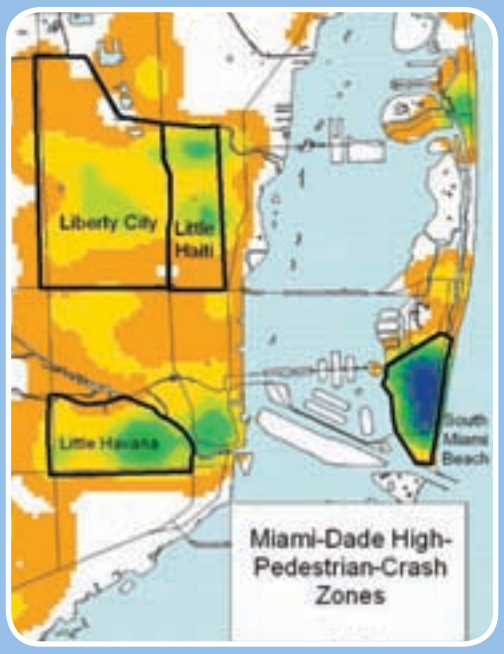
How to Develop a
Pedestrian Safety Action Plan



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How to Develop a Pedestrian Safety Action Plan

FINAL REPORT

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Introduction

The purpose of this guide on "How to Develop a Pedestrian Safety Action Plan" is to present an overview and framework for state and local agencies to develop and implement a Pedestrian Safety Action Plan tailored to their specific problems and needs. A Pedestrian Safety Action Plan is a plan developed by community stakeholders that is intended to improve pedestrian safety in the community. An objective of the guide is to help state and local officials know where to begin to address pedestrian safety issues. It is also intended to assist agencies in further enhancing their existing pedestrian safety programs and activities, including identifying safety problems and selecting optimal solutions. This guide is primarily a reference for improving pedestrian safety through street redesign and the use of engineering countermeasures as well as other safety-related treatments and programs that involve the whole community. This guide can be used by engineers, planners, traffic safety and enforcement professionals, public health and injury prevention professionals, and decision-makers who have the responsibility of improving pedestrian safety at the state or local level.

"In a society that values choice and freedom, people should be able to walk safely, whether for fun and recreation, errands, getting to work or school, shopping, or other reasons."

Pedestrian Safety Problem Background

Pedestrian crashes and the resulting deaths and injuries are a serious problem on our roadways. In 2004, 4,641 pedestrians were killed in traffic crashes, representing 12 percent of all roadway-related fatalities (National Highway Traffic Safety Administration, 2004). In urban areas, pedestrian deaths typically represent 25 to 40 percent of traffic fatalities. Approximately 70,000 pedestrians were injured on roadways in 2004, and many of these were severe injuries. While reducing pedestrian crashes has recently gained increasing priority among some state and local agencies as well as the U.S. Department of Transportation (DOT), more efforts and programs are needed to develop and implement effective strategies to reduce pedestrian-related injuries and deaths.

For more crash statistics, see NHTSA's Traffic Safety Facts: 2004 Data, available at http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/ncsa/TSF2004/809913.pdf

The safety literature reveals a variety of risk factors that influence pedestrian crashes and severity. For example, pedestrian crash risk increases on wide roads (four lanes or more) with high motor vehicle speeds and/or volumes. Intersections are more dif-

ficult to cross when pedestrians encounter wide crossing distances, wide turning radii, multiple turn lanes, or traffic control that is confusing or complex. Other high-risk factors include drug/alcohol use by motorists and pedestrians, lack of nighttime roadway lighting, and the lack of walkways along roads. Older pedestrians are much more susceptible to serious or fatal injuries because of their frailty, while young children (particularly males aged 5 to 9) are more likely to be struck by a motor vehicle after darting into the street (Campbell, 2004).

Many pedestrian crashes are the result of unsafe motor vehicle driver and pedestrian behaviors. Certain roadway designs features can contribute to unsafe behaviors by pedestrians and motorists. For example, excessively-wide streets encourage higher motorist speeds. High-volume multilane roads with a lack of safe crossings at regular intervals can contribute to pedestrians crossing streets at unsafe locations, particularly those who cannot or will not walk great distances to signalized locations. Land use decisions can also result in areas that are unsafe for pedestrians. For example, separating residential areas from shopping areas with high-volume multilane roads forces some pedestrians to cross streets in places that may not be safe. These types of issues must also be addressed in long-term solutions for pedestrian safety.

Walking is a basic human activity, and pedestrians are the lifeblood of many urban areas.

The American Association of State Highway and Transportation Officials' (AASHTO, also called the Green Book) *A Policy on Geometric Design of Highways and Streets* states:

"Pedestrians are a part of every roadway environment, and attention should be paid to their presence in rural as well as urban areas… pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas" (AASHTO, 2001).

The National Cooperative Highway Research Program (NCHRP) Report 500, Volume 10, *A Guide for Reducing Collisions Involving Pedestrians*, states:

"Walking is a basic human activity, and almost everyone is a pedestrian at one time or another…Even though pedestrians are legitimate roadway users, they are frequently overlooked in the quest to build more sophisticated transportation systems. Whether building new infrastructure or renovating existing facilities, it should be assumed that people will walk, and plans should be made to accommodate pedestrians. Where people aren't walking, it is often because they are prevented or discouraged from doing so" (Zegeer, Stutts, et al., 2004).

Unfortunately, many of our nation's streets and highways were primarily built to facilitate the smooth flow of motor vehicles. Yet, walking is the fundamental mode of human mobility; everyone is a pedestrian at some point in every journey that they take. This includes walking to a bus or walking to a parking lot. It includes people of all ages from children to older adults as well as pedestrians with visual and mobility impairments.

It is important to recognize that although many people choose to walk instead of drive as their only or primary mode of transportation, many others do not have the choice of driving. According to 2000 Census figures, nearly 15 percent of U.S. households do not own a vehicle. Also, 25 to 30 percent of U.S. citizens do not have a valid driver's license. This includes children under age 16, as well as many older and physically-impaired adults. This portion of our population should not be prevented from safe and reasonable opportunities to walk.

In a society that values choice and freedom, people should be able to walk safely, whether for fun and recreation, errands, getting to work or school, shopping, or other reasons. Many Americans want to be able to walk more if given the opportunity to do so. Yet, many street environments are often inhospitable and unsafe for walking.

Many Americans want to be given the opportunity to walk more, whether for fun and recreation, errands, shopping, or other reasons.

Pedestrian safety and mobility must be elevated to a top priority for the situation to improve substantially. The engineers, planners, and other public officials in state and local agencies can leave an important legacy of improved walking conditions and fewer pedestrian crashes and injuries for future generations.

There are several objectives that transportation professionals should address to improve pedestrian safety and mobility (adapted from *A Guide for Reducing Collisions Involving Pedestrians*):

- Reduce the speed of motor vehicles.
- Reduce pedestrian risks at street crossing locations.
- Provide sidewalks and walkways separate from motor vehicle traffic.
- Improve awareness of and visibility between motor vehicles and pedestrians.
- Improve pedestrian and motorist behaviors.

A variety of strategies are available to improve pedestrian safety. A comprehensive approach involving the "three E's" (Engineering, Education, and Enforcement), as well as making pedestrian-conscious land use decisions, is recommended. Engineers, educators, planners, and enforcement officials all play a role in helping to identify and implement effective safety improvements

Guide Contents

This guide contains the following chapters:

- Chapter 1: Planning and Designing for Pedestrian Safety—The Big Picture.
- Chapter 2: Involving Stakeholders.
- Chapter 3: Collecting Data to Identify Pedestrian Safety Problems.
- Chapter 4: Analyzing Information and Prioritizing Concerns.
- Chapter 5: Selecting Safety Solutions.

- Chapter 6: Providing Funding.
- Chapter 7: Creating the Pedestrian Safety Action Plan.

Chapter 7 provides the framework that state and local agencies can use to develop a customized Pedestrian Safety Action Plan. The concepts, principles, and information contained in this guide are based on national guidelines, including (among others):

- AASHTO
  - *Guide for the Planning, Design, and Operation of Pedestrian Facilities.*

- Federal Highway Administration (FHWA)
  - *Manual on Uniform Traffic Control Devices.*
  - *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System.*

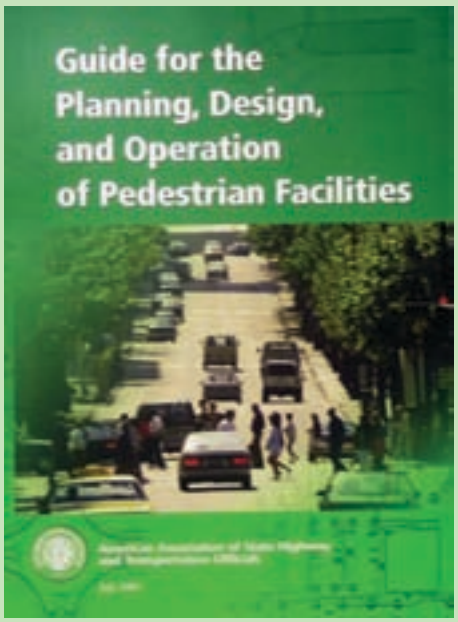
- Institute of Transportation Engineers (ITE)
  - *Traffic Control Devices Handbook.*
  - *Design and Safety of Pedestrian Facilities.*

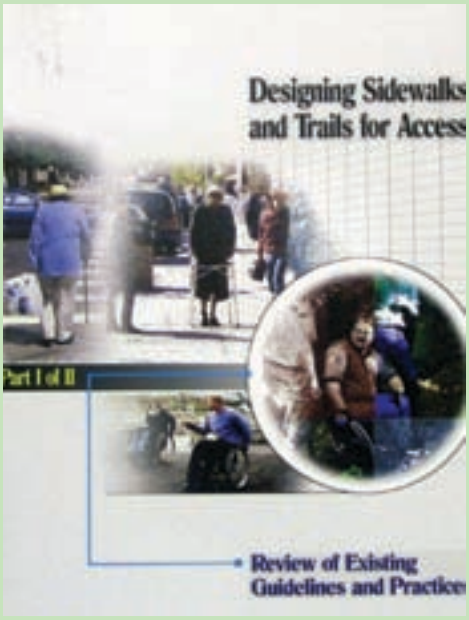
- NCHRP
  - Report 500, Vol. 10, *A Guide for Reducing Collisions Involving Pedestrians*).

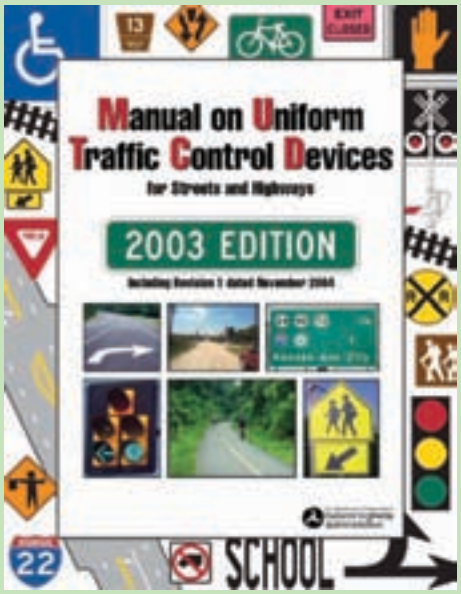
Pedestrian plans and design guidelines from local and state transportation agencies throughout the U.S. are referenced throughout this guide. Most of the facility recommendations and design principles given here are based on the latest pedestrian safety research, particularly FHWA and NCHRP research. This guide provides a framework for 1) reviewing pedestrian problem sites, roadway segments, and other targeted areas in an organized manner and 2) selecting and implementing appropriate safety measures.

National Guidelines and Resources

Design Guidelines





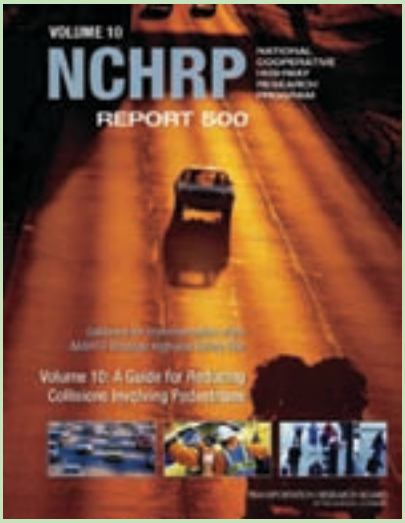


For descriptions of these documents and links to additional resources, see Appendix F.

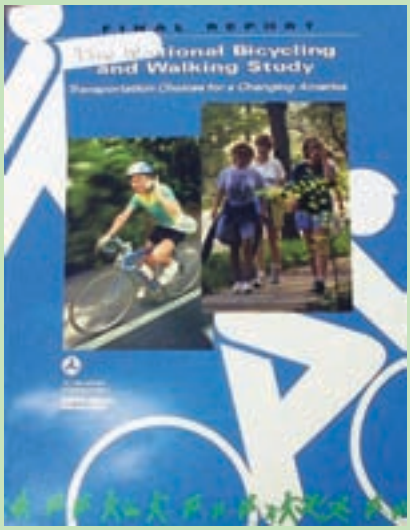
National Guidelines and Resources

For descriptions of these documents and links to additional resources, see Appendix F.

Countermeasure Selection Tools



Research and Policy Tools



Chapter 1: Planning and Designing for Pedestrian Safety—The Big Picture

The automobile has irrefutably altered the way in which transportation systems and the built environment are designed and constructed, often at the expense of pedestrians. In the majority of crashes between pedestrians and motor vehicles, the pedestrian is trying to navigate in an environment designed primarily for automobile use. This chapter explains how some common roadway design practices can have negative impacts on pedestrian travel and safety as well as the policies that have led to these design practices. It also discusses other major factors that affect pedestrian safety such as street connectivity, site design, land use, and access management. Next, it suggests changes that can lead to improvements in the pedestrian environment. Finally, it discusses the need to institutionalize these changes by reviewing, amending, and adopting policies and design guidelines to better accommodate pedestrian travel. It is important to be proactive as well as responsive to pedestrian safety problems. This chapter reflects the need to develop a Pedestrian Safety Action Plan both as a response to current design issues and as an effort to integrate pedestrians into the design process from the beginning to ensure the quality of future developments.

“In the majority of crashes between pedestrians and motor vehicles, the pedestrian is trying to navigate in an environment designed primarily for automobile use.”

Understanding Pedestrian Characteristics

Good pedestrian safety planning must include an understanding of the characteristics of pedestrians. With an understanding of pedestrian needs and characteristics, those involved in pedestrian safety planning can more effectively understand how new and existing facilities must operate, as well as how pedestrians will act when faced with certain conditions. Applying a practical understanding of pedestrian characteristics will provide insights when considering appropriate safety solutions and will particularly help ensure that facilities are inviting to pedestrians.

Important characteristics include understanding why and where pedestrians walk, what types of design features create a safer pedestrian environment, and what types of behavioral decisions pedestrians are likely to make. In addition, pedestrians also consist of specific populations with different characteristics, including children (who may be impulsive or unpredictable), persons with mobility impairments (who may require specific visibility devices or facility features), and senior citizens (who may require additional time for roadway crossings).

The AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (2004) includes a comprehensive discussion of pedestrian characteristics and needs.

Transportation Design and Policy Elements that Impact Pedestrian Safety

Several design practices and policies conceived to improve motor vehicle mobility are now recognized as barriers to a safe pedestrian environment. There are many factors that affect the safety and mobility of the pedestrian transportation network. The major planning, design, and policy elements that impact pedestrian safety include:

Many arterial streets are designed to accommodate large volumes of fast moving vehicles, often a risk to pedestrian safety.

1. Street design.
2. Street connectivity.
3. Site design.
4. Land use.
5. Access management.

Because this guide includes a large section on improving pedestrian safety through street redesign and engineering-related crash countermeasures, it provides a more detailed focus on the street design elements and those policies influencing street design choices. The interrelated subjects of street connectivity, site design, land use, and access management—while major components of a well-built environment—will be discussed briefly within the context of providing safer pedestrian environments.

Street Design

The traditional street system is based on a simple hierarchy: most trips originate on local streets; travelers are then ferried via collector streets to arterials, which are intended to carry large amounts of motor vehicle traffic long distances at higher speeds. This system is based on the assumption that most trips occur by motor vehicle, so most of the facilities are designed primarily for motor vehicle travel. The system results in street designs that do not serve pedestrians well for several reasons:

1. **They lack pedestrian facilities**: Some collector and arterial streets are built with inadequate or no sidewalks or walkways, discouraging or limiting safe pedestrian movement along streets. Continuous lighting may not exist to provide adequate nighttime pedestrian conditions.

2. **They are wide or have multiple lanes that are difficult to cross**: Since arterial roads are designed to facilitate smooth and efficient motor vehicle flow, they often have multiple lanes in each direction to accommodate high motor vehicle traffic volumes and also multiple turn lanes. The number of lanes a pedestrian must cross has a direct effect on the complexity of the crossing task and the pedestrian crash risk. The pedestrian must find an adequate gap in motor vehicle traffic, a task that increases exponentially with the number of lanes.

3. **They have high speeds**: Wide streets encourage and allow higher vehicle speeds, which relate directly to more severe injuries (to motorists and pedestrians) when a crash occurs; the majority of pedestrian crashes and most fatalities occur on higher speed arterials.

4. **They have complex intersections**: Typically, wide arterial streets have intersections that are even wider due to the addition of multiple turn lanes. They also often have large turning radii to allow larger vehicles, such as trucks and buses, to make turns easily and quickly. This requires pedestrians to cross longer distances and watch for more cars in more lanes, an often challenging and dangerous task. Skewed intersection designs and high vehicle right- and left-turn volumes at an intersection can also add complexity to the crossing task. Left turn arrows can also be confusing to pedestrians.

5. **They create long delays for pedestrians at intersections**: Wide intersections and those with multiple turn lanes create a long wait for pedestrians. At times, crossing prohibitions may be designated for one or more crosswalks to facilitate turning movements. If a crosswalk is closed, the pedestrian is left with three choices: cross illegally with no signal protection, walk a long distance around the intersection, or walk to another location to cross.

6. **They provide little "friction" to protect pedestrians**: Much of the traffic engineering philosophy of the last few decades has been aimed at stripping roads of "friction" (for example, removing trees, etc.) in order to facilitate motor vehicle traffic flow. This creates a barren, unsafe, and unattractive environment for pedestrians, often with high vehicle speeds.

Many of the solutions and designs proposed for increased pedestrian safety require revisiting some of these assumptions. But none of the proposed designs will create a less safe environment for motorists or other road users.

Design Speeds

One important concept to understand is design speeds. According to the AASHTO Green Book (2001), the design speed of a roadway is the speed that is selected by the designer for determining the various geometric design features for the road. Although design speeds for rural roads are typically higher than for downtown urban streets, it is important to provide design speeds that account for the needs of pedestrians, bicyclists, and other road users. Lower design speeds may be achieved by providing such features as narrow street widths, on-street parking, tight turning radii, buffered sidewalks with street trees, short block lengths, short building setbacks, and streetlights.

It is also important to select a design speed for the type and purpose of the road. For example, on a low-volume, urban local street, it may be appropriate to provide narrow roadway widths and allow trees fairly close to the road. A suburban arterial street might typically have wider lanes, trees and utilities set back further from the road, and no on-street parking. Although a design speed may be higher on suburban arterial streets (compared to urban local or collector streets), it is still important to provide

pedestrian accommodations on such roads (e.g., well-designed sidewalks, safe street crossings, adequate lighting), since pedestrians in those situations should also be able to walk and cross streets safely

Street Design Policies that have Affected Pedestrians

Achieving a Desired Level of Service

Level of Service (LOS) for motor vehicle traffic is usually measured in letter grades A through F. LOS A describes free-flowing unimpeded motor vehicle traffic; LOS F is near gridlock. LOS D is typical of congested urban areas where streets are full and motor vehicle traffic is moving relatively slowly. It is not uncommon for intersections to operate at LOS F during the peak periods of traffic.

See the Highway Capacity Manual for more on LOS. The HCM can be ordered from the Web site http://trb.org/news/blurb_detail.asp?id=1166.

The measurements and calculations needed to predict or determine LOS are quantitative. However, the desired LOS is often a political decision (or policy), based on how much congestion decision-makers assume the public will tolerate. Those communities that have sought to have motor vehicle traffic flow smoothly often have characteristically wide roads with minimal pedestrian accommodations. Consequently, they often experience higher crash rates for all roadway users, as both motorists and pedestrians suffer from the less safe conditions created to achieve these higher levels of vehicle mobility.

Careful planning and design assures that even narrow streets such as the one pictured here remain accessible to emergency vehicles and other large vehicles such as school buses and moving vans.

Accommodating Special Vehicles

Roadway design is usually predicated on the concept of the "design vehicle." The design vehicle is the largest vehicle that can be expected to use the road often enough to justify designing the roadway to accommodate that vehicle. Large design vehicles are commonly trucks and buses, including trash collection trucks, moving vans, school buses, and fire trucks. A typical design vehicle for local streets is known as an SU (Single Unit delivery truck), such as those used by UPS.

The most critical application of this concept is at intersections, where the radius is made large enough so the design vehicle can make a right turn without encroaching into the opposing lane. This can have a major negative effect on pedestrian safety and comfort, because a large radius allows passenger vehicles to make right turns at higher speeds and requires pedestrians to cross a longer distance. Large radii at intersections can contribute to a higher pedestrian crash risk as pedestrians are often hit by turning vehicles.

Street Connectivity

Within the context of the previously described street hierarchy, local streets typically do not connect well to each other, arterial streets, or destinations such as transit stops

or stores. This leads to larger collector and arterial streets that convey heavy motor vehicle traffic. This discontinuous pattern of local streets limits travel choices for pedestrians to higher-risk arterial streets that reduce both comfort and safety. A lack of street connectivity leads to intersections that are few in number—but often large in size—that are more difficult for pedestrians to navigate. Many local streets have curvilinear or cul-de-sac designs that:

1. Limit pedestrians' ability to travel in the most direct path.
2. May be disorienting.
3. Increase the distances to destinations.
4. Increase pedestrian exposure time to other vehicles on the road.
5. Discourage walking because of the added travel distance to destinations.

Fewer people walking reduces the motorist's expectation of seeing pedestrians along and crossing streets.

Improving Connectivity of Local Streets

Street layout directly impacts the ability to walk or bike. Connected local streets, sidewalks, and bicycle facilities help reduce walking or biking distances, provide more choices on travel, including the use of more local streets, at the same time dispersing vehicle traffic. In this example, a path was created at the end of a neighborhood cul-de-sac to improve the connectivity of the streets for pedestrian and bicyclist use.

These street designs have some negative impacts on motorists as well, increasing driving distance and time, and affecting the response time for emergency vehicles.

Site Design

Many existing developments do not provide direct, clear, and convenient access for pedestrians. Pedestrians wishing to access a site may have to determine their own path and navigate through driveways, parking lots, landscaping, and other buildings in order to reach the destination. This often leads to confusion and conflicts between pedestrians and motorists, resulting in more pedestrian crashes.

Land Use

The practice and evolution of land use planning is long, complex, and generally beyond the scope of this document; however, an acknowledgement of certain issues pertaining to pedestrian safety is in order. Land use practices that took shape after World War II have typically favored the segregation of land uses (e.g., commercial and employment areas, schools, and residences) and the concentration of commercial activities along auto-dominated arterial corridors. This has produced the following unintended consequences:

1. Trip origins and destinations are often far apart.
2. Longer travel distances lead to fewer people walking and more driving.

3. More people driving creates more hectic motor vehicle traffic conditions not conducive to safe pedestrian environments—those who do walk are exposed to long distances and high levels of risk when they walk along or try to cross busy high-speed arterial streets.
4. The premise that most trips will be made by automobile leads to street designs intended to accommodate only the automobile, built to handle large volumes of motor vehicle traffic; when this occurs, pedestrians are often minimally accommodated only as an afterthought, if at all.
5. Many of the destinations and commercial activities along a roadway corridor are also designed to serve motorists, fostering strip development with ample parking to capture passing motorists. As most of these destinations are located on arterials, they are hard for pedestrians to access.

The typical land use pattern of concentrating commercial activities along auto-dominated corridors creates generic-looking roads that are hard for pedestrians to cross. The safety consequences are evident when one analyzes crash data and sees that many pedestrian crashes occur along higher speed suburban corridors with few or no pedestrian facilities and very separated land uses.

Access Management

According to AASHTO, access management "involves providing (or managing) access to land development while simultaneously preserving the flow of traffic on the surrounding roadway system in terms of safety, capacity, and speed" (AASHTO, 2001). It has widely been used to improve the efficiency and flow of motor vehicle traffic by limiting the number of driveways and intersections on arterials and highways. In some cases this has improved safety for pedestrians and motorists alike, but in other instances it has had the unintended consequence of facilitating the design of larger intersections spaced far apart. These intersections are often difficult and unsafe for pedestrians to cross due to their size and large numbers of turning vehicles. Pedestrians wishing to cross at an intersection may have to walk long distances out of their way.

Poorly designed driveways can become conflict points for pedestrians and motorists.

For communities that do not limit the number of driveways and intersections, the issue of intersection size and spacing may not be a problem, but an excessive number of driveways can create another problem. For pedestrians, every driveway is a potential conflict point. Vehicles pull in and out of commercial driveways continuously, and when driveways are designed like street intersections, turning speeds can be quite high. Too many driveways along a street without proper driveway design can also create a challenging walking environment for people with disabilities.

Methods to Improve Pedestrian Safety at the Macro-Level

In addition to improving the compliance of all roadway users with traffic controls and laws, there are several measures that can be taken to improve conditions for pedestrians within these transportation conventions previously discussed. Improved pedestrian safety can be achieved in a variety of ways, including:

Street Design Improvements

To make streets safer for pedestrians, planners, designers, engineers, and officials need to focus on:

- Slowing vehicle speeds.
- Reducing street crossing distances for pedestrians.
- Improving the visibility of pedestrians and motorists.
- Increasing the level of caution taken by pedestrians and motorists.
- Providing pedestrian facilities (sidewalks, crossing islands, etc.) where the needs and potential crash reductions are the greatest by establishing a routine system to identify gaps in the network along streets and highways, particularly in urban and suburban areas.

For additional information on pedestrian-friendly street design, refer to the ITE Traffic Calming State of the Practice report, available online at: http://www.ite.org/traffic/tcstate.htm.

Other Web sites that provide useful information include: http://www.walkable.org/ and http://www.trafficcalming.org/.

Achieving one or more of these objectives not only reduces the risk of pedestrian crashes, but also usually improves safety for motor vehicle drivers and passengers. Sometimes a design issue may result in a complication or delay to other roadway users, and transportation officials will have to make a choice to balance the competing interests. Officials may perceive these choices to be unpopular or difficult to make, especially for those whose job has been to move motor vehicle traffic and who may not be aware of values held by the community. However, most often a community will be supportive of improved pedestrian safety; it is important to educate and inform people about how and why certain choices are made (see Chapter 2 for a discussion on how to involve stakeholders).

Some wide streets are intimidating and unsafe for pedestrians (top photo), but wide streets can still be designed to work for pedestrians (bottom photo).

To achieve these objectives, some policies may require rethinking or reprioritization. These include:

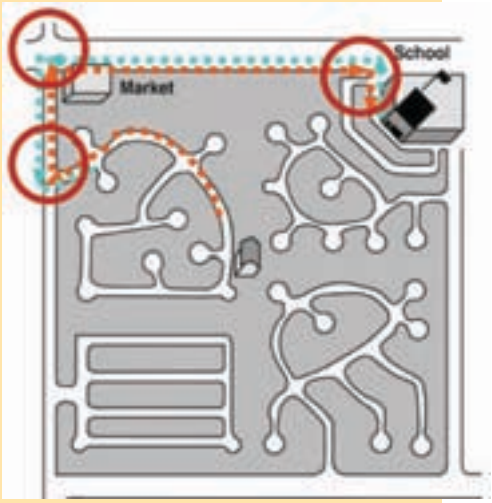
Achieving a Desired Level of Service

Some effective pedestrian safety measures may increase motor vehicle travel time and have a slight negative impact on motor vehicle LOS. A rebalancing of the transportation system where pedestrian LOS and safety are included may sometimes mean a change in expectations about the priority that motor vehicle LOS is given in design and decision-making. If serious safety measures are to be achieved, the particular LOS may be lower for motor vehicles than if those measures were not taken. Improvements in capacity can be achieved in other ways: by

expanding the capacity of other transportation options, re-thinking land use strategies, or determining where important destinations—such as schools—are to be located.

Accommodating Special Vehicles

The conflict between vehicle accommodation and pedestrian safety is usually considered a design decision, but it is also a values (policy) decision. An intersection can be designed with a smaller radius than is typically used for a particular design vehicle, thereby increasing pedestrian safety by reducing crossing distance/exposure. The motor vehicle driver can still make the turn, but the truck will have to maneuver into an inside lane to complete the turn. Communities with streets designed around the concept of "bigger is better" are communities that often provide poor pedestrian service and typically have poor pedestrian safety records. Conversely, communities that place a high priority on pedestrian safety and convenience do more to balance the needs of large vehicles with the needs of pedestrians in their street designs. This does not mean trucks, school buses, and fire trucks cannot use the streets—they are accommodated; they just usually need to travel at a lower speed and take care in making turns. Transportation professionals are asked to carefully weigh these factors when making street design decisions.



In the top image, the residential streets are not well-connected and the pedestrian path is very long; below, connected streets provide a more direct route to the school.

Street Connectivity Improvements

Increasing street connectivity creates a safer, more pedestrian-friendly street system by:

- Reducing walking distances.
- Offering more route choices along quiet local streets.
- Dispersing motor vehicle traffic with more two-lane, neighborhood commercial streets, which relieves motor vehicle traffic from arterials to makes streets safer for pedestrians to walk along.
- Reducing the need for wide, difficult to cross streets and intersections by providing more connections.

Street connectivity with the transit network is very important. If people are to use transit, then their role as pedestrians on both ends of their trip is important and should be accommodated on well-connected streets.

Street connections are vital to pedestrians, and there are many things that can be done to improve the connectivity of existing street networks and plan for the connectivity of future developments. Here are a few potential solutions:

- Improve existing local street connectivity and circulation by adding sidewalks, paths, stairs/ramps, gates, etc. to link dead-end streets and cul-de-sacs to other

Importance of Pedestrian Facilities in Disaster Preparedness

State of New York

Mass evacuation on-foot is often the only available means for people to quickly escape terrorist attacks, sudden natural disasters, or to cope with other actions or incidents that may cause highway, transit and/or commuter rail systems to shut down for an undetermined period. Successful mass movement of pedestrians witnessed during the September 11, 2001 attacks in New York City, the August 2003 Northeast Power Outage, and the 2005 transit strikes show that walking is the most reliable and sustainable mode of transportation for overcoming obstacles.

From a design and operational standpoint, at-grade/street-level pedestrian access has been found to be the safest design feature for expediting pedestrian traffic movements when mass evacuation occurs. Inhibitors to mass evacuation (that should be avoided) include:

- Restricted at-grade pedestrian access due to longer blocks, fencing, and barriers.
- Pedestrian structures susceptible to movement and/or collapse (partial or total).
- Pedestrian tunnels susceptible to flooding or exit/entry obstructions.
- Building site and frontage design configurations that impede pedestrian traffic.

While vehicular travel lanes in urban main streets and central business/walking districts may experience surges of pedestrian traffic, adequate pedestrian facilities are still more suitable for use during more localized mass evacuations. This is because:

- Travel lanes may be clogged or obstructed with abandoned vehicles and/or debris.
- On-street and highway motor vehicle traffic may still be active during evacuation.
- Motorist panic and general confusion may make pedestrian use of roadways hazardous.
- Travel lanes may be restricted to emergency, military, or government uses.

When a major sub-regional or regional catastrophic event occurs, the pedestrian use of travel lanes must be included in transportation, law enforcement, emergency management, and military coordinated evacuation planning and recovery action plan efforts. This is important because major catastrophic events will involve massive pedestrian traffic surges at critical regional transportation bottlenecks and should be fully anticipated and strategically planned. Based on prior experience, travel lanes expected to carry the highest pedestrian volumes should be mapped and pre-designated for the quickest removal of any obstructions that might hinder rapid at-grade pedestrian evacuation.

This information provided by Jim Ercolano at the NYDOT. For more information, contact Mr. Ercolano at jercolano@dot.state.ny.us.

parts of the street network.

- Maintain a pedestrian connection (e.g., provide a path in the right-of-way or sidewalk easement) when a street is being severed (it is more difficult to purchase an easement for a connection later).
- Increase the number of access points to and from neighborhoods and other destinations, so not all trips are funneled through one or two large intersections or access points. More neighborhood travel options means less motor vehicle traffic on any given street.
- Design future developments with improved circulation patterns within neighborhoods so more neighborhood automobile trips can be taken on local streets, reducing the need to widen arterials. This may conflict with some traffic-calming techniques, but speeds can be controlled through other measures (see Chapter 5 for further discussion).

Site Design Improvements

Both small-scale and large-scale developments should be directly accessible from the sidewalk through a safe and convenient sidewalk or pathway. Many communities are achieving better pedestrian safety records by requiring businesses and developments to locate close to the street (with parking provided in the back) in more pedestrian-oriented site developments that balance auto access with pedestrian needs and facilities. This does not mean that auto access is denied; it is just managed more appropriately.

Site design matters to pedestrians. In this example, the design of driveways, building setbacks, parking, buffers, and sidewalks all contribute to the safety of the walking environment.

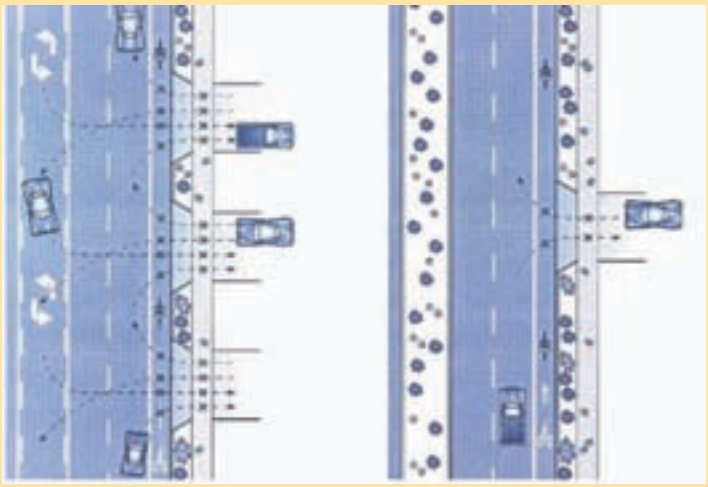
These site design goals are achieved by enacting local zoning ordinances, which must be enforced. These principles contribute greatly to the safety, comfort, and aesthetics of the walking experience.

Land Use Improvements

Land use planning has often been considered a discipline separate from transportation planning, street design, and traffic engineering, and insufficient emphasis has been placed on the coordination of the two planning processes. However, the relationship between land use and transportation is evident, and the responsibility to coordinate between the two is imperative. Some changes to land use patterns that may positively influence pedestrian safety include:

- Encouraging mixed-use development (such as allowing small-scale retail in neighborhoods or placing schools in the center of neighborhoods) to help create destinations within walking distance of where people live and work.
- Designing new neighborhoods in a cluster pattern with many destinations accessible on foot to residents.

Other ideas are detailed in Chapter 5.



Proper access management can control turning movements to reduce conflict points, encourage cluster development, improve street connectivity, and create more accessible land use patterns to improve the overall safety of the pedestrian environment.

Access Management Improvements

One of the most important access management techniques includes reducing conflicts at driveways to improve the walking environment. Some driveways can be closed—increasing the safety of both pedestrians and motorists—without impeding access to local businesses. Access management tools should not be used to reduce public street connections, especially pedestrian connections to the transportation network. Other access management goals can work in favor of pedestrians within the context of other important planning and policy issues, including:

- Constructing medians to control turning movements.
- Encouraging clustered development and mixed land uses.
- Improving street and neighborhood connectivity.
- Converting auto-oriented strip development into more accessible land use patterns more suitable for pedestrians.

Reviewing Pedestrian Policies and Design Guidelines to Improve Pedestrian Safety

A multimodal approach to policy-making is needed. Agencies need to review their design guidelines and policies to ensure that quality facilities are provided with both developer-built and new agency-built roadway projects. New facilities must be fully accessible to all pedestrians. Chapter 5 provides a more complete list of common and effective practices that may serve as a template for reviewing the current status of agency policies and guidelines. It provides policies and design recommendations organized into the following sections:

1. Improvements along the road (on sidewalks, at driveways, etc.).
2. Improvements for crossing the road (at midblock locations and signalized/unsignalized intersections).
3. Transit improvements.
4. Speed control measures.
5. Land use and site design.

The image on the left provides the "before" view of a typical arterial street designed primarily for automobile use. In the "after" photo on the right, a digital illustration provides an example of how simple changes—access management, a raised median, bicycle lanes, sidewalks, and landscaping—can make such spaces more safe and appealing for pedestrians.

To list a few examples from the chapter:

- Sidewalks or walkways are desirable on most urban and suburban roadways, and efforts should be made to establish priorities for adding needed sidewalks.
- Pedestrian signals (i.e., WALK/DON'T WALK messages, symbolic hand/walking man messages) and marked crosswalks are desirable at all traffic signals where pedestrian crossing activity is expected, particularly at wide streets.
- Transit stops should be located where pedestrians can safely cross the street.

For more information, read Dan Burden's essay, "How Can I Find and Help Build a Walkable Community" at http://www.walkable.org/article1.htm.

There are numerous other guidelines that can be used to identify design and traffic management practices to incorporate into appropriate agency manuals. The review of agency policies and design guidelines for pedestrian facilities should be a priority. Most improvements to the street/pedestrian infrastructure will be gradual and implemented over many years as a part of future development and roadway reconstruction projects.

Finding the Appropriate Documents to Review

In most communities, the built environment is governed by a variety of processes. In some communities, public works departments have developed their own guidelines for roadway design that may need to be revised to conform to recommended practices. In other localities, subdivision ordinances are the key element to be reviewed and updated to ensure the development of safe pedestrian facilities. It may be challenging to pinpoint what is wrong with those ordinances, what is missing, or what effect they are actually having on the built environment, but they provide a starting point for the review and comparison of policies and guidelines outlined in this guide. The process of plan review is also important, and transportation officials need to know what to look for in development proposals. This chapter and Chapter 5 provide important examples of both macro- and micro-level elements that should be considered in development plans to ensure the highest level of pedestrian safety.

Chapter 2: Involving Stakeholders

Stakeholders include people who have a share or an interest in a particular policy, program, or project and may be affected by its implementation. Stakeholder involvement is an essential element in creating publicly supported and trusted policies, programs, and projects that reduce pedestrian crashes while creating livable, walkable communities.

Public participation is not an end in itself, but part of a broader process of sustainable development. Participation is an important mechanism that can help create trust and credibility with stakeholders. The public should be included throughout the planning process, and the participation of all interested and affected parties—including vulnerable and disadvantaged persons—must be promoted.

Public stakeholders should be seen as useful partners in bringing helpful information and judgment to the table. They often are the on-the-ground scouts who can identify problems, needs, and opportunities. Since the professional staff cannot be everywhere at all times, the public can serve as additional eyes and ears and be effective resources.

The extent of the processes in which local agencies involve the public will vary according to their size and budget. Some communities are better equipped to implement these strategies while others may not have the resources and staff to implement all the strategies, so some modification and "tailoring" of these recommendations may be required.

State and local agencies operate and relate to the public differently, so some modifications of the recommendations in this report will be needed to accommodate these differences.

"Stakeholder involvement is an essential element in creating publicly supported and trusted policies, programs, and projects that reduce pedestrian crashes while creating livable, walkable communities."

Public Involvement Through Meetings and Workshops

Denver, CO

The City of Denver held two rounds of four public meetings at key points in the process of developing the Pedestrian Master Plan in order to identify all potential issues and problem locations within the pedestrian environment. A final ninth public meeting was held prior to finalization of the Pedestrian Master Plan.

During the first round of workshops, citizens were given the opportunity to comment on the general obstacles they faced in the pedestrian system and to provide information on ways to improve the infrastructure. During the second round of workshops, the public provided feedback on the proposed pedestrian routes, among other issues.

Public input was received not only from the workshops but also from email and facsimile. This input was used to develop policy and to prioritize projects. In addition to expert review and monitoring by the Advisory Team, input was also solicited from other City officials within various City departments. The plan was reviewed by several special interest groups, internal staff, the Planning Board, and the City Council prior to finalizing the Pedestrian Master Plan.

For more information, visit: http://www.denvergov.org/transportation_planning/.

Who are the Stakeholders?

Stakeholders include five distinct groups:

1. Individual citizens.
2. Citizen-based organizations.
3. Public employees, officials, and agencies.
4. The private sector (including local business owners and developers).
5. The media.

All have a unique role to play and require a different strategy for involvement.

Individual Citizens

Requests from individual citizens are an important way for agencies to learn about problems at specific locations. Typically, citizens will contact agencies with a request for a particular treatment such as a marked crosswalk. While citizens may or may not have asked for the correct solution, they are likely to have identified a pedestrian problem. Sometimes, the problem citizens perceive is different than an analysis of data reveals. Consequently, the first step is to figure out the problem that the citizen is trying to solve. Sometimes it is obvious, other times it may require further communication with the citizen, a field visit, and an engineering study.

Responding to citizen requests can be a time-consuming task. Agencies should develop procedures for quickly determining which requests deserve a higher level of attention. Time and money are often best spent addressing the problems that are most likely to reduce pedestrian crashes. For example, in Seattle, the staff gets together once a week to review citizen requests to perform a quick assessment of needs and priorities, asking questions such as:

- What is the crash history?
- Have there been previous complaints?
- Is it a location with a high volume of pedestrians?
- Is it likely that this problem will cause a crash?
- Is there a clear design problem?
- Is it a maintenance problem?
- Would moving a transit stop eliminate the problem?
- Is there already a project in the area that will address the problem?

Using the collective memory of the group with some data, it is often possible to prioritize the requests and identify those that require further analysis. Citizens always deserve a response whether it is a phone call, email or letter. Most agencies already have procedures that dictate the appropriate way to respond.

Public Involvement to Develop a Transportation Needs Database

Portland, OR

Portland's Pedestrian Transportation Program has made use of the city's active and engaged citizenry to help identify, develop, and prioritize pedestrian projects and to create its 1998 Pedestrian Master Plan.

The city held a series of nine open houses in the spring of 1995 to solicit comments and needs requests for the Pedestrian Master Plan. Among other activities, attendees were offered the opportunity to "pin the tail on the problem" by filling out a card to identify a need and marking the location on a map with a numbered sticker. Later, a second series of nine Pedestrian Master Plan Workshops were held around the city to present the projects proposed in the Plan. Throughout the project, presentations were made upon request by neighborhoods and other groups in order to encourage further participation.

All the needs, requests, and project suggestions received during the open houses, district coalition presentations, and workshops for the Pedestrian Master Plan project were added to a database of information regarding neighborhood transportation needs. Also included in the database were suggestions or complaints collected through phone calls, letters, and various public presentations.

For more information, visit: http://www.trans.ci.portland.or.us/plans/pedestrianmasterplan/default.htm or http://www.portland transportation.org.

One obstacle to receiving citizen requests and feedback is that citizens often do not know who they should address their concerns to or how. In a heavily populated county, there may be several municipalities with jurisdiction over local streets, as well as the county and state DOT, each with its own roads. Many citizens have little idea which agencies actually maintain the roadways and traffic signals and do not know who to turn to to make a request. One way to obtain more feedback from pedestrians is to increase and improve Web-based outreach programs. A highly visible link on a traffic agency Web site can help direct feedback to the best place or provide additional information. Another technique helpful to citizens may include posting an agency phone number or Web site on traffic signal controller boxes, typically located near the corners of signalized intersections, or in areas with high pedestrian activity.

Citizen-Based Organizations

Citizen-based organizations can roughly be divided into special interest groups such as a Pedestrian Advisory Board (PAB), and geographically-based groups where people are members by virtue of living or having a business in a particular neighborhood. Also included in this category are various advocacy and non-profit organizations. All these groups can play a critical role in creating a better walking environment.

Pedestrian Advisory Boards

State and local agencies should consider forming a Pedestrian Advisory Board (or Council or Committee) to obtain ongoing, good citizen input. It is an excellent way to get a better product while building support for agency policies, programs, projects and funding. Meeting times, places, and frequencies will vary depending on whether it is a state or local PAB. State PABs tend to only meet several times a year—often at locations around the state to accommodate its members. Local PABs usually meet monthly, often at the same location. It is preferable to have separate pedestrian and bicycle boards so that pedestrian boards can focus solely on pedestrian issues. If this can't be achieved, measures need to be made to ensure that both the pedestrian and bicycle modes get equal attention. Creating and running an effective PAB requires a thoughtful, purposeful, and informed strategy. See Appendix A for detailed recommendations on how to create and run a successful Board.

