SAFE ROUTES TO TRANSIT™

Toolkits for Safe Crossings in Metro Atlanta

PEDS®

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This report was written by Andrew McBurney for PEDS. Graphic design by Laurel Rummel of Good, Clean Design. Additional writing, editing and production by Sally Flocks, President & CEO of PEDS.

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About PEDS

PEDS

Pedestrians Educating Drivers on Safety (PEDS) is an advocacy organization dedicated to making metro Atlanta a great place to walk. We believe increased investment in safe pedestrian access to transit is one of the Atlanta region's most important needs. Programs and technologies exist that can cut pedestrian fatalities and serious injuries. Government officials will increase safety dramatically as they take the actions needed to implement them.

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Executive Summary

Making the Case for Safe Routes to Transit

Pedestrians who travel regionally use transit for much of their cross-jurisdictional travel. The Atlanta Regional Commission's 2010 On-Board Transit Survey showed that 72 percent of transit trips in the Atlanta region begin with walking trips and 80 percent end with walking trips.[1] Yet many people lack safe pedestrian access to transit stops. Research shows that 21 percent of vehicle-pedestrian crashes in metro Atlanta occurred within 100 feet of a transit stop. Nearly half occurred with 300 feet of a transit stop.

Pedestrian fatalities are a serious and growing problem in Georgia. Unlike the downward trend in occupant fatalities during the past decade, pedestrian fatalities have increased dramatically. Pedestrians account for over 15 percent of Georgia's traffic fatalities. Of these, half occur in metro Atlanta.

"Pedestrians have a right to cross roads safely," the Federal Highway Administration states, "and planners and engineers have a professional responsibility to plan, design, and install safe and convenient crossing facilities."[2] This is especially important on transit corridors. On these, there will be pedestrians, they must be able to cross the street, and they must be able to do so safely.[3]

The Safe Routes to Transit toolkits aim to answer the question, "How can this need best be addressed?" The toolkits also recommend strategies and performance measures that can help agencies increase safety and measure their progress.

Factors Impacting Crossing Safety

Wide, high-speed roads are especially dangerous for pedestrians to cross. Each additional pair of through lanes doubles the risk of a pedestrian crash. On roads with high traffic volumes, gaps long enough for a pedestrian to cross may be rare. Dark conditions are another major concern. Over half of pedestrian fatalities occur between 6:00 p.m. and midnight. Pedestrian sight distance is a critical factor, and one that is rarely addressed in road design. To determine whether they can cross safely, pedestrians must see all cars that could arrive while they are crossing.

Human factors are also important. Most people are unwilling to walk 200 feet out of their way to get to a crosswalk. And few tolerate long delays. Where pedestrian delay exceeds 45 seconds, the likelihood of risky behavior is high.

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1 tp_arcregionalonboardsurveyfinalreport_063010.pdf

2 http://www.fhwa.dot.gov/publications/research/safety/04100/01.cfm

3 http://www.fhwa.dot.gov/publications/research/safety/04100/04100.pdf

Safe Crossing Treatment Options: Enhanced, Active and Red Light

Enhanced crossings increase the ability of pedestrians to cross by either simplifying the crossing or increasing its visibility to motorists. Treatments include median refuge islands, marked crosswalks, high visibility signs, in-street crosswalk signs and overhead lighting. By providing a safe refuge, median islands enable pedestrians to evaluate traffic in each direction.

Many treatments are available to make crossing the street safer.

Active crossings dynamically alert drivers to the presence of pedestrians who are crossing or are about to cross. Among active treatments, Rectangular Rapid Flash Beacons are the most effective, prompting 80 to 90 percent of drivers to stop or yield.

At locations with traffic signals or HAWK beacons, red lights tell motorists to stop before pedestrians get a "walk" signal. These treatments are usually the safest options for high-speed, multi-lane roads and on ones where high traffic volumes leave few gaps for pedestrians.

Driver compliance with crosswalk laws

Each level of treatment influences driver behavior. Devices using a red light are most effective in prompting drivers to stop for pedestrians. At active treatments, drivers stop or yield about two thirds of the time. Enhanced crossings have the lowest driver compliance, making them appropriate only on smaller, low speed roads.

Cost estimates

The three levels of crosswalk improvements are generally reflected in their price tag. Most simple crosswalk enhancements can be installed for under $1,000. More advanced treatments range in cost from $25,000 to $100,000.

Road width, speed limits and traffic volume

Enhanced and active crosswalk treatments are well suited for roads with two- and three-lane cross-sections and for multi-lane roads with medians or median islands. On roads with speed limits of 30 mph or less, all treatments may be appropriate. On roads with speed limits of 45 mph or higher, crosswalk treatments may require a red light. On roads with speed limits of 35 or 40, creating safe crossings may require more than one treatment.

The tables below use road width, speed limits and vehicle and pedestrian volume to help select appropriate treatments. Site-specific studies should consider these and other factors.

NUMBER OF LANES	2	3	4	5	6	7
Crosswalk	✓	✓	✓	✓		
Traffic Calming	✓	✓		✓		
In-Street Sign	✓	✓	✓	✓		
Yellow-Green Signs	✓	✓		✓		
2-Sided Signs	✓	✓		✓		
Crossing Flags	✓	✓	✓	✓		
2-Beacon RRFB	✓	✓				
4-Beacon RRFB	✓	✓	✓	✓		
Flashing Beacons	✓	✓	✓	✓	✓	✓
Embedded Lights	✓	✓	✓	✓	✓	✓
HAWK	✓	✓	✓	✓	✓	✓
Mid-Block Signal	✓	✓	✓	✓	✓	✓
Signal	✓	✓	✓	✓	✓	✓

VEHICLE TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	✓
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	✓
Yellow-Green Signs	✓	✓	
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	✓
2-Beacon RRFB	✓	✓	✓
4-Beacon RRFB	✓	✓	✓
Flashing Beacons	✓	✓	
Embedded Lights	✓		
HAWK		✓	✓
Mid-Block Signal		✓	✓
Signal		✓	✓

SPEED LIMIT (MPH)	30	35	40	45	50	55
Crosswalk	OK	?	?	NO	NO	NO
Traffic Calming	OK	OK	?	?	NO	NO
In-Street Sign	OK	OK	?	NO	NO	NO
Yellow-Green Signs	OK	OK	?	NO	NO	NO
2-Sided Signs	OK	OK	?	NO	NO	NO
Crossing Flags	OK	OK	?	?	?	?
2-Beacon RRFB	OK	OK	OK	?	?	?
4-Beacon RRFB	OK	OK	OK	?	?	?
Flashing Beacons	OK	OK	OK	?	?	?
Embedded Lights	OK	OK	OK	?	?	?
HAWK	OK	OK	OK	OK	OK	OK
Mid-Block Signal	OK	OK	OK	OK	OK	OK
Signal	OK	OK	OK	OK	OK	OK

PEDESTRIAN TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	
Yellow-Green Signs	✓		
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	
2-Beacon RRFB	✓	✓	
4-Beacon RRFB	✓	✓	
Flashing Beacons	✓	✓	
Embedded Lights	✓	✓	
HAWK		✓	✓
Mid-Block Signal			✓
Signal			✓

LEGEND

✓ indicates the treatment may be feasible

OK indicates the treatment may provide adequate warning to drivers

? suggests other conditions may limit treatment effectiveness

NO indicates the treatment is not appropriate

Bus stop location

People who use transit expect to cross the street where they get on or off the bus. This makes it especially important to locate bus stops at places where pedestrians can cross the street safely or where a safe crossing can be created.

To provide bus stops within walking distance of their customers, transit agencies often place them at locations other than signalized intersections. This is common on high-speed, multi-lane arterials, where signalized intersections are sometimes a half-mile to a mile apart. If a bus stop location lacks safe pedestrian access, transit providers should ask their road authority to install crossing treatments. At locations where poor sight distance makes it impossible to install adequate safety treatments, bus stops should be removed or relocated.

Remaining Gaps: Funding, Data Collection, and Collaboration

The scarcity of funds dedicated to pedestrian safety may be the biggest barrier to increasing safe pedestrian access to transit. Transportation planners should measure the cost of traffic fatalities and injuries to help determine whether they are allocating sufficient funds to facilities that increase safety.

Gathering more data about pedestrian crashes, exposure and infrastructure would help agencies increase safety. Important priorities include an analysis of crash reports, sidewalk and bus stop inventories and pedestrian counts.

On some issues important to pedestrian access to transit, no agency has full responsibility. Better collaboration among agencies is essential.

Performance Measures

Transportation agencies lack clear ways to measure safe access to transit. Suggested performance measures include:

1. Pedestrian crashes, injuries and fatalities near bus stops
2. Bus stops locations with safe pedestrian access
3. Bus stops with an ADA-compliant landing pad
4. Sidewalks within walking distance of transit
5. Expenditures on pedestrian infrastructure and the share allocated to projects within ¼ mile of transit
6. Locations receiving crossing improvement funding.

Recommended Goals and Strategies

Increased investment in pedestrian safety is one of the state and region's most important needs. Programs and technologies exist that can result in substantial cuts in pedestrian fatalities and serious injuries. These benefits will happen as government officials take the actions needed to implement them.

PEDS calls on the Atlanta Regional Commission to approve a goal of a 50 percent reduction by 2040 in pedestrian fatalities and serious injuries in the 10-county region, compared to 2013. Implementation strategies include:

1. **Revise regional standards** to consider safety equally important as vehicular capacity.
2. **Complete a regional study and report** that compiles and analyzes pedestrian crash data and assesses the cost of crashes.
3. **Increase Last Mile Connectivity funds** to $25 million per year.
4. **Inventory bus stop locations** and assess safe pedestrian access.
5. **Incorporate pedestrian safety performance measures** into all regional transportation plans.

PEDS also calls on the Georgia Department of Transportation to approve a goal of a 50 percent reduction by 2040 in statewide pedestrian fatalities and serious injuries, compared to 2013. Implementation strategies should:

1. **Expand the Complete Streets policy** to require agencies to install safe crossings on transit corridors that have a high number of fatal or serious pedestrian injury crashes.
2. **Adopt policies to improve the quality and frequency of pedestrian crossings** on multi-lane arterials and other transit corridors.
3. **Increase the share of Highway Safety Improvement Program funds allocated to pedestrian safety** hot spots so it matches the share of traffic fatalities accounted for by pedestrians.
4. **Incorporate pedestrian safety performance measures** into the Georgia Strategic Highway Safety Plan.