Geographically-Based Groups

Working with local neighborhood associations is another excellent way to get a better product while building support for agency policies, programs, projects, and funding. As with PABs, it requires a thoughtful, purposeful, and informed strategy.

Citizen's Pedestrian Advisory Board

Oakland, CA

The Citizen's Pedestrian Advisory Committee (CPAC) provided continuous public oversight and feedback during the development of the Pedestrian Master Plan. The CPAC was composed of district representatives appointed by each City Council member and one mayoral appointee from each of the Mayoral Commissions on Aging and Disability. Additional representatives of several community stakeholder groups including the Building Owner's and Manager's Association (BOMA), the Bicycle and Pedestrian Advisory Committee, and Urban Ecology also attended meetings. The CPAC met monthly for one and a half years to oversee the planning process.

For more information, visit: http://www.oaklandnet.com/government/pedestrian/index.html.

Advocacy and Non-Profit Groups

These organizations may represent a spectrum of interests, from promoting walking or advocating for the rights of people with varying disabilities, to protecting the environment or encouraging bicycle facility development. Often, these groups will have an interest in promoting pedestrian safety in concord with their overall objectives but may in other cases be opposed to certain changes. Agencies should be aware of these groups and work to include them in the public involvement process, forming partnerships when applicable.

Public Employees, Officials, and Agencies

Public employees, elected officials, and local agencies are also stakeholders, but their level of participation in the public involvement process may differ, depending on the level at which the pedestrian safety action plan is meant to be implemented. A regional plan developed by a state, Metropolitan Planning Organization (MPO), county, or other similar government will most likely address these stakeholders in a different manner than local plans will. Public agencies are important stakeholders to the extent that the policies, projects, and programs developed in the plan affect their areas of responsibility. For example, a major arterial project is likely to have a significant impact on area drainage and therefore will require involvement and buy-in from the agency that manages surface water runoff. The same will be true for all major public and private utilities. Transit agencies are an important stakeholder group for projects related to pedestrian facilities and safety near and at transit stops. Agencies involved with Public Health may also take an interest in promoting pedestrian safety and be able to provide valuable resources and partnership opportunities. It is in the states' and localities' interest to build positive, working relationships with these individuals and agencies.

Private Sector

The private sector includes individual business owners (e.g., local businesses or development firms) or more formal business-related organizations. Members of the private sector have an interest in the built environment from several perspectives: as members of the community, from an investment standpoint, and as users of the environment (e.g., employees or customers). Some will be interested in investing more—they may offer to provide financial resources to make improvements or help out with maintenance. Many businesses are important pedestrian generators that contribute to the life of a street and can affect a street's walkability; therefore, it is valuable to include these business owners when implementing a pedestrian safety action plan.

There are, of course, regulatory tools that impact the private sector, such as zoning or building regulations. Private individuals will be interested in participating in discussions that propose to make changes that will impact them as well.

Involving the business community may require a different approach than traditional public participation methods. Members of the private sector may not come to public meetings but respond better on a one-on-one basis or in forums dedicated to only

their participation where they will get a chance to meet and network with elected leaders.

The Media

Media outlets have an interest in public welfare and information. Good working relationships with the media contribute to more effective pedestrian safety programs. It is important to develop strong lines of communication with media personnel so that they are able to give an informed, accurate report on the issues. Agencies can actively seek media coverage through press releases, news conferences, or other media events in order to provide information to the media in a planned and professional way. By including the media as a stakeholder group, state and local agencies will be able to make them part of the solution and avoid potential negative or ill-informed media coverage. They will gain more accurate publicity to spread awareness of pedestrian safety issues as well attention to what is being done at the state and local levels.

General Strategies for Involving Stakeholders

Provide Quality Information

For more information on stakeholder involvement, see the Virginia Tech On-line toolbox "Partnerships and Participation in Planning" at http://www.uap.vt.edu/cdrom/intro/index.htm or read the FHWA document "Public Involvement Techniques for Transportation Decision-making" at http://www.fhwa.dot.gov/reports/pittd/cover.htm.

Part of the strategy for working with stakeholders is to provide information that invites good input. Informed citizens and other groups are more likely to identify real problems and provide more constructive feedback on project proposals. A good Web site along with written information can be helpful. For example, it is often useful to provide information on when, where, and why marked crosswalks are installed. An informative Web site with answers to lists of Frequently Asked Questions (FAQs) can reduce the number of frivolous or misguided requests or complaints.

Include Both State and Local Agencies

This activity is important for both local agencies and for state projects on state roads. Most policy, program, and project initiatives will be an activity for local agencies since they involve local residential and arterial streets. This, however, will vary from state to state. In some states, most arterial streets are state roads; in some big cities, very few arterials are state roads; in small towns, it is not uncommon for the two or three major roads running through the city to be state roads. Some cities are multijurisdictional (e.g., Las Vegas). Make sure all concerned agencies are involved.

Consider Neighborhood Plans

Neighborhood (or sector) plans can be an excellent way to establish community priorities and generate support for pedestrian related safety improvements. Many cities have named neighborhood districts, each with its neighborhood plan. For example, Phoenix is subdivided into 15 urban villages, each with their own Village Planning Committee. In Seattle, the city has been divided into 38 neighborhood sub-areas. When given the opportunity to develop their own neighborhood plans, 34 of these sub-areas identified pedestrian safety issues as their top priorities. Transportation agencies should always look to these plans for guidance when developing policies, projects, and programs be-

cause these plans will only have value if they are used and referenced. More information about the Phoenix and Seattle plans is available in Appendix F. Also see previous section on Geographically-Based Groups.

Establish Venues for Participation

Stakeholders should have multiple ways to participate. Outreach should include opportunities to attend public meetings, emails, telephone calls, and filling out comment forms. These approaches will result in a broader, more diverse group of citizens providing input that will increase project acceptance and success.

Hold Public Meetings or Events

Public meetings and events can be an excellent way to solicit public input on plans and projects. They require structure and control in order to make progress and remain focused. Public meetings may have different formats or elements:

1. Open House with tables with project information—citizens get a chance to look at plans, write on the plans, ask questions, and talk face to face with project planners, designers, and managers.
2. Formal Presentation—citizens hear a formal presentation explaining the project, typically followed by a question and answer session.
3. Formal Public Testimony—this may be desired or mandatory at certain phases of a project.

While public meetings have value, it is also important for citizens to have other opportunities for providing feedback. Not everyone is willing or able to attend a public meeting. Sometimes hosting forums at different times (e.g., weekends) or providing childcare can help. Other ways of soliciting general input—such as charettes, walking meetings, Web surveys, etc.—should also be considered.

Create a Project-Specific Task Force

A task force may be desirable and useful for large, complicated, and/or controversial projects. Typically, a task force will be more involved in the early stages of planning and design. When forming a task force, many of the same principles used for forming PABs will apply. It should represent the community, and roles and responsibilities should be clear. The task force should include both local residents and members from the larger community to provide a balanced representation of the community as a whole.

Chapter 3: Collecting Data to Identify Pedestrian Safety Problems

Agencies need to know where pedestrian safety deficiencies exist, how extensive the safety problems are, and what new projects, programs, and polices can provide the biggest safety benefit, including those related to engineering, education, and enforcement. As discussed in Chapter 2, stakeholders can be a good resource in identifying safety concerns and deficiencies, and data may be required to verify these problems. Other deficiencies are identified by collecting data and developing procedures to analyze the data. This process occurs before an action plan can be formulated. While collecting and analyzing data are crucial, an agency should not spend excessive resources on this task to the point where there are no resources available for implementing safety improvements. It is important to know how much data and what types of data are needed to identify, prioritize, and implement safety projects (discussed in Chapter 4) as well as evaluate the effectiveness of completed safety improvements (discussed in Chapter 7).

"Crash, roadway, traffic, and other data are essential to identify pedestrian safety deficiencies and to select the appropriate improvements to make conditions safer for pedestrians and other roadway users."

Types of Safety Projects

Agencies should identify and prioritize the following types of projects for pedestrian safety improvements:

1. Spot Locations: individual intersections and non-intersections.
2. Corridors: may be roadway sections of 0.8 km to 8 km (0.5 mi to 5 mi) or more in length.
3. Targeted Areas: may be as small as a single neighborhood or business district to a large area where pedestrian crashes are disproportionately high.
4. Entire Jurisdictions: Some types of crashes are frequent but are scattered throughout an entire jurisdiction (i.e. they are not spot location- or area-specific). They must be addressed through system-wide changes, such as making it a policy to install pedestrian WALK/DON'T WALK signals at all traffic signals.

Agencies should challenge themselves to make safety improvements immediately and not wait until all data collection efforts are completed. Very little data are needed to

make simple, low-cost improvements such as the installation of advanced stop bars on multilane roads, or the upgrade or installation of warning signs where high numbers of pedestrians cross busy streets. Additionally, when there is a known problem spot location or targeted area, data should be collected immediately without waiting to complete larger, more comprehensive computerized databases which can take several years to develop. Early improvements will allow the community to understand the value of the pedestrian safety program and will encourage elected officials and staff to make further improvements.

Information Needed to Identify and Quantify Pedestrian Safety Deficiencies

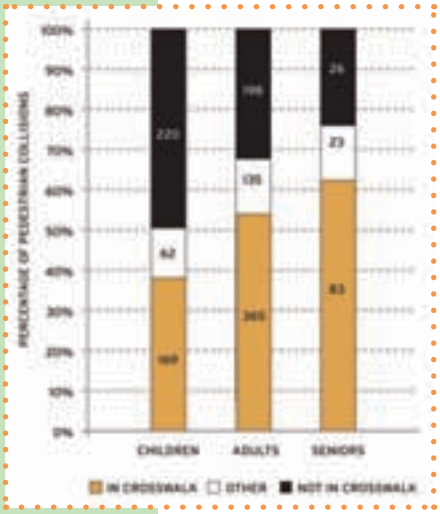
Crash, roadway, traffic, and other data are essential to identify pedestrian safety deficiencies and to select the appropriate improvements to make conditions safer for pedestrians and other roadway users. More data and higher quality data will typically give an agency more tools to identify and address safety problems. An agency cannot collect everything; it will have to prioritize its data needs. In some instances, improvements in databases or more accurate or timely data will enhance the ability to identify pedestrian deficiencies.

Every effort should be made to create geo-coded pedestrian crash databases that allow for easy identification of problem locations and areas. This is especially important for large agencies that may need to examine extensive areas and numerous pedestrian crash reports. Most crash reports do not include geo-coded location data, so agencies may need to rely on their expertise about their jurisdiction to properly geo-code crash locations. Once created, databases should be maintained and updated so they retain usefulness over time.

Pedestrian/Vehicle Crash Data
Oakland, CA

The Pedestrian Master Plan for the City of Oakland includes a lengthy description of pedestrian/vehicle crash data. The Oakland plan relies upon data collected from the Statewide Integrated Traffic Records System (SWITRS), a database of crash records collected by the California Highway Patrol (CHP) and local police throughout California. The document reveals rates of pedestrian crashes and the most common causes of pedestrian crashes, including percentages of crashes which were primarily the fault of the motorist versus the pedestrian. In addition to providing a map of pedestrian crashes, the plan outlines the intersections with the greatest number of pedestrian crashes, senior pedestrian crashes, and child pedestrian crashes and specifies which of the high pedestrian crash intersections are controlled by traffic signals. The plan reports groups most at risk of pedestrian injury by age and sex and highlights the times of day when pedestrians are most at risk of injury. Finally, the plan compares rates of pedestrian/vehicle crashes in Oakland with statewide averages.

For more information, visit: http://www.oaklandnet.com/government/pedestrian/index.html



The graph above from the Oakland plan displays the pedestrian action in vehicle collisions by age group.

Agencies need to review their capability to collect data and should ensure that they have sufficient staffing and training for this task. Data should only be collected if they will be used. Modest improvements in data may be more effective than collecting large quantities of additional data that an agency does not have the ability to manage. The following is a list of data that can be helpful in identifying and prioritizing pedestrian safety deficiencies.

Elements of a good crash database:

- Inclusive of ALL pedestrian crashes available.
- Timely.
- Accurate (will require a review of police narrative).
- Geo-coded (with programs to assist in identifying problem locations).

Crash Data

The most important data are pedestrian crash records. State and local agencies should collect and maintain crash data, and every effort should be made to include all pedestrian crashes. In some cases, pedestrian crash data collection efforts may be linked with data collection on bicycle crashes, because both are often not included in highway safety data. Agencies must understand the limitations of the state computerized crash databases; most only include crashes with motorized vehicles, and many non-injury pedestrian crashes or those involving minor injuries are unreported. There have been examples of agencies collaborating with hospitals to reduce non-reporting, but there may be some privacy issues associated with these efforts. Statewide crash data need to be timely and accurate so an agency can promptly identify and respond to a crash problem and monitor trends. Having to wait several months for statewide computerized data can severely hamper an agency's ability to respond to a crash location, especially in rapidly developing areas. Collaboration between state and local agencies assures that all involved parties have access to current data.

For more information, refer to the study "Pedestrian and Bicycle Data Collection in United States Communities: Quantifying Use, Surveying Users, and Documenting Facility Extent" at http://www.pedbikeinfo.org/pdf/casestudies/PBIC_Data_Collection_Case_Studies.pdf.

If there is a long time lag in the availability of crash data, a local jurisdiction may need to maintain its own interim database to allow for timely identification of problem locations. Furthermore, the police should develop procedures to notify traffic or public works officials responsible for operating the roadway system when a serious pedestrian crash occurs in order to immediately assess the conditions. News reporters will often contact the traffic department as soon as they learn of a serious pedestrian crash. The traffic department should have the same timely information as the media.

Police Reports

Computerized pedestrian crash data are essential to efficiently identify high-crash locations, corridors, and/or larger areas, but individual police reports are essential in documenting precisely where, how, and why each crash occurred. The most important part of the police crash report is the officer's narrative, and the police should thoroughly and precisely document crash details. Care should be taken with some of the information included in a police report. Some investigating police officers are not aware of the legal definition of an unmarked crosswalk, and sometimes a pedestrian in an unmarked crosswalk will incorrectly be listed "at fault" for not using a crosswalk. Educating officers in proper terminology and police training on pedestrian legislation can help reduce such errors. Rather than assign fault, it is better for police crash re-

ports to simply list actions in a neutral manner, such as "failed to yield while turning." This makes it easier for analysts to classify and sort the data. Another common error in crash data is that the nearest intersection is coded when the crash really occurred at a midblock location.

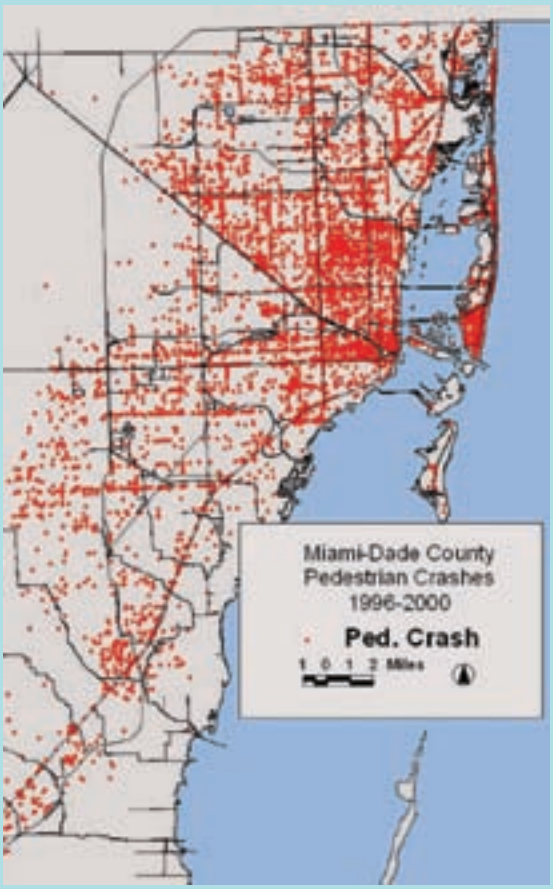
Some information may require follow-up investigation such as issuing citations or BAC/drug testing, which may not be recorded on the original police report. For serious injury or fatal crash reports there is often a supplemental police investigation that can provide considerably more details on the crash, including witness statements and a thorough investigation of roadway, motorist, and pedestrian conditions at the time of the crash.

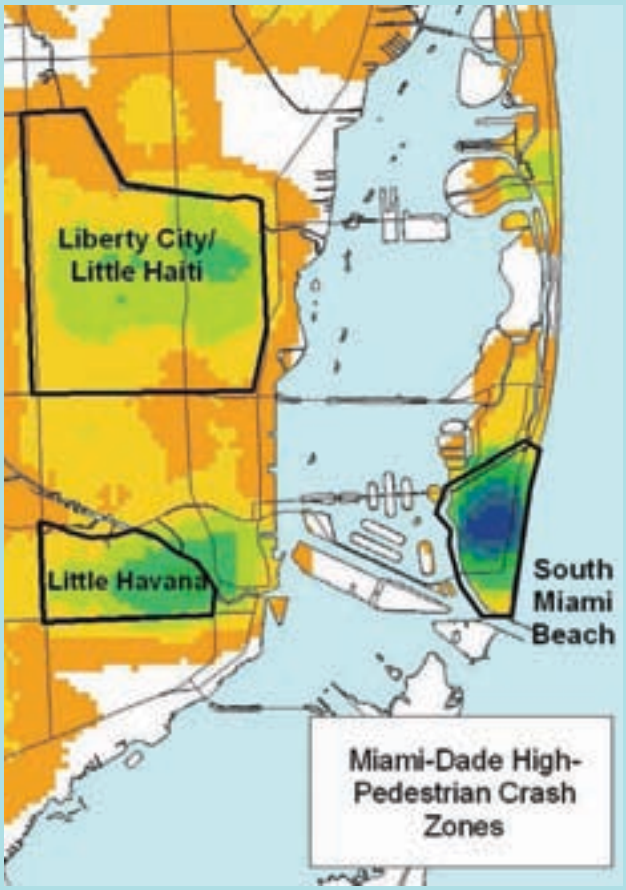
Pedestrian Crash Data

Miami Dade, FL

The Miami-Dade County MPO has created a series of maps using Geographic Information Systems (GIS) software in order to identify high pedestrian crash areas to be addressed with pedestrian crash countermeasures. The maps shown below were created by the Miami-Dade MPO in conjunction with the National Highway Traffic Safety Administration (NHTSA) pedestrian safety demonstration project, which seeks to reduce the deaths, injuries, and associated crash costs within the county's urban setting. Miami-Dade County had a high number of pedestrian crashes and number of deaths and injuries relative to other counties in the state.

For more information, visit: http://www.miamidade.gov/mpo/docs/MPO_ped_plan_2001.pdf.





System-wide crash data is needed to efficiently identify high crash corridors or areas, in addition to high crash locations. To identify high crash corridors or areas, three years of crash data is ideal, but as little as one year of crash data may be sufficient. Agencies should also review the types of information available in their computerized crash database so they have ready access to information such as the age of the pedestrian, physical condition of the pedestrian or motorist, behaviors of the pedestrian and motorist prior to the crash, direction of travel, and other details that can be used in identifying safety problems.

Pedestrian Walking Tours

Madison, WI

The Pedestrian Transportation Plan for Madison, Wisconsin includes a hypothetical walking tour to investigate situations pedestrians are likely to encounter. It focuses on questions such as 1) "Can I walk there?" that examines sidewalk access, continuity and connectivity of the pedestrian network, missing links, transit access, construction projects which close off sidewalk access; 2) "Is walking convenient?" that examines land-use issues, street patterns, and crossings; 3) "Is walking safe?" a question examining curb ramps, sidewalks, and street crossings; and 4) "Is walking enjoyable?" examining buffers between motor vehicle traffic and pedestrians and neighborhood character. Observing situations that pedestrians encounter suggests criteria that can be used to evaluate the pedestrian-friendliness of an area and standards that should be strived for in making Madison a better place to walk.

For more information, visit http://www.cityofmadison.com/transp/PedTransPlanTableOfContents.html.

Pedestrian behavior researchers have found that pedestrians will often take the most direct route possible if other paths are not considered more safe or convenient.

Smaller agencies can also use the low tech method of identifying high crash corridors and other areas by developing manual pin maps or spot maps.

It is important to note, especially in relationship to crash data, that very little is known about pedestrian exposure. For instance, it is difficult to compare the crash records of two intersections without understanding the respective pedestrian exposures. When exposure data is not readily available (as it rarely is), many officials turn to surveys, behavior studies, and pedestrian counts to provide an approximation of exposure. In some cases, patterns of pedestrian crashes are not readily identifiable using GIS and crash data analysis alone. Because some pedestrian crashes are rarely repeatable, other types of data should also be used to identify where pedestrian safety improvements are needed. Specifically:

Pedestrian Counts and Behavior Studies

Ideally, collecting pedestrian counts and observing crossing behavior can be useful in understanding the pedestrian activity and in considering needs for facilities. Pedestrian crash data can be used to identify high crash loca-

tions, corridors, areas, and jurisdictions; supplemental pedestrian volume and behavioral data can be valuable at those sites to provide insights into specific crash causes and potential countermeasures. Count and behavior studies are best employed when there is a decision (design or operational) to be made that the information can influence (i.e., is a traffic signal warranted?). However, low pedestrian counts should not be used as a justification to not take any action. If there is a clear indication that pedestrians need access to a destination, but roadway conditions are so intimidating that few people are seen walking, then a safety improvement can open up new opportunities for pedestrians.

Count and behavior studies (that include observing the number, age, or behavior of pedestrians) are typically needed to more fully assess pedestrian conditions and determine what type of improvements are needed. Because collecting this data is labor-intensive, many agencies do not collect system-wide pedestrian counts or behavior data. If the data are collected, it is helpful to maintain the data in an easily retrievable database. Due to budget constraints, it is acceptable to focus this data collection to areas of higher pedestrian concern. See Appendix B for details on how to conduct pedestrian counts and behavioral studies.

High pedestrian volumes do not necessarily result in high numbers of pedestrian crashes. In many downtown areas, pedestrian crashes are relatively low despite the high pedestrian and motor vehicle traffic volumes. This results from lower motor vehicle traffic speeds, short blocks, and a greater motorist expectation and awareness of pedestrians. Conversely, pedestrians can often be at greater risk in areas with low pedestrian use due to lower motorist expectation and awareness of pedestrians. But high pedestrian volumes can be used to justify a higher priority for pedestrian facility or traffic control improvements.

Behavior Studies within Crash Site Reviews

Reviewing pedestrian crash reports is another way to identify pedestrian safety deficiencies, but some deficiencies are not readily apparent by reviewing collision or condition diagrams or by simple field reviews or audits. Behavior studies of motorists and pedestrians at the particular crash site are needed to determine other factors that may be contributing to a pedestrian safety problem.

Assessing Pedestrian Behavior

After a pedestrian crash has occurred, safety officials often ask, "What was the pedestrian doing there? Why did the pedestrian cross there? Why didn't he or she cross at the traffic signal or use the crosswalk?" Pedestrians will act according to human nature, most often taking the shortest or most convenient route between two points. Traffic controls that regulate motor vehicle traffic often do not meet the needs of pedestrians. "Thinking like a pedestrian" can help others to understand why a crash occurred and how to prevent one in the future by looking at the circumstances from the pedestrian's perspective.

"Thinking like a pedestrian" is a process that analyzes factors such as the pedestrian and roadway environment and other conditions as well as the perceptions of safety to assess the pedestrian behavior. It also takes into account factors outside of the study area that may modify or develop pedestrian behaviors (e.g., a lack of sidewalks causes pedestrians to choose to walk in the roadway). It requires an evaluator to observe pedestrian movements at a site and then emulate those movements. This will give a true sense of what the pedestrian experiences. This process may have limitations when a pedestrian is intoxicated, under the influence of drugs, or is otherwise disoriented. See Appendix C for a detailed, step-by-step guide for performing this assessment.

Assessing Motorist Behavior

The same "thinking like a pedestrian" process can be used for motor vehicle drivers. Street designs and traffic controls have been created primarily to facilitate motor vehicle traffic flow. Motorists respond by driving with the assumption that they will be able to drive at a reasonable speed with minimal interruptions. Major interruptions such as traffic signals at busy intersections are acceptable because the motorists understand the risk associated with the two conflicting traffic flows if controls were not in place. However, a vulnerable pedestrian is often not seen as a risk and motorists are often not willing to slow down or stop to let a pedestrian cross, especially when the motor vehicle driver is frustrated or traveling at a high speed. The pedestrian is seen as an interruption to smooth motor vehicle traffic flow. Also, a distracted motorist may not even see a pedestrian in time to slow down.

"Thinking like a motorist" is a process that analyzes factors such as driving environment, facilities, other conditions, and perceptions of safety to assess motorist behavior. It requires an evaluator to observe motorist behavior on site and then emulate these movements. This gives the evaluator a true sense of what the motorist experiences. The process has limitations in that the professional may assume the motorist did what the roadway and traffic control devices expected of them. The process is also limited when motorists are drunk, under the influence of drugs, fatigued, or distracted, such as talking on a cell phone without paying proper attention to the roadway environment. See Appendix C for further details on performing this type of assessment.

Roadway/Sidewalk Inventories

Not all pedestrian deficiencies can be identified by crash data. Since pedestrian crashes at particular locations are relatively rare and random events in general, roadway infrastructure can be used to identify locations needing pedestrian facility improvements. While most pedestrians are not hit while walking along a road, the presence or absence of a sidewalk often determines when and where a pedestrian will cross a street. It can be difficult or expensive to create and maintain a database of roadway, sidewalk, and traffic characteristics for an entire city, county, state, agency, or system. In working to create such a database, an agency should begin by collecting data for arterial or major streets, and then phase in data collection on collector streets. Data collection for local streets may be limited to school walking routes or walkways near major pedestrian

destinations, such as parks, churches, community centers, senior centers, and medical facilities.

Inventories should include the presence (one side or both sides) and quality of sidewalks (width, surface condition, separation from traffic, accessibility, etc.). Roadway characteristics include street classification; posted speed limits; school zones; number of lanes; width of lanes; the presence of medians, traffic signals, or marked crosswalks; curb ramps; pedestrian regulatory, warning, and wayfinding signs; streetlights; and bike lanes. Inventories can also include other features such as school sites, major school crossings, walking routes, or school-specific signs and marking. Since transit stops are associated with high pedestrian activity, an inventory of transit stops is also useful. Other facilities that generate high levels of foot-traffic include parks, libraries, churches, community centers, and medical facilities. These inventories can help identify and prioritize where pedestrian improvements should be implemented.

Agencies can start building some of these inventories by reviewing up-to-date aerial photographs, or they may already exist in other computerized databases. However, sidewalk information generally cannot be accurately extracted from aerial photos; this information needs to be collected manually or extracted from photo-logs or video-logs. Sidewalk inventories can also be completed when pavement inventories are conducted. All the data should be in a GIS database that can be displayed on a computerized map or aerial photograph.

Traffic Counts and Characteristics

These data include Average Daily Traffic (ADT), peak hour motor vehicle traffic and the percentage of trucks in the traffic mix. Many agencies maintain motor vehicle traffic count maps showing flows on all arterial and most collector streets, and this information is generally updated every three to five years. Also, some agencies post the motor vehicle traffic volumes maps on their Web sites and are continuously updating the ADTs when new counts are made. Speed limit data files or maps are also maintained and updated by many agencies. Ideally these databases should be geo-coded and combined with roadway/sidewalk inventories; they can be used to help prioritize pedestrian improvements or to assess a location, corridor, or area for safety improvements. Jurisdictions can conduct pedestrian volume counts at intersections at the same time as they perform vehicle turning movement counts. These data are relevant to pedestrian safety as most severe injury pedestrian crashes typically occur in areas with high motor vehicle traffic speeds and on wide roadways which often have high motor vehicle traffic volumes.

Other inventories that can be compiled to assist agencies in keeping track of where pedestrian improvements are or should be made include:

Pedestrian Surveys

State of Arizona

The Arizona Department of Transportation gathered information from the public regarding walking and bicycling through the use of a survey. The survey solicited detailed information regarding the existing walking conditions and issues, the Plan, and potential improvements to walking and bicycling facilities. A summary of the comments received as well as a copy of the survey instrument are included in the 2003 Arizona Department of Transportation Statewide Bicycle and Pedestrian Plan.

For more information, visit: http://www.azbikeped.org/statewide-bicycle-pedestrian-intro.html.

Census Data Use

Cambridge, MA

The City of Cambridge included 1990 Census data in its 2000 Pedestrian Plan to reveal the role that walking plays in the City. The data show that of the city's 39,405 households, 11,107 (or 28.2 percent) have no car. The plan also reports Census data showing that 25.4 percent of Cambridge residents walk to work and 24.5 percent take transit. In addition, of the 107,000 people who work in Cambridge, 13.3 percent walk to work, and 21.3 percent take transit.

For more information, visit: http://www.cambridgema.gov/~CDD/et/ped/plan/ped_plan.html.

- Street light inventories—single versus double sided lighting, spacing of lights, and the size of lights (level of illumination).
- Crosswalk inventories—location and type of crosswalk markings (especially helpful for maintenance activities).
- Inventories of school locations, crosswalk locations, and school-related signs.
- Inventories of pedestrian warning signs, and the last dates when the signs were replaced (to ensure retro-reflective signs are in place).
- Inventories of pedestrian generators such as parks, libraries, medical facilities, senior citizen homes, etc.

Pedestrian Surveys

Travel surveys can provide a measure of pedestrian travel, including origins and destinations, trip purpose, and travel routes. This is especially helpful where an agency does not have the resources to conduct pedestrian counts. Travel surveys are generally done on a sample of the population and are extrapolated to represent the entire community. Travel surveys are generally conducted for all modes, including pedestrian travel. It is important to remember that bus riders are also pedestrians when they walk to and from transit stops on either end of their trip. Consider the language in which the survey is written; some areas (e.g., international areas) may have predominately non-English speaking populations.

Surveys also provide helpful information on the quality of the walking environment and unmet pedestrian needs, fears, or other concerns. Safety-related problems can be identified by these surveys as well as barriers to walking.

Surveys can be conducted over the phone, in person, or via the internet. Each method has advantages and disadvantages, and the surveys can be very labor intensive to collect. The length of the survey is important: complex or long surveys may not be returned. Short surveys will provide limited information but are more likely to be completed and returned.

Another form of pedestrian survey is a pre-addressed mail-back postcard that can be made available at community centers, libraries, on buses, etc. for pedestrians who face travel challenges along the sidewalk or at street crossings. They can be used to report the need for sidewalk repair, curb ramps, more crossing time at a traffic signal, etc. This service is ideal for getting feedback from pedestrians with disabilities. This survey should have check boxes for the most common problems, and should ask for the person's name and phone number for follow-up investigation. The public is the "eyes and ears" for a public agency, and this type of input from the public should be welcomed. Each complaint should be investigated, and the person who submitted the card should be contacted when the repair is completed. Other forms of public input are discussed in Chapter 2.

Other Data Sources to Use: Census and NHTS

Information obtained from the Census can be included in a plan to reveal the mode split for transport to and from work and the rate of auto ownership by census tract. The National Household Travel Survey (NHTS), a joint effort by the Bureau of Transportation Statistics and the Federal Highway Administration, includes information on both long-distance and local travel by the American public. The joint survey gathers trip-related data such as mode of transportation, duration, distance, and purpose of trip. Both sources also include demographic, geographic, and economic data, which can be used for analysis purposes. Census data typically are too coarse to identify problem areas, but can be a helpful tool for pedestrian safety advocacy.

Audits

An audit is another tool which can be used to assess the pedestrian needs of a community. Audits involve a review of all of the data for a location or travel corridor analyzed by a multi-disciplinary team independent of the site or project being audited that will include someone from the traffic and/or public works departments, police, and other agencies that serves pedestrians such as Neighborhood Services, Planning, Housing, or Development Services. A multi-disciplinary team will often allow a fresh look at pedestrian and motor vehicle traffic conditions at a location or along a corridor. A more detailed discussion on needs assessments and how to develop countermeasures appears in Chapter 4.

Pedestrian Level of Service

Many of the data collected in the aforementioned methods can be used in a Pedestrian Level of Service (PLOS) model which can determine areas where pedestrian levels of service are insufficient. PLOS models can focus on intersection crossings or road segments. A PLOS model describes in quantitative terms what the pedestrian experiences qualitatively. It is quite different from the LOS measures found in the *Highway Capacity Manual*, which essentially measures delay to the motorist or pedestrian caused by other vehicles on the road or pedestrians on the sidewalk. Rather, newer PLOS models developed and used take into account such measures as comfort and safety as well as ease of mobility.

The sidewalk in the top photo has a LOS "A" while the photo below has a LOS "F" according to the *Highway Capacity Manual* model that is based primarily on delay. Clearly, for pedestrians, mobility is not the only thing that determines the quality of the walking experience. This example illustrates the need for new PLOS models to take into account other factors such as safety and comfort. These factors can be measured both quantitatively and qualitatively in various types of PLOS models.

While typical PLOS analyses are strictly quantitative (number of lanes, conflicting volume, delay), the perceived LOS for pedestrians may involve more qualitative concerns. These qualitative variables—including the aesthetic quality of land use along the roadside or the quality of the sidewalk surface—may be collected separately in a "Walkability Audit." Some qualitative factors can be measured quantitatively such as separation of sidewalk from traffic lanes, the amount of motor vehicle traffic, and presence of pedestrian enhancements such as shade trees and benches. Some PLOS models go further and include elements of the environment adjacent to the right-of-way, such as the presence, type, setback, and orientation of buildings. PLOS and walkability audits may also consider the difficulty of crossing the street, essentially a form of gap analysis. The greatest obstacles to safe crossings are a combination of high motor vehicle traffic speed and volumes, numerous travel lanes, and wide streets. While these measures of comfort or perceived safety clearly affect pedestrian walking decisions, they should be distinguished from the standardized LOS procedure to assure objective results.

A comprehensive PLOS measure captures the multifaceted complexity of pedestrian travel, from the ability to walk comfortably down a street, with interesting things to see along the way, to the ease and safety of crossing the street. No standardized PLOS procedure has yet been adopted. Several states, including Florida and Oregon, are in the process of developing PLOS models as one tool to be used to assess pedestrian conditions. The relative weight to place on various factors is being debated among practitioners. This process requires substantial field investigation. The process involves listing all factors considered important to the comfort, convenience, and safety of the pedestrian. Scores are given to each factor, weighted as to their relative importance. Typical factors (both quantitative and qualitative) include but are not limited to:

PLOS variables for intersections include:

- Presence or absence of marked crosswalks.
- Width and quality of the crosswalks.
- Volume and speed of conflicting motor vehicle traffic.
- Width of street/number of travel lanes.
- Traffic control at crossings.
- Signal timing and displays.

- Curb radii.
- Existence of median islands or safety islands at crossings.

PLOS variables for road segments include:

- Presence or absence of sidewalks.
- Width and quality of the sidewalks.
- Separation of the sidewalk from moving motor vehicle traffic.
- Presence of amenities such as benches and shade trees.
- Volume and speed of adjacent motor vehicle traffic.
- Width of adjacent street/number of travel lanes.
- Accessibility of adjacent land uses.

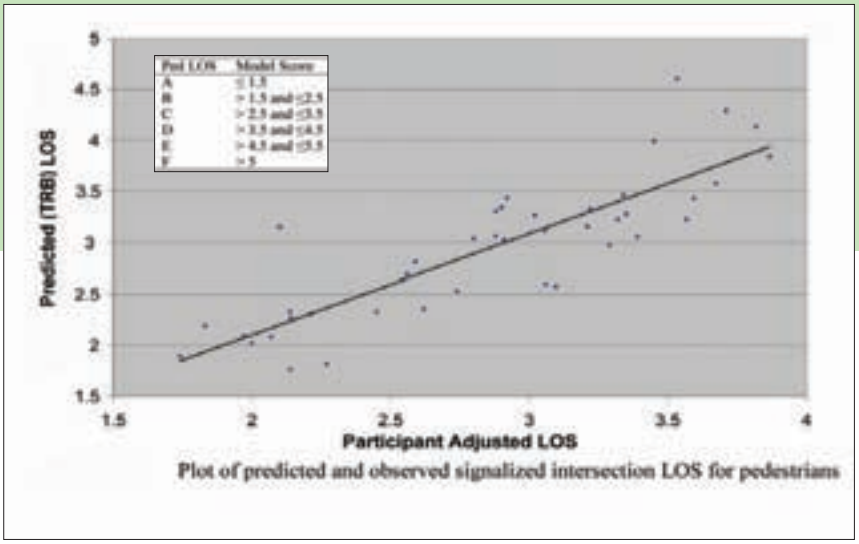
Level of Service Model for Signalized Intersections for Pedestrians

State of Florida

The Florida Department of Transportation uses a level of service (LOS) model to represent pedestrians' perceptions of crossings at signalized intersections. The model is more quantitative than others, considering geometric characteristics of intersections and adjacent streets. The model incorporates perceived safety/comfort (i.e., perceived exposure and conflicts) and operations (i.e., delay and signalization) to provide a measure of the pedestrian's perspective on how well an intersection's geometric and operational characteristics meet his or her needs. The general model for the Pedestrian LOS at intersections is highly reliable, has a high correlation with the average observations (see chart below), and is transferable to the vast majority of metropolitan areas in the United States. Studies of the model reveal that primary factors in the PLOS model for intersections include right-turn-on-red volumes for the street being crossed, permissive left turns from the street parallel to the crosswalk, motor vehicle volume on the street being crossed, midblock 85 percentile speed of the vehicles on the street being crossed, the number of lanes being crossed, the pedestrian's delay, and the presence or absence of right-turn channelization islands (Petritsch, 2005; FDOT, 2002).

For more information, see:

http://www.dot.state.fl.us/safety/ped_bike/ped_bike_standards.htm.



Plot of predicted and observed signalized intersection LOS for pedestrians

Chapter 4: Analyzing Information and Prioritizing Concerns

"There will always be more improvements to be made than can be accommodated. Thus, a prioritization system needs to be developed to rank the various competing projects."

Improving pedestrian safety in a community or region is typically the result of implementing different safety treatments and changing agency design policies. Crash countermeasures, or treatments intended to address pedestrian safety concerns, can take several different forms: operational and construction projects intended to fix specific problems; changes in design guidelines to help improve streets and intersections in future projects; and education and enforcement programs aimed at achieving changes in motorist and pedestrian behavior or attitude.

Projects involving pedestrian crash countermeasures can be further subdivided into:

1. Countermeasures for spot locations.
2. Countermeasures for corridors.
3. Countermeasures for targeted areas (including neighborhoods).
4. Countermeasures for general problems common to an entire jurisdiction.

This chapter presents methods to categorize concerns, identify locations, and address the issues of pedestrian safety through prioritizing improvements and utilizing other implementation strategies. A detailed discussion of actual countermeasures is provided in Chapter 5.

Categorizing Concerns for Pedestrian Safety

A systematic procedure is needed to identify what (and where) countermeasures should be implemented to provide for a safer walking environment. There will always be more improvements to be made than can be accommodated. Thus, a prioritization

system needs to be developed to rank the various competing projects. Typically, the severity of pedestrian crashes is so disproportionately high compared to other motor vehicle crashes that the elimination of a few pedestrian crashes will result in a high safety dividend and high benefit/cost ratios.

Unlike vehicle crashes, crash rates for pedestrians are typically not used, since pedestrian volumes are usually not known. The crash to volume relationship for pedestrians is different than for vehicles. A single pedestrian crash at a low volume location will result in a high rate, while several crashes at a major downtown crossing may correspond to a low rate. Additionally, it is uncommon for agencies to invest extensive manpower to collect the system-wide pedestrian counts that are needed to develop rates; pedestrian crash rates would also need to account for motor vehicle volumes.

Instead, high pedestrian crash locations, corridors, and targeted areas should be initially identified by comparing the total number of pedestrian crashes. System-wide concerns for a jurisdiction can be inferred from the sum of all data.

Another method of identifying and prioritizing high crash locations is by using weighted pedestrian crash data, giving more weight to severe or fatal pedestrian crashes. When identifying and prioritizing high crash locations, three to five years of computerized crash data should be used. For prioritizing corridors or other targeted areas, one to three years of pedestrian data are acceptable.

The first step in determining the right countermeasure is to look at the problem and determine whether the problem is a spot problem, a problem evident in a targeted area or along a corridor, or a broader and more general problem that affects an entire jurisdiction.

1. A spot location problem is unique to one location.
2. A corridor problem may be evident at several sequential intersections or along the roadside of a corridor; to successfully reduce crashes, countermeasures need to be applied throughout the corridor, not just at a single location; fixing one location may leave other similar areas untreated.
3. A targeted area problem may repeat itself in a neighborhood or other area where conditions are similar throughout. Similar to the corridor problem, the nature of the roadway is such that fixing a spot area may leave other potential areas untreated; the solutions are very likely to be the same all around the neighborhood. A neighborhood or targeted area problem may be common throughout a local area due to unique circumstances such as a large university, commercial or business district, or other neighborhood characteristic.
4. An entire jurisdiction problem is common to an entire city, county, or state and is usually caused by an undesirable practice such as failing to routinely install sidewalks or paved shoulders for pedestrians or failing to provide streetlights.

Once it has been determined that a problem is one of these types, the next step is to determine whether the appropriate solution is an operational/construction, general design, or an education/enforcement countermeasure.

Identifying High Crash Locations, Corridors, Targeted Areas, and Jurisdictions

Pedestrian safety problem locations, areas, and jurisdictions are most readily identified using computerized crash information.

Above is an example of a spot location where closing a driveway close to the intersection and constructing a sidewalk reduced the potential for pedestrian-motor vehicle conflicts.

In this corridor, pedestrian level lights and planter boxes have been added to buffer pedestrians from vehicle traffic and provide safer and more secure nighttime conditions.

Spot Locations

For spot locations, countermeasures are most likely going to be operational/construction changes, but they could occasionally be changes to education/enforcement programs. Operational/construction countermeasures include anything from a change in crosswalk striping or signal timing to construction projects such as curb extensions, realignment of an intersection approach, or building a pedestrian crossing island. Education/enforcement solutions include spot enforcement of drivers-yield-to-pedestrian laws or education materials aimed at well-defined user group. Three to five years of pedestrian crash data are typically beneficial in identifying and prioritizing high crash locations.

Corridors

For problems that occur along corridors, an assessment of the entire corridor is necessary. For analysis purposes, study areas can be subdivided into roadway segments of 0.8 km to 8 km (0.5 mi to 5 mi) in length. Crashes at first may seem to occur in undefined, almost random locations. A more thorough analysis may reveal patterns such as crashes occurring primarily at transit stops or at night. What seemed like an insurmountable problem can be tackled systematically and comprehensively by focusing one or two countermeasures throughout the corridor. For example, in the case of a predominance of nighttime crashes, improving illumination throughout the corridor may solve many problems. In the case of transit-related crashes, working with the local transit provider to assess all bus stops may lead to simple solutions such as relocating, adding, or eliminating some stops, and implementing countermeasures to assist pedestrians in crossing the street at a limited number of critical locations. Two to three years of pedestrian crash data are typically sufficient for corridors.

Targeted Areas

When identifying high crash targeted areas within the agency, geographic information system (GIS) data are important. Small communities or jurisdictions may be able to manually map pedestrian crashes, but this task is difficult and time-consuming for larger cities with several hundred annual pedestrian crashes. It is important that statewide computerized crash data systems allow for geographically mapping crashes for analyses purposes. One to three years of pedestrian crash data are reasonable to identify area-wide problems.

For targeted area problems occurring throughout a neighborhood, a similar approach to that outlined in corridor problems should be taken. Are there patterns, similarities, or a predominance of one crash type? Neighborhood problems may be more amenable to education/enforcement solutions, as the traffic that goes though a given neighborhood tends to be made up of the same travelers nearly every day. Engineering improvements can include area-wide traffic calming or the installation of sidewalks or streetlights. In some cases, changes in local, regional, or state policy may be necessary to allow or promote these improvements.

Traffic calming techniques, such as chicanes, were used in this targeted area to slow vehicle speeds on neighborhood streets.

An example of a jurisdictional change is a city-wide policy for the installation of ADA-compliant curb ramps.

Jurisdiction-wide Problems

For a problem that is common throughout an entire jurisdiction, agencies should ensure that their policies, plans, and engineering design guidelines adequately embrace the appropriate countermeasures. Problems in spot locations, targeted areas, corridors, and jurisdictions can often reveal a fundamental design flaw in the roadway; solutions then include changes in design guidelines. Chapter 5 provides a list of design solutions and countermeasures that should be incorporated into the agency's design manuals, practices, and procedures so all future road projects are designed with these safety features at the onset.

High Pedestrian Crash Potential

A lack of pedestrian crashes does not mean that conditions are safe or ideal for pedestrians. Pedestrians may avoid certain areas because they perceive danger. Consequently, low pedestrian crash frequencies are not necessarily indicative of a safe facility, but may be a consequence of low or zero pedestrian activity. A pedestrian safety analysis should therefore go beyond just looking at pedestrian crashes.

Identifying Pedestrian Safety Concerns

State of California

Some states, such as California, may have output reports (SWITRS, TASAS) that can be provided to assist jurisdictions in indentifying their injury and fatality statistics beyond just numbers (e.g., crashes and victim data by hour of day, day of week, month, year, motorist data, vehicle data, victim gender, race, and age, extent of injury). In California, this information can be provided by the California Highway Patrol (CHP) or Caltrans. This information is easily obtained and analyzed to help further develop crash countermeasures. Analyzing the data can be performed with simple EXCEL spreadsheets or advanced packaged software, such as Crossroads or Intersection Magic, depending on the agency resources. The Metropolitan Transportation Commission (MTC) is working to develop an online toolkit to help Bay Area jurisdictions of all sizes to perform collision analyses using available data and to offer a variety of countermeasures for consideration. The toolkit is available online at: http://www.mtc.ca.gov/planning/bicyclespedestrians/index.htm.

Methods to identify pedestrian deficiencies at low-crash or no-crash locations involve an analysis of the roadway, traffic, and other agency databases. By looking at the deficiencies that occur at high crash locations, an agency should be able to identify other locations with similar deficiencies. Safety improvements that are successful at one location should be implemented at all similar locations. This requires an inventory of spot locations, corridors, or areas to allow an agency to identify those places that have similar characteristics as the high pedestrian crash sites. Field reviews and public input through surveys or workshops can help identify these locations.

In this image, a team performs a roadway safety audit on a local roadway.

Analyzing High Crash Locations, Corridors, or Areas

Field Reviews

Once high crash locations, corridors, or areas have been identified, individual crash reports, complete with the police narratives and other detailed information, should be used when conducting field reviews. The detailed crash information and field reviews can be used to identify how each pedestrian crash occurred, and what may be done to prevent future similar crashes. The outcome is a list of improvements that can be implemented to address those crashes and enhance safety. For crashes involving severe and fatal injuries, police investigations are available for in-depth and detailed reviews of how the crash occurred and may provide information on what may have prevented it. These typically include witness statements as well as more detailed investigations of motorist and

pedestrian behavior and site conditions at the time of the crash. See Chapter 3 for a more detailed discussion of crash site reviews.

Roadway Safety Audits and Reviews

Roadway Safety Audit Reviews (RSARs) involve the use of a multi-disciplinary team approach to review and evaluate a location, corridor, or area after it is built or before it is open to the public. Audit review team participants should include a variety of transportation professionals such as a traffic engineering expert, a human factors expert, a police representative, or a Planning-Neighborhood Services specialist. This team is provided all of the crash history and other data for the crash location or study area such as pedestrian and motor vehicle traffic counts. In order to have the best chance of observing the pedestrian safety problems, the team should visit the site when conditions best simulate the problems. For instance, if crashes are happening at night, the team should visit the site at night. The multi-disciplinary team members visit the location or corridor together with each member making their own observations of vehicle, traffic and environmental conditions. The observations and suggested solutions are summarized in a report once the team has a chance to compare notes. Pedestrian safety improvements implemented at one location can be implemented at other similar locations, even where no pedestrian crashes have occurred. Roadway Safety Audits (RSAs) are similar to RSARs except they are conducted before the system is built.

Pedestrian crashes may continue to occur at locations or along corridors or targeted areas where safety improvements have been implemented. This phenomenon may occur because more pedestrians are willing to cross at locations with one or more engineering enhancements, thereby increasing exposure. This may also be an indication that engineering solutions alone will not result in totally safe conditions. A proper before-and-after evaluation of any treatment is essential to determine how effective it has been.

The occurrence of a seemingly illogical pedestrian crash after the implementation of a safety measure has sometimes been attributed to a pedestrian's lack of understanding of the roadway environment. It can equally be attributable to the motorist's lack of understanding of the roadway environment. In many cases, therefore, education and enforcement programs may be necessary to achieve a true safety benefit. There are few engineering projects that can prevent motorists or pedestrians from choosing to travel intoxicated or that can stop motorists from willfully breaking the law. Education and enforcement programs addressing pedestrian safety problems should also be carefully implemented and evaluated (see Chapter 5 for more details).

Roadway Safety Audits

FHWA's Pedestrian Road Safety Audit Guidelines and Prompt Lists can be used to assess the safety of pedestrian facilities. The guidelines and prompt lists will help familiarize RSA teams with potential pedestrian issues and help them identify specific safety concerns related to pedestrian safety throughout the RSA process. For more information, visit http://www.walkinginfo.org/library/details.cfm?id=3955.

Crash Typing

A crash type describes the pre-crash actions of the parties involved. When crashes in a database are "crash typed," a pattern often emerges that helps safety officials identify what the problem is and what countermeasures are generally related to each crash type. The following six crash types are some of the most common pedestrian crash experiences:

1. Dart/Dash
The pedestrian walked or ran into the roadway at an intersection or midblock location and was struck by a vehicle. The motorist's view of the pedestrian may have been blocked until an instant before the impact.

2. Multiple Threat/Trapped
The pedestrian entered the roadway in front of stopped or slowed traffic and was struck by a multiple-threat vehicle in an adjacent lane after becoming trapped in the middle of the roadway.

3. Through Vehicle at Unsignalized Location
The pedestrian was struck at an unsignalized intersection or midblock location. Either the motorist or the pedestrian may have failed to yield.

4. Turning Vehicle
The pedestrian was attempting to cross at an intersection, driveway, or alley and was struck by a vehicle that was turning right or left.

5. Through Vehicle at Signalized Location
The pedestrian was struck at a signalized intersection or midblock location by a vehicle that was traveling straight ahead.

6. Walking Along Roadway
The pedestrian was walking or running along the roadway and was struck from the front or from behind by a vehicle.

Other crash types include Working/Playing in roadway, Backing Vehicle, Bus-related, Crossing an Expressway, and Unique Midblock. For more details on the crash types and related countermeasures, see Chapter 3 of the "PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System" or find the "Crash Analysis" section in the on-line version at http://www.walkinginfo.org/pedsafe.

Selecting the Appropriate Solutions

Once crash locations have been identified based on data analysis, crash patterns should be determined by narrowing in on specific crash types occurring at individual locations. If a pattern is observed, then it will be easier to select the solution that best applies to the crash type experienced. The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) is a tool designed to assist transportation professionals in determining crash types based on data collected (see below). *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System* (Harkey, 2004) is another resource for comparing crash types to appropriate countermeasures. It describes crash types and provides pedestrian crash statistics and includes descriptions of 49 different countermeasures or treatments that may be implemented to improve pedestrian safety and mobility. Also included are 71 case studies that illustrate the concepts applied in practice in a number of U.S. communities. Details about *PEDSAFE* are contained in Appendix F.

To view PEDSAFE online, go to http://www.walkinginfo.org/pedsafe. To obtain a hard copy of PEDSAFE, please view the following link: http://safety.fhwa.dot.gov/ped_bike/ped_bike_order.htm

Determining the Extent of Implementation

Once pedestrian safety solutions have been selected, the final decision is usually based on a combination of factors: is the project to be implemented in phases or all at once; is the project to be permanent or temporary; what are the cost constraints?

FHWA's PBCAT Crash Typing Tool

The development of effective countermeasures to help prevent pedestrian crashes is often enhanced through the use of detailed computerized state crash files. Analysis of these data can provide information on where pedestrian crashes occur (city, street, intersection, two-lane road, etc.), when they occur (time of day, day of week, etc.), and characteristics of the people involved (age, gender, injury severity, etc.).

The NCDOT Division of Bicycle and Pedestrian Transportation employs PBCAT on its Web site.

FHWA's Pedestrian and Bicycle Crash Analysis Tool (PBCAT) is a crash-typing software product intended to assist state and local transportation professionals in improving pedestrian safety through the development and analysis of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists. One of these details is the crash type, which describes the pre-crash actions of the parties involved. With the database developed, the software can then be used to produce reports and select countermeasures to address the problems identified. For further details about crash typing, see page 44.

For more information, visit: http://www.walkinginfo.org/pc/pbcat.htm.

Phasing projects

Phasing projects is most applicable to corridor or neighborhood/targeted problem areas. A desirable countermeasure may be very costly or politically challenging to implement all at once. Phasing allows certain elements to be implemented right away, as others wait further funding. There are several ways projects can be phased: geographically, by urgency, by opportunity, or by type of treatment.

Geographically—starting at one end of a corridor and completing it in units. For example, an 8 km (5 mi) corridor where a sidewalk is planned can be built in five 1.6 km (1 mi) sections over five years. This is a practical method, but may not address the most urgent needs first. Conversely, safety projects may be disbursed equally in different regions of a state or city so that all areas can share an improved safety for pedestrians and no areas feel slighted.

By urgency—treating the areas with the highest crash numbers or highest pedestrian activity first. This may seem logical and politically acceptable, but in reality there may be constraints that make the most needed areas the hardest to address. Reasons may include lack of right-of-way or topographical constraints.

By opportunity—if a certain type of treatment is needed up and down a corridor and it can be piggy-backed onto other planned projects in that corridor (such as maintenance or resurfacing projects), then it makes sense to implement these countermeasures along with the planned work.

By type of treatment—scheduling countermeasures by type of work. For example illumination may come first, as an agreement with the utility company makes it easy to do so right away. A more controversial countermeasure such as a traffic circle may have to wait until the political or design issues have been settled. Assuming both treatments will independently contribute to pedestrian safety, proceeding with one treatment while waiting for the other is acceptable.

Duration of Improvement

Projects can be further subdivided into temporary and permanent categories.

In most cases, a permanent solution should be sought. It will cost the most, but will last for the duration of the roadway. A good estimate for the life of a permanent treatment such as a sidewalk is 20 years or more, but in reality they typically last much longer. In some cases, a temporary solution is more appropriate. This is the obvious choice where it is known a road is to be rebuilt soon, but the pedestrian safety needs must be addressed right away. There are other reasons to consider a temporary installation: if the solution is new and untested in the community or if the design cannot be finalized based on local conditions. A temporary installation can be used to gauge public acceptance and can be modified when user observations demonstrate corrections that may be helpful.

There are a variety of materials and designs that can be used for temporary solutions:

- Paint is the cheapest and can give an immediate impression of how the permanent solution will look and affect traffic operations; if simple lines are not enough to redirect traffic, hashing out areas with zebra stripes is often more effective at keeping cars out of certain areas; paint is very short term and should not be left in place for more than a few months, as it will wear out; nor should the experiment be considered a failure if motorists cross over the painted area, as there is really no physical barrier preventing them from doing so.
- Plastic posts or barrels provide more positive guidance and may last longer than paint.
- Plastic curbs offer a greater opportunity to create a picture of the proposed permanent solution, such as curb extensions or raised median islands.
- Concrete curbs can also be laid on the pavement; these are usually referred to as "wheel stops," such as those found in parking lots. They are almost never used in the travel portion of the roadway but can be used as a substitute for a curb to protect a walkway. Wheel stops should be firmly anchored and supplemented with other measures. One potential disadvantage of wheel stops is that they may cause pedestrians to trip.

Temporary solutions should then be evaluated for their effectiveness. The techniques range from a full traffic study to observation and receiving public input. To warrant the time and expense of a traffic study, the temporary installation should closely resemble the final solution and therefore be made to look substantial—evaluating the effect of paint will not predict how a raised curb would perform.

Temporary Project Solutions

Bend, OR

The intersection in these photos was reconfigured in stages: first a curb was installed to redirect traffic at a right angle and the striping had to be redone to reflect the new geometry. Motorists and pedestrians were aware of the modified geometry and engineers were able to monitor its effect on traffic operations. In the second stage, the curbed area was filled with landscaping, offering a more permanent solution. This two-step process enabled the city to implement a change immediately and at a low cost. The more permanent landscaped solution had to be contracted out, a more time-consuming process. Temporary projects and strategically-phased solutions allow for fast implementation, leaving the agency time to consider more permanent alternatives.

Conversely, a temporary installation has its pitfalls, since plastic cones, posts, curbs, or orange barrels are usually not aesthetically pleasing, and may generate negative reactions just because it "looks cheap" or "ugly." This can be mitigated by showing adjacent property owners an artist rendering of the completed project or photos of a similar treatment implemented elsewhere.

A temporary installation helps to identify unintended negative consequences. If the traffic study or public input indicates a problem, steps can be taken to redesign the countermeasure to avoid these consequences.

However, temporary installations may generate one major unintended consequence: total removal of the countermeasure because of negative public reactions. Complaints from a small but vocal minority may cause elected officials to bow to this pressure. The complaints often stem from the fact that some people simply do not like change, or the countermeasure affects their trip, requires them to drive more prudently, or creates a slightly longer distance. Opposition may also be generated from a lack of prior knowledge about the change or test. Garnering public support and buy-in from a citizen committee or stakeholders and effectively working and communicating with the community prior to implementing countermeasures will go a long way in blunting opposition before it is generated (see Chapter 2).

Bowing to pressure, removing the temporary installation, and then not installing the permanent countermeasure can have dire consequences for the intended beneficiaries: pedestrians. Many countermeasures such as curb extensions can be built right the first time with a great degree of confidence they will work as intended. Some users may complain, but rarely will an agency remove a permanent and fairly expensive feature if it is working as intended.

Safety evaluation results of temporary solutions should be shared with the public (area residents and/or business people, elected officials etc.). It should be made clear that the results may not be the same as the permanent solution, for the reasons cited above.

Prioritizing Pedestrian Improvements

Initial Factors to Consider

After all the steps outlined to this point have been implemented (stakeholder involvement, data collection and analyses, review of problem areas), the list of needed improvements may appear overwhelming at first. Pedestrian safety countermeasures can be prioritized taking into account the following factors:

Availability of Right-of-Way (ROW)

Most pedestrian safety countermeasures will not require additional ROW, as they usually involve road narrowing, striping, illumination, etc. Occasionally, additional ROW (or at least an easement) will be required, to create a sidewalk buffer for example. ROW negotiations can be lengthy, and it is best to start the process as soon as it is

determined the improvement is needed so the project is not unduly held up. A conceptual design should be enough to determine how much ROW will be needed, to help speed things along. Easements can often be obtained much quicker and at a much lower cost.

Federal and/or State Mandates

Certain countermeasures can be piggybacked to projects scheduled to fulfill Federal or state requirements. ADA and curb ramp requirements are one example: if a safety countermeasure requires changing a corner radius, and the corner is slated for an ADA upgrade (ramp installation), the two projects can be combined for efficiency. Some Federal or state requirements are safety-related, such as upgrading deficient bridge guardrails; these projects should also include pedestrian safety measures.

Public Support

The data collection methods outlined in Chapter 3 will often make the most problematic areas rise to the surface. Yet there are some crashes that strike an emotional chord in the public, like when a child is hit while walking to school. This will create tremendous public support for a countermeasure that addresses this issue. The responsible agency should pursue a solution to this problem while not losing sight of the goal of making improvements where most crashes occur. Similarly, the solution should be one that improves pedestrian safety and is not a response that may make conditions less safe for motorists and pedestrians. However, responding positively to an emotionally-charged situation is an opportunity for the agency to pursue funding for other needed pedestrian crash countermeasures as well as gain acceptance of a fairly progressive countermeasure.

Prioritization of Crosswalk Improvements

Seattle, WA

Over 600 crosswalk locations were surveyed and divided into "compliant," "possibly compliant," and "non-compliant" using recommendations from a FHWA safety study (Zegeer et al., 2005). The possibly compliant and non-compliant locations were then mapped as shown below. It was immediately clear that most of the locations were along 12 corridors. This, combined with crash data, provided a list of prioritized corridors for making improvements. The crosswalk inventory allowed analysts to identify crosswalks with safety concerns and determine feasible safety measures for the prioritized list (Hefferan, 2004).

Legend: yellow dots indicate possibly compliant locations and red dots indicate non-compliant ones.

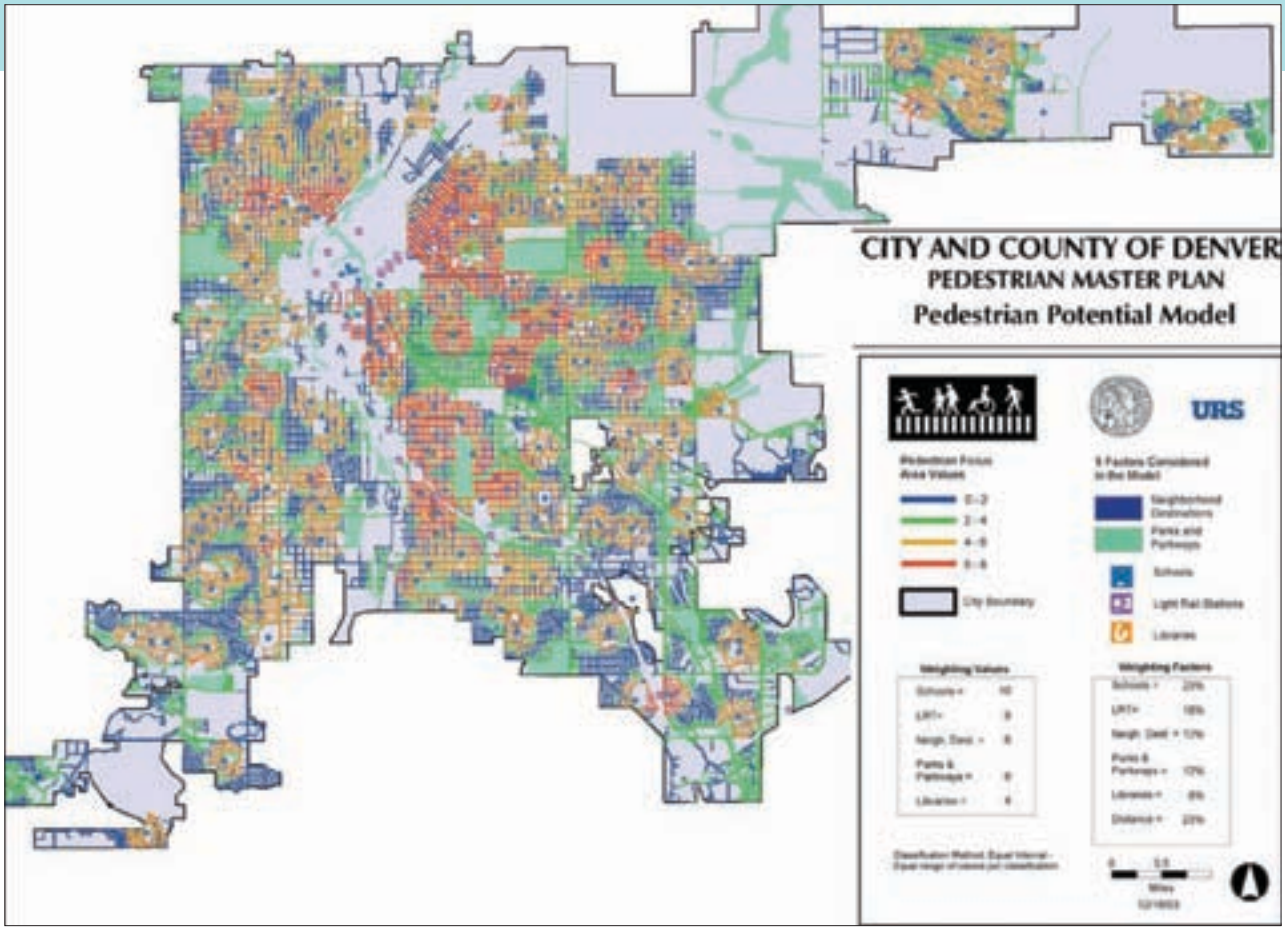
Project Prioritization System

Phoenix, AZ and Denver, CO

Phoenix, AZ has a sidewalk retrofit and street modernization program to build missing pieces of sidewalks and other street infrastructure improvements in developed neighborhoods. Projects are ranked based on various factors including the street classification (collector streets are given a higher priority than a local street) and the proximity to a pedestrian generator (school, church, park, or medical facility). Projects are assigned points in several such categories and are ranked in each of the eight Council Districts so that all parts of the City receive some safety and infrastructure improvements rather than all of the funding being directed to one area.

The Denver, CO pedestrian plan prioritized potential improvements using several different criteria. This criteria included a proximity analysis—an analysis of the presence of sidewalks and the proximity of facilities that are likely to generate pedestrian activity, including light rail transit stations, schools, parks and parkways, libraries, and neighborhood destinations. In addition, socio-economic data, existing sidewalk conditions, auto-pedestrian crash history, and pedestrian route proximity were used in the prioritization of projects. A project scored zero, one, or two points in each criteria or category; the maximum points a project could score was ten while zero was the lowest a project could score. This system of scoring projects based upon points they earn for each criteria allowed the Advisory Team to objectively determine the level of importance for each project and therefore the priority for project implementation and completion. See the image below for a geographical representation of the pedestrian potential model developed.

For more information, visit: http://phoenix.gov/streets/index.html or http://www.denvergov.org/transportation_planning/.



Travel Demand

Though pedestrian crashes do not always correlate to pedestrian use (pedestrians often get hit in areas where fewer people walk), countermeasures in an area where there are many pedestrians will be easier to justify.

Cost of Improvements

This is always an important factor in all decision-making: should an agency try to spread available funding to many low-cost countermeasures, or target funds for a few high-profile projects? Some of the most expensive countermeasures are not necessarily the most effective. The best examples are pedestrian bridges and underpasses: they can cost millions of dollars but get little use because of inconvenience or security concerns. Several new pedestrian signals can be installed for the cost of one tunnel or bridge. Conversely, inexpensive measures, such as improved striping, can be quickly implemented over an entire corridor or neighborhood for comparatively little cost.

Funding

Some funding sources can only be used for limited applications. Many common funds can be used only for construction, only for education, or only for enforcement. This is not necessarily a limitation, as a typical safety program will involve all three components. If a funding source becomes available, but has limitations, this should not be an impediment to implementation—every funding opportunity should be seized as it becomes available (see Chapter 6 for more about funding).

Safety Benefits

Decision-makers want to ensure the maximum cost-effectiveness, so the most effective countermeasures that offer the greatest safety benefits should be considered first. Some pedestrian safety countermeasure will have benefits for other road users, and some may have negative consequences for others. These issues need to be weighed against all other considerations. This highlights the need to develop a ranking system to prioritize projects.

Developing a Ranking System to Prioritize Projects

Transportation agencies often develop a ranking system for making improvements such as surface preservation, modernization, or safety. Pedestrian safety countermeasures are no different. The idea is to assign scoring to the various criteria, weighting each one according to the values of the community, available funding, political climate etc. Other scoring factors can be added, and each one needs to be weighted so it represents an agreed-upon value.

Pedestrian Needs Index

The primary input to a Pedestrian Needs Index (also called a Pedestrian Potential Index or Deficiencies Index) is pedestrian crash data. In addition to crash data, inventories of missing sidewalks, lighting, and other pedestrian facilities can be used to identify where upgrades are needed. Lists can be prioritized using pedestrian count data or proximity to schools or other pedestrian generators. Projects should be reassessed and reprioritized annually, and funding should be assigned so that all regions within a state or an agency receive some level of pedestrian facility enhancements and all of the improvements are not concentrated in one area. Each agency should create its own Pedestrian Deficiency Index based on the resources available, and develop a point system to compare and assess various projects. Pedestrian crash history can be an input to this ranking system.

Category	Possible Points
Severity of problem (how many crashes have occurred or are likely to occur)	15
Effectiveness of solution	15
Probable use (travel demand)	15
Likelihood of funding	10
Feasibility (constructability: piggy-backing, available ROW, etc.)	15
Public support	15
Cost	15
Bonus: achieves other goals (motorist/bicyclist safety, aesthetics)	possible 10 points
Total	**100**

Above is an example of a ranking system used to establish pedestrian project priorities.

Any ranking system can be subject to personal bias if multiple observers or analysts contribute. A standardized form or checklist can enhance objectivity of the results. GIS methods can be used to automate the ranking process for large areas from a database. A scoring system where the total possible points add up to 100 makes it easier for the public to appreciate how a proposal fares; it also makes it easier to tweak individually weighted category scoring. Sample categories, with sample weightings, could be similar to the ones in the table at left.

The first attempt at a scoring and weighting system is rarely perfect. A Pedestrian Advisory Board (PAB) as described in Chapter 2 can help develop the ranking system. It should then be field-tested on real-world problem areas so that the results appear rational and those projects that are obviously needed score highly. A potential downside is that a problem the public has identified as a major crisis may score low if it fails in several important categories. A scoring system created and backed by a PAB that represents the public's interests can help deflect criticism. It can also help ensure that projects that solve a real but ignored problem get the attention they deserve. However, if a scoring system is created and the high-scoring projects are not implemented, it may create a liability problem for the agency.

Legislative/Public Oversight

As stated in Chapter 2 on stakeholders, prioritizing pedestrian safety projects transparently and based on good data and public input can help an agency make decisions that lead to the best projects being selected within their given funding limitations. It also

enables the agency to pursue its charter with assurance that it is accomplishing the goals it was set out to achieve: reduce pedestrian crash risks.

Legislative/public oversight helps establish goals, secure funding, etc. But much of what is known by professionals in the field of pedestrian safety may not be fully understood by the general public. The agency should operate in a climate of open communication and explain to the public, elected officials, and the media what it is doing as well as how and why. This will help ensure that the agency is allowed to pursue its mission and implement the best solutions to the most urgent problems without constant questioning or review. An effective solution that is installed quickly can demonstrate the agency's overall effectiveness in dealing with pedestrian safety problems and will facilitate future successes.

Chapter 2 describes how to proceed with this information in a manner that ensures maximum effectiveness. Jurisdictions that have been given the responsibility of oversight to a Pedestrian Advisory Board (PAB) should trust the PAB to carry out its mission with minimal interference.

Chapter 5: Selecting Safety Solutions

Jurisdictions should ensure that all of their policies, plans, and engineering design guidelines include considerations for pedestrian safety. The design solutions mentioned in the first part of this chapter should not be viewed only as fixes to spot problems; they should be incorporated into the agency's design manuals, practices, and procedures so all future road projects are designed with appropriate access and safety features.

"Measures to improve pedestrian safety should not be limited to engineering treatments; education and enforcement are also important for pedestrians."

This chapter explores the most commonly used and effective pedestrian crash countermeasures. Each is briefly described with available information concerning its effectiveness. A few other design considerations are also explained. Appendix H complements this chapter, providing a checklist of things to consider when implementing crash countermeasures. The chapter is organized into the following topics:

- Design Specifications and Guidelines.
- Engineering Solutions.
- Enforcement and Education Solutions.
- Policy and Planning Solutions.
- Countermeasures to be Used with Caution.
- Consequences of Countermeasures for Other Road Users.

Design Specifications and Guidelines

There are numerous policy, planning, and design guidelines that transportation planners and engineers can use; however, only a few address pedestrian designs thoroughly. AASHTO has recently published the *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. An example of a state pedestrian design guide is Washington DOT's *Pedestrian Facilities Guidebook*; one city/regional example is the *Planning and Designing for Pedestrians: Model Guidelines for the San Diego Region*. Additionally, FHWA has an excellent publication: *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System* (FHWA-SA-04-003). The *Manual on Uniform Traffic Control Devices* (MUTCD) should be used for selecting appropriate traffic controls: signs, traffic signals, marked crosswalks,

and other pavement markings. See Appendix F for more information on these and other available references.

Many of the above-mentioned pedestrian policy, planning, and design guidelines—along with those in Appendix F—were used to develop the following list of some of the more effective countermeasures in terms of improving pedestrian safety. They should also be used by jurisdictions for guidance to fix spot problems and to update and improve agency design manuals, practices, and procedures.

Engineering Solutions

The countermeasures presented here are organized according to the type of pedestrian crash.

Walking Along the Road Crashes

Rural environments:

1. Paved shoulders—Paved shoulders provide room for pedestrians to walk separate from motor vehicle traffic in rural areas when providing sidewalks is not a feasible option. Paved shoulders also provide room for bicyclists. Paved shoulders have many safety and operational advantages for motor vehicle traffic as well. To be effective, paved shoulders should be 1.8 m (6 ft) wide or more; 1.2 m (4 ft) is considered the minimum acceptable width to accommodate pedestrians (AASHTO Green book, 2001). Rural environments near large urban areas or those experiencing rapid growth should be considered suburban, where sidewalks are the preferred pedestrian accommodation. Newly-developed communities should provide sidewalks and other pedestrian facilities.

Paved shoulders offer pedestrians on rural roadways a safer place to walk.

Urban and Suburban Environments:

1. Sidewalks—Sidewalks can eliminate most walking-along-the-road pedestrian crashes by providing positive separation from motor vehicle traffic. Continuous and connected sidewalks are needed along both sides of streets to prevent unnecessary street crossings. Sidewalks generally should not be placed immediately adjacent to moving motor vehicle traffic. Whenever possible, they should be buffered with a planter strip, parking lane, shoulder, or bike lane. This will increase pedestrian safety and comfort and can make it easier to meet the ADA requirement for a level passage through driveways and the requirement for a

Sidewalks provide safe spaces for pedestrians to walk.

clear passage around utility poles, posts, fire hydrants, etc. (these can be placed in a landscaped buffer zone). Planter strips should be 1.5 m (5 ft) wide or greater; 1.8 m (6 ft) is a desirable minimum. Separated sidewalks should also be 1.5 m (5 ft) wide or greater; 1.8 m (6 ft) is a desirable minimum along arterial streets in non-commercial areas. Along arterials where there is no buffer, curbside sidewalks should be 3.0 m (10 ft) wide or greater. Sidewalks should provide a continuous effective width to prevent choke points from being created by street furniture. In downtown areas, considerations must be made for outdoor seating for restaurants. Rolled (mountable) curbs are not recommended. Continuous and connected sidewalks are needed along both sides of streets to prevent unnecessary street crossings.

Driveways should be designed so that the sidewalk continues through the driveway in a relatively flat and level alignment.

2. Driveways—Well-defined driveways clearly mark the area where motorists will be crossing the pedestrian's path. Non-defined vehicle access points with continuous access to parking create a long conflict area between pedestrians and motorists. This added area of ambiguity complicates the motorist's task of watching for pedestrians.

3. Driveway design and spacing—driveways should be designed to look like driveways, not street intersections (sidewalks should continue through the driveway). Local policies should prohibit blocking the sidewalk at driveways and these policies should be enforced. Driveways should be kept as narrow as possible. The level of the sidewalk should be maintained, and the driveway should be sloped so that the motorist goes up and over the sidewalk. This will help with a number of goals: meeting ADA accessibility requirements will be easier, the fact that the pedestrian has the right-of-way will be clear, and motorists will need to slow down slightly to enter the driveway, which will help promote pedestrian safety. Driveways should be located away from intersections. The number of driveways should be minimized (consolidate whenever possible) to reduce the number of conflict points for pedestrians. This access management is also a safety advantage for motorists.

Pedestrian-level light fixtures increase pedestrian visibility at night and provide a better sense of security.

4. Illumination—Pedestrian crashes disproportionately occur at times of poor lighting (mostly dusk and nighttime). Illumination greatly increases the motorist's ability to see pedestrians walking along the road. Double-sided lighting should be provided along wide arterial streets to illuminate both sidewalks for the security and safety of the pedestrian. Light uniformity along a road is also important. Lights

should be spaced to minimize or eliminate dark areas along the road and sidewalks. For midblock and intersection crossings, it may be helpful to provide extra lighting to crossings with high nighttime pedestrian use.

Crossing the Road Crashes

Midblock crashes:

1. Pedestrian crossing island—On two-way streets, a median island at uncontrolled locations can help reduce crashes by up to 40 percent. The benefits are greatest on busy multilane streets where gaps are few and difficult to find. A pedestrian crossing island breaks an otherwise difficult crossing maneuver into two easier steps: instead of needing to find a gap long enough to cross all lanes at ones, a pedestrian looks left, finds an acceptable gap in one direction only, crosses to the island, then looks right and finds a second gap.

Pedestrian crossing islands provide a refuge when crossing wider roads.

In-Street Pedestrian Crossing Signs

State of Pennsylvania; State of New York; and Portland, OR

In 2001, the State of Pennsylvania began providing municipalities with in-street pedestrian crossing signs. The in-street crossing signs are incorporated in the MUTCD in Section 2B.12. To date, more than 2,000 signs have been installed. The signs cost about $200 each and are distributed to municipalities through the DOT regional offices. The signs are to be placed at unsignalized crossings on roadways with a speed limit of 56 km/h (35 mi/h) or less. The signs are typically set 1.5 to 3.0 m (5 to 10 ft) in advance of the crosswalk (attached to the pavement) but can be placed as far as 15.2 m (50 ft) from the crosswalk. A number of Pennsylvania municipalities have used the signs as a visible part of larger pedestrian safety programs, involving education, enforcement, and design components.

A study has been conducted evaluating the effects of pedestrian safety cones placed in streets in upstate New York, Long Island, and Portland, OR (Huang, 2000). The in-street pedestrian crossing cones, like the in-street pedestrian crossing signs, serve the same purpose: to display a consistent and accurate message, i.e., the relevant law for yielding to pedestrians. The study findings confirm that pedestrian safety cones can improve conditions for pedestrians who benefit from motorists' yielding to them. Findings suggests that motorists were more likely to yield to pedestrians after the signs had been placed on the roadway.

For more information, visit: http://www.dot.state.pa.us or http://www.tfhrc.gov/safety/pedbike/pubs/00-098.pdf.

Two-stage crosswalks with fencing help direct pedestrians to look for vehicles coming from the right.

Curb extensions can increase the visibility of pedestrians and motorists.

Advance stop lines can help prevent multiple threat pedestrian crashes.

2. Two-stage crosswalk with median fencing—Some agencies provide railings/fencing in the medians of multilane roads that channel pedestrians to the right, increasing the likelihood that they will look for vehicles coming from their right in the second half of the crossing. It should be mentioned, however, that these types of crossings can be problematic for pedestrians who are blind and for wheelchair users.

3. Curb extensions—On streets with on-street parking, curb extensions reduce the total crossing distance. Reducing the crossing distance helps pedestrians in two ways: it reduces the time they are exposed to moving traffic, and it makes it easier for pedestrians to assess and find an acceptable gap, as the time needed to cross is shorter. They also increase visibility: the waiting pedestrian can better see approaching motor vehicle traffic and motorists can better see pedestrians waiting to cross the road; their view is no longer blocked by parked cars. Curb extensions should be designed to accommodate storm water drainage and should never extend more than 1.8 m (6 ft).

4. Illumination—See discussion on page 56 concerning illumination.

5. Crosswalks at uncontrolled locations with advance stop bar (or yield line)—On multilane streets a common and often fatal crash type is the "multiple-threat" crash, in which a motorist in one lane stops to let a pedestrian cross, but so close to the crosswalk as to mask a motorist in the adjacent lane who is not slowing down. The second motorist does not have time to react and the pedestrian is struck at a high speed. The advance stop bar or yield line (accompanied with a R1-5 or R1-51a YIELD HERE TO PEDESTRIANS sign) requires all motorists to stop back (30 to 50 ft is desirable); when the first motorist stops at the stop bar, it allows the pedestrian to see if a motorist in the second lane is stopping. This enables the pedestrian to wait or step back if he or she has started to proceed into the second lane. While the advance stop bar with appropriate signing has the potential to reduce the probability of a multiple-threat crash, this is no guarantee that 1) all motorists will stop for pedestrians and 2) all stopping vehicles will necessarily stop at the stop line, potentially on high-speed roads. Therefore, it is important to carefully select locations for unsignalized crossings, even if the advance stop bar and signing is used. Also, such sites should be monitored to ensure that pedestrians are able to cross safely and if not,

Advance Stop/Yield Markings

Halifax, Nova Scotia, Canada

Crosswalks on streets with multilane, uncontrolled approaches are often associated with a type of pedestrian crash termed a multiple threat crash. A major factor contributing to this kind of crash is the fact that the yielding vehicle stops (or slows) too close to the crosswalk, screening the pedestrian from the view of another motorist fast approaching in the lane that the pedestrian is to cross next. One treatment that addresses the issue of multiple-threat crashes is the use of yield markings placed 9.1 to 15.2 m (30 to 50 ft) in advance of the crosswalks along with a "YIELD HERE TO PEDESTRIANS" sign placed adjacent to the markings (the sign is incorporated in MUTCD in Section 2B.11). Data show that this treatment can produce a marked reduction in multiple threat conflicts (Van Houten, 1988; Van Houten, 1992).

In a study conducted in Halifax, Nova Scotia, Canada, 24 crosswalks were randomly assigned to a treatment or control condition. Following a baseline measurement period, twelve of the streets had advance yield markings and the "YIELD HERE TO PEDESTRIAN" sign installed 7.0 m (23 ft) to 19.8 m (65 ft) in advance of the crosswalk. The remaining half of the crosswalks remained in the baseline condition and served as control sites. Each of the streets used in the study included multiple travel lanes in both directions or multiple lanes on a one-way street with a posted speed limit of 48 km/h (30 mi/h) (Van Houten, 2001).

The sign and markings increased the percentage of motorists yielding to pedestrians and decreased the percentage of motor vehicle/pedestrian conflicts at all 12 sites. For the control crosswalks, motorist-yielding behavior remained almost unchanged between the before- and after-treatment measurements. However, the percentage of motorists who yielded to pedestrians at crosswalks with the added sign and markings increased from around 70 to 75 percent to around 80 to 85 percent. Further, vehicle-pedestrian conflicts remained nearly constant for the control sites but declined from about 10 to 15 conflicts per 100 crossings to under 5 conflicts per 100 crossings at the treatment sites. Follow-up data collected six months after the markings and signs were introduced show no reduction in treatment effectiveness. These data are in accord with previous findings, which show that effects are maintained over time.

For more information, visit: http://www.walkinginfo.org/pedsafe.

then other treatments (e.g., traffic signals) should be considered.

Traffic signals with pedestrian signals create a gap for pedestrians to cross intersections.

6. Traffic signal with pedestrian signal displays—On busy multilane highways with significant volumes, a signal may be the only way to create a gap for pedestrians to cross. It is often difficult to meet the MUTCD warrants for a traffic signal based solely on existing pedestrian counts; it is often necessary to anticipate how many pedestrians might cross there once the signal is installed. All signals have associated operational and safety concerns that must be addressed, including the distance to adjacent signals.

Nighttime Pedestrian Crashes:

Many nighttime crashes can be prevented through better lighting. See previous discussion on illumination (page 56).

Intersection Straight-Through Crashes:

Most of the techniques described under midblock crashes are applicable at intersections for straight-through crashes: pedestrian crossing islands, curb extensions, illumination, and advance stop bars or yield lines.

Wide radii (top) allow faster turning speeds and create unsafe pedestrian environments. A simple extension (bottom) can reduce the turning radius and vehicle turning speed as well as provide a safer crossing place for pedestrians.

Intersection Right Turn Crashes (Signalized or Unsignalized):

1. Tighter radius—Tightening the intersection radius has many benefits for pedestrians: it shortens the crossing distance, brings the crosswalk closer to the intersection, increases visibility of the pedestrian or the approaching motor vehicle, slows right-turning vehicles, and it makes it much easier to install two ADA compliant curb ramps at each corner. The choice of a curb radius is dependent on the design vehicle and whether the street is a local residential street, a neighborhood collector, or a major arterial. This requires the designer to calculate the appropriate radius for each corner of an intersection and to accept occasional difficult turns for the rare event—for example a large moving truck turning onto a local street; this occurs seldom enough that there's little reason to provide large radii for truck turns onto local streets. The presence of on-street parking on both intersecting streets can also result in the opportunity to tighten the curb radius.

2. Curb extensions—See previous discussion on curb extensions on page 58.

3. Pork-chop islands—While right-turn slip lanes (also called channelized right-turn lanes) are often considered negative facilities for pedestrians (especially vision-impaired pedestrians) due to the emphasis on easy and fast motor vehicle travel, they can be designed to be less problematic. Where an exclusive right-turn lane is provided, a pork-chop island between the right-turn lane and the through lanes can shorten the crossing, resulting in less pedestrian exposure and improved signal timing. The island also enables pedestrians and motorists to negotiate one conflict separately from the others. A properly designed pork-chop island has the longer tail pointing upstream to the approaching right-turn motorist; this channelization brings the approaching motorist at close to a 90º angle, so the motorist is looking forward at the crosswalk; the crosswalk is placed one car length back from the intersection proper (the AASHTO Green Book now includes this better option). This enables the motorist to move forward once the pedestrian conflict has been resolved so the right-turning motorist can focus on traffic. The pedestrian then can cross to a shorter street crossing.

Well-designed pork-chop islands can help pedestrians navigate an intersection more safely.

Intersection Left-Turn Crashes:

1. Median islands—A median island helps channelize left-turning vehicles, slowing their speeds in the process. An island also gives pedestrians a refuge for long crossings or if a conflict cannot be avoided. However, signal phasing should ideally be designed to allow the pedestrian to cross the entire street during a single cycle.

Median islands provide a safe waiting place for pedestrians crossing multilane roads.

2. Curb ramp placement and design—Poor ramp placement and design can make a street crossing more difficult and may lead to crashes. For example, poorly placed or oriented ramps force wheelchair users to make long detours and they may not cross in the allotted time at a signalized intersection; or they may force wheelchair users to cross outside the crosswalk lines at a location where motorists do not expect them. Proper ramp placement and design ensures that all users cross in crosswalks, close to the intersection, where motorists can see them, and without undue delay. Ramps must be wholly contained within the marked crosswalk area. Usually, this can only be accomplished if the curb radius is 7.6 m (25 ft) or less. Single ramps that direct the pedestrian into the middle of the intersection should be avoided (especially on arterial streets) but may be necessary where a large radius precludes the use of two ramps. Ramps must be designed to meet ADA Guidelines,

Well-designed curb ramps provide pedestrians with disabilities better access to the sidewalk system.

Crosswalks and pedestrian signals encourage pedestrians to cross at signalized intersections.

and two ramps at a corner are generally preferred over single-ramp corners. ADA Guidelines can be found online at http://www.access-board.gov/adaag/html/adaag.htm.

Signalized Intersection Crashes:

All signalized intersections should have the following (unless no pedestrians are expected):

- Pedestrian signals are needed (pedestrian WALK/DON'T WALK signals) to ensure that a pedestrian knows when the signal phasing allows them to cross and when they should not be crossing. On one-way streets (or streets with unusual configuration) a pedestrian approaching from the opposite direction may not realize an intersection is signalized and cannot see the vehicle signal heads nor know when it is safe to cross if there is no pedestrian signal. The same is true for intersections with left turn arrows. Wide streets require more information on when to cross and when not to start crossing due to the long pedestrian clearance intervals that may exist.

- Marked crosswalks clearly indicate to the motorist where to expect pedestrians and help keep the crossing area clear of vehicles. It should be standard practice to mark all four legs of a signalized intersection unless unusual circumstances exist.

- A WALK signal (walking person symbol) should be long enough to get pedestrians started and a clearance interval (flashing upraised hand or DON'T WALK signal) long enough to ensure that a pedestrian can fully cross the entire street. While many agencies have traditionally used a 1.2 m/s (4 ft/s) assumed walking speed, slower walking speeds of 1.1 m/s (3.5 ft/s) or even 0.9 m/s (3 ft/s) may be appropriate at locations which have a substantial number of older pedestrians. The *Highway Capacity Manual* specifically recommends a slower walking speed when the percentage of walkers over the age of 65 represent 20 percent or more of the pedestrian population using that crossing (National Research Council, 2000). Another option is to consider the use of automatic pedestrian detectors, which can detect slower-moving pedestrians in a crosswalk and automatically extend the pedestrian clearance interval until the pedestrian is safely on the other side of the street (see link to recent research on automatic pedestrian detectors at the Pedestrian and Bicycle Information Center Web site: http://www.walkinginfo.org/rd/

technology.htm#peddetect). New detection methods such as video are being tested but some may still be expensive to implement.