Pedestrian fatalities have increased dramatically since 2009 and now account for 15 percent of all traffic fatalities in Georgia. Half occur in the Atlanta region. We cannot allow this to be the new normal. By increasing their attention to pedestrian safety, setting goals, developing strategies and measuring results, state and regional agencies can ensure it won't be.

Making the Case for Safe Routes to Transit

Transit is the middle leg of two walking trips. Yet many pedestrians lack safe access to transit. Transportation agencies have a responsibility to design and install safe crossings, especially on transit corridors. The Safe Routes to Transit toolkits aim to answer the question, "How can this task best be accomplished?"

Pedestrians who travel regionally use transit for much of their cross-jurisdictional travel. Rather than walk between activity centers, people walk to transit, take trains or buses and walk to destinations. The 2010 On-Board Transit Survey showed that 72 percent of transit trips in the Atlanta region begin with walking trips and 80 percent end with walking trips. Transit users with low household incomes are especially likely to walk to transit.[1]

People often stand in a center turn lane while waiting for a gap in traffic.

Many people lack safe pedestrian access to transit stops. Research by the Atlanta Regional Commission (ARC) in 2010 confirmed that 21 percent of vehicle-pedestrian crashes occurred within 100 feet of a transit stop. Nearly half occurred with 300 feet of a transit stop.[2]

Most pedestrian crashes occur in urban areas, where people walk more. Yet pedestrian crashes that occur in suburban areas are more likely to be fatal. For people on foot, the combination of wide roads, high speeds, infrequent crosswalks and missing sidewalks often has tragic outcomes. Some 90 percent of pedestrian crashes occur when people are trying to cross the street. Yet for transit users, traveling round trip requires crossing the street at least once.

The aging of the metro Atlanta population increases the need for safe pedestrian access to transit. The ARC expects people over 60 to account for one out of five residents by 2030.[3] When struck by a car, crashes involving seniors are more likely to be fatal. If seniors are unable to safely access transit on foot, the region's paratransit and Human Services Transportation costs will increase dramatically.

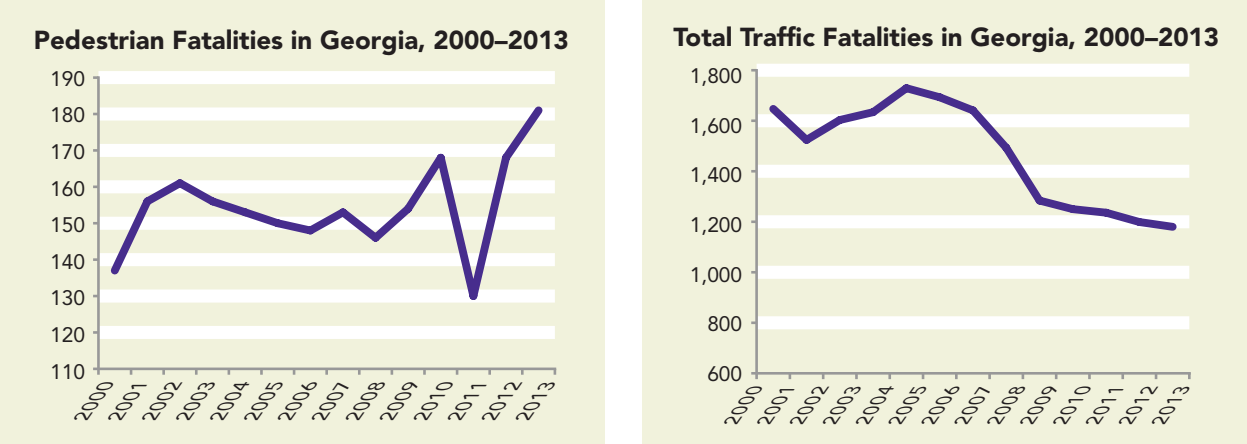
1 tp_arcregionalonboardsurveyfinalreport_063010.pdf

2 Trudell_GAHwySftyConf_PedsTransit_2011_final_03.pdf

3 http://www.atlantaregional.com/aging-resources/demographic-data

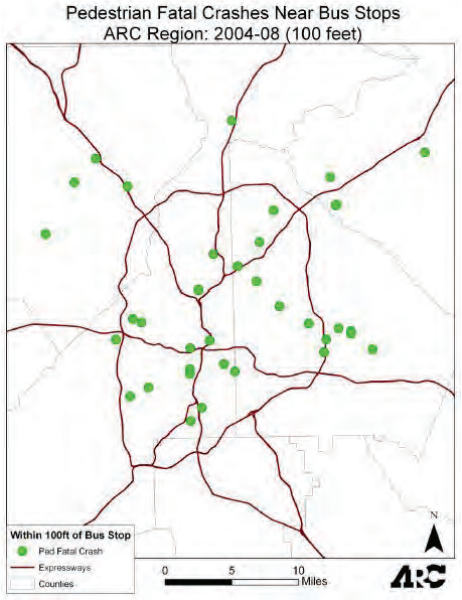
The State of Pedestrian Safety

Pedestrians account for 15 percent of all traffic fatalities in Georgia. Unlike the downward trend in occupant fatalities during the past decade, pedestrian fatalities in Georgia have increased dramatically. From 2004 through 2013, 1,553 pedestrians were killed in Georgia. During three of the past four years, pedestrian fatalities were higher than in any year since 1997. Fatalities in 2013 exceeded the average for the previous 20 years by over 13 percent.[4]



Unlike the downward trend in occupant fatalities, pedestrian fatalities have risen dramatically.

Metro Atlanta accounts for close to half of all pedestrian fatalities in Georgia. As in metropolitan areas throughout the country, an increasing share of the Atlanta region's low-income population lives in suburban areas.[5] Many are transit-dependent and live along multi-lane roads that were not designed to accommodate pedestrians. Research by the ARC in 2010 showed a strong overlap between Equitable Target Areas — defined by poverty, education, older adults, housing value and race — and fatal pedestrian crashes near transit.



Many fatal pedestrian crashes occur on multi-lane roads in the inner suburbs.

4 http://gahighwaysafety.org/statistics/pedestrians.html; Georgia Department of Transportation, DailyFatalityReportWithNames_2014-02-17-06-10-28.pdf

5 http://www.brookings.edu/research/papers/2010/01/20-poverty-kneebone

Designing for Pedestrian Safety

The FHWA calls on transportation professionals to include pedestrians as "design users for all streets."

> Pedestrians are legitimate users of the transportation system, and they should, therefore, be able to use this system safely and without unreasonable delay. Pedestrians have a right to cross roads safely, and planners and engineers have a professional responsibility to plan, design, and install safe and convenient crossing facilities.[6]

This is especially important on transit corridors. On these, there will be pedestrians, they must be able to cross the street, and they must be able to do so safely.[7]

The Safe Routes to Transit toolkits aim to answer the question, "How can this need best be addressed?"

Purpose of Toolkits

The Safe Routes to Transit toolkits are intended to help local, regional and state agencies identify appropriate crossing treatments at transit stops. They also propose updates for local, regional and state pedestrian safety plans, including the Georgia Strategic Highway Safety Plan, the Georgia Bicycle-Pedestrian Safety Action Plan, the Atlanta Region Bicycle Transportation and Pedestrian Walkways Plan, and the City of Atlanta Pedestrian Safety Action Plan. Retrofitting transit corridors with safe crossings will help the Atlanta region solve its epidemic of preventable pedestrian deaths.

The toolkits explain factors impacting pedestrian safety, describe and compare safety treatments, address bus stop location and identify issues that call for increased collaboration among agencies. They also recommend strategies and performance measures that can help state, regional and local agencies increase safety and measure their progress in achieving safe access to transit.

The toolkits are based on guidelines published in the *Manual of Uniform Safety Devices* (MUTCD) and the latest research available from the Federal Highway Administration (FHWA), National Cooperative Highway Research Program, Pedestrian and Bicycle Information Clearinghouse, Transit Cooperative Research Program, Atlanta Regional Commission and others. The toolkits incorporate new crossing treatments appropriate for midblock or other uncontrolled locations included in the 2009 MUTCD or that have received approval by FHWA for experimental use in Georgia. They also include cost estimates provided by the University of North Carolina Highway Safety Research Center.[8]

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6 http://www.fhwa.dot.gov/publications/research/safety/04100/01.cfm

7 http://www.fhwa.dot.gov/publications/research/safety/04100/01.cfm

8 http://katana.hsrc.unc.edu/cms/downloads/Countermeasure%20Costs_Report_Nov2013.pdf

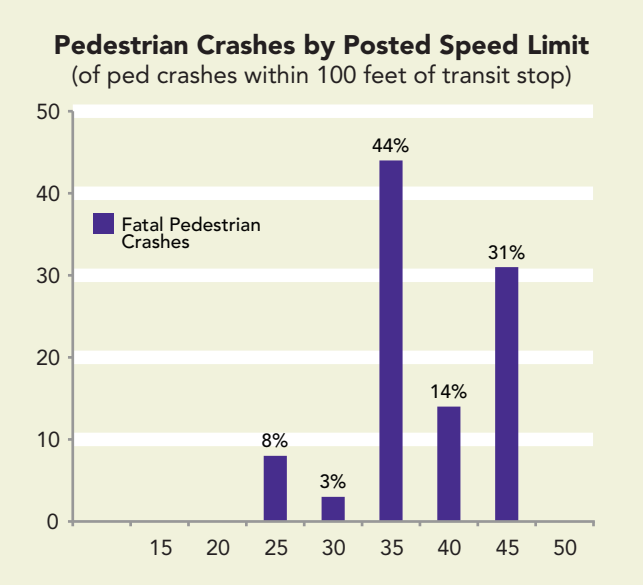
Toolkit 1 | Factors Impacting Crossing Safety

This toolkit addresses numerous variables influencing crossing safety. These include vehicle speed, road width, traffic volume, illumination, pedestrian sight distance, distance to the nearest crosswalk, pedestrian volume, delay and vulnerable users.

Vehicle speed

Vehicle speed matters. When moving fast, drivers travel farther while reacting to potential conflicts and bringing their vehicles to a stop. This requires pedestrians to see and be seen from longer distances.