- Push buttons, placed where a pedestrian who is in a wheelchair or is visually impaired can easily reach them, are often needed. They should be located so as to clearly indicate which crosswalk each button regulates for crossings in two different directions. The best practice is to provide push buttons mounted on two separate pedestals separated by at least 3 m (10 ft). Illuminated push buttons (that light up when activated) are used to notify the pedestrian that the actuated signal is working and/or connected. They increase the likelihood that pedestrians will actuate the push button and comply with the pedestrian signal. Push buttons are not used in downtown/central business districts and other area of high pedestrian use where pedestrians can be expected at every signal cycle. The pedestrian phase should be on recall at these locations. Push buttons should not be needed at fixed-time traffic signals where pedestrian crossings are reasonably expected on more than an occasional basis, and the crossing (WALK) interval should occur every signal cycle. The MUTCD Part 4 should be used to design signals to the latest accessibility standards (ADA); it is available online at http://mutcd.fhwa.dot.gov/pdfs/2003/Ch4.pdf.

Push buttons such as this one should be placed where they can be easily accessed when waiting to cross an intersection.

Many crashes occur while the pedestrian is crossing with the WALK signal, and some signal-timing techniques can help reduce the incidence of these crashes. Additional countermeasures at signalized locations may include:

1. Protected left-turn phases—This allows left-turning vehicles to have their own separate interval, which can also separate vehicle left-turning movement from pedestrian crossing intervals. Thus, pedestrians can cross without interference from left-turning motorists. Red and green left turn arrows are used to make it clear to motorists they must wait before turning left.

2. All-red phase—A short (i.e., 2 second) all-red interval may help prevent a crash resulting from a high-speed red-light runner hitting a pedestrian who has begun crossing with the WALK signal or who may have a slower walking speed and did not clear the crosswalk.

3. Lead Pedestrian interval (LPI)—The LPI can help reduce conflicts between turning vehicles and pedestrians

Countdown signals help pedestrians know how much time they have left to cross an intersection.

when turning vehicles encroach onto the crosswalk before pedestrians leave the curb. The LPI releases pedestrians (WALK phase) 3 to 5 seconds prior to the green light for vehicles. This enables pedestrians to enter and occupy the crosswalk before turning motorists enter it. This treatment is particularly effective where there is a double right or left turn movement.

4. Pedestrian countdown signal—This tells the pedestrian how much time is left in the pedestrian clearance interval (flashing DON'T WALK or upraised hand). This information encourages pedestrians to leave the crossing before the crossing time runs out and reduces the number of pedestrians who initiate a crossing too late in the cycle or who are still in the street at the end of the crossing interval. The countdown signal should begin during the pedes-

Lead Pedestrian Intervals (LPIs)

St. Petersburg, FL

A lead pedestrian interval was created for study at three signalized intersections in downtown St. Petersburg, Florida where pedestrian crossings occurred at the average rate of 60 per hour. An LPI is intended to decrease crashes that involve motor vehicles and pedestrians by separating them in time. The LPI permits pedestrians to gain a head start before turning vehicles are released. Following the introduction of the LPI, conflicts were virtually eliminated for pedestrians departing during the start of the WALK interval.

There were 44 total pretreatment observation periods at all three sites. During each of these sessions, the sites averaged between 2 and 3 conflicts per 100 pedestrians, with some periods having up to 5 conflicts per 100 pedestrians. After the LPI was installed, 34 of the 41 sessions had no conflicts, and no session had more than 2 conflicts per 100 pedestrians. This effect was noted for senior citizens and non-seniors alike. There was also a smaller reduction in conflicts during the remainder of the WALK interval. This reduction was likely the result of pedestrians claiming the right-of-way during the earlier portion of the WALK interval. The percentage of pedestrians yielding to vehicles also declined following the introduction of the LPI, and data showed that pedestrians tended to cross more lanes during the 3 second LPI the longer the intervention was in effect. This was likely the result of regular users discerning the presence of the LPI and modifying their behavior to utilize it to the fullest extent possible. Over a period of four months at these three sites, no reduction in intersection effectiveness for motor vehicles was detected. Moreover, local authorities opted to retain the LPI in places where the range of permitted turning movements governed by the signal cycles allows safe use of the LPI. This intervention was shown to increase pedestrian safety and improve pedestrian comfort and perceived safety levels as well.

For more information, visit http://www.walkinginfo.org/pedsafe and read Case Study No. 65 and 66 (follow links to case studies in Florida and click on the two links to LPI studies).

trian clearance interval (flashing DON'T WALK) phase. The standards for pedestrian countdown signals can be found in Section 4E.07 of the MUTCD.

5. All-pedestrian phase (also known as Barnes dance or scramble phase)—By stopping all vehicle movements and allowing pedestrians to cross in all directions (including diagonally), virtually all conflicts are eliminated. But pedestrians are not allowed to cross during the regular motor vehicle phase, so motorists can turn without needing to yield to pedestrians. This introduces a third signal phase that generally increases delay for motorists and pedestrians. This signal phasing technique has been removed from many intersections as both pedestrians and motorists do not typically tolerate the extra delay, and such phasing may only be appropriate for a few central city crossing locations with very high pedestrian traffic, relatively low vehicle volumes, and a high number of turning conflicts. Also, where intersecting streets are narrow and cycle lengths are short, such timing schemes may be more practical, since increased delay will be less of a problem. The all-pedestrian phase may also be better when applied at intersections where all street approaches have a similar cross-section and traffic flow.

An all-pedestrian phase may be appropriate at certain intersections where there is a large volume of pedestrians crossing the street regularly.

6. Prohibited right-turn-on-red at selected locations—Consideration should be made to prohibit right-turn-on-red (RTOR) at intersections where there are high volumes of pedestrians, particularly near schools, and/or where older pedestrians cross regularly. Placing NO TURN ON RED signs may also be appropriate at complex intersections (e.g., skewed intersections, intersections with more than four legs), and also where pedestrians are having trouble crossing on a WALK signal due to a high volume of right-turning motorists. It should be noted that at locations where RTOR is prohibited, right-turn-on-green collisions or conflicts with pedestrians may still occur.

Prohibiting certain turning movements may protect pedestrians in the crossing.

Pedestrian Crashes on Road Sections:

1. Road diets—Reducing travel speeds and reducing the number of travel lanes a pedestrian has to cross are beneficial in all cases. One well-documented technique that accomplishes both goals is a "road diet" that takes a four-lane undivided street (two lanes in each direction) and reconfigures the lanes to two travel lanes, a center turn lane, and two bike lanes. The benefits for pedestrians include a shorter effective crossing, fewer lanes to cross, and slightly

A road diet, such as the one above, may decrease motor vehicle travel speeds and reduce the number of lanes a pedestrian must cross.

slower motor vehicle traffic speeds. The addition of a center-turn lane also creates space for pedestrian crossing islands. All this is accomplished without having to change the curb lines. The bike lanes add a buffer for pedestrians as well as a place for bicyclists to ride. The key to a successful road diet is to ensure that all signals are set up to handle expected volumes of left-turn movements and to monitor adjacent streets to ensure that they are not overly impacted by higher speed or higher volume motor vehicle traffic.

There are many variations on this road diet, for example reducing a multilane one-way street by one lane. A more expensive road diet can involve moving the curbs to actually narrow the roadway surface. A simpler road diet can involve narrowing the travel lanes to 10 or 11 ft to slow motor vehicle traffic speeds and create space for bike lanes that acts as a buffer for pedestrians.

Traffic calming devices such as this raised crosswalk help illuminate pedestrian crossings and slow motor vehicle traffic.

2. Traffic calming—Within neighborhoods, traffic calming measures can be used to slow motor vehicle traffic, such as speed tables, speed humps, traffic circles, chokers, and chicanes, or to break up long stretches of straight streets. For more information on traffic calming devices and techniques, visit http://www.trafficcalming.com, http://www.walkable.org, or refer to *PEDSAFE* (Harkey, 2004) or other relative documents listed in the References section or in Appendix F.

The decision for where to place bus stops, especially midblock bus stops, can impact pedestrian safety and can influence pedestrian travel and accessibility. They should always be located near a safe crossing location.

Transit-Related Crashes

A high number of pedestrian crashes are related to transit. Most involve a pedestrian crossing the street to get to a bus or after getting off the bus. All of the street-crossing techniques described so far are applicable to transit stops. All transit stops must be accessible to all pedestrians, and policies should include the following provisions:

Transit stops need sidewalks with adequate width to accommodate waiting pedestrians.

- All stops should consider the safety of the pedestrian crossing. This does not necessarily mean a marked crosswalk at each stop location; rather, each stop should be placed where it is possible for a pedestrian to cross safely at or very near the stop.
- Transit (and school bus) stops must provide a safe place to stand and wait, even if there are no sidewalks. The lack of a defined waiting area is undesirable, especially for children.
- Sidewalks (or paved shoulders in rural areas) should be

built to provide pedestrian access to all transit stops.
- Lighting should be provided at or near all bus stop locations for security and safety reasons and to minimize vandalism.
- The transit agency should review all its stop locations to facilitate access and crossing.

Techniques include:

a. Improve the pedestrian crossing (this may involve installing a new signal).
b. Consolidate closely-spaced stops by eliminating some stops (this not only limits the number of crossings, but helps with transit efficiency as the buses stop less often).
c. Place crosswalks (where warranted) behind the bus stop at midblock locations. This allows pedestrians to cross behind the bus, where they can see oncoming traffic; it also enables the bus driver to pull away without endangering pedestrians.
d. Move stops to a location where it is easier to cross. This often involves decisions regarding nearside and farside locations at intersections. In general, farside locations are preferred for pedestrian safety, as pedestrians are encouraged to cross behind the bus, and the bus can leave without having to wait for pedestrians to cross. It also allows for right-turn-on-red movements on the nearside of the intersection. However, there are locations where a nearside stop may be more practical for operational and accessibility reasons.

Transit stops should be well-designed with pedestrian needs in mind, including shelter, signs, lighting, sidewalks connecting to the pedestrian travel network, and bus loading areas that are wheelchair accessible.

Education Solutions

Overview

Education plays an important role in the process to improve pedestrian safety. Education efforts can improve the ability of drivers and pedestrians to use and respond to the roadway environment safely and correctly. Education can complement enforcement programs to teach motorists and pedestrians about safe driving and crossing practices, as well as the laws that govern them.

Numerous research studies have supported the notion that education efforts can succeed in changing pedestrian and driver behaviors and reducing pedestrian crash risks and rates. Some of the successful earlier programs aimed at the conditions of those times include:

Education Efforts Across the Nation

Countywide Example

WalkSafe Miami is a program aimed at reducing the incidence of children struck by vehicles by educating elementary school-aged children, teachers, parents, and their communities about traffic safety. The program uses educational training, engineering modifications, and enforcement to help achieve its goal. The Miami-Dade Metropolitan Planning Organization (MPO) produced six different pedestrian education posters aimed at increasing pedestrian safety practices. The posters' safety messages were in English, Spanish, and Creole. They covered pedestrian-related topics ranging from interpreting pedestrian signals and being visible, to watching for turning cars and making eye contact with an oncoming motorist before crossing the street. The first of the posters were mounted in the county's 600 buses and most of the 135 MetroRail train cars free as a county public service beginning in July 2003.

Statewide Example

One method for implementing educational programs to counter pedestrian crashes is to institutionalize pedestrian safety curricula in schools. US studies have shown that elementary school children (age 5-9) are more likely to be involved in a pedestrian crash than any other age group. This is particularly true in urban areas where there is heavy traffic and few pedestrian amenities. Maryland has a comprehensive, hands-on safety curriculum based on a building block approach; it contains a series of lessons teaching pedestrian safety skills to younger grades (e.g. K-2) and bicycling skills to older students (e.g., grades 3-5). There is an Administrator's Guide, Teacher's Guide, and Lesson Handbook for the program, developed by the City of Rockville. From initial roll-out in the fall of 2002 to the end of the 2003-04 school year, the program has reached over 7,000 Rockville students at 10 different elementary schools. The Maryland Pedestrian and Bicycle Safety Education Program has been made available to public and private schools, law enforcement agencies, and community organizations throughout Maryland. For more information, visit the Maryland Pedestrian and Bicycle Safety Education Program Web site at http://www.rockvillemd.gov/recreation/bicycling/education-program.htm.

Nationwide Example

The FHWA Pedestrian Safety Campaign is "designed to help communities conduct their own multi-media public education and information campaign." The online document provides a step-by-step discussion of how to conduct a pedestrian safety marketing campaign. Starting with goals and strategies for a campaign, the guide elaborates on forming coalitions with other agencies and advocacy groups, provides hints on interacting with the media, and presents methods of campaign evaluation. The document further contains large amounts of actual campaign material and sample letters to aid agencies in the process of planning a public marketing campaign. For more information, visit: http://safety.fhwa.dot.gov/local_program/pedcampaign/index.htm.

- The "Willy Whistle" pedestrian safety public information and education messages were used to teach child pedestrians ages 5 to 9 how to look before crossing the street and safely conduct a midblock crossing. An evaluation found that the education campaign resulted in significantly reducing the number of dart-out pedestrian crashes involving 3- to 7-year-old children by approximately 30 percent in the three test cities of Los Angeles, CA; Columbus, OH; and Milwaukee, WI (Blomberg et al., 1983). Part of this reduction may be attributed to PSAs that alerted parents to increase direct supervision of young children when outdoors, rather than changing the behavior of the young children. Subsequent research has found that educational videos alone can increase knowledge but usually result in little behavior change.
- An evaluation of the efficacy of the film, "And Keep on Looking," targeting children in 4th through 7th grades, showed an increase in safe street-crossing knowledge for children ages 9 to 12 in Seattle, WA. An assessment in Milwaukee, WI indicated a pedestrian crash reduction of greater than 20 percent for children aged 9 to 12 compared with children in areas surrounding Milwaukee and in comparison cities (Preusser and Lund, 1988).

Recent studies have included education as part of a more comprehensive safety program and have shown similar successes:

- A 2007 study for NHTSA evaluated a pedestrian safety program consisting mostly of education and enforcement measures in Miami-Dade County. Countywide pedestrian crashes were reduced by 8 to 12 percent. The child pedestrian education program, "Walk Safe Miami," was implemented in elementary schools throughout the county. There was a 22 percent reduction in child pedestrian crashes countywide in the first year after full program implementation. (See case study write-up on page 109).
- *Walk Smart Baltimore,* a comprehensive safety project was conducted in Baltimore, MD, aimed at reducing the pedestrian crash problem related to alcohol. Countermeasures were targeted to two "zones" in the city that accounted for 73 percent of the pedestrian alcohol-related crashes but only 21 percent of the land area. The countermeasures included a police training video, press kits for the local media, radio and TV PSAs, brochures, posters, and flyers. Using a surrogate measure of alcohol involvement in crashes, the project team found an overall 16 percent decrease in pedestrian crashes. The surrogate measure crashes decreased 22.3 percent in the zones where the majority of countermeasures were focused.

Other evaluations of pedestrian education programs can be found in the Online Library at www.walkinginfo.org.

Left-turning vehicle failing to yield to pedestrians at an intersection.

Pedestrians failing to obey a traffic signal.

Education is an important and effective part of a pedestrian safety program, but having streets designed for pedestrians is a prerequisite. **Most education campaigns will have limited long-term success if the streets are designed for high-speed traffic and do not safely accommodate all users.**

While many education programs have shown positive results in improving pedestrian safety, others have failed to demonstrate significant improvements. This is likely because not all education efforts have all the necessary components for success or are not tailored to meet the needs of the community. To ensure the most effective and successful education programs, an agency should:

- Understand the local context and apply messages to the appropriate audience.
- Combine and coordinate the education program with other planning, engineering, and enforcement measures.
- Use both concentrated short and long-term efforts.
- When appropriate, supplement informational programs (i.e., programs using PSAs or other passive education techniques) with opportunities to put learning into practice (i.e., skills training or active education).

Defining Education-Related Problems and Goals

Education programs and campaigns work best when there is a clear understanding of the audience, the objective, and the messages to be conveyed. Such programs produce the greatest safety benefits when they are part of a long-term program and not just designed to achieve short-term changes. The education program should target a real and specific community problem. In some cases, behavior-related problems are a symptom of other concerns, such as poor street design or lack of enforcement; in these cases, education should be coupled with additional measures to treat all of the underlying factors related to the concern. Examples of common pedestrian-related problems that can be addressed (in-part) through education include:

- Pedestrians at an intersection don't appear to understand the newly-installed pedestrian signals and/or don't choose to activate them. The novelty of the signal requires some additional information on its meaning and use.
- Pedestrians do not think they have enough time to cross at a traffic signal.
- Drivers don't yield to pedestrians in crosswalks.
- Parents don't understand the need to supervise children under the age of 10 when they are walking.

- Children ages 10 to 18 don't know where or how to safely cross a street to get to school.
- Motorists are speeding in neighborhoods.
- Commuters in the downtown area aren't taking advantage of non-motorized modes of travel.
- Pedestrian crashes are occurring in an area with a concentration of bars due to pedestrian drinking and walking.
- Designers and engineers aren't using pedestrian-friendly design practices.

Educational messages and strategies used to convey them should be tailored to a particular audience and goal.

Though there are many studies showing that education can have an impact, it is equally relevant to consider local conditions and factors to develop an education program tailored to the community. The goals of an education program should be specific, measurable, and related to the problems identified. For instance, if an intersection safety study reveals that only 20 percent of pedestrians are activating the push-button (assuming the button is properly designed and located and works correctly) for a crossing signal, an education campaign can be developed to focus on increasing pedestrians' understanding of the existence and benefits of the crossing features. The goal should be to increase activation of the push-button and safe crossing behavior. Establishing baseline conditions helps in setting realistic goals and evaluating program effectiveness.

Targeting Specific Audiences

There are major differences in the knowledge of safe pedestrian practices, walking abilities, behavioral patterns, and learning capacities of different groups of pedestrians and other road users. Because of this, education programs need to be tailored to the specific audiences and types of safety problems they intend to address, and to the behaviors they seek to modify. Common audiences for focused, pedestrian-related education programs include:

1. Road users, including:
   a. Child pedestrians (several different age groups)
   b. High school and college age pedestrians
   c. Adults
   d. Older pedestrians (65+)
   e. Drivers
   f. Alcohol consumers (especially heavy drinkers)
2. Commuters/employees
3. Transportation officials and decision makers, including engineers, planners, developers, local officials/leaders, and law enforcement officers.

Especially for child audiences, it is important to consider when and how the audience should receive information.

Education campaigns can teach children about safe pedestrian practices.

More details and examples of pedestrian safety programs are provided in NCHRP Report 500, Volume 10, "A Guide for Reducing Collisions Involving Pedestrians," (2004), which can be found at the site: http://www.national-academies.org.

Safe Routes to School programs provide communities with strategies to make walking to school safer.

These audiences can be reached in a variety of ways: through public awareness campaigns reaching a broad group of people at once; through interventions targeting narrow groups or situations; or through an intermediary—such as a pediatrician, a parent, or a grandparent—targeting people on a one-on-one basis.

For an education program to be successful, it is important to consider:

1. When and how the audience should receive information—for instance, children, depending on their developmental level, may not be able to understand certain messages or complicated images used to convey messages.
2. Demographic factors—for example, the percentage of non-English speakers in a community affects the development of the educational materials. Educational materials in several languages and/or a range of distribution methods (e.g., PSAs, posters, or presentations to neighborhood groups) may be needed for certain populations.

The following section provides important safety messages and strategies for conveying those messages to each of the aforementioned groups. Based on identified safety concerns, goals, and other considerations (e.g., available resources, etc.), each community should determine the most important group or groups to target in an education program and the appropriate strategy to use.

Key Educational Messages and Strategies for Targeted Audiences

Educational messages for road users commonly focus on improving personal safety and obedience to traffic laws. Campaigns aimed at commuters or employees often focus on messages to encourage drivers to use carpools or transit, or to consider non-motorized transportation modes. Education and training programs aimed at transportation officials and decision makers usually focus on encouraging stronger support for policies, programs, and facilities that promote safe walking.

The following sections provide more detailed educational messages that could be incorporated into education campaigns and strategies that could be used to target the audiences described earlier.

<u>Educating child (elementary and middle school) pedestrians</u>

Being struck by a car is a leading cause of death and injury to children. Children, especially males age 5 to 9, are at high risk

of being hit in a pedestrian crash. Young children are frequently struck on the neighborhood streets near their homes. The task of teaching pedestrian safety to children is complicated by their level of development. To obtain significant results, education programs must improve knowledge and awareness and teach skills appropriate for the level of development of the children they target. One excellent resource for educating children about pedestrian and bicycle safety skills is the Education section of the National Center for Safe Routes to School Online Guide (available at http://www.saferoutesinfo.org/guide/education/index.cfm). It describes what groups to bring together to educate children (including parents, caregivers, and teachers) and others who need to know about children's needs and abilities as bicyclists and pedestrians (including drivers and neighbors). It also addresses when education programs need to take place.

The NCSRTS Resource Center contains tip sheets for parents and other adults for teaching pedestrian safety to children. See www.saferoutesinfo.org/resources/education_tip-sheets.cfm.

The Education section of the SRTS Guide by the National Center for Safe Routes to School describes key messages for children (primarily elementary age) (http://www.saferoutesinfo.org/guide/education/key_messages_for_children.cfm#health), including:

- Pedestrian safety skills.
- Personal safety.
- Health and environmental benefits of walking.

National Safe Routes to School Program

Nationwide

Through the 2005 passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Congress designated a total of $612 million toward developing the National Safe Routes to School Program. The Program provides funds to the states to substantially improve the ability of primary and middle school students to walk and bicycle to school safely.

Each state administers its own program and develops its own procedures to solicit and select projects for funding. The program establishes two distinct types of funding opportunities: infrastructure projects, such as engineering improvements; and non-infrastructure related activities, such as education, enforcement, and encouragement programs.

For more information on the National Safe Routes to School Program, go to the FHWA Web site http://safety.fhwa.dot.gov/saferoutes/ or the National Center for Safe Routes to School Web site http://www.saferoutesinfo.org/.

Mapping best routes to school (above) and participating in SRTS programs can help provide school children with safer trips to school and back.

The National Center for Safe Routes to School Online Guide's section on Education (http://www.saferoutesinfo.org/guide/education/strategies_for_educating_children.cfm) also addresses various strategies to educate children, including:

- One-time instruction (such as an assembly).
- Classroom or physical education lessons (e.g., stand-alone, integrated, or comprehensive curriculum for every grade).
- Parent involvement strategies for at-home education.
- Structured skills practice (e.g., class-based lessons, after-school programs, or one-time events such as bike and pedestrian rodeos).
- Traffic safety quizzes or games that can be used at safety fairs for children; traffic safety information that can be made into games, coloring books, or other activity books.

One key message to emphasize in child and parent education programs is that children through the age of 10 should be supervised by an adult whenever walking or crossing the street.

Mapping Out A Safer Community: Safe Routes to School

Detroit, Michigan

The following content is taken directly from the site, http://maps.culma.wayne.edu/community.htm:

"In Detroit, neighborhood crime, gang activity, unrestrained dogs, and declining or dangerous properties affect students' safety to and from school. To help address a broad range of community safety concerns, The Urban Safety Program partners with schools and community groups to implement the "Mapping Out A Safer Community" program. In this program, Detroit middle school students receive instruction in state-of-the-art computerized mapping (a.k.a. GIS-geographic information systems) and portable computing to study neighborhoods near their school. Using PocketPCs, students map locations and characteristics of dangerous properties, take photographs, and research property ownership. They also set priorities and identify the most problematic locations near their school. Properties with the most egregious violations, known as "The Dirty Dozen", offer a compelling picture of hazards Detroit children face daily. This information is presented to community leaders and city officials who attempt to correct dangerous situations.

To date, the Urban Safety Program has worked with students from: Foch Middle School, Butzel Middle School, Spain Middle School, Finney High School, and community-based after school and summer programs. For more information, visit the Web site http://maps.culma.wayne.edu/index.htm."

Sustainable Transportation Education Project (STEP)

Various Cities in Canada

The Sustainable Transportation Education Program (STEP) was developed by Green Communities Canada to test various approaches to engaging high school students in sustainable transportation issues. It was piloted in urban and rural (Peterborough, Markham, and Toronto) schools in Ontario, Canada. The program helped schools tackle transportation problems while increasing awareness and education about air quality, climate change, and healthy lifestyle issues. The program involved student-led events and activities, such as climate change presentations, a campaign against car idling, and participation in Walk to School Week. It also included classroom resources regarding sustainable transportation that could be incorporated into the curriculum of communications technology, geography, science, and civics courses. Additionally, traffic surveys were conducted with high school populations; these can be adapted for use by environmental clubs, environmental science, geography, social studies, civics or other courses.

For detailed case studies and reports, as well as downloadable resources related to the STEP program, visit the site http://www.saferoutestoschool.ca/index.php?page=step.

There is less information available on messages and strategies targeting middle-school age children. What is known is that middle school children still need skills practice as well as exposure to messages that convey the importance of walking and safety. To be effective, these messages should be conveyed within themes that matter to that age group, such as fitness and independence. Pre-teen audiences can be difficult to reach, so creativity is a must in any educational effort. Some potential strategies for targeting middle-school-age children include:

- Put them in control—Organize a student committee to address the problem of safety, physical inactivity, or issues related to excess weight. Ask them to come up with contests or program ideas.
- Integrate walking into the culture in a subtle way—Have teachers and administrators walk on local field trips.
- Start a Kids Teaching Kids program—Middle school students can develop a safety assembly for elementary students and then deliver it (or high school students can deliver it to middle schools). Make sure that the student teachers are well-trained to convey correct strategies and that the teaching is within the children's developmental level.
- Use multimedia to convey messages—Consider the use of music, video games, and computer software in addition to traditional media. Ask students to consider how many

songs have the word "walk" in the title. Think about using "walk" songs as "music of the week" or as links in a class assembly about walking to school. California's Rad Rider Web site (www.radrider.com) has bicycle safety messages incorporated into an online comic book and safety tests; the site also offers a bicycle stunt show. See the example on page 74 on how GIS and PocketPC technology has been used to engage youth in pedestrian safety issues.

Educating high school and college-age pedestrians

High school and college-age students represent unique pedestrian education opportunities and challenges. High school students are probably the least likely of any student age group to walk to school, either because their high schools are sited in areas where they are unable to walk safely to school, or because they want to take advantage of newfound driving privileges. However, ignoring high school populations for education programs would be missing an important opportunity to engage young drivers (and pedestrians) in safety issues. One excellent way to reach high school students is to couple pedestrian and safety issues with broader concerns about transportation, health, and the environment. Almost every high school has an environmental club or other group that will help champion these messages; at the high school level, messages that come from peer groups may be better received than messages coming from teachers, parents, or other authorities.

Many college-age students are more likely to walk and bike than drive on campus.

Many college-age students are more likely to walk and bike than drive on campus. This is due to restricted campus parking; the expense of car ownership; and the fact that students are young, able, and generally more physically fit than other age groups. They are an ideal target for pedestrian safety and promotion campaigns. However, college-age students also tend to take more risks than many other age groups, such as older pedestrians. They have a stronger perception of "invincibility," and may be apathetic to safety outreach initiatives. Also, alcohol can be a factor, even for campuses that are technically "dry."

Several universities have developed education programs and campaigns in partnership with their Parking and Transportation Services Office or Department of Public Safety. The College of New Jersey and the University of Kentucky distribute a student-oriented pamphlet of "tips, guidelines, and resources" for getting around the campus "quickly, conveniently, and safely." Key messages include:

- Reasons to walk or bike:
  - Save money.
  - Stay healthy (avoid the "Freshman 15").
  - Avoid vehicle parking hassles.

- Tips for crossing campus safely on foot:
  - Cross the street at marked crosswalks or at intersections, and observe traffic-control signals. At intersections, watch for turning vehicles that may not be yielding to pedestrians.
  - Yield to motor vehicles and bicyclists when you are not in a crosswalk or are not crossing at an intersection.
  - Stay to the right on shared pathways and avoid walking in "bike only" lanes.
  - While walking or jogging alongside a road without sidewalks, always walk or jog facing traffic.
  - Make eye contact with oncoming motorists and cyclists, indicate your intention to cross (e.g., extend your arm, place a foot in the crosswalk, or lean toward the crossing), and wait for the driver to slow or stop.
  - Avoid cell phone use when walking in congested areas or crossing busy streets; wear bright colors and walk in well-lighted areas at night; don't step into the street from behind an obstruction.

Some important strategies for educating high school and college-age pedestrians include:

- Develop partnerships for education programs—with Parking and Transportation Services Office, Department of Public Safety, campus health organizations, public health/

For more links to educational strategies for various audiences, visit http://www.walkinginfo.org/education/messages.cfm.

University of North Carolina "Yield to Heels" Campus Safety Campaign

Chapel Hill, North Carolina

The University of North Carolina's "Yield to Heels" campaign is an ongoing pedestrian safety awareness campaign implemented by the UNC Department of Public Safety and the UNC Highway Safety Research Center. The "Yield to Heels" campaign intends to remove myths about traffic and pedestrians and make helpful information about pedestrian safety available to the University community. The campaign focuses on three main messages for pedestrians, drivers and bicyclists: Be Aware, Be Safe, and Be Considerate. It involves high-visibility posters and signs; handing out promotional materials, coupons, and giveaways (such as tee-shirts and retro-reflective gear); as well as issuing warnings to pedestrians and drivers observed breaking the laws during the campaign effort. See the campaign Web site (http://www.hsrc.unc.edu/y2h/) for the event flier, a description of student-oriented pedestrian safety messages, and other helpful links.

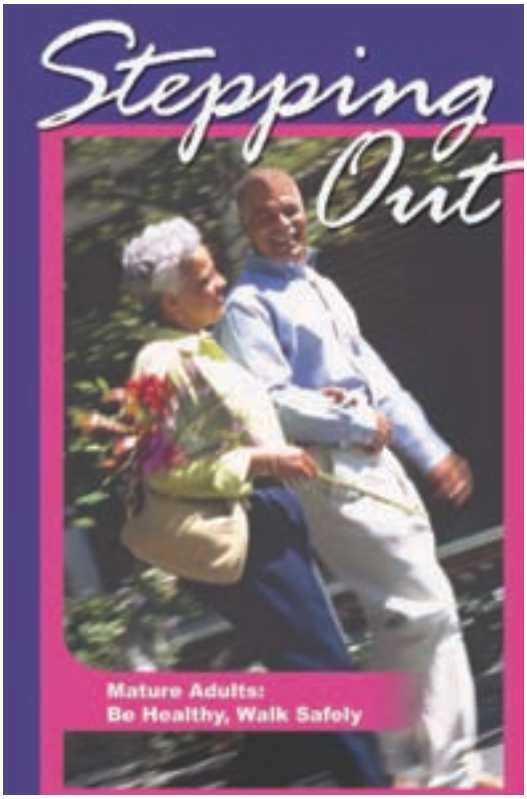
injury prevention alliances or student associations, or other student groups such as walking/bicycling clubs or environmental groups.
- Take advantage of campus life and university events—distribute pamphlets or other materials at new student orientations, large student assemblies (such as sporting events), or through campus housing.
- Give incentives—While distributing safety messages, garner student interest by giving away food, wristbands, retro-reflective gear, posters, coupons for local restaurants, or other freebies.
- Tailor a program to relate to specific student population needs and interests—This helps engage students in understanding why pedestrian safety is important and how it affects them directly. They learn what they can do, both personally and as part of the school or college/university, to improve pedestrian safety and increase walking on campus and beyond.

Educating adult pedestrians

The challenge of walking along and crossing streets can make a casualty of even a fit, healthy, and alert adult. Bad weather, fast-moving traffic, and inattention by drivers or pedestrians can make situations worse. Some general pedestrian safety messages include:

- Make yourself visible to drivers
  - Wear retro-reflective materials and bright/light colored clothing.
  - Carry a flashlight when walking at night.
  - Use caution when wearing headphones and talking on cell phones while walking, especially when crossing the street.
  - Stand clear of buses, hedges, parked cars or other obstacles before stepping into the street so drivers can see you.

- Avoid dangerous behaviors
  - Always walk on the sidewalk; if there is no sidewalk, walk facing traffic.
  - Stay sober; walking while impaired increases your chance of being struck.
  - Don't assume vehicles will stop; make eye contact with drivers and wait until they show signs of slowing or stopping for you.



Brochures and educational handouts can be used to spread adult pedestrian safety messages.

"Cross the Street As If Your Life Depends On It" Education Campaign

Greater Toronto Area, Ontario, Canada

In 2002, Toronto experienced one of the worst years in terms of pedestrian fatalities. The Injury Prevention Coalition began a campaign to increase citizen awareness and reduce pedestrian deaths and injuries in the Greater Toronto Area. Ads were developed with the slogan, "Cross The Street As If Your Life Depends On It, Because It Does." Posters and safety brochures were sent to 900 different community agencies, all with the dramatic photo of a staged pedestrian fatality scene. These community agencies included health services, police and fire stations, parks and recreations centers, senior centers, licensing centers, and more. Additionally, ads were placed in 30 bus shelters at key intersections, and a short slide show was developed to be shown in local movie theatres, which directed viewers to a Web site with further information. The media launch for the event was covered by several city newspapers. Over 867,000 people viewed the pedestrian safety ad showed in movie theatres. The media images and brochures were evaluated for the effectiveness of the message, and both were found to educate readers and viewers, and bring up previous information regarding pedestrian safety. For more information, visit http://www.sunnybrook.ca/programs/trauma/injuryprevent/injurypreventtipc.

  - Cross with traffic signals and not against the DON'T WALK signal.
  - Don't rely solely on pedestrian signals; look before you cross the road.
  - Watch for cars backing up in parking lots and near on-street parking spaces.

- Look before you take a step
  - Cross streets at marked crosswalks or at intersections, if possible.
  - Look left, right, behind, and left again before crossing a street or stepping into traffic.
  - Watch for turning vehicles; make sure the driver sees you and will stop.
  - When crossing multiple lanes, look across all lanes you must cross and visually clear each lane before proceeding.

Strategies for educating adult pedestrians include:

- Incorporate pedestrian safety messages into public relations efforts (news releases, fact sheets for local officials, press events, etc.).

For more information on pedestrian education and enforcement measures, read Chapter 8 of NHTSA's "Countermeasures That Work" document, availbale online at http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/HS810891.pdf.

Making presentations at group meetings with older pedestrians is one strategy for educating senior pedestrians.

- Highlight pedestrian facilities when introducing new infrastructure.
- Create a Web-based pedestrian safety quiz on a local agency Web site for the purpose of educating pedestrians.

Educating older pedestrians (65+)

For older pedestrians, whether they are in good health or not, walking can provide strong health and quality of life benefits. However, research has shown that older pedestrians are often overrepresented in fatal pedestrian crashes. If they survive the crash, they may be disabled or confined to a nursing home. Older adults are often struck while crossing streets in crosswalks or by drivers making turning movements through crosswalks.

Older adults can be receptive to well-crafted safety messages. In addition to the general messages described in the "Adult Pedestrian" section, key messages for older pedestrians could include:

- The threats presented by cars making turns.
- Tips for crossing intersections slowly but safely, including waiting for a 'fresh' green light before crossing at a signal.
- Good choices of footwear (for better traction) and visible clothing (bright and retro-reflective) for walking at night.
- Tips for avoiding backing vehicles, including watching for back-up lights on vehicles or listening for engine noise before walking behind vehicles.

Strategies for educating older pedestrians include:

- Initiate campaigns to targeted settings/situations where older pedestrians may be concentrated (e.g., retirement communities, healthcare clinics/hospitals, libraries, churches, etc.).
- Contact established organizations, such as AARP, or community centers that may already have a strong network with the older pedestrian community.

Educating drivers

An important educational feature is how motorists come to think of pedestrians. Most motorists do not adequately look for pedestrians, and this is, in part, a result of how public or law enforcement officials educate them and enforce (or fail to enforce) certain behaviors. In pedestrian-vehicle crashes, the pedestrians are often blamed, even when the motorist was at fault because of the underlying assumption is that streets are

primarily for motorists. Educators and law enforcement officers need to work to change these views to ensure that pedestrians are accepted as legitimate users of the street network.

Roadway safety is a shared responsibility, and motorists have their fair share of things to do to comply with the rules of the road and help keep pedestrians safe. Some general driver safety messages include:

- Watch for pedestrians at all times
  - Scan the road and the sides of the road ahead for potential pedestrians.
  - Before making a turn, look in all directions for pedestrians crossing.
  - Don't drive distracted or after consuming alcohol or other drugs.
  - Do not talk on a cell phone while driving.
  - For maximum visibility, keep your windshield clean and headlights on.

- Yield to pedestrians at crossings
  - Yield to pedestrians at crosswalks, whether marked or unmarked.
  - Yield to pedestrians when making right or left turns at intersections.
  - Do not park in or block crosswalks. Provide a safety zone for pedestrians.

- Drive within the posted speed limit and avoid aggressive maneuvers
  - If you are traveling on a road with more than one lane of traffic, be especially aware of motor vehicles stopped for crossing pedestrians. Do not pass the stopped vehicles.
  - Obey speed limits and come to a complete stop at stop signs and signals.
  - Always be prepared to stop for pedestrians.

Strategies for educating drivers include:

- Plug into local media—have driver safety awareness campaigns on TV, in radio traffic-watch PSAs, and in newspapers; host a commute-time radio talk series on pedestrian safety issues, or develop an ad campaign to be displayed on billboards, in parking garages, or in other places most visible to drivers.
- Place and distribute driver safety material alongside pedestrian safety material. Most walkers are drivers, too.

- Couple education with enforcement to reinforce driver knowledge of and compliance with pedestrian-related laws.
- Add pedestrian safety information to state driver's license manuals and maps where traffic safety tips provided by a state or community are displayed.
- Create Web-based traffic safety quizzes (that include pedestrian safety questions) on a local agency Web site for the purpose of educating drivers.
- Use engineering treatments (such as roadway signs and in-street signs) to alert drivers to pedestrians and spread educational messages about yielding to pedestrians. See the Engineering treatments section for more engineering tools related to educating drivers.

Excessive drinking can pose a serious concern for pedestrians and drivers alike.

Educating alcohol consumers

Most people know the risks of drinking and driving, but what many people may not know is that excessive drinking can have the same deadly consequences for pedestrians. Alcohol plays an important factor in one-third of all pedestrian deaths—this number is based on pedestrians who have been drinking and doesn't include drinking on the part of the driver. Alcohol-related pedestrian deaths often involve males and occur at night, especially on weekends. Unfortunately there are typically no 'drunk pedestrian' laws that allow police officers to arrest and easily remove a pedestrian from harm's way. The problem of alcohol-impaired drivers and pedestrians is complex and requires a multifaceted approach including both education-based programs as well as other intervention methods, including engineering and enforcement.

Alcohol impairs physical agility and balance. It also adversely affects vision, judgment, and other thought processes, which become extremely important when pedestrians try to cross the road. It is widely accepted that the alcohol-impaired driver is a major threat to pedestrians and all other road users. Researchers have also found that for a pedestrian, high levels of blood alcohol are associated with an increased risk of being hit by a motor vehicle. The following messages for alcohol consumers are described in the NHTSA resource guide, *The Facts: Impaired Pedestrians:*

For motorists:

- Do not drive impaired. It slows your reaction time, impairs your judgment, and affects your alertness and coordination.

- When you drive, particularly at night around populated areas, watch for sudden, unexpected movements by pedestrians. Scan the road widely and often, and prepare for the unexpected. Slow down!
- If you know someone who has been drinking and is planning to walk, call them a cab or offer to drive or escort them, even if it is only a short distance.

For pedestrians:

- Remember that alcohol affects your balance, impairs your judgment, and reduces your alertness and coordination. It can also affect your vision.
- Limit how much alcohol you consume, especially if you plan to walk. Do not fool yourself about your ability to walk in traffic safely.
- Be more visible to traffic by carrying a flashlight or wearing retro-reflective clothing at night. During the day, wearing fluorescent colors is best. Wearing white, especially at night, is not enough for you to be seen adequately by motorists.
- If you know someone who has been drinking and is planning to walk, offer to call them a cab or escort them, even if it is only for a short distance.

Most alcohol-related crashes occur at night. Safety messages aimed at alcohol consumers and intermediaries should describe ways for pedestrians to be more visible at night.

One strategy for educating alcohol consumers is to initiate public awareness and education campaigns to inform pedestrians and alert drivers about the hazards associated with walking while impaired. It is also important to train law enforcement officers and point-of-sale personnel about impaired pedestrian issues and the dangers of over-serving in general.

The following are some additional strategies that could be combined with public awareness campaigns to provide a more comprehensive approach to the alcohol issue:

- Develop or amend local or state laws that control the availability of alcohol (e.g., laws that dictate when bars must close, etc.).
- Develop or amend laws to allow police to arrest or detain a pedestrian if they are out walking impaired and may harm themselves or others.
- Work with health officials, employment centers, and other related groups for the early identification and treatment of persons with alcohol problems.
- Address environmental issues (e.g., through improved lighting, speed control measures on commercial strips, etc.) and devise different interventions for use on high-

speed roads in rural areas and medium-speed roads in urban areas where there is a pattern of drunk pedestrians being struck by motorists. See the Engineering solutions described in the first part of Chapter 5 for more strategies related to environmental issues.

Educating employees about the benefits of walking, and encouraging commuters to consider walking can be an important part of a company or agency's traffic safety program.

Educating commuters/employees

There are many who drive to work daily who could walk, bicycle, or take transit. Often, this creates unnecessary roadway congestion, which may lead to increases in motorist-pedestrian crashes, as well as increases in pollution. Many communities and local agencies have transportation demand management (TDM) programs, which aim to educate road users about their commute choices, provide incentives and alternatives to reduce driving to work, and can result in more efficient use of transportation resources. Educating commuters about travel options, benefits, and safe practices is an important component of any comprehensive pedestrian education program. The key to encouraging more commuters to travel by foot is to educate them on the benefits of walking and the feasibility of doing it.

Educating employees about the benefits of walking and safe walking/driving habits can be part of a company or agency traffic safety program. It is not uncommon for large companies to institute a driver safety program to reduce the chance that their employees will get into a crash, keep insurance premiums low, and help reduce the company's exposure to tort liability by reducing crashes. Some companies, such as Dow Chemical, require employees to take a traffic safety and map reading course before being allowed to travel for the company. Others require employees to take a mandatory defensive driving course every couple of years. Companies can include information on safe walking practices and driving practices around pedestrians in their curricula.

For more information on business-based walking programs, visit http://www.americanheart.org/presenter.jhtml?identifier=3040830.

For more information on promoting walking, visit: http://www.walkinginfo.org/promote/strategies.cfm.

The following are some ideas for marketing non-motorized travel modes, and providing choices and incentives for walking as part of a commute, drawn from the Victoria Transport Policy Institute (http://www.vtpi.org/tdm/index.php#incentives):

- Hold bicycling and walking events and activities, particularly on trails and cycling routes.
- Develop bicycling and walking commute campaigns; these can involve contests as to which workers and worksites commute most by nonmotorized modes.
- Provide and promote bicycle parking, showering, and

clothes changing facilities at worksites, transportation terminals, and other destinations.
- Develop and distribute education materials and programs that teach cycling skills.
- Create walking and bicycling maps showing recommended routes and facilities, roadway conditions (shoulders, traffic volumes, special barriers to cycling, etc.), hills, recreational facilities, and other information helpful to pedestrians and bicyclists.
- Develop tourist promotion materials highlighting bicycling and walking.
- Create a Multi-Modal Access Guide, which includes maps and other information on how to walk and cycle to a particular destination.
- Employers (including public agencies) can create a mandatory defensive driving program to improve the safety of their employees and reduce their tort liability. This campaign should include pedestrian safety information.

Educating elected officials, transportation officials and decision-makers

Educating the pedestrian alone is not enough. An effective program to improve pedestrian safety and mobility should also address those responsible for approving, planning, designing, and developing a safe pedestrian network. Elected officials, transportation officials, and other decision-makers must have buy-in on the importance of walking and the need for safe walking conditions. Otherwise, they may not provide the resources to address the problems. Their support for pedestrian education programs, stepped-up enforcement activities, and infrastructure improvements is crucial. It is important for elected officials and transportation decision-makers to understand and believe that:

- Walking is an integral and critical part of the transportation system.
- The presence of pedestrians is a good indication of the health and vitality of a community.
- Walking is the most basic form of transportation, and yet also the easiest to overlook or take for granted.
- Designing a safe, convenient, and comfortable walking environment requires careful planning, engineering, attention to detail, and ongoing maintenance and care.
- Physical improvements must go hand in hand with land use control, legal changes, enforcement, education, and a complete package of measures that require coordination and support from politicians as well as professionals.

Get Active Orlando

Orlando, Florida

Orlando's expansive program, Get Active Orlando, (funded by Active Living By Design) aims to encourage and facilitate walking and biking in the downtown area. Get Active Orlando's vision is to establish downtown Orlando and its adjacent neighborhoods as an "Active Living District," with residents, employees, and others in the downtown area routinely making the active choices in an environment that encourages safe physical activity. The Get Active Orlando partnership plans to develop and implement a campaign that focuses on the importance of daily active living and is developing a "Point of Choice" campaign that educates people on their options for active traveling. For more information, visit http://www.activeliving.org/node/291?tab=summary.