Speed also contributes to the severity of impact when pedestrians are struck. When hit at 40 mph, the risk of pedestrian death is 85 percent. In metro Atlanta, 89 percent of pedestrian fatalities within 100 feet of bus stops occurred on streets with speed limits of 35 mph or faster.[9]



Fatal pedestrian crashes within 100 feet of transit stops are especially high on roads with speed limits of 35 mph or higher.

Road width

Crossing wide streets takes more time. The longer the crossing distance, the larger the traffic gap a pedestrian needs to cross safely. More lanes also make streets more complicated to cross. On multi-lane streets, drivers' view of pedestrians is often blocked by cars in other lanes. Research suggests that each additional pair of through lanes doubles the chances that a pedestrian will be hit. It also triples the risk that the crash will be fatal. [10]

Traffic volume and traffic gaps

Traffic signals along a corridor pack cars into discrete "platoons," which creates gaps when the road is clear for pedestrians to cross. Traffic volume, a primary determinant of the frequency and length of gaps, serves as an easy-to-measure proxy for gaps.

9 Atlanta Regional Commission, 2010

10 http://library.oregonmetro.gov/files/appendix_22_safetyreport.pdf
CARE Export, GDOT crash data

Engineers should determine the "critical gap"— the minimum break in traffic needed to cross the street — and then count how often these gaps are available to a waiting pedestrian. On average, at least one suitable gap per minute is needed for pedestrians to cross safely. On wide, multi-lane roads, gaps long enough for a pedestrian to cross the entire street may be rare, especially during peak hours.

Illumination

Dark conditions are a major concern in pedestrian fatalities. Over half of all pedestrian fatalities occur between 6:00 p.m. and midnight.[11] During fall and winter, most people return from work after dark. Many pedestrians wear dark clothes, which makes it difficult for drivers to see them in time to stop.

Pedestrian crossing sight distance

When calculating sight distance, transportation engineers typically consider the time it takes for drivers to see a hazard in the road, slam on their brakes and bring their cars to a stop. Pedestrian sight distance is rarely a factor in road design. In many locations, a pedestrian can begin crossing the road with no cars in sight, only to be surprised by a car coming suddenly over a hill or around a curve. If drivers do not notice the pedestrian or react in time, pedestrians may be helpless to save themselves.

Pedestrians cannot trust drivers to slow or stop for them. To determine whether they can cross safely, pedestrians must see all cars that could arrive while they are crossing. Doing so requires pedestrians to see much farther than drivers do. Sufficient pedestrian sight distance depends on vehicle speed and the time pedestrians need to cross the street.[12]

Bus stops located in areas with inadequate pedestrian sight distance should be moved or eliminated.

Consider a four-lane road with a 35 mph speed limit. It was designed with 250 feet of sight distance, as needed by drivers. The road is 44 feet wide, which takes 12.6 seconds to cross at a standard 3.5 feet per second. To know whether they can cross safely, pedestrians must see at least 618 feet down the road. If drivers exceed speed limits by 10 mph, pedestrians will need to see at least 834 feet down the road.

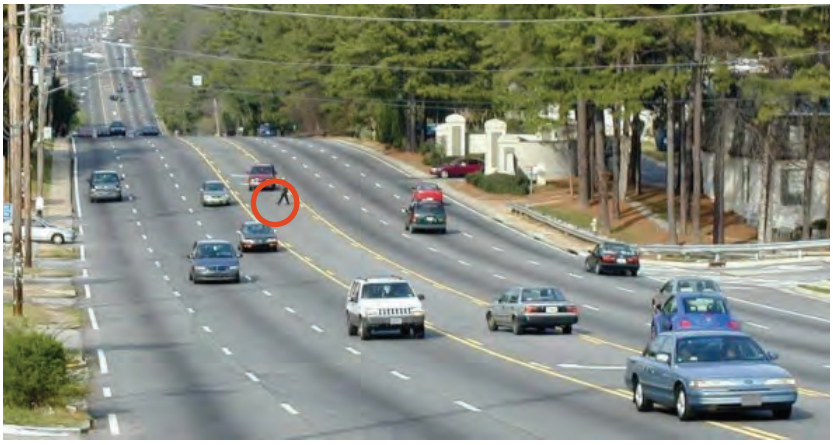
11 http://www-nrd.nhtsa.dot.gov/Pubs/809-456.pdf

12 http://trid.trb.org/view/1984/M/214398

Distance to nearest crosswalk

Placing crossings close to people's starting points and destinations increases the likelihood that pedestrians will use them.

Research suggests that most people would not walk 200 feet out of their way to use the nearest crosswalk. Indeed, one survey found that half of pedestrians would not walk more than 200 feet to cross at a signalized intersection. At distances beyond 200 feet, only one-fourth of people said they would walk to the signal.



In areas with long distances between intersections, people will cross midblock.

High-speed, high-volume streets with six or more lanes are an exception. On these, 65 percent of people indicated they would walk 600 feet to cross.[13]

Delay

For decades, transportation agencies have prioritized minimizing driver delay. Professionals recently developed similar measures for pedestrians. The *Highway Capacity Manual* rates pedestrian crossings based on how long pedestrians have to wait.[14] The longer the pedestrian wait time, the more likely people are to try crossing without a sufficient gap in traffic. Pedestrian delays that exceed 45 seconds create a high likelihood of risk-taking behavior.[15]

Pedestrian volume

Traffic signal warrants require a high minimum number of pedestrians. On roads with speed limits of 35 mph or higher, at least 93 pedestrians during the peak hour or 300 in a four-hour period are needed to warrant a traffic signal. In places where over 15 percent of pedestrians cross slower than 3.5 feet per second, the MUTCD reduces the number of people required to warrant a pedestrian signal to 47 pedestrians per hour or 152 over a four- hour period.

13 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

14 http://www.apbp.org/news/news.asp?id=62828

15 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

Similarly, the MUTCD requires at least 20 pedestrians per hour for the installation of a Pedestrian Hybrid Beacon (HAWK).

Yet requiring a minimum pedestrian volume creates problems. Gap analysis finds many locations where a pedestrian cannot cross without unreasonable delay.

Adopting minimum-access guidelines for pedestrians would help prevent disparities in the treatment of vulnerable road users. Transportation investments that benefit motorists and transit users are not based on current usage, but on projections of latent demand. At locations that currently show low pedestrian volumes, installing safe crossings may increase the number of pedestrians who choose to cross the street.

Vulnerable users

Locations frequented by seniors, children, people with disabilities or people likely to be under the influence of drugs or alcohol require a higher safety standard.

Seniors

Seniors need more time to cross the street. To accommodate this, pedestrian signal timing should be based on an assumed walking speed of 2.8 feet per second.[16]

Children

Children under 10 lack the developmental skills needed to cross safely. They're also difficult to see. Georgia law prohibits drivers from passing a school bus that has stopped to pick up children or let them off bus. This law does not apply to public transit buses that take children to or from school.

In metro Atlanta, 7.7 percent of transit trips are to schools other than colleges.[17] Transit agencies and schools should identify which bus stops are used by school children and work with transportation agencies to promote safety improvements where needed.

16 http://www.fhwa.dot.gov/publications/publicroads/99mayjun/olddrvrs.cfm

17 http://www.atlantaregional.com/transportation/travel-demand-model/on-board-transit-survey

Lack of ADA-compliant curb ramps and sidewalks forces many wheelchair users to ride in the street

People with disabilities

Lack of ADA-compliant ramps and sidewalks forces many wheelchair users to ride in the street, where they are at high risk of being hit. Unlike other pedestrians, people using assistive devices cannot step off the road when they see oncoming traffic.

At intersections with complex geometry or signal phasing, people with visual disabilities find it difficult to determine when it's their turn to cross the street. Listening for the onset of parallel traffic is not enough to enable pedestrians with visual impairments to determine the beginning of the WALK interval. People with visual impairments also find it difficult to obtain usable orientation and directional information about crossings from the available cues. For them, too little traffic can be as great a problem as too much traffic.[18]

Pedestrians under the influence

People under the influence of drugs or alcohol need a safe alternative to driving. Just as passive safety techniques have made roads safer for drivers, designers should create streets that are forgiving to pedestrians.

Median refuge islands and other devices described in Toolkit 2 can all contribute to a safer pedestrian environment for people on foot.

18 http://accessforblind.org/aps/

Toolkit 2 | Safe Crossing Treatment Options

This toolkit describes available crossing safety treatments, assesses the pros and cons of each and describes the locations where they are most and least appropriate. The toolkit categories crossings in three ways: enhanced, active or red light. It also considers how changes to the road can influence the effectiveness of safety improvements.

Enhanced crossings

Enhanced crossings simplify crossings or increase their visibility to motorists. These measures do not, however, ensure that drivers will stop.

Medians and median islands

The Federal Highway Administration has identified medians and median refuge islands as one of the top safety countermeasures, especially in urban and suburban areas.

Median islands can be built prior to considering or installing crosswalks or other treatments.

When used without marked crosswalks, median islands are not intended to cause drivers to stop. Instead, raised islands provide a safe refuge so pedestrians can split crossings into two stages, with a safe place to wait in between. Benefits include:

- Making it easier and quicker for people to achieve safe gaps in traffic
- Enabling pedestrians to evaluate traffic in each direction separately
- Increasing pedestrian visibility
- Cutting the distance pedestrians must see by half
- Providing a safe refuge for people unable to cross the whole road in the allotted time
- Providing space for installing road lighting or additional safety countermeasures.

Raised islands enable people to split their crossing into two phases.

Medians and median refuge islands should be at least six feet wide to accommodate wheelchairs, baby strollers and bicycles. Installing bollards on each end of islands can increase their visibility and provide additional protection to pedestrians. Installing push buttons on refuge islands will help prevent seniors, people with disabilities and others from becoming stranded.

When used at locations with crosswalks, median refuge islands cut pedestrian crashes by 46 percent.

Pedestrian refuge islands should include an angled or zig-zag cut-through, even when used without crosswalks. Cut-throughs make medians and islands accessible to all users and will cut costs if crosswalks are later added. Zig-zag cut-throughs encourage pedestrians to look toward oncoming traffic during the second phase of their crossing. When used with crosswalks, staggering the crosswalks in the appropriate direction will reinforce this behavior.

Research shows that medians and median islands reduce pedestrian crashes by 39 percent at locations without marked crosswalks and by 46 percent at locations with marked crosswalks.[19] Even on multi-lane streets, median refuge islands can cut pedestrian crash rates by 50 to 75 percent. Raised medians or median islands may also improve traffic flow and driver safety.[20]

The average cost of a median island is $13,520, with costs ranging from $2,100 for a simple island to $40,000 or more for installations with crosswalks, cut-throughs, and railings to direct pedestrians.

Marked crosswalks

Marked crosswalks facilitate crossings at many uncontrolled locations. Yet research shows that marked crosswalks on their own are insufficient on multi-lane streets with high traffic speeds or volumes. In most cases, they should be used in combination with other treatments, such as raised islands, enhanced lighting and signage.[21]

19 http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.htm

20 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

21 http://www.fhwa.dot.gov/publications/research/safety/04100/04.cfm

The MUTCD calls on agencies to perform an engineering study prior to installing a marked crosswalk at locations that are not controlled by signals, HAWKs or stop signs. The MUTCD also limits where new marked crosswalks can be installed. Unless supplemented with other pedestrian safety countermeasures, crosswalks should not be installed across roads with over three lanes where the speed limit exceeds 40 mph and the road has either

- 12,000 or more cars a day without a raised median or refuge island, or
- 15,000 or more cars a day with a raised median or refuge island.

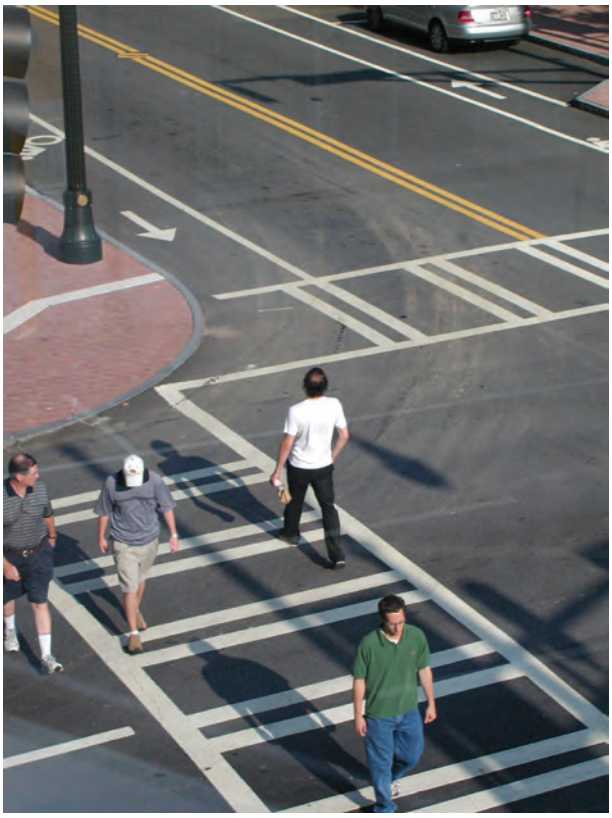
The MUTCD allows aesthetic crosswalk treatments, but only when they are supplemented with retro-reflective markings. High-contrast colors are more visible than other treatments, which makes brick-colored crosswalks a poor choice at uncontrolled crossings.

On streets with more than one lane of traffic in the same direction, using advanced stop bars will help ensure that when one vehicle stops, drivers in the other lane can see crossing pedestrians.

High-visibility signs and pavement markings

High-reflectivity yellow-green signs and high-visibility pavement markings both increase crosswalk visibility. Crosswalk markings painted parallel to the direction of vehicle travel, such as continental, bar, and ladder-style crosswalks greatly increase visibility.[22] Placing reflective markings on sign poles also may increase their visibility to drivers.

The R1-9A overhead regulatory signs may be more effective than the diamond-shaped W11-2 warning sign in increasing driver compliance with crosswalk laws.



Crosswalk markings painted parallel to the direction of vehicle traffic increase visibility.

22 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

Using multiple treatments, such as advanced stop bars and "Stop Here" signs also enhances visibility. Placing advanced stop bars 30 to 50 feet before a crosswalk reduces the risk of multiple-threat crashes. Research shows drivers begin slowing earlier for a crosswalk with advanced stop bars. Advanced stop bars and "Stop Here for Pedestrians" signs are best used in combination.[23]

In-street crossing signs

At locations on two-lane roads with in-street crosswalk signs, 87 percent of drivers yield or stop for pedestrians.[24] Transportation professionals favor using these on roads with a speed limit of 30 mph or less.

Several factors may contribute to the effectiveness of in-street crosswalk signs:

- Drivers are more likely to notice signs located in the street
- The signs remind drivers to look for pedestrians waiting to cross
- Drivers slow down to avoid hitting the signs
- Pedestrians are more likely to use crosswalks at locations with in-street signs

In-street crosswalk signs are frequently hit by cars and need periodic replacement.[25] Placing these on a raised or flush median reduces maintenance costs. Signs cost about $300 each.[26]

Overhead lighting

Overhead lighting at intersections reduces fatal vehicle-pedestrian crashes by 80 percent. It also reduces other pedestrian-injuring crashes by 59 percent.[27] Proper lighting involves an overhead light just upstream of the crosswalk on each half of the crossing.[28]

Overhead lights should be located just upstream of crosswalks.

23 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf
24 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf
25 http://trb.metapress.com/content/f166777741250518/
26 http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/physical-alphabetical.htm
27 http://www.cmfclearinghouse.org/study_detail.cfm?stid=14
28 http://www.fhwa.dot.gov/publications/research/safety/08053/index.cfm

Additional lighting is a cost-effective treatment in locations where other options are limited. The cost of crosswalk lighting projects varies by location.

Active crossings

Active crossings dynamically alert drivers to the presence of pedestrians who are crossing or are about to cross. Active treatments include Rectangular Rapid Flash Beacons, crossing flags, flashing amber beacons and embedded lights. These treatments are most effective on streets with four lanes or fewer and speed limits of 35 mph or less.

Standard crosswalk laws apply: the driver of a vehicle must stop and remain stopped to allow a pedestrian to cross the street. Pedestrians must not leave a sidewalk or other place of safety and walk into the path of a vehicle so close that the driver cannot stop. Yet activating these treatments does not obligate the driver to stop until pedestrians step into the crosswalk. Pedestrian education remains important.

Rectangular Rapid-Flash Beacons (RRFBs)

RRFBs use Light Emitting Diode (LED) lights with a "stutter-flash" similar to that used by emergency vehicles. Research shows they prompt higher driver compliance rates than other active treatments. Even where no median exists and just one RRFB is used in each direction, RRFBs can be effective on multi-lane roads, with more than four out of five drivers stopping for pedestrians.[29]

When using RRFBs on multi-lane roads, installing a second set of beacons in the median or on a median island increases effectiveness. Going from two RRFBs to a four-beacon setup increases the safety of the crossings by 35 percent. [30] RRFBs are new, so insufficient data exists on how well they maintain their effectiveness over time.

The Georgia Department of Transportation recommends having one RRFB per travel lane. RRFBs should not be used on roads with three or more through lanes in each direction. On four-lane roads with speed limits of 30 mph or less, two RRFBs could be used in combination with in-street crosswalk signs.

RRFBs have been especially effective at night, a time when traditional crosswalks and signage are harder to see. While the traditional crosswalk lost three-fourths of its effectiveness at night, over 99 percent of drivers stopped for pedestrians at locations with four-beacon RRFBs.[31]

29 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

30 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

31 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

When installing RRFBs, the LEDs should be angled toward the eyes of drivers where they must begin stopping. RRFBs where the LEDs are unadjusted lost half their effectiveness in getting drivers to yield or stop.[32]

Rectangular Rapid Flash Beacons prompt more drivers to stop at crosswalks than other active treatments.

Not yet incorporated into the MUTCD, RRFBs still hold experimental status. In Georgia, the FHWA has approved their use on state highways, as well as on local roads in Atlanta, Decatur, Roswell, and other local municipalities.

RRFBs are especially appropriate at locations where pedestrian volumes are too low to warrant a signal or HAWK. Unlike HAWKs, RRFBs can be used at intersections.

The average price for a pair of RRFBs is $22,250. A four-beacon installation costs $30,000 to $40,000.[33]

Crossing flags

Providing orange flags for pedestrians to carry while using crosswalks enables people to enhance their visibility. Research shows that flag crossings can be effective in low-speed locations. One study found that motorists yield to pedestrians 65 percent of the time, even on multi-lane roads with posted speed limits of 30 to 35 mph.

At locations with flags, people are more likely to cross at crosswalks and look both ways before crossing.

Flags tend to get stolen, especially when treatments are first installed. Yet crossing flags can be replaced at a fairly low cost. Salt Lake City cut material and labor costs by having local community groups adopt responsibility for replenishing flags.[34]

32 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

33 http://safety.fhwa.dot.gov/intersection/resources/techsum/fhwasa09009/

34 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

Flashing beacons

Flashing beacons equip crosswalk signs with amber warning lights, illuminated in an alternating fashion. They can be mounted overhead, on roadside signs or both. Flashing beacons can be pedestrian-activated or flash continuously. They are used in a variety of circumstances. Driver compliance with crosswalk laws at locations with these signs varies widely, from 25 percent to 75 percent.[35]

In metro Atlanta, flashing overhead beacons have been relatively ineffective at prompting driver compliance with crosswalk laws. Drivers tend to tune out beacons that flash continuously. Yet research shows that the impact of converting continuously flashing beacons to ones that flash only when activated by pedestrians is low. [36]

Field observations suggest that pedestrians have little confidence in the effectiveness of flashing beacons. In one study, only 22 percent of pedestrians crossing at pedestrian-activated flashing beacons both pushed the button and waited for the appropriate time to cross. Nine out of ten looked both ways when crossing.[37] The average cost of flashing beacons is $10,000.

Embedded lights

When installed properly, lights embedded in the roadway at crosswalks and in crosswalk warning signs lead 50 to 90 percent of drivers to stop. Embedded lights have also been shown to increase the distance at which drivers recognize the crosswalk and begin slowing, suggesting that they may be effective even on higher-speed roads.

Embedded lights are more visible at night than in sunlight. These installations may be most appropriate for college campuses, bar districts or at transitions in road environment, such as in a rural town or at a freeway exit. Embedded lights should not be used where queuing traffic is likely to block drivers' view of the lights.[38] The MUTCD regulates use of embedded roadway lights.