Some strategies for educating elected officials and transportation officials and other decision-makers include:

- Show the facts—improve data to better describe the nature of the pedestrian problem in the community and to justify attention to pedestrian concerns.
- Conduct internal campaigns within the organization to build staff support for the pedestrian safety program (in-house meetings, newsletters, forums, etc.).
- Develop relationships and partner with other agencies (such as transit agencies, public health agencies, police departments, etc.) that have an interest in pedestrian issues and a responsibility for the public welfare.
- Plan events and activities that encourage officials to walk with an escort that can point out challenges and potential solutions.
- Partner with safety groups, community groups, homeowners associations, and others to lobby to politicians and decision-makers at the local and state level.

An effective program to improve pedestrian safety and mobility should include elected officials and transportation decision-makers responsible for approving, planning, designing, and developing a safe pedestrian network.

Enforcement Solutions

Overview

Programs to improve pedestrian safety should consider enforcement activities, in addition to engineering and education strategies. Enforcement, as well as education, teaches motorists and pedestrians about traffic safety and the laws that govern their rights and responsibilities.

The main goal for enforcement strategies is to deter unsafe driver and pedestrian behavior and to encourage all road users to obey traffic laws and share the road safely. Enforcement is one strategy to improve pedestrian safety, but enforcement alone will not likely have a long-term effect. Communities must combine enforcement, engineering and education strategies to address specific needs and achieve long-term results.

An important issue is motorists' awareness of the presence of pedestrians. Many motorists do not routinely look for and yield to pedestrians. The pedestrians are often blamed in pedestrian-vehicle crashes because of the underlying assumption that roadways are primarily for motorists. Law makers, local officials, and law enforcement officers need to work to change these views to ensure that pedestrians are accepted as legitimate users of the street network. Motorists need to be taught and reminded that pedestrians are more difficult to see than motor vehicles and

therefore conscious efforts are needed to reach for pedestrians in order to avoid collisions.

Furthermore, the Uniform Vehicle Code (UVC), that contains the vehicle and traffic laws of the United States, and most state laws require drivers to exercise due care any time they see a pedestrian in the roadway. The UVC was established by the national committee on Uniform Traffic Laws and Ordinances—a private, non-profit membership organization—as a set of guidelines related to motor vehicle safety. These guidelines or model legislation are then adopted by states as is or with changes to wording as each state chooses. UVC Section 11-504 states that "Notwithstanding other provisions of this chapter or the provisions of any local ordinance, every driver of a vehicle shall exercise due care to avoid colliding with any pedestrian. … and shall give an audible signal when necessary, and shall exercise proper care and precaution upon observing any child or any obviously confused, incapacitated or intoxicated person."

Complementary enforcement, education and engineering measures increase the effectiveness of safety programs. For example, to encourage more motorist yielding to pedestrians in crosswalks, the roadway should be designed to promote lower motor vehicle speeds and provide clear sight lines between drivers and walkers. Police enforcement should give warnings and tickets

Enforcement Programs Work

Enforcement programs increase the percentage of motorists yielding to pedestrians and also motorist awareness of pedestrians. They can also target motorists that are speeding or those that pass vehicles that are yielding to pedestrians. Malenfant and Van Houten (1989) measured large increases in yielding behavior in three Canadian cities employing enforcement complemented with educational outreach and several engineering interventions. Although safety may have been greatly influenced by the engineering interventions, the enforcement component increased yielding behavior (Malenfant, 1989).

More recently, this program has been applied to increase yielding behavior in Miami Beach, Florida. Data collected to date show that yielding has increased in both corridors following the introduction of the program and that maintenance strategies are working to maintain the increase in yielding behavior. Data also indicated that enforcement tactics for increasing yielding behavior to pedestrians in marked crosswalks at uncontrolled locations can be applied at other crosswalk locations.

For more information, visit: http://www.hsrc.unc.edu/pdf/pedbike/99090.PDF.

to violating motorists. Simultaneous public education programs should be used to educate the public about the importance of motorist compliance to such laws and the possible consequences of not doing so. A pedestrian safety program in Miami-Dade County, Florida, that incorporated engineering, education and enforcement components reduced pedestrian crash rates. (For more information, see Comprehensive Approaches on page 108 and 109.)

The public typically thinks of enforcement as officers writing tickets. In reality, enforcement should be a network of community members working together to promote safe walking and driving. This can be accomplished through safety awareness, education, and, where necessary, the use of warnings and/or ticketing for dangerous and illegal behaviors. Enforcement entails members of the community working in conjunction with law enforcement. Working together to enforce rules for reasonable and careful walking and driving makes it safer and easier for everyone to walk.

Enforcement should include a network of community members working together to promote safe walking and driving.

A critical factor in conducting pedestrian enforcement is having support from important stakeholders including local politicians and traffic court judges as well as law enforcement personnel. Politicians can ensure financial support for programs, and judges, once they understand the magnitude of the problem and how a particular enforcement program is conducted, may be more likely to convict violators. This is critical as law enforcement officers may not continue to write citations if they are consistently thrown out in court.

An adequate level of enforcement is needed to control motorist and pedestrian behavior, especially in school zones. Studies by Van Houten (2004) and others have found that enforcement aimed at motorists is more effective than enforcement aimed at pedestrians. "Anti-jaywalking" campaigns have proven ineffective and very unpopular. Police interaction with pedestrians should focus on education and warnings rather than giving citations. It has generally been more effective to cite motorists for violations related to pedestrian safety. While the laws clearly explain the dual responsibility of motorists and pedestrians, the reality is that the greatest threat to safety is a motorist who is operating a heavy motor vehicle, often at relatively high speeds. Also, enforcement programs that involve frequent and reasonable motorist penalties are more effective than enforcement that is less frequent but imposes high penalties for a motorist violation.

Police resources should be used to enforce pedestrian crossing rights and to control motorist speeds. This requires speed limits to be established at reasonable and desirable levels. Police departments should undertake training programs so that the police officers who are responsible for enforcement programs understand the laws and issues surrounding pedestrian safety.

Existing Pedestrian and Traffic Laws and their Enforcement

Many laws and ordinances addressing the safety of pedestrians currently exist. The Resource Guide on Laws Related to Pedestrian and Bicycle Safety includes provisions of vehicle and traffic laws for every state in the U.S. that may affect pedestrian or bicycle safety. The Guide also contains existing state laws and local ordinances that are not included in the Uniform Vehicle Code, but have been implemented in one or more states or municipalities and are considered to have a positive effect on pedestrian or bicycle safety. Model legislation designed to enhance pedestrian safety is also included. The Guide is available as a download or can be ordered from the NHTSA Web site. (See http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/resourceguide/index.html.)

Enforcement programs that involve frequent and reasonable motorist penalties are more effective than enforcement that is less frequent but imposes high penalties for a motorist violation.

A comprehensive enforcement program includes reviewing existing relevant laws in a given locality. If necessary, modifications to the laws to improve the safety of pedestrians can be explored. A team of law enforcement officials, city attorneys, traffic court personnel and other interested stakeholders should review laws and ordinances that impact pedestrian safety, compare them with existing model ordinances, and consider changing them to increase the safety benefit to pedestrians. For example, statutes that require drivers to yield to a pedestrian standing on the curb at a crosswalk are stronger than those that say you must only yield to pedestrians in the crosswalk. Statutes that require drivers traveling in both directions to yield can reduce the number of pedestrians trapped in the center of the roadway. Changes to laws or ordinances should be made first at the state level, and then at the local level. Any changes or additions need to be publicized to the public to have any positive effect.

Identifying Unsafe Behaviors

Effective enforcement programs, like any safety efforts, first must identify unsafe behaviors of drivers and pedestrians, and then select appropriate strategies for improving these behaviors. There are many ways to identify unsafe behaviors; an observation of driver and pedestrian activity is a good way to

start. Speed measurements and examination of recent crash reports provide additional information. Collecting data to identify pedestrian safety problems is discussed in Chapter 3 and approaches used to analyze this information are discussed in Chapter 4. To start, look for the common unsafe behaviors listed below when observing traffic.

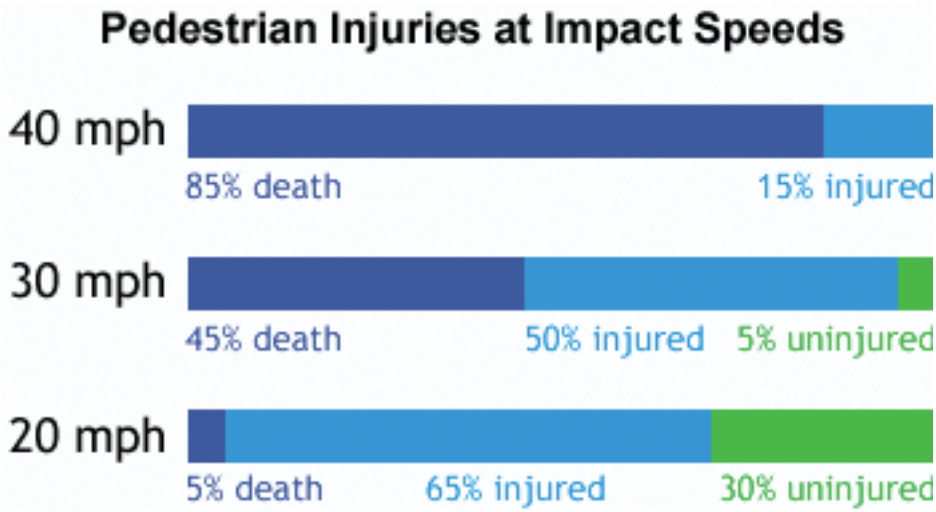
Motorist fails to yield to pedestrian in crosswalk.

Driver Behaviors

Unsafe motorist behaviors may include the following:

- Speeding, especially through residential streets and school zones. (Speed is directly related to crash severity and is also a likely factor in crash causation.)
- Failing to yield to pedestrians, especially in crosswalks. (The law requires drivers to yield or stop for pedestrians in crosswalks — it's a law that is often ignored.)
- Running red lights or STOP signs.
- Passing cars stopped for pedestrians crossing the street.
- Passing stopped school buses.
- Parking or stopping in crosswalks.
- Failing to yield to pedestrians when making right or left turns.
- Failing to yield to pedestrians on sidewalks when entering or leaving driveways or alleys.
- Driving while distracted.

Some drivers don't think about the risks they create. A driver may not think going 10 mph over the speed limit will be noticeably less safe, especially on a wide, inviting street. Nevertheless, just a 10 mph difference in speed can greatly affect vehicle stopping distance and greatly affects whether a pedestrian lives or dies when struck by a car. In a 20 mph impact, a pedestrian



If a pedestrian is hit by a motor vehicle traveling 40 mph, the risk of dying increases to 85 percent.

has about a 5 percent chance of dying when hit by a car. At 30 mph, the chance of dying increases to roughly 45 percent. If a pedestrian is hit by a motor vehicle traveling 40 mph, the risk of dying increases to 85 percent (see graph below).

Pedestrian Behaviors

A critical component of enforcement activities is ensuring that pedestrians know and follow the safety rules whether or not they are laws. Some unsafe pedestrian behaviors that enforcement can influence include:

- Crossing a street at an undesirable location.
- Not looking left, right and left again before crossing the street.
- Not continuing to look for traffic while crossing.
- Darting out between parked cars and trucks.
- Not stopping and looking any time before stepping in front of a vehicle or obstacle that is blocking the view of traffic.
- Wearing dark clothes when there is poor lighting.
- Not following the directions of traffic signals or crossing guards.
- Walking along a street with their back to traffic.

Pedestrian signal violations can lead to crashes.

Using information obtained from crash and other data, the review of relevant laws, and direct observation of behavior, a team of law enforcement officers, traffic officials and other stakeholders can develop a plan and determine strategies to use to enforce laws and improve the safety of pedestrians.

Role of Law Enforcement Officers

Law enforcement officers see the consequences of motor vehicle crashes and the behaviors that cause these consequences. It is vital that they connect the two. From conducting education and enforcement campaigns to identifying unsafe conditions, law enforcement officers can play multiple roles. Demands on a law enforcement department and the level of participation they can offer vary among communities. It is important to understand the level of resources available for local law enforcement. Some communities reserve law enforcement resources for situations where pedestrians face direct or demonstrated harm, or when unsafe behaviors persist despite engineering improvements.

Enforcement measures can be taken to help encourage safer motorist habits.

Types of Law Enforcement Officers

State police or highway patrols, sheriff departments and local law enforcement agencies all may be partners in a pedestrian safety program. There are at least three general types of law enforcement officers that typically assist pedestrian safety efforts:

- Traffic Enforcement Specialists/Motor Officers—These officers are assigned to specialize in traffic enforcement. They respond quickly to traffic safety hot-spots. Often these officers utilize motorcycles, and are often referred to as 'motor officers'.

- Community Action Officers (CAOs)/Precinct Officers—These officers are generally assigned to a specific portion of the city and work on problem areas. While they do not specialize in traffic enforcement, they can be called in for enforcement activities and help coordinate with motor officers.

Law enforcement officers can help improve pedestrian safety in a number of ways, including evaluating traffic concerns, providing enforcement presence, and educating members of the community.

- School Resource Officers (SROs)—Some law enforcement officers are assigned to schools and concentrate on special problems such as gangs, drugs, and other problems. They can also be used to help solve special traffic problems on or near a school campus and can coordinate with the motor officers and CAOs.

Officers can serve in the following ways:

- Teach members of the community to recognize and understand traffic, pedestrian and bike safety problems. In addition to participating in community meetings, school safety assemblies, and safety fairs, educational efforts can include pedestrian and bicycle rodeos and providing media interviews on traffic safety issues.
- Evaluate local traffic concerns, observe problem areas and behaviors, and provide input about safety improvements. Law enforcement officials can be a valuable part of a safety audit team.
- Provide an enforcement presence that discourages dangerous behaviors. For example, this may involve issuing warnings to drivers breaking traffic laws. Drivers who have made a minor error will often respond to a warning from an officer by being more careful. Drivers who continue to violate traffic laws need to be ticketed.
- Collaborate with traffic engineers and other stakeholders regarding problem areas.

Community Enforcement Approach

Members of a community can work together to improve safety behaviors in many ways. Neighborhood speed watch programs and yard sign campaigns can provide opportunities for residents to educate drivers about the consequences of excessive driving speeds, while simultaneously making drivers aware that the neighborhood is concerned about safety. The community can work together to improve the safety of children walking to school by developing school crossing guard programs and safe routes to school walking plans. All adults in a community need to be good role models for their children and others by driving safely, by actively looking left-right-left before entering the street, by crossing streets at prescribed locations such as marked crosswalks when they are available, and by following other traffic rules.

Neighborhood Speed Watch

Neighborhood Speed Watch programs are a traffic-related variation of neighborhood watch or crime watch programs. Such programs encourage residents to take an active role in changing the behavior of motorists on their neighborhood streets by helping raise public awareness and educate drivers about the negative impact of speeding. Residents record the speed, and the license plate and vehicle information of speeding motor vehicles using radar units borrowed from a local law enforcement agency. This information along with a letter is sent to the owners of the vehicles informing them of the observed violation and encouraging them or other drivers of their vehicles to drive in compliance with the posted speed limit. This type of awareness encourages some speeding drivers to slow down, but it often has limited long-term effectiveness in changing the problem, and many people are reluctant to 'tattle' on their fellow residents. Neighborhood Speed Watch programs can educate neighbors about the issue and help boost support for long-term solutions, such as traffic calming. Drivers also learn that residents will not tolerate speeding in their neighborhoods. This program is more effective when implemented along with a neighborhood education program involving distributing traffic safety information through door hangers or other means.

The organization of neighborhood speed watch programs can vary. Some jurisdictions have "Citizen's Patrol" elements in the police department and others have neighborhood volunteers to oversee the program.

Neighborhood speed watch programs can increase motorists' awareness of their speeds and the posted speed limits.

For more information on local neighborhood speed watch programs, visit http://www.slcgov.com/transportation/TrafficManagement/speedwatch.htm and http://www.ci.seattle.wa.us/transportation/speedwatch.htm.

Yard sign campaigns remind drivers to slow down.

Slow Down Yard Sign Campaigns and Pace Car Campaigns

Slow down yard sign campaigns allow residents to participate in reminding drivers to slow down. Neighborhood leaders, safety advocates and law enforcement officials work in partnership to identify problem areas, recruit residents to post yard signs, organize distribution of yard signs, garner media attention, and evaluate the effectiveness of the campaign. Slow down yard sign campaigns may be conducted along with other speed enforcement efforts, such as progressive ticketing campaigns, and other safety efforts, such as neighborhood pace car campaigns and the use of speed radar trailers.

An evaluation of a yard sign campaign by the Safe Community Coalition of Madison and Dane County, Wisconsin, concluded that the signs are noticed and people do slow down when the signs are up, especially when speed boards are used to show drivers their approaching speed.

"KEEP KIDS ALIVE, DRIVE 25" Campaign

Omaha, Nebraska

Speeding in residential areas is all too common and renders neighborhoods unsafe for children and other pedestrians. Beginning in 1998, a local resident of Omaha, Nebraska started a grassroots education campaign to reduce residential speeding, a campaign that has since spread to over 240 communities all over the US. Collaborations between local residents, schools, neighborhood associations, local businesses, law enforcement, and traffic engineering and transportation departments improved mutual trust and strengthened opportunities to get the message out.

The education program was founded on the recognition that the majority of speeders in neighborhoods are residents themselves and that most speeders simply aren't paying attention. Elements of the public awareness campaign have included street and yard signs, brochures, bumper stickers, trash can decals and even public service announcements, all containing the dramatic and effective slogan, "Keep Kids Alive, Drive 25." Other slogans expanded the message outside the neighborhood: "No Need to Speed," "STOP. Take 3 To See," "Check Your Speed," and a Spanish language version, "Mantenga A Los Niños Vivos, Maneje A 25." Funding has come through both the sale of related educational products as well as partnerships with local businesses. For example, Radio Disney sponsored public service announcements in Omaha, and Blue-Cross-Blue Shield of Nebraska underwrote the cost of bumper stickers. In some cases, local departments of transportation have sponsored joint enforcement or engineering efforts, such as the installation of radar trailers and street signs.

The campaign has been a widely recognized success. The first study of effectiveness, conducted in Oceanside, CA, found a 16 percent decrease in average speed of vehicles in targeted neighborhoods. A similar success was found in Omaha, where 75 percent of drivers braked when passing a yard sign. For more information, contact Tom Everson at Tom@kkad25.org or visit www.keepkidsavlivedrive25.org.

Neighborhood pace car programs aim to make neighborhoods safer for pedestrians, bicyclists and drivers. Resident pace car drivers agree to drive courteously, at or below the speed limit, and follow other traffic laws. Programs usually require interested residents to register as a pace car driver, sign a pledge to abide by the rules, and display a Pace Car bumper sticker on their vehicle.

For more information on pace car programs, visit http://www.ci.madison.wi.us/health/pubnews/pdf_files/yardsign.pdf.

Neighborhood Fight Back Programs

Neighborhood Fight Back programs are collaborative efforts between local governments and concerned residents to address crime, blight and other issues negatively impacting their neighborhoods. Though typically used to address illegal drug and other criminal activity, traffic and pedestrian safety is another area of concern targeted by Fight Back programs. The local government provides multi-agency support over a limited period of time to concentrate enforcement activities in specific neighborhoods.

For information on neighborhood fight back programs, visit http://phoenix.gov/NSD/fightbck.html and http://www.asu.edu/copp/morrison/public/FightBackEvaluation.pdf.

Adult School Crossing Guards

Well-trained adult school crossing guards can play a key role in promoting safe driver and pedestrian behaviors at crosswalks near schools. They help children cross the street safely and remind drivers of the presence of pedestrians. A guard helps children develop the skills to cross streets safely at all times. Adult school crossing guards can be parent volunteers, school staff or paid personnel. Annual classroom and field training for adult school crossing guards as well as special uniforms or equipment to increase visibility are recommended, and in some locations required. For more information, visit http://www.saferoutesinfo.org/guide/crossing_guard/index.cfm.

Trained adult school crossing guards play a key role in promoting safe driver and pedestrian behaviors near schools.

Safe Routes to School Programs

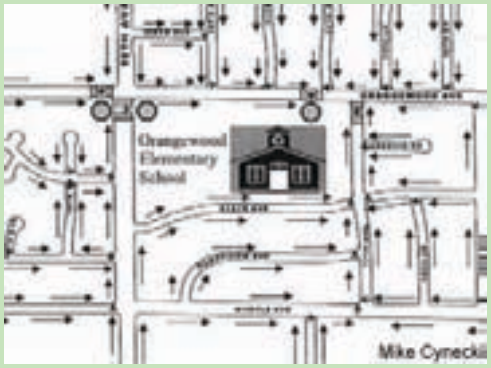
Safe Routes to School (SRTS) is a national program teaching education, enforcement, engineering, and encouragement strategies for communities to make walking to school safe and more widespread. The main goal for SRTS enforcement strategies is to deter unsafe behaviors of drivers, pedestrians, and bicyclists, and to encourage all road users to obey traffic laws and share the road safely. Enforcement used alone will not likely have a long-term effect. Communities must utilize a combination of strategies to address the specific needs of their schools and achieve long-term results.

To learn more about Safe Routes to School, go to http://www.saferoutesinfo.org. FHWA program guidance for Safe Routes to School is available at http://safety.fhwa.dot.gov/saferoutes/srtsguidance.htm.

Developing Safe Route to School Walking Route Maps

Phoenix, AZ

Phoenix, like many other communities, is working with school officials and parents to develop walking route maps to provide young students guidance on routes to walk to and from school. The intent of the program is not only to make the school trip safer by identifying the safest routes, but it also involves a comprehensive review of the walking routes by school officials and parents to identify problem areas. The walking route plan helps to identify where improvements are needed and where to place crosswalks, STOP signs and adult school crossing guards. The ultimate purpose of the walking routes is to encourage more children to walk to school and discourage parents from driving their children to school.



The school provides the walking attendance boundary map and parent volunteers to work on reviewing and developing the walking routes. The city provides aerial photographs, quarter-section maps and guidelines for parents and school officials on how to conduct their reviews. The process requires parent volunteers or school officials to review the entire walking route and to identify the most desirable walking route to serve each household within the walking attendance boundary. This exercise may also involve a revision of the walking attendance boundary if safe routes can be identified or created to serve more students.

Once the walking route maps are completed, traffic officials review the areas of concern and work with school officials to assure that the right number and placement of adult school crossing guards exists. The city provides final versions of the maps and maintains the computer files for the walking routes. It is the responsibility of the school officials to distribute the walking route plans to the parents at the start of the school year and when new students are enrolled at the school. School walking route maps are reviewed annually to identify if there are any changes to or within the school walking attendance boundary.

Although SRTS programs vary among communities, they often include exercises to map out the best ways to walk to school and implement strategies to encourage more walking. These plans can relate to enforcement and help identify where crossing guards or police enforcement can significantly reduce crash risk.

Safe walking routes can also be developed to help other groups, such as senior citizens, identify routes to walk to nearby stores and medical centers. Developing the route maps can help target problem areas for improvements.

Recommended Law Enforcement Approach

Effective law enforcement has four basic steps:

1. Notify the community. An effective program will seek to notify all community members that a strong traffic law enforcement program is beginning.

2. Use public awareness and education first. Public awareness and education is effective when applied prior to law enforcement activities. The awareness and education messages should inform people of the problem and why enforcement action is needed. This will generate public support and help offset complaints from those who are caught breaking the law. The public then needs to know what the enforcement activities will be and when they will start, as tickets are more likely to hold up in court when this groundwork has been done. Mass mailing and media campaigns using local television stations, radio and newspapers may help spread the message. Radio 'traffic watch' programs are an excellent way to spread the traffic safety message. Portable speed limit signs and speed reader boards are effective tools for providing real time speed information to drivers. For some drivers, raising that awareness may be enough to cause them to alter their behavior.

3. Provide officer training. Officer training is critical to an effective law enforcement program. The training should occur prior to the start of an enforcement program and include information on why, what, when, where and how law enforcement should occur to maximize behavior change, and to reduce the number of crashes involving pedestrians. Existing laws that impact pedestrian safety should be reviewed and discussed. For example, the officers need to know the definition of crosswalks includes unmarked crosswalks and they need to know pedestrian and motorist rights and responsibilities in crosswalks.

Officer training is critical to an effective law enforcement program.

4. Follow up. Enforcement activities, regardless of the specific method used, require follow-up to maintain their effectiveness. To measure the impact of an enforcement activity in a specific situation, make a quick study before and after the enforcement effort. Before-and-after studies do not have to be elaborate. They can be as simple as measuring speeds, or observing behaviors at crosswalks and parent drop-off and pick-up zones. Examine the results and decide on the next steps. If the results are positive, the method used was likely effective in improving behavior. If the results indicate little change in unsafe behaviors, perhaps another method should be used. Even with initial success, communities will need to repeat enforcement efforts periodically in order to sustain improvements in drivers' behaviors.

Law Enforcement Methods

Law enforcement can use a variety of methods that utilize technology and personnel to raise awareness and educate motorists about driving behaviors and their relationship to safety. A variety of law enforcement methods can help change unsafe behaviors, making walking safer and more attractive.

Speed trailers may be temporary or permanent devices to help monitor the speed of vehicles, especially inside neighborhoods.

Active speed monitors are permanent devices to keep drivers aware of their speeds and the need to slow down.

Traffic Complaint Hot Line

Agencies can establish a central hot line phone number or Web site address for citizen traffic complaints. This allows police to coordinate their responses and concentrate on areas where there are numerous complaints. Traffic complaints are often associated with pedestrian crossings and other violations relating to pedestrian safety such as speeding. Where traffic complaint hot lines have been established, most of the calls are about traffic problems at or near schools. It is important for police to follow up with the complainant on the enforcement action and citations written. The complainants need to be told to provide information on the time of day and day of week when the violations are most prevalent to allow the police to better focus their resources. The police must then analyze the complaint to determine if it is truly the problem or merely a symptom of an underlying cause.

Radar Speed Trailers and Active Speed Monitors

Fixed motorist feedback signs or movable radar speed trailers can be used as part of a community education and enforcement program. The more effective units have bright strobe lights that will flash like a photo-enforcement camera or display red and blue flashing lights when motorists exceed a preset speed. Radar trailers are moved to different locations and are occasionally supplemented with motor officer enforcement. Some radar speed trailers can record speed data and traffic counts by 15-minute or hourly intervals throughout the day. This is useful information to compare to speeds prior to and following trailer placement. Radar speed trailers have limited long-term effectiveness if left in place. If moved around on a somewhat random schedule and augmented by ticketing, they can have long-term benefits. They can also be useful in educating people and helping to boost support for other long-term solutions.

Active speed monitors are permanent devices to keep drivers aware of their speeds and the need to slow down. They are typically mounted in conjunction with a speed limit sign and visually display drivers' real-time speeds as they pass. Drivers see

how fast they are actually driving compared to the posted speed limit. Some active speed monitors are solar-powered.

Progressive Ticketing

Progressive ticketing is a method for introducing ticketing through a three-staged process. Issuing tickets is the most severe strategy of an enforcement program. It is usually reserved for changing unsafe behaviors that other strategies failed to change or that pose a real threat to the safety of pedestrians and drivers. However, some communities actively advertise that the police will cite drivers for the more egregious violations, such as motorists speeding more than 20 mph over the posted speed limit.

There are three main steps of an effective progressive ticketing program:

1. Educate—Establish community awareness of the problem. The public needs to understand that drivers are speeding and the consequences of this speeding for people's safety. Raising awareness about the problem will change some behaviors and create public support for, or at least understanding of, the enforcement efforts to follow. The start of a safety campaign can be done as a part of a press conference.

2. Warn—When violations are observed, give motorists written warnings instead of citations. This allows police to stop motorists for lesser violations. This educational stop allows the officers to hand out safety literature that indicates what harm is caused by excessive speed and the stopping distances required by higher speeds. Motorists are often relieved that the officer did not give them a citation and may heed the warning. There are times during the warning period when some discretionary citations will be given for the more flagrant violations.

   Beginning a ticketing program with education and warnings provides time to build support for the program as well as time for offenders to change behaviors. Issuing warnings allows police to contact up to 20 times more non-compliant drivers than does ticketing. In addition, the high frequency of stops ensures not only that many people directly make contact with law enforcement, but also that many others witness these stops and are prompted to start to obey the rules.

Begin a ticketing program with education and warnings.

Law enforcers participate in pedestrian decoy operations.

3. Ticket—Finally, after the warning time expires and offenders continue their unsafe behaviors, officers should issue tickets. Ticketing also gives the program credibility by showing that law enforcement is doing exactly what they said they would do if unsafe behavior did not change. Unfortunately, for some people receiving a ticket and experiencing the consequences is necessary, with the hopes of encouraging them to become safer drivers.

Pedestrian Decoy Operations

Pedestrian decoy operations are carefully designed and thoroughly coordinated activities to warn motorists that the yield-to-pedestrian laws will be enforced at target locations. Officers prepare a site ahead of time by establishing the safe stopping distance to a crosswalk, with a 16 km/h (10 mi/h) over the speed limit leeway. Cones are set out in that location. An officer in plain clothes steps into the crosswalk just before a vehicle

Heed the Speed safety campaigns have proven to be effective in reducing motorists' speeds in neighborhoods. The campaign in the above two photos included adding visual illusion speed humps to the pavement to encourage slower driving speeds.

Heed the Speed

Nationwide

The Heed the Speed neighborhood safety program is a combined education and enforcement neighborhood safety program that has been evaluated by NHTSA. The traffic safety campaign is conducted with active neighborhood participation using a public information campaign and a short (i.e., three month), intensive police enforcement campaign. Warnings are given out at first, followed by citations by the end of the three-month period. The education component involves community meetings to get the word out about the consequences to pedestrians and motorists of speeding and how it affects insurance rates. Residents are asked to voluntarily comply with the speed limits. Safety articles are written in community newsletters and local newspapers about the dangers and consequences of speeding. Nearby high schools and car dealerships are contacted with the same information. Residents are provided with yard signs with the HEED THE SPEED safety message. Radar speed trailers and radar speed training of new officers in these neighborhoods help to provide a high level of police visibility. The program is repeated at intervals when speeds increase. Machine speed studies can be used to record and monitor speed results.

passes the cone. This gives the motorist plenty of time to yield to the pedestrian. If the motorist doesn't yield, either a warning or a citation is given to the driver, based on the severity of the incident. The most effective campaigns have been accompanied by an extensive media blitz ahead of time. All the interactions can be recorded on video so if motorists dispute a ticket, their behavior can be viewed by the courts. This usually leads to a guilty plea. These campaigns have proven to be very popular, as pedestrians are happy to see enforcement oriented at motorists, who often act aggressively towards pedestrians. The use of law enforcement officers as decoy pedestrians provides the officer with first-hand experience as a pedestrian at a difficult and busy crossing.

A van equipped with photo enforcement technology can be used at several locations where speeding threatens pedestrian safety.

Photo Enforcement

Automated photo speed enforcement (photo radar) and red light enforcement take a real-time photo of traffic to record vehicle speeds and behaviors. It can be used to document speeders and those who drive dangerously through crosswalks. In several evaluations, the presence of photo enforcement at intersections has resulted in fewer drivers running red lights and a decline in speeds and collisions. The mere presence or threat of photo speed enforcement may result in better driver compliance and behavior.

Automated photo speed enforcement is just one of many tools law enforcement has to influence driver behavior and reduce vehicle speed. Laws on the use of photo enforcement vary from state to state, and some states currently do not allow this type of enforcement. Photo radar systems typically operate on set speed thresholds, (e.g., 11 mph or more over the posted speed limit) only capturing images of motor vehicles moving at or above the established threshold. When a violation occurs, the system captures speed data, as well as images of the motor vehicle (and in some systems the driver) at the time of the violation. Citations are typically issued through the mail to the registered owner of the vehicle after a review of the vehicle and registration information is completed.

Photo enforcement technology does not replace traditional methods of traffic enforcement. Rather, it serves as a supplement to traditional traffic enforcement techniques, in addition to education and engineering efforts designed to enhance traffic safety.

Communities wishing to apply this technology to their traffic safety efforts should consult with local courts, prosecuting au-

For more research and information on photo enforcement, see:

Case Study 67, Red Light Camera Enforcement, Boulder Colorado. In PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, September, 2004. FHWA-SA-04-003 U.S. Department of Transportation Federal Highway Administration. Available online at www.walkinginfo.org/pedsafe/case_studies2.cfm?op=L&subop=I&state_name=Colorado.

Case Study 68, Red Light Photo Enforcement, West Hollywood, California. In PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, September, 2004. FHWA-SA-04-003 U.S. Department of Transportation Federal Highway Administration. Available online at www.walkinginfo.org/pedsafe/case_studies2.cfm?op=L&subop=I&state_name=California.

Pedestrian Decoy Operation

City of Miami Beach

Van Houten and Malenfant (2004) conducted a study of driver yielding behavior at four crosswalks in each of two—an east and west—high crash corridors in the City of Miami Beach. Police teams were situated at eight selected crosswalks. Each team included a decoy pedestrian who crossed the street when other pedestrians were not present, and a spotter who radioed failure to yield violations to other officers who flagged the violators and gave them a verbal warning (or citation) and an enforcement flyer.

"Decoy" Pedestrian Crossing the Street in Enforcement Operation.

Enforcement Operations in Miami-Dade.

The police stopped 1,562 motorists for failing to yield to pedestrians over the period of a year, with 1,218 of these stopped during the first two weeks of the program (Van Houten and Malenfant, 2004). Three hundred seven citations were issued, of which 188 were given during the first eight weeks of the program. At baseline, 3.3 percent and 18.2 percent of the drivers yielded to pedestrians in the west and east corridors respectfully. The introduction of the enforcement program at the four sites in the west corridor led to an increase in yielding to 27.6 percent during the first week of the program while no increase in yielding occurred at the untreated east corridor. The introduction of the enforcement operations in the east corridor led to an increase in yielding to 28.8 percent in this corridor, while increased yielding was maintained in the west corridor. Monthly follow-up data indicated that the gains produced by the program were maintained in the absence of high levels of police enforcement with overall yielding rates of 27.8 percent in the west corridor and 34.1 percent in the east corridor during the follow-up data collection (Van Houten and Malenfant, 2004).

Additionally, police officers in Miami Beach and Miami Springs received training on pedestrian safety and enforcement activities that have been used to address a variety of violations and behaviors that often lead to collisions between pedestrians and motor vehicles (Zegeer et al, 2007).

thorities, law enforcement and community groups in the planning and development of their photo enforcement programs. Some states may not allow photo enforcement in general, but may permit it in school zones. Also, in some locations where photo enforcement is not permitted, citizen advocates can petition their legislators to permit its use. Photo enforcement provides communities with a highly flexible tool that can be deployed when and where it is needed for maximum effect. Most systems also capture data on traffic flow and average speeds, enabling communities to measure the effectiveness of the deployments in relation to crash data for the area.

A permanent, fixed photo speed enforcement camera in a neighborhood will almost never be financially viable, but a mobile photo speed unit that can be carried in vans provides a feasible alternative. Such mobile units can provide excellent citywide coverage for problem areas. In these cases, a vendor can operate the equipment, but a police officer must review the photos and approve the citations before they are issued. The implementation of any photo enforcement program should be carefully planned, have reasonable and attainable expectations, and include public input and political support. It should also emphasize the safety benefits rather than the monetary benefits, as the public may be against these devices if raising revenue is emphasized. Alerting the public to the photo speed enforcement effort before it begins is critical to avoid negative publicity. Visible warning signs should be placed in advance of the camera location before the effort begins so drivers will understand what will happen. An effective photo enforcement program will allow for the continuous two-way exchange of information with the community and have the flexibility to meet changing traffic safety issues and concerns.

Double Fines in School Zones and Other Special Interest Areas

Strict enforcement of speed laws in school zones and other locations where pedestrian traffic is high, or crash data suggests that speeding may be a factor in pedestrian crashes, can improve the safety for pedestrians and drivers. Along with school zones, senior centers, park and recreation facilities, college campuses, hospitals and shopping areas are some of the locations that may warrant special attention by law enforcement officials to discourage speeding and encourage proper behavior for yielding to pedestrians who are crossing roadways. A zero tolerance policy for speeders in these special areas, and even an increase in fines for drivers who violate the posted speed limit, are potential approaches.

Double Fines in School Zones

State of Washington

In 1997, Washington State enacted legislation that doubled the basic fine for drivers speeding in a school zone. This fine cannot be waived, suspended or reduced. One-half of the revenue generated is directed into an account managed by the State's Governor's Highway Safety Office (the Washington Traffic Safety Commission), which is designed to enhance safety in school zones and student transportation. The legislation allows $1.5 million to be spent per biennium, with $1 million for law enforcement and $500,000 for public education. Funds for law enforcement are available to agencies through an application process. These funds can be used to purchase equipment—such as radars, computers, patrol cars or motorcycles—that improves safety in school zones or student transportation. The public education funds make it possible to produce and disseminate products, such as public service announcements, radio and bus ads, and crossing guard equipment. The funds have also been used to provide mini-grants to support International Walk to School Day celebrations around the state and have paid for the creation and distribution of the School Administrator's Guide to Pedestrian Safety and the School Safety Resource Kit.

Through proactive enforcement, where law enforcement officers are focusing on school zone safety, communities have seen reductions in collisions in school zones. For example, collision rates in school zones have declined by 23 percent in Bremerton, Washington, and by 13 percent in Tumwater, Washington.

Defining the 3 E's: Engineering, Education, and Enforcement. Sometimes other groups like to add other E's as well: Encouragement, Emergency Services, Evaluation.

Building Partnerships and Coordination with Other E's

Developing and implementing a successful education or enforcement program cannot be achieved by any one organization or agency—it takes a team effort. The benefits of effective partnerships and collaboration include:

- Strength in numbers.
- Additional resources, expertise, and funding.
- Well-coordinated and more efficient use of resources.
- Better anticipation of program obstacles and potential solutions.

Identifying all interested or potentially affected parties will help ensure success. A successful partnership will include:

- Policy and decision makers.
- Engineers and transportation planners.
- Educators (including teachers, principles, school board

members etc.).
- Law enforcement officers and judges.
- Advocates and community representatives.
- Health and safety professionals.
- Transit officials.
- Media.

Some strategies for building effective partnerships include:

- Understand the issues and the purpose of the partnership.
- Seek to interest agencies and encourage cooperation.
- Establish agreed-upon, long-term goals, strategies, and responsibilities.
- Create achievable short-term goals to show progress and early successes.

More information on building partnerships and working with stakeholders is provided in Chapter 2.

Media's Role in Education and Enforcement

All the components of a good education and enforcement program—creating awareness, alerting the public, and enforcing safe practices—benefit from media coverage. For enforcement events, the goal is to garner substantial media attention and edu-

Building Partnerships
Portland, Oregon

At the Oregon Department of Transportation in Portland, OR, a forward-thinking manager brought together a diverse coalition of community groups to form a Community and School Traffic Safety Partnership. Included in the partnership are school boards, neighborhood associations, businesses, nonprofits, elder advocacy groups, insurance providers, enforcement agencies, and bike and pedestrian advocacy groups. The coalition implements a wide variety of programs with success, such as an interactive half hour sidewalk pedestrian presentation. Another innovative program is the crosswalk enforcement action, where the ODOT partners with police enforcement to pull over anyone violating a monitored intersection for half an hour, during which a representative acts as a pedestrian repeatedly crossing the road. Both drivers and pedestrians are stopped and given an informational pamphlet and, in certain cases, a citation. This active enforcement action is performed wherever requested by a community.

The partnered organizations play an active role in the program as well. For example, various senior centers work closely with representatives from the ODOT to address problem areas and to develop localized pedestrian maps for use by members and residents. The maps show all points of interest including transit stops, benches, water fountains, curb cuts, and more, and designate a prioritized route to frequent destinations. Suggestions for revision are solicited from residents themselves, a bilingual explanation of signals is included, and the maps are distributed at the senior center and by local Meals on Wheels partners. For more information, contact Sharon White at (503) 823-7100.

cate the public to change behavior, not issue numerous tickets. If 10 motorists receive tickets and 100,000 people hear about it, the enforcement effort will have a more significant impact than if officers issue 100 tickets and only the recipients know what happened. The key to a successful campaign is to provide information before the education or enforcement event occurs to encourage community support and facilitate positive coverage. Without such prior notification, motorists may claim to be caught by surprise, which can lead to negative publicity.

Informed members of communities can talk to media to raise awareness of pedestrian safety issues.

There are many ways to involve the media. For example:

- Neighborhood groups or community leaders can hold a press conference to talk about pedestrian safety and tell the public that they are requesting more enforcement or are implementing an education campaign.
- Organizers can provide the press with packets of information about walking and safety statistics. Press packets can include frequently asked questions to help a reporter ask the right questions in an interview.
- Informed members of the community can be available to talk to the media. A child who is well-versed in the pedestrian problems in the neighborhood can provide an important perspective. Hearing a child explain how difficult it is to cross a street will have a bigger impact than reading a statistic. Properly educated police and elected officials can also deliver a powerful message.

The entire community can be made aware of the pedestrian safety program in a variety of ways to ensure they know what will happen before the program begins in force. Event organizers can:

- Publish an article in the local newspaper or in a neighborhood newsletter.
- Send an e-mail to residents.
- Put up speed reader boards so drivers see for themselves what their speeds are compared to posted speeds.
- Post information signs near where the enforcement or education effort will occur.
- Post yard signs in their front yards to get the message out.
- Participate in media events and community safety fairs.

In ethnically diverse communities, providing safety messages to the public in various languages and with culturally-relevant messages will be critical for the success of the effort. Some safety out-reach efforts may require bilingual staff to provide the safety message to all targeted groups.

Finding Funding and Support

Successful education and enforcement programs need long-term funding and support. This can be through local or regional agency budgets, support and contributions provided by local businesses or other stakeholders and partners (such as area hospitals or advocacy groups like Safe Kids), or state and federal grants. Chapter 6 and Appendix D provide information on funding strategies and sources for pedestrian projects.

Comprehensive Pedestrian Safety Program
Burlington, Vermont

The Burlington Department of Public Works launched an annual pedestrian safety campaign in the summer of 2006, based on materials in FHWA's Pedestrian Safety Toolkit. The campaign included engineering, education, and enforcement components.

For the engineering component, the town worked to develop a multi-modal transportation improvement plan; improve pedestrian access to transit and to the waterfront; and facilitate the development of pedestrian improvements to Cliff Street and other locations. On the enforcement side, the department worked with the Mayor and the Police Department to distribute educational materials to violators, with specific information targeted at motorists, cyclists, pedestrians. Extra enforcement in the downtown area focused on bicycle- and pedestrian-related violations. For the education component, public service announcements were broadcast over radio and television and displayed on safety slides at the downtown cinema. The Department of Public Works collaborated with the Mayor, Police Department, and local advocacy organizations to develop press releases and hold press conferences highlighting safety initiatives, using the media to spread the message. Additionally, safety coupons were designed and distributed for discounts on retro-reflective clothing and other safety products. For more information visit: http://www.dpw.ci.burlington.vt.us/transportation/bikewalk/safety/.

Example FHWA safety campaign materials are available online at http://safety.fhwa.dot.gov/local_program/pedcampaign/index.htm.

Comprehensive Pedestrian Safety Programs

Hamilton Township, New Jersey

From 1998 to 2004, Hamilton Township experienced 23 pedestrian crashes and 6 deaths along the same corridor. At the end of 2004, the Township began a concerted safety campaign involving education, engineering, and enforcement solutions.

Several low cost measures were taken immediately, including fencing along the highway medians, temporary message signs to pedestrians and drivers, improved intersection markings, countdown signals, and revised intersection timing. Longer-term solutions were also planned, including median barriers, sidewalks, and pedestrian overpasses. To educate the public, flyers were distributed at intersections and to pedestrians crossing at unsafe and unauthorized locations. Presentations were given at schools and community centers in addition to radio and television messages. Additionally, the city undertook an aggressive enforcement effort, issuing summonses to jaywalkers rather than warnings. The Police Department increased traffic enforcement along the route by 600 percent and established a traffic safety coordinator. The New Jersey Division of Highway Safety helped establish funds for the creation of a Traffic Safety Unit dedicated to pedestrian and other traffic safety concerns.

From 2005 to 2006, there were two pedestrian crashes, as compared with 10 in 2004 alone. For more information, contact Chief of Police, Jay McKeen at: jmckeen@townshipofhamilton.com.