The average cost of embedded lights is $17,620 per crosswalk. Embedded roadway lights often have high maintenance costs. Over time, road grit and dirt obscures lights, which leads to high maintenance costs.

35 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

36 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

37 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

38 http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

Red-light treatments

Red light crossings use traffic signals or HAWK beacons to stop drivers before pedestrians get a walk signal. These are usually the safest treatments for high-speed roads or those with high traffic volumes. The MUTCD considers red light treatments to be traffic control devices and regulates where they can be used.

HAWKs

The MUTCD identifies the **H**igh-intensity **A**ctivated Cross**W**al**K** (**HAWK**) as a "Hybrid Pedestrian Beacon." The "beacon" designation allows HAWKs to be installed in locations with too few pedestrians to warrant a traffic signal. Locations with at least 20 pedestrians per peak hour may meet MUTCD warrants for a HAWK.

The HAWK was designed for mid-block pedestrian crossings and is well-suited for high-speed, multi-lane roads. Federal guidance recommends that HAWKs be used where gaps in traffic are too few to allow pedestrians to cross, where pedestrians delay is excessive or where high-speed roads make the crossing overly hazardous for pedestrians. Such locations often include crossings near schools and at transit stops.

HAWKs should be located at least 100 feet from the nearest intersection or driveway. They should be used in combination with high-visibility crosswalk markings and advanced stop bars.

HAWK beacons are well-suited for mid-block crossings on high-speed, multi-lane roads.

To reduce driver delay on wide roads, HAWKS can be timed for a multi-stage crossing. This requires drivers to stop only when pedestrians are on their side of the road. Yet field observations show that most pedestrians fail to activate buttons located on medians. Using automated detection of pedestrians or synchronizing the timing of the second phase would eliminate the need for pedestrians to push a button when standing on the median.

The Georgia Department of Transportation runs HAWK beacons on "free operation" for a few months following installation. This enables pedestrians to learn that pushing the button triggers a response. If traffic flow is a concern, GDOT will later program HAWKs to coordinate with adjacent signals.

Research shows that HAWKs reduce pedestrian crashes by 69 percent and reduce all crashes by 29 percent. By prompting drivers to begin stopping sooner, HAWKs may also reduce the severity of crashes that do occur. Field observations show that motorists often fail to understand they are allowed to proceed during the red flashing phase once pedestrians have finished crossing their half of the road.[39]

The average cost for a pair of HAWKs is $57,680, with annual electricity expenses averaging $2,000. On wider streets, the need for longer mast arms and stronger poles and foundations make HAWK installations more expensive.[40]

Traffic signals

Drivers nearly always stop for signals with red lights. Yet in congested traffic, drivers may run red lights or make reckless turns without looking for pedestrians.

Turning drivers often fail to look for pedestrians.

Numerous options may increase pedestrian safety and propensity to use signalized intersections. These include:

Restricting turns

- Banning right-on-red turns cuts injury crashes by 35 percent. Banning right-on-red is most appropriate at locations with poor driver visibility or where right-turning drivers consistently fail to stop before turning.

Signage

- The MUTCD R10-15 sign reminds drivers to stop for pedestrians before turning. When posted in Georgia, the sign should use a "Stop" image instead of the yield symbol.

The R10-15 signs reminds drivers to stop to stop for pedestrians before turning.

39 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

40 http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/physical-alphabetical.htm
http://katana.hsrc.unc.edu/cms/downloads/Countermeasure%20Costs_Report_Nov2013.pdf

Pedestrian-friendly signal timing

- A Leading Pedestrian Interval gives pedestrians a few seconds head start before motorists get a green light. This increases pedestrian visibility and turning drivers' compliance with crosswalk laws.
- Designating an exclusive pedestrian interval, where all vehicles remain stopped while pedestrians cross, protects pedestrians from turning cars.
- Replacing leading left turns with lagging lefts helps protect pedestrians from turning cars.
- Limiting signal cycle lengths to 90 seconds or less increases pedestrian compliance with crosswalk laws.
- Installing countdown timers provides information that discourages pedestrians from stepping into the street too late. It also increases safety for seniors and people with disabilities.
- Timing "Walk" intervals for pedestrians who can travel no faster than 3.5 feet per second provides sufficient time for people to finish crossing before the signal changes. In areas with older pedestrians or people with disabilities, longer walk intervals may be needed.

Automatic recall, concurrency and automatic detection

- Using concurrent "walk" intervals wherever the green phase for parallel traffic is long enough for pedestrians to cross, increases the likelihood that people will cross with the walk signal.
- Using automatic recall rather than pedestrian-activated signals for walk signals in urban activity centers, eliminates the need for pedestrians to push a button.
- Installing pedestrian pushbuttons that provide feedback, such as a light or a sound, may increase pedestrians' willingness to wait for the walk signal.
- Installing equipment that detects pedestrians automatically eliminates the need for people to push a button.

Midblock signals

Most traffic signals are located at intersections. Yet where schools or other activity centers lead a large number of people to cross at a mid-block location, a traffic signal may be warranted. Locating signals away from intersections and driveways increases safety by minimizing conflicts with turning vehicles.

Any signal warranted by pedestrian volume should meet the requirements set forth in the MUTCD. On roads with speed limits of 35 mph or higher, at least 93 pedestrians are

required during the peak hour or 300 during a four-hour period to warrant a midblock crossing. If over 15 percent of pedestrians cross slower than 3.5 feet per second, however, the threshold can be reduced to 47 pedestrians per hour or 152 over a four-hour period.

Accessibility to people with disabilities

ADA-compliant ramps or cut-throughs are especially important at locations where seniors or people with disabilities are likely to use assistive devices.

Accessible pedestrian signals (APS) provide audible and/or vibrotactile information that coincide with visual pedestrian indicators. These may be needed around trains stations and bus stops, since many people with visual disabilities use transit. The installation of APS should be based on an engineering study. Intersections where APS may be needed include those with:

- Split phase signal timing
- Leading pedestrian intervals
- T-shaped intersections
- Skewed intersections
- Wide crossings
- High volumes of turning vehicles
- Low volumes of through vehicles
- Crossings of major streets where minor streets have minimal or intermittent traffic
- Exclusive pedestrian phasing, especially where right-turn-on-red is permitted.[41]

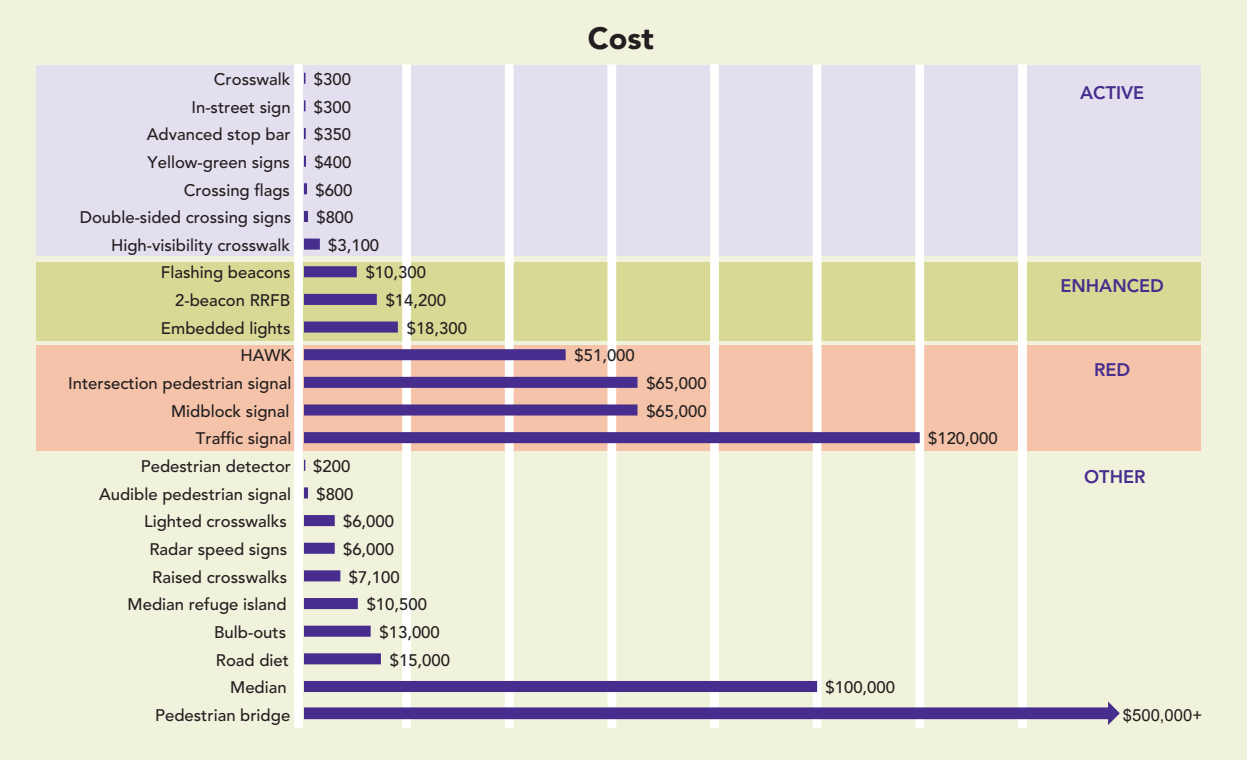
41 http://www.apsguide.org/chapter5_installations.cfm

TOOLKIT 3 | Summary Charts: Cost, Effectiveness and Feasibility

This toolkit compares crossing treatment costs and their effectiveness at getting drivers to stop or yield to pedestrians. Reference charts show which treatments are feasible for various conditions, including vehicle speed, number of lanes, and pedestrian and vehicle traffic. Check marks indicate which devices may be feasible in each circumstance.

Cost estimates

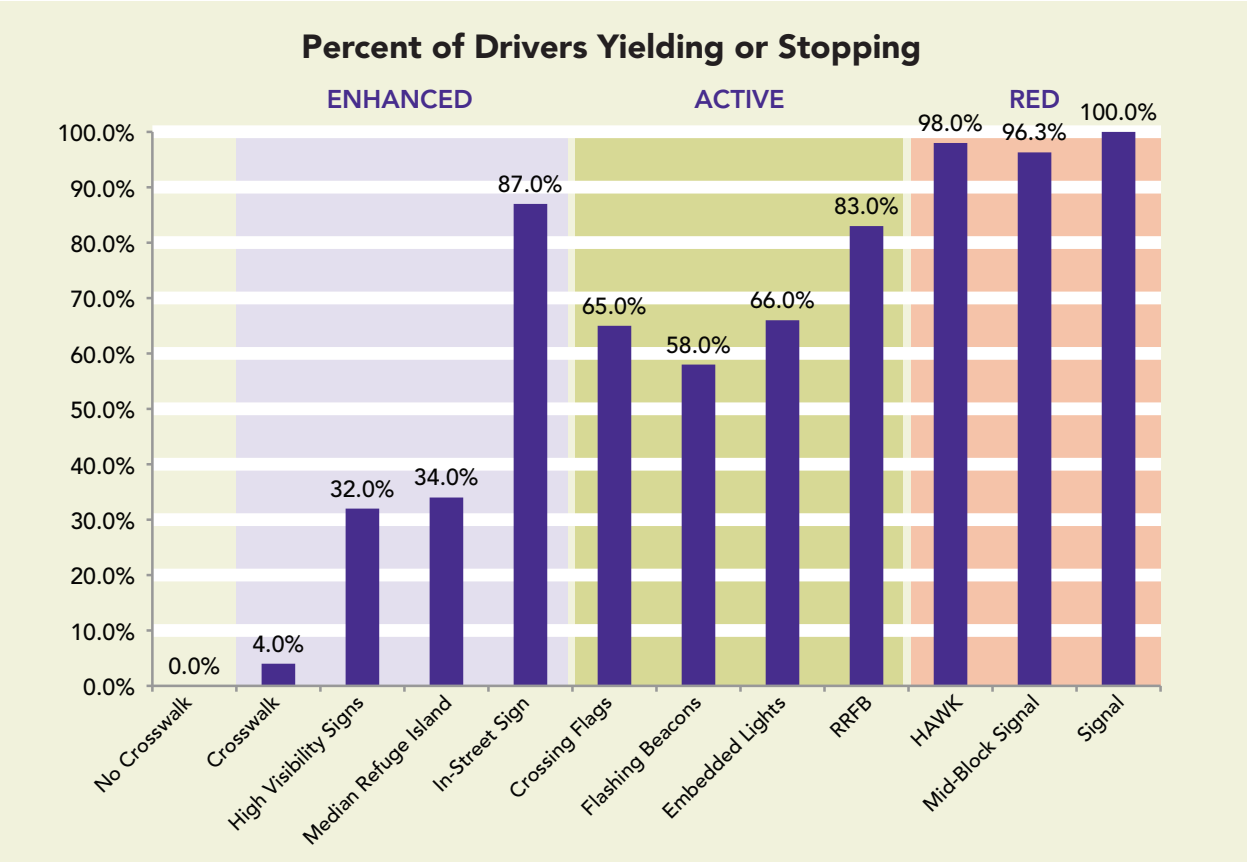
The three levels of crosswalk improvements — enhanced, active, and red light — are generally reflected in their price tag. Most simple crosswalk enhancements can be installed for under $1,000. Treatments that involve constructing a median or median refuge island are higher. Active treatments start at around $10,000, but often will also include constructing a median, which can cost up to $25,000. Active treatments mounted overhead are most expensive, since their poles require deep foundations. Devices using red lights are typically mounted overhead and cost about $100,000. The chart below provides price estimates for various safety improvements.[42]



42 http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/physical-alphabetical.htm; http://katana.hsrc.unc.edu/cms/downloads/Countermeasure%20Costs_Report_Nov2013.pdf

Driver compliance with crosswalk laws

Each level of treatment influences driver behavior.[43] Devices using a red light are most effective in prompting drivers to stop for pedestrians, with compliance rates between 95 and 100 percent. At active treatments, drivers stop or yield about two-thirds of the time. Among active treatments, RRFBs are the most effective, prompting 80 to 90 percent of drivers to stop or yield. Enhanced crossings have the lowest driver compliance, making them appropriate only on low speed roads with three lanes or less. In-street crosswalk signs prompt a high compliance rate on two- and three-lane streets with speed limits of 30 mph or lower.[44]



Selecting treatments

Determining appropriate crossing treatments requires careful consideration of road width, vehicle speeds and volume of vehicles and pedestrians. The tables that follow are intended as a quick reference guide, but are not intended to supplant engineering standards and professional judgment.

43 http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

44 TCRP 112 / NCHRP 562, FHWA-HRT-0139;
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf;
http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

The tables below use road width, speed limits and vehicle and pedestrian volume to help select appropriate treatments. Site-specific studies should consider these and other factors.

NUMBER OF LANES	2	3	4	5	6	7
Crosswalk	✓	✓	✓	✓		
Traffic Calming	✓	✓		✓		
In-Street Sign	✓	✓	✓	✓		
Yellow-Green Signs	✓	✓		✓		
2-Sided Signs	✓	✓		✓		
Crossing Flags	✓	✓	✓	✓		
2-Beacon RRFB	✓	✓				
4-Beacon RRFB	✓	✓	✓	✓		
Flashing Beacons	✓	✓	✓	✓	✓	✓
Embedded Lights	✓	✓	✓	✓	✓	✓
HAWK	✓	✓	✓	✓	✓	✓
Mid-Block Signal	✓	✓	✓	✓	✓	✓
Signal	✓	✓	✓	✓	✓	✓

VEHICLE TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	✓
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	✓
Yellow-Green Signs	✓	✓	
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	✓
2-Beacon RRFB	✓	✓	✓
4-Beacon RRFB	✓	✓	✓
Flashing Beacons	✓	✓	
Embedded Lights	✓		
HAWK		✓	✓
Mid-Block Signal		✓	✓
Signal		✓	✓

SPEED LIMIT (MPH)	30	35	40	45	50	55
Crosswalk	OK	?	?	NO	NO	NO
Traffic Calming	OK	OK	?	?	NO	NO
In-Street Sign	OK	OK	?	NO	NO	NO
Yellow-Green Signs	OK	OK	?	NO	NO	NO
2-Sided Signs	OK	OK	?	NO	NO	NO
Crossing Flags	OK	OK	?	?	?	?
2-Beacon RRFB	OK	OK	OK	?	?	?
4-Beacon RRFB	OK	OK	OK	?	?	?
Flashing Beacons	OK	OK	OK	?	?	?
Embedded Lights	OK	OK	OK	?	?	?
HAWK	OK	OK	OK	OK	OK	OK
Mid-Block Signal	OK	OK	OK	OK	OK	OK
Signal	OK	OK	OK	OK	OK	OK

PEDESTRIAN TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	
Yellow-Green Signs	✓		
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	
2-Beacon RRFB	✓	✓	
4-Beacon RRFB	✓	✓	
Flashing Beacons	✓	✓	
Embedded Lights	✓	✓	
HAWK		✓	✓
Mid-Block Signal			✓
Signal			✓

LEGEND

✓ indicates the treatment may be feasible

OK indicates the treatment may provide adequate warning to drivers

? suggests other conditions may limit treatment effectiveness

NO indicates the treatment is not appropriate

Number of lanes

Enhanced and active crosswalk treatments are well suited for roads with two- and three-lane cross-sections and for multi-lane roads with medians or median islands.

# OF LANES	2	3	4	5	6	7
Crosswalk	✓	✓	✓	✓		
Traffic Calming	✓	✓		✓		
In-Street Sign	✓	✓	✓	✓		
Yellow-Green Signs	✓	✓		✓		
2-Sided Signs	✓	✓		✓		
Crossing Flags	✓	✓	✓	✓		
2-Beacon RRFB	✓	✓				
4-Beacon RRFB	✓	✓	✓	✓		
Flashing Beacons	✓	✓	✓	✓	✓	✓
Embedded Lights	✓	✓	✓	✓	✓	✓
HAWK	✓	✓	✓	✓	✓	✓
Mid-Block Signal	✓	✓	✓	✓	✓	✓
Signal	✓	✓	✓	✓	✓	✓

For treatments that rely on roadside signs or devices, GDOT recommends providing one device adjacent to each through lane. This would exclude the use of many devices on four-lane undivided arterials and roads with more than two through lanes in each direction. Where three or more travel lanes are adjacent to each other, crosswalk treatments should include devices that span the road overhead, are carried by pedestrians or are located in the street.

At locations with fewer than 20 pedestrians per peak hour, engineers should consider supplementing an active treatment with one that increases visibility. On a four-lane road, for example, RRFBs could be supplemented with in-street crosswalk signs or crossing flags.

Reducing the number of through lanes allows room for raised medians or median islands in a two-way left turn lane. If a road diet is not feasible, engineers should look for other space where median islands could be installed. Consolidating driveways may increase the feasibility of installing medians.

Speed limits

On roads with speed limits of 30 mph and below, all treatments may be appropriate. On roads with speed limits of 45 mph and higher, signage and high visibility markings are not enough to

SPEED LIMIT (MPH)	30	35	40	45	50	55
Crosswalk	OK	?	?	NO	NO	NO
Traffic Calming	OK	OK	?	?	NO	NO
In-Street Sign	OK	OK	?	NO	NO	NO
Yellow-Green Signs	OK	OK	?	NO	NO	NO
2-Sided Signs	OK	OK	?	NO	NO	NO
Crossing Flags	OK	OK	?	?	?	?
2-Beacon RRFB	OK	OK	OK	?	?	?
4-Beacon RRFB	OK	OK	OK	?	?	?
Flashing Beacons	OK	OK	OK	?	?	?
Embedded Lights	OK	OK	OK	?	?	?
HAWK	OK	OK	OK	OK	OK	OK
Mid-Block Signal	OK	OK	OK	OK	OK	OK
Signal	OK	OK	OK	OK	OK	OK

OK indicates the treatment may provide adequate warning to drivers.

NO indicates the treatment is not appropriate.

? suggests other conditions may limit effectivenes.

create safe crossings. Active treatments may be insufficient as well. Crosswalk treatments may require a red light that brings drivers to a stop before pedestrians cross.

On roads with speed limits of 35 or 40 mph, creating safe crossings is more complex and may need multiple treatments. Selecting treatments requires use of professional judgment skills.