Measuring Program Effectiveness

Measuring program effectiveness is important to:

- Show an outcome that demonstrates that the program met or exceeded the objectives.
- Help determine if the program needs to be adjusted or changed.
- Document and justify the need for continued funding or program expansion.
- Provide guidance for other communities looking to implement a similar program.

Program measures must relate to the objectives established for the program, and should include observable phenomena—things that can be seen and quantified. Outcomes to be measured could include:

- Number of crashes, injuries, and fatalities.
- Behaviors of pedestrians (such as looking, crossing, and yielding), and drivers (such as speeding and yielding).
- Citations issued/enforcement hours.
- Number of people walking.
- Knowledge, opinions, and attitudes.
- Changes in organizational activity/procedures.

Pedestrian Safety Demonstration

Miami-Dade County, Florida

A multidisciplinary team took part in a long-term effort to educate drivers and pedestrians, and enforce laws in high-crash locations and zones in Miami-Dade County, Florida. Using pedestrian crash data from 1996-2001, four zones were identified as having abnormally high pedestrian crash experiences. Based on locational crash characteristics, as well as pedestrian (age, ethnicity) factors, a total of 16 different types of education, enforcement, and engineering treatments were selected and targeted to reduce pedestrian crashes.

Education strategies included interactive programs, workshops, and events; brochures, videos, and posters in several languages (including Spanish and Creole), and giveaways. The education programs were targeted at specific audiences (e.g., children walking to school, older pedestrians, etc.), and materials and communication strategies were tailored to those groups. For more information on the education program targeting children, visit www.walksafe.us. The enforcement effort involved conducting officer training in pedestrian safety enforcement at the City of Miami Beach Police Department. This enforcement program complemented other countermeasures in South Beach that were implemented during the Miami-Dade Demonstration project. It also included a Driver Yielding Program that targeted drivers at crosswalks to try to increase awareness and yielding behaviors. The engineering component involved several studies to identify high pedestrian crash corridors, prioritize locations, and help select countermeasures. Over $6.5M in pedestrian safety projects were programmed or implemented on these corridors as a result.

A before-after study was used with three separate control groups to evaluate the effects of the combined pedestrian safety program on pedestrian crashes. A three-year "after" period was used (2002-2004). Multivariate intervention auto-regressive integrated moving average (ARIMA) time series analysis was used, along with non-parametric (i.e., Mann-Whitney) U-tests to test for statistically significant differences in pedestrian crash experiences. Results showed that the pedestrian safety program reduced Countywide pedestrian crash rates by between 8.5 percent and 13.3 percent, depending on which control group was used. This effect translated to approximately 180 fewer crashes each year in Miami-Dade County for the first two years (2003 and 2004) after the study period ended. The greatest reductions were found in pedestrian crashes among children, where there was a 32 percent reduction in child pedestrian crashes in the four zones, and a 22 percent reduction Countywide. Educational and other measures to reduce crashes involving older pedestrians showed no effect. A number of lessons learned were identified for future implementation of such a program by other jurisdictions.

For more information, contact Charlie Zegeer at zegeer@claire.hsrc.unc.edu or 919-962-7801.

Having good plans and policies in place to support walking enables safer streets for pedestrians.

Designing streets with pedestrians in mind can result in streets that are pedestrian-friendly with lower vehicle speeds (bottom photo) rather than higher-speed auto-oriented (top photo) designs.

For more information about pedestrian-friendly site design, see Georgia's "Site Design for Pedestrians" Toolkit at http://www.dot.state.ga.us/DOT/plan-prog/planning/projects/bicycle/ped_facilities_guide/10_site_design_for_pedestrians.pdf. Other site design resources can be found in Appendix G.

How and when a program/project is evaluated is determined by the objectives and activities of the project. It is easier to measure the success of a program if decisions are made about what to measure and how/when to evaluate it before implementing the program. Appendix E provides guidance on evaluating pedestrian safety plans; much of this information can be applied to evaluating pedestrian education or enforcement programs.

Comprehensive Approaches

Successful approaches to improve pedestrian safety usually involve a comprehensive program that includes elements of engineering, planning, education, and enforcement measures. The sidebars on pages 107 through 109 show some examples.

Policy and Planning Solutions

Over and beyond incorporating features designed specifically to improve pedestrian safety, there are many aspects of general street design that result in safer conditions for pedestrians:

General Street Design

1. Speed control—For many pedestrian crashes, speed is an important factor; high speeds reduce the possibility of crash avoidance, and increase the likelihood of a severe injury or fatality. Cities that have made concerted efforts to reduce pedestrian crashes use speed reduction as a primary tool. Speed reduction must be a matter of both policy (by setting lower speed limits) and design. However, simply lowering speed limits on streets where motorists can go fast is usually ineffective. Streets must be redesigned to encourage lower speeds.

2. Traffic Calming—Local agencies often develop plans and polices for using a variety of traffic calming measures for reducing pedestrian and/or other crash types on local and neighborhood streets. Such measures include, speed tables, traffic circles, speed humps, chokers, and chicanes, to break up long straight stretches of straight streets and to reduce vehicle speeds and/or reduce cut-through motor vehicle traffic.

3. Residential Street Design—Many residential streets built in the last few decades have been built too wide and without interruptions for long distances, encouraging higher speeds than appropriate for streets where children are frequently expected. Most small children who are involved in a crash

are hit within a block of their homes. Features of residential streets that are safe for pedestrians include narrow width, on-street parking, tight curb radii, short block length, buffered sidewalks with street trees, short building setbacks, and streetlights.

Land Use and Site Design

Land use patterns can have an impact on pedestrian crashes. Many pedestrian crashes occur in suburban, auto-oriented locations. One reason is motorists simply do not expect pedestrians on some streets, but are much more highly aware of their presence on streets where pedestrian use is high. Other reasons include higher driving speeds in suburban areas and possibly diminished motorist reaction times or their willingness to slow and yield to crossing pedestrians. The following land use and site design techniques can help manage speed and therefore lower crash rates:

1. Buildings that define streets—Buildings located at the back of the sidewalk give the motorist sense of enclosure; buildings set far back, with large parking lots in front, create the illusion of a wide road which encourages higher speeds and discourages walking.

2. Mixed-use development—Buildings with retail on the bottom, housing on the top encourage pedestrian activity. This includes parking garages, office buildings and fast food restaurants.

3. Street connectivity—Lack of street-connectivity and pedestrian connections discourages walking because of the added travel distance to reach destinations. Long super blocks also reduce pedestrian crossing opportunities; midblock crossings should be provided about every 91 m (300 ft)—the length of a typical urban block.

4. Curb/Parking Management—Curb management practices (such as painted curbs) can be used to regulate parking. Parking should not be placed between the sidewalk and a building, as stated previously. The principles of access management should be extended to parking: single lots serving multiple stores are preferred over single stores each with its own parking and driveway.

These site design practices need to be incorporated in city codes for future development. Also, many retail outlets such as fast food restaurants are remodeled or rebuilt about every ten years,

Land Use Policies
State of Pennsylvania

New land use policies will help remedy future developments but will not solve the immediate problems in urban and suburban areas, where existing land uses do not accommodate—much less encourage—walking or bicycling. Therefore, the Pennsylvania Statewide Bicycle and Pedestrian Master Plan includes a section on retrofitting existing land uses to serve pedestrians. It provides guidance on downtown redevelopment, "pedestrianizing" existing retail/office developments, and retrofitting suburban residential neighborhoods, including recommendations such as:

- Maximize pedestrian transit access to the site from adjacent land uses.
- Improve the layout of buildings and parking lots.
- Bring destinations closer to home.
- Encourage denser development or redevelopment.
- Provide sidewalks and street trees.
- Reduce the speed of automobile traffic.
- Provide off-road internal pathway systems.
- Provide "pocket" parks and community green space.

For more information, visit: http://www.dot.state.pa.us.

Curb management (such as painted curbs to keep cars away from the marked crosswalk) would help this pedestrian to better see cars approaching the intersection. In this case, a curb extension would also help the pedestrian to better see cars approaching the crossing.

which may present opportunities to implement new site design requirements to retrofit existing facilities, such as installing sidewalks with a planting strip.

Countermeasures to be Used with Caution

Concerned citizens and elected officials often respond to a tragic pedestrian crash with a call for an immediate solution. Among the most commonly requested solutions are a traffic signal, a flasher, a pedestrian bridge or underpass, or a marked crosswalk. While these all can be an effective solution in certain places, in some instances they are not appropriate or effective.

Traffic Signals

The primary purpose of a traffic signal is to create gaps in motor vehicle traffic that otherwise would be hard to find. The MUTCD warns against the overuse of signals for a variety of reasons. Used inappropriately, traffic signals may increase crashes. See MUTCD Chapter 4 for information on signal warrants (http://mutcd.fhwa.dot.gov/pdfs/2003/Ch4.pdf).

Traffic signals can range from $35,000 to $300,000 for one intersection, if no associated road widening is necessary. Furthermore, resources are needed for annual maintenance of the signal.

In many cases, the only solution to crossing a busy, multilane arterial street is to install a pedestrian crossing signal. This is especially true in locations where there is not another signal for 0.4 km (0.25 mi) or more in an area with lots of pedestrian activity.

Traffic signal installations may be the only solution to enable pedestrians to cross some busy, multilane streets. However, signals do not solve all pedestrian crossing problems and should be used with caution.

Traffic signals (with pedestrian displays) are one possible option to be considered in helping to get pedestrians safely across busy streets. Adding a traffic signal, however, does not guarantee safety for a pedestrian, since some motorists run red lights and some turning motorists fail to yield to a pedestrian in a crosswalk during the WALK interval; also, some pedestrians will cross against the traffic signals.

Pedestrian Bridge or Underpass

A popular but often ineffective countermeasure is to install a pedestrian bridge or underpass. These solutions are appealing because they give the impression of complete separation of pedestrians from motor vehicle traffic. In theory this is true, but in practice this rarely occurs for several reasons:

- Bridges and underpasses are so expensive, they cannot be provided at most locations where pedestrians may want to cross.
- Underpasses are often prone to security concerns due to low visibility.
- The inconvenience of out-of-distance travel is high, up to 305 m (1,000 ft) or more, because of the need to provide accessible ramps; many pedestrians will not walk this extra distance and cross at-grade.
- To be effective, there has to be a self-enforcing feature that requires the pedestrian to use the bridge, such as topography, or fencing along one side of the street or in the median for several hundred feet on either side of the grade-separated crossing.

These reasons explain why pedestrian bridges or underpasses are under-used, and motorists are frustrated when they see pedestrians crossing in the vicinity of an bridge or underpass; this in turn increases the risk to pedestrians crossing at grade.

The high cost of a pedestrian bridge or underpass (from several hundred thousand to several million dollars) makes them impractical for all but a few locations. Many pedestrian crossing islands with illumination can be provided for the cost of one bridge; along a corridor with multiple crossing points, the crossing islands are a more effective use of resources.

Marked Crosswalks without Additional Treatments

Marked crosswalks tell the pedestrian where to cross. For example, where sight distance is compromised, it may be desirable to direct the pedestrian to the location where the site distance is best. Marked crosswalks also tell the motorist to expect pedestrians at a particular location, but motorists on higher-speed streets frequently cannot see them until it is too late to stop. Without other safety features mentioned thus far (islands, curb extensions, illumination etc.), marked crosswalks on their own do not necessarily increase the security of a pedestrian crossing the street. Zegeer et al. (2005) have completed an exhaustive study on the effectiveness of marked crosswalks, which can be downloaded at http://www.walkinginfo.org/rd/devices.htm#cros1. In general, the following principles apply to the installation of marked crosswalks alone (i.e., without other substantial pedestrian treatments):

- On two-lane streets, a crosswalk can be marked without compromising pedestrian safety.
- On multilane streets with an average daily traffic (ADT)

Pedestrian bridges should be convenient for pedestrians (see top photo); otherwise they will not be used (as in bottom photo).

The underpass in the top photo is not well-lit or secure. Underpasses should be designed so that they are safe for pedestrians to use (see better example in bottom photo).

Summary of Marked Crosswalk Study (Zegeer et al., 2005)

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT < 9,000			Vehicle ADT >9000 to 12,000			Vehicle ADT >12,000 - 15,000			Vehicle ADT > 15,000		
	Speed Limit**											
	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h
2 Lanes	C	C	P	C	C	P	C	C	N	C	P	N
3 Lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multi-Lane (4 or More Lanes) With Raised Median***	C	C	P	C	P	N	P	P	N	N	N	N
Multi-Lane (4 or More Lanes) Without Raised Median	C	P	N	P	P	N	N	N	N	N	N	N

C = Candidate site for marked crosswalks.

P = Possible increase in pedestrian crash risk may occur if crosswalk markings are added without other pedestrian facility enhancements.

N = Marked crosswalks alone are insufficient and pedestrian crash risk may increase when providing marked crosswalks alone. Consider using other treatments such as traffic signals with pedestrian signals where warranted or other substantial crossing improvements to increase crossing safety.

of up to 15,000 vehicles per day (VPD) and a median or island, crosswalk can be marked without compromising pedestrian safety.

- On streets with an ADT over 12,000 (or 15,000 with a median) marked crosswalks on their own are not recommended; other, more substantial, measures are needed to provide a safe pedestrian crossing.

At locations where crosswalks alone are not appropriate (e.g., on multilane roads with ADTs above about 12,000), the study recommends consideration of more substantial pedestrian crossing treatments, such as enhanced nighttime lighting, traffic and pedestrian signals (if warranted), among others. Marked crosswalks should be given priority where there is an expectation of regular pedestrian activity such as near a school, park, or other generator.

As stated in the report, "the results of this study should not be misused as justification to do nothing to help pedestrians to safely cross streets. Instead, pedestrian crossing problems and needs should be routinely identified, and appropriate solutions should be selected to improve pedestrian safety and access. Deciding where to mark or not mark a crosswalk is only one consideration in meeting that objective" (Zegeer et al., 2005).

Textured and/or Colored Crosswalks

Textured or colored crosswalks are often requested based on the assumption that they stand out and are more visible by motorists. In many cases, the opposite is true: red or gray pavers are barely visible from afar, and they disappear from sight completely at dusk or at night. Textured crosswalks are difficult for pedestrians in wheelchairs or with walkers or canes; their efforts

when crossing the street should not be impeded. If a community decides to implement colored crosswalks, it is best to color the pavement around a conventional, high-visibility white crosswalk; this way it really does stand out and is smooth.

Assessing the Effects of Treatments on Other Road Users

A safe roadway environment will take into account all modes of travel.

Many pedestrian problems result from auto-oriented designs that didn't take pedestrian safety into account; for example, adding turn lanes at an intersection without considering the effect on pedestrian crossing distance. The same principle applies to pedestrian countermeasures: a solution that benefits pedestrians at one location may have negative effects on other users of the street, intersection, corridor or neighborhood. For example, street diverters to reduce cut-through traffic on a local street may increase turn movements at an intersection at the edge of the neighborhood.

Each solution should be evaluated for unintended negative consequences, or consequences that may need further mitigation. A solution should not be rejected just because it has a negative impact on other users, nor is a benefit/cost analysis needed in every case. A common example is the dilemma associated with placing median pedestrian crossing islands on commercially-developed arterials. The crossing island is typically a safety benefit to the pedestrian, but may restrict left turns into a driveway or side-street. Usually, an island can be designed to aid motorists and pedestrians. At times driveways can be moved or combined to adequately serve the adjacent land uses. In cases where this cannot be done, decision makers have to choose between a higher level of pedestrian safety and accommodating land use access for motorists or look into other alternatives.

Many of the recommended pedestrian safety improvements may also have safety benefits for motor vehicle traffic. Common examples include medians, which have been shown to reduce motor vehicle crashes, traffic calming that slows traffic (slower speeds equate to fewer and less severe crashes), and simplified intersections that are easier for motorists to negotiate, and right turn "pork-chop" islands which make it easier to time traffic signals.

Safety Effects on Other Roadway Users

Bicyclists

Bicyclists should not be negatively impacted by pedestrian treatments. In general, most designs that make roads safer and more

comfortable for pedestrians also benefit cyclists, especially measures that slow traffic, or that narrow or reduce motor vehicle traffic lanes to create more space for other users. But certain countermeasures may impact bicyclists; others are perceived by bicyclists to be dangerous, but in reality they do not have negative impacts based on crashes— sometimes it is a matter of perception.

Pedestrian crash countermeasures that may impact bicyclists negatively include speed bumps (which are typically only allowed in shopping centers), curb extensions that protrude into the bike lane (those more than 1.8 m [6 ft] wide), and street closures with no bicycle access. Countermeasures that should be considered in the context of protecting bicycle safety include on-street parking, narrow lanes, curb extensions, and chicanes.

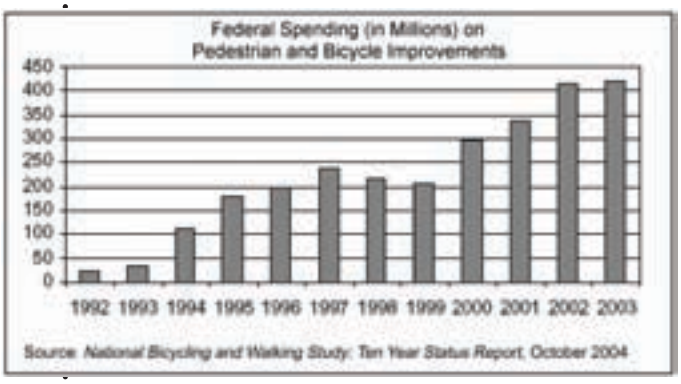
Improvements made for the safety of vulnerable populations (such as clearly defining the pedestrian path) also benefit other roadway users.

Meeting the Safety Needs of All Pedestrians

Safety improvements should meet the needs of all pedestrians to the maximum extent possible. Improvements that benefit young children, older persons, and people with vision, mobility, or hearing impairments also increase the safety of all pedestrians.

Federal (and some state) laws and regulations spell out what must be done to accommodate pedestrians with disabilities. When facilities are provided for pedestrians, they must be accessible for persons with disabilities unless that is not physically feasible.

The most current accessible design requirements can be found at http://www.access-board.gov/. Designing Sidewalks and Trails for Access, Parts 1 and 2, provide the state of the practice for applying the American with Disabilities Act and similar requirements to pedestrian facilities. Find Part one at: http://www.fhwa.dot.gov/environment/bikeped/access-1.htm and Part 2 at: http://www.fhwa.dot.gov/environment/sidewalk2/.



Chapter 6: Providing Funding

Funding is critical to implementation. It can be the enabler for making improvements that reduce crashes, or it can be the barrier that prevents needed improvements from being made. With most state and local governments facing severe budget constraints, allocating funds to address pedestrian safety issues can be a challenge. Nevertheless, some states and urban areas are achieving very low pedestrian crash numbers in spite of limited funding. The challenge is to figure out how these outcomes are being achieved and then apply them to states and communities with high numbers of pedestrian crashes.

Commitment to Safety

Achieving better outcomes always begins with a commitment to safety for all modes. It should be the number one priority of state and local transportation agencies. Once this commitment is made, it allows transportation agencies to allocate funds to reducing all crash types, including pedestrian crashes. Projects that only focus on reducing congestion or motor vehicle crashes may jeopardize the safety of pedestrians and bicyclists.

A simple benefit/cost analysis is an excellent way to justify and increase expenditures on pedestrian improvements. Most of the improvements that reduce pedestrian crashes are relatively inexpensive when compared to efforts to reduce motor vehicle crashes. It costs an agency less, per crash, to reduce pedestrian crashes than motor vehicle crashes. It may not cost the agency anything if it is a policy change or a change in a design standard that leads to fewer pedestrian crashes. For example, almost all Seattle arterial streets are designed to a 48 km/h (30 mi/h) design speed, which is the legal speed limit unless otherwise posted. This is one of the reasons Seattle has one of the lowest pedestrian fatality rates in the nation; Seattle has made a commitment to safety as the number one priority.

“Most of the improvements that reduce pedestrian crashes are relatively inexpensive when compared to efforts to reduce motor vehicle crashes.”

Funding Strategies

The following funding strategies can be applied to finance pedestrian safety improvements:

- Routine accommodation in new projects.
- Partnerships.
- Dedicated funds and set asides.
- Annual maintenance budget.

Routine Accommodation in New Projects

Routinely including pedestrian facilities with other roadway improvement projects is a cost-effective strategy for reducing pedestrian crashes and encouraging more walking. The construction of good pedestrian infrastructure as part of normal public and private development and the adoption of good traffic management practices are known as "routine accommodation." The majority of pedestrian infrastructure is built in conjunction with other projects: pedestrian crossings are built in conjunction with the construction of intersections; pedestrian signals are installed in conjunctions with traffic signals; and most sidewalks in residential neighborhoods are built as part of private, residential housing construction. The same applies to traffic management practices: high visibility crosswalks can be marked after pavement overlays as a matter of standard practice.

Routine accommodation allows for significant improvements over time, even if there is no special funding available for pedestrian safety improvements. Chapter 5 provides a list of standardized traffic management and design practices that will reduce crashes over time. Routine accommodation for new projects does not diminish the importance of immediately addressing high crash locations, corridors, and other targeted areas immediately.

Partnerships

Both public works and many private development projects provide partnership opportunities for making improvements to increase pedestrian safety in addition to what might be accomplished through routine accommodation. For example, opportunities to construct sidewalks can be provided with resurfacing projects; opportunities for placing utilities underground (and thus eliminating obstructions on sidewalks) can be found with other projects. There are opportunities to develop partnerships around the following project types:

Voluntary/No Cost Improvements

Many projects will generate some neighborhood concern or opposition. More often than not, public and private projects include some pedestrian amenities, supported by the neighborhood, to build good will. In other cases, there may be a common benefit. Private developers and other agencies are often willing to make needed pedestrian

safety improvements, as a safer, more accessible development is more attractive to potential tenants or customers.

Required Restoration and Mitigation

Large projects present an opportunity for significant pedestrian improvements. For example, a new development may generate enough traffic to warrant a signal near a school or other pedestrian destination. Utility work next to a roadway or in an abandoned railroad line can provide an opportunity for constructing a sidewalk or pathway.

Combined Improvements

Combined improvements involve grouping smaller projects with an existing funded project. Funding improvements as part of larger projects creates economies of scale. For example, if there is a public works project to construct a concrete roadway, it may be cheaper to add construction of sidewalks on nearby streets instead of building them as a separate project. It may also be advantageous to provide funding for a spot improvement such as a midblock crossing where pedestrians are expected to cross. Not only are costs reduced when two types of work are combined into one project, but other advantages include reduced impact to traffic, residents, and businesses.

Partnership Opportunities: Universities
Chapel Hill, North Carolina

The University of North Carolina at Chapel Hill is centered in the heart of downtown. The University currently maintains an extensive network of sidewalks that are internal to UNC property. In addition, the UNC Department of Transportation and Parking makes periodic recommendations to the Town about UNC off-campus sidewalk needs. These projects do not fall under University jurisdiction but impact pedestrian traffic (mostly UNC students and employees) going to and from the University. Some of these off-campus projects have evolved into "joint projects" financed by both entities.

One such project included an investigation of pedestrian safety risk locations on and around campus performed by the University of North Carolina Chancellor's Pedestrian Safety Committee (UNC Pedestrian Safety Committee), working with the University community, the Town of Chapel Hill, and the North Carolina Department of Transportation. Based on the results of the study, this group was able to improve signage, modify roadways and crosswalks, increase enforcement, and create a long-term plan for pedestrian safety on the 740 acre campus.

For more information, visit: http://townhall.townofchapelhill.org/planning/bikeped/bikepedplan.htm.

Dedicated Funds and Set Asides

Some states, MPOs (Metropolitan Planning Organizations) and local governments have set aside dedicated funds for pedestrian and/or bicycle improvements. Set asides are either a percentage of a larger fund; for example, a percentage of Federal funds (beyond the mandated Federal Enhancement fund) for pedestrian and/or bicycle projects; or set asides with an independent funding source; typical examples include developer funds (funds deposited by developers into a centralized fund or escrow account for future use), resource funds (taxes on extracted natural resources such as gravel or oil), and real estate excise funds.

While dedicated funds and set asides are possible funding sources, they should not be a substitute for routine accommodation. For example, funding for shoulder and sidewalk improvements should be routine practice and not paid for through set aside funds. In general, changing policy to include pedestrian improvements in all programs and projects will produce more funding than set asides.

Annual Maintenance Budget

Existing annual maintenance budgets can be used to make small but important pedestrian improvements. For example, limited budgets for painting marked crosswalks can be focused around schools and high crash locations. Crosswalks can be widened or changed to high-visibility markings when they are scheduled to be repainted. Crosswalk signs scheduled for replacement can be upgraded to the brighter fluorescent yellow-green signs that have been adopted by the MUTCD as an option for pedestrian and bicycle warning signs.

Dedicated Funds

State of Wisconsin

The Wisconsin Department of Transportation currently funds sidewalks and other pedestrian facilities through many different state and Federal programs. Since 1990, WisDOT has included sidewalks in construction projects along a State Trunk Highway (STH) if the local municipality agrees to pay 25 percent of the cost and agrees to accept responsibility for future sidewalk repair, maintenance, and spot replacement. WisDOT will pay the full cost to replace existing sidewalks when they must be replaced due to WisDOT action (i.e. roadway-widening projects that require the removal of sidewalks). WisDOT administers Federal funds for local road projects that are eligible to include sidewalks and other pedestrian facilities. These projects generally require a 20 percent local match while Federal funds cover the remaining 80 percent of expenses. Through General Transportation Aids (GTAs), WisDOT helps fund local sidewalk construction and replacement work as well as all other pedestrian-related work, such as crosswalk painting and crossing signal installation, on a partial reimbursement basis.

Another major source of funding for pedestrian projects is the Statewide Multimodal Improvement Program (SMIP). This includes the following components:

- An enhancement program for local and state highway enhancements.
- A surface transportation program.
- A surface transportation program discretionary (STP-D).
- An urban surface transportation program (STP-U).
- A congestion mitigation and air quality program (CMAQ).
- A hazard elimination program.
- Interstate maintenance.
- National highway system funds.
- A highway bridge replacement and rehabilitation program.
- A transportation and community and system preservation pilot program.

For more information, visit: http://www.dot.wisconsin.gov/projects/state/ped2020.htm.

Revising Funding Selection Criteria

State of New Jersey

In New Jersey's Statewide Bicycle and Pedestrian Master Plan, the section on "Implementing the Plan" includes a list of funding strategies. One such strategy involves working through Metropolitan Planning Organizations to revise Transportation Improvement Program (TIP) project selection criteria to promote bicycle and pedestrian projects and ensure that an adequate percentage of transportation funding is used for pedestrian and bicycle transportation facilities.

Another strategy involves partnering with various agencies: the Office of Travel and Tourism within the NJ Commerce and Economic Growth Commission to provide grants in support of walking tours and events; the NJ Department of Law and Public Safety to make use of NHTSA (Section 402) funds for pedestrian program activities that deal with safety and enforcement; and the NJ Department of Environmental Protection to pursue funding sources for trails to augment existing National Recreational Trails and Green Acres funding.

The plan also states that counties are responsible for routinely funding pedestrian improvements and incorporating incidental improvements into roadway projects. Municipalities are to dedicate funds for independent pedestrian projects and establish funding sources for pedestrian improvements related to roadway projects (land use/recreation fees, general funds, etc.).

For more information, visit: http://www.bikemap.com/RBA/.

Funding Criteria

State and local governments typically use multiple funding sources for transportation projects, from Federal grants to gas taxes to general tax revenues. These sources often have funding criteria that determine what projects are eligible. Funding criteria are reviewed and updated periodically; they can be rewritten to increase funding for pedestrian safety projects. There are two ways these sources can be levied to make pedestrian safety improvements: 1) The funding criteria should give higher scores to projects that include pedestrian safety elements; and 2) The funding criteria should allow for good pedestrian projects (those likely to reduce crashes) to compete for the funding. Some states have constitutional provisions banning the use of gas taxes for anything but highway projects; but the definition of "highway" should include pedestrian facilities such as sidewalks.

Major Funding Sources

Federal funding for pedestrian improvements has increased dramatically in the last 12 or so years. Prior to the 1990s only a few million dollars a year of Federal funds were being invested in bicycle or pedestrian facilities. While the energy crisis of the early 1970s had spawned new interest and some modest government initiatives to make improvements, very little money from the government at any level was invested in bicycle and pedestrian facilities. Likewise, the outdoor recreation industry and business community in general provided very little funding for facilities, planning, programs, or organizational development. Throughout the late 1970s and 1980s, the largest

amounts of funds for bicycling and walking were invested by state and local parks agencies building multi-use trails; however, even these levels of investment were very small compared to what is happening today.

Federal Funds

Transportation Funds

The Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU), passed in August 2005, authorized $286.4 billion in Federal gas tax revenue and other Federal funds over five years for all modes of surface transportation, including highways, bus and rail transit, bicycling, and walking. Walking and bicycling improvements are not only eligible to receive funding from most of the transportation funds made available by SAFETEA-LU, but "shall be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted" (23 U.S.C., §217 (g) (1)).

For the most current FHWA Program Guidance, visit the Web site: http://www.fhwa.dot.gov/environment/bikeped/guidance.htm.

The full memo can be viewed at http://www.fhwa.dot.gov/environment/bikeped/memo.htm.

In a February 1999 Guidance memo (still in effect), FHWA stated,

> *"We expect every transportation agency to make accommodation for bicycling and walking a routine part of their planning, design, construction, operations and maintenance activities… Bicycling and walking ought to be accommodated, as an element of good planning, design, and operation, in all new transportation projects unless there are substantial safety or cost reasons for not doing so….Even where circumstances are exceptional and bicycle use and walking are either prohibited or made incompatible, States, MPOs, and local governments must still ensure that bicycle and pedestrian access along the corridor served by the new or improved facility is not made more difficult or impossible. Maintaining access to the transportation system for nonmotorized users is not an optional activity"* (FHWA, 1999).

This memo (FHWA, 1999) also spelled out planning requirements for nonmotorized facilities. "States and metropolitan areas (with populations of more than 50,000) are required to plan for the "development and integrated management and operations of transportation systems and facilities (including pedestrian walkways and bicycle transportation facilities) that will function as an intermodal transportation system…" (based on 23 U.S.C., §134 (a)(3) and 23 U.S.C., §135 (a)(3)).

Non-Transportation Funds

Outside of the Federal transportation programs there are a wide range of other Federal funds that can be used for walking facilities. Community Development Block Grants through the Department of Housing and Urban Development (HUD) are a likely source of funds for community-based projects such as commercial district streetscape improvements, sidewalk improvements, Safe Routes to School, or other neighborhood-based walking facilities that improve local transportation or help revitalize neighborhoods. The National Transportation Enhancements Clearinghouse has prepared a useful Technical Brief: Financing and Funding for Trails that cites over

Funding Examples from around the Nation

Creative Local Partnerships

- Selling bricks for local sidewalk projects, especially those in historic areas or on downtown Main Streets, is increasingly common. Donor names are engraved in each brick, and a tremendous amount of publicity and community support is purchased along with basic construction materials. Portland, Oregon's downtown Pioneer Square is a good example of such a project.

- A pivotal 40-acre section of the Ice Age Trail between the cities of Madison and Verona, Wisconsin, was acquired with the help of the Madison Area Youth Soccer Association. The soccer association agreed to a fifty year lease of 30 acres of the parcel for a soccer complex, providing a substantial part of the $600,000 acquisition price.

- The City of Phoenix partners with school boards to provide funding for the Safe Routes to School program. A part of the funding is a result of a grant from the Governor's Office of Highway Safety; $27,000 for additional police enforcement at schools and brighter safety vests for crossing guards. The Maricopa Association of Governments (MAG) has partnered with Phoenix to expand the school crossing guard training across the entire metropolitan area. Any community can adopt the Phoenix School Safety program if there is the political will to fund the program elements and devote the resources to school crossing safety. For more on this example, see: http://www.iwalktoschool.org/award_app_template.cfm?ID=196.

- In Chapel Hill, North Carolina, localized requests can be granted through a public improvement petition and assessment fee alternative when neighborhoods support the construction of a sidewalk in their area and are willing to be assessed for all or part of the project cost.

Dedicated Funding From State Transportation Revenues

- Since the mid-90s, California Highway Patrol (CHP) has been awarded pedestrian safety corridor grants through the State Office of Traffic Safety (OTS). The CHP uses a formula to assess and rate the most severe corridors in the state in terms of crashes, fatalities, and injuries. The OTS typically awards two grants per year spanning over a 12-month period in an amount of $100,000. Typical goals are a 10 to 15 percent reduction in crashes and a 5 to 10 percent reduction in fatalities and injuries. Since inception, favorable results have been recorded with the program expanding each year. Ginny Mecham (GMecham@chp.ca.gov) and Ophelia Torpey (OTorpey@chp,ca.gov) can both be reached at 916-657-7222 for more information about this program.

- In Indiana, motorists are paying extra for special license plates that benefit greenways, open space, parks, and trails. In 1995 about $1.9 million was netted from sale of 75,740 plates. The plates cost an additional $35, of which $25 goes to the Indiana Heritage Trust. Maine and Florida use similar license plate fee add-ons for conservation, parks, and bicycle and pedestrian program funding.

- By constitutional amendment, Oregon dedicates one percent of state gas-tax revenue to providing improvements for bicycling and walking on state-managed highways. Michigan also has a one percent law.

thirty Federal and national funding sources that could be used to help fund bicycling and walking facilities and/or programs, especially trails: http://www.enhancements.org.

State and Local Funds

States typically raise revenue for highway and transportation infrastructure through a state motor-vehicle fuel tax and/or vehicle licensing fees. Similar to the Federal legislation, laws in many states make most pedestrian programs eligible for funding. In some states, use of funds may be limited to improvements on state owned and operated facilities.

Some examples of revenue streams used by local communities to improve conditions for pedestrians include: special bond issues, dedications of a portion of local sales taxes or a voter-approved sales tax increase, and the use of the annual capital improvement budgets of Public Works and/or Parks agencies.

Private Sector Funds

Foundations

A wide range of foundations have provided funding for walking projects and programs. A few national and large regional foundations have supported the national organizations involved in bicycle and pedestrian policy advocacy. However, it is usually the regional and local foundations that get involved in funding particular pedestrian projects. These same foundations may also fund statewide and local advocacy efforts. The best way to find such foundations is through the research and information services provided by the National Foundation Center. They maintain a huge store of information including the guidelines and application procedures for most foundations as well as their past funding records. They can be reached online at: http://www.fdncenter.org.

Developer Funded Projects

In some cases, developers are required to provide funding for roadway improvement projects that will build sidewalks, walkways and trails. In other cases, developers are required to build off-site improvements, largely in response to master plans or stipulations on their development. While in the latter case, they may not be providing funding to the agency to build the project, the result may be the same.

See Appendix D for a list of these and other funding sources.

Chapter 7: Creating the Pedestrian Safety Action Plan

Implementing changes to reduce pedestrian crashes requires an action plan that takes identified countermeasures and puts them into a practical and achievable strategy that allows progress to be measured over time. Creating a pedestrian safety action plan is the culmination of effective stakeholder involvement, problem identification, and prioritization of solutions. It can be thought of as going from the "where" to the "what" to the "how."

The quality and effectiveness of an action plan does not depend on its length or depth. The key is to come up with a plan that effectively focuses resources on making the changes that reduce the greatest number of crashes. Short, straightforward, and well thought out plans are the most easily implemented. Appendix I contains a checklist of things to consider when developing a safety action plan.

"Implementation requires the ongoing commitment of an entire transportation agency. Momentum will only be achieved over time through constant attention and action."

A pedestrian safety action plan should incorporate the following steps:

Step 1: Define Objectives.
Step 2: Identify Locations.
Step 3: Select Countermeasures.
Step 4: Develop an Implementation Strategy.
Step 5: Institutionalize Changes to Planning and Design Standards.
Step 6: Consider Land Use, Zoning and Site Design Issues.
Step 7: Reinforce Commitment.
Step 8: Evaluate Results.

Step 1: Define Objectives

The key to a successful pedestrian safety action plan is to clearly state its purpose at the very beginning. In addition to the general goal of improving pedestrian safety, an agency should define specific and measurable objectives that can later be used to evaluate the level of success of the program.

Explicit goals of a pedestrian safety action plan include a target percentage reduction of pedestrian crashes in defined locations or areas. More specifically, it ought to be stated what types of pedestrian crashes shall be reduced (walk to school, multiple threat crashes, etc.).

While the action plan typically emphasizes safety goals of reducing crash frequency or severity (of certain types of crashes in specific areas), the plan may also include more general objectives such as increased pedestrian activity or enhanced walkability of a community.

Step 2: Identify Locations

Chapters 3 and 4 discuss how to use crash and other data to identify where improvements need to be made and provide guidance on how to organize and prioritize locations. Using this information, the first step in writing an action plan is to compile lists of actual locations. High crash or high-risk locations should be organized into four categories:

1. Spot locations.
2. Corridors.
3. Targeted areas (including neighborhoods).
4. Entire jurisdictions.

Step 3: Select Countermeasures

Chapter 4 provides guidance on how to identify and prioritize countermeasures to address different types of crashes. Using this information, the third step in completing an action plan is to identify engineering, educational, and enforcement countermeasures that can be implemented over time. Specifically:

1. For each high crash location, create a list of appropriate countermeasures based on the collision history and local conditions; include everything from simple measures such as spot speed enforcement, to more complex measures such as installing a new traffic signal.

2. For each high crash corridor and neighborhood/targeted area, identify needed countermeasures; for example, by reorganizing all the bus stops along a corridor, it may be possible to direct pedestrians to signalized crossing locations and away from crossings at uncontrolled intersections.

3. For all locations, identify countermeasures that will be installed everywhere as a matter of "routine accommodation" (discussed in Chapter 6). Chapter 5 provides

Implementation Plan Example

Oakland, CA

The Oakland Pedestrian Master Plan includes a chapter which identifies implementation policies, priority projects, staffing needs, and funding sources to ensure that pedestrian projects are managed, funded, and implemented. The plan specifies five goals to promote Oakland as a walkable city, including: pedestrian safety, access, streetscaping and land use, education, and implementation. General plan policies are listed to support each of these goals. The section also includes 20 years of priority projects to improve safety, access, and streetscaping for pedestrians in the City of Oakland. Projects are prioritized in two phases: projects to be completed within 1 to 5 years and projects to be completed within 6 to 20 years.

For more information, visit: http://www.oaklandnet.com/government/pedestrian/index.html.

lists of highly effective countermeasures that should be incorporated into agency design manuals and routinely applied to all public and private projects.

Step 4: Develop an Implementation Strategy

The fourth step in creating an implementation plan is to identify "how" improvements will be made. This requires commitment of the entire agency, not just one or two people focusing on pedestrian safety. It requires public involvement and political will (Chapter 2) and agency resources (Chapter 6). It can also involve phasing and making use of temporary measures (Chapter 4).

Timing as an Implementation Strategy

Critical to implementing an action plan is maintaining ongoing, continuous progress. Small, immediate changes that are highly visible create the momentum and support needed to make the more costly and substantive changes that require more time.

Proposed improvements identified in Step 3 of the plan should be divided into three categories: simple measures, moderately complex measures, and complex measures. More complex measures may require more time, money, and coordination among different departments and agencies.

Simple, moderately complex, and complex countermeasures will require different time lines. All treatments can begin immediately and continue into the future in parallel. The improvements requiring the least amount of time and resources will likely be completed first, and those that require the most will be completed later as resources allow.

This approach also helps to address liability concerns. While no agency can be expected to address all issues at once, an agency must be able to demonstrate that it has a well-conceived and systematic implementation plan for making improvements over time.

The timing approach that divides improvements into simple, moderately complex, and complex measures should be done within the context of addressing high crash locations, corridors, and neighborhoods (or places with high crash potential). Some examples include:

1. A simple strategy may propose that over a three-year period, all school zone signs will be upgraded, starting with high crash locations, corridors and neighborhoods; new crosswalks and spot police enforcement may also be simple strategies.

2. A moderately complex strategy may be to upgrade lighting at unmarked crosswalks over a six-year period, starting with high crash locations, corridors, and neighborhoods/targeted areas; other moderately complex solutions may be signal changes, retiming, roadway restriping, or institutionalizing safety education programs in schools.

Timing as an Implementation Strategy

The following examples are case studies from PEDSAFE that each deal with countermeasure implementations ranging from simple to complex:

Simple Solutions:
Radar Trailers in Neighborhoods

For the past ten years, residents of Bellevue, WA have been able to request city-owned portable radar trailers to target excessive speeds along corridors and in neighborhoods. The trailers have resulted in average speed reductions of 4.8 to 8.0 km/h (3 to 5 mi/h), are very popular, and cost relatively little.

Moderately Complex Solutions:
Traffic Calming

In an effort to improve the safety of neighborhood children going to and from school and reduce vehicle speeds, Cambridge, MA implemented several traffic calming measures along Granite Street, including curb extensions, a raised crosswalk, and a raised intersection. The 85th percentile motor vehicle speed was reduced from 28 mi/h to 45 to 38 km/h (24 mi/h) after the improvements.

Complex Solutions:
Area Revitalization

Wall Street in Asheville, NC is an aesthetically re-designed downtown center of economic activity. What once originated as a delivery alley has now been transformed into a walkable and livable streetscape conducive to pedestrian activity on wide sidewalks. Average vehicle speeds are below 32 km/h (20 mi/h) on the adjacent one-way street.

3. A complex strategy may be to reconstruct major intersections over a ten-year period, again starting with high crash locations, corridors, and neighborhoods/targeted areas; others may include acquiring right-of-way, realigning roadways, or revitalizing areas.

Built into this approach is the concept of phasing. For example, a high crash intersection may initially only get new ladder style crosswalk markings and a temporary median island or warning signs, with more complex measures (such as the installation of a traffic signal with pedestrian signals or a roadway narrowing treatment) to be added later when funding becomes available. This approach also allows for temporary improvements such as painted curb extensions that can be installed as a low cost strategy until funding can be found for permanent curb revisions.

Using the list of effective measures from Chapter 5, agencies can develop a matrix or other system of organization to provide an easy and effective way to set program objectives and track simple, moderately complex, and complex measures over time. Measures listed in an action plan will vary somewhat based on local conditions, crash patterns, and priorities; state and local agencies are also likely to focus on different measures.

Step 5: Institutionalize Changes to Planning and Design Standards

Design and traffic management practices that can lead to a reduction in pedestrian crashes should be incorporated into all appropriate planning, design, and maintenance manuals as well as standard specifications. This is referred to as institutionalization. It ensures that good design will automatically occur with all future agency projects and programs as a matter of routine accommodation. It provides the basis for installing countermeasures such as marked crosswalks and pedestrian signals at all signalized intersections. However, it is not always enough to have the best standards in the correct manuals; continued training may be necessary to ensure that all responsible parties understand the standards and interpret and apply them consistently and accurately.

Appendix F provides a list of recommended publications that address pedestrian policies and designs. It also provides a list of key policy and design issues that should be addressed first if pedestrian crashes are to be reduced. Institutionalizing good design and traffic management practices for pedestrians may take some time, some issues may be controversial, and it may require several iterations to complete all the changes. However, it is one of the most important and effective ways to reduce pedestrian crashes over time and should be vigorously pursued.

It is important to be aware of problems that may occur during project implementation, construction, or maintenance that may lead to a pedestrian crash if certain precautions are not taken. For example, closing sidewalks during a sidewalk repair or maintenance can cause pedestrians to be forced to walk in the travel lane or to cross the street to use the sidewalk on the other side. Pedestrians should never be forced to walk in the travel lane unless the lane is barricaded off and the route is made to be accessible. Construction zone provisions that accommodate pedestrian safety should be an important part of the new policies and practices adopted (institutionalized) by the

Examples of Comprehensive Plans

Plan Components of the Florida State Highway Safety Plan

The Florida State Highway Safety Plan includes the following elements:

1. Identify high pedestrian crash corridors or areas.
2. Analyze corridors and areas of pedestrian crash patterns and causal factors.
3. Apply multimodal level of service analysis to supplement crash data.
4. Implement pedestrian education programs.
5. Set priorities based on crashes, percentage of walkers, etc.
6. Include sidewalks in all applicable new construction, widening, and resurfacing projects (on and off-system).
7. Implement traffic calming strategies.
8. Increase enforcement of pedestrian laws.

For more information on these two plans, visit the site http://www.dot.state.fl.us/safety/TransSafEng/strategicplandocs/Strategic%20Hwy%20Safety%20Plan%205-8-03.pdf.

The Washington D.C. Pedestrian Safety and Accessibility Program

The Washington D.C. Pedestrian Safety and Accessibility Program is an example of a comprehensive pedestrian safety program. The primary goal of the program is to reduce pedestrian fatalities and injuries. The secondary goals of the program are to increase walking trips and transit use while achieving reductions in motorized trips. The program features four main categories of strategies, including: Networking and Coalition Building; Education; Engineering, Planning, and Design; and Enforcement and Regulation.

The Networking and Coalition Building component involves coordination among numerous agencies, including the District Department of Transportation, the Department of Motor Vehicles, the Department of Health, the Department of Public Schools, Washington Metropolitan Area Transit Authority, the Metropolitan Washington Council of Governments, and the Metropolitan Police Department.

The Education component includes increasing outreach and awareness of pedestrian safety and accessibility issues, the provision of educational materials in English and Spanish, the preparation of a toolkit of resources and lessons for schools, and participation in the "International Walk to School Day."

The Engineering, Planning, and Design component includes targeting high-risk locations; improving data collection, analysis, and problem identification; deploying the necessary engineering countermeasures; adopting Pedestrian-Oriented Developmental Regulations; integrating pedestrian accommodation issues into the planning, design, and approval processes; and advocating for the construction of light rail.

The Enforcement and Regulation component of the program involves targeting enforcement zones; enforcing existing motorist, bicyclist, and pedestrian laws; reviewing existing motorist, bicyclist, and pedestrian laws and advocating for stiffer penalties; pursuing professional training and education; advocating for innovative policing (officers on bikes, horses, and skates); reviewing right-turn-on-red and left-turn regulations; and enforcing harsher penalties for speeding, especially in school areas.

agency. To prevent causing problems in work zones, adequate signing and/or provisions must be made to direct pedestrians to safe paths and/or to provide safe street crossings to sidewalks on the other side of the street. A good resource on this topic is Chapter 13 in the *Traffic Control Devices Handbook* (Pline, 2001).

For purposes of an implementation plan, an agency must commit to reviewing and revising its planning and design guidelines and specifications. Using the information in Chapter 5, the agency should list the design and policy changes that need to be incorporated into its documents and create a time line for completing the changes.

Step 6: Consider Land Use, Zoning, and Site Design Issues

As noted in Chapter 1, there is a direct relationship between land use and pedestrian safety. Land use affects motorist speed, trip frequency, and behavior. It also affects pedestrian trip frequency and behavior. Communities that have been successful in implementing various land use, zoning, and site design regulations have often been successful in reducing their number of pedestrian crashes. Land use and development patterns should encourage pedestrian trips. Provisions should be created for pedestrian facilities, and developers should be required to provide pedestrian infrastructure (e.g., sidewalks) along roads in new developments.

While it is recognized that transportation agencies, especially those at the state level, may have a limited ability to directly affect land use, zoning, and site design, there is a very direct relationship between land use and transportation planning. New roads open up new areas for development and new development creates demands for new roads. Furthermore, planning and zoning departments and those agency functions involved with reviewing and approving private and public developments should be thoroughly involved in the process to promote pedestrian-friendly and safe infrastructure and roadway designs. Effective stakeholder participation is one way that broad support for changes to land use policies might be built during the pedestrian safety planning process.

Chapter 5 lists some of the most highly effective land use, zoning, and site design measures for reducing pedestrian crashes and creating a more pedestrian-friendly walking environment. For purposes of an implementation plan, an agency should recognize the importance of land use and commit to working with the appropriate parties in implementing some or all of the measures listed in Chapter 5.

Step 7: Reinforce Commitment

Implementation requires the ongoing commitment of an entire transportation agency. Momentum will only be achieved over time through constant attention and action.

There are many things an agency can do to achieve ongoing commitment to pedestrian safety. An agency should choose the strategies that work and incorporate them into its implementation plan. The following is a short list of strategies used by various transportation agencies in communities that have been successful in reducing pedestrian crashes over time:

- Provide ongoing internal training to ensure that designs do not inadvertently impact pedestrian mobility and safety.
- Provide ongoing external training to help the public focus on changes that will improve pedestrian safety.
- Have transportation agencies write Requests for Proposals (RFPs) that require appropriate pedestrian expertise.
- Institute an award system to acknowledge good projects that provide safer conditions for pedestrians.
- Work cooperatively with the Health Department on pedestrian safety research or education programs.

Step 8: Evaluate Results

A successful pedestrian safety plan must contain a mechanism to evaluate results. This ensures that implemented countermeasures are effective in reducing crashes and improving safety and helps ensure future funding opportunities if the plan is perceived as a success. In order to perform a thorough evaluation, the specific objectives of the Pedestrian Safety Action Plan need to be defined early-on in the process. Given limited resources, it is critical that the most effective countermeasures are identified and pursued when prioritizing improvements. Most communities that fail to reduce pedestrian crashes do so not because of a lack of funds, but because they do not implement the right countermeasures and make the right changes to agency design and management policies. This may be because they fail to continually evaluate the results to see if their efforts are actually reducing crashes. Evaluation means that implementation plans are not static documents—they should change over time as various crash countermeasures are tried and evaluated.

A key prerequisite to any evaluation process is to quantify the before conditions and track changes in the after condition. The data collection efforts discussed previously in Chapter 3 ought to be maintained throughout the implementation of the pedestrian safety plan. Appendix E elaborates on specific evaluation techniques.

Combining a record of successful projects is very helpful in showing progress over time. Good safety plans will include a comprehensive documentation of successful projects or institutional changes. It is also important to note that in some cases, the number of pedestrian crashes may not go down due to the fact that pedestrian activity and access has been increased. In these instances, the rate of pedestrian crashes may have decreased, and a well-documented evaluation of results is needed to provide the most accurate measure of success.

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Appendix A: How to Create and Run an Effective Pedestrian Advisory Board

Step 1: Create an Official PAB

Pedestrian Advisory Boards (PABs) should be created through an official action. At the local level, local officials can pass a resolution; at the state level, it may be an agency directive or a law passed by state legislators. Creating an official PAB is important for two reasons:

1. The creation of the PAB will immediately make decision-makers aware of the Board and its importance while also educating them on important pedestrian issues; and
2. An official PAB cannot be easily disbanded or ignored when the decision-makers change (e.g. new department director, mayor, or governor).

Step 2: Recruit and Interview PAB Members

PABs should be made up of about eight to fifteen people—any fewer, and participants will be overwhelmed; any more, and the size can become unmanageable. Often state PABS are larger than local PABs. It is useful to have up to 15 people for a few reasons: it can be difficult to get anything done if some do not show up for a meeting; there is always attrition for unrelated reasons (e.g., people moving); when the group is established, it can more effectively work in subcommittees if more people are involved. Appointments should be staggered to avoid large turnover and promote continuity. In order to prevent discontinuity, the Chair position should not be a rotating position.

To create an effective, balanced, and diversified PAB, all prospective candidates should be recruited and interviewed. Simply contacting various organizations and asking them to send a representative is not enough; openings should be advertised through local media sources or political offices. A letter of interest and a resume should be required. People who invest their time are more likely to be committed PAB members. The interview should be like any other job interview. For example, interviews could be conducted by a representative from the executive office (mayor or city manager), the person who will be staffing the PAB, and a current PAB member.

There are three qualities to look for in prospective PAB members:

1. Candidates need to have the interests of the broader community in mind rather than be focused on an issue close to home (e.g. a stop sign on their street), or they are likely to leave once their issue has been addressed..
2. Candidates should have a history of volunteerism; experienced volunteers will be more likely to attend meetings and commit the time needed to make the PAB successful.
3. Candidates need to be good listeners and have a collaborative approach to problem solving.

Since PABs are advisory, they will only be effective and legitimate if their members reflect the community they represent. Gender, race, age, type of walker (casual to fitness walkers), and the geographic location of residence for each applicant should be considered to ensure a balanced, representative board.

Step 3: Determine Logistic Support

The local or state agency should make it very clear from the beginning what services can and cannot be provided to a PAB. Staffing a PAB should require about four to eight hours a month. Direct services should be limited to providing a meeting place and attending meetings. Minutes and meeting notices are typically done by the Board members—email makes this easy—but can also be done by a secretary on loan to the Board from a state or local agency. A PAB may benefit from secretarial support to take notes or transcribe audio tapes, write minutes, send out announcements, make copies, schedule rooms, etc. However, the more the board members take responsibility for their logistics, the more invested and effective they will be.

Step 4: Provide PAB Members with Timely and Useful Information

The most important role for local and state agency staff is to provide the PAB with timely and useful information so their input is effective. PAB members are volunteers who are giving of their limited time to the community and their time should be well spent. For example, board members need to know when they can provide comments on an Environmental Impact Statement (EIS) or a major public works project.

An informed PAB will be a better board. For example, in Seattle, PAB members get together once a year for an all day, facilitated retreat. As part of the retreat, Seattle Department of Transportation staff conducts a short training session on pedestrian design issues. One of the purposes of the training is to help participants better understand things that can't be changed (e.g. shape and color of a regulatory sign) versus things that involve more choices and engineering judgment (e.g. determining the number of lanes needed on an arterial that is being reconstructed).

Step 5: Set the PAB Agenda

The Board Chair should coordinate with agency staff and departmental representatives (listed in Step 3) to develop a list of topics for Board review and input. The rela-

tionship of the agency with the Chair is critical to the success of the Board. Typically, PABs will want to provide input on agency policies, programs, and projects. Board meetings should feature a presentation on one of these topics. This makes every meeting important and ensures good attendance and participation. The Chair (not agency staff) should invite the program/project manager to participate and present at a PAB meeting. The person who staffs the PAB should help with the presentation. This builds teamwork and can make presenting to a citizen's group a positive experience.

Appendix B: How to Conduct Pedestrian Counts and Behavior Studies

Step 1: Determine Study Location and Scope

When conducting a pedestrian study it is important to identify the exact location of where the data is to be collected. Counts at intersections or along short segments of streets may include an observation of the location where the pedestrians are crossing (intersection versus midblock, in or outside of the crosswalk, and which crosswalk at an intersection is to be studied).

Step 2: Decide on Types of Studies to Perform

Pedestrian studies may include collecting data on pedestrian volumes, walking speeds, gaps in motor vehicle traffic, conflicts between vehicles and pedestrians, or pedestrian behavior. The type of study should be determined based on what problems exist at a location and should aim to assist in selecting appropriate countermeasures.

Step 3: General Observation of the Study Site and Pedestrians

Before starting the actual data collection, the analysts should familiarize themselves with the study location and note the types of signal control, the location of crosswalks and markings and other features such as sight distance restrictions. It is also appropriate to note general observations of pedestrian behavior such as walking patterns and compliance with signal control devices.

Step 4: Develop a Data Collection Plan

It is important to create a plan for what type of data will be collected and during what time period. Depending on the specific geometry of the site, locations need to be identified where the analyst can readily observe all necessary data. Pedestrian count and behavior data should focus on the time of day or day of week when a concern exists. This could include times with high or low pedestrian volumes, depending on when pedestrian crashes occurred. Pedestrian counts at schools should be conducted during school arrival or departure times and the duration may be limited to the start

Pedestrian Count Examples

Manual Pedestrian Counts

A number of localities around the country collect manual counts on a regular basis. The Washington, D.C. District Department of Transportation conducts pedestrian counts at each leg of approximately 100 intersections annually. The District of Columbia has been taking pedestrian counts at intersections and other pedestrian crossing locations for over 20 years. Counts are currently on file for approximately five to ten percent of the 13,000 intersections in the District.

In Albuquerque, New Mexico, the Mid-Region Council of Governments (MRCOG) collects bicycle and pedestrian counts at all signalized intersections in Albuquerque (more than 500 sites) on a three-year cycle.

Automated Pedestrian Counts

A number of agencies have installed infrared devices to collected automated counts of pedestrians, as well as bicyclists. The City Government of Cheyenne, Wyoming has installed an infrared counter to take the path counts on the Dry Creek Greenway. In Licking County, Ohio, the Licking County Area Transportation Study has installed infrared counters in 11 locations along a shared-use path system.

The Massachusetts Highway Department and the University of Massachusetts Transportation Center have installed an infrared sensor placed above the Norwottuck Rail Trail at the end of Route 116 underpass in Amherst, MA. The Autosense II sensor was placed on an underpass structure, 5.4 m (18 ft) above the trail, in order that pedestrians and bicyclists passing underneath the device could be detected. The active infrared sensor detected pedestrians and bicyclists with two separate infrared beams (Noyce, 2002). For more information, visit: http://www.walkinginfo.org/pdf/UMTCBikeReport02-01.pdf.

A variety of types of technologies are available for automated counting of pedestrians. These technologies are evaluated in detail in the research paper, "An Evaluation of Technologies for Automated Detection and Classification of Pedestrians and Bicyclists," which is available online at http://www.walkinginfo.org/pdf/UMTCBikeReport02-01.pdf.

and end of the school day. Concerns along bus routes should focus on the peak commute times or whenever pedestrian crashes are occurring. Pedestrian concerns in a business area may include both the peak commute times and the midday lunch period. If there is a nighttime pedestrian safety concern, nighttime counts and observations should be made. The study duration should be matched to signal warrants in the MUTCD and other local or state requirements. In general, the duration of a study may vary from an hour to multiple days, possibly affecting the personnel requirements.

Step 5: Collect the Data

The actual data collection process varies depending on the type of study. Examples of study types include:

- Volume Study: Pedestrian counts can be performed manually using tally sheets, mechanical count boards, or electronic count boards. There are also technologies available to perform automated pedestrian counts, including video detection,

infrared, or microwave technology. When pedestrian counts are made, they are generally short-term counts of two to four hours. In rare instances, counts may be made for up to eight hours. Counts should ideally be summarized by 15-minute intervals, but hourly summaries are also acceptable. If 15-minute intervals are used, a single individual may be able to count each movement of a busy intersection in an hour. Pedestrian activity along a sidewalk or in a crossing may be recorded on a video camera and then reviewed at a later date at high speed to save time. If pedestrian counts are very high, a single observer can be used to conduct the count from a videotape by reviewing the videotape slowly.

- Walking Speed Study: Determining average pedestrian walking speeds is necessary for pedestrian signal warrants, pedestrian signal timing and other applications. Walking speed studies are especially important when the average walking speed is significantly different from the typically assumed 1.0 to 1.2 m/s (3.5 to 4 ft/s). The difference may be due to pedestrian characteristics such as high volumes, age distribution, pedestrian cell phone use, level of physical fitness, and disabilities; or it can be related to geometric characteristics of the study site such as steep grades, narrow sidewalks, and shared-use paths. Adverse weather conditions including rain, snow and wind may also affect walking speeds in coastal or mountain regions.

- Gap Study: In some cases it may be necessary to analyze gaps in the motor vehicle traffic stream at pedestrian crossing locations to determine appropriate crossing treatments. For example, the MUTCD warrants a pedestrian signal if the frequency of crossable gaps falls below a certain threshold.

- Behavior Study: While general observations on pedestrian behavior should be made before any detailed data is collected, there may be situations where a more in-depth analysis of pedestrian behavior is appropriate. Elements of pedestrian behavior of interest may include the occurrence of pedestrian-vehicle conflicts, an assessment of pedestrian understanding and compliance with traffic control devices, or other exhibited behavior, such as running, or hesitating. Measures of effectiveness of behavioral studies can be quantitative (number of conflicts or violations), but may also be more qualitative in nature (pedestrians seem to be unclear about meaning of signs).

Step 6: Analyze the Data

It is good practice to decide on the method of data analysis prior to collecting the data. This will assure that all necessary information is in fact collected and will be available during data extraction and analysis. Depending on the type and extent of the study, it may be appropriate to consult a statistician to assure that large amounts of data (especially before-and-after or time series data) are properly interpreted.

Appendix C: How to Conduct Pedestrian and Motorist Behavior Assessments

Step 1: Understand the Human Element of a Crash

First and foremost on the observer's mind should be the realization that, in most cases, the pedestrian did not walk into the street with the intention of being struck. Similarly, the motorist involved in a pedestrian crash did not collide with the pedestrian intentionally. If the motorist could have avoided the crash, he or she would have done so. Crashes can result from:

- Motorist or pedestrian inattention.
- Poor judgment on the part of the motorist or pedestrian (possibly a factor of age [young and elderly pedestrians and motorists], mental or physical disabilities, fatigue, or drug/alcohol use).
- Miscalculation of risks.
- Pedestrians not understanding the speed of an approaching vehicle.
- Motorists miscalculating their own speed.
- Pedestrians assuming that approaching motorists see them and will react to them.
- Motorists not understanding the speed and direction of a pedestrian, or unexpected pedestrian movement.
- Visual screens (parked or stopped vehicles, landscaping) or insufficient lighting.

Step 2: Observe Pedestrian and Motorist Movements

The best way to conduct the process of "thinking like a pedestrian" is to first observe pedestrian movements. In many cases, pedestrians will follow a variety of patterns in areas with a high number of crashes. For example, some pedestrians will wait at a signalized intersection and cross on the WALK signal, while others will cross against the signal when they see a gap in motor vehicle traffic.

Next, observe motorist movements to "think like a motorist." In many cases, motorists appear to travel oblivious to the presence of pedestrians. Observers should note their movements. For example, some motorists at a signalized intersection will yield to

pedestrians while turning right or left when the pedestrians are in the crosswalk, while others will try to drive around the pedestrian and through the crosswalk as soon as there is a sufficient gap to do so.

Step 3: "Walk a Mile" in Their Shoes

The observer should begin where the pedestrians initiate their movements, preferably under typical conditions (including at night), and look up and down the street to see what the pedestrian sees. With all due caution, the observer should then attempt to emulate the observed movement without placing himself or herself at risk. At times, an illegal maneuver may be safer than the legal or intended movement.

To focus on the motorist's experience, the observer should also drive through the area and make the observed movements, preferably under typical conditions (including at night), and look up and down the street to see if there are any pedestrians in the problem areas identified earlier. With all due caution, the observer should then attempt to emulate the observed vehicle movement (again, without placing anyone at risk).

Step 4: Record Objective and Subjective Observations

The observer should then note what he or she saw, heard, felt, including a subjective evaluation such as the relative safety of both the pedestrian and motorist maneuvers observed and experienced. Objective observations can point out design flaws such as poor sight distance, or other roadway features. The subjective evaluation may lead to an observation such as "no wonder pedestrians do not cross there—it is so far away from the bus stop" or "I can see why the motorist could have missed seeing the pedestrian crossing—that billboard is so distracting." The observer should note these behaviors uncritically and record these movements.

Step 5: Visualize a Solution

The observer then should take a step further and imagine a pedestrian safety solution that better accommodates the pedestrian's needs as well as the motorist's. With that solution in mind, the observer should again cross the road making the movement as if the solution were in place (if possible), as well as drive along the roadway. This process may require the use of spotters to watch for approaching motor vehicle traffic and pedestrians and ensure that no one is placed at undue risk.

Appendix D: List of Funding Sources

Federal

A brief description of various federal funding sources available is listed below. For more detailed information, please see Appendix 2 of the "FHWA Guidance—Bicycle and Pedestrian Provisions of Federal Transportation Legislation" (FHWA, 1999), available online at http://www.fhwa.dot.gov/environment/bikeped/bp-guid.htm.

Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU)

SAFETEA-LU was signed into law on August 10, 2005. It represents the largest surface transportation investment in U.S. history and contains a number of provisions to address pedestrian safety, many of which are highlighted below. More information can be found at: http://www.fhwa.dot.gov/safetealu/.

Surface Transportation Program (STP)

The Surface Transportation Program provides flexible funding to states which can be used on a wide variety of projects including pedestrian improvements. States should consider the STP as a primary source of funds for pedestrian projects because of its broad eligibility requirements. More information can be found at: http://www.fhwa.dot.gov/safetealu/factsheets/stp.htm.

Transportation Enhancement Program (TE)

Transportation Enhancements funds are available for communities to help expand transportation choices such as safe pedestrian facilities. These provisions include funding for non-construction safety-related activities, including pedestrian safety training. More information can be found at: http://www.enhancements.org/.

Congestion Mitigation and Air Quality Improvement Program (CMAQ)

The CMAQ Program provides funding for air quality non-attainment areas. Programs and projects that contribute to air quality improvements and reduce congestion can be provided funding through the CMAQ Program. These funds can be used for a variety of pedestrian projects including constructing pedestrian walkways and non-construction projects such as maps and brochures. More information can be found at: http://ops.fhwa.dot.gov/safetea/congairfactsheet.htm.

Highway Bridge Program

The Highway Bridge Program provides funds to replace or rehabilitate highway bridges. Sidewalks and pathways under crossings or bridges can be built as part of bridge rehabilitation. More information can be found at http://www.fhwa.dot.gov/safetealu/factsheets/bridge.htm.

National Highway System Program (NHS)

This program provides funding for improvements to roads that are part of the National Highway System, which includes the Interstate System and other arterial routes. Funding can be used for pedestrian facilities along NHS routes. More information can be found at: http://www.fhwa.dot.gov/safetealu/factsheets/nhs.htm.

Federal Lands Highway Program (FLHP)

These funds are available for transportation planning, research, engineering, and construction on Federal lands. This funding can be used for pedestrian facilities within these lands. More information can be found at: http://www.fhwa.dot.gov/flh/flhfs051028.htm.

Highway Safety Improvement Program (HSIP)

The Highway Safety Improvement Program provides funding to reduce the number and severity of traffic fatalities and injuries on all public roads including publicly-owned pedestrian pathways and trails. More information can be found at: http://www.fhwa.dot.gov/safetealu/factsheets/hsip.htm.

Railway-Highway Crossings

There is also specific funding to reduce the number and severity of traffic fatalities and injuries at public highway-rail grade crossings by reducing the hazards to vehicles and pedestrians and installation of protective devices at crossings. More information can be found at: http://www.fhwa.dot.gov/safetealu/factsheets/railcrossings.htm.

Recreational Trails Program (RTP)

The Recreational Trails Program provides funding to develop recreational trails and related facilities for both motorized and non-motorized uses. More information can be found at: http://www.fhwa.dot.gov/environment/rectrails/.

National Scenic Byways Program

Funding is available for the construction of pedestrian facilities along state and national scenic byways. More information can be found at: http://www.bywaysonline.org/grants/guidance/.

Safe Routes to School Program (SR2S)

The Safe Routes to School Program provides funding to enable and encourage children to walk to school safely. Included in this program are infrastructure funds, which are used to assess and make improvements to the walking and bicycling physical environment around schools, and non-infrastructure funds, which are used to educate or encourage children to walk or bike to school. More information can be found at: http://www.saferoutesinfo.org/legislation_funding/.

Metropolitan and Statewide Planning Funds

These funds are available for states and metropolitan areas for transportation planning and research. Statewide and metropolitan planning funds can be used for pedestrian plans. More information can be found at: http://www.fhwa.dot.gov/safetealu/factsheets/mp.htm and http://www.fhwa.dot.gov/safetealu/factsheets/statewide.htm.

State and Community Highway Safety Grant Program (Section 402)

The National Highway Traffic Safety Administration helps administer this program which can be used for pedestrian safety initiatives. More information can be found at: http://safety.fhwa.dot.gov/state_program/section402/.

Federal Transit Administration Grants (FTA)

The Federal Transit Administration offers many grants to improve transit systems, which includes pedestrian access and walkways. More information can be found at: http://www.fta.dot.gov/25_ENG_HTML.htm.

Community Development Block Grants (HUD)

The U.S. Department of Housing and Urban Development administers the Community Development Block Grants. These grants assist low- and moderate-income neighborhoods and can be used for pedestrian enhancement projects such as sidewalk installation or repair. More information can be found at: http://www.hud.gov/offices/cpd/communitydevelopment/programs/index.cfm.

State

In addition to federal funding, there are also many sources of state funding that can be used for pedestrian safety projects. Review the statewide pedestrian master plan, if one is available, for information on sources specific to the state. State DOTs may also provide information on their Web sites as to available funding mechanisms. Many of the examples below are from the *Arizona Statewide Bicycle and Pedestrian Plan* (Arizona DOT, 2003) and the *Alaska Bicycle and Pedestrian Plan* (Alaska DOT and Public Facilities, 1995). Although each state will differ, some funding examples include:

- Capital Budgets.
- Legislative Discretionary Funding.
- Local Service Roads and Trails (LSR&T).
- Trails, Footpaths, and Campsites.
- Operating Budgets.
- State Funds as Federal Match.
- State Sales Tax.
- Highway User Revenue Fund (HURF).
- Local Transportation Assistance Fund (LTAF).
- State Park Heritage Fund.
- Game and Fish Department Heritage Fund.
- Growing Smarter Planning Grant Program.
- State Highway Fund.
- State bicyclist and pedestrian grants.
- Special transportation funds (financed by state sales tax).
- Transportation/Growth Management Programs.
- Specialty license tag fees.

Regional

The following are two common examples of regional funding that may be available:

- Association of Governments (or Regional Planning Council) Funds.
- Municipal Planning Organization Budgets.

Local

Local funding resources can also be used for pedestrian safety projects. These will vary greatly from place to place. Details for many of the examples below can be found in the *Arizona Statewide Bicycle and Pedestrian Plan* (Arizona DOT, 2003) or in *Main Street…when a highway runs through it: A Handbook for Oregon Communities* (Transportation and Growth Management, 1999). These plans provide excellent examples of the type of local funding sources that may be available. A general list of local funds includes:

- General Funds (from property taxes and gas tax revenues).
- Development Impact Fees.
- Parks and Recreation Funds.

- Flood Control District Funds.
- Revenue and General Obligation Bonds.
- Tribal Casino Revenues (depending on the state).
- Local Funds as Federal Match.
- Special Bond levies.
- Transportation Impact fees.
- System development charges.
- Local Improvement Districts.
- Charges to adjacent property owners.
- Cooperative projects with utility districts, etc.
- Urban renewal district.
- Economic improvement district.
- Business improvement district.

Private

Funding can also be found in the private sector. Some sources include:

- Developer off-site improvements (not money, but they are improvements).
- Dedications.
- Contributions.
- Corporate underwriting.
- Donations of right of way/easements.
- Clubs, groups, and volunteers.
- Grants and loans.

Appendix E: Evaluation of a Pedestrian Safety Plan

Evaluation serves as a tool to guide the efforts of the project staff, to demonstrate project success to the public, and to assure continued support from sponsors. The extent and methods of evaluation may differ for pedestrian safety plans on the local, MPO or state level, but the general principles stay the same. A thorough evaluation of a pedestrian safety plan investigates effectiveness of countermeasures, monitors public opinion, and constantly reassesses the actual program plan.

Countermeasure Evaluation

Implemented treatments should generally be evaluated in terms of their overall effectiveness, which typically has already been done by national research institutes and other agencies (at least for the treatments discussed in Chapter 7). But the usefulness of any treatment in reducing pedestrian crashes is likely to vary across locations. The following questions should be asked:

- Is the treatment effective (in general)?
- Does the treatment work as intended?
- How did the treatment affect drivers and vehicle LOS?

Public Opinion Evaluation

Stakeholder involvement early in the plan development process is important for improving the quality of the plan. Chapter 2 discusses the importance of stakeholder involvement to both tailor the action plan to the (perceived) needs of the community and continuously update the public of the progress of implementation. The main questions to ask are:

- Does the program address the needs of the community?
- Is the general public aware of the program?
- Is the program well received?
- Is there opposition by certain groups?

Before-and-After Evaluation Study Examples

University Place, WA; Portland, OR; and Boulder, CO

A number of agencies have performed evaluations of pedestrian safety before-and-after improvements were made to a facility. While many of the assessments focus upon travel speeds, others examine vehicle volumes, number of conflicts, and number of incidents before and after facility improvements.

The City of University Place, Washington built and transformed a major corridor, Bridgeport Way, into an inviting main street that would allow pedestrians and bicyclists to move about comfortably and safely while still accommodating vehicular movement through the corridor. The improvements included the placement of sidewalks and bicycle lanes along both sides of the corridor, as well as planter strips buffering the road from the sidewalk. A median and street lighting were also added, among other improvements. The City analyzed speed and accident data before and after the construction of the Bridgeport Way improvements. The project's traffic calming features reduced speeds by 13 percent and reduced crashes by 60 percent compared to pre-improvement conditions.

Bridgeport Way in University Place, WA before (above) and after (below) improvements were made.

In Portland, Oregon, a variety of traffic calming techniques were implemented along SE Harold Street, including the construction of one median island, eleven speed humps placed 91 to 274 m (300 to 900 ft) apart, and curb extensions at five intersections. A before-and-after evaluation revealed that traffic volumes had decreased from a range of 3,400 to 4,800 vehicles per day (vpd) to a range of 2,000 to 3,500 vpd. The 1,600 vpd average drop in daily traffic is a reduction of 37 percent. This drop presumably represents cut-through motorists who found the speed humps to be inconvenient. The 85th percentile speed on SE Harold prior to project construction ranged from 59 to 64 km/h (37 to 40 mi/h). Measurement since speed hump construction shows an average decrease in the 85th percentile speed of 9.6 km/h (6 mi/h).

In Boulder, Colorado, high traffic volumes and speeds were creating an unsafe and unpleasant walking and bicycling environment along 55th Street. A Capital Improvement Project was implemented to provide improved bicycle and pedestrian facilities in the corridor, and to provide some traffic calming for vehicles. Continuous sidewalks and bicycle lanes were provided along the street, as well as a bicycle/pedestrian underpass, two raised crossings and one raised intersection, with pedestrian refuge islands at both of the raised crossing locations. Data collected by the city staff indicate that both travel speeds and traffic volumes decreased following completion of the project. The 85th percentile speeds decreased from 67 km/h (42 mi/h) before the project to 61 km/h (38 mi/h) after the project. Average vpd decreased from 12,400 before the project to 9,400 after the project.

For more information, visit http://www.walkinginfo.org/pedsafe and find the case studies relating the details of these improvements.

Program Plan Evaluation

It is furthermore important to assess if the overall objectives of the program plan have been achieved. Depending on the specific objectives, questions could include:

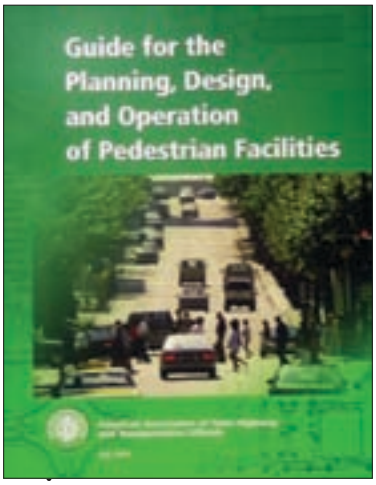
- Did the overall number of pedestrian crashes decrease?
- Do stakeholders perceive that roads are safer?
- Are agencies collaborating on efforts?
- Did the design manuals get updated with new policies and countermeasures?
- Have proposed procedures been adopted by agencies?

An important precondition to program evaluation is that goals are formulated early-on in the process. If assessment results can be matched to explicitly stated goals, the success in achieving those objectives can be demonstrated and decisions can be made on how to improve or modify the program if necessary. To assure proper evaluation, it should be included in the project budget from the beginning. Types of evaluation include:

- Before and After Studies—Typical measures of effectiveness for pedestrian safety projects include crash frequency, number of crossing events, or number of observed conflicts (a short-term proxy measure for actual crashes), yielding rates.

- Public Surveys—Surveys could include opinion polls about the program, knowledge tests following an education campaign, or questionnaires investigating perceived safety of improved intersections.

- Expert Rating—The project team could hire experts on pedestrian safety to evaluate (or re-evaluate) an intersection, a corridor, or the general safety of a community.



Appendix F: Reference Guide and Plan Summaries

National Guides

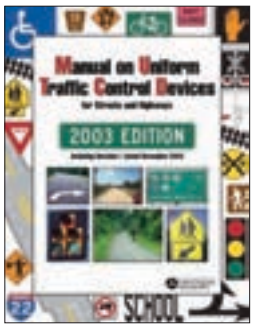
Guide for the Planning, Design and Operation of Pedestrian Facilities (2004)

The American Association of State and Highway Transportation Officials (AASHTO) *Guide for the Planning, Design and Operation of Pedestrian Facilities* presents effective measures for accommodating pedestrians on public rights-of-way. The guide recognizes the profound effect that land use planning and site design have on pedestrian mobility and addresses these topics as well. The guide can be purchased through the AASHTO Web site at http://www.aashto.org.

Designing Sidewalks and Trails for Access, Parts 1 (1999) and 2 (2001)

The guides *Designing Sidewalks and Trails for Access Parts 1 and 2* provide the state of the practice for applying the American with Disabilities Act (ADA) and similar requirements to pedestrian facilities. Find Part one at: http://www.fhwa.dot.gov/environment/bikeped/access-1.htm and Part 2 at: http://www.fhwa.dot.gov/environment/sidewalk2/.

Manual on Uniform Traffic Control Devices (2003)



The *Manual on Uniform Traffic Control Devices* (*MUTCD*) defines the standards used by road managers nationwide to install and maintain traffic control devices on all streets and highways. The *MUTCD* is published by the Federal Highway Administration (FHWA). The *MUTCD* audience includes the insurance industry, law enforcement agencies, academic institutions, private industry, and construction and engineering professionals. Find the document at http://mutcd.fhwa.dot.gov/pdfs/2003r1/pdf-index.htm.

Traffic Control Devices Handbook (2004)

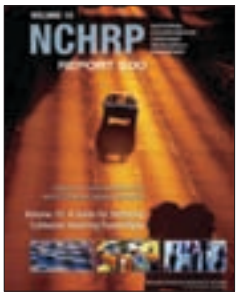
The Traffic Control Devices Handbook (*TCDH*) was prepared by the Institute of Transportation Engineers (ITE) to augment the *MUTCD* as adopted nationally by the Federal Highway Administration. While the *MUTCD* outlines the design and application of traffic control devices on public roadways in the United States, criteria and data to make decisions on the use of a device and its application are not always fully covered in the *MUTCD*. This Handbook bridges the gap between the *MUTCD* provisions and those decisions to be made in the field on device usage and application. The Handbook can be ordered through the Institute of Transportation Engineers online bookstore at http://www.ite.org.

Design and Safety of Pedestrian Facilities, A Recommended Practice of the Institute of Transportation Engineers (1998)

Design and Safety of Pedestrian Facilities, A Recommended Practice of the Institute of Transportation Engineers is intended to provide guidance on how to implement a comprehensive program of engineering, education and enforcement to improve safety for pedestrians. Find the document at http://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf.

Pedsafe: The Pedestrian Safety Guide and Countermeasure Selection System (2004)

Pedsafe: The Pedestrian Safety Guide and Countermeasure Selection System is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and/or mobility based on user input about a specific location. It can be found at http://www.walkinginfo.org/pedsafe/.



A Guide for Reducing Collisions Involving Pedestrians (2004)

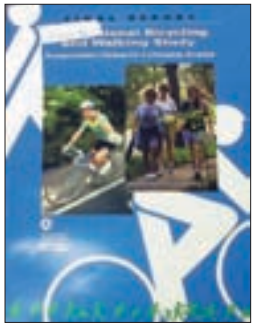
The National Cooperative Highway Research Program (NCHRP) Report 500, Volume 10: *A Guide for Reducing Collisions Involving Pedestrians* provides strategies that can be employed to reduce the number of collisions involving pedestrians. The NCHRP Report 500, Volume 10 can be purchased through the Transportation Research Board Web site at http://www.trb.org.

A Review of Pedestrian Safety Research in the United States and Abroad (2004)

The purpose of this report is to provide an overview of research studies on pedestrian safety in the United States and abroad. Readers will find details of pedestrian crash characteristics, measures of pedestrian exposure and hazard, and specific roadway features and their effects on pedestrian safety. Such features include crosswalks and alternative crossing treatments, signalization, signing, pedestrian refuge islands, provisions for pedestrians with disabilities, bus stop locations, school crossing measures, reflectorization and conspicuity, grade-separated crossings, traffic-calming measures, and sidewalks and paths. Pedestrian educational and enforcement programs

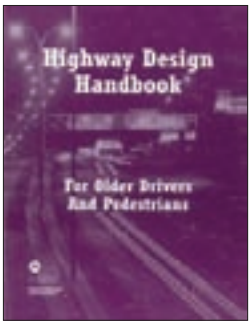
are also discussed. Review this document online at http://www.walkinginfo.org/pdf/PedSynth/Ped_Synthesis_Report.pdf.

National Bicycling and Walking Study (1994)



The *National Bicycling and Walking Study* includes a series of 24 case studies highlighting model activities conducted with respect to bicycle and pedestrian planning. The *National Bicycle and Walking Study* presents a plan of action for activities at the Federal, state, and local levels for increasing the amount of walking and bicycling in the United States. A five-year status report on the *National Bicycling and Walking Study* was published in 1999. A ten-year status report on the study was published in 2004. Selected case studies included in the 1994 *National Bicycling and Walking Study* can be obtained through the National Transportation Library at http://ntl.bts.gov/DOCS/nbws.html. The 1999 five-year status report is available through the FHWA Web site at http://www.fhwa.dot.gov/environment/bikeped/study.htm. The 2004 ten-year status report is available at http://www.fhwa.dot.gov/environment/bikeped/study/.

Highway Design Handbook for Older Drivers and Pedestrians (2001)



The *Highway Design Handbook for Older Drivers and Pedestrians* provides recommendations that upon implementation may remedy deficient designs that disproportionately penalize older road users due to changes in functional ability experienced with normal aging. These may be most urgently needed where a crash problem with older drivers or pedestrians has already been demonstrated; however, the greater benefit arguably lies in designing safer new roads and identifying and modifying problems with existing roads before statistics reveal a crash problem. The engineering enhancements described in this document should benefit all road users, not just older persons. The document is available online at http://www.tfhrc.gov/humanfac/01103/coverfront.htm#toc.

Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations (2005)

Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines presents the results of a study that examined the safety of pedestrians at uncontrolled crosswalks and provides recommended guidelines for pedestrian crossings. Review this document online at http://www.walkinginfo.org/pdf/r&d/safetyeffects.pdf.

An Analysis of Factors Contributing to "Walking Along Roadway" Crashes: Research Study and Guidelines for Sidewalks and Walkways (2002)

An Analysis of Factors Contributing to "Walking Along Roadway" Crashes: Research Study and Guidelines for Sidewalks and Walkways summarizes the results of a study that examined the safety impacts of having sidewalks and walkways along roadways. The document also provides guidelines and recommendations for providing such facilities. Review this document online at http://www.walkinginfo.org/pdf/r&d/SidewalkReport.pdf.

Resource Guide on Laws Related to Pedestrian and Bicycle Safety

This Guide presents a selection of vehicle and traffic law provisions from the Uniform Vehicle Code prepared by the National Committee on Uniform Traffic Laws and Ordinances (NCUTLO), other state laws and local ordinances that have a positive effect on pedestrian or bicycle safety, and model laws prepared or adapted to meet specific safety needs. The safety relevance of each provision is assessed in terms of its likely effects on the causes of bicycle or pedestrian crashes with motor vehicles, the prevention or reduction of bicyclist or pedestrian injuries and possible effects on pedestrian and bicycle injury-producing situations that do not involve motor vehicles. Each provision is cross-referenced to a description of how the concept is implemented in each state. The Guide is available as a download or can be ordered from the NHTSA Web site. http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/resourceguide/index.html.

Bicycle and Pedestrian Safety Resource Guide (2005)

The Bicycle and Pedestrian Safety Resource Guide is a compilation of existing and proposed countermeasures to help solve a range of bicycle and pedestrian safety problems. The Guide was prepared for the bicycle and pedestrian safety professionals and others who are developing programs at the state or community level. The Guide is available for download from NHTSA's Web site at http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/BikePedestrian/index.htm.

Safe Routes to School Guide (2006)

The Safe Routes to School Guide is a comprehensive online reference manual designed to support communities in developing Safe Routes to School programs. The guide was developed by the Pedestrian and Bicycle Information Center (PBIC) in collaboration with SRTS experts from around the country and support from the National Highway Traffic Safety Administration (NHTSA), Federal Highway Administration (FHWA), Centers for Disease Control and Prevention (CDC) and Institute of Transportation Engineers (ITE). Find the Guide at http://www.saferoutesinfo.org/guide/.

Adult School Crossing Guard Guidelines

The Adult School Crossing Guard Guidelines outline the role of the adult school crossing guard and the elements of a crossing guard program. The guide was prepared by the National Center for Safe Routes to School and the Pedestrian and Bicycle Information Center with funding from the National Highway Traffic Safety Administration and can be found at http://www.saferoutesinfo.org/guide/crossing_guard/index.cfm.

State Guides

Arizona: Statewide Bicycle and Pedestrian Plan (2003)

This is a guide for making pedestrian-related transportation decisions at the state and local level. The plan provides a long-term agenda for implementing a system of pedestrian facilities on the ADOT State Highway System and seeks to coordinate the relationship between ADOT and smaller jurisdictions. The plan described state policies and codes that affect pedestrian planning and provides a matrix of creative ordinances from around the nation, encouraging localities to implement and follow them. It contains an informative table on potential funding opportunities and resources that consist of project type, required matching funds, deadlines, etc. The plan is well-organized and presents a great example of citizen participation and stakeholder involvement. Development of the plan involved a comprehensive steering committee of representatives from pedestrian activist organizations, municipalities, state engineering agencies, a review committee, and engineering input. Find the document at http://www.azbikeped.org/statewide-bicycle-pedestrian-intro.html.

New Jersey: Statewide Bicycle and Pedestrian Master Plan, Phase 2 (2004)

This plan provides clear guidance for the most effective use of Federal, state, and local resources to implement pedestrian and bicycle facilities. The stated goals and objectives are supported with proposed performance measures to determine the effectiveness and critical success factors. The plan presents a good example of how to use GIS analysis to prioritize the improvement of pedestrian facilities around the state. It used demand forecasting (showing pedestrian trips by census tract and roadway crossability) and suitability forecasting (calculating the suitability of making capital investments) to identify and prioritize project locations. Summarized in a matrix form, the implementation section includes several strategies and assigns responsibility to various agencies and organizations. This document is available online at http://www.bikemap.com/RBA/NJBikePed.pdf.

Virginia: VTrans 2025 Statewide Pedestrian Plan (2004)

This plan is a tool for establishing a consistent approach to integrate a consideration for walking into transportation planning in Virginia. The preliminary draft remains general, providing a basic framework of the vision, strategies, and action items. It discusses several influences on the need to offer and operate pedestrian facilities, including Federal legislation such as the Intermodal Surface Transportation Efficiency Act (ISTEA), ADA accessibility requirements, and Virginia Department of Transportation policies. The plan reveals a regional program for obtaining public input, holding twelve public stakeholder meetings across the state. It acknowledges that disagreements exist on how to accommodate pedestrians and that there is a need to arrive at a cooperative solution. For more information, see the Web site http://www.transportation.virginia.gov/VTrans/home.htm.

Florida: Pedestrian Planning and Design Handbook (1996)

The plan presents guidelines, standards, and criteria for pedestrian planning and facilities. It is intended as a reference for any locality, agency, organization, group, or citizen interested in improving the walking environment. It offers an overview of the pedestrian planning process and discusses the various steps of public involvement, data collection, development of goals and strategies, and implementation resources. The plan provides a comprehensive analysis of pedestrian-motor vehicle crashes in the state. It discusses the design details of roadway crossings, intersection treatments, and traffic calming strategies as well as presents other pedestrian considerations such as signage and signalization, school/work zone practices, and street lighting. A chapter is devoted to each element and includes recommendations, maintenance, and further references. This document can be downloaded from the site http://www.dot.state.fl.us/safety/ped_bike/ped_bike_standards.htm#Florida%20Ped%20Handbook.

Georgia: Pedestrian and Streetscape Guide (2003)

The guide focuses on the design of pedestrian environments and streetscape facilities. It offers technical information on "best practices" that apply to situations encountered in project development. It provides a thorough examination of pedestrian characteristics and factors that influence pedestrian travel. The guide supplies an interesting spatial analysis, diagramming the space needs for different types of pedestrians—adults, children, elders, and those with disabilities. It discusses ways to prioritize projects using Geographic Information Systems (GIS), referencing the Latent Demand Model and Portland, OR's Pedestrian Potential Index. The bulk of the guide exists in several toolkits, each devoted to different subjects. The toolkits begin with general design guidelines and move into more specific topics such as accessibility, school zones, trails and paths, sidewalks, crossings, etc. Detailed facility diagrams provide useful technical information for other agencies and localities. This report can be found at http://www.dot.state.ga.us/dot/plan-prog/planning/projects/bicycle/ped_facilities_guide/index.shtml.

Vermont: Pedestrian and Bicycle Facility Planning and Design Manual (2002)

The manual assists agencies, organizations, and citizens with the planning, design, construction, and maintenance of pedestrian facilities in a variety of settings. It incorporates a separate analysis of characteristics of traffic-related pedestrian fatalities and common characteristics of pedestrian crashes. It primarily focuses on the sidewalk environment adjacent to the roadway, considering width, slope, surface, and access points. The supporting street cross-sections give a clear representation of desired space and scale. The manual also recognizes special treatment of pedestrian planning for rural areas. Visit the Web site http://www.aot.state.vt.us/progdev/Documents/LTF/FinalPedestrianAndBicycleFacility/PedBikeTOC.html for more information.