VEHICLE TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	✓
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	✓
Yellow-Green Signs	✓	✓	
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	✓
2-Beacon RRFB	✓	✓	✓
4-Beacon RRFB	✓	✓	✓
Flashing Beacons	✓	✓	
Embedded Lights	✓		
HAWK		✓	✓
Mid-Block Signal		✓	✓
Signal		✓	✓

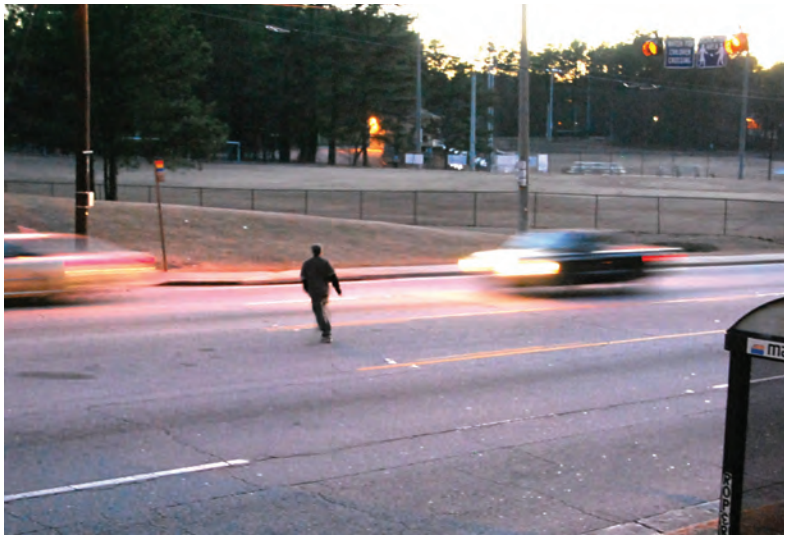
A ✓ indicates the treatment may be feasible, based on traffic volume

Traffic gaps

In areas with light vehicular traffic, pedestrians do not have to wait long to find a safe gap in traffic. Yet limited sight distance or low driver expectancy could lead to crashes. This may make crossing treatments desirable even in areas with low traffic volumes.

In moderate traffic, pedestrians can find safe gaps in traffic, but may have to wait an unreasonably long time to do so. Long delays prompt risky crossing behavior, so pedestrians may try crossing on shorter gaps. Supplementing a crosswalk with other safety treatments would make traffic conditions more manageable for pedestrians. An acceptable pedestrian level of service includes at least 60 safe traffic gaps per hour.

On roads with few traffic signals and heavy automobile traffic, safe gaps are rare. Crossing the street would require pedestrians to use shorter gaps. Yet people should not have to run to make it across the street. Nor should drivers have to slam on the brakes to avoid hitting them. Installing a traffic signal, HAWK or other high-visibility crosswalk treatment will increase safety.



On roads with heavy traffic, safe gaps are rare.

Pedestrian use

High pedestrian traffic volume often increases driver delay. At locations with many pedestrians, installing more expensive treatments is likely to reduce motorist delay and increase pedestrian safety. Balancing pedestrian and motorist delay may require installing a traffic signal or HAWK beacon.

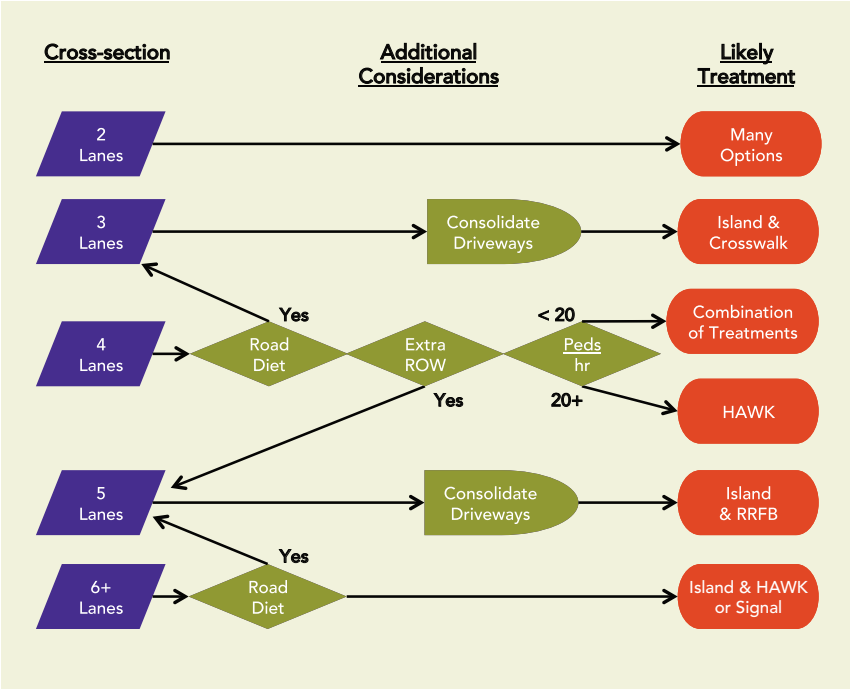
PEDESTRIAN TRAFFIC	LIGHT	MEDIUM	HEAVY
Crosswalk	✓	✓	
Traffic Calming	✓	✓	✓
In-Street Sign	✓	✓	
Yellow-Green Signs	✓		
2-Sided Signs	✓	✓	
Crossing Flags	✓	✓	
2-Beacon RRFB	✓		
4-Beacon RRFB	✓		
Flashing Beacons	✓	✓	
Embedded Lights	✓	✓	
HAWK		✓	✓
Mid-Block Signal			✓
Signal			✓

A ✓ indicates the treatment may be feasible, based on number of pedestrian users.

Possible crossing solutions

The flowchart below shows common treatments, based on the number of lanes and other considerations. It is intended to inform, but not supplant, engineering standards and professional judgment.

Four-lane and six-lane streets are especially dangerous and often need a combination of treatments. For both, reconfiguring the road increases options. Road diets reduce the number of motor-vehicle through lanes and create space for median islands. Consolidating driveways may enable median islands to be located closer to pedestrians' desired travel line.



Toolkit 4 | Bus Stop Location

This toolkit describes best practices for locating bus stops and safety treatments in ways that maximize the accessibility and safety of both. This toolkit considers distance between bus stops, accessibility requirements, legal responsibilities, bus stop and crosswalk visibility and inter-agency collaboration. It also recommends when bus stops should be closed or relocated.

Distance to a bus stop

Each transit agency determines its own standard for optimal bus stop spacing. Many transit planners consider one-fourth of a mile to be the farthest transit users are willing to walk to a bus stop. To increase access for seniors and individuals with disabilities, most U.S. transit agencies place stops more frequently than that.[45] Short distances between stops make them quick and easy to access. Placing bus stops close together may also expand the area within walking distance of transit.

To create stops within walking distance of their customers, transit agencies often place bus stops at locations other than signalized intersections. This is common on high-speed, multi-lane arterials, where signalized intersections are sometimes a half-mile to a mile apart. In many places, transit users need to cross at uncontrolled locations to reach the nearest bus stop.

Minimum safety standards

People who use transit expect to cross the street when they get on or off the bus. Given that, all bus stops should be located where pedestrians can cross the street safely or where a safe crossing can be created.

Ideally, a pair of bus stops across the street from one another should be connected by a crosswalk with adequate safety treatments. Otherwise, a pedestrian rushing to catch a bus may make risky decisions about where to cross. Similarly, a passenger disembarking from a bus may not gather enough information about the surroundings before trying to cross the street. Whenever possible, bus stops should be located immediately adjacent to crosswalks to encourage their use.

Well-placed bus stops can direct pedestrians to cross at locations without hills and curves that limit driver visibility or block pedestrians' view of traffic. To minimize conflicts with

45 http://www.humantransit.org/2010/11/san-francisco-a-rational-stop-spacing-plan.html

turning traffic, bus stops can be placed away from intersections and driveways. When evaluating bus stop spacing, transit agencies should consider proximity to existing median refuge islands and safe crossings.

If a bus stop location does not meet minimum safety standards, transit providers should ask their road authority to install crossing treatments. Transportation engineers have many ways to make installing a crosswalk more feasible, including clearing sight lines, changing speed limits, or altering the cross section, profile, or alignment of the road. At bus stop locations where crosswalks are not feasible, installing a median refuge island and overhead lighting can increase safety and accessibility.

Accessibility requirements

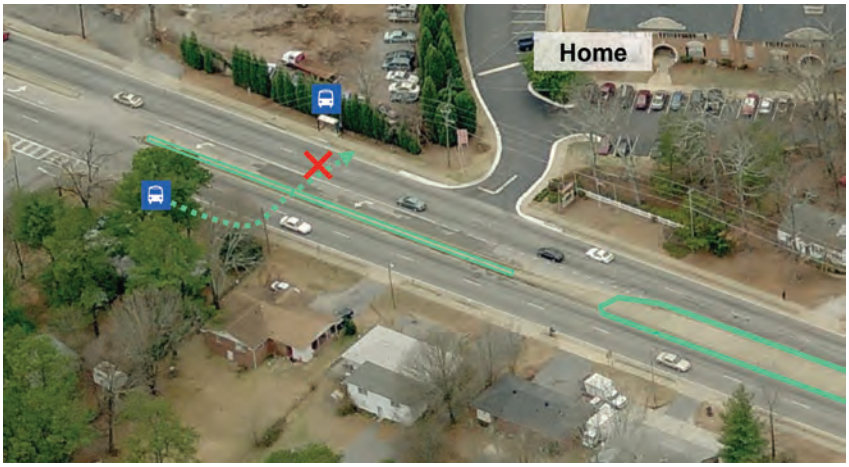
Transit must be accessible to all users, including people with disabilities. The U.S. Access Board affirms that a transit system as a whole must be accessible, even if some stops do not meet minimum access standards.[46] Installing concrete "landing pads" for boarding and exiting at bus stops will increase accessibility.

Landing pads enable people with disabilities to board and exit buses.

Relocating or closing bus stops

Relocating bus stops is a low-cost way to improve pedestrian safety. At locations where poor sight distance makes it impossible to install safety treatments that enable the bus stop to meet the minimum safety standards, the bus stop should be removed or relocated.

If poor sight distance means people would have to walk father than a quarter mile to reach the nearest bus stop, transportation agencies should install measures that make the crossing safe.



Relocating bus stops to places with medians is a low-cost way to increase safety.