Oregon: Bicycle and Pedestrian Plan (1995)

This is one of the first plans developed to promote walking. It is in-depth and informative, addressing various aspects of pedestrian planning. The plan is divided into two sections—policy/action planning and network planning—with the purpose of presenting ODOT with general principles and policies for providing walkways along state highways. It provides a framework for cooperation between ODOT and local jurisdictions and offers guidance to cities and counties wanting to develop local pedestrian plans. The plan presents an overview of existing legislation relating to pedestrians, describes the current conditions statewide, and suggests implementation actions to ensure achievement of stated goals and policies. It contains clear, measured diagrams and street cross-sections of most desirable design facilities. The Oregon plan can be read and ordered online at http://www.oregon.gov/ODOT/HWY/BIKEPED/docs/or_bicycle_ped_plan.pdf.

Oregon: Main Street...when a highway runs through it: A Handbook for Oregon Communities (1999)

This handbook was designed for communities that are working together to enhance the vitality of a main street which also serves as a state highway. It describes the many tools available to identify the problems and figure out good solutions to strike a balance between the needs of pedestrians, shoppers, employees, business owners, and residents with the needs of through traffic—both auto and freight—to move safely and efficiently over longer distances. It can be found at http://egov.oregon.gov/LCD/TGM/docs/mainstreet.pdf.

California: Pedestrian and Bicycle Facilities in California, Technical Reference Report (2005)

Caltrans' *Technical Reference Report* is intended to help accommodate pedestrian transportation throughout the State of California. It is intended as a resource for professionals, agency staff, and citizens. Through the collection of demographic and pedestrian collision data, the report makes a strong case for the need to improve pedestrian facilities. It contains a grant source matrix that shows available funding by agency, amount, deadline, and requirements. The bulk of the report is related to pedestrian travel, organized from broad topics to design detail. Each page contains a description and discussion of a different element, drawing, diagram or photo that enables standard and innovative practices to be easily understood. This document can be found at http://www.dot.ca.gov/hq/traffops/survey/pedestrian/pedbike.htm.

North Carolina: Bicycling and Walking in North Carolina, A Long Range Transportation Plan (1996)

Developed by the Office of Bicycle and Pedestrian Transportation of the NCDOT, this pedestrian plan builds upon the NC long-range transportation plan, elaborating on the goals, focus areas, and programming specific to walking. It also demonstrates a technique for performing a statewide inventory: in the plan- making process, city managers or mayors of NC communities with populations of at least 1,000 were surveyed for information on the community's walking environment. The plan summed the

individual data to obtain the total miles of a particular pedestrian facility in the state. The plan also discusses crash data and reviews relevant pedestrian content of different Metropolitan Planning Organization (MPO) plans. The plan formulates actions, supplies funding sources/levels, and calls for an evaluation of projects. This document is available at http://www.ncdot.org/transit/bicycle/about/longrangeplan2.pdf.

North Carolina: Planning and Designing Local Pedestrian Facilities (1997)

The *Local Pedestrian Facilities* manual provides suggestions and guidelines for local planners and traffic engineers to increase pedestrian safety and friendliness. The manual demonstrates design details for pedestrian treatments and traffic calming. It contains a table of sidewalk placement and width recommendations according to street type and gives individual consideration to pedestrians with disabilities as well as pedestrians in school and work zones. The manual focuses on signage and signalization, treatments often overlooked in pedestrian design manuals. The manual finishes with a comprehensive matrix summarizing pedestrian problems and possible solutions. It can be ordered online at http://www.ncdot.org/transit/bicycle/projects/resources/projects_peddesign.html.

Washington: Pedestrian Facilities Guidebook (1997)

The purpose of the *Pedestrian Facilities Guidebook* is to assist various agencies and organizations in pedestrian planning and encourage good design practices when developing these spaces. It discusses the importance of construction, maintenance, and operations. The guidebook presents the needs and characteristics of pedestrians and then provides several toolkits, highlighting important information in boxes, tables, diagrams, and graphs. The guidebook gives attention to the spatial needs of all types of pedestrians. The toolkits address the design of important walking facilities like trails, sidewalks, intersections, and crossings, and they also discuss important accessibility issues and school zone safety. The guidebook provides an opportunity for citizen comments through a request form and a detailed resource guide. For further information, visit the Web site http://www.wsdot.wa.gov/EESC/Design/DesignManual/desEnglish/1025-E.pdf.

Pennsylvania: Pedestrian Planning and Design Guidelines (1996)

The *Pedestrian Planning and Design Guidelines* is one part of the *Statewide Bicycle and Pedestrian Master Plan* for Pennsylvania. The plan-making process involved a comprehensive public outreach program that held workshops across the state, established a toll-free number and questionnaire, and included representatives from several stakeholder groups. The *Pedestrian Planning and Design Guidelines* act as a guide for PENNDOT and localities to make the current transportation system more accessible to pedestrians. The guide recognizes the importance of incorporating pedestrians into land use and planning policies and discusses ways to retro-fit existing developments to better serve pedestrians. The design guidelines focus on best practices for sidewalks, intersections, and other crossings. This document can be found by visiting http://www.dot.state.pa.us.

District of Columbia: Traffic Calming Policies and Guidelines (2002)

To reduce the negative impact of motor vehicle use and ensure overall safety, the *District of Columbia Traffic Calming Policies and Guidelines* provide a process for involving the public in implementing traffic calming measures. It supplies a formal request form for citizens and describes the process from request to implementation. The document presents criteria for rating and selecting traffic calming projects when competing for specific funding. Also, it describes and diagrams traffic calming measures approved for the District of Columbia. The document is available at http://www.ddot.dc.gov/ddot/lib/ddot/services/pdf/traffic_calming.pdf.

Idaho: Bicycle and Pedestrian Transportation Plan (1995)

This document serves as a first step in establishing a statewide vision and comprehensive approach to pedestrian transportation planning. It provides a clear, simple statement of goals and objectives as well as action strategies, policies, statutes, and design standards that can be used to meet those goals. It provides guidelines pertaining to pedestrian facilities combined with helpful planning and design information for local agencies. It can be found at http://itd.idaho.gov/planning/reports/bikepedplan/idt.pdf.

Wisconsin: Pedestrian Policy Plan 2020 (2001)

This statewide pedestrian plan focuses on the policies and programs that will help improve conditions for walking. The plan was conceived with assistance from the Pedestrian Plan Citizen's Advisory Committee and citizens around the state provided additional insights, suggestions, and reactions through public sessions and hearings as well as focus group meetings; this enables the plan to better reflect citizen concerns. The plan is meant to be used by local traffic officials seeking guidance to meet pedestrian needs on local road systems. It can be found at http://www.dot.wisconsin.gov/projects/state/ped2020.htm.

Local Guides

Denver, CO: Pedestrian Master Plan (2004)

The plan establishes a city-wide pedestrian network. It uses a detailed development process that incorporates existing conditions assessment, existing plans, GIS studies, public involvement, and policy review. Development of the plan included two rounds of public workshops and input from an inter-agency advisory team. The plan uses GIS analysis to measure potential pedestrian activity by locating concentrations of pedestrian destinations; GIS allows for a systematic strategy for building, improving, and maintaining the pedestrian infrastructure. The plan prioritizes projects with a scoring system and provides several funding sources. It can be found at http://www.denvergov.org/Transportation_Planning/141113406template3jump.asp.

Marina, CA: Pedestrian and Bicycle Master Plan (2003)

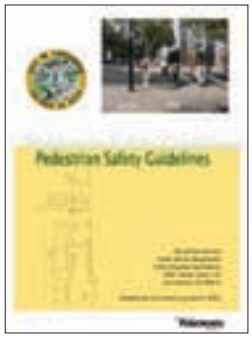
This plan contains a clear outline and discussion of goals and action strategies. It offers a comprehensive street inventory and assessment of deficiencies. The plan suggests changes to the pedestrian environment and sets guidelines for different size roadways. It uses several graphic examples, describes design details, and mentions proper placement to enhance the walking environment. The plan can be downloaded from the Web site http://www.lgc.org/marina/.

Bellevue, WA: Pedestrian and Bicycle Transportation Plan Update (1999)

This is a policy-oriented document that aims to revise the 30-year plan. It presents key issues that have appeared during the implementation of pedestrian facilities, proving to be a helpful resource for localities considering such improvements. The document emphasizes the importance of maintenance policies. It supplies an organized, informative table that contains description, justification, cost, priority, and jurisdiction of projects. Find this document online at http://www.ci.bellevue.wa.us/departments/Transportation/pdf/PedBikePlan99.pdf.

San Diego, CA: Planning and Designing for Pedestrians, Model Guidelines for the San Diego Region (2002)

These guidelines provide an extremely thorough look at how to plan and design for the pedestrian. The plan discusses the land use and community structure elements that affect the pedestrian environment. It contains a comprehensive list of site and design details that includes information on considerations, guidelines, example images, and technical diagrams. The pedestrian measures index is a good tool for identifying appropriate countermeasure to use depending on roadway volume and speed. To download this plan, go to the site http://www.sandag.org/uploads/publicationid/publicationid_713_3269.pdf.



Sacramento, CA: Pedestrian Safety Guidelines (2003)

These guidelines focus on street crossing treatments at controlled and uncontrolled intersections, discussing tools such as pavement marking and signal options and giving attention to roadway design. The guidelines create a four level system to address crosswalk placement for uncontrolled locations as well as a matrix of appropriate treatments for streets with different numbers of lanes, average daily traffic volume (ADT), and posted speed. The Sacramento plan is available online at http://www.cityofsacramento.org/dsd/dev_eng_finance/entitlements/pdfs/ped_safety.pdf.

Portland, OR: Pedestrian Master Plan (1998)

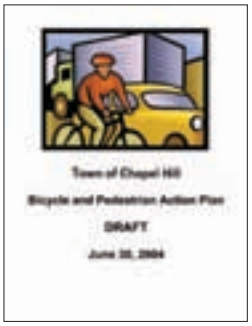
The *Master Plan* outlines an action plan to achieve the city's pedestrian-oriented goals. To identify needed improvements, the plan used a rigorous identification process, including several opportunities for public input. Data collection included citizen requests, street inventories, and an examination of crash data. Using GIS mapping capabilities, it developed a Pedestrian Potential Index, which measures the strength of

environmental factors (policy, proximity, and quantitative) that favor walking, and a Deficiency Index, which measures how critically pedestrian improvements are needed based on traffic volumes, crash data, and a lack of sidewalks. The plan contains a section on sources and strategies for obtaining funding. It also presents a graph of the past pedestrian funding and gives five different scenarios for the implementation of future pedestrian improvements. For more on this plan, visit the Web site https://www.portlandonline.com/shared/cfm/image.cfm?id=90244.

Madison, WI: Pedestrian Transportation Plan (1997)

This plan dedicates a significant section to the history and importance of pedestrian planning, as well as "thinking like a pedestrian." It includes a hypothetical walking tour of photographs that reveal possible locations for pedestrian improvements. It incorporates planning, design, and maintenance into long-term goals and objectives. The plan emphasizes the importance of education and encouragement of pedestrian travel as integral to the success of pedestrian transportation. For more on this plan, visit the site http://www.cityofmadison.com/transp/PedTransPlanTableOfContents.html.

Chapel Hill, NC: Bicycle and Pedestrian Action Plan (2004)

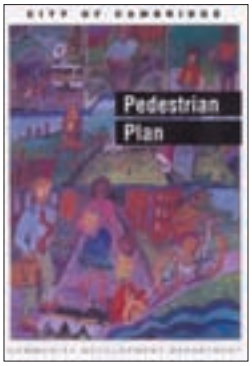


This is a concise, general plan that provides a foundation for future pedestrian planning. The plan contains information on policies and guidelines that should be used in planning for future pedestrian needs. It discusses how to encourage pedestrian movement, highlighting characteristics and influences on pedestrian travel. The plan reinforces design guidelines from previous studies and establishes local standards for streets. Finally, it addresses the role of the state, MPO, university and private developers in the identification of projects and funding process. This plan is available at http://townhall.townofchapelhill.org/planning/bikeped/bikepedplan.htm.

Oakland, CA: Pedestrian Master Plan (2002)

The plan is a fine example of how to examine census information and pedestrian collision data, showing graphs on speed, location, time of day, age, etc. The development of the plan involved an extensive community outreach process with technical and citizen advisory board, as well as neighborhood meetings. The plan identifies a pedestrian route system through the city from the specified criteria and then focuses improvements in those areas first. It contains comprehensive descriptions and graphics of design details and provides a detailed implementation plan with prioritization and cost of individual projects. To find this plan online, go to http://www.oaklandnet.com/government/pedestrian/index.html.

Cambridge, MA: Pedestrian Plan (2000)

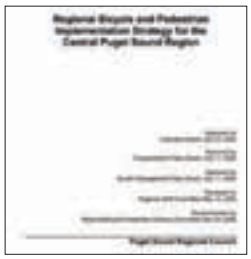


This is a beautiful and creative plan that addresses safety and walkability. It begins with general pedestrian issues and then moves on to specific action in Cambridge. The analysis tools include census data and an examination of the pedestrian environment. The plan separates pedestrian design guidelines from roadway issues and vehicular

movements, allowing for the safety issues to be addressed from different, independent viewpoints. For the pedestrian improvements specific to Cambridge, the plan classifies the city into nodes, spines, and other areas pedestrians are most likely use. It then presents needed actions to improve the space. This plan is available at http://www.cambridgema.gov/~CDD/et/ped/plan/ped_plan.html.

Phoenix, AZ: Pedestrian Plan 2000 (1999)

The Maricopa Association of Governments plan promotes the accommodation of pedestrian travel throughout the low-density, automobile-oriented Phoenix metropolitan area. It uses a two-step process in creating roadway design guidelines: (1) the Latent Demand Model estimates potential pedestrian activity based upon the frequency and proximity of adjacent trip generators, and (2) the Roadside Pedestrian Condition Model analysis statistically separates results based on roadway and traffic variables. The focus of the plan is on providing sidewalks and lateral separation (buffer). The online version of this document is available at http://www.mag.maricopa.gov/pdf/cms.resource/ped-plan2000sum-web_427.pdf.



Seattle, WA: Regional Bicycle and Pedestrian Implementation Strategy for the Central Puget Sound Region (2002)

This regional plan identifies more than 2,000 miles of needed bike lanes and paths and pedestrian improvements around activity centers. It can be found online at http://www.psrc.org/projects/nonmotorized/strategy.pdf.

Boulder, CO: Transportation Master Plan (2003)

Pedestrian planning is fully integrated into the Boulder, CO *Transportation Master Plan*. The plan outlines modal split targets of 15 percent by bike and 24 percent by foot by 2020 and offers a variety of resources to transportation officials seeking to increase pedestrian travel. More about the plan and its elements can be found at http://www.ci.boulder.co.us/publicworks/depts/transportation/tmp.html.

Appendix G: Pedestrian-Related Land Use Planning Resources

Access Management

Access Management Awareness Project, Iowa State University. Available online at http://www.ctre.iastate.edu/Research/access/ (includes report, case studies, and toolkit).

Giguere, Ronald K., *Access Management in the New Millennium*, TRB Committee on Access Management (A1D07). Available online at http://gulliver.trb.org/publications/millennium/00000.pdf.

TRB Access Management Committee. Available online at http://www.accessmanagement.gov/.

Access Management, Victoria Transport Policy Institute. Available online at http://www.vtpi.org/tdm/tdm1.htm.

Site Planning and Design

Design and Safety of Pedestrian Facilities: A Proposed Recommended Practice of the Institute of Transportation Engineers, ITE Technical Council Committee 5A-5.

Jarvis, Frederick D., *Site Planning and Community Design for Great Neighborhoods*, Home Builder Press, 1993.

Lynch, Kevin, *Site Planning*, MIT Press, 1984.

Rubenstein, Harvey M., *Pedestrian Malls, Streetscapes, and Urban Spaces*, Wiley, 1992.

Untermann, Richard K., *Accommodating the Pedestrian, Adapting Towns and Neighborhoods for Walking and Bicycling*, Van Nostrand Reinhold Company, 1984.

Russ, Thomas H., *Site Planning and Design Handbook*, McGraw Hill: Boston, Massachusetts, 2002.

Vernez-Moudon, Anne, et al., *Effects of Site Design on Pedestrian Travel in Mixed-Use Medium Density Environments*, Transportation Research Record 1587. Available online at http://www.enhancements.org/trb%5C1578-07.pdf.

Street Connectivity

Dill, Jennifer, *Measuring Network Connectivity for Bicycling and Walking*, School of Urban Studies and Planning, Portland State University. Available online at http://web.pdx.edu/~jdill/Dill_ACSP_paper_2003.pdf), 2003.

Handy, Susan, R. Paterson, and K. Butler, *Planning for Street Connectivity: Getting from Here to There*, Planning Advisory Service Report 515, American Planning Association, 2004.

Roadway Connectivity: Creating More Connected Roadway and Pathway Networks. Available online at http://www.vtpi.org/tdm/tdm116.htm.

Transit Accessibility

Jeng, One-Jang and George Fallat, *Pedestrian Safety and Mobility Aids for Crossings at Bus Stops*, Report No. FHWA-NJ-2003-013, Federal Highway Administration, Washington, D.C., September 2003. Available online at http://www.transportation.njit.edu/nctip/final_report/PedestrianSafety.pdf.

Khan, Arif., *Pedestrian-Transit Connection Analysis*, Alta Planning and Design, Portland, OR. Available online at http://www.americawalks.org/PDF_PAPE/Khan.pdf.

Moundon, Anne Vernez and Paul M. Hess, *Pedestrian Safety and Transit Corridors, Washington State Transportation Center*, Report No. WA-RD-556.1, Washington Department of Transportation, January 2003. Available online at http://www.wsdot.wa.gov/ppsc/research/CompleteReports/WARD556_1Ped_Safe_Transit_Corridor.pdf.

Texas Transportation Institute (TTI), *Guidelines for the Location and Design of Bus Stops,* Transit Cooperative Research Program, No. 19, National Academy Press, Washington, D.C., 1996. Available online at http://trb.org/news/blurb_detail.asp?ID=2597.

Transportation Resource Associates, *Transit Bus Safety Program*, Federal Transit Association, Washington, D.C., March 2001.

Tucker, Lisa E., *Safer Stops for Vulnerable Customers*, Report No. NCTR-473-13, National Center for Transit Research (NCTR), US-DOT, Washington D.C., March 2003. Available online at http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PTO/FDOT_BC137_38_SS.pdf.

Appendix H: Checklist for Engineering and Planning Solutions

This section lists effective and commonly used pedestrian crash countermeasures, each with a brief description. It follows the outline provided in Chapter 5, although the order may be slightly different in some places. Please fill in the blanks with information on whether or not your agency has adopted these practices; if not, what changes in your policies would be required for these countermeasures to become "routine accommodation"?

I. Walking Along the Road Crashes

Rural environments

Paved shoulders provide room for pedestrians to walk away from traffic; they also provide room for bicyclists and increase safety for motor vehicle operators. To be effective, paved shoulders should be 1.8 m (6 ft) wide or more; 1.2 m (4 ft) is considered the minimum acceptable width.

☐ Do you routinely provide paved shoulders on rural highways and trunk roads? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure shoulders are routinely provided? _____
_____

Urban and suburban environments

Sidewalks reduce walk-along-the-road crashes by providing positive separation from traffic. Continuous and connected sidewalks are needed along both sides of streets to prevent unnecessary street crossings. Sidewalks should be buffered with a planter strip to increase pedestrian safety and comfort; separation makes it easier to meet ADA requirements for a continuous level passage and for a clear passage around obstacles.

☐ Do you routinely provide sidewalks on urban and suburban arterials? Yes / No
☐ If yes, please state your policy: _____
☐ If so, what is the standard width? _____
☐ Are your sidewalks curbtight or separated? _____
☐ What change(s) need to be instituted to ensure separated sidewalks are routinely provided? _____

Driveways clearly mark the area where motorists will be crossing the pedestrian's path. Continuous access to parking creates long conflict areas between pedestrians and motorists; this ambiguity complicates the motorist's task of watching for pedestrians.

☐ Do you routinely ensure that access points are limited and well defined? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure access points are well defined?_____

Driveways should be designed to look like driveways, not street intersections: sidewalks should continue through the driveway, the level of the sidewalk should be maintained, and the driveway should be sloped so that the motorist goes up and over the sidewalk. Driveways should be away from intersections. The number and width of driveways should be minimized.

☐ Do you routinely require that driveways be located away from intersections and designed to look like driveways, not intersections? Yes/No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure driveways are properly designed and located? _____

Illumination greatly increases the motorist's ability to see pedestrians walking along the road at night. Double-sided lighting illuminates both sidewalks for increased pedestrian safety.

☐ Do you routinely provide illumination on both sides of the street? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure streets are well lit?

II. Crossing the Road Crashes

Pedestrian crossing islands reduce crashes substantially at uncontrolled locations, especially on busy multilane streets where gaps are difficult to find. An island breaks an otherwise complex crossing maneuver into two easier steps: a pedestrian looks left, finds an acceptable gap in one direction, crosses to the island, then looks right and finds a second gap.

☐ Do you routinely provide pedestrian crossing islands at identified crossing points? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure islands are provided?

_____

_____

Curb extensions reduce the total crossing distance on streets with on-street parking and increase visibility: the waiting pedestrian can better see approaching traffic and motorists can better see pedestrians waiting to cross the road, as their view is no longer blocked by parked cars.

☐ Do you routinely provide curb extensions at identified crossing points? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure curb extensions are provided?

_____

_____

Illumination greatly increases the motorist's ability to see pedestrians crossing the road. Increased lighting should be provided at the primary crossing points. Double-sided lighting should be provided along wide arterial streets; this enables motorists to see pedestrians along the road, who may decide to cross anywhere, anytime.

☐ Do you routinely provide illumination at identified crossing points? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure illumination is provided?

_____

_____

III. Popular Crossing Solutions and How to Improve Them

The public often responds to a tragic pedestrian crash with a call for an immediate solution. Commonly requested solutions include traffic signals, flashers, overcrossings or undercrossings, or marked crosswalks. While these can be effective solutions in certain places, in some instances they are not appropriate or effective.

Traffic Signals

The primary purpose of a traffic signal is to create gaps in traffic that otherwise would be hard to find. The MUTCD warns against the overuse of signals for a variety of reasons. Inappropriate traffic signals may increase crashes. Traffic signals are expensive, from $35,000 to $300,000 for one intersection, not including any associated road widening.

But in some cases, the only solution to crossing a busy, multilane arterial street is to install a pedestrian crossing signal. This is especially true in locations where there is no other signal for 0.4 km (0.25 mi) or more in an area with lots of pedestrian activity.

Improving Traffic Signals

Traffic signals may be the only way to create a gap for pedestrians to cross busy multi-lane highways with significant volumes. Since it is difficult to meet MUTCD warrants for a pedestrian signal based solely on existing pedestrian counts, it may be necessary to anticipate how many pedestrians might cross once a signal is installed. A median island and a two-stage pedestrian crossing help reduce impacts on traffic flow: the pedestrian stops one direction of traffic at a time, and the two crossings are separated at a fenced-in median island.

☐ Do you install traffic signals based on anticipated pedestrian volumes? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted so warranted signals are provided?
_____
_____

Overcrossing or Undercrossing

These solutions are appealing because they give the impression of complete separation of pedestrians from motor vehicle traffic. In practice, this rarely occurs because:

1. Overcrossings and undercrossings are expensive and cannot be provided at most locations where pedestrians want to cross.
2. Undercrossing are often prone to security problems due to low visibility.
3. The out-of-distance travel is so inconvenient many pedestrians will refuse to walk this extra distance and cross at-grade.
4. Overcrossings or undercrossings are seldom used, and motorists are frustrated when they see pedestrians crossing in the vicinity of an overcrossing or undercrossing; this in turn increases the risk to pedestrians crossing at grade.

The high cost of an overcrossing or undercrossing makes them impractical for all but a few locations.

Improving Overcrossings and Undercrossings

☐ Do you install separated crossings based on well-defined criteria? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted so separated crossings are provided only where warranted? _____
_____

Marked Crosswalks Without Additional Crossing Treatments

Marked crosswalks (without additional crossing treatments) should only be installed where there is an expectation of a significant number of pedestrians such as near a school, park or other generator. Without the associated features mentioned so far (islands, curb extensions, illumination etc.), marked crosswalks on their own do not

necessarily increase the security of a pedestrian crossing the street. The most recent study on marked crosswalks can be downloaded at http://www.walkinginfo.org/rd/devices.htm. In general, the results can be summarized as follows:

- Two-lane roads: no significant difference in crashes.
- Multilane roads (three or more lanes):
  - Under 12,000 ADT: no significant difference in crashes.
  - Over 12,000 ADT without median: crashes at marked crosswalks > crashes at unmarked crosswalks.
  - Over 15,000 ADT and with median: crashes at marked crosswalks > crashes at unmarked crosswalks.

The study also made the following observations:

- Medians reduce crashes by 40 percent.
- Pedestrians over 65 are over-represented in crashes relative to crossing volumes.
- No evidence was found to indicate that pedestrians are less vigilant in marked crosswalks.
- Looking behavior increased significantly after crosswalks were installed.

☐ Do you have a program for evaluating, upgrading and installing marked crosswalks at unsignalized locations? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) are needed to ensure that this occurs?

_____

_____

Textured and/or colored crosswalks are another popular request. In reality, they are often less visible to motorists than white marked crosswalks, may create maintenance problems, and are difficult for pedestrians with disabilities to negotiate.

Improving Marked Crosswalks

Using high visibility markings ensures that motorists see the crosswalk as well as the pedestrian.

☐ Do you routinely install high-visibility crosswalks? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that high-visibility crosswalks are provided?

_____

_____

Crosswalks with advance stop bars (or yield lines) help prevent "multiple-threat" crashes on multilane streets. These occur when a motorist in the outside lane stops to let a pedestrian cross and—by stopping so close to the crosswalk—masks a vehicle in the adjacent lane who is not slowing down. The second motorist does not have time to react, and the pedestrian is struck at high speed. The advance stop bar (or yield line)

encourages the first motorist to stop back 9.1 m (30 ft)—plus or minus a distance—so the pedestrian can see if a motorist in the second lane is not stopping. This enables the pedestrian to wait or even pull back if he has started to proceed into the second lane.

☐ Do you routinely install advance stop bars at crosswalks on multilane streets? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that advance stop bars are provided?

_____

_____

Proper signing increases the motorist's awareness of a pedestrian crossing.

☐ Do you routinely provide signing at pedestrian crossings? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that signing is provided?

_____

_____

Illumination increases the motorist's ability to see pedestrians crossing the road.

☐ Do you routinely provide illumination at pedestrian crossings? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that illumination is provided?

_____

IV. Intersection Geometry

Intersection geometry has a profound effect on pedestrian safety as it determines to a large extent whether or not motorists will perceive pedestrians, the length of crosswalks, and the speed of approaching and turning vehicles.

☐ Do you have an intersection design policy that takes pedestrian safety into account? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that pedestrian safety is considered?

_____

_____

Tighter radii benefit pedestrians by shortening the crossing distance, bringing crosswalks closer to the intersection, increasing visibility of pedestrians, and slowing right-turning vehicles. The appropriate radius must be calculated for each corner of an intersection; difficult turns for the occasional event are acceptable (for example a large moving truck turning onto a local street).

☐ Do you routinely encourage tight radii at urban/suburban intersections? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that tight radii are provided?

_____

_____

Pork-chop islands between an exclusive right-turn lane and through lanes shorten the crossing distance, reduce pedestrian exposure and improve signal timing. The island enables pedestrians and motorists to negotiate one conflict separately from the others. The island should have the longer tail pointing upstream to the approaching right-turn motorist; so motorists approach at close to 90º and are looking at the crosswalk. The crosswalk is placed one car length back from the intersecting street so the motorist can move forward once the pedestrian conflict has been resolved. The right-turning motorist can focus on traffic and the pedestrian can focus on cross or through traffic.

☐ Do you routinely provide pedestrian-friendly pork-chop islands (long tail design) at right-turn lanes? Yes / No
☐ If so, are they designed to enhance pedestrian safety?
☐ If not, what change(s) need to be instituted to ensure that well designed islands are provided?

_____

_____

Median islands channelize and slow down left-turning vehicles. An island provides pedestrians a refuge for long, unsignalized crossings or if a conflict cannot be avoided, though signalized intersections should be designed to allow pedestrians to cross the entire street during a single signal cycle.

☐ Do you routinely provide median islands at intersections? Yes / No
☐ If so, are signals times so pedestrians can cross in one cycle?
☐ If not, what change(s) need to be instituted to ensure that islands are provided?

_____

_____

Proper crosswalk and curb ramp placement and design ensures that all users cross in crosswalks, close to the intersection, where motorists can see them, and without undue delay. Ramps (wings not included) must be wholly contained within the marked crosswalk. Poorly placed or oriented ramps force wheelchair users to make long detours and they may not cross in the allotted time at a signalized intersection; they may be crossing outside the crosswalk lines where motorists do not expect them.

☐ Do you routinely provide crosswalks and ramps at all corners of all intersections? Yes / No
☐ If yes, please state your policy: _____
☐ If so, are they designed to enhance pedestrian safety?

☐ If not, what change(s) need to be instituted to ensure that crosswalks and ramps are provided?

_____

_____

V. Signalized Intersections

All signalized intersections where pedestrians are reasonably expected to cross should have the elements described in the following sections.

Pedestrian signals ensure that pedestrians know when the signal phasing allows them to cross, and when they should not be crossing. On one-way streets a pedestrian approaching from the opposite direction cannot see the vehicle signal heads and may not realize an intersection is signalized, nor know when it is safe to cross. Left turn arrows are not visible to the pedestrian.

☐ Do you routinely provide pedestrian signals at signalized intersections? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that pedestrian signals are provided?

_____

_____

Marked crosswalks indicate to the motorist where to expect pedestrians and help keep the crossing area clear of vehicles. All legs of a signalized intersection should be marked.

☐ Do you routinely provide marked crosswalks at signalized intersections? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure crosswalks are provided?

_____

_____

It is important to provide a WALK signal long enough to get pedestrians started, and a clearance interval long enough to ensure that a pedestrian can fully cross the street. Traditionally, 1.2 m/s (4 ft/s) is assumed adequate, though 1.1 m/s (3.5 ft/s) or even 0.9 m/s (3.0 ft/s) may be appropriate at locations that have a substantial number of older pedestrians or pedestrians with mobility impairments.

☐ Are your signals timed to give pedestrians adequate time to cross? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure enough time is provided?

_____

_____

Push buttons should be located where a pedestrian who is in a wheelchair or is visually-impaired can easily reach them, and positioned so that they clearly indicate which

crosswalk the button regulates. Push buttons mounted on two separate pedestals work best, as it is nearly impossible to place two push buttons correctly on one signal pole. Push buttons are not needed in downtown/central business districts and other area of high pedestrian use where pedestrians can be expected at every signal cycle.

☐ Do you routinely place pedestrian push buttons where they can be reached? Yes / No
☐ If yes, please state your policy: _____
☐ Do you routinely avoid using pedestrian push buttons in downtown/central business districts and other areas of high pedestrian use? Yes/No
☐ If not (either question), what change(s) need to be instituted to ensure that push buttons are accessible?

_____

_____

Signal timing techniques to reduce the incidence of crashes that occur while the pedestrian is crossing with the WALK signal include:

1. Protected left-turn phases that allow pedestrians to cross without interference from left-turning motorists. Red (then green) left turn arrows make it clear to motorists they must wait before turning (especially important where there are double right or double left turns).

☐ Do you routinely provide protected left turns at signalized intersections? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that protection is provided?

_____

_____

2. Lead Pedestrian Intervals (LPIs) reduce conflicts between turning vehicles and pedestrians when turning vehicles encroach onto the crosswalk before pedestrians leave the curb. The LPI releases pedestrians 3 to 5 seconds prior to the green light for vehicles so pedestrians can enter and occupy the crosswalk before turning motorists enter it.

☐ Do you provide an LPI at signalized intersections with known turning conflicts? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to provide a LPI where helpful?

_____

_____

3. Pedestrian countdown signals indicate to the pedestrian how much time is left in the pedestrian clearance interval, encourage pedestrians to finish crossing before the crossing time runs out, and reduce the number of pedestrians who initiate a crossing too late in the cycle.

☐ Do you provide countdowns at signalized intersections where it would help? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to provide countdowns where helpful?

_____

_____

VI. Other Techniques to Create a Better Pedestrian Environment

Road Diets

Reducing the number of travel lanes a pedestrian has to cross can be beneficial to all users. A well-documented technique takes a four-lane undivided street (two lanes in each direction) and reconfigures it to two travel lanes, a center-turn lane, and two bike lanes (without changing the curb lines). The benefits for pedestrians include fewer lanes to cross and slower traffic speeds. The center-turn lane also creates space for pedestrian crossing islands. The bike lanes add a buffer for pedestrians as well as a place for bicyclists to ride. Variations include reducing a multilane one-way street by one lane; narrowing the travel lanes to slow traffic and create space for bike lanes; or moving the curbs in to narrow the roadway.

☐ Do you routinely consider reducing the number of travel lanes where practical? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that road diets are considered?

_____

_____

Arterial Street Design

High speeds make it harder to avoid a crash and increase the severity of a crash or the likelihood of a fatality. Speed reduction should be a primary tool in reducing pedestrian crashes. Simply lowering speed limits is usually ineffective. Streets must be redesigned to encourage lower speeds.

☐ Are your design standards predicated on slow speeds in urban environments? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that speeds are reasonable in urban areas?

_____

_____

Residential Street Design and Traffic Calming

Residential streets built in the last few decades are often wide and barren, encouraging speeds higher than appropriate for streets where children can be expected. Good

residential street designs are narrow and have on-street parking, tight curb radii, short block length, buffered sidewalks with street trees, short building setbacks, and street-lights.

☐ Have you adopted pedestrian-oriented residential street design standards? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to change your standards?

_____

_____

Traffic calming slows traffic inside neighborhoods. Common techniques include speed tables or humps, traffic circles, diverters, chokers, and chicanes to break up long, straight streets.

☐ Do you routinely consider traffic calming on neighborhood streets? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) are needed to institutionalize traffic claming?

_____

_____

VII. Transit-related Crashes

Many crashes involve a pedestrian crossing the street to access transit. All street-crossing techniques are applicable to transit stops. Transit providers and road authorities should ensure that all transit stops are accessible to all pedestrians. The following policies are recommended:

All stops should consider the safety of the pedestrian crossing—not necessarily a marked crosswalk at each stop location; rather, locating stops where it is possible for a pedestrian to cross safely at or very near the stop.

☐ Do you collaborate with transit providers to ensure pedestrians can cross the street wherever there is a transit stop? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure that transit stops are safer?

_____

_____

Provide a safe place to stand and wait at transit and school bus stops, even if there are no sidewalks. Transit stops with a lack of space push people out into the roadway.

☐ Do you collaborate with transit providers to ensure stops have a hard surface? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure transit stops are paved?

_____

_____

Sidewalks or paved shoulders provide pedestrian access to all transit stops.

☐ Do you collaborate with transit providers to ensure stops are accessible? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure transit stops are accessible?

_____

_____

Lighting should be provided at or near all bus stop locations.

☐ Do you collaborate with transit providers to ensure stops are lit? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure transit stops are lit?

_____

_____

The transit agency should also review all its stop locations to facilitate access and crossing. Techniques include:

1. Eliminating or moving transit stops in areas that are hard to cross.
2. Consolidating closely-spaced stops to limit the number of crossings and improve transit efficiency (as the buses stop less often).
3. Moving stops to a location where it is easier to cross. In general, farside locations are preferred for pedestrian safety, as pedestrians can cross behind the bus and the bus can leave without having to wait for pedestrians to cross. However, there are locations where a nearside stop may be safer and better for operational reasons.
4. Placing crosswalks (where warranted) behind the bus stop at midblock locations so pedestrians can cross behind the bus, where they can see oncoming traffic; it also enables the bus driver to pull away without endangering pedestrians.

Transit providers also have their concerns:

1. Bus stops should be easily accessible: a stop should not be moved to a far side location if this location requires a lot of out-of-direction travel for users.
2. Bus stops should be located where the motorist can easily stop and move back into traffic again.
3. Bus stops need to be located where passengers with disabilities can board the bus.

☐ Do you collaborate with transit providers to ensure stops are practical? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to ensure transit stops meet the transit provider's needs?

_____

_____

VIII. Planning Solutions

Land Use and Site Design

Land use patterns impact pedestrian crashes and the general feasibility of walking. Pedestrian crash severity is higher in suburban, auto-oriented locations where speeds are faster and motorists do not expect pedestrians. Pedestrian crashes are less severe in established, traditional urban areas where motorists are more aware of pedestrians. Sample land use and site design techniques that can encourage more walking and help manage speed and therefore affect crash rates include:

Buildings should define streets. Buildings located at the back of the sidewalk give the motorist sense of enclosure; buildings set back with large parking lots in front create wide high-speed roads. Mixed-use development can encourage walking trips and enhance the pedestrian environment. Buildings with retail on the bottom and housing on the top encourage pedestrian activity.

Street connectivity encourages walking because of the reduced travel distance to reach destinations (cul-de-sacs without connector paths reduce pedestrian connectivity).

Parking should not be placed between the sidewalk and buildings; on-street parking can be a very effective way to slow traffic and encourage pedestrian-oriented development. The principles of access management should be extended to parking: single lots serving multiple stores are preferred over single stores each with its own parking lot and driveway.

☐ Have you adopted city codes for future development that create a pedestrian-friendly environment? Yes / No
☐ If yes, please state your policy: _____
☐ If not, what change(s) need to be instituted to change codes?

_____

_____

Appendix I: Checklist for Pedestrian Safety Action Plan Elements

This checklist provides effective and commonly used elements of a Pedestrian Safety Action Plan (PSAP). The template generally follows the outline of the *How to Develop a Pedestrian Safety Action Plan* guide.

To the extent possible, please fill in the blanks prior to the training workshop. On day two of the training workshop, this checklist will be used to conduct a guided exercise to create an outline that can later be used as a basis for a PSAP.

I. Goals and Objectives

Commitment to safety for all modes should be the number one goal and priority of state and local transportation agencies. Once this commitment is made, it allows transportation agencies to allocate funds to reducing all crash types, including pedestrian crashes.

☐ Do you have a clearly stated commitment to safety as your number one priority? Yes / No
☐ If yes, please state: _____
_____
☐ If not, what change(s) need to be instituted to ensure that safety becomes the number one priority of your agency? _____
_____

Clear objectives are needed for a pedestrian plan to be successful in reducing pedestrian crashes. They allow for the development of practical and achievable strategies; they also provide a way to measure progress over time. To be effective, objectives must be specific and measurable.

☐ Do you have a clearly stated objective for reducing pedestrian crashes? Yes / No
☐ If yes, please state: _____
_____

☐ If not, what change(s) need to be instituted to ensure that objectives are adopted?

_____

_____

II. Stakeholders

Individual stakeholder involvement is an excellent way to get a better product. Public stakeholders should be viewed as partners who are the on-the-ground scouts who can identify problems, needs and opportunities. To be effective, stakeholders must be involved in a regular, ongoing and systematic way.

☐ Do you routinely provide for individual stakeholder involvement? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that stakeholders are routinely involved?

_____

_____

A Pedestrian Advisory Board (PAB) is another excellent way to get a better product. They also build public support for policies, programs, and projects to reduce pedestrian crashes. To be effective, stakeholders must be involved in the review of policies, programs and projects.

☐ Do you have a PAB that regularly reviews policies, programs, and projects? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure the creation of an effective PAB?

_____

_____

Public agency staff in other agencies are also stakeholders. Building positive, working relationships is essential for coordination on regional planning issues; it also provides a way to coordinate on solving specific problems such as identifying high crash locations where additional enforcement may be needed, and coordinating transit stops with crossing locations.

☐ Do you routinely coordinate with other agencies on crash, transit, etc., issues? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure you coordinate with other agencies?

_____

_____

III. Data Collection

Computerized, timely, geo-coded pedestrian crash data are essential to identify high-crash locations, corridors, and/or larger areas and to select appropriate improvements to make conditions safer for pedestrians and other roadway users.

☐ Do you routinely collect pedestrian crash data? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that crash data are routinely collected?

Pedestrian counts along with crossing observations can be very useful in understanding pedestrian behavior and in considering the need for facilities. Counts and behavior studies, when combined with crash data, can also provide insights into specific crash causes and potential countermeasures.

☐ Do you routinely collect pedestrian counts and complete crossing observations? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that pedestrian counts and observations are routinely completed?

_____

_____

Sidewalk and marked crosswalk (at uncontrolled locations) inventories help identify system gaps and unsafe conditions. When combined with crash data, pedestrian counts, and traffic characteristics, they can be very useful in prioritizing locations for countermeasures and other improvements.

☐ Do you routinely inventory sidewalks and marked crosswalks? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that inventories of sidewalks and marked crosswalks are routinely completed?

_____

_____

Inventories of traffic characteristics (such as ADT, road widths, and speeds) help identify likely crash locations. When combined with actual crash data and pedestrian counts, they can be very useful in prioritizing locations for countermeasures and other improvements.

☐ Do you routinely inventory roadway ADT, widths and speeds? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that ADT, width and speed information is routinely collected and coded?

_____

_____

IV. Analyzing Information and Prioritizing Concerns

Categorizing pedestrian crash data should be done to determine whether they are occurring at a) spot locations, b) along corridors, c) in a neighborhood area, or d) throughout an entire jurisdiction (poor standard practice such as failing to install pedestrian indicators at signals). Once categorized, this information can be used to focus resources and prioritize projects.

☐ Do you routinely categorize pedestrian crash data? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that crash data is routinely categorized?

_____

Conducting field reviews and safety audits can be used to identify how each pedestrian crash occurred, and what may be done to prevent future similar crashes. The outcome is a list of improvements that can be implemented to address those crashes and enhance safety.

☐ Do you routinely conduct field reviews and safety audits? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that field reviews and safety audits are routinely completed?_____

_____

Crash typing describes the pre-crash actions of the parties involved. When crashes are "crash typed," a pattern often emerges that helps identify what the problem is and what countermeasures are generally related to each crash type. Crash typing is particularly useful in developing education and enforcement strategies.

☐ Do you routinely "crash type" your pedestrian crash data? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that crash typing is routinely completed?_____

_____

Prioritizing pedestrian safety improvements is the final step once all appropriate data has been collected. Priorities should be established based on a variety of factors including safety consequences, cost, travel demand, availability of right-of-way, federal

and/or state mandates and public support. Solutions can be phased and divided into temporary or permanent improvements.

☐ Do you routinely prioritize (rank) pedestrian safety improvements? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that safety improvements are routinely prioritized?_____

_____

V. Providing Funding

Routine accommodation for pedestrians in all projects, programs and maintenance activities is the most cost-effective funding strategy for reducing pedestrian crashes and encouraging more walking. The majority of pedestrian infrastructure is built in conjunction with other projects. It allows for significant improvements over time, even if there is no special funding available for pedestrian safety improvements.

☐ Do you routinely include pedestrian safety improvements in all projects, programs, and maintenance activities? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that pedestrian safety improvements are included?

_____

_____

Dedicated funds and set-asides for pedestrian projects allow for immediate action in addressing high crash locations, corridors, and other targeted areas. They can be federal, state or local funds and are often a percentage of another fund.

☐ Do you routinely set aside funds that are dedicated to pedestrian safety? Yes / No
☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that funds are routinely set aside?_____

_____

VI. Creating the Pedestrian Safety Action Plan

A Pedestrian Safety Action Plan focuses resources on making the changes that reduce the greatest number of pedestrian crashes. To be effective, it must provide a framework for involving stakeholders, collecting and analyzing data, selecting countermeasures, developing implementation strategies and providing funding.

☐ Do you have a Pedestrian Safety Action Plan that includes all these elements? Yes / No

☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that a comprehensive plan is created? _____

_____

Evaluation of results ensures that implemented solutions are effective in reducing crashes and improving the safety and accessibility of pedestrian facilities; it also helps ensure future funding opportunities if the plan is perceived as a success. Success should be measured against the objectives set forth in the Pedestrian Safety Action Plan—typically to reduce pedestrian crashes by a certain percentage.

☐ Do you routinely evaluate results of your efforts to reduce pedestrian crashes? Yes / No

☐ If yes, please describe: _____

_____

☐ If not, what change(s) need to be instituted to ensure that regular evaluation occurs?

_____

_____

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