46 http://www.tripplannermag.com/index.php/2011/01/the-old-stick-in-the-mud

To prevent transit users from crossing at dangerous locations, some bus stops may need to be eliminated. Where bus stops are closely spaced, the impact of removing one stop can be minimal. From an operations perspective, consolidating bus stops may even be desirable.

Transit agencies can also place bus stops off the road on private property. This solution is most appropriate for major generators of transit trips, such as retail plazas or apartment complexes. Transit users will not need to cross the street if the bus makes a left turn onto private property, then makes another left to return to the road and continue on its route. Agencies can determine if needs justify the legal and operational costs of this alternative.

If none of these options are possible, zoning and land use plans should be updated to acknowledge that this area cannot be served by transit.

Far-side bus stops

On multi-lane roads, a bus stopped at a crosswalk might put pedestrians at risk of a multiple-threat crash. Even at locations with advanced stop bars, buses might block other drivers' view of roadside devices or crosswalk warning signs. Locating bus stops on the far side of crosswalks will help preserve drivers' ability to see crossing pedestrians. Pedestrians can get off the bus and cross behind it in a crosswalk.

Inter-agency collaboration

State law authorizes GDOT to regulate signs on all public roads in Georgia, including the location and design of bus stop signs. This helps keep traffic control signs uniform across the state and encourages input from transportation engineers on bus stop location.

State and local transportation agencies should develop maps showing sight distance along transit corridors. In sections with sufficient pedestrian sight distance, bus stops could be allowed without crosswalks. Agencies should prohibit bus stops and crosswalks in any section of road where drivers lack adequate stopping sight distance. GDOT policy should allow crosswalks, supplemented with appropriate safety devices, to be installed at least every quarter mile along transit routes.

The checklist below provides a useful way to evaluate safe pedestrian access to bus stops.

MINIMUM PEDESTRIAN ACCESS CHECKLIST

Bus stop location _____

Route # _____ Date: _____

ALL LOCATIONS

YES	NO	
☐	☐	Are crosswalks illuminated at night?
☐	☐	Are locations with frequent crossings marked with a crosswalk and supplemented with appropriate safety treatments?

LOCATIONS WITHOUT A CROSSWALK

☐	☐	Is pedestrian sight distance sufficient for pedestrians to see all cars that might come while they're crossing the street?
☐	☐	Do multi-lane streets have medians or median islands?

LOCATIONS WITH A CROSSWALK

☐	☐	Are marked crossings located where drivers can see far enough to stop in time?
☐	☐	Do marked crosswalks at unsignalized locations on multi-lane streets have advanced stop bars?
☐	☐	Are all signs or devices visible from each through-lane? From the edge of the road? On a median, in the street, or overhead?
☐	☐	Have treatments been adjusted if analysis shows a high crash rate or low driver compliance with crosswalk laws?
☐	☐	Have HAWK or traffic signals been installed at locations with high pedestrian counts?
☐	☐	Do crosswalks that fall in the "?" section on page 30 have enhanced visibility?
☐	☐	Do crosswalks that fall in the "No" section on page 30, or with posted speed limits over 40 mph have enhanced visibility or active crosswalk treatments?

Toolkit 5 | Remaining Gaps: Funding, Data Collection and Collaboration

This toolkit identifies safety-related concerns and calls on all agencies to work together to address them. Many agencies share responsibility for ensuring pedestrian safety. This often makes it difficult for them to determine appropriate levels of attention to issues.

Funding

Limited transportation funds dedicated to pedestrian safety infrastructure may be the biggest barrier to increasing safe pedestrian access to transit. The Atlanta Regional Commission and others have used models to calculate the cost of traffic congestion to individuals and the region. The ARC should use similar criteria to measure the cost of traffic fatalities and injuries. Such a study would help determine whether safety improvements are receiving a fair share of the region's transportation funds. The cost of pedestrian and bicycle fatalities and injuries should each be calculated separately from the cost of occupant injuries and fatalities.

Data collection

Gathering more data about pedestrian infrastructure and exposure would help agencies increase the safety of pedestrians' access to transit. Important data priorities include:

- A multi-year analysis of pedestrian crash reports
- A complete sidewalk / pedestrian network inventory
- An updated bus stop inventory
- An inventory of HAWKs and RRFBs in Georgia and an assessment of their effectiveness
- Pedestrian counts at street crossings near high-use transit stops
- Pedestrian counts in urban areas undergoing redevelopment

Responsibility and collaboration

Responsibility gaps create barriers to implementing needed safety improvements. On some issues important to pedestrian access to transit, no agency has full responsibility. Increased communication between agencies is needed. Maintenance projects, for example, provide opportunities for transit planners to work with engineers to identify opportunities for median islands and other low-cost safety improvements.

Road work

Road projects provide opportunities to relocate bus stops or install safe crossings and ADA-compliant landing pads at bus stops. Before designing road projects on transit corridors, transportation agencies should contact transit agencies to discuss opportunities for safety improvements.

During construction, temporary traffic control plans should address bus circulation, keeping bus stops open and maintaining pedestrian access. The MUTCD addresses temporary traffic control.

Streetscapes

Streetscape projects provide opportunities to enhance pedestrian access to transit. Prior to construction, designers and landscape architects should consider links with transit and submit plans to transit agencies for their review. Landscaping or street furniture must not obstruct front or rear-door zones.

Private development

Most jurisdictions in metro Atlanta require developers to install sidewalks on street frontage abutting their property. Some developers request a bus stop placed in front of their properties. Yet few projects address the demand for street crossings generated by bus stops. Jurisdictions should update their policies to require developers to pay for crosswalk safety treatments.

Other issues that fall through the cracks include:

- At intersections of local and state roads, local and state agencies often assign responsibility for addressing crossing hazards to the other agency
- Road construction projects sometimes obstruct bus stops and routes to transit without giving notice to transit users or operators
- The Georgia Regional Transportation Authority's Development of Regional Impact requirements do not require interaction between developers and transit agencies.

To increase safe pedestrian access to transit, increased collaboration among agencies is essential.

Toolkit 6 | Regional Performance Measures

Transportation agencies lack clear ways to measure safe access to transit. The Atlanta Regional Commission should adopt metrics that encourage agencies to assess the safety of current bus stop locations and to invest in safety improvements.

Suggested performance measures include:

1. Bus stops meeting the minimum safe pedestrian access standards

Determine "minimum pedestrian access" standards and measure the percent of bus stops meeting these standards. The percent can be increased either by installing crossing treatments at bus stops or removing or relocating bus stops currently at unsafe locations. Adopting these measures would encourage agencies to assess and document whether pedestrians can safely access existing bus stops.

2. Pedestrian crashes, injuries, and fatalities near bus stops

Track the annual number of pedestrian crashes, injuries, and fatalities in metro Atlanta by geography. Also track the number and percent of pedestrian crashes, serious injuries and fatalities that occur within 100 and 300 feet of transit stops. This would allow comparisons between jurisdictions.

3. Bus stops with an ADA-compliant landing pad

Track the percent of bus stops that have ADA-compliant landing pads. Adopting this measure would encourage transit agencies to assess the accessibility of their system to people with disabilities.

4. Sidewalks within walking distance of transit

Calculate the miles of ADA-compliant sidewalk per miles of road within walking distance of transit. A value of 2.0 indicates sidewalks on both sides of every street within walking distance of transit. This distance is generally regarded to be ¼ mile from every bus stop and ½ mile from every rail station. Adopting this measure would require a better inventory of pedestrian walkways in the region.

5. Expenditures on pedestrian infrastructure

Calculate total annual pedestrian expenditures throughout the Atlanta region. This measure assesses the commitment of the region to funding pedestrian projects.

6. Expenditures for pedestrian infrastructure within ¼ mile of transit

Track percent of total annual expenditures for pedestrian infrastructure that is used for projects located on or within one-fourth mile of transit corridors.

7. Locations with crosswalk enhancements

Track the number of crossing locations impacted by available funding each year. Jurisdictions could improve their score in this category by installing many low-cost treatments rather than installing a small number of expensive devices.

Toolkit 7 | Recommended Goals and Strategies

Programs and technologies exist that can dramatically increase safe pedestrian access to transit. This toolkit recommends goals and strategies that will help local, regional and state agencies take the actions needed to solve Georgia's epidemic of preventable pedestrian deaths.

Increased investment in pedestrian safety is one of the state and region's most important needs. Programs and technologies exist that can result in substantial cuts in pedestrian fatalities and serious injuries. These benefits will happen as government officials take the actions needed to implement them.

PEDS calls on the Atlanta Regional Commission to approve a goal of a 50 percent reduction by 2040 in pedestrian fatalities and serious injuries in the 10-county region, compared to 2013.

Implementation strategies should:

1. **Revise regional standards** to consider safety as equally important, at a minimum, as vehicular capacity.
2. **Complete a regional study and report** that compiles and analyzes pedestrian crash data, assesses the cost of fatal and serious injury crashes, identifies trends and considers relationships between serious crashes and environmental factors.
3. **Increase Last Mile Connectivity Program funds** to $25 million per year.
4. **Inventory bus stop locations** and assess minimum access standards for pedestrians.
5. **Incorporate pedestrian safety performance measures** in all regional transportation plans.

PEDS also calls on the Georgia Department of Transportation to approve a goal of a 50 percent reduction by 2040 in statewide pedestrian fatalities and serious injuries, compared to 2013.

Implementation strategies should:

1. **Expand Georgia's Complete Streets Policy** to require agencies to install safe crossings on transit corridors that have a high number of fatal or serious pedestrian injury crashes.
2. **Adopt policies to improve the quality and frequency of pedestrian crossings** on multi-lane arterials and other transit corridors.

3. **Increase the share of Highway Safety Improvement Program funds allocated to pedestrian safety hot spots** so it matches the share of traffic fatalities accounted for by pedestrians. The share of HSIP funds allocated to pedestrian safety should not include the cost of sidewalks or traffic signals that are installed as part of road widening projects.
4. **Incorporate pedestrian safety performance measures** in the Georgia Strategic Highway Safety Plan.

Pedestrian fatalities have increased dramatically since 2009 and now account for 15 percent of all traffic fatalities in Georgia. Half occur in the Atlanta region. We cannot allow this to be the new normal. By increasing their attention to pedestrian safety, setting goals, developing strategies and measuring results, state and regional agencies can ensure it won't be